

# MOSFET – N-Channel, UniFET™ II

500 V, 22 A, 220 mΩ

## FDP22N50N

### Description

UniFET II MOSFET is onsemi's high voltage MOSFET family based on advanced planar stripe and DMOS technology. This advanced MOSFET family has the smallest on-state resistance among the planar MOSFET, and also provides superior switching performance and higher avalanche energy strength. In addition, internal gate-source ESD diode allows UniFET II MOSFET to withstand over 2 kV HBM surge stress. 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.

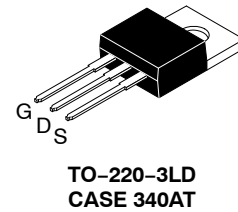
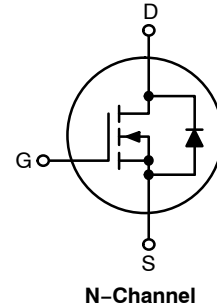
### Features

- $R_{DS(on)} = 185 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 11 \text{ A}$
- Low Gate Charge (Typ. 49 nC)
- Low  $C_{rss}$  (Typ. 24 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability
- RoHS Compliant

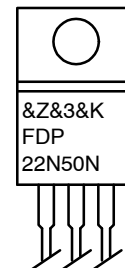
### Applications

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

| $V_{DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|-----------|------------------|-----------|
| 500 V     | 220 mΩ @ 10 V    | 22 A      |



### MARKING DIAGRAM



|           |                         |
|-----------|-------------------------|
| &Z        | = Assembly Plant Code   |
| &3        | = 3-Digit Date Code     |
| &K        | = 2-Digits Lot Run Code |
| FDP22N50N | = Specific Device Code  |

### ORDERING INFORMATION

| Device    | Package    | Shipping          |
|-----------|------------|-------------------|
| FDP22N50N | TO-220-3LD | 1000 Units / Tube |

# FDP22N50N

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

| Symbol                            | Parameter                                                            |                                       | FDP22N50N   | Unit |
|-----------------------------------|----------------------------------------------------------------------|---------------------------------------|-------------|------|
| V <sub>DSS</sub>                  | Drain to Source Voltage                                              |                                       | 500         | V    |
| V <sub>GSS</sub>                  | Gate to Source Voltage                                               |                                       | ±30         | V    |
| I <sub>D</sub>                    | Drain Current                                                        | – Continuous (T <sub>C</sub> = 25°C)  | 22          | A    |
|                                   |                                                                      | – Continuous (T <sub>C</sub> = 100°C) | 13.2        |      |
| I <sub>DM</sub>                   | Drain Current                                                        | – Pulsed (Note 1)                     | 88          | A    |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                              |                                       | 1000        | mJ   |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)                                           |                                       | 22          | A    |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)                                 |                                       | 31.25       | mJ   |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)                                   |                                       | 10          | V/ns |
| P <sub>D</sub>                    | Power Dissipation                                                    | (T <sub>C</sub> = 25°C)               | 312.5       | W    |
|                                   |                                                                      | –Derate above 25°C                    | 2.5         | 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. L = 4.1 mH, I<sub>AS</sub> = 22 A, V<sub>DD</sub> = 50 V, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 22 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, starting T<sub>J</sub> = 25°C

## THERMAL CHARACTERISTICS

| Symbol           | Parameter                                     | FDP22N50N | Unit |
|------------------|-----------------------------------------------|-----------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction to Case, Max.    | 0.4       | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient, Max. | 62.5      |      |

