

# MOSFET – N-Channel, UniFET™

**200 V, 39 A, 66 mΩ**

**FDP39N20, FDPF39N20**

## Description

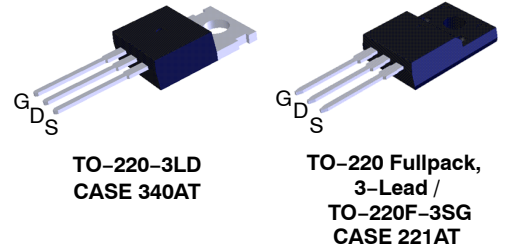
UniFET™ MOSFET is onsemi's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.

## Features

- $R_{DS(on)} = 66 \text{ m}\Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 19.5 \text{ A}$
- Low Gate Charge (Typ. 38 nC)
- Low  $C_{rss}$  (Typ. 57 pF)
- 100% Avalanche Tested

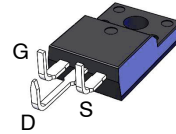
## Applications

- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply



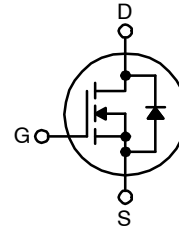
TO-220-3LD  
CASE 340AT

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

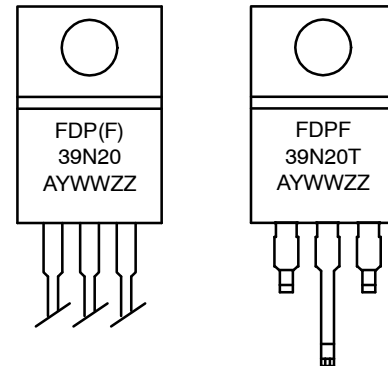


TO-220 FULLPAK 3LD L-FORMED  
CASE 340BM

## N-CHANNEL MOSFET



## MARKING DIAGRAMS



FDP(F)39N20(T) = Specific Device Code  
 A = Assembly Location  
 YWW = Date Code (Year and Week)  
 ZZ = Assembly Lot

## ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 9 of this data sheet.

# FDP39N20, FDPF39N20

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

| Symbol                            | Parameter  | FDP39N20  | FDPF39N20 / FDPF39N20TLDUTU | Unit      |
|-----------------------------------|--|---|-----------------------------|-----------|
| V <sub>DSS</sub>                  | Drain–Source Voltage   | 200   | 200                         | V         |
| I <sub>D</sub>                    | Drain Current  | – Continuous (T <sub>C</sub> = 25°C)<br>– Continuous (T <sub>C</sub> = 100°C) | 39*<br>23.4*                | A<br>A    |
| I <sub>DM</sub>                   | Drain Current  | – Pulsed (Note 1)   | 156*                        | A         |
| V <sub>GSS</sub>                  | Gate–Source Voltage  | ±30   | ±30                         | V         |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                              | 860   | 860                         | mJ        |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)   | 39  | 39                          | A         |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)                                 | 25.1  | 25.1                        | mJ        |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)                                   | 4.5   | 4.5                         | V/ns      |
| P <sub>D</sub>                    | Power Dissipation  | (T <sub>C</sub> = 25°C)<br>– Derate Above 25°C                                | 37<br>0.29                  | W<br>W/°C |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range                              | –55 to +150   | –55 to +150                 | °C        |
| T <sub>L</sub>                    | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | 300   | 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.

## THERMAL CHARACTERISTICS

| Symbol           | Parameter                                     | FDP39N20 | FDPF39N20 / FDPF39N20TLDUTU | Unit |
|------------------|---|----------|-----------------------------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction–to–Case, Max.    | 0.5      | 3.4                         | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction–to–Ambient, Max. | 62.5     | 62.5                        | °C/W |

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

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

### OFF CHARACTERISTICS

|                                      |   |   |        |        |         |          |
|--------------------------------------|---|---|--------|--------|---------|----------|
| BV <sub>DSS</sub>                    | Drain–Source Breakdown Voltage            | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA  | 200    | –      | –       | V        |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, Referenced to 25°C   | –      | 0.2    | –       | V/°C     |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 200 V, V <sub>GS</sub> = 0 V<br>V <sub>DS</sub> = 160 V, T <sub>C</sub> = 125°C | –<br>– | –<br>– | 1<br>10 | μA<br>μA |
| I <sub>GSSF</sub>                    | Gate–Body Leakage Current, Forward        | V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V   | –      | –      | 100     | nA       |
| I <sub>GSSR</sub>                    | Gate–Body Leakage Current, Reverse        | V <sub>GS</sub> = –30 V, V <sub>DS</sub> = 0V   | –      | –      | –100    | nA       |

### ON CHARACTERISTICS

|                     |                                   |   |     |       |       |   |
|---------------------|-----------------------------------|---|-----|-------|-------|---|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA | 3.0 | –     | 5.0   | V |
| R <sub>DS(on)</sub> | Static Drain–Source On–Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 19.5 A             | –   | 0.056 | 0.066 | Ω |
| g <sub>FS</sub>     | Forward Transconductance          | V <sub>DS</sub> = 40 V, I <sub>D</sub> = 19.5 A             | –   | 28.5  | –     | S |

### DYNAMIC CHARACTERISTICS

|                  |                              |  |   |      |      |    |
|------------------|------------------------------|--|---|------|------|----|
| C <sub>iss</sub> | Input Capacitance            | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz | – | 1640 | 2130 | pF |
| C <sub>oss</sub> | Output Capacitance           |  | – | 400  | 520  | pF |
| C <sub>rss</sub> | Reverse Transfer Capacitance |  | – | 57   | 85   | pF |

