FAIRCHILD SEMICONDUCTOR®

November 2013

# FQI13N50C

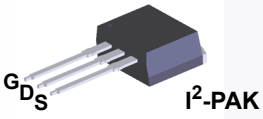
## N-Channel QFET® MOSFET
### 500 V, 13 A, 480 mΩ

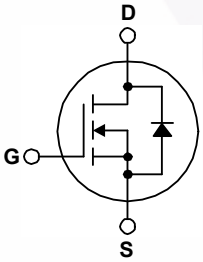
### Features

- 13 A, 500 V, $R_{DS(on)}$ = 480 mΩ (Max.) @$V_{GS}$ = 10 V, $I_D$ = 6.5 A
- Low Gate Charge ( Typ. 43 nC)
- Low Crss ( Typ. 20 pF)
- 100% Avalanche Tested
- RoHS Compliant

### 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.




## Absolute Maximum Ratings $T_C$ = 25°C unless otherwise noted.

| Symbol | Parameter | | FQI13N50CTU | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 500 | V |
| $I_D$ | Drain Current - Continuous ($T_C$ = 25°C) | | 13 | A |
| | Drain Current - Continuous ($T_C$ = 100°C) | | 8 | A |
| $I_{DM}$ | Drain Current - Pulsed | (Note 1) | 52 | A |
| $V_{GSS}$ | Gate-Source Voltage | | ± 30 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note 2) | 860 | mJ |
| $I_{AR}$ | Avalanche Current | (Note 1) | 13 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | (Note 1) | 19.5 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 4.5 | V/ns |
| $P_D$ | Power Dissipation ($T_C$ = 25°C) | | 195 | W |
| | - Derate above 25°C | | 1.56 | 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 |

## Thermal Characteristics

| Symbol | Parameter | FQI13N50CTU | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max. | 0.64 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 62.5 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FQI13N50C | FQI13N50CTU | $I^2$-PAK | Tube | N/A | 50 units |

## 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 | 500 | -- | -- | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | -- | 0.5 | -- | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 500 V, $V_{GS}$ = 0 V | -- | -- | 1 | μA |
| | | $V_{DS}$ = 400 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 | 2.0 | -- | 4.0 | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 6.5 A | -- | 0.39 | 0.48 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 6.5 A | -- | 15 | -- | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | -- | 1580 | 2055 | pF |
| $C_{oss}$ | Output Capacitance | | -- | 180 | 235 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 20 | 25 | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 250 V, $I_D$ = 13 A, $R_G$ = 25 Ω (Note 4) | -- | 25 | 60 | ns |
| $t_r$ | Turn-On Rise Time | | -- | 100 | 210 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 130 | 270 | ns |
| $t_f$ | Turn-Off Fall Time | | -- | 100 | 210 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 400 V, $I_D$ = 13 A, $V_{GS}$ = 10 V (Note 4) | -- | 43 | 56 | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 7.5 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 18.5 | -- | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 13 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 52 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 13 A | -- | -- | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_S$ = 13 A, $dI_F$ / dt = 100 A/μs | -- | 410 | -- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 4.5 | -- | μC |

**NOTES:**

1. Repetitive Rating : Pulse width limited by maximum junction temperature.
2. L =6.0 mH, $I_{AS}$ = 13A, $V_{DD}$ = 50V, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 13A, di/dt ≤ 200A/μs, $V_{DD}$ ≤ $BV_{DSS}$, starting $T_J$ = 25°C.
4. Essentially independent of operating temperature.

