

# MOSFET – N-Channel, SUPERFET® II

800 V, 6 A, 1.3  $\Omega$

## FCPF1300N80Z

### Description

SUPERFET II 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 technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. In addition, internal gate-source ESD diode allows to withstand over 2 kV HBM surge stress. Consequently, SUPERFET II MOSFET is very suitable for the switching power applications such as Audio, Laptop adapter, Lighting, ATX power and industrial power applications.

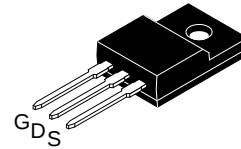
### Features

- $R_{DS(on)} = 1.05 \Omega$  (Typ.)
- Ultra Low Gate Charge (Typ.  $Q_g = 16.2$  nC)
- Low  $E_{oss}$  (Typ.  $1.57 \mu J @ 400$  V)
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 48.7$  pF)
- 100% Avalanche Tested
- RoHS Compliant
- ESD Improved Capability

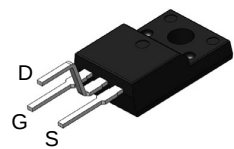
### Applications

- AC-DC Power Supply
- LED Lighting

| $V_{DSS}$ | $R_{DS(on)}$ MAX    | $I_D$ MAX |
|-----------|---------------------|-----------|
| 800 V     | 1.3 $\Omega @ 10$ V | 6 A       |

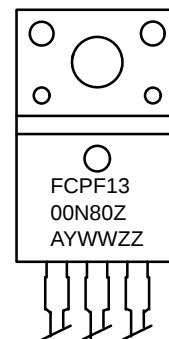


TO-220 Fullpack,  
3-Lead / TO-220F-3SG  
CASE 221AT



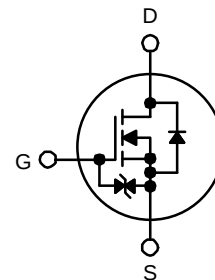
TO-220-3LD LF  
CASE 340BJ

### MARKING DIAGRAM



FCPF1300N80Z = Specific Device Code  
A = Assembly Location  
YWW = Date Code (Year & Week)  
ZZ = Assembly Lot

### N-CHANNEL MOSFET



### ORDERING INFORMATION

| Part Number    | Package             | Shipping          |
|----------------|---------------------|-------------------|
| FCPF1300N80Z   | TO-220              | 1000 Units / Tube |
| FCPF1300N80ZYD | TO-220F<br>Y-formed | 800 Units / Tube  |

# FCPF1300N80Z

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

| Symbol         | Parameter                                                            |                                            | FCPF1300N80Z<br>FCPF1300N80ZYD | Unit                |
|----------------|----------------------------------------------------------------------|--------------------------------------------|--------------------------------|---------------------|
| $V_{DSS}$      | Drain to Source Voltage                                              |                                            | 800                            | V                   |
| $V_{GSS}$      | Gate to Source Voltage                                               | – DC                                       | $\pm 20$                       | V                   |
|                |                                                                      | – AC ( $f > 1\text{ Hz}$ )                 | $\pm 30$                       |                     |
| $I_D$          | Drain Current                                                        | – Continuous ( $T_C = 25^\circ\text{C}$ )  | 6.0*                           | A                   |
|                |                                                                      | – Continuous ( $T_C = 100^\circ\text{C}$ ) | 3.8*                           |                     |
| $I_{DM}$       | Drain Current                                                        | – Pulsed (Note 1)                          | 12*                            | A                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                              |                                            | 48                             | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)                                           |                                            | 0.8                            | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                 |                                            | 0.26                           | mJ                  |
| dv/dt          | MOSFET dv/dt                                                         |                                            | 100                            | V/ns                |
|                | Peak Diode Recovery dv/dt (Note 3)                                   |                                            | 20                             |                     |
| $P_D$          | Power Dissipation                                                    | ( $T_C = 25^\circ\text{C}$ )               | 24                             | W                   |
|                |                                                                      | – Derate Above $25^\circ\text{C}$          | 0.19                           | 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 Seconds |                                            | 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, with heatsink.

1. Repetitive rating: pulse width limited by maximum junction temperature.

2.  $I_{AS} = 0.8\text{ A}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .

