FAIRCHILD SEMICONDUCTOR®

March 2013

# FQP9N90C / FQPF9N90C

## N-Channel QFET® MOSFET

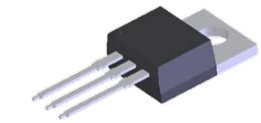
### 900 V, 8.0 A, 1.4 Ω

### 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

- 8 A, 900V, $R_{DS(on)}$ = 1.4 Ω @$V_{GS}$ = 10 V, $I_D$ = 4 A
- Low Gate Charge (Typ. 45 nC)
- Low Crss (Typ. 14 pF)
- 100% Avalanche Tested



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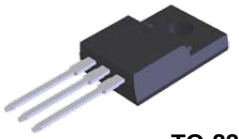

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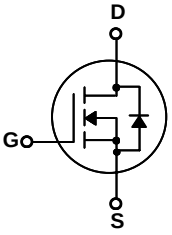



## Absolute Maximum Ratings

$T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | | FQP9N90C | FQPF9N90C | Unit |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 900 | | V |
| $I_D$ | Drain Current - Continuous ($T_C$ = 25°C) | | 8.0 | 8.0 * | A |
| | Drain Current - Continuous ($T_C$ = 100°C) | | 2.8 | 2.8 * | A |
| $I_{DM}$ | Drain Current - Pulsed | (Note 1) | 32 | 32 * | A |
| $V_{GSS}$ | Gate-Source Voltage | | ± 30 | | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note 2) | 900 | | mJ |
| $I_{AR}$ | Avalanche Current | (Note 1) | 8.0 | | A |
| $E_{AR}$ | Repetitive Avalanche Energy | (Note 1) | 20.5 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 4.0 | | V/ns |
| $P_D$ | Power Dissipation ($T_C$ = 25°C) | | 205 | 68 | W |
| | - Derate above 25°C | | 1.64 | 0.54 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +150 | | °C |
| $T_L$ | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | | 300 | | °C |

* Drain current limited by maximum junction temperature

## Thermal Characteristics

| Symbol | Parameter | FQP9N90C | FQPF9N90C | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 0.61 | 1.85 | °C/W |
| $R_{\theta JS}$ | Thermal Resistance, Case-to-Sink Typ. | 0.5 | -- | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62.5 | 62.5 | °C/W |

## Electrical Characteristics

$T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA | 900 | -- | -- | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | -- | 0.99 | -- | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 900 V, $V_{GS}$ = 0 V | -- | -- | 10 | μA |
| | | $V_{DS}$ = 720 V, $T_C$ = 125°C | -- | -- | 10 | μA |
| $I_{GSSF}$ | Gate-Body Leakage Current, Forward | $V_{GS}$ = 30 V, $V_{DS}$ = 0 V | -- | -- | 100 | nA |
| $I_{GSSR}$ | Gate-Body Leakage Current, Reverse | $V_{GS}$ = -30 V, $V_{DS}$ = 0 V | -- | -- | -100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | 3.0 | -- | 5.0 | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 4 A | -- | 1.12 | 1.4 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 4 A (Note 4) | -- | 9.2 | -- | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | -- | 2100 | 2730 | pF |
| $C_{oss}$ | Output Capacitance | | -- | 175 | 230 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 14 | 18 | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 450 V, $I_D$ = 9.0A, $R_G$ = 25 Ω (Note 4, 5) | -- | 50 | 110 | ns |
| $t_r$ | Turn-On Rise Time | | -- | 120 | 250 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 100 | 210 | ns |
| $t_f$ | Turn-Off Fall Time | | -- | 75 | 160 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 720 V, $I_D$ = 9.0A, $V_{GS}$ = 10 V (Note 4, 5) | -- | 45 | 58 | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 13 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 18 | -- | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 8.0 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 32.0 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 8 A | -- | -- | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_S$ = 9 A, $dI_F$ / dt = 100 A/μs (Note 4) | -- | 550 | -- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 6.5 | -- | μC |

**Notes:**
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 21 mH, $I_{AS}$ = 9A, $V_{DD}$ = 50V, $R_G$ = 25 Ω, Starting $T_J$ = 25°C
3. $I_{SD}$ ≤ 9.0A, di/dt ≤ 200A/μs, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Characteristics

