

FDP12N50NZ / FDPF12N50NZ

N-Channel UniFET™ II MOSFET

500 V, 11.5 A, 520 mΩ

Features

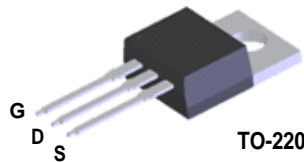
- $R_{DS(on)} = 460 \text{ m}\Omega$ (Typ.) @ $V_{GS} = 10 \text{ V}$, $I_D = 5.75 \text{ A}$
- Low Gate Charge (Typ. 23 nC)
- Low C_{RSS} (Typ. 14 pF)
- 100% Avalanche Tested
- ESD Improved Capability
- RoHS Compliant

Applications

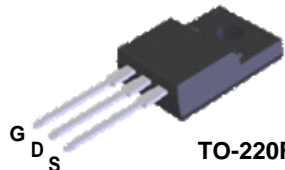
- LCD/LED/PDP TV
- Lighting
- Uninterruptible Power Supply

Description

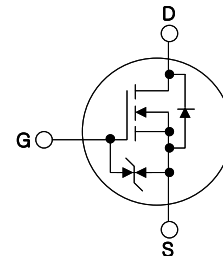
UniFET™ II MOSFET is Fairchild Semiconductor®'s high voltage MOSFET family based on advanced planar stripe and DMOS technology. This advanced MOSFET family has the smallest on-state resistance among the planar MOSFET, and also provides superior switching performance and higher avalanche energy strength.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



TO-220



TO-220F



MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted*

| Symbol | Parameter | | FDP12N50NZ | FDPF12N50NZ | Unit |
|----------------|--|--|-------------|-------------|------------------|
| V_{DSS} | Drain to Source Voltage | | 500 | | V |
| V_{GSS} | Gate to Source Voltage | | ±25 | | V |
| I_D | Drain Current | - Continuous ($T_C = 25^\circ\text{C}$) | 11.5 | 11.5* | A |
| | | - Continuous ($T_C = 100^\circ\text{C}$) | 6.9 | 6.9* | |
| I_{DM} | Drain Current | - Pulsed (Note 1) | 46 | 46* | A |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | | 560 | | mJ |
| I_{AR} | Avalanche Current (Note 1) | | 11.5 | | A |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | | 17 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 4.5 | | V/ns |
| P_D | Power Dissipation | ($T_C = 25^\circ\text{C}$) | 170 | 42 | W |
| | | - Derate above 25°C | 1.37 | 0.33 | |
| T_J, T_{STG} | Operating and Storage Temperature Range | | -55 to +150 | | $^\circ\text{C}$ |
| T_L | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | | 300 | | $^\circ\text{C}$ |

*Drain current limited by maximum junction temperature

Thermal Characteristics

| Symbol | Parameter | FDP12N50NZ | FDPF12N50NZ | Unit |
|-----------------|---|------------|-------------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.73 | 3.0 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta CS}$ | Thermal Resistance, Case to Sink Typ | 0.5 | - | |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5 | 62.5 | |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|-------------|---------|-----------|------------|----------|
| FDP12N50NZ | FDP12N50NZ | TO-220 | - | - | 50 |
| FDPF12N50NZ | FDPF12N50NZ | TO-220F | - | - | 50 |

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

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

Off Characteristics

| | | | | | | |
|--------------------------------------|---|---|-----|-----|----------|---------------------------|
| BV_{DSS} | Drain to Source Breakdown Voltage | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$ | 500 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$, Referenced to 25°C | - | 0.5 | - | $\text{V}/^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 500\text{V}, V_{GS} = 0\text{V}$ $V_{DS} = 400\text{V}, T_C = 125^\circ\text{C}$ | - | - | 1 10 | μA |
| I_{GSS} | Gate to Body Leakage Current | $V_{GS} = \pm 25\text{V}, V_{DS} = 0\text{V}$ | - | - | ± 10 | μA |

On Characteristics

| | | | | | | |
|--------------|--------------------------------------|---|-----|------|------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$ | 3.0 | - | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{V}, I_D = 5.75\text{A}$ | - | 0.46 | 0.52 | Ω |
| g_{FS} | Forward Transconductance | $V_{DS} = 20\text{V}, I_D = 5.75\text{A}$ | - | 12 | - | S |