3.  $I_{SD} \leq 6\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .

## THERMAL CHARACTERISTICS

| Symbol          | Parameter                                     | FCPF1300N80Z<br>FCPF1300N80ZYD | Unit                      |
|-----------------|-----------------------------------------------|--------------------------------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max.    | 5.2                            | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5                           |                           |

# FCPF1300N80Z

## 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         | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C    | 800 | –    | –   | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 1 mA, Referenced to 25°C                              | –   | 0.85 | –   | V/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 0 V                         | –   | –    | 25  | μA   |
|                                      |                                           | V <sub>DS</sub> = 640 V, V <sub>GS</sub> = 0 V, T <sub>C</sub> = 125°C | –   | –    | 250 |      |
| I <sub>GSS</sub>                     | Gate to Body Leakage Current              | V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V                         | –   | –    | ±10 | μA   |

### ON CHARACTERISTICS

|                     |                                      |                                                             |     |      |     |   |
|---------------------|--------------------------------------|-------------------------------------------------------------|-----|------|-----|---|
| V <sub>GS(th)</sub> | Gate Threshold Voltage               | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 0.4 mA | 2.5 | –    | 4.5 | V |
| R <sub>DS(on)</sub> | Static Drain to Source On Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2 A                | –   | 1.05 | 1.3 | Ω |
| g <sub>FS</sub>     | Forward Transconductance             | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 2 A                | –   | 4.5  | –   | S |

### DYNAMIC CHARACTERISTICS

|                        |                               |                                                                                |   |      |     |    |
|------------------------|-------------------------------|--------------------------------------------------------------------------------|---|------|-----|----|
| C <sub>iss</sub>       | Input Capacitance             | V <sub>DS</sub> = 100 V, V <sub>GS</sub> = 0 V, f = 1 MHz                      | – | 661  | 880 | pF |
| C <sub>oss</sub>       | Output Capacitance            |                                                                                | – | 22.3 | 30  | pF |
| C <sub>rss</sub>       | Reverse Transfer Capacitance  |                                                                                | – | 0.74 | –   | pF |
| C <sub>oss</sub>       | Output Capacitance            | V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, f = 1 MHz                      | – | 11.4 | –   | pF |
| C <sub>oss(eff.)</sub> | Effective Output Capacitance  | V <sub>DS</sub> = 0 V to 480 V, V <sub>GS</sub> = 0 V                          | – | 48.7 | –   | pF |
| Q <sub>g(tot)</sub>    | Total Gate Charge at 10 V     | V <sub>DS</sub> = 640 V, I <sub>D</sub> = 4 A, V <sub>GS</sub> = 10 V (Note 4) | – | 16.2 | 21  | nC |
| Q <sub>gs</sub>        | Gate to Source Gate Charge    |                                                                                | – | 3.5  | –   | nC |
| Q <sub>gd</sub>        | Gate to Drain “Miller” Charge |                                                                                | – | 6.8  | –   | nC |
| ESR                    | Equivalent Series Resistance  | f = 1 MHz                                                                      | – | 4    | –   | Ω  |

### SWITCHING CHARACTERISTICS

|                     |                     |                                                                                                        |   |     |    |    |
|---------------------|---------------------|--------------------------------------------------------------------------------------------------------|---|-----|----|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 4 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 4.7 Ω (Note 4) | – | 14  | 38 | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |                                                                                                        | – | 8.3 | 27 | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |                                                                                                        | – | 33  | 76 | ns |
| t <sub>f</sub>      | Turn-Off Fall Time  |                                                                                                        | – | 6   | 22 | ns |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                 |                                                          |                                                                              |   |     |     |    |
|-----------------|----------------------------------------------------------|------------------------------------------------------------------------------|---|-----|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain to Source Diode Forward Current |                                                                              | – | –   | 6   | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain to Source Diode Forward Current     |                                                                              | – | –   | 12  | A  |
| V <sub>SD</sub> | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 4 A                                 | – | –   | 1.2 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 4 A, dI <sub>F</sub> /dt = 100 A/μs | – | 275 | –   | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                                  |                                                                              | – | 2.9 | –   | 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