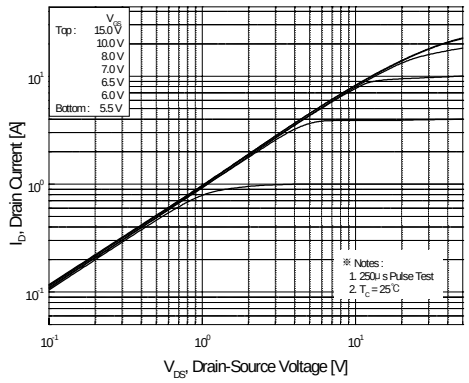



**Figure 1. On-Region Characteristics**

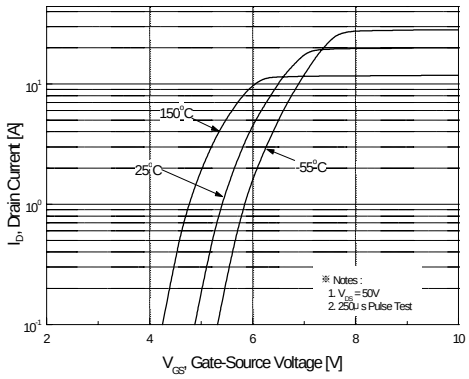



**Figure 2. Transfer Characteristics**

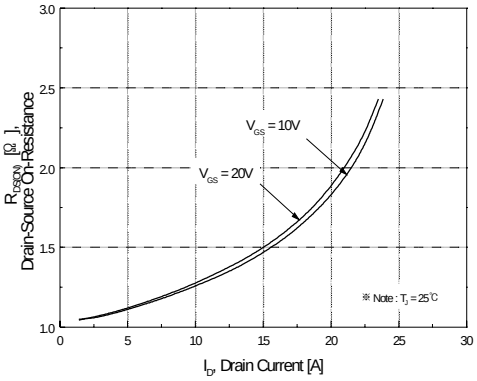



**Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage**

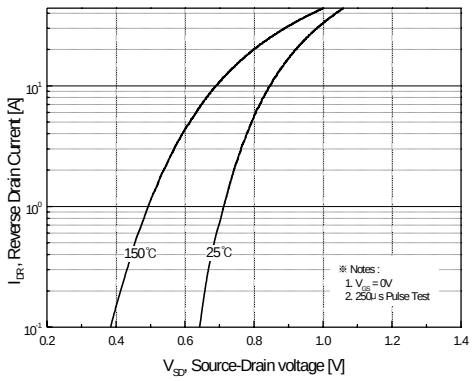



**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**

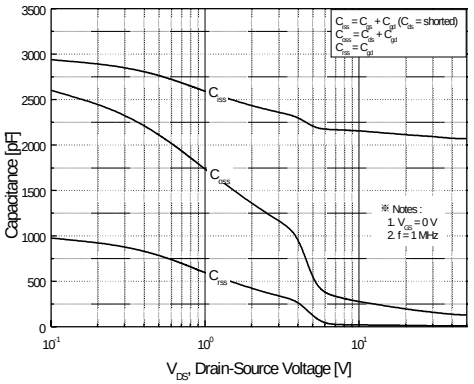



