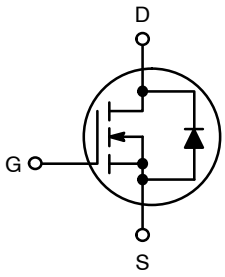
# MOSFET – N-Channel, SUPERFET®, FRFET®

## 600 V, 11 A, 380 mΩ

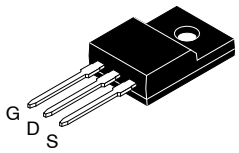
# FCPF11N60F

| $V_{DS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|---|---|---|
| 600 V | 380 mΩ @ 10 V | 11 A* |

*Drain current limited by maximum junction temperature.




**N−Channel**




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

### Description

SUPERFET MOSFET is **onsemi**'s first generation of 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. Consequently, SUPERFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications. SUPERFET FRFET MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.

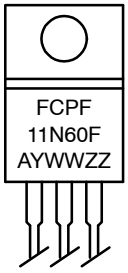
### Features

- 600 V @ $T_J$ = 150°C
- $R_{DS(on)}$ = 320 mΩ (Typ.)
- Fast Recovery Type ($t_{rr}$ = 120 ns)
- Ultra Low Gate Charge (Typ. $Q_g$ = 40 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 95 pF)
- 100% Avalanche Tested
- These Devices are Pb−Free and are RoHS Compliant

### Applications

- LCD/LED/PDP TV
- Lighting
- Solar Inverter
- AC−DC Power Supply

### MARKING DIAGRAM




| | |
|---|---|
| FCPF11N60F | = Specific Device Code |
| A | = Assembly Location |
| YWW | = Date Code (Year & Week) |
| ZZ | = Assembly Lot |

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| FCPF11N60F | TO−220−3 FULLPAK | 1000 Units / Tube |

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

| Symbol | Parameter | | FCPF11N60F | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 600 | V |
| $I_D$ | Drain Current | – Continuous ($T_C$ = 25°C) | 11* | A |
| | | – Continuous ($T_C$ = 100°C) | 7* | |
| $I_{DM}$ | Drain Current | – Pulsed (Note 1) | 33* | A |
| $V_{GSS}$ | Gate to Source Voltage | | ±30 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 340 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | | 11 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 12.5 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 4.5 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 36 | W |
| | | – Derate Above 25°C | 0.29 | 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. $I_{AS}$ = 5.5 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 11 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ $BV_{DSS}$, starting $T_J$ = 25°C.

**THERMAL CHARACTERISTICS**

| Symbol | Parameter | FCPF11N60F | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 3.5 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5 | °C/W |


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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA, $T_C$ = 25°C | 600 | – | – | V |
| | | $V_{GS}$ = 0 V, $I_D$ = 250 μA, $T_C$ = 150°C | – | 650 | – | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | – | 0.6 | – | V/°C |
| $BV_{DS}$ | Drain−Source Avalanche Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 11 A | – | 700 | – | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | – | – | 1 | μA |
| | | $V_{DS}$ = 480 V, $T_C$ = 125°C | – | – | 10 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | – | – | ±100 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | 3.0 | – | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On−Resistance | $V_{GS}$ = 10 V, $I_D$ = 5.5 A | – | 0.32 | 0.38 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 5.5 A | – | 6 | – | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | – | 1148 | 1490 | pF |
| $C_{oss}$ | Output Capacitance | | – | 671 | 870 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | – | 63 | 82 | pF |
| $C_{oss}$ | Output Capacitance | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, f = 1 MHz | – | 35 | – | pF |
| $C_{oss(eff.)}$ | Effective Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | – | 95 | – | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10 V | $V_{DS}$ = 480 V, $I_D$ = 11 A, $V_{GS}$ = 10 V (Note 4) | – | 40 | 52 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | – | 7.2 | – | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | – | 21 | – | nC |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn−On Delay Time | $V_{DD}$ = 300 V, $I_D$ = 11 A, $R_G$ = 25 Ω (Note 4) | – | 34 | 80 | ns |
| $t_r$ | Turn−On Rise Time | | – | 98 | 205 | ns |
| $t_{d(off)}$ | Turn−Off Delay Time | | – | 119 | 250 | ns |
| $t_f$ | Turn−Off Fall Time | | – | 56 | 120 | ns |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | – | – | 11 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | – | – | 33 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 11 A | – | – | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 11 A, $dI_F/dt$ = 100 A/μs | – | 120 | – | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | – | 0.8 | – | 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