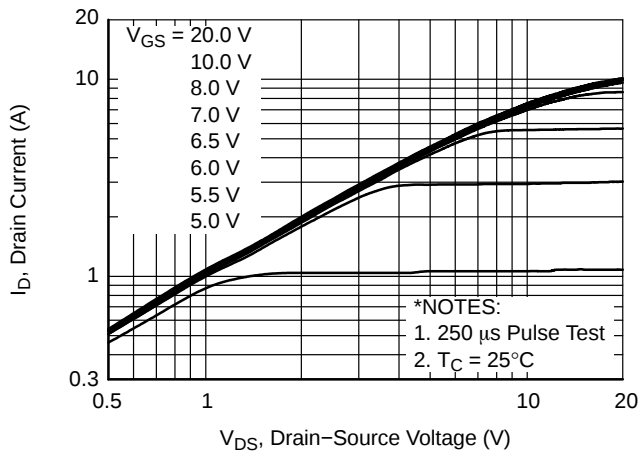


Figure 1. On-Region Characteristics

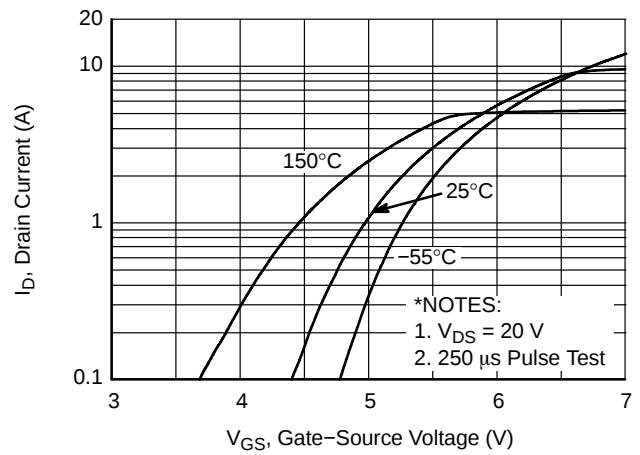


Figure 2. Transfer Characteristics

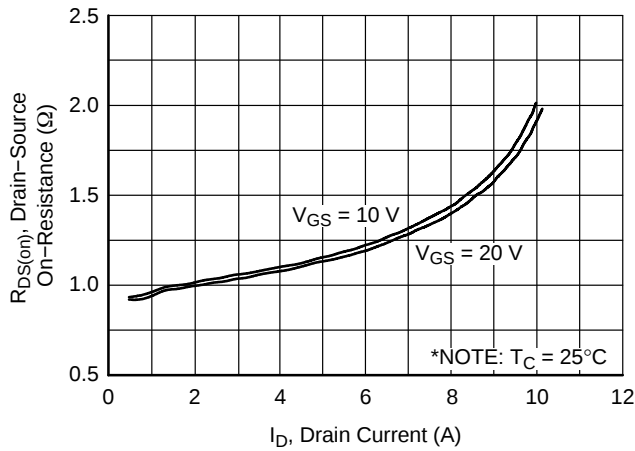


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

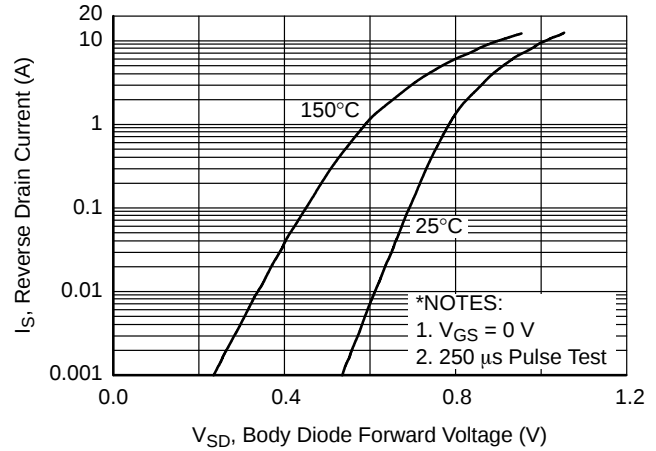