# FDP22N50N

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

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

### OFF CHARACTERISTICS

|                                |                                           |                                                     |     |      |           |         |
|--------------------------------|-------------------------------------------|-----------------------------------------------------|-----|------|-----------|---------|
| BV <sub>DSS</sub>              | Drain to Source Breakdown Voltage         | I <sub>D</sub> = 250 $\mu$ A, V <sub>GS</sub> = 0 V | 500 | –    | –         | V       |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 $\mu$ A, Referenced to 25°C    | –   | 0.45 | –         | V/°C    |
| I <sub>DSS</sub>               | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V      | –   | –    | 1         | $\mu$ A |
|                                |                                           | V <sub>DS</sub> = 400 V, T <sub>C</sub> = 125°C     | –   | –    | 10        |         |
| I <sub>GSS</sub>               | Gate to Body Leakage Current              | V <sub>GS</sub> = $\pm$ 30 V, V <sub>DS</sub> = 0 V | –   | –    | $\pm$ 100 | nA      |

### ON CHARACTERISTICS

|                     |                                      |                                                                  |     |       |       |          |
|---------------------|--------------------------------------|------------------------------------------------------------------|-----|-------|-------|----------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage               | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 $\mu$ A | 3.0 | –     | 5.0   | V        |
| R <sub>DS(on)</sub> | Static Drain to Source On Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 11 A                    | –   | 0.185 | 0.220 | $\Omega$ |
| g <sub>FS</sub>     | Forward Transconductance             | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 11 A                    | –   | 24.4  | –     | S        |

### DYNAMIC CHARACTERISTICS

|                     |                               |                                                                                    |   |      |      |    |
|---------------------|-------------------------------|------------------------------------------------------------------------------------|---|------|------|----|
| C <sub>iss</sub>    | Input Capacitance             | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz                           | – | 2456 | 3200 | pF |
| C <sub>oss</sub>    | Output Capacitance            |                                                                                    | – | 351  | 460  | pF |
| C <sub>rss</sub>    | Reverse Transfer Capacitance  |                                                                                    | – | 24   | 50   | pF |
| Q <sub>g(tot)</sub> | Total Gate Charge at 10 V     | V <sub>DS</sub> = 400 V, I <sub>D</sub> = 22 A, V <sub>GS</sub> = 10 V<br>(Note 4) | – | 49   | 65   | nC |
| Q <sub>gs</sub>     | Gate to Source Gate Charge    |                                                                                    | – | 15   | –    | nC |
| Q <sub>gd</sub>     | Gate to Drain “Miller” Charge |                                                                                    | – | 19   | –    | nC |

### SWITCHING CHARACTERISTICS

|                     |                     |                                                                                           |   |    |     |    |
|---------------------|---------------------|-------------------------------------------------------------------------------------------|---|----|-----|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 250 V, I <sub>D</sub> = 22 A, R <sub>G</sub> = 4.7 $\Omega$<br>(Note 4) | – | 22 | 55  | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |                                                                                           | – | 50 | 110 | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |                                                                                           | – | 48 | 110 | ns |
| t <sub>f</sub>      | Turn-Off Fall Time  |                                                                                           | – | 35 | 80  | ns |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                 |                                                          |                                               |   |     |     |    |
|-----------------|----------------------------------------------------------|-----------------------------------------------|---|-----|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain to Source Diode Forward Current |                                               | – | –   | 22  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain to Source Diode Forward Current     |                                               | – | –   | 88  | A  |
| V <sub>SD</sub> | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 22 A | – | –   | 1.4 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                    |                                               | – | 472 | –   | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                                  |                                               | – | 6.5 | –   | 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

