

FCP380N60 / FCPF380N60

N-Channel SuperFET® II MOSFET

600 V, 10.2 A, 380 mΩ

Features

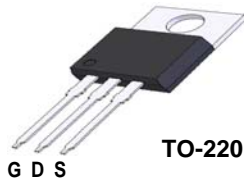
- 650 V @ $T_J = 150^\circ\text{C}$
- Max. $R_{DS(on)} = 380\text{ m}\Omega$
- Ultra low gate charge (typ. $Q_g = 30\text{ nC}$)
- Low effective output capacitance (typ. $C_{oss-eff} = 95\text{ pF}$)
- 100% avalanche tested

Applications

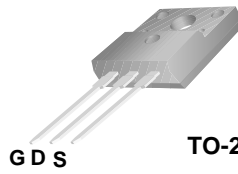
- LCD / LED / PDP TV Lighting
- Solar Inverter
- AC-DC Power Supply

Description

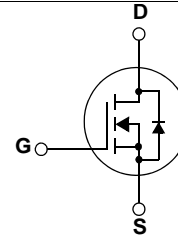
SuperFET®II MOSFET is Fairchild Semiconductor®'s first generation of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. Consequently, SuperFETII MOSFET is suitable for various AC/DC power conversion for system miniaturization and higher efficiency.



TO-220



TO-220F



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

| Symbol | Parameter | FCP380N60 | FCPF380N60 | Unit | |
|----------------|------------------------------------------------------------------------------|-------------------------------------------|------------|------------------|---------------------|
| V_{DSS} | Drain to Source Voltage | 600 | | V | |
| V_{GSS} | Gate to Source Voltage | -DC | ± 20 | V | |
| | | -AC (f > 1 HZ) | ± 30 | | |
| I_D | Drain Current | -Continuous ($T_C = 25^\circ\text{C}$) | 10.2 | 10.2* | A |
| | | -Continuous ($T_C = 100^\circ\text{C}$) | 6.4 | 6.4* | |
| I_{DM} | Drain Current | - Pulsed (Note 1) | 30.6 | 30.6* | A |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 211.6 | | mJ | |
| I_{AR} | Avalanche Current (Note 1) | 2.3 | | A | |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | 1.06 | | mJ | |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 20 | | V/ns | |
| | MOSFET dv/dt | 100 | | | |
| P_D | Power Dissipation | ($T_C = 25^\circ\text{C}$) | 106 | 31 | W |
| | | - Derate above 25°C | 0.85 | 0.25 | 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 Purpose, 1/8" from Case for 5 Seconds | 300 | | $^\circ\text{C}$ | |

*Drain current limited by maximum junction temperature

Thermal Characteristics

| Symbol | Parameter | FCP380N60 | FCPF380N60 | Unit |
|-----------------|-------------------------------------------------|-----------|------------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 1.18 | 4 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta CS}$ | Thermal Resistance, Case to Heat Sink (Typical) | 0.5 | 0.5 | |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 62.5 | 62.5 | |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|------------|---------|-----------|------------|----------|
| FCP380N60 | FCP380N60 | TO-220 | - | - | 50 |
| FCPF380N60 | FCPF380N60 | 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 | $V_{GS} = 0\text{ V}, I_D = 10\text{ mA}, T_J = 25^\circ\text{C}$ | 600 | - | - | V |
| | | $V_{GS} = 0\text{ V}, I_D = 10\text{ mA}, T_J = 150^\circ\text{C}$ | 650 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 10\text{ mA}$, Referenced to 25°C | - | 0.6 | - | $\text{V}/^\circ\text{C}$ |
| BV_{DS} | Drain-Source Avalanche Breakdown Voltage | $V_{GS} = 0\text{ V}, I_D = 10\text{ A}$ | - | 700 | - | V |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}$ | - | - | 1 | μA |
| | | $V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$ | - | - | 10 | |
| I_{GSS} | Gate to Body Leakage Current | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$ | - | - | ± 100 | nA |

On Characteristics

| | | | | | | |
|--------------|--------------------------------------|-------------------------------------------------|-----|------|------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 2.5 | - | 3.5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}, I_D = 5\text{ A}$ | - | 0.33 | 0.38 | Ω |
| g_{FS} | Forward Transconductance | $V_{DS} = 20\text{ V}, I_D = 5\text{ A}$ | - | 11 | - | S |