# FDP39N20, FDPF39N20

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

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

### SWITCHING CHARACTERISTICS

|              |                     |   |   |      |     |    |
|--------------|---------------------|---|---|------|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 100\text{ V}$ , $I_D = 39\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_G = 25\ \Omega$ (Note 4) | – | 30   | 70  | ns |
| $t_r$        | Turn-On Rise Time   |   | – | 160  | 330 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |   | – | 150  | 310 | ns |
| $t_f$        | Turn-Off Fall Time  |   | – | 150  | 310 | ns |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 160\text{ V}$ , $I_D = 39\text{ A}$ , $V_{GS} = 10\text{ V}$<br>(Note 4)                      | – | 38   | 49  | nC |
| $Q_{gs}$     | Gate-Source Charge  |   | – | 11   | –   | nC |
| $Q_{gd}$     | Gate-Drain Charge   |   | – | 16.5 | –   | nC |

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

|          |   |   |   |     |     |               |
|----------|---|---|---|-----|-----|---------------|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current |   | – | –   | 39  | A             |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current     |   | – | –   | 156 | A             |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}$ , $I_S = 39\text{ A}$   | – | –   | 1.4 | V             |
| $t_{rr}$ | Reverse Recovery Time                                 | $V_{GS} = 0\text{ V}$ , $I_S = 39\text{ A}$ ,<br>$di_F/dt = 100\text{ A}/\mu\text{s}$ | – | 152 | –   | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                               |   | – | 1.1 | –   | $\mu\text{C}$ |

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.

1. Repetitive rating; pulse-width limited by maximum junction temperature.
2.  $L = 0.85\text{ mH}$ ,  $I_{AS} = 39\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 39\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