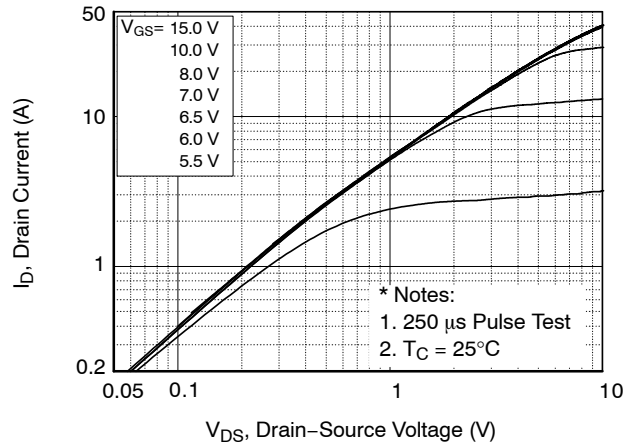


Figure 1. On-Region Characteristics

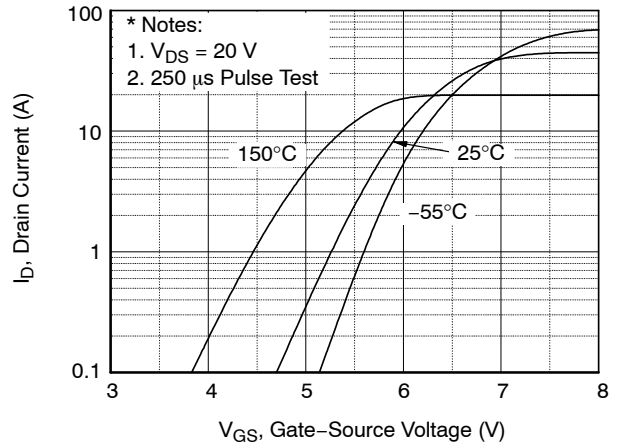


Figure 2. Transfer Characteristics

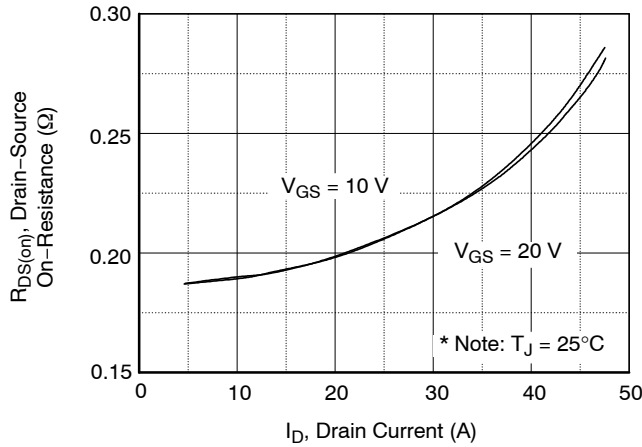


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

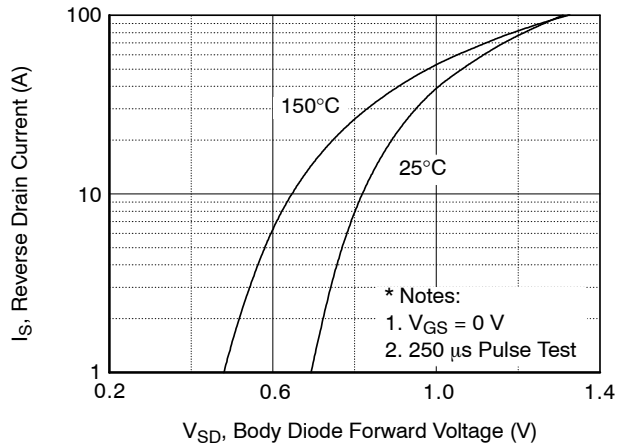


Figure 4. Body Diode Forward Voltage Variation vs. Source Current And Temperature

