



December 2013

FQP5N60C / FQPF5N60C

N-Channel QFET® MOSFET

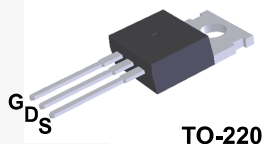
600 V, 4.5 A, 2.5 Ω

Description

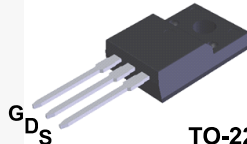
This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

Features

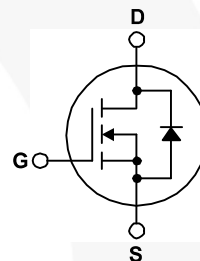
- 4.5 A, 600 V, $R_{DS(on)} = 2.5 \Omega$ (Max.) @ $V_{GS} = 10 \text{ V}$, $I_D = 2.25 \text{ A}$
- Low Gate Charge (Typ. 15 nC)
- Low C_{rss} (Typ. 6.5 pF)
- 100% Avalanche Tested



TO-220



TO-220F



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

| Symbol | Parameter | FQP5N60C | FQPF5N60C | Unit |
|----------------|--|-----------------|-----------|---------------------|
| V_{DSS} | Drain-Source Voltage | 600 | | V |
| I_D | Drain Current - Continuous ($T_C = 25^\circ\text{C}$) | 4.5 | 4.5 * | A |
| | - Continuous ($T_C = 100^\circ\text{C}$) | 2.6 | 2.6 * | A |
| I_{DM} | Drain Current - Pulsed (Note 1) | 18 | 18 * | A |
| V_{GSS} | Gate-Source Voltage | ± 30 | | V |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 210 | | mJ |
| I_{AR} | Avalanche Current (Note 1) | 4.5 | | A |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | 10 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 4.5 | | V/ns |
| P_D | Power Dissipation ($T_C = 25^\circ\text{C}$) | 100 | 33 | W |
| | - Derate above 25°C | 0.8 | 0.26 | 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 | | $^\circ\text{C}$ |

* Drain current limited by maximum junction temperature.

Thermal Characteristics

| Symbol | Parameter | FQP5N60C | FQPF5N60C | Unit |
|-----------------|---|----------|-----------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max. | 1.25 | 3.79 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink Typ, Max. | 0.5 | -- | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 62.5 | 62.5 | $^\circ\text{C}/\text{W}$ |

Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|-------------|-----------|---------|----------------|-----------|------------|----------|
| FQP5N60C | FQP5N60C | TO-220 | Tube | N/A | N/A | 50 units |
| FQPF5N60C | FQPF5N60C | TO-220F | Tube | N/A | N/A | 50 units |

Electrical Characteristics

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

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

Off Characteristics

| | | | | | | |
|--------------------------------|---|---|-----|-----|------|---------------------|
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 600 | -- | -- | V |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C | -- | 0.6 | -- | V/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ | -- | -- | 1 | μA |
| | | $V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$ | -- | -- | 10 | μA |
| I_{GSSF} | Gate-Body Leakage Current, Forward | $V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$ | -- | -- | 100 | nA |
| I_{GSSR} | Gate-Body Leakage Current, Reverse | $V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$ | -- | -- | -100 | nA |

On Characteristics

| | | | | | | |
|--------------|-----------------------------------|---|-----|-----|-----|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 2.0 | -- | 4.0 | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 2.25\text{ A}$ | -- | 2.0 | 2.5 | Ω |
| g_{FS} | Forward Transconductance | $V_{DS} = 40\text{ V}, I_D = 2.25\text{ A}$ | -- | 4.7 | -- | S |

Dynamic Characteristics

| | | | | | | |
|-----------|------------------------------|--|----|-----|-----|----|
| C_{iss} | Input Capacitance | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$ | -- | 515 | 670 | pF |
| C_{oss} | Output Capacitance | | -- | 55 | 72 | pF |
| C_{rss} | Reverse Transfer Capacitance | | -- | 6.5 | 8.5 | pF |