Dynamic Characteristics

| | | | | | | |
|-----------------------|-------------------------------|---------------------------------------------------------------------|----------|------|------|----------|
| C_{iss} | Input Capacitance | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$ | - | 1250 | 1665 | pF |
| C_{oss} | Output Capacitance | | - | 905 | 1205 | pF |
| C_{rss} | Reverse Transfer Capacitance | | - | 45 | 60 | pF |
| C_{oss} | Output Capacitance | $V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$ | - | 23 | - | pF |
| $C_{oss\text{ eff.}}$ | Effective Output Capacitance | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$ | - | 95 | - | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS} = 380\text{ V}, I_D = 5\text{ A}$ $V_{GS} = 10\text{ V}$ | - | 30 | 40 | nC |
| Q_{gs} | Gate to Source Gate Charge | | - | 5 | - | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | (Note 4) | - | 10 | - |
| ESR | Equivalent Series Resistance | Drain Open | - | 1 | - | Ω |

Switching Characteristics

| | | | | | | |
|--------------|---------------------|--------------------------------------------------------------------------------------------|----------|----|-----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 380\text{ V}, I_D = 5\text{ A}$ $V_{GS} = 10\text{ V}, R = 4.7\text{ }\Omega$ | - | 14 | 38 | ns |
| t_r | Turn-On Rise Time | | - | 7 | 24 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 45 | 100 | ns |
| t_f | Turn-Off Fall Time | | (Note 4) | - | 6 | 22 |

Drain-Source Diode Characteristics

| | | | | | | |
|----------|----------------------------------------------------------|--------------------------------------------|---|------|-----|---------------|
| I_S | Maximum Continuous Drain to Source Diode Forward Current | - | - | 10.2 | A | |
| I_{SM} | Maximum Pulsed Drain to Source Diode Forward Current | - | - | 30.6 | A | |
| V_{SD} | Drain to Source Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_{SD} = 5\text{ A}$ | - | - | 1.2 | V |
| t_{rr} | Reverse Recovery Time | $V_{GS} = 0\text{ V}, I_{SD} = 5\text{ A}$ | - | 240 | - | ns |
| Q_{rr} | Reverse Recovery Charge | $di/dt = 100\text{ A}/\mu\text{s}$ | - | 2.7 | - | μC |

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_{AS} = 2.3\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 5.1\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