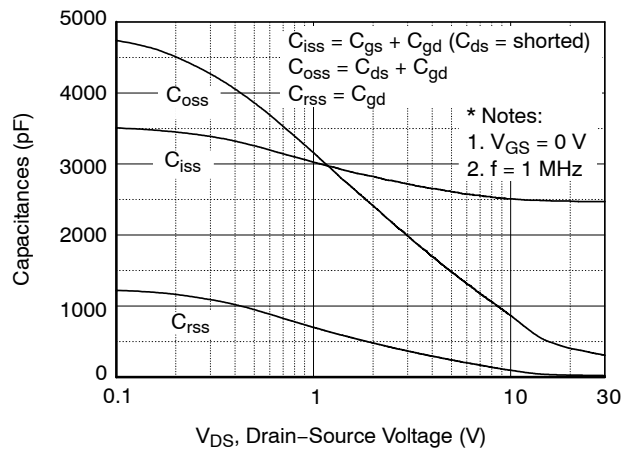


Figure 5. Capacitance Characteristics

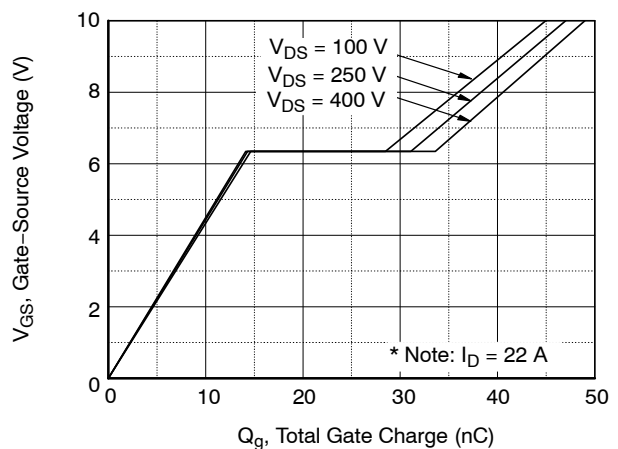


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

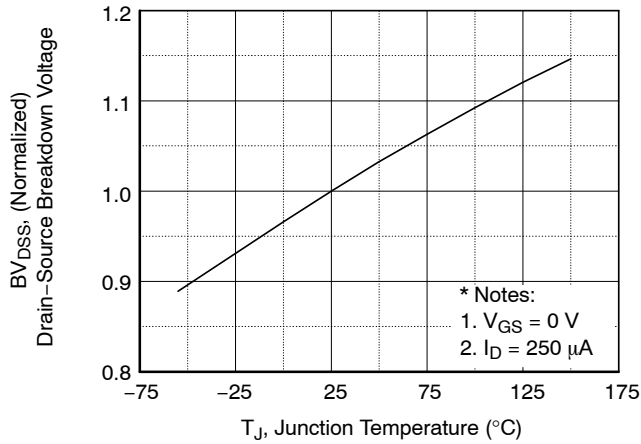