TYPICAL PERFORMANCE CHARACTERISTICS

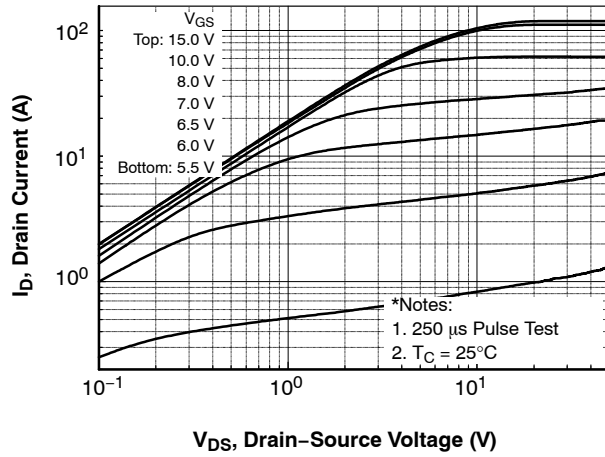


Figure 1. On-Region Characteristics

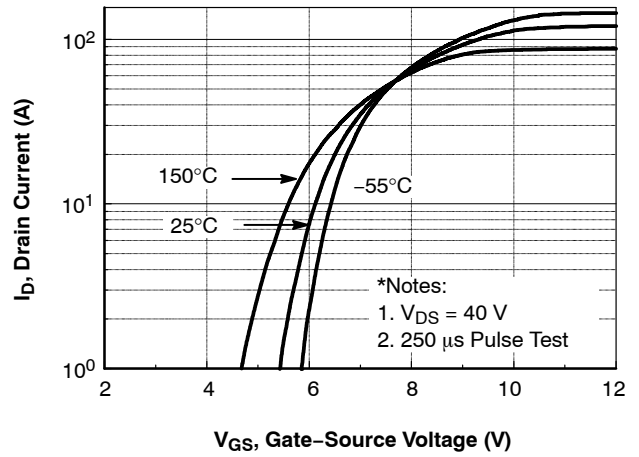


Figure 2. Transfer Characteristics

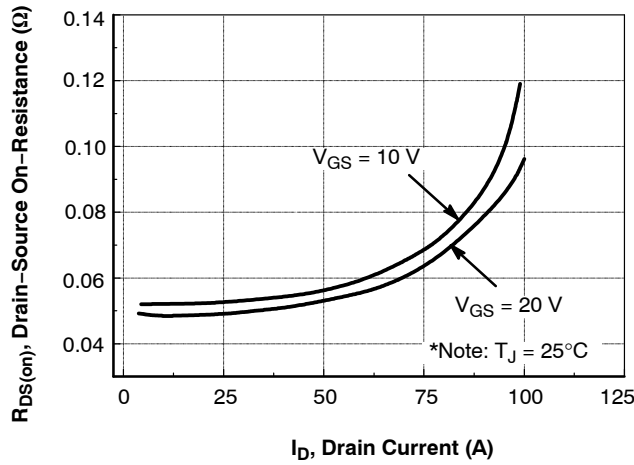


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

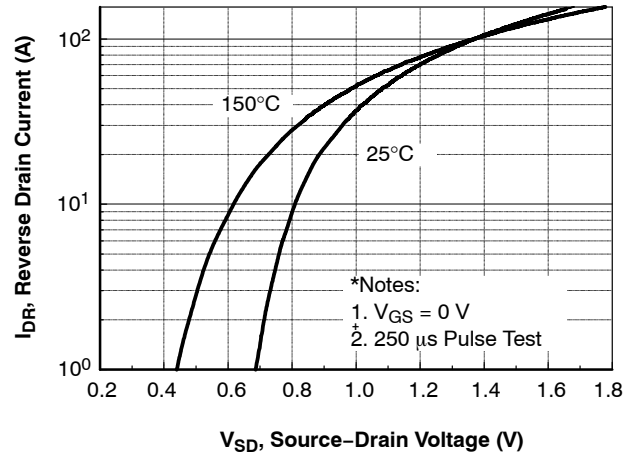