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## TYPICAL PERFORMANCE CHARACTERISTICS

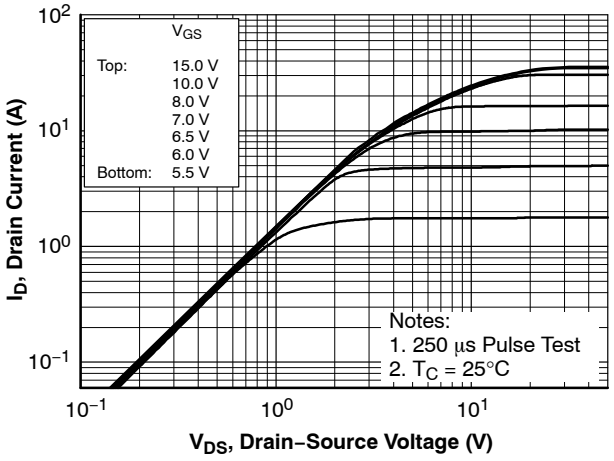



**Figure 1. On−Region Characteristics**

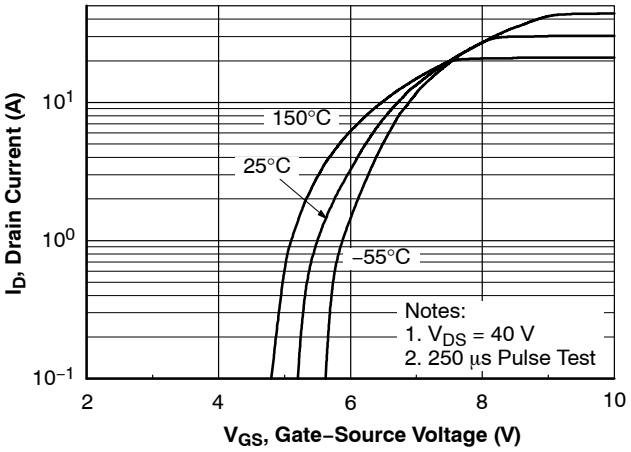



**Figure 2. Transfer Characteristics**

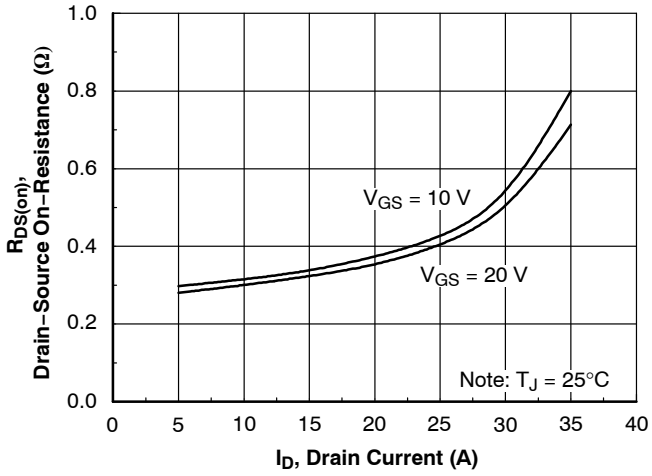



**Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage**

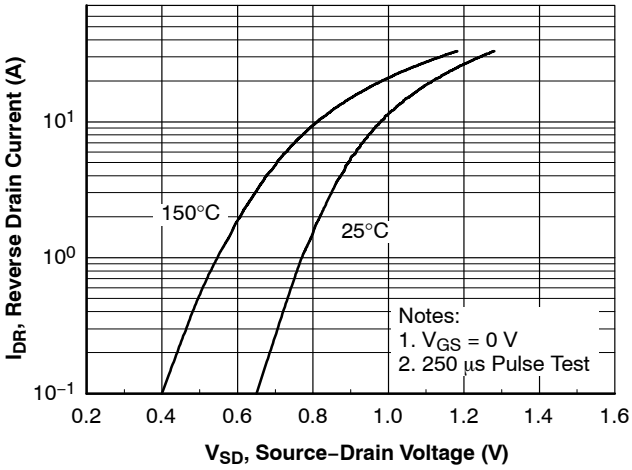



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

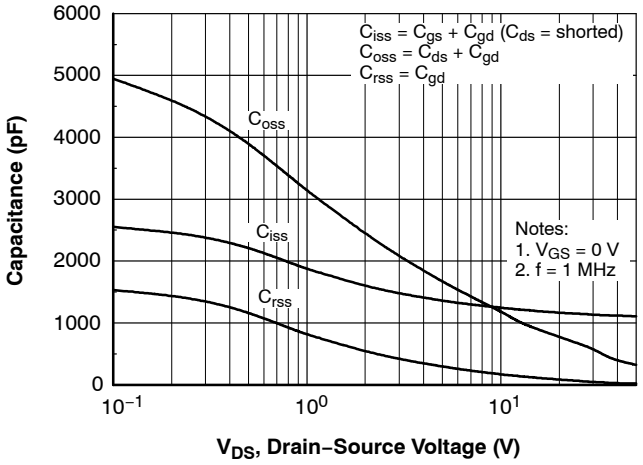



**Figure 5. Capacitance Characteristics**

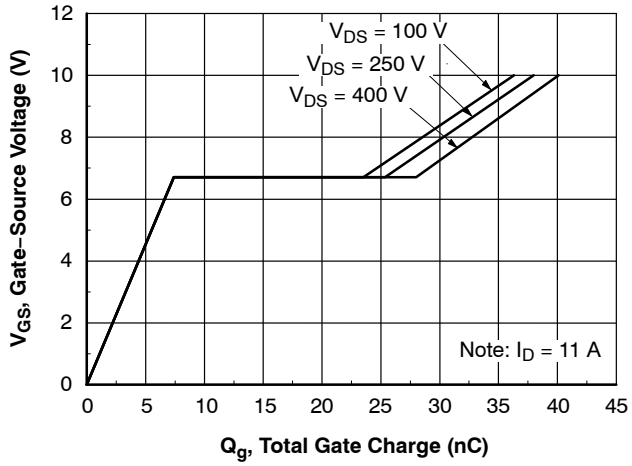



**Figure 6. Gate Charge Characteristics**



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## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