Switching Characteristics

| | | | | | | |
|--------------|---------------------|--|----|-----|-----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 300\text{ V}, I_D = 4.5\text{ A},$ $R_G = 25\text{ }\Omega$ | -- | 10 | 30 | ns |
| t_r | Turn-On Rise Time | | -- | 42 | 90 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | (Note 4) | -- | 38 | 85 | ns |
| t_f | Turn-Off Fall Time | | -- | 46 | 100 | ns |
| Q_g | Total Gate Charge | $V_{DS} = 480\text{ V}, I_D = 4.5\text{ A},$ $V_{GS} = 10\text{ V}$ | -- | 15 | 19 | nC |
| Q_{gs} | Gate-Source Charge | | -- | 2.5 | -- | nC |
| Q_{gd} | Gate-Drain Charge | | -- | 6.6 | -- | nC |

Drain-Source Diode Characteristics and Maximum Ratings

| | | | | | | |
|-----------------|---|---|----|-----|-----|----|
| I _S | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 4.5 | A |
| I _{SM} | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 18 | A |
| V _{SD} | Drain-Source Diode Forward Voltage | V _{GS} = 0 V, I _S = 4.5 A | -- | -- | 1.4 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0 V, I _S = 4.5 A, dI _F / dt = 100 A/μs | -- | 300 | -- | ns |
| Q _{rr} | Reverse Recovery Charge | | -- | 2.2 | -- | μC |

Notes:

1. Repetitive rating : pulse-width limited by maximum junction temperature.
2. $L = 18.9\text{ mH}, I_{AS} = 4.5\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$, starting $T_J = 25^\circ\text{C}$.
3. $I_{SD} \leq 4.5\text{ A}, dI/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$.
4. Essentially independent of operating temperature.