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

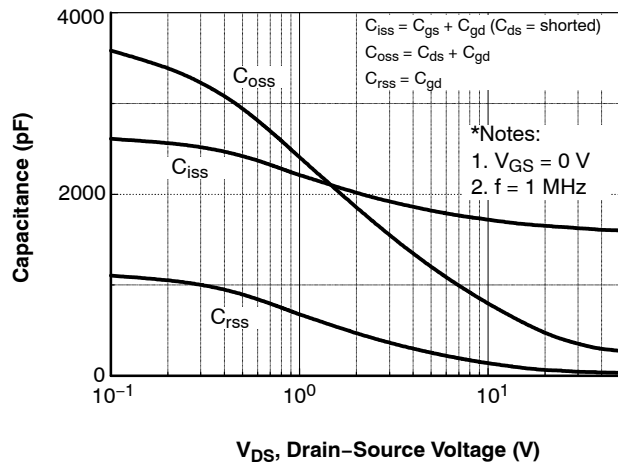


Figure 5. Capacitance Characteristics

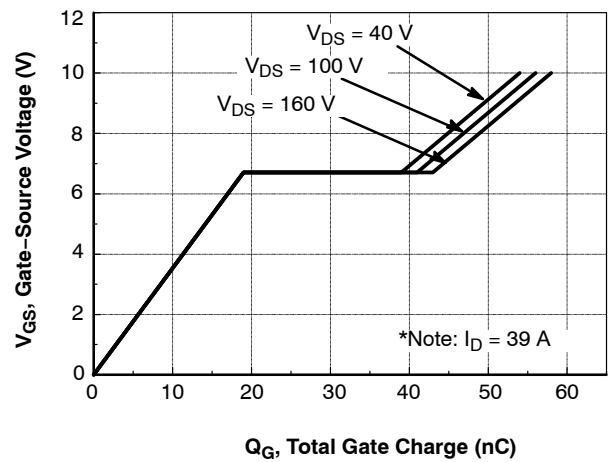
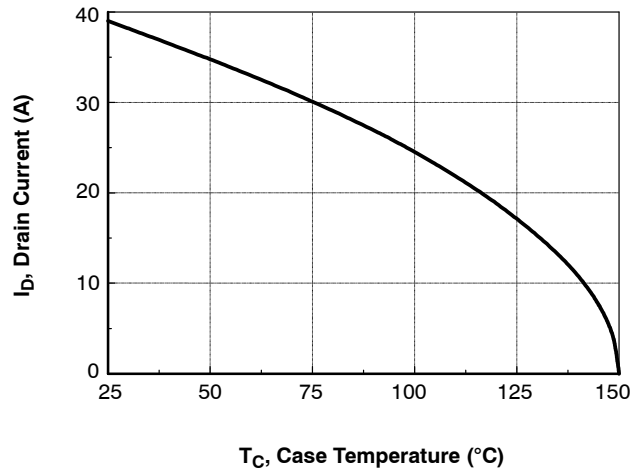
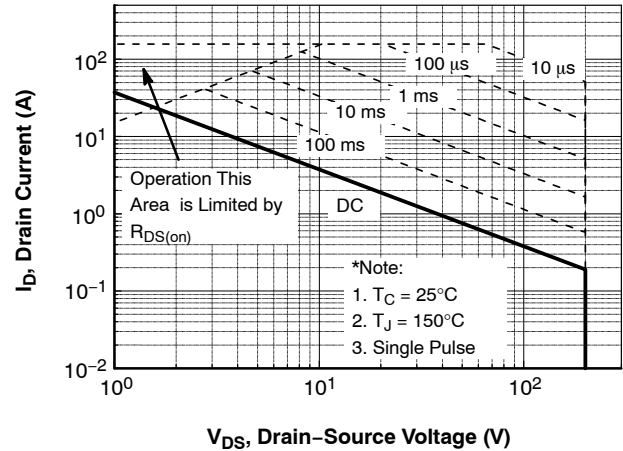
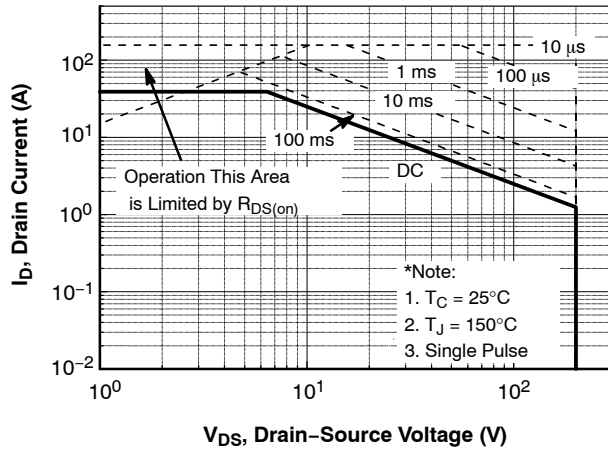
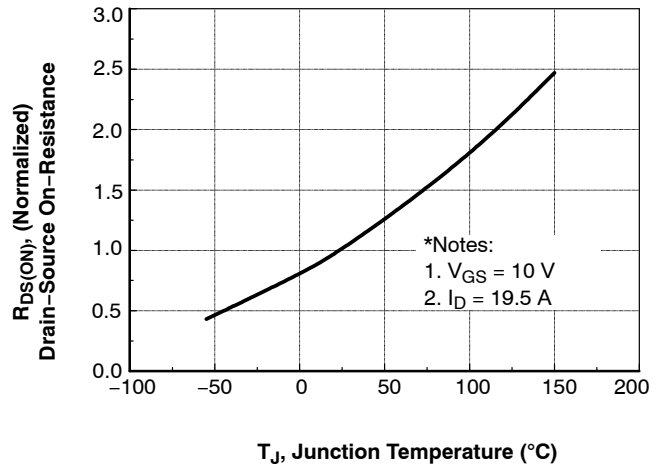
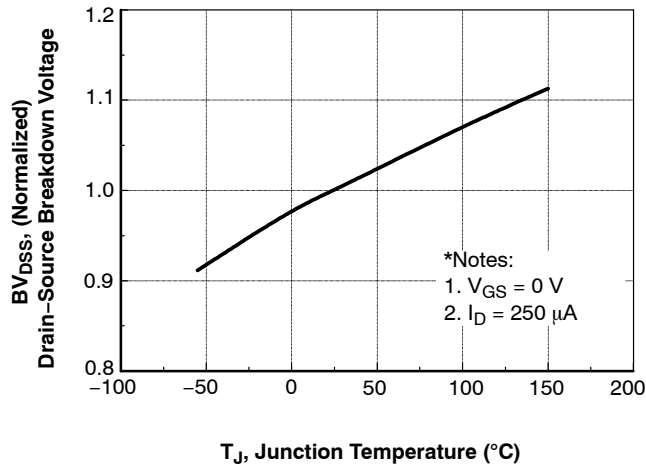