Figure 7. Breakdown Voltage Variation vs. Temperature

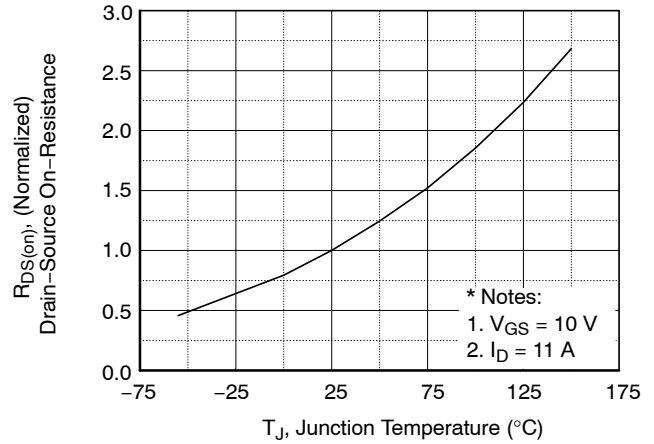


Figure 8. On-Resistance Variation vs. Temperature

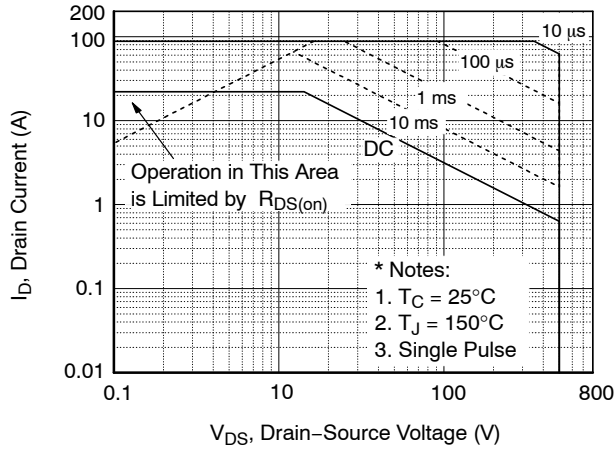


Figure 9. Maximum Safe Operating Area

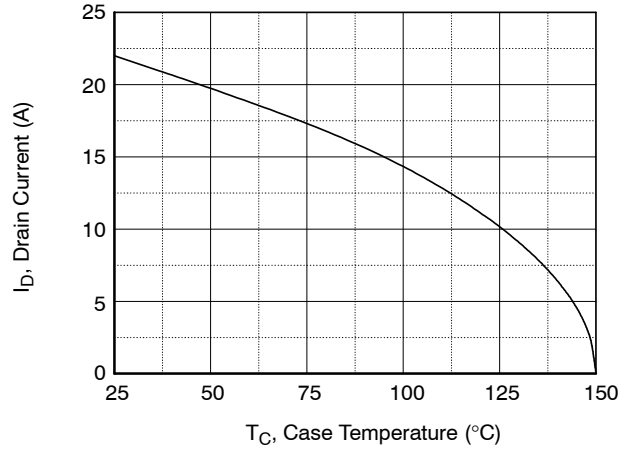