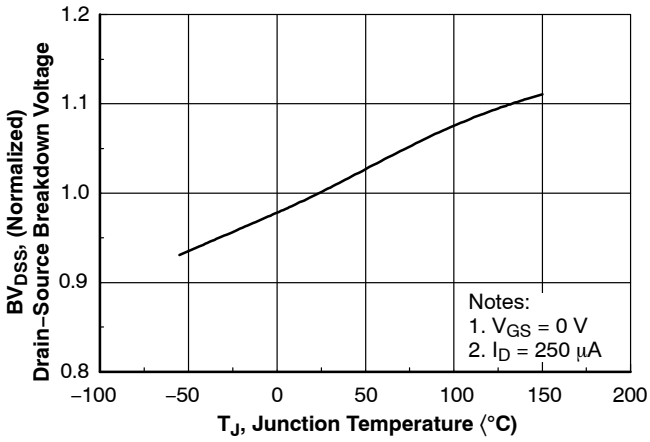



**Figure 7. Breakdown Voltage Variation vs. Temperature**

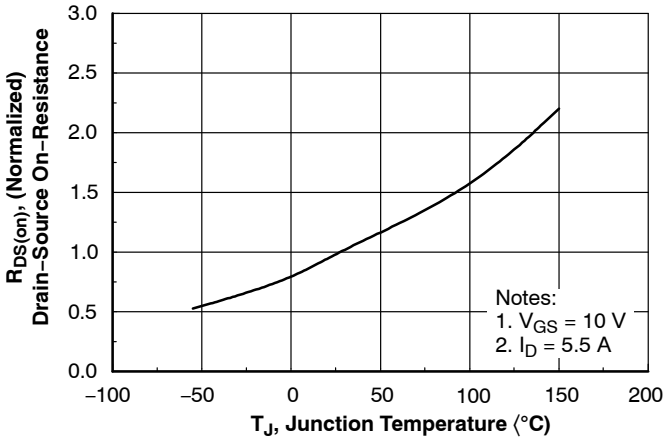



**Figure 8. On−Resistance Variation vs. Temperature**

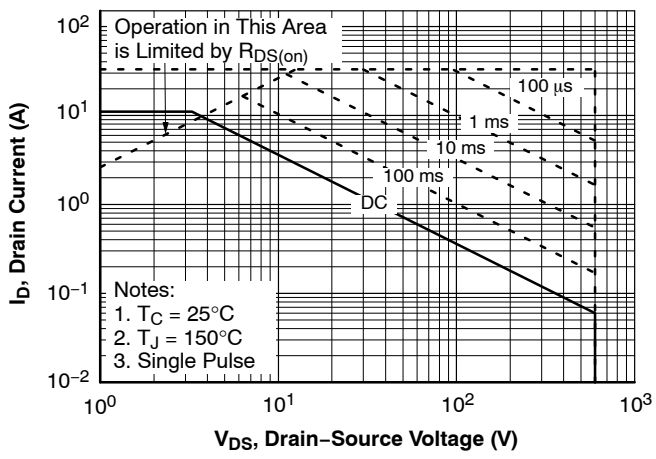



**Figure 9. Safe Operating Area**

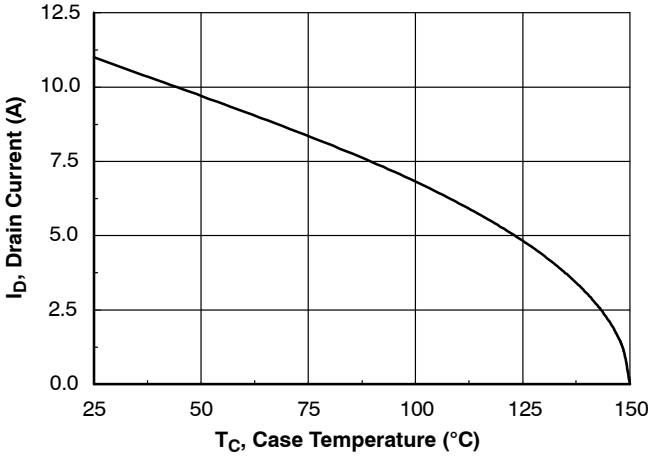