Figure 6. Gate Charge Characteristics

# FDP39N20, FDPF39N20

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)



# FDP39N20, FDPF39N20

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

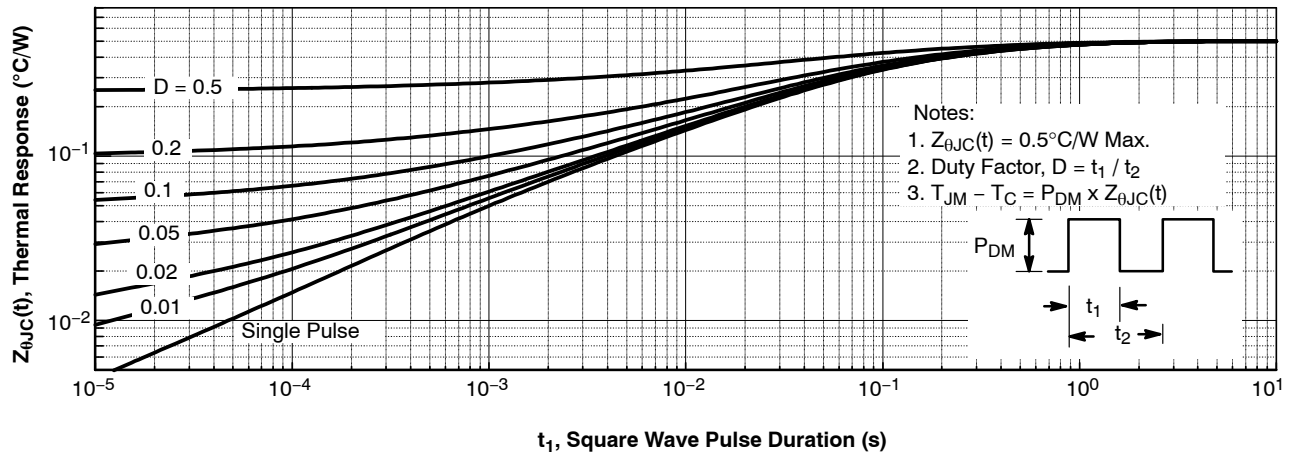


Figure 12. Transient Thermal Response Curve – FDP39N20

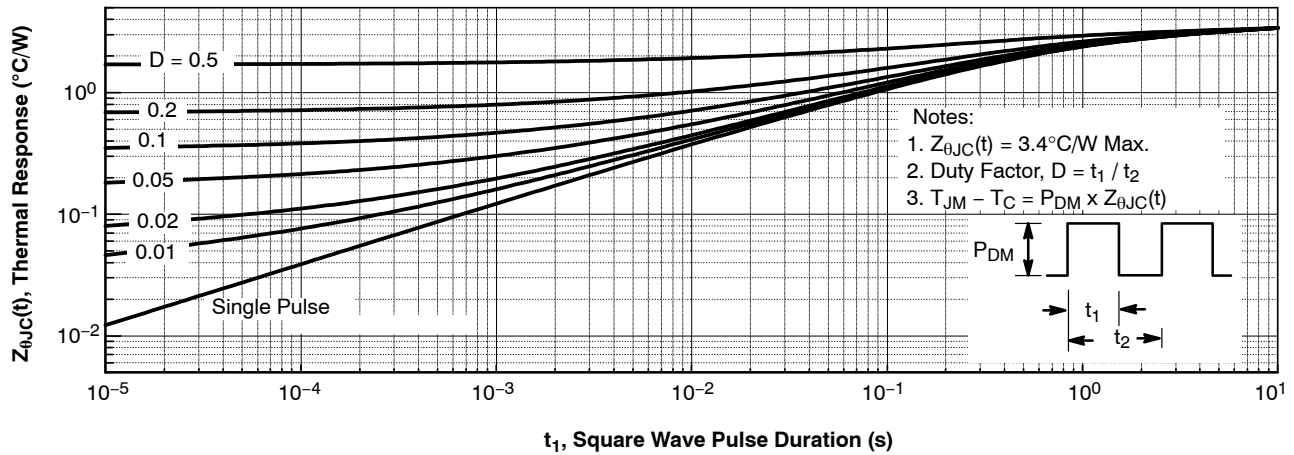


Figure 13. Transient Thermal Response Curve – FDPF39N20

# FDP39N20, FDPF39N20

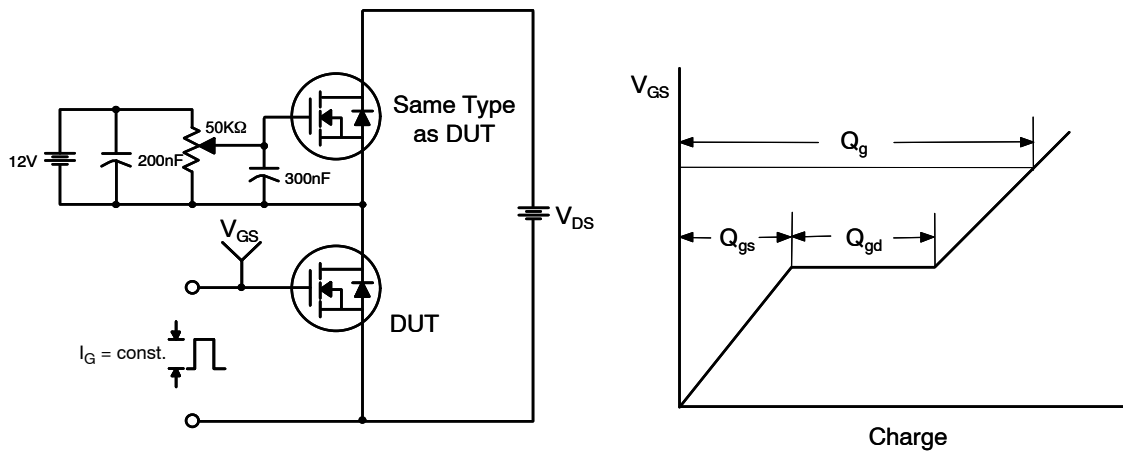


Figure 14. Gate Charge Test Circuit & Waveform

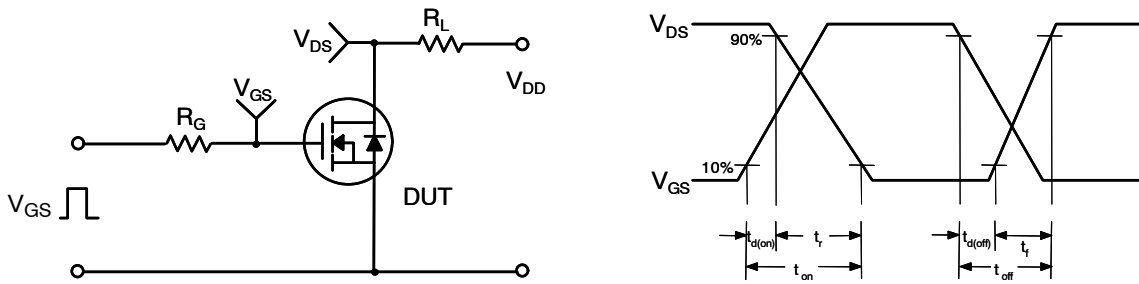


Figure 15. Resistive Switching Test Circuit & Waveforms

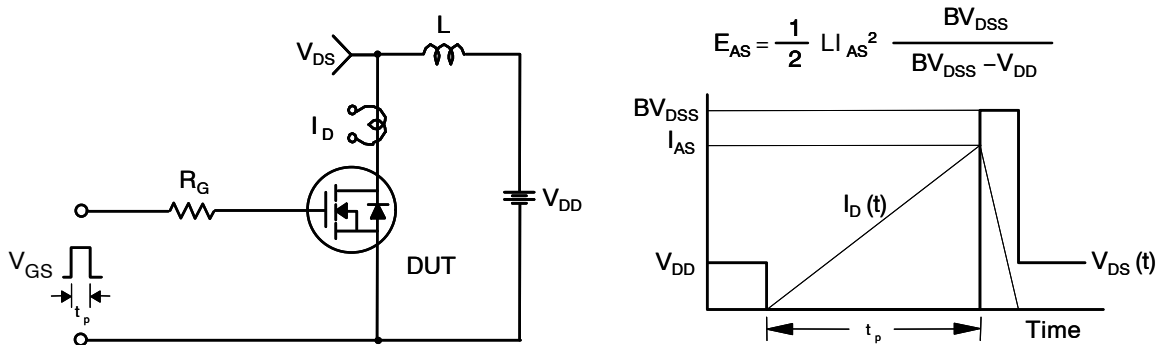


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

# FDP39N20, FDPF39N20

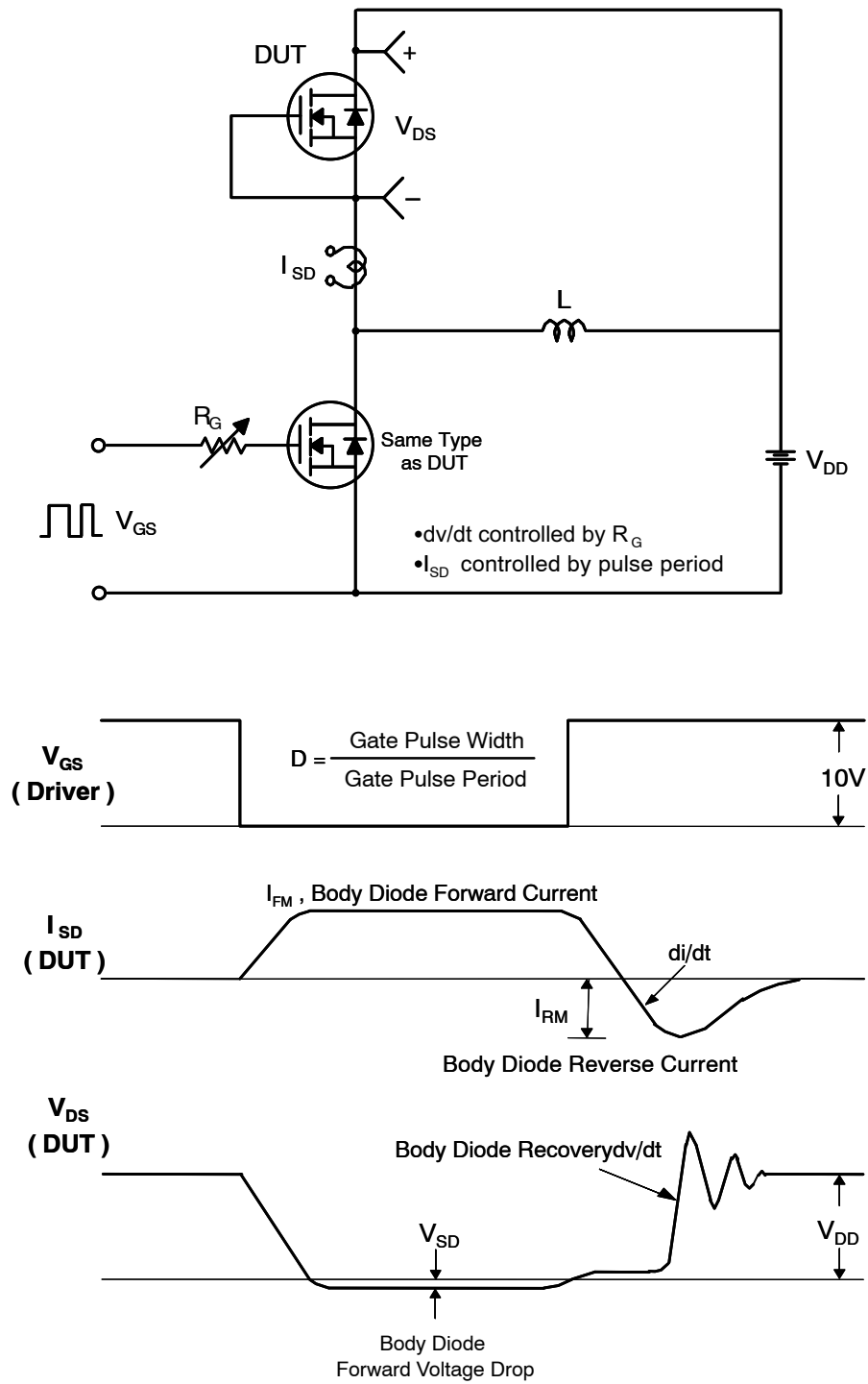