Figure 10. Maximum Drain Current vs. Case Temperature

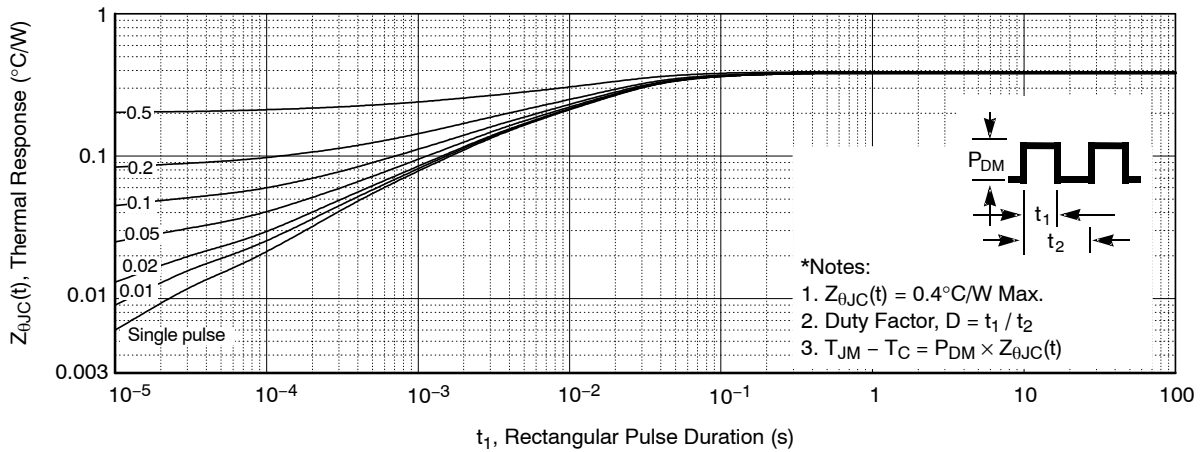


Figure 11. Transient Thermal Response Curve

## FDP22N50N

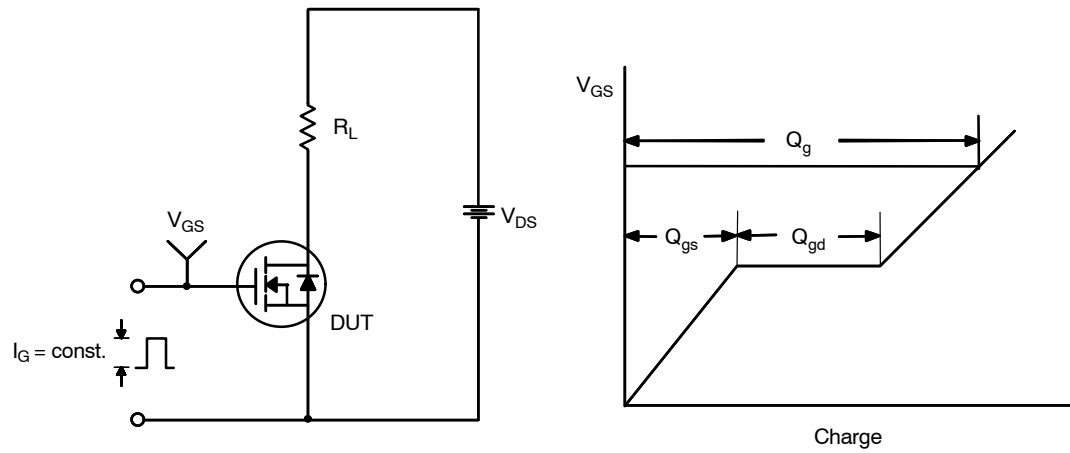


Figure 12. Gate Charge Test Circuit & Waveform