**Figure 10. Maximum Drain Current vs. Case Temperature**

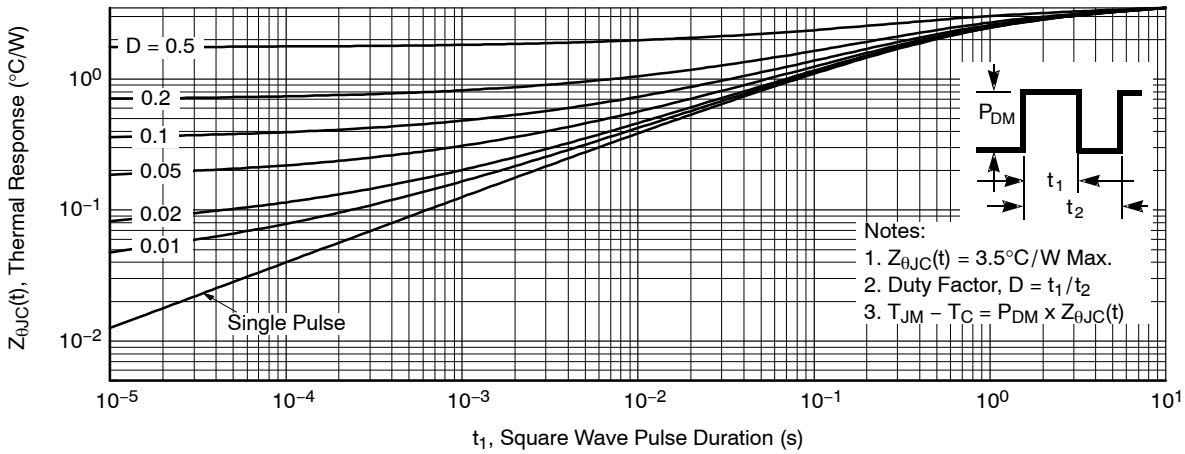



**Figure 11. Transient Thermal Response Curve**



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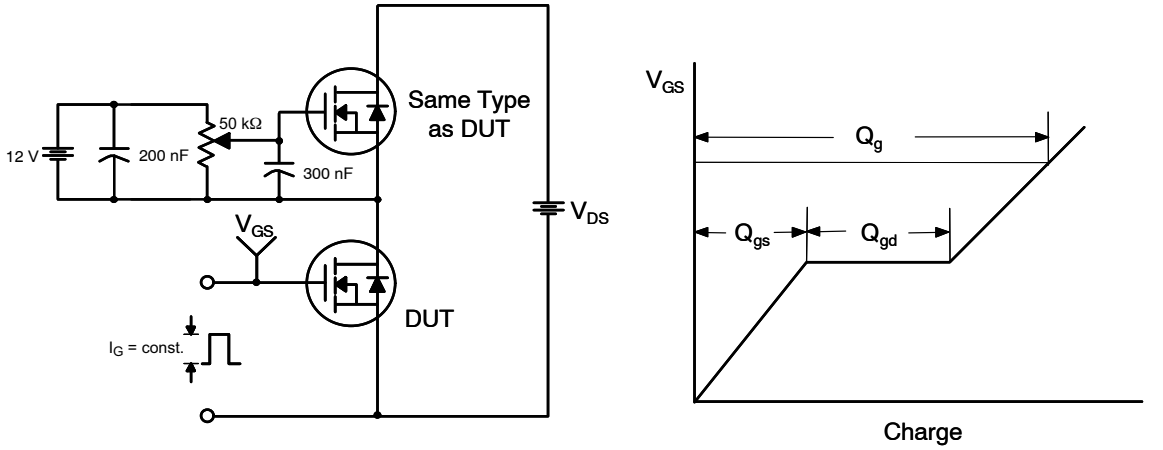