Typical Characteristics

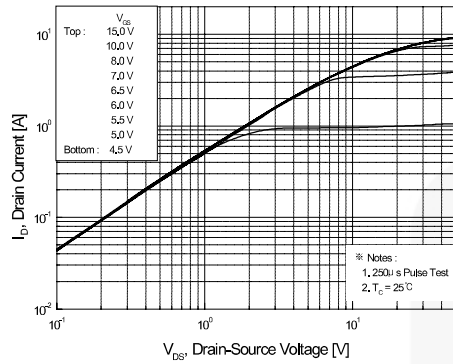


Figure 1. On-Region Characteristics

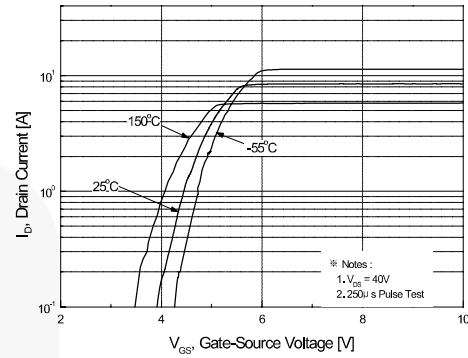


Figure 2. Transfer Characteristics

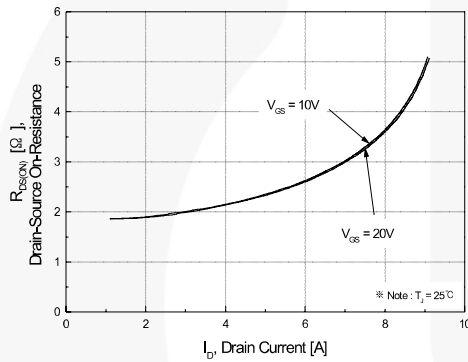


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

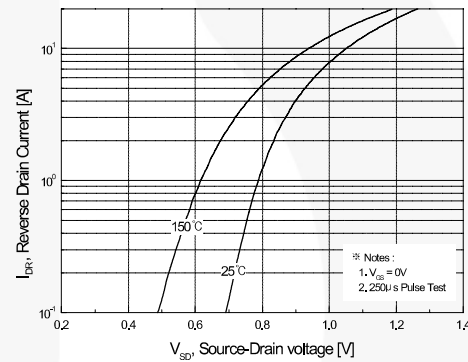


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

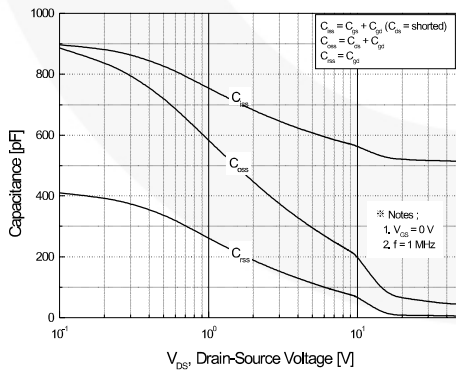


Figure 5. Capacitance Characteristics

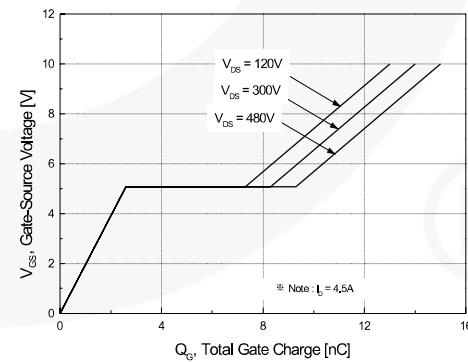


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