**Figure 5. Capacitance Characteristics**

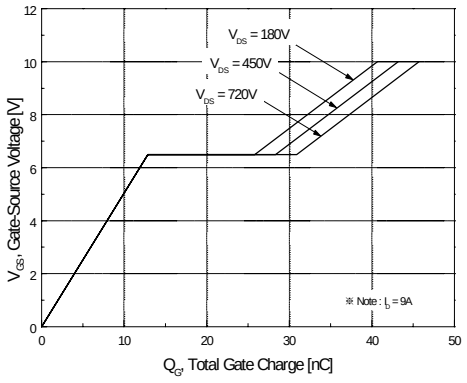



**Figure 6. Gate Charge Characteristics**

## Typical Characteristics (Continued)

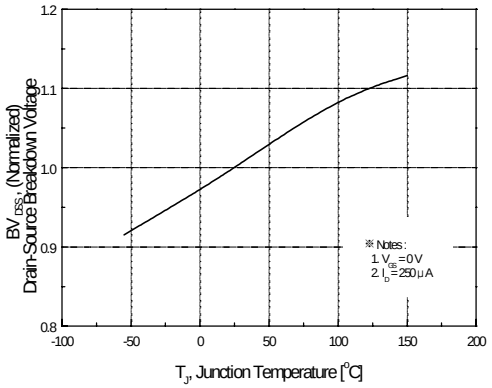



**Figure 7. Breakdown Voltage Variation vs Temperature**

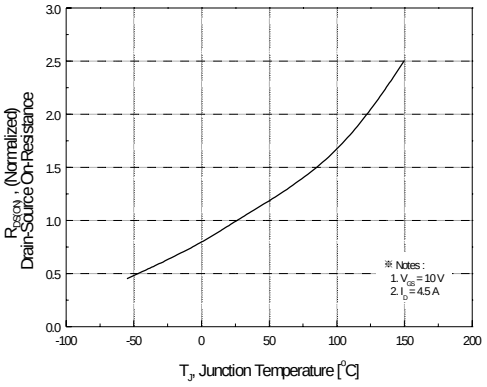



**Figure 8. On-Resistance Variation vs Temperature**

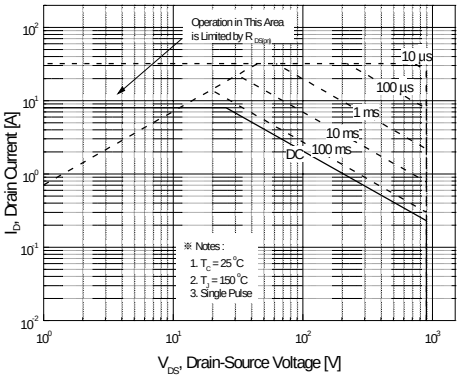



**Figure 9-1. Maximum Safe Operating Area for FQP9N90C**

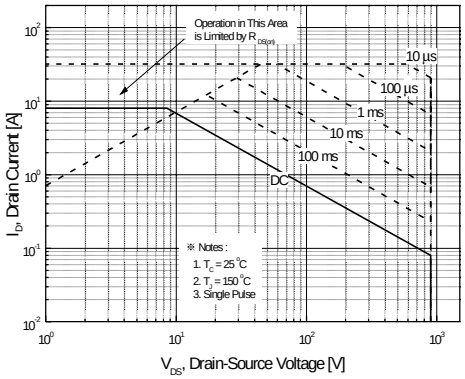