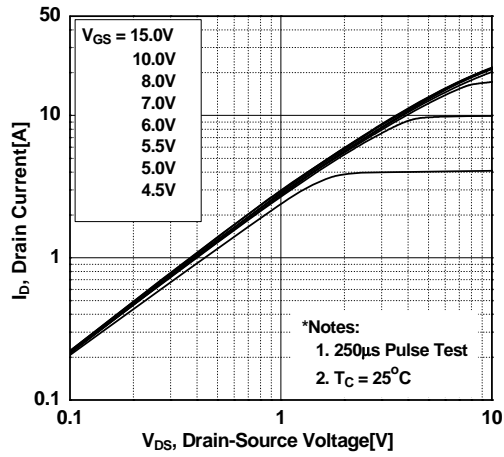


Figure 2. Transfer Characteristics

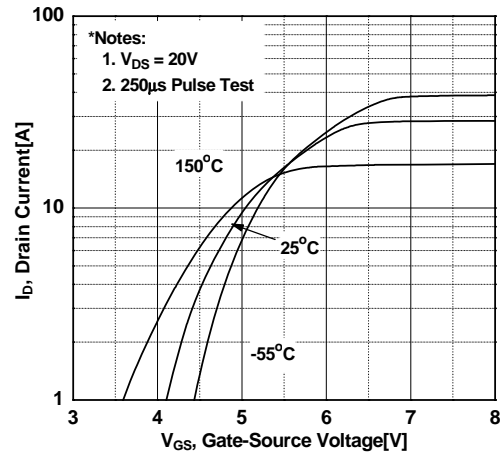


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

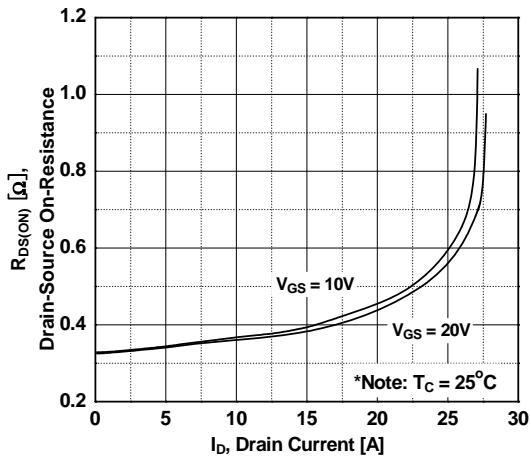


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

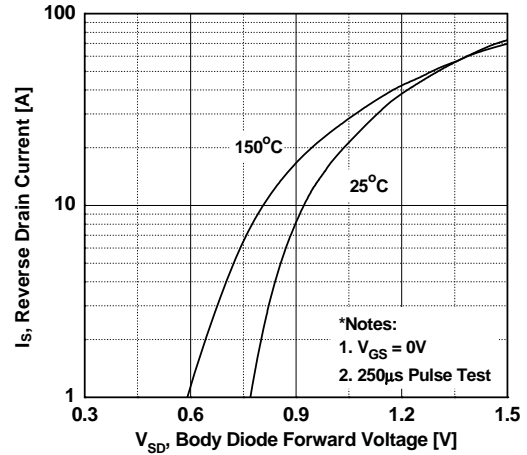


Figure 5. Capacitance Characteristics

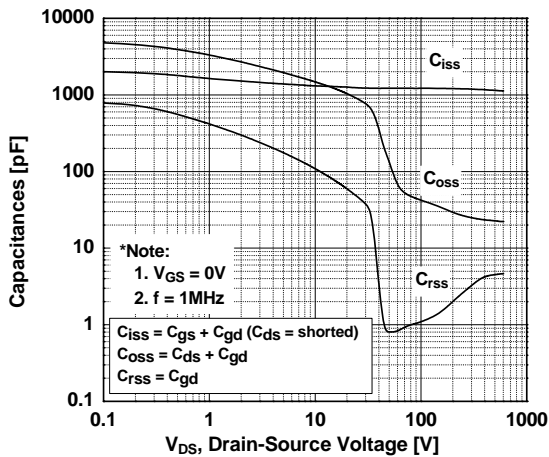
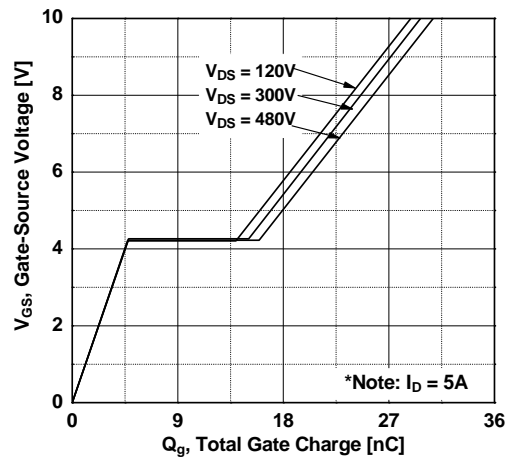