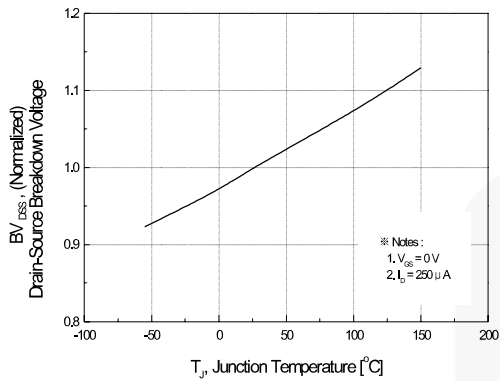


Figure 7. Breakdown Voltage Variation vs Temperature

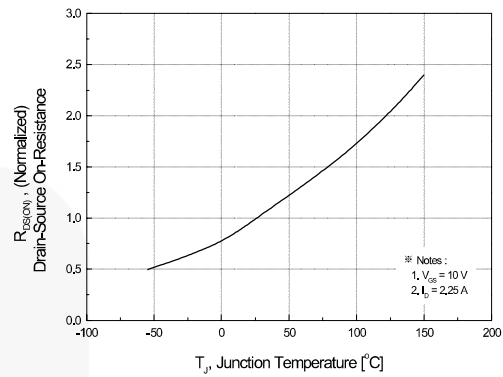


Figure 8. On-Resistance Variation vs Temperature

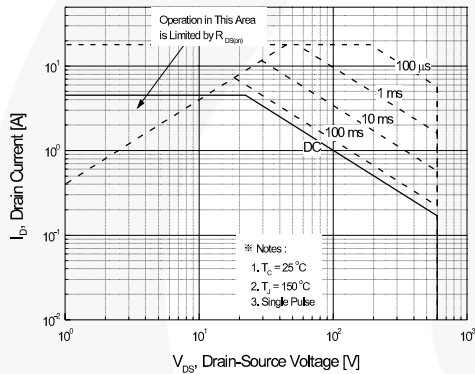


Figure 9-1. Maximum Safe Operating Area for FQP5N60C

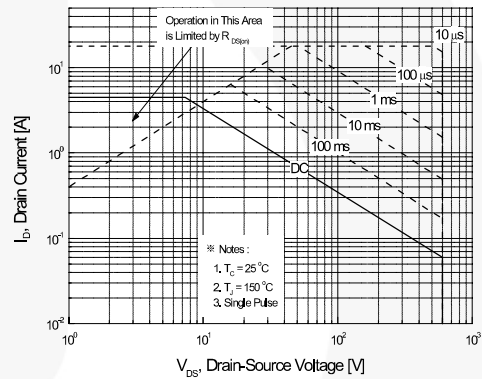


Figure 9-2. Maximum Safe Operating Area for FQPF5N60C

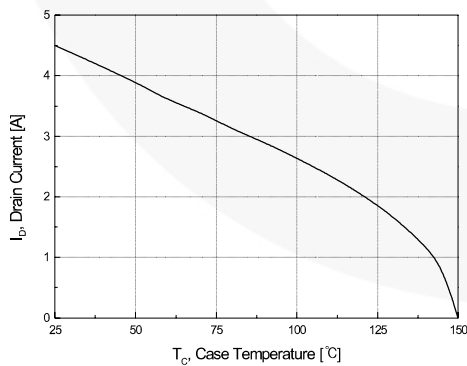


Figure 10. Maximum Drain Current vs Case Temperature

Typical Characteristics (Continued)