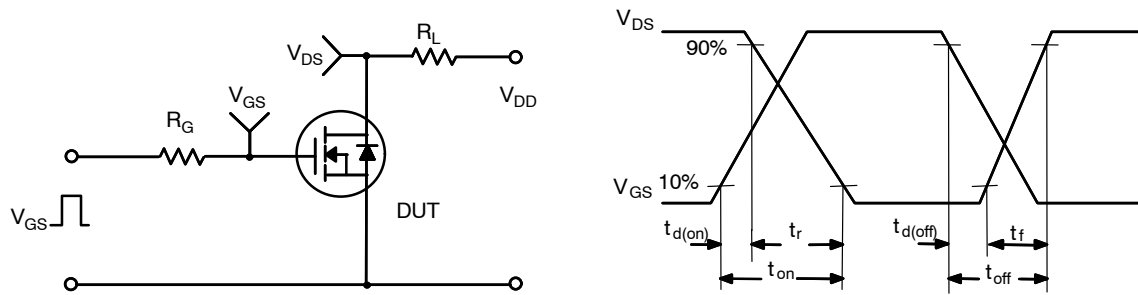


Figure 13. Resistive Switching Test Circuit & Waveforms

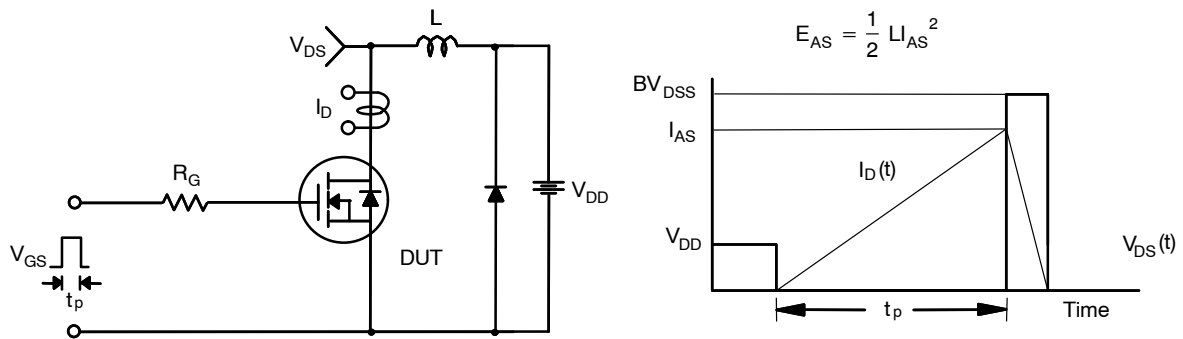
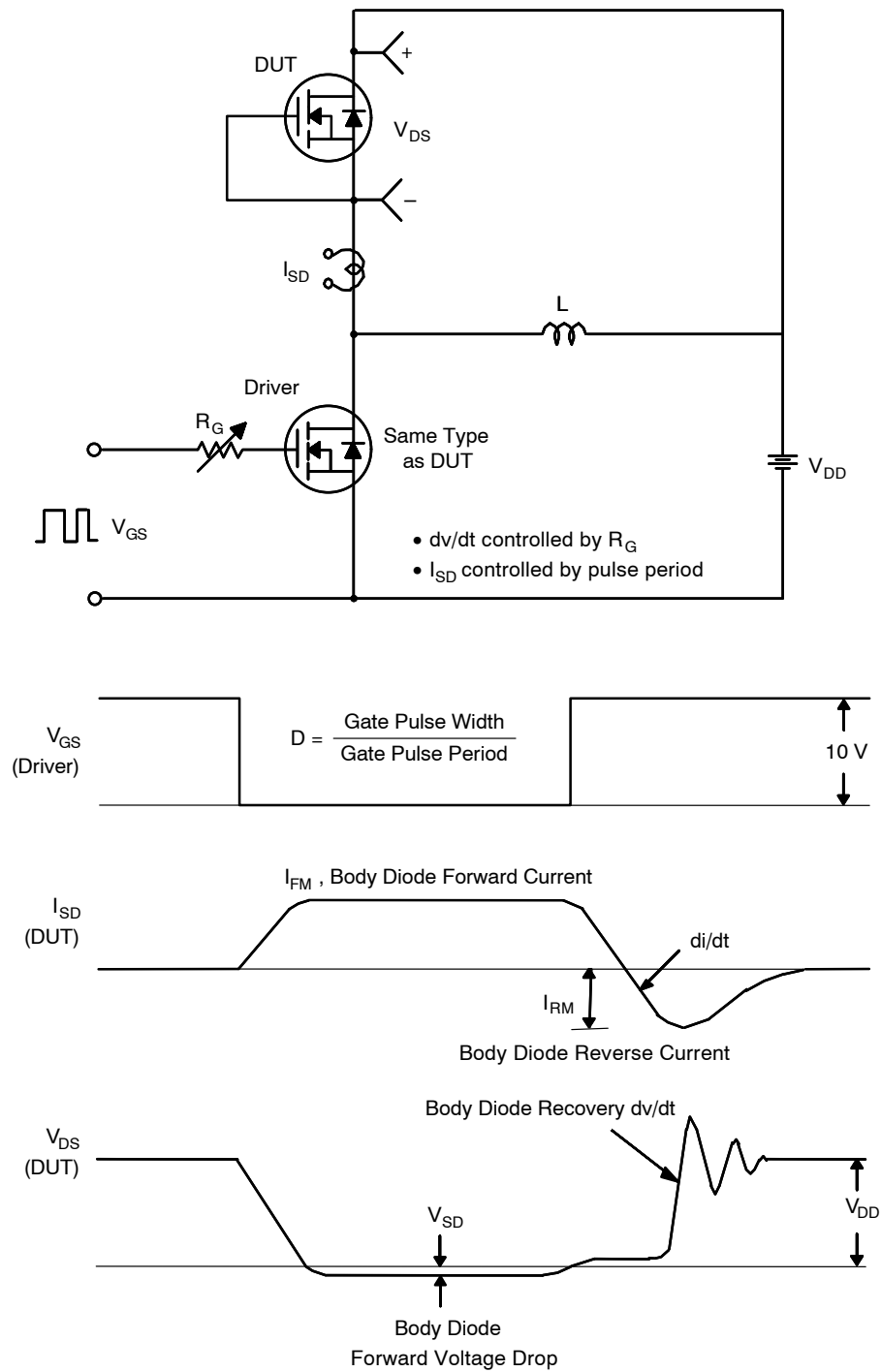
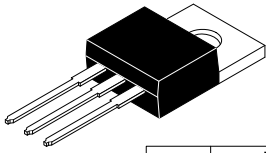