Figure 17. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms



## FDP39N20, FDPF39N20

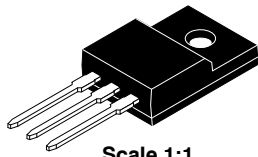
### ORDERING INFORMATION

| Device         | Device Marking | Package            | Shipping          |
|----------------|----------------|--------------------|-------------------|
| FDP39N20       | FDP39N20       | TO-220             | 1000 Units / Tube |
| FDPF39N20      | FDPF39N20      | TO-220F            | 1000 Units / Tube |
| FDPF39N20TLDTU | FDPF39N20T     | TO-220F (L-formed) | 800 Units / Tube  |

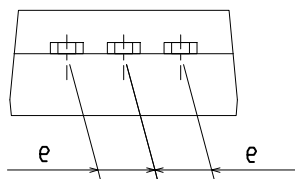
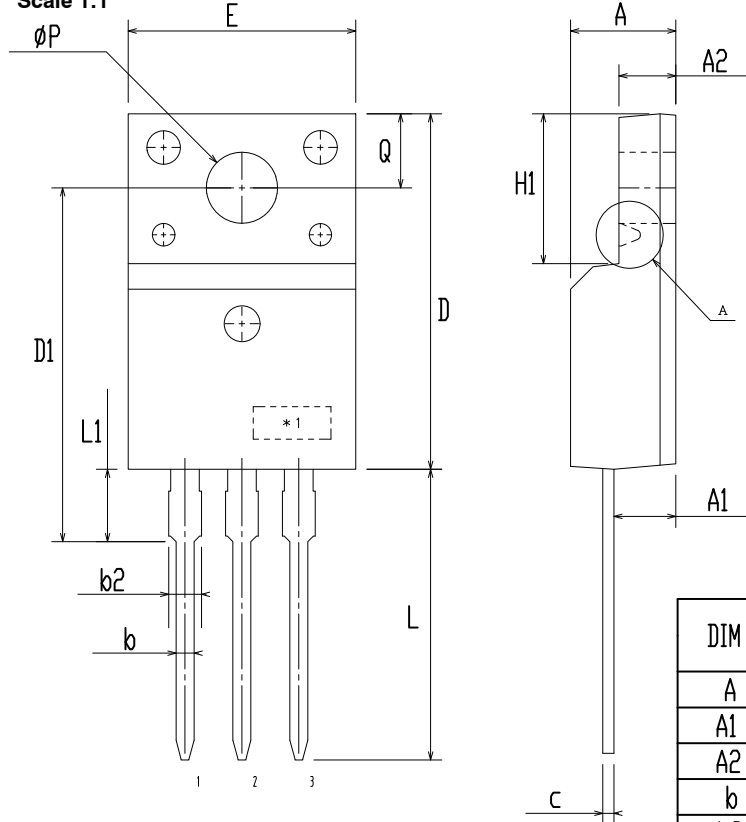
UniFET is trademark of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries.