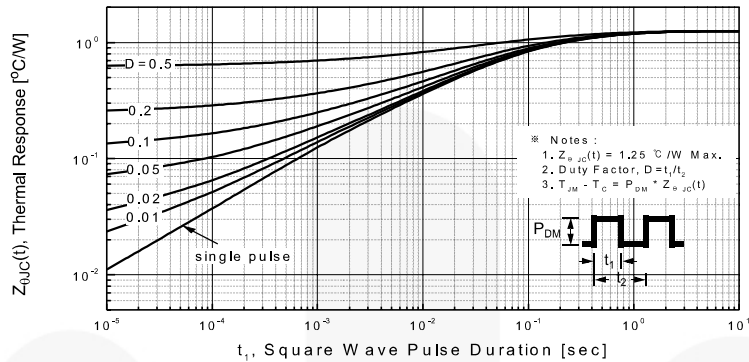


Figure 11-1. Transient Thermal Response Curve for FQP5N60C

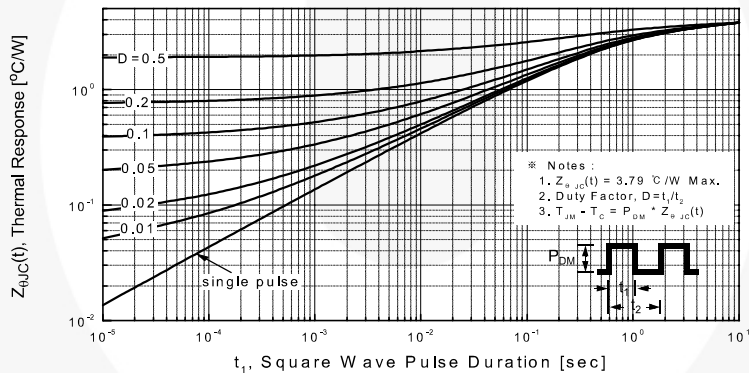


Figure 11-2. Transient Thermal Response Curve for FQPF5N60C

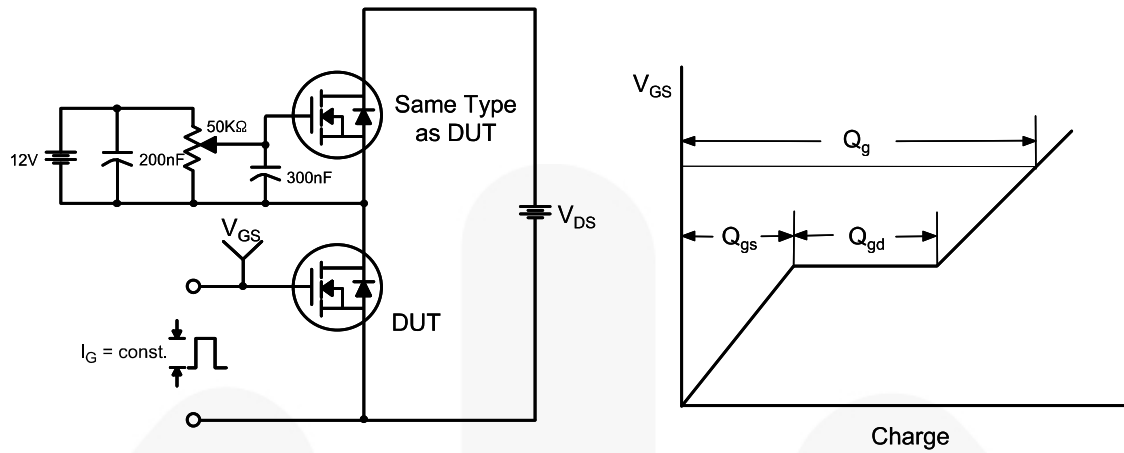