**Figure 9-2. Maximum Safe Operating Area for FQPF9N90C**

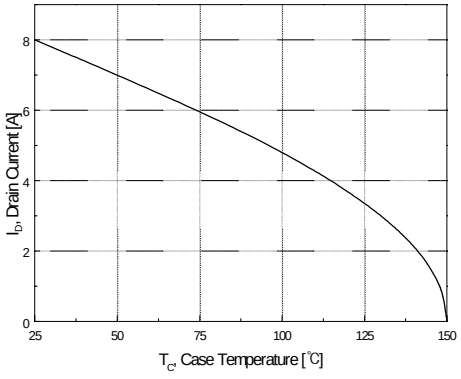



**Figure 10. Maximum Drain Current vs Case Temperature**

## Typical Characteristics (Continued)

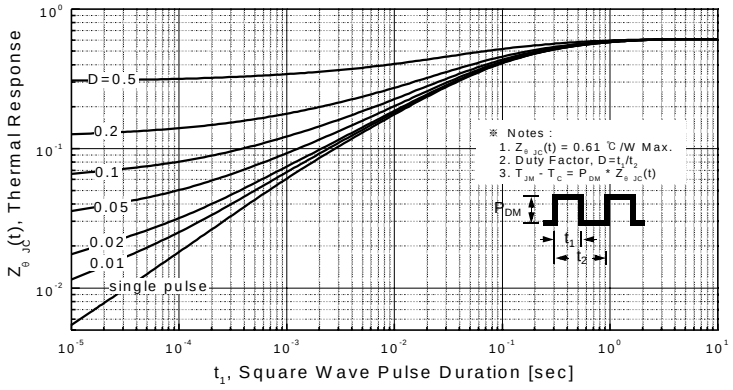



**Figure 11-1. Transient Thermal Response Curve for FQP9N90C**

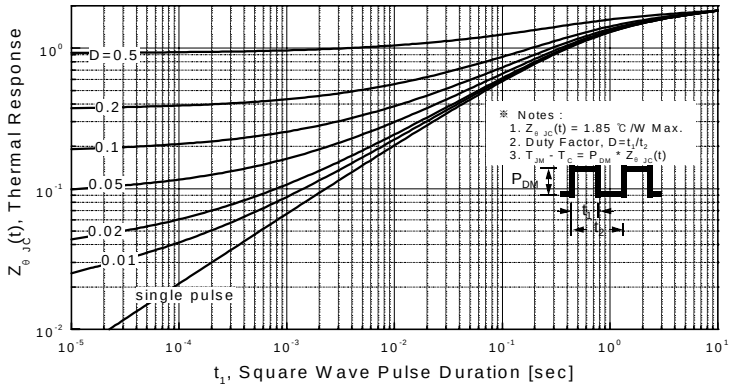
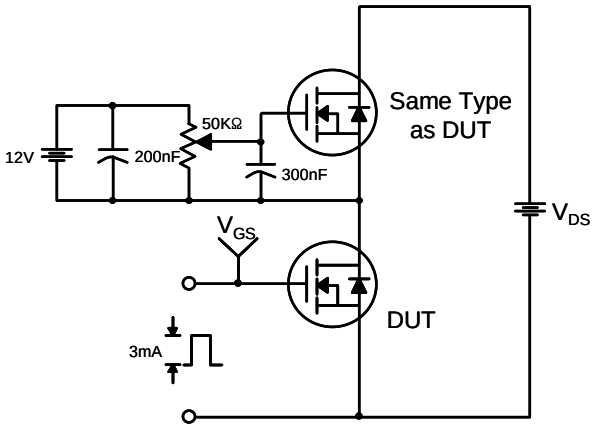
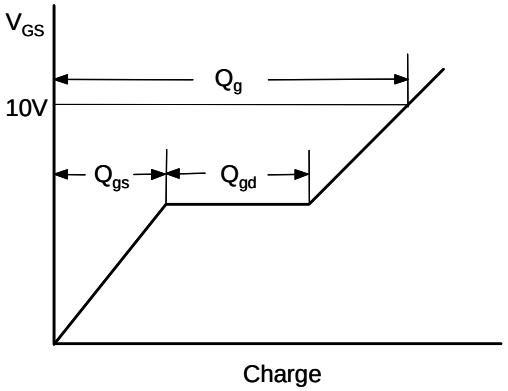