Dynamic Characteristics

| | | | | | | |
|-----------|-------------------------------|---|----------|-----|------|----|
| C_{iss} | Input Capacitance | $V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$ | - | 945 | 1235 | pF |
| C_{oss} | Output Capacitance | | - | 155 | 205 | pF |
| C_{rss} | Reverse Transfer Capacitance | | - | 14 | 20 | pF |
| Q_g | Total Gate Charge at 10V | $V_{DS} = 400\text{V}, I_D = 11.5\text{A}$ $V_{GS} = 10\text{V}$ | - | 23 | 30 | nC |
| Q_{gs} | Gate to Source Gate Charge | | - | 5.5 | - | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | (Note 4) | - | 9.6 | - |

Switching Characteristics

| | | | | | | |
|--------------|---------------------|--|----------|----|-----|-----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 250\text{V}, I_D = 11.5\text{A}$ $R_G = 25\Omega$ | - | 20 | 50 | ns |
| t_r | Turn-On Rise Time | | - | 50 | 110 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 60 | 130 | ns |
| t_f | Turn-Off Fall Time | | (Note 4) | - | 45 | 100 |

Drain-Source Diode Characteristics

| | | | | | | |
|----------|--|--|---|------|-----|---------------|
| I_S | Maximum Continuous Drain to Source Diode Forward Current | - | - | 11.5 | A | |
| I_{SM} | Maximum Pulsed Drain to Source Diode Forward Current | - | - | 46 | A | |
| V_{SD} | Drain to Source Diode Forward Voltage | $V_{GS} = 0\text{V}, I_{SD} = 11.5\text{A}$ | - | - | 1.4 | V |
| t_{rr} | Reverse Recovery Time | $V_{GS} = 0\text{V}, I_{SD} = 11.5\text{A}$ $di_F/dt = 100\text{A}/\mu\text{s}$ | - | 315 | - | ns |
| Q_{rr} | Reverse Recovery Charge | | - | 2.0 | - | μC |

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $L = 8.5\text{mH}, I_{AS} = 11.5\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 11.5\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