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

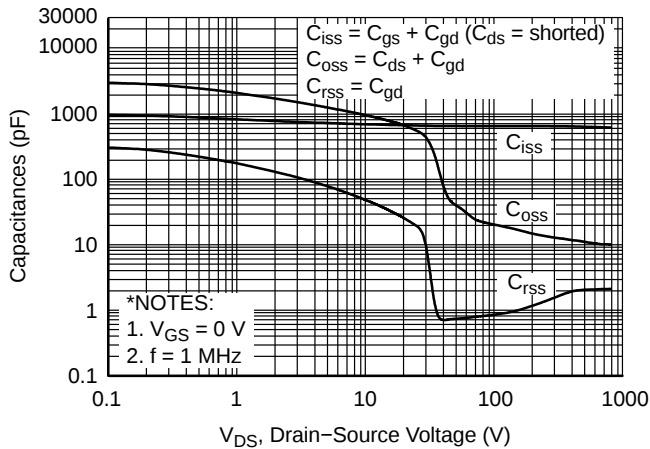


Figure 5. Capacitance Characteristics

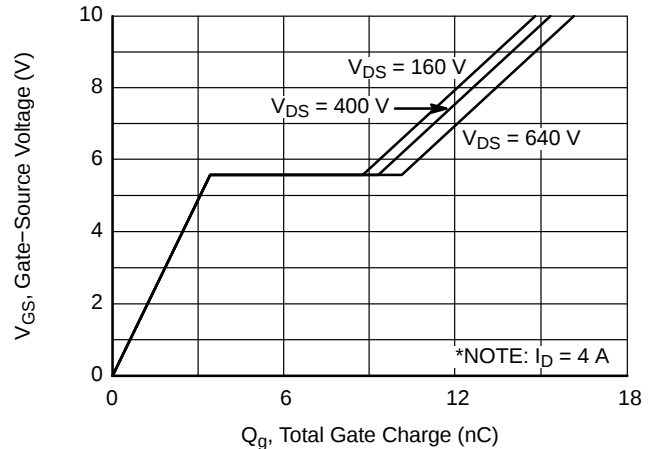


Figure 6. Gate Charge Characteristics

## TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

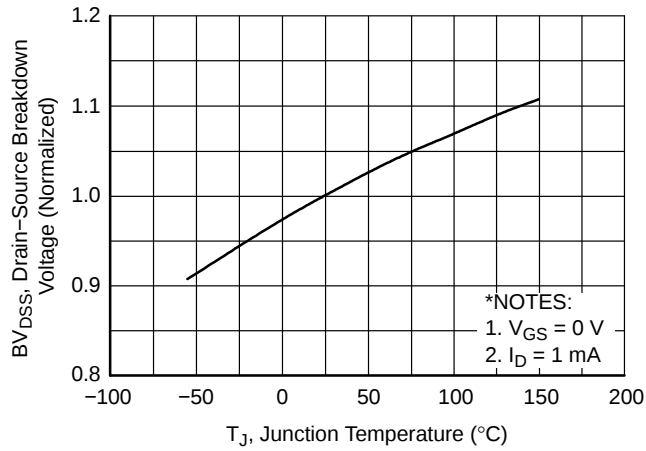