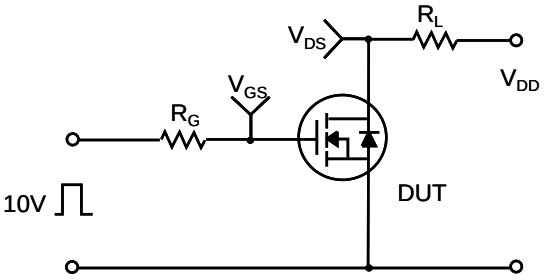

**Figure 11-2. Transient Thermal Response Curve for FQPF9N90C**

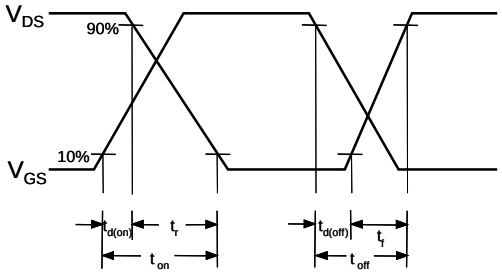
**Gate Charge Test Circuit & Waveform**



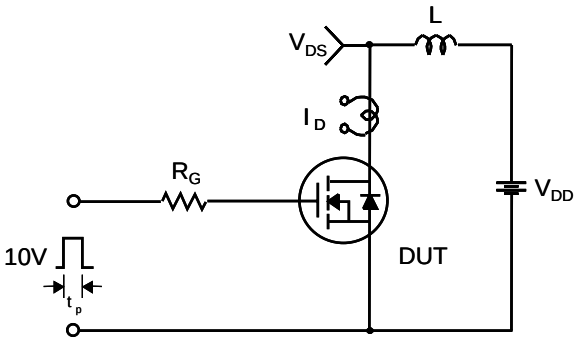




**Resistive Switching Test Circuit & Waveforms**

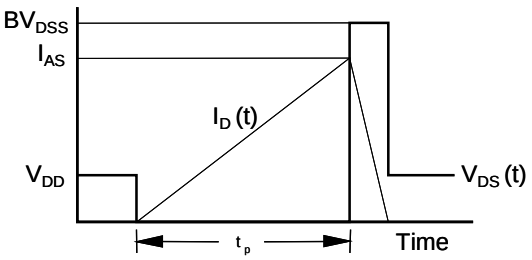