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

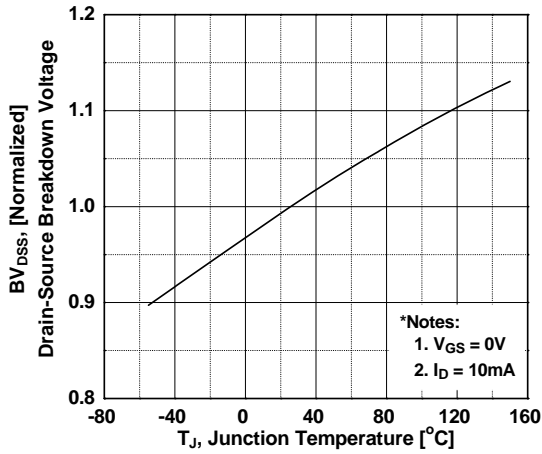


Figure 8. On-Resistance Variation vs. Temperature

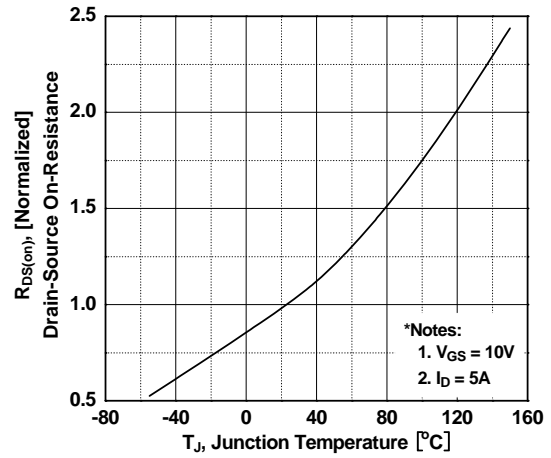


Figure 9. Maximum Safe Operating Area vs. Case Temperature - FCP380N60

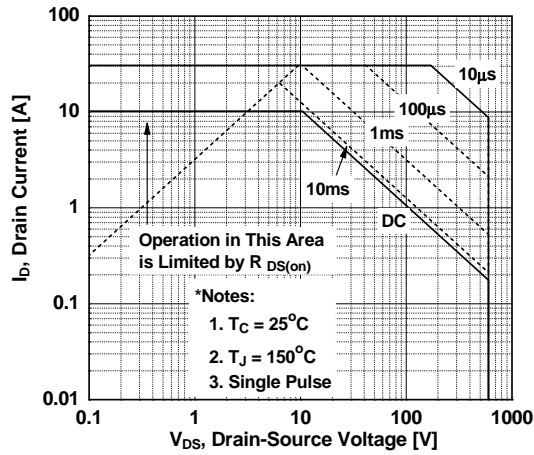


Figure 10. Maximum Safe Operating Area vs. Case Temperature - FCPF380N60

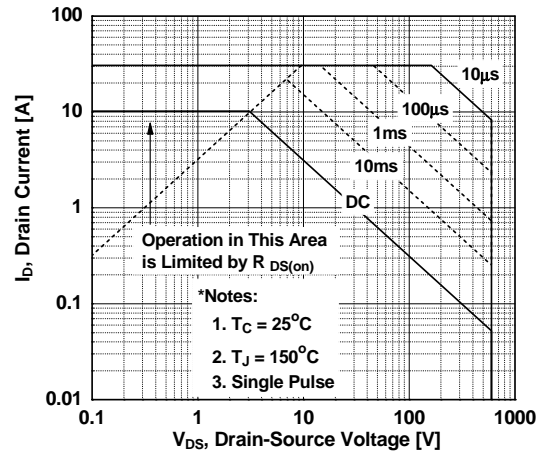


Figure 11. Maximum Drain Current

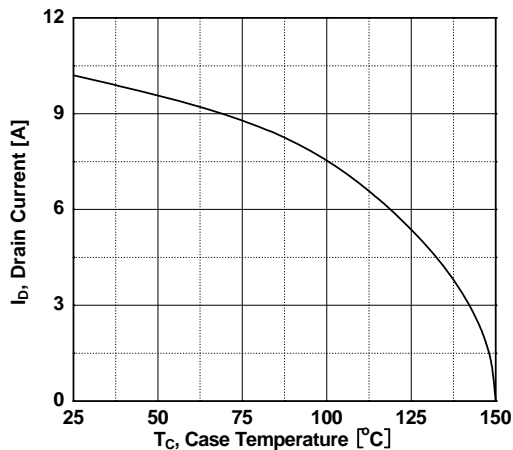
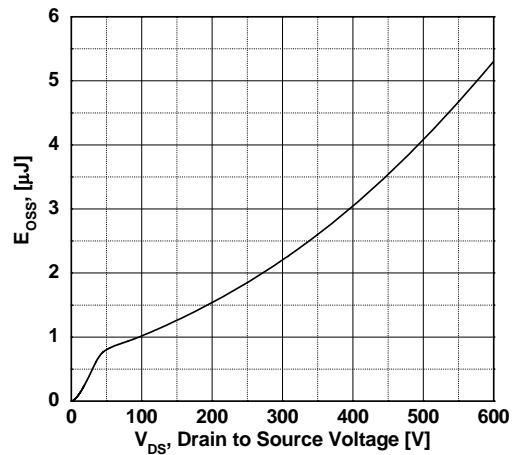


Figure 12. E_{oss} vs. Drain to Source Voltage Switching Capability



Typical Performance Characteristics (Continued)