Figure 7. Breakdown Voltage Variation vs. Temperature

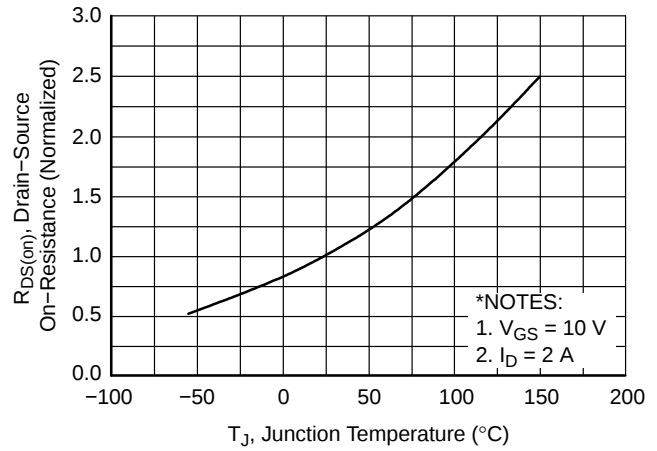


Figure 8. On-Resistance Variation vs. Temperature

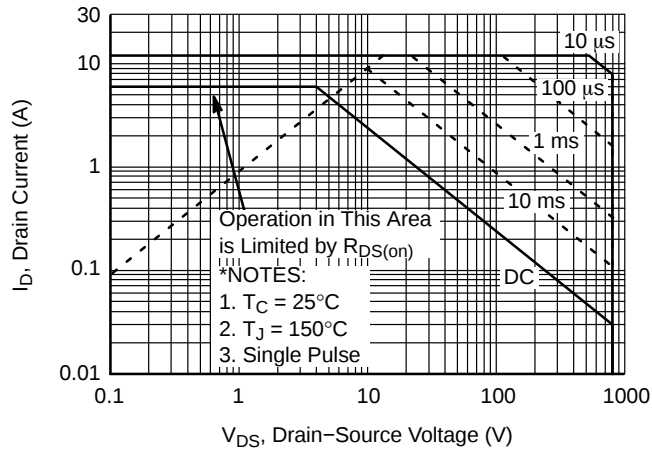


Figure 9. Maximum Safe Operating Area

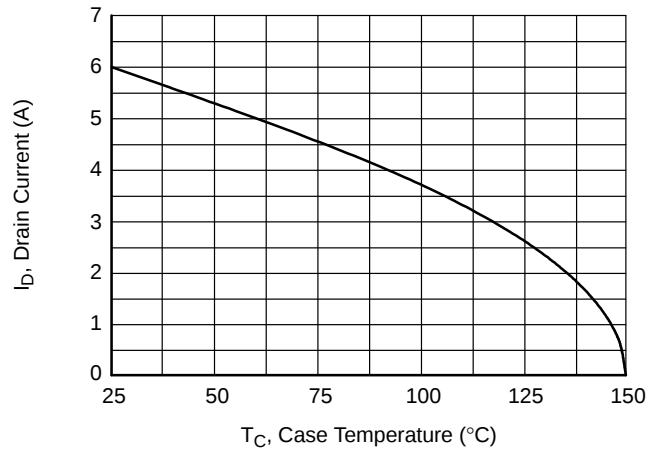
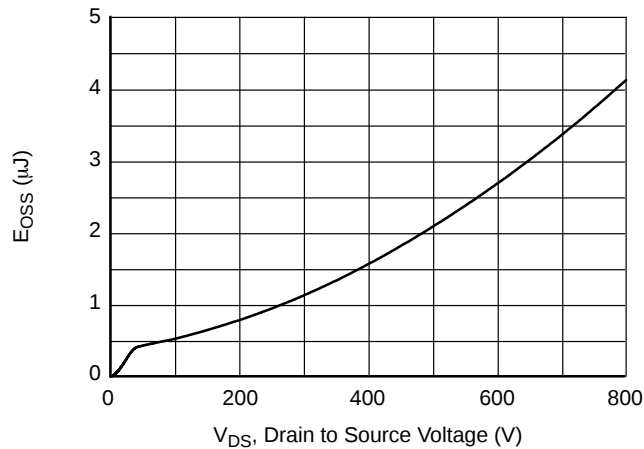