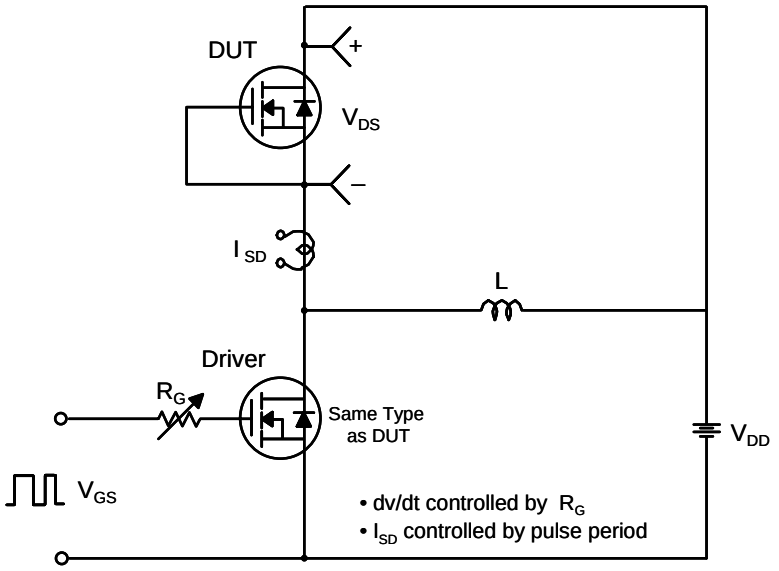

**Unclamped Inductive Switching Test Circuit & Waveforms**

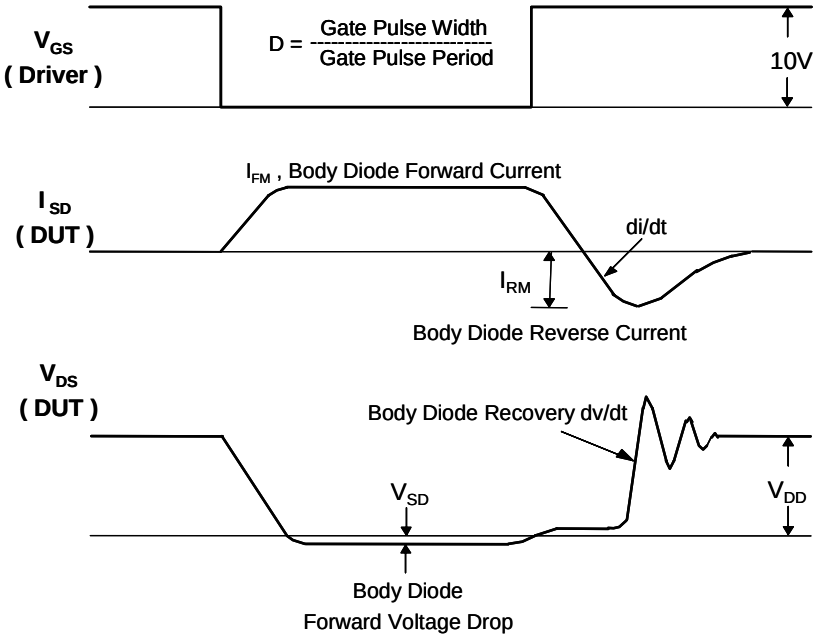



$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



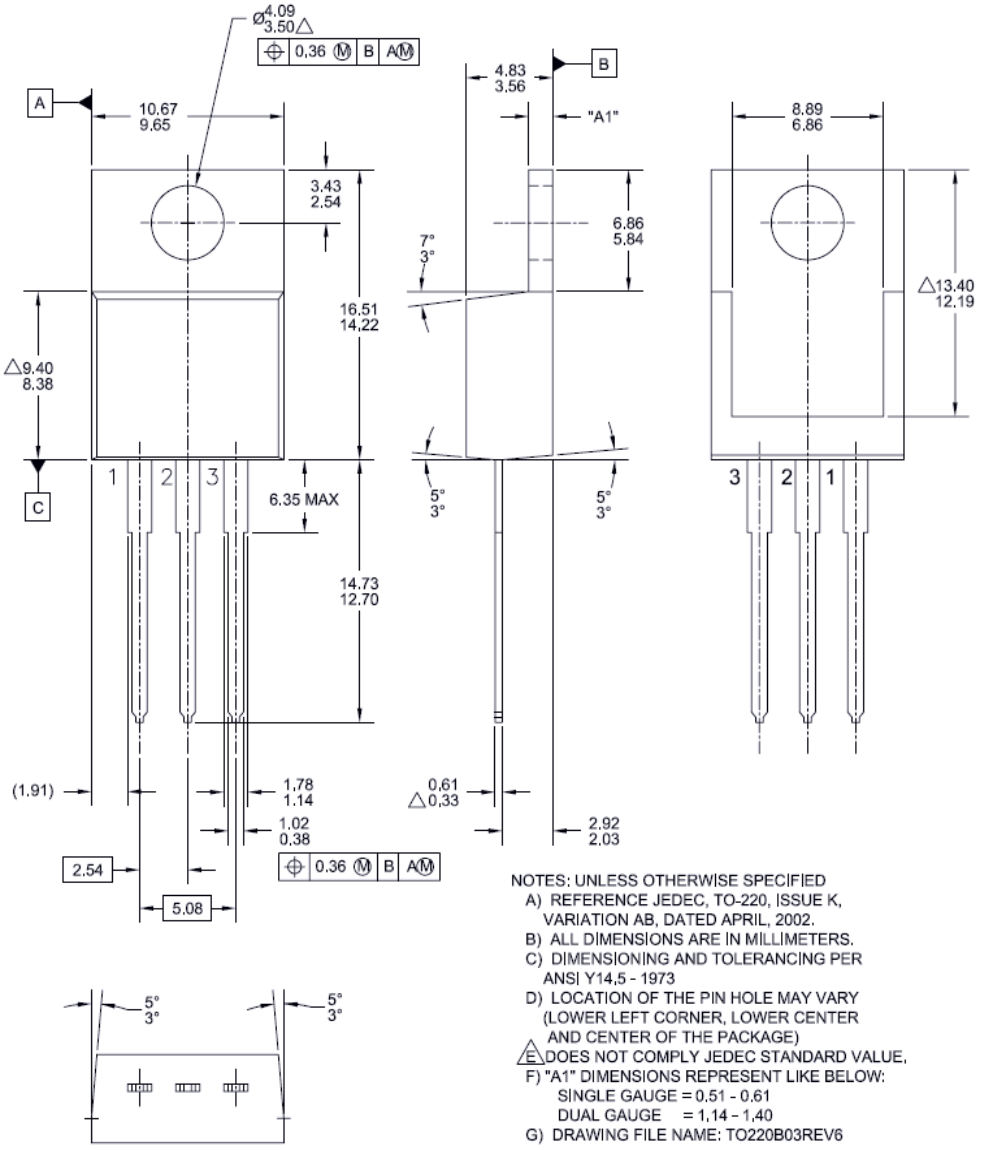
**Peak Diode Recovery dv/dt Test Circuit & Waveforms**