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

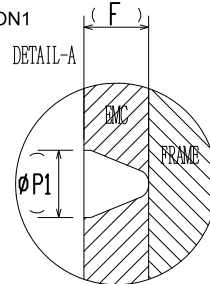
DATE 19 JAN 2021



Scale 1:1



OPTION1



| 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  |
| 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

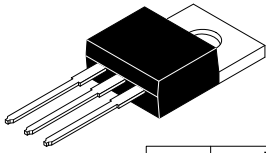
B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUCTIONS.

C. OPTION 1 - WITH SUPPORT PIN HOLE

OPTION 2 - NO SUPPORT PIN HOLE

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

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.



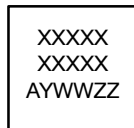
TO-220-3LD  
CASE 340AT  
ISSUE B

DATE 08 AUG 2022

| DIM | MILLIMETERS  |      |       |
|-----|--------------|------|-------|
|     | MIN.         | NOM. | MAX.  |
| A   | 4.00         | --   | 4.70  |
| A1  | SEE NOTE "F" |      |       |
| A2  | 2.10         | --   | 2.85  |
| b   | 0.55         | --   | 1.00  |
| b2  | 1.10         | --   | 1.62  |
| b4  | 1.42         | --   | 1.62  |
| c   | 0.36         | --   | 0.60  |
| D   | 13.90        | --   | 16.30 |
| D1  | 8.13         | --   | 9.40  |
| D2  | 11.50        | --   | 14.30 |
| D3  | 15.42        | --   | 16.51 |
| E   | 9.65         | --   | 10.67 |
| E1  | 7.59         | --   | 8.65  |
| e   | 2.40         | --   | 2.67  |
| H1  | 6.06         | --   | 6.69  |
| L   | 12.70        | --   | 14.04 |
| L1  | 2.70         | --   | 4.10  |
| P   | 3.50         | --   | 4.00  |
| Q   | 2.50         | --   | 3.40  |
| z   | 2.13 REF     |      |       |
| z1  | 2.06 REF     |      |       |
| θ   | 3°           | --   | 5°    |

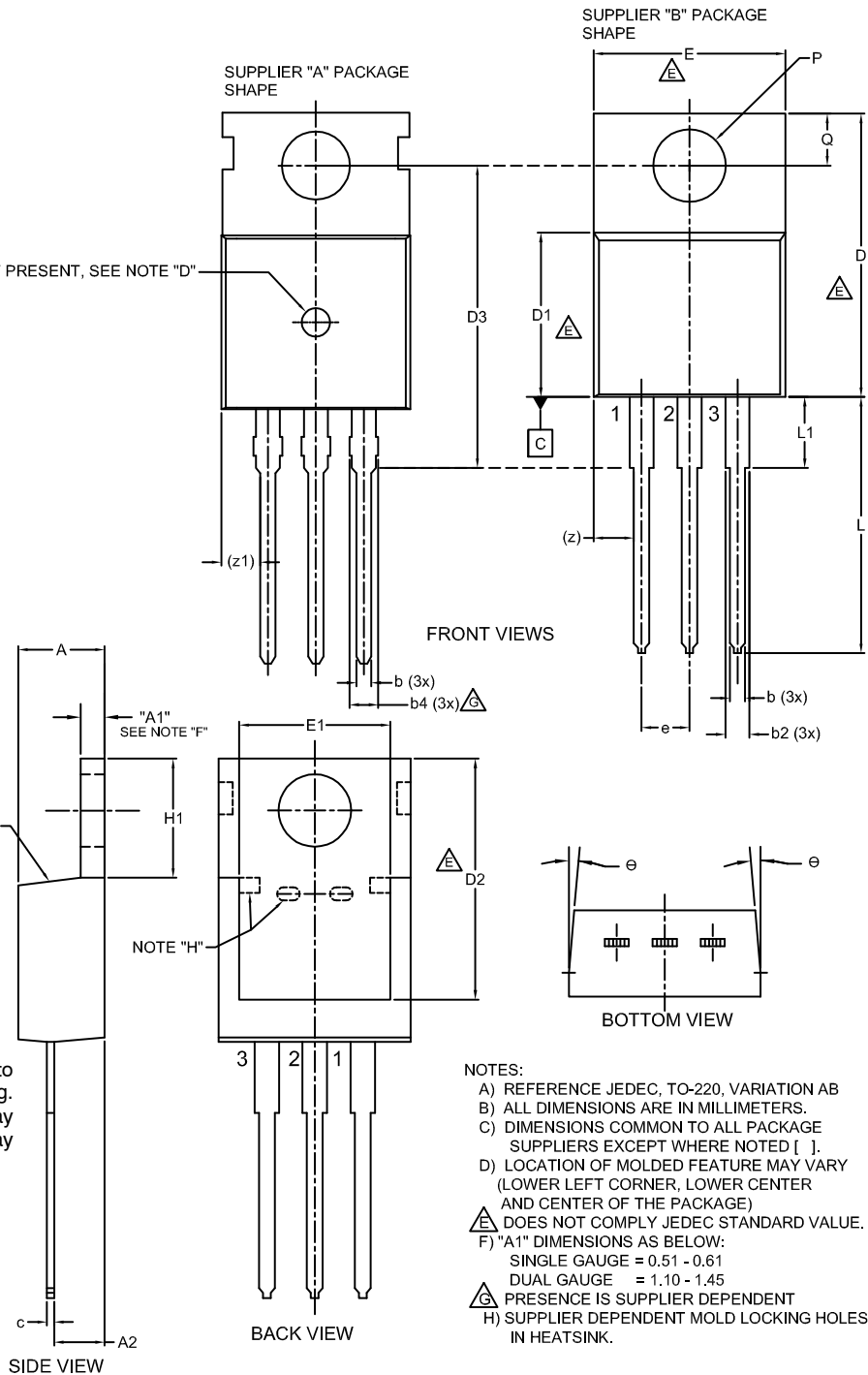
IF PRESENT, SEE NOTE "D"

GENERIC  
MARKING DIAGRAM\*



XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code

\*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. Some products may not follow the Generic Marking.