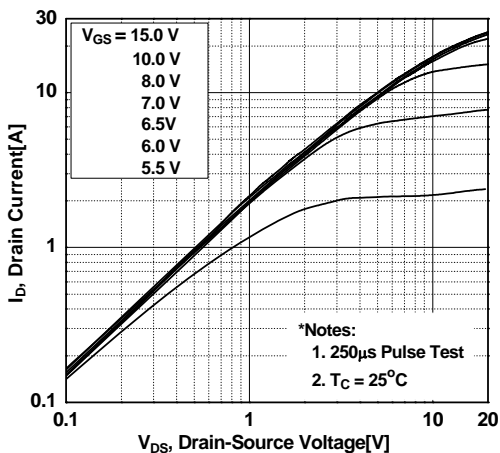


Figure 2. Transfer Characteristics

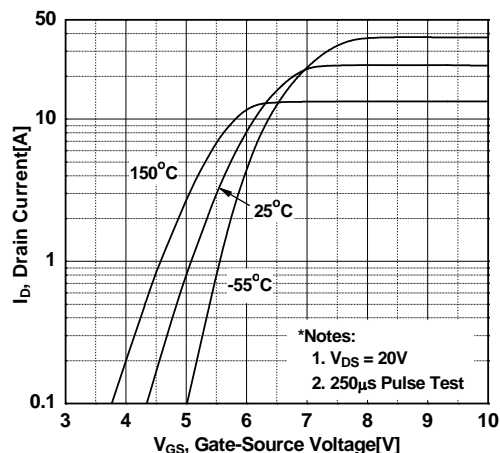


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

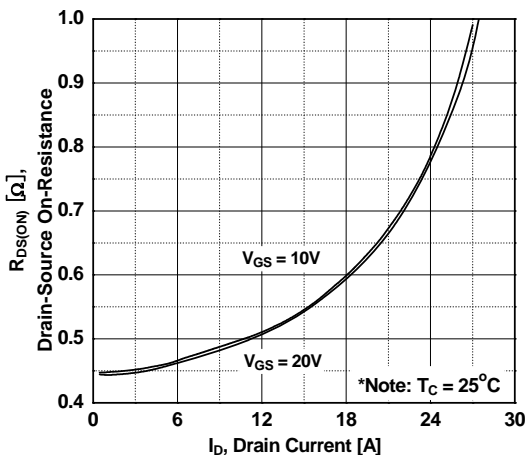


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

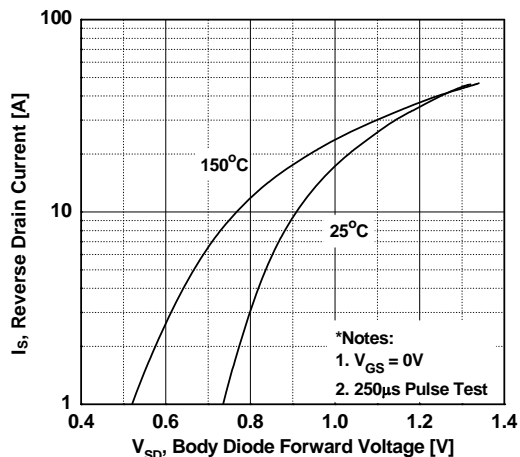


Figure 5. Capacitance Characteristics

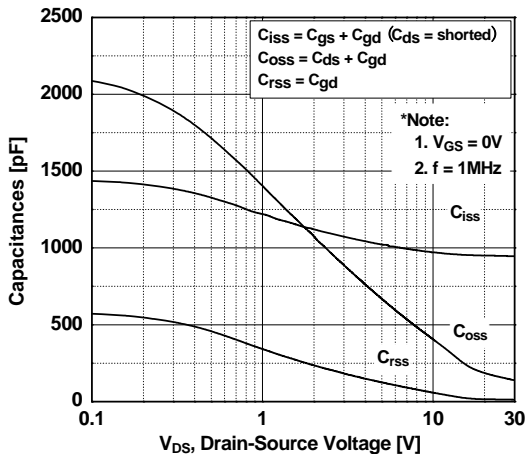
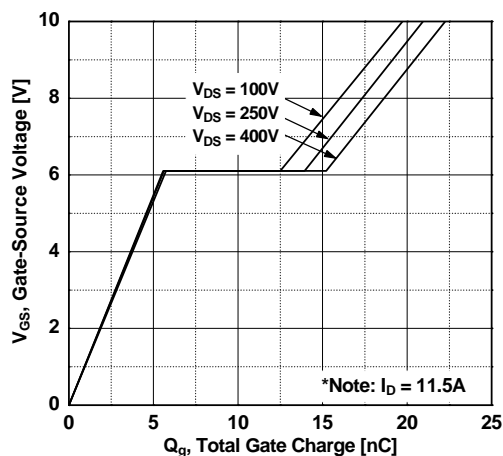