Figure 10. Maximum Drain Current vs. Case Temperature

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

## TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

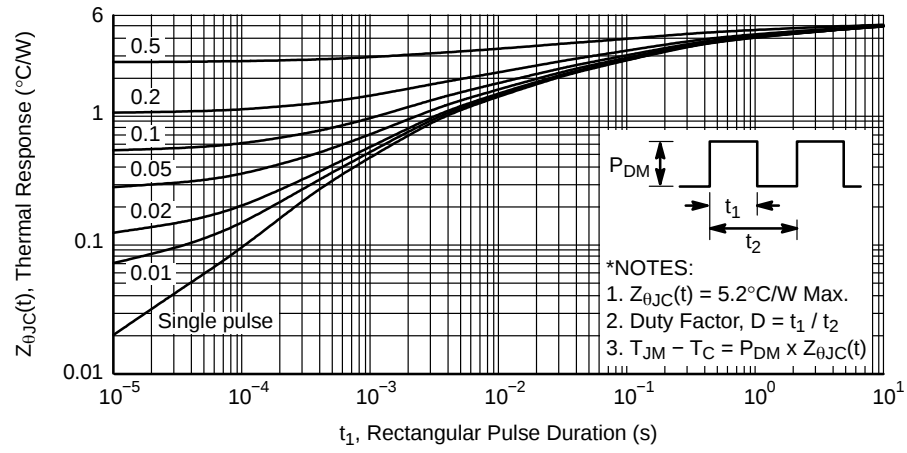


Figure 12. Transient Thermal Response Curve