NOTES:

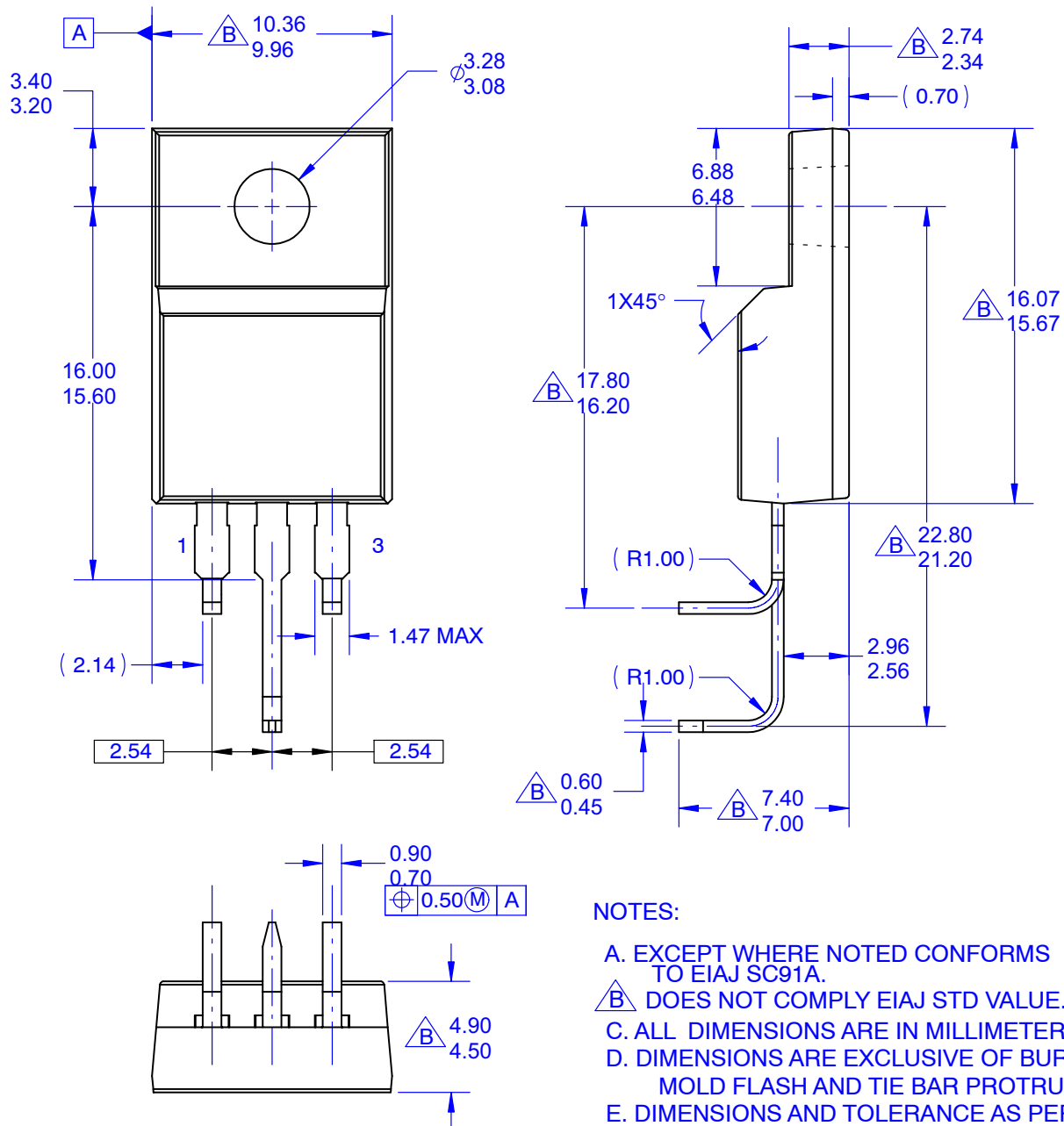
- A) REFERENCE JEDEC, TO-220, VARIATION AB
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
- D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
- △ DOES NOT COMPLY JEDEC STANDARD VALUE.
- F) "A1" DIMENSIONS AS BELOW:  
SINGLE GAUGE = 0.51 - 0.61  
DUAL GAUGE = 1.10 - 1.45
- △ 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.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION:     | TO-220-3LD  | 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.

**TO-220 FULLPAK 3LD LF**  
**CASE 340BM**  
**ISSUE O**

DATE 31 AUG 2016



**NOTES:**

- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- B. DOES NOT COMPLY EIAJ STD VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSIONS AND TOLERANCE AS PER ASME Y14.5-1994

|                         |                              |  |
|-------------------------|------------------------------|--|
| <b>DOCUMENT NUMBER:</b> | <b>98AON13846G</b>           | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>TO-220 FULLPAK 3LD LF</b> | <b>PAGE 1 OF 1</b>   |

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.

**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](http://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](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at  
[www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)