Figure 12. Gate Charge Test Circuit & Waveform

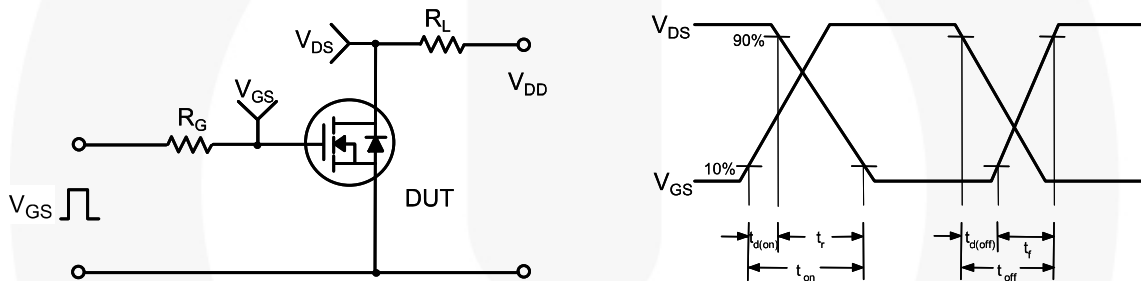


Figure 13. Resistive Switching Test Circuit & Waveforms

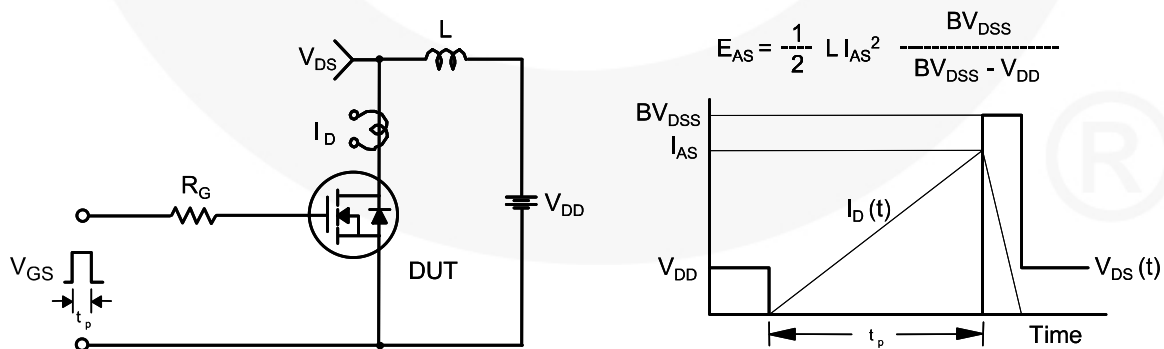
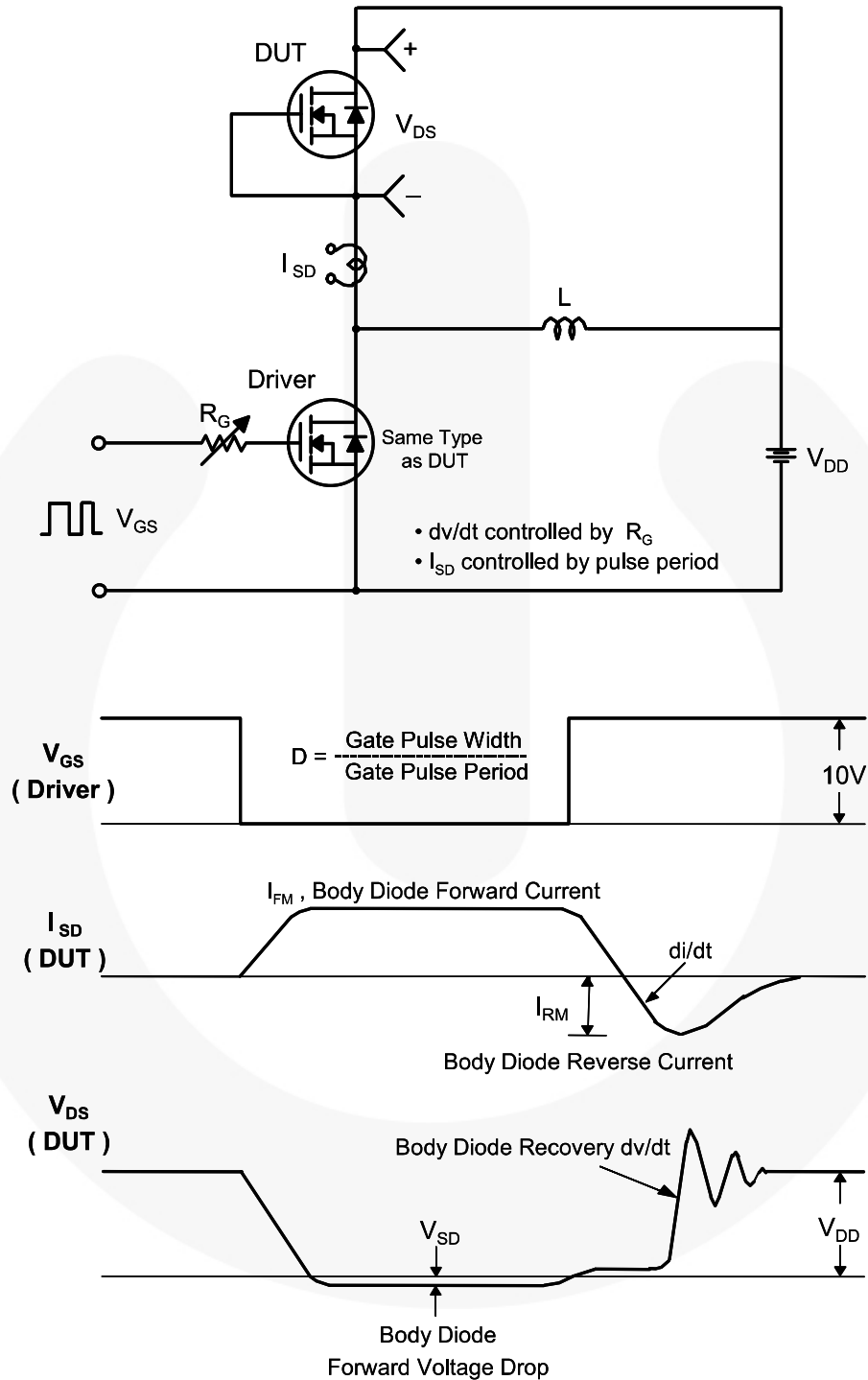