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

## FDP22N50N



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



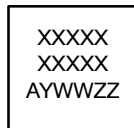
TO-220-3LD  
CASE 340AT  
ISSUE B

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°    |

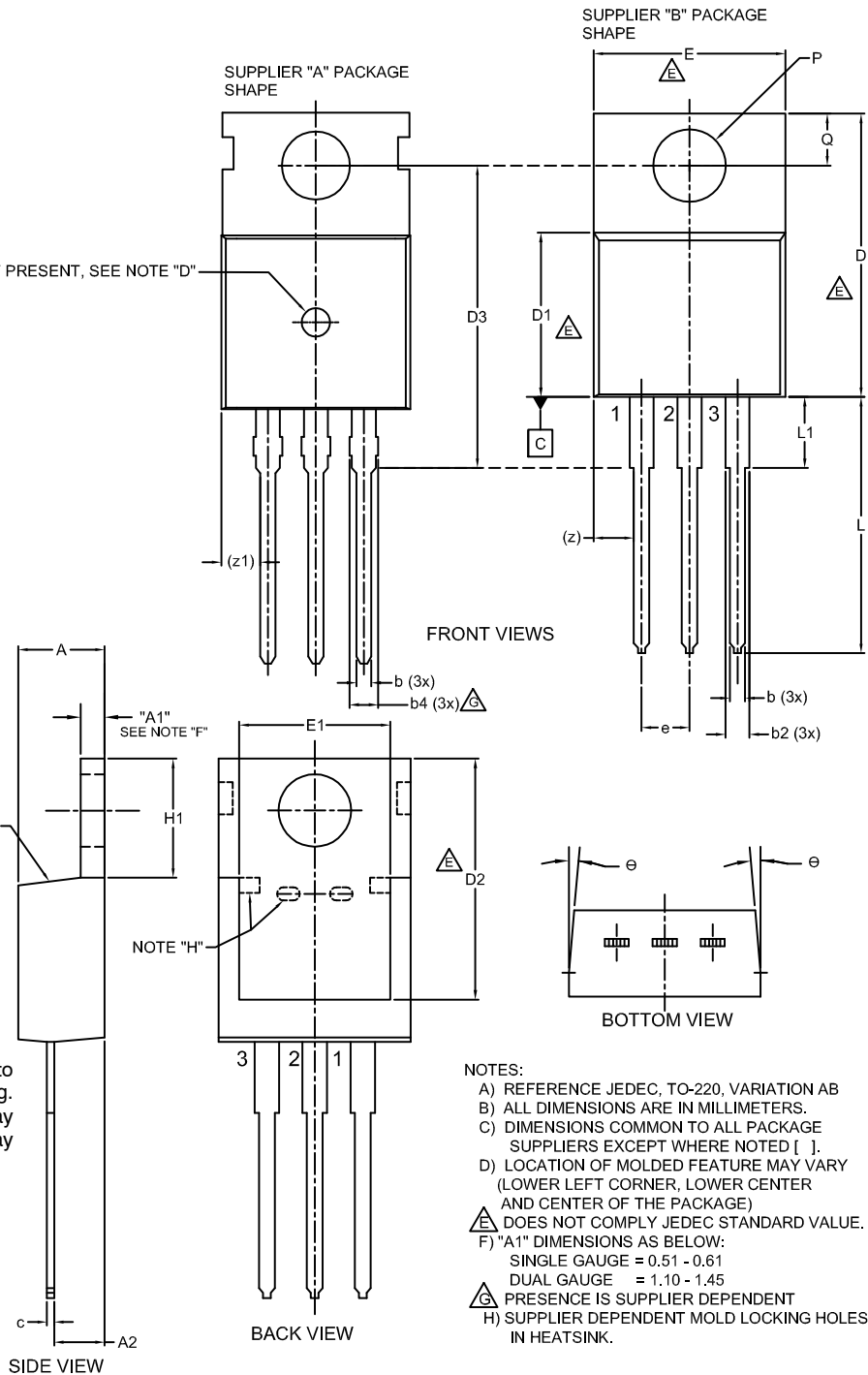
IF PRESENT, SEE NOTE "D"

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)
- 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.

|                  |             |                                                                                                                                                                                     |
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