**Figure 12. Gate Charge Test Circuit & Waveform**

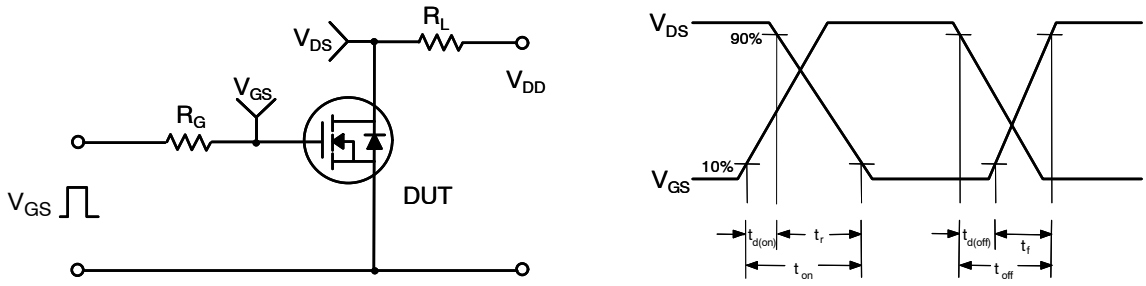



**Figure 13. Resistive Switching Test Circuit & Waveforms**

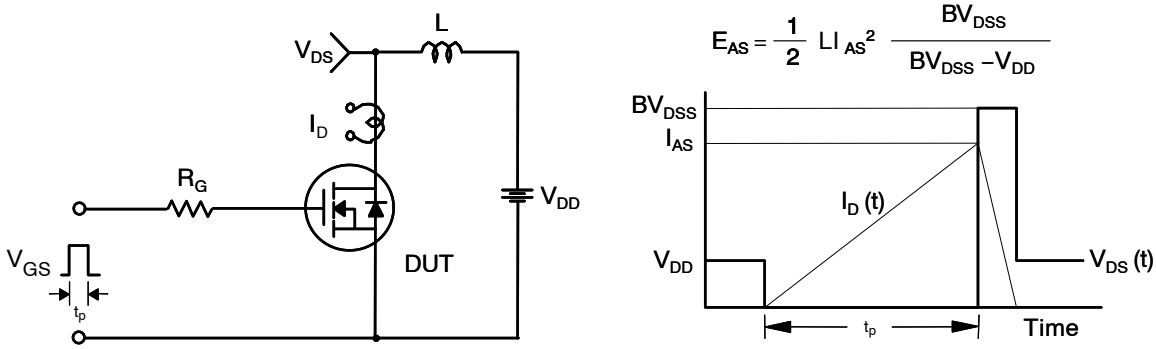