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

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

Mechanical Dimensions

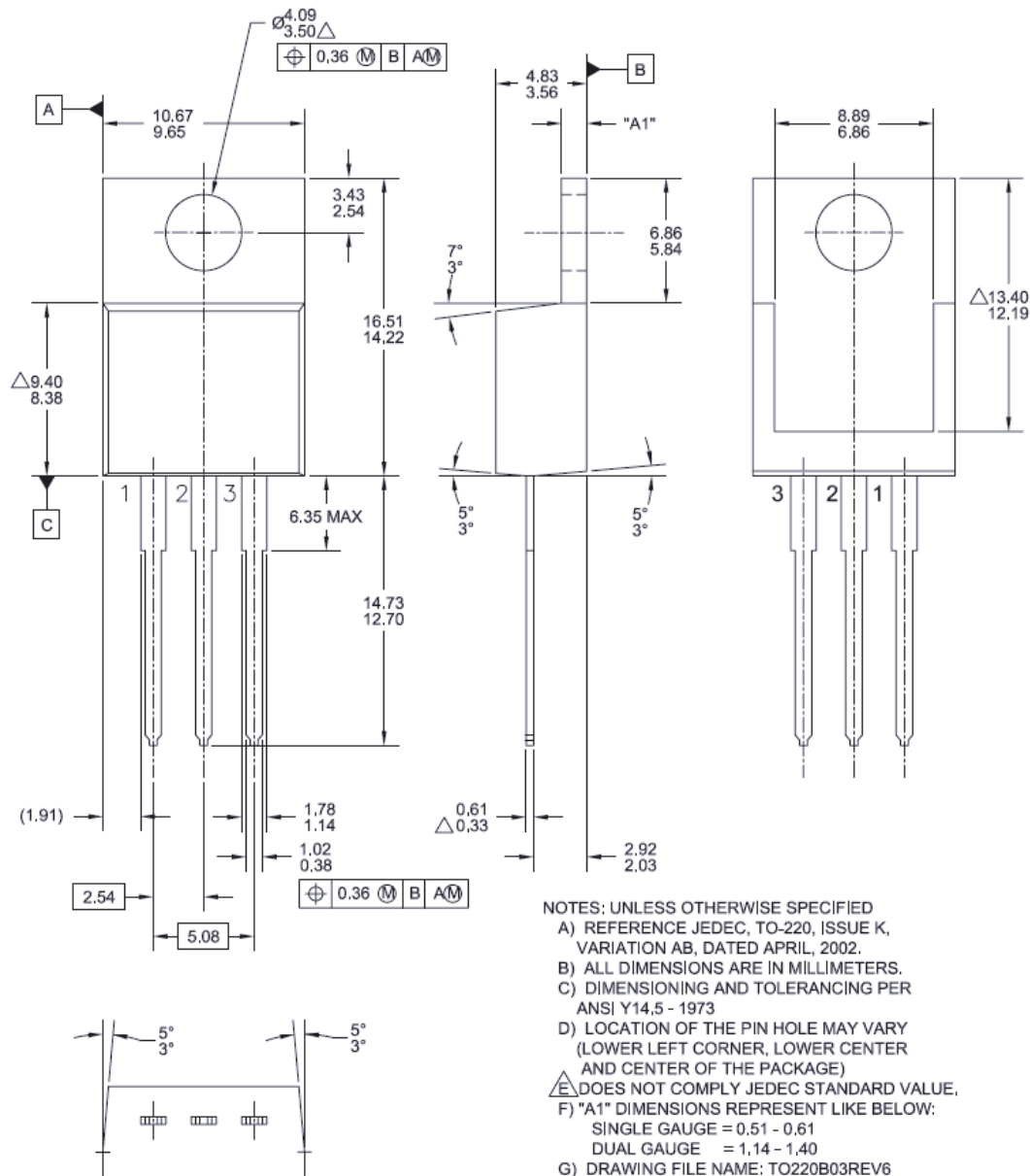


Figure 16. TO-220, Molded, 3-Lead, Jedec Variation AB