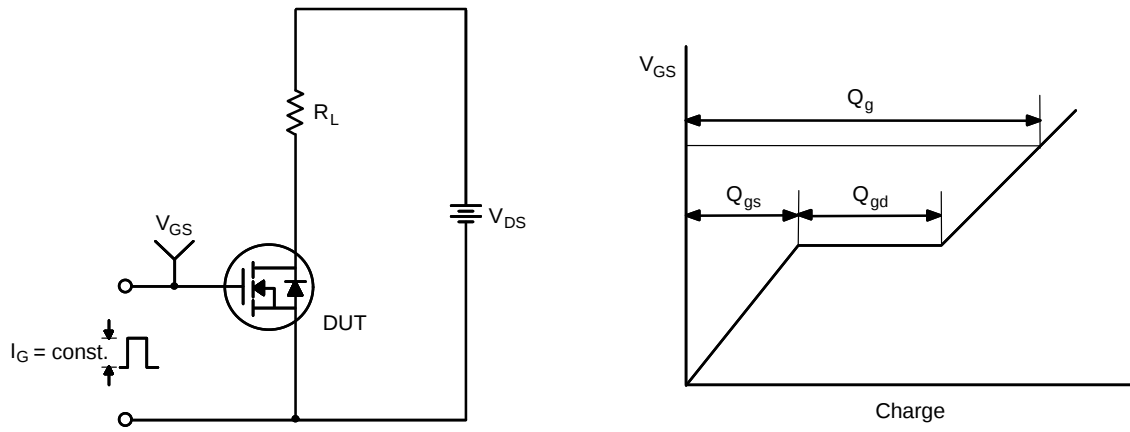


Figure 13. Gate Charge Test Circuit & Waveform

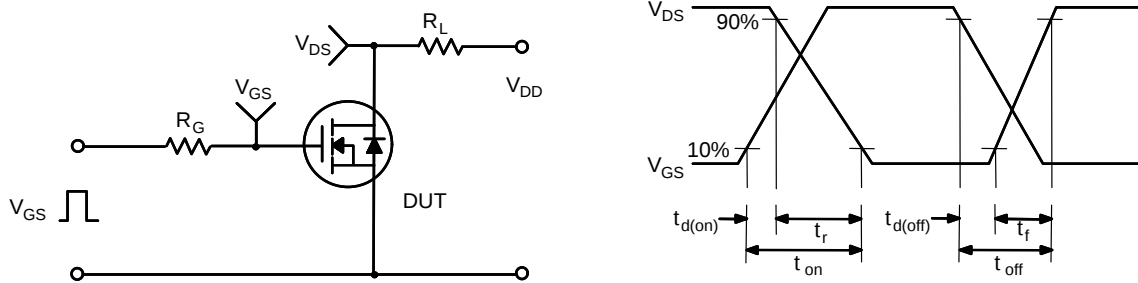


Figure 14. Resistive Switching Test Circuit & Waveforms

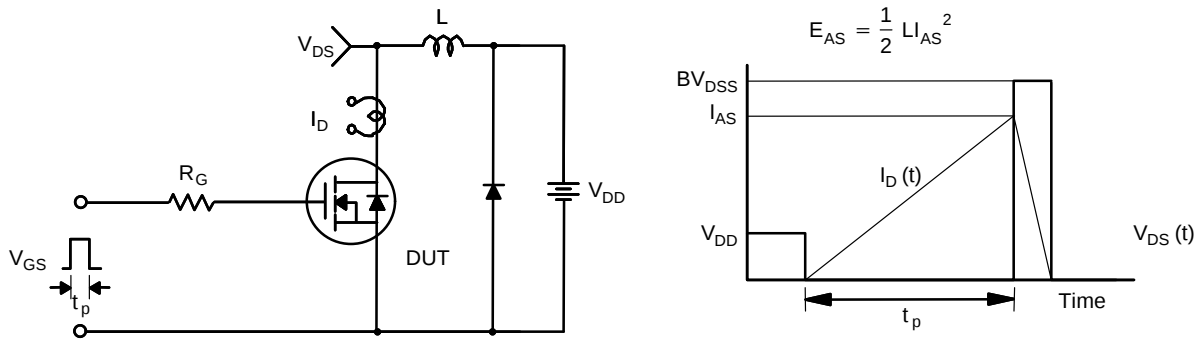
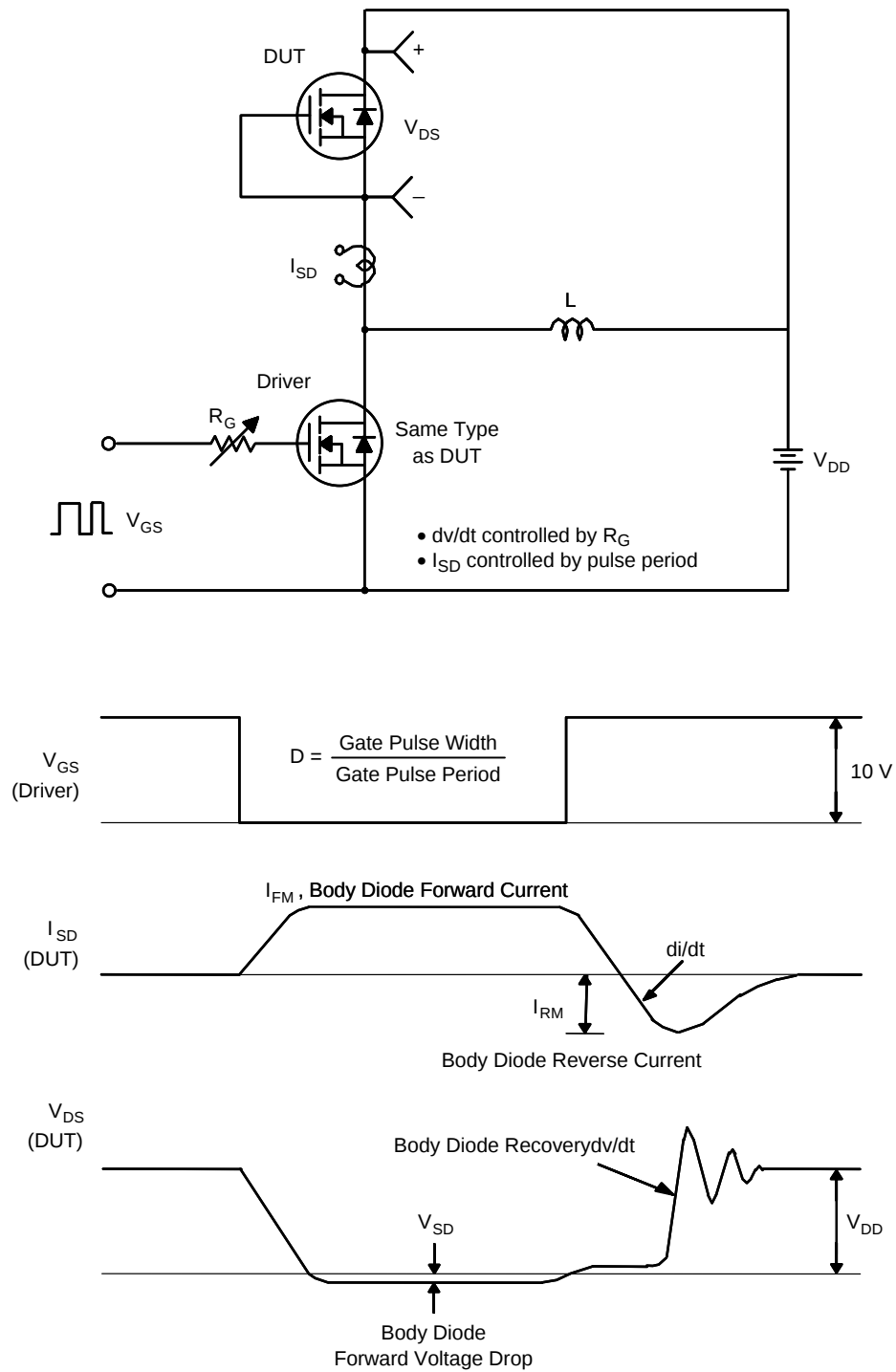