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**



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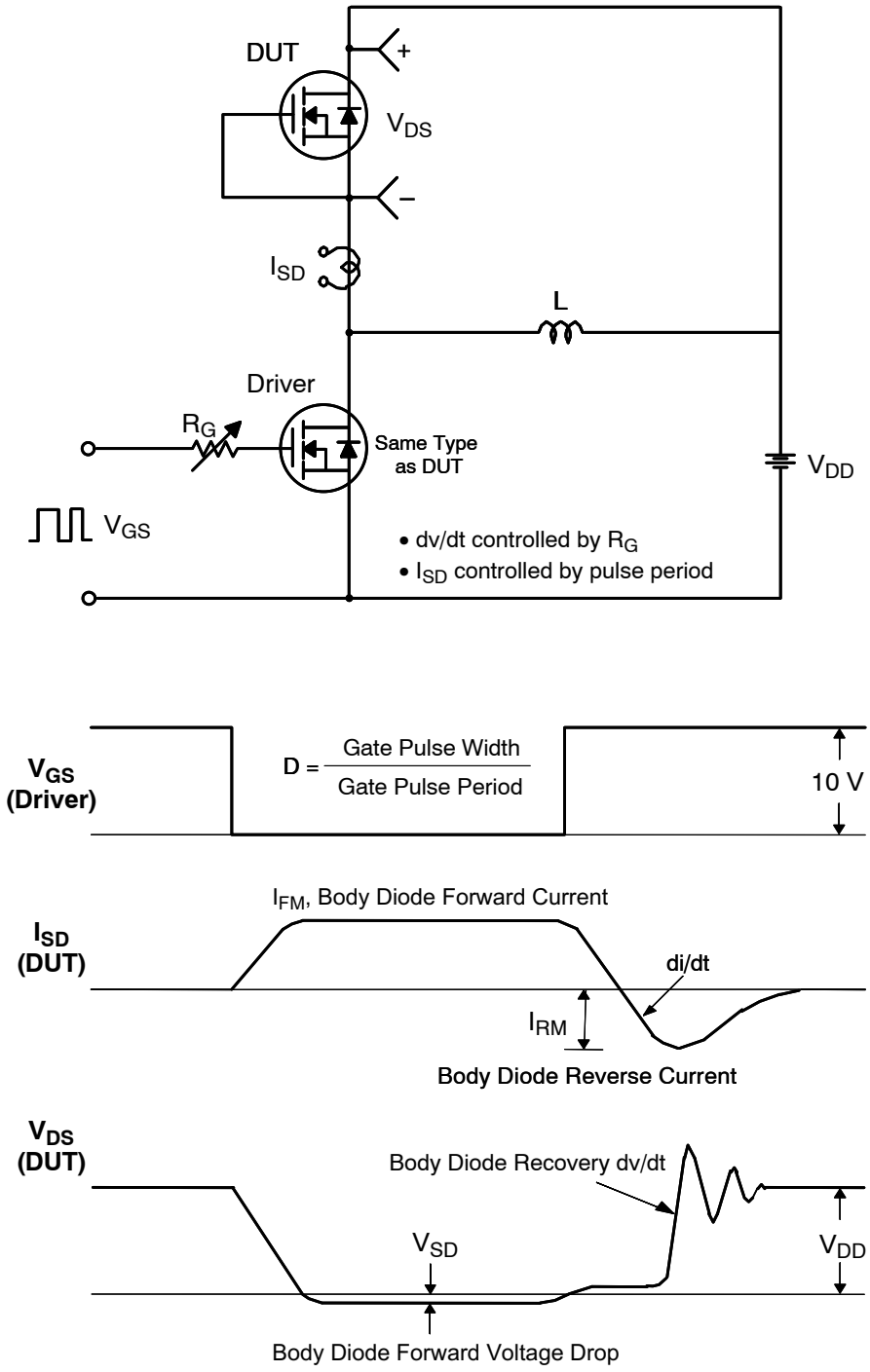