Figure 13. Transient Thermal Response Curve - FCP380N60

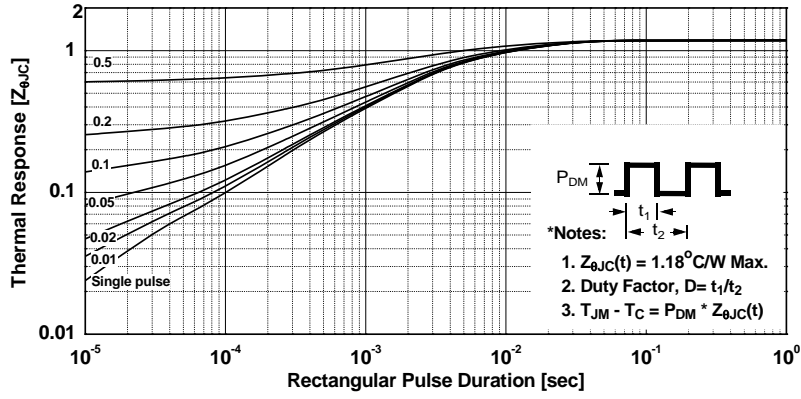
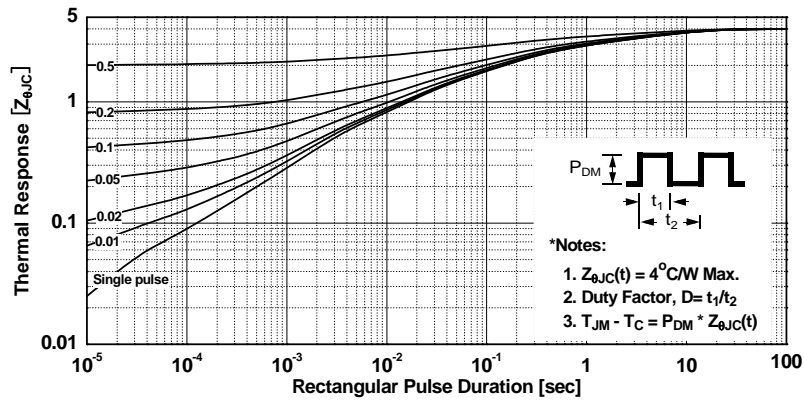
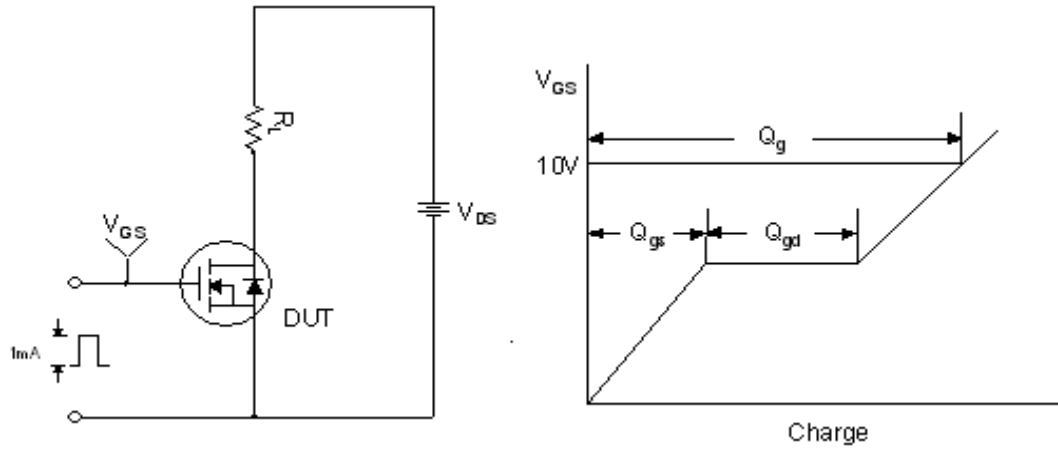


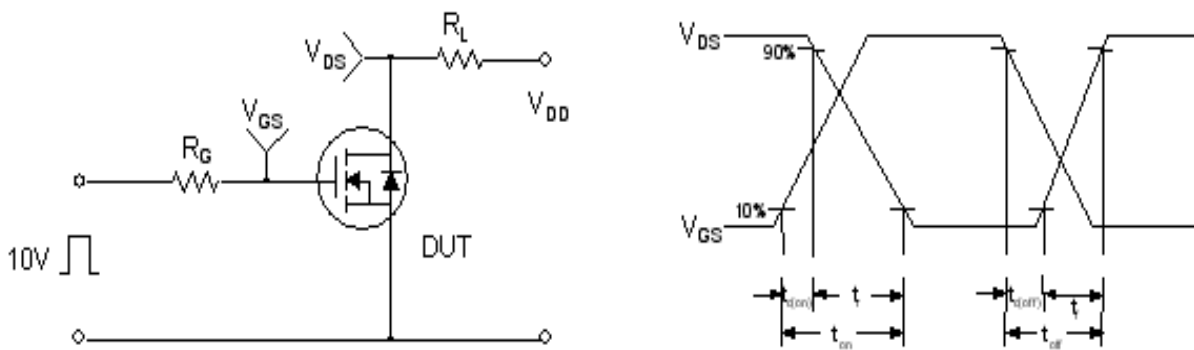
Figure 14. Transient Thermal Response Curve - FCPF380N60