## Mechanical Dimensions

# TO-220

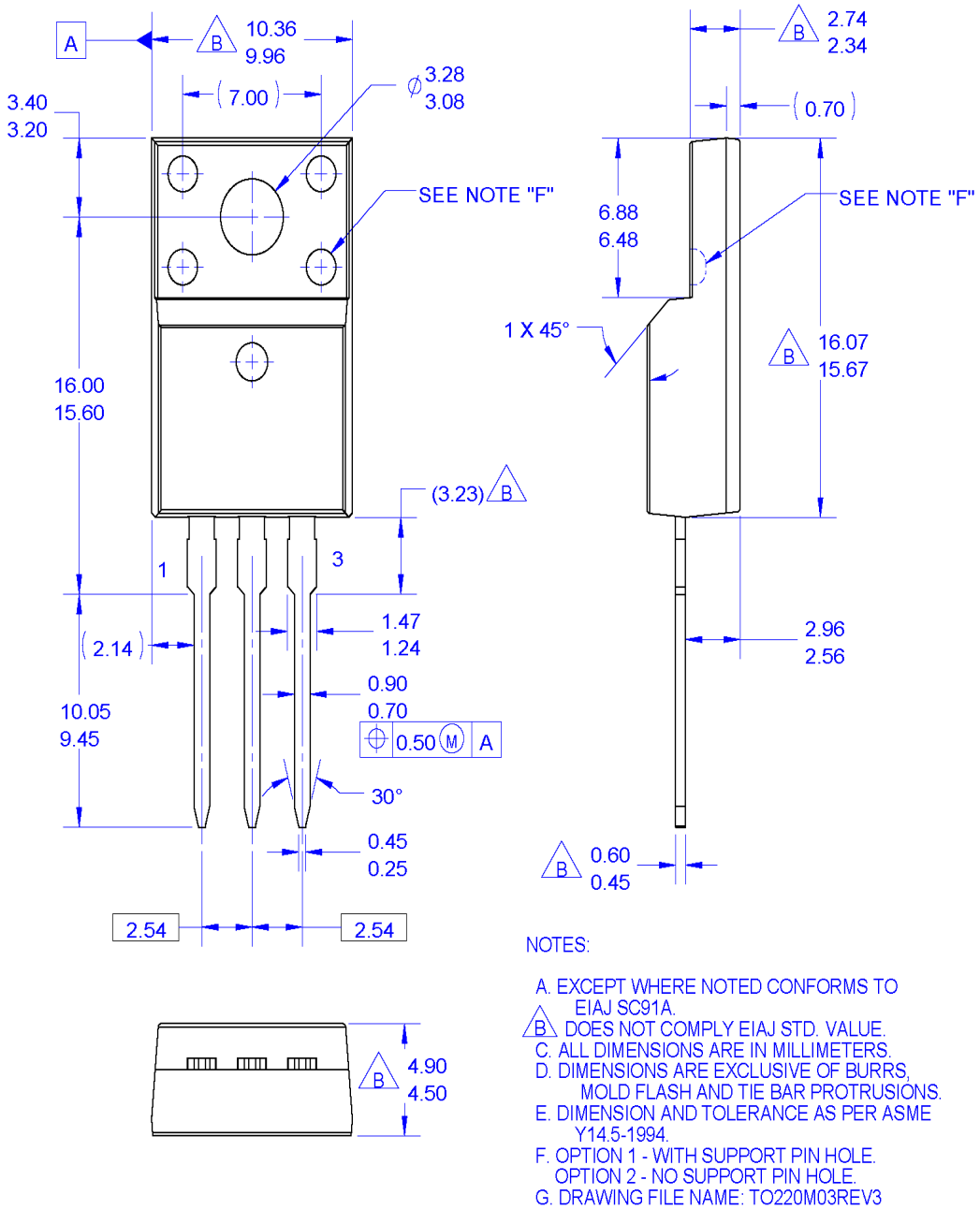



NOTES: UNLESS OTHERWISE SPECIFIED
A) REFERENCE JEDEC, TO-220, ISSUE K, VARIATION AB, DATED APRIL, 2002.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONING AND TOLERANCING PER ANSI Y14,5 - 1973
D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
△E DOES NOT COMPLY JEDEC STANDARD VALUE,
F) "A1" DIMENSIONS REPRESENT LIKE BELOW:
SINGLE GAUGE = 0,51 - 0,61
DUAL GAUGE = 1,14 - 1,40
G) DRAWING FILE NAME: TO220B03REV6

Dimensions in Millimeters

## Mechanical Dimensions

# TO-220F




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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| Datasheet Identification | Product Status | Definition |
|---|---|---|
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