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

# FCPF1300N80Z



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

**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

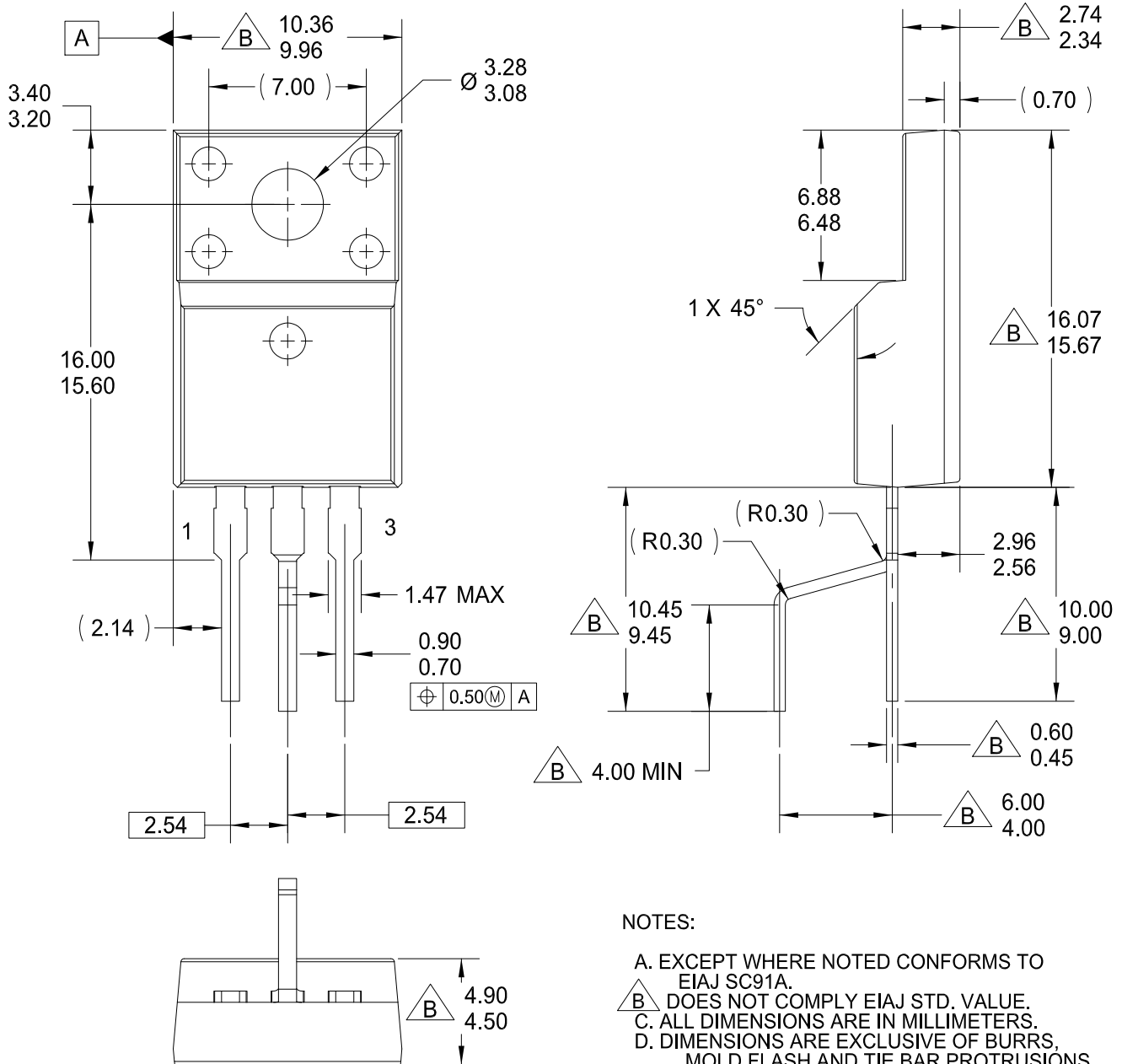
OPTION 2 - NO SUPPORT PIN HOLE

|                         |                                              |                                                                                                                                                                                     |
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**TO-220-3LD LF**  
**CASE 340BJ**  
**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. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.

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