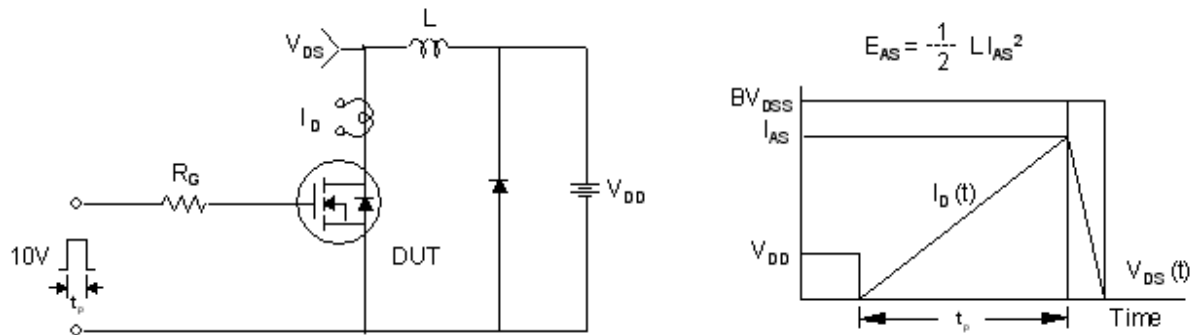
Gate Charge Test Circuit & Waveform



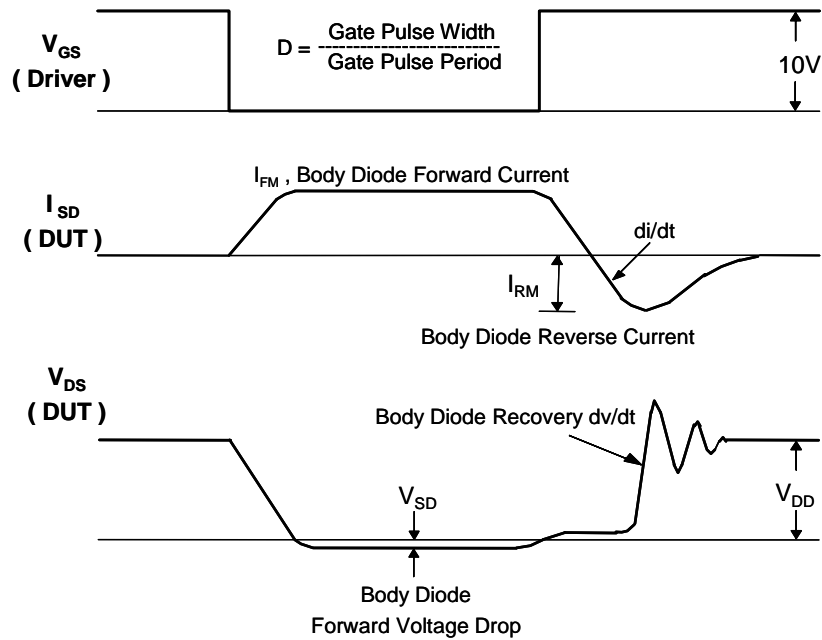
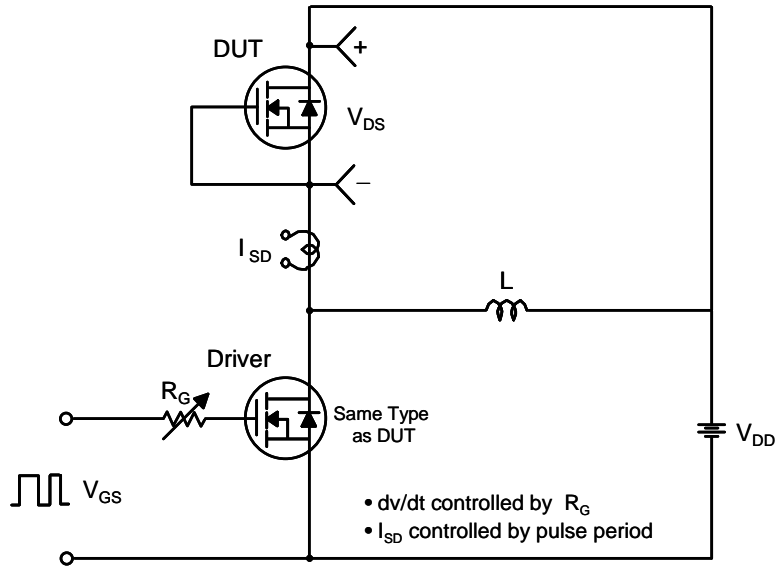
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