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

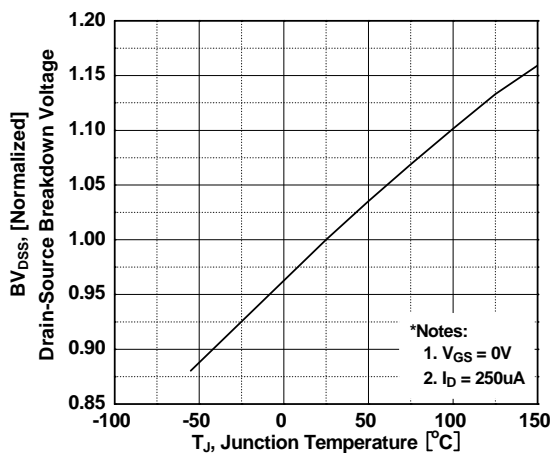


Figure 8. On-Resistance Variation vs. Temperature

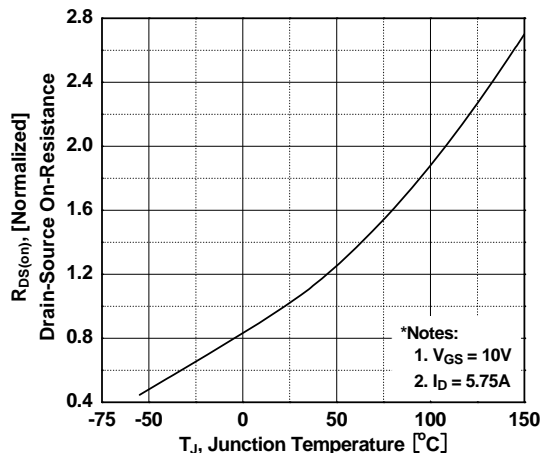


Figure 9. Maximum Safe Operating Area - FDP12N50NZ

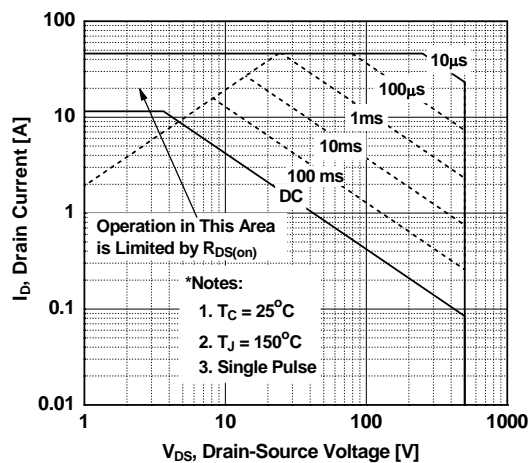


Figure 10. Maximum Safe Operating Area - FDP12N50NZ

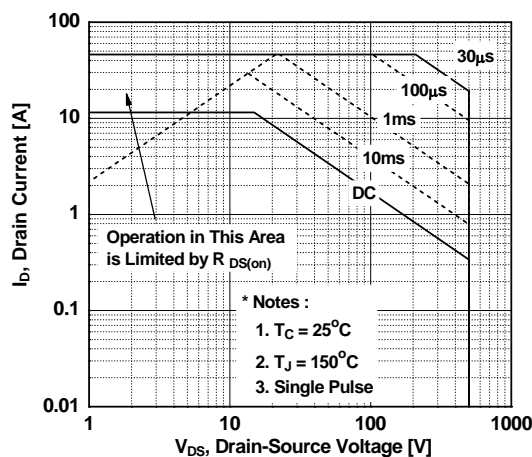
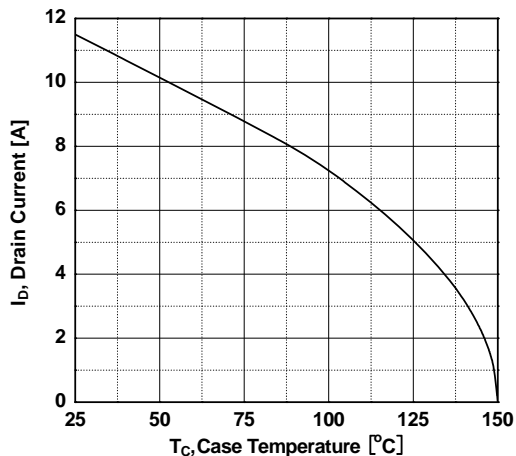