**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

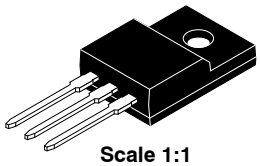
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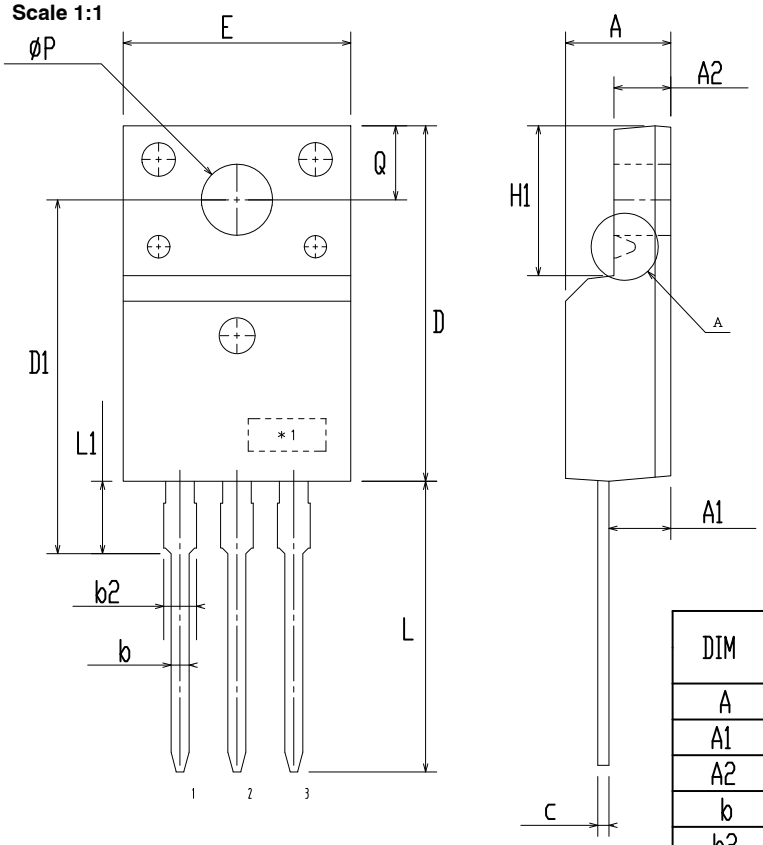
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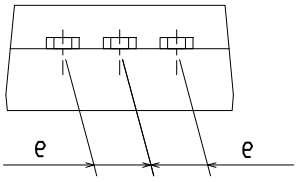
**TO−220 Fullpack, 3−Lead / TO−220F−3SG**
CASE 221AT
ISSUE B

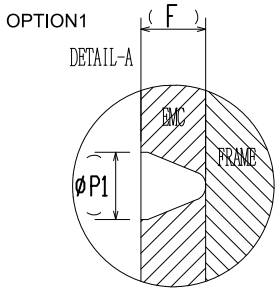
DATE 19 JAN 2021



**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

| | | | |
|---|---|---|---|
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