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Mechanical Dimensions

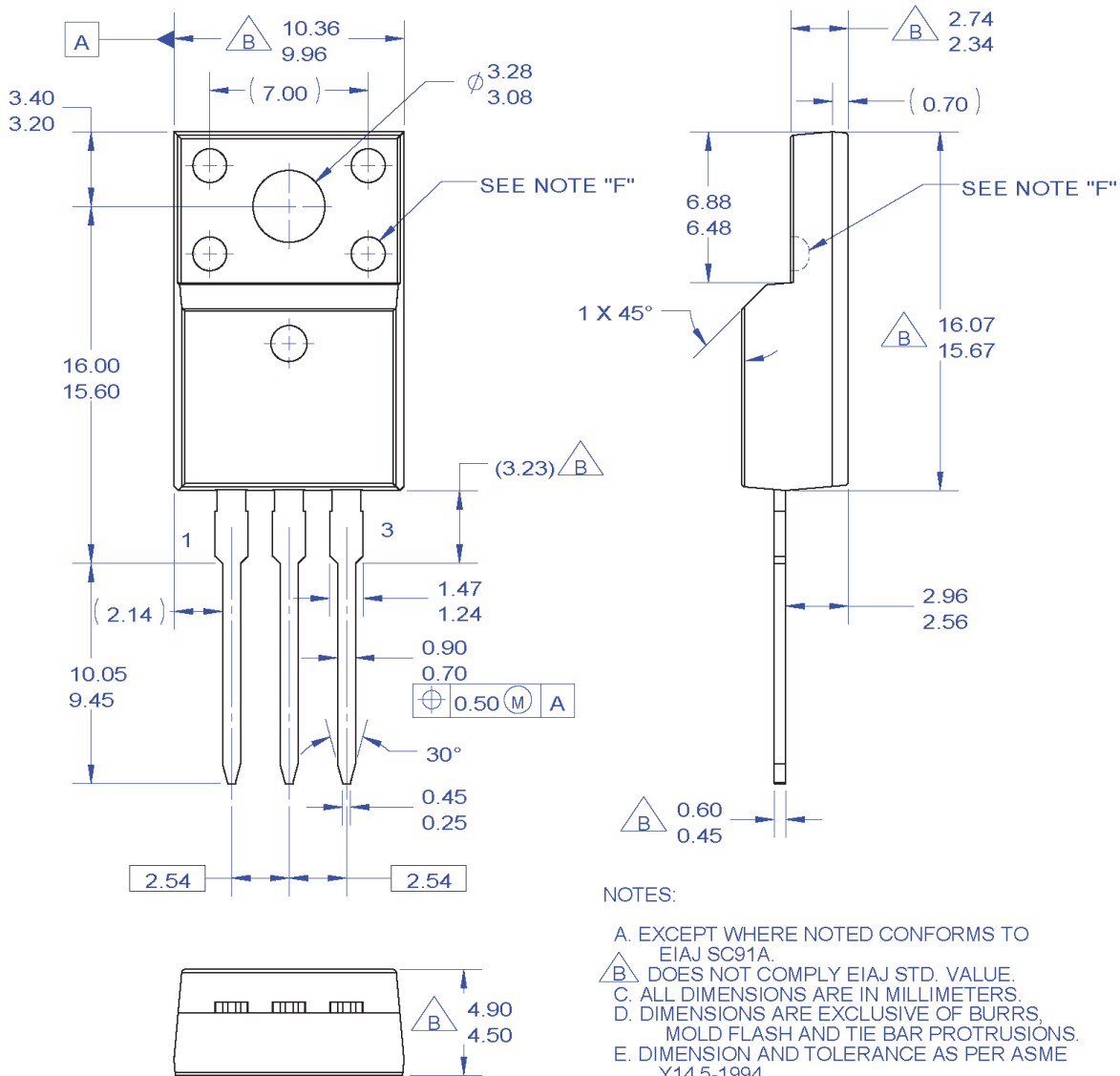


Figure 17. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead

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