Figure 11. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve - FDP12N50NZ

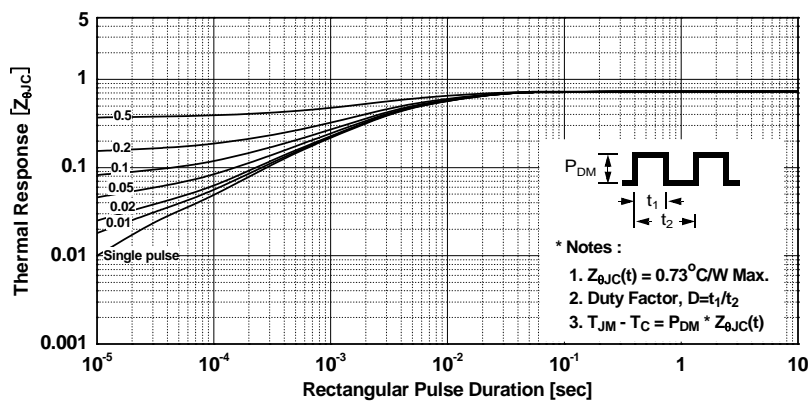
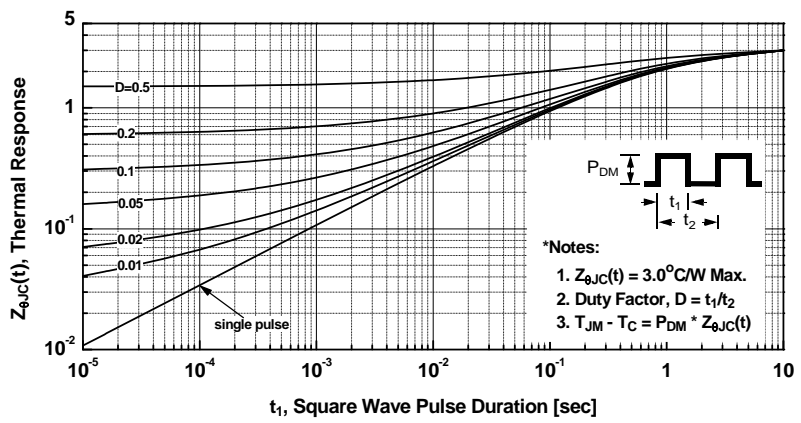
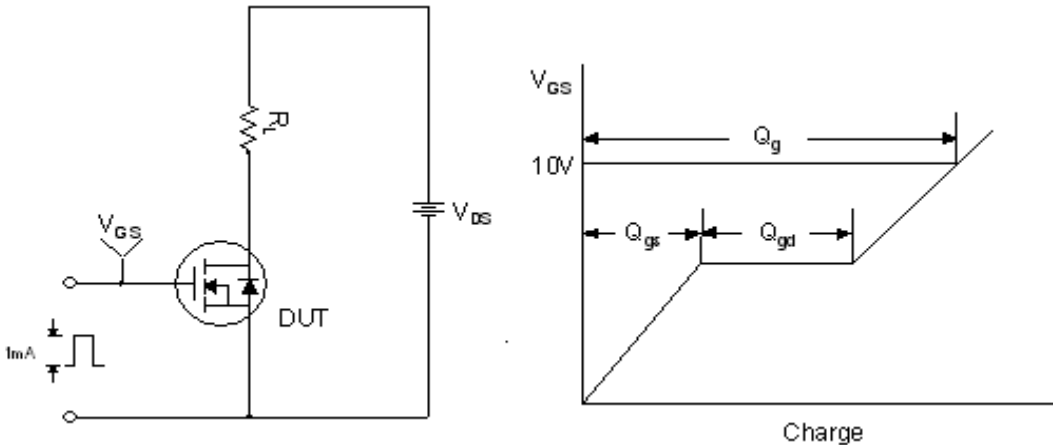


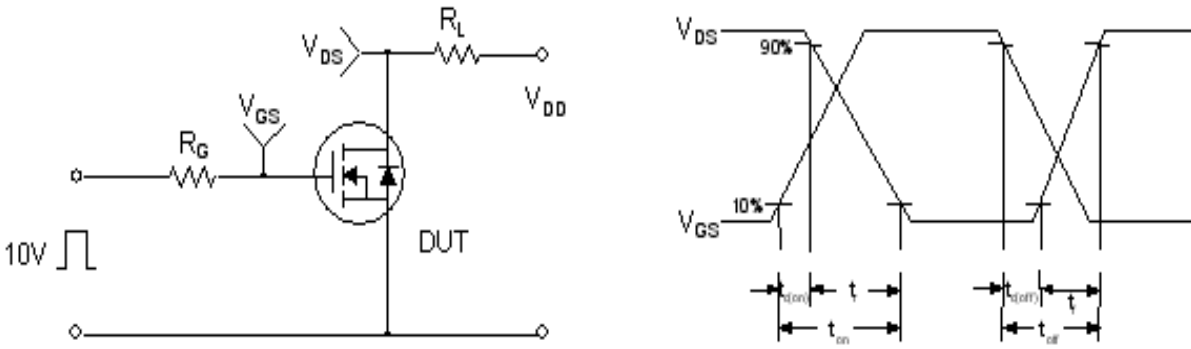
Figure 13. Transient Thermal Response Curve - FDPF12N50NZ