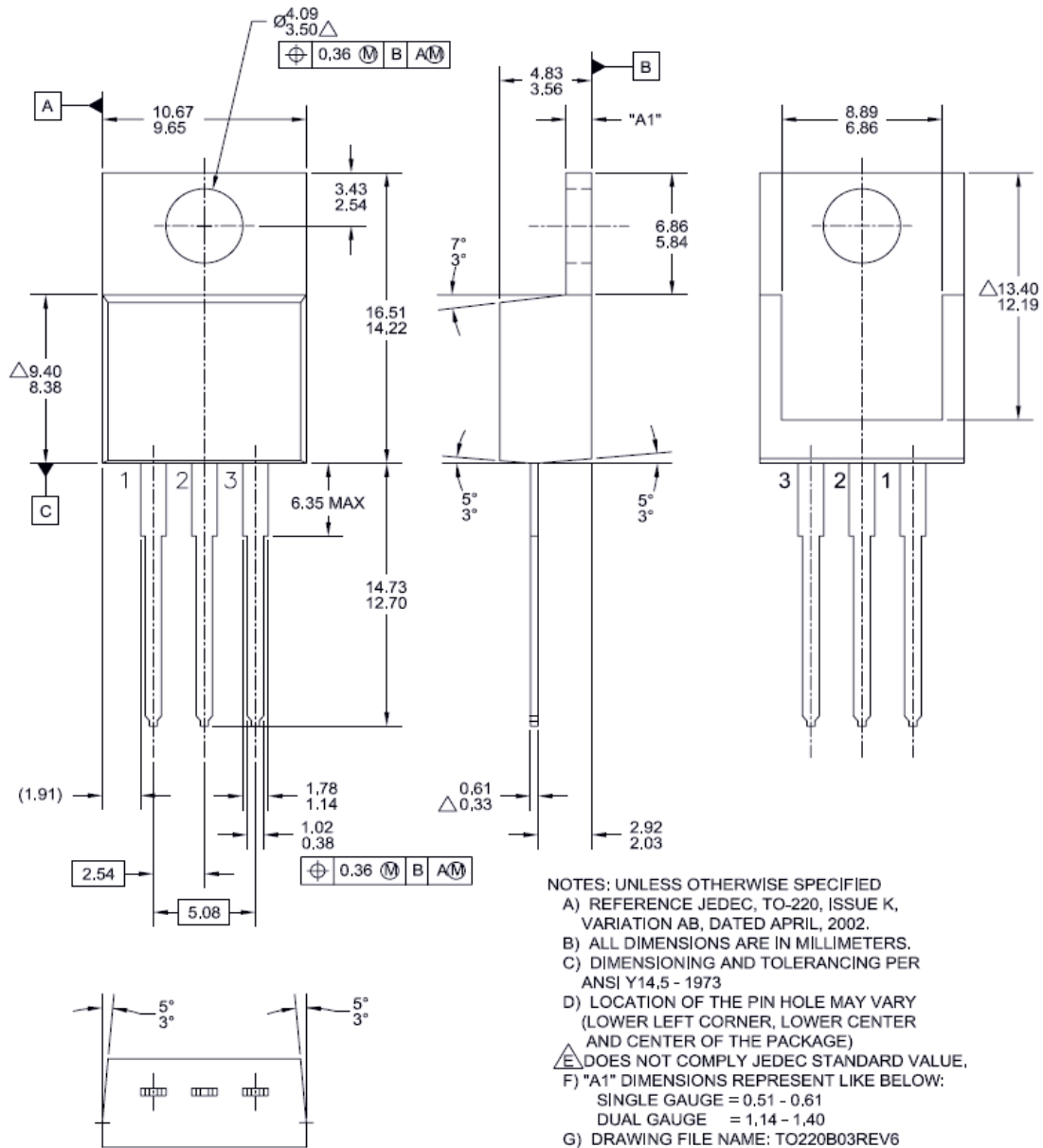


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

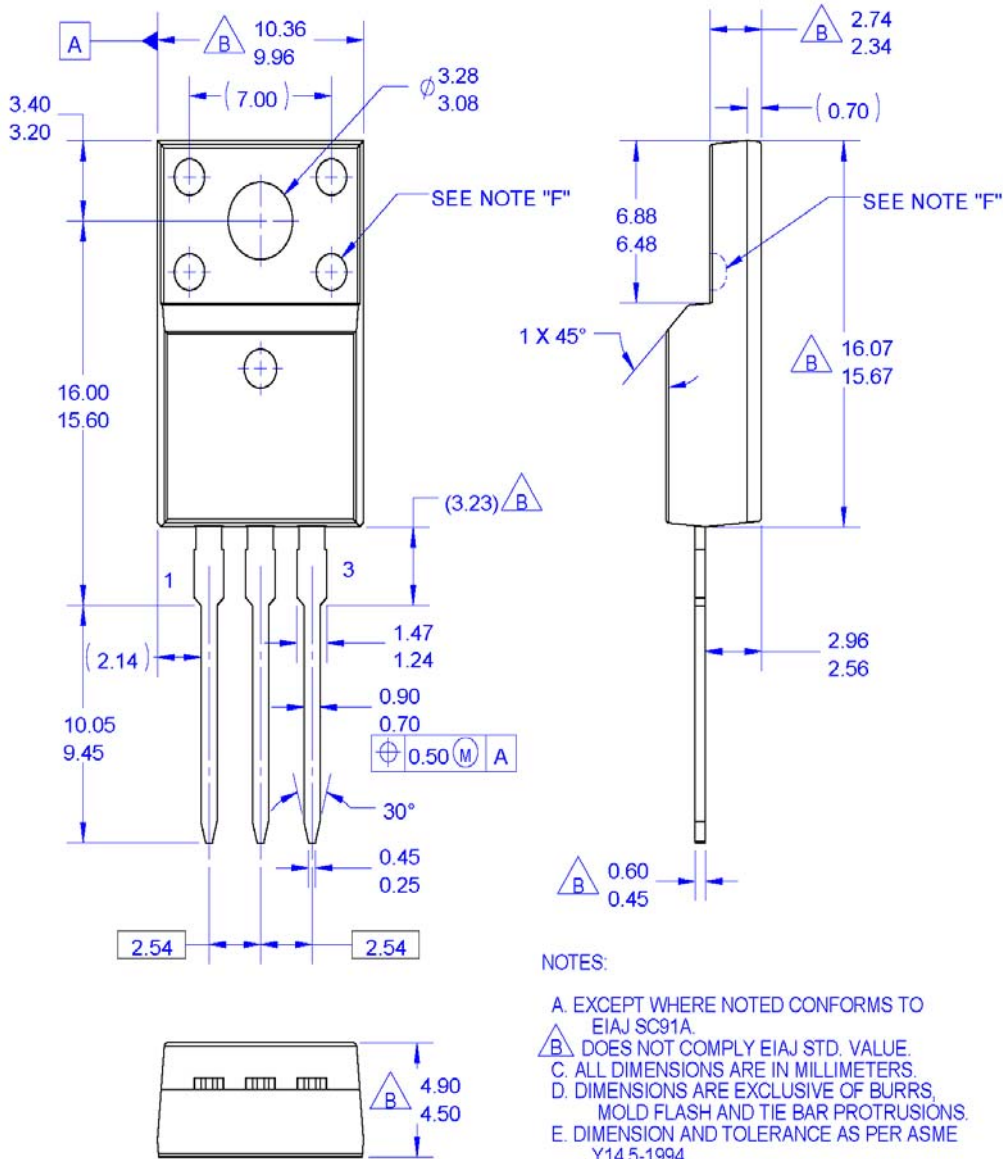
TO-220



Dimensions in Millimeters

Package Dimensions

TO-220F (Retractable)



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





* Front/Back Side Isolation Voltage : AC 2500V

Dimensions in Millimeters



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| AccuPower™ | F-PFST™ | PowerXS™ |  SYSTEM GENERAL®* |
| AX-CAP®* | FRFET® | Programmable Active Droop™ | TinyBoost™ |
| BitSiC™ | Global Power Resource SM | QFET® | TinyBuck™ |
| Build it Now™ | Green Bridge™ | QS™ | TinyCalc™ |
| CorePLUS™ | Green FPS™ | Quiet Series™ | TinyLogic® |
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| DEUXPEED® | ISOPANAR™ | SmartMax™ | TranSiC® |
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