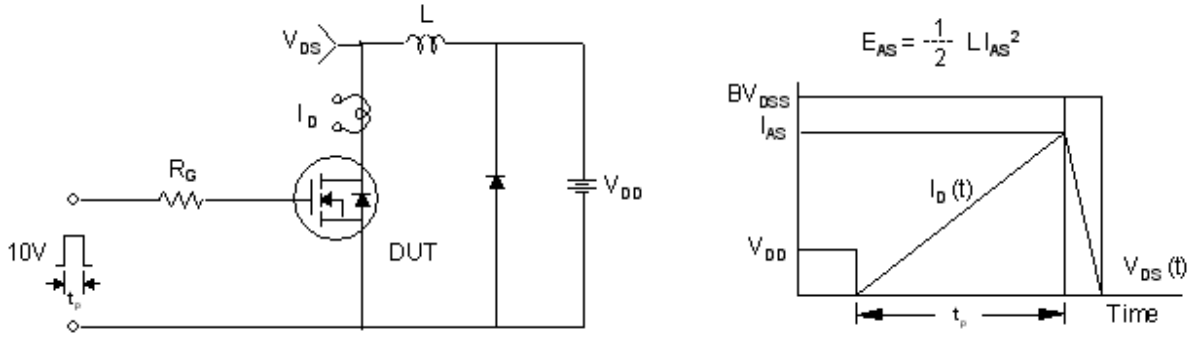
Gate Charge Test Circuit & Waveform



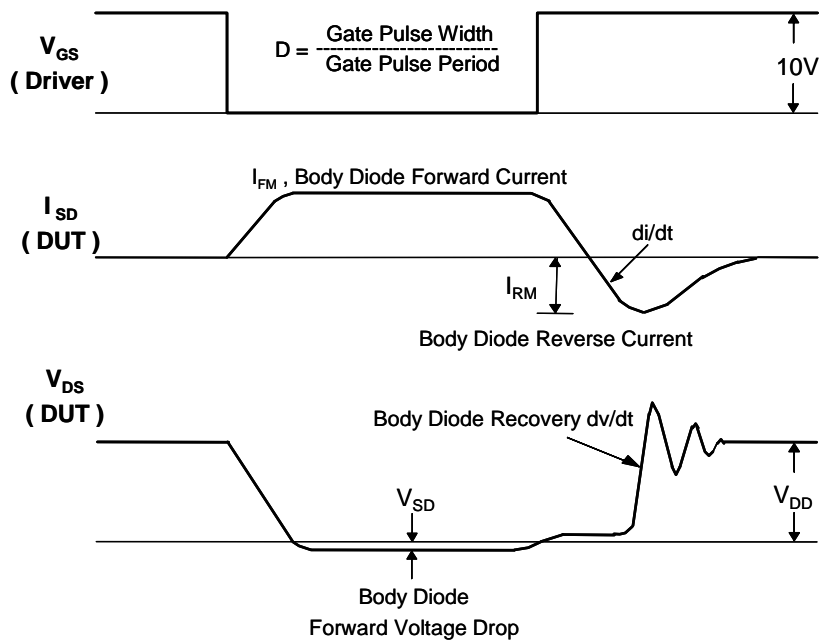
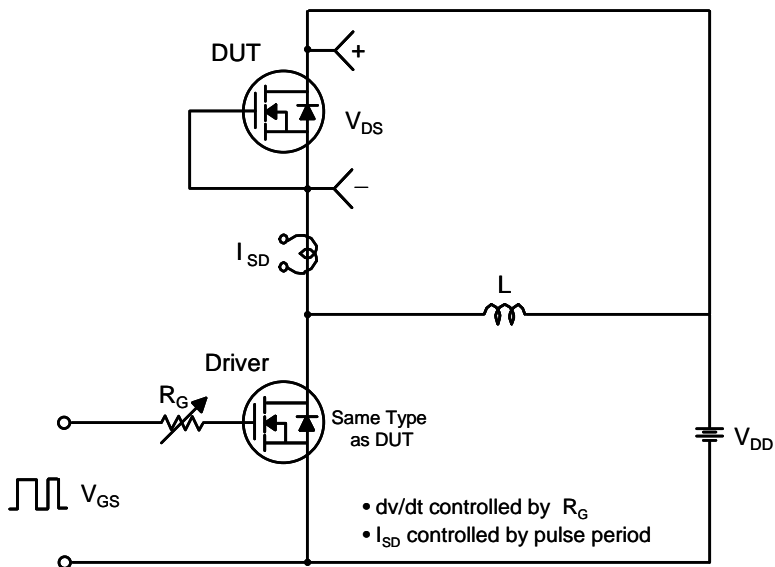
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

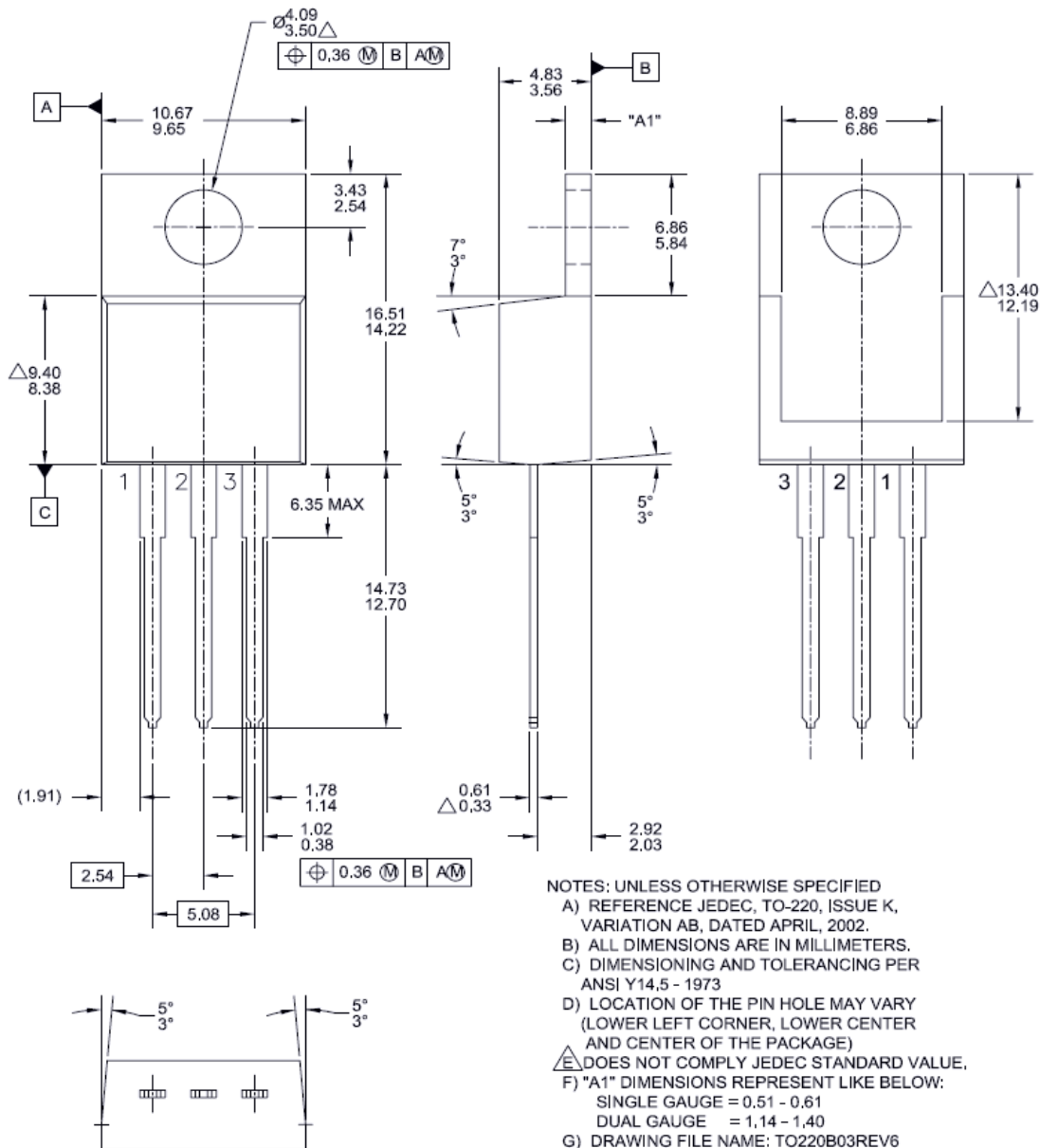


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

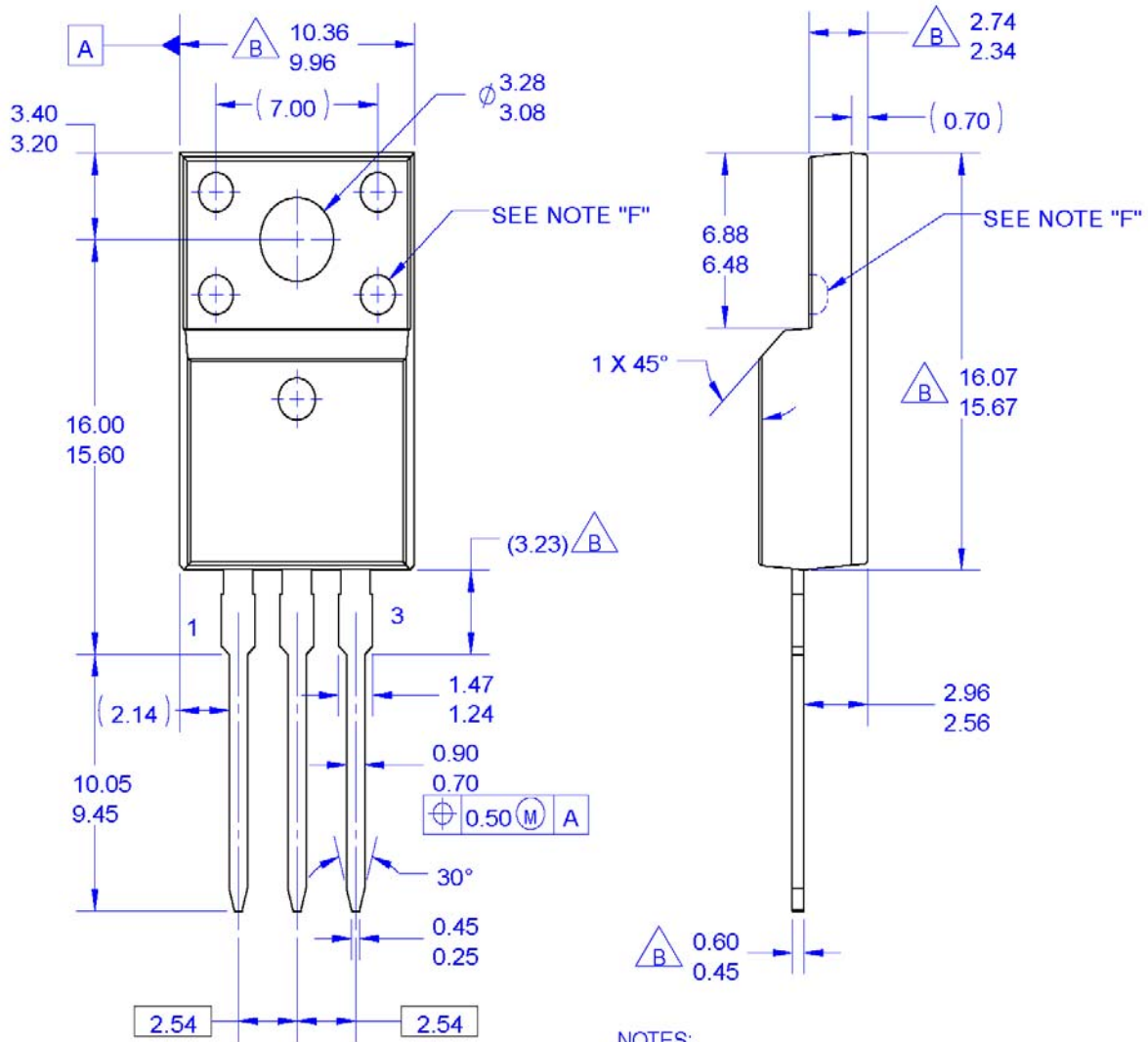
TO-220B03



Dimensions in Millimeters

Mechanical Dimensions

TO-220M03



- 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.
 - F. OPTION 1 - WITH SUPPORT PIN HOLE. OPTION 2 - NO SUPPORT PIN HOLE.
 - G. DRAWING FILE NAME: TO220M03REV3

Dimensions in Millimeters



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