## Typical Characteristics

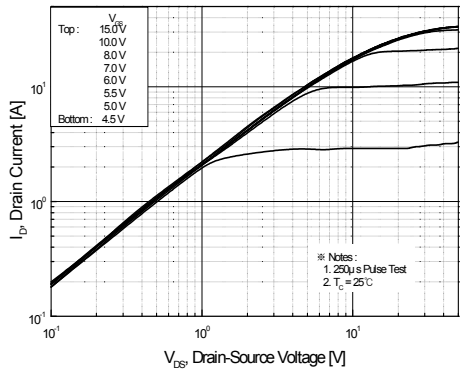



**Figure 1. On-Region Characteristics**

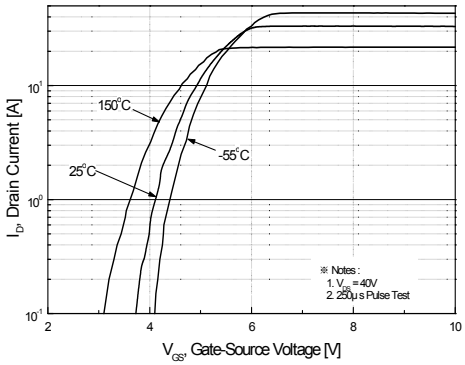



**Figure 2. Transfer Characteristics**

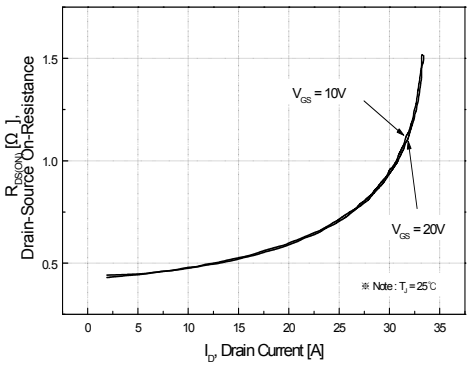



**Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage**

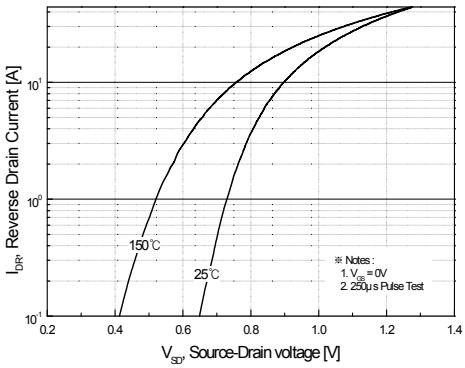



**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**

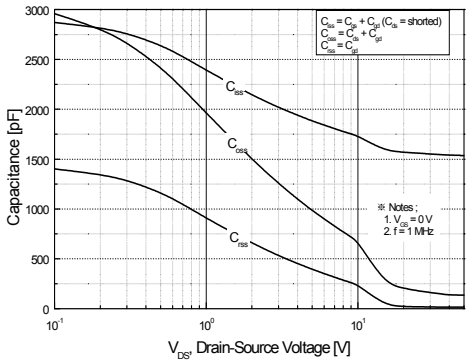



**Figure 5. Capacitance Characteristics**

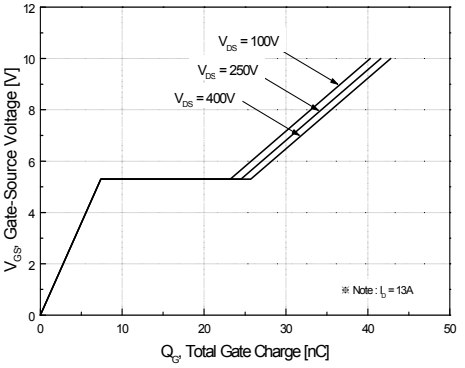



**Figure 6. Gate Charge Characteristics**

## Package Dimensions (Continued)

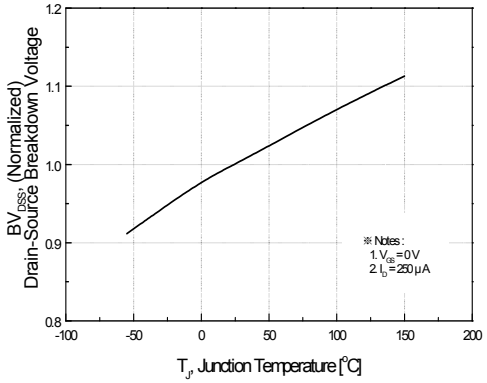



**Figure 7. Breakdown Voltage Variation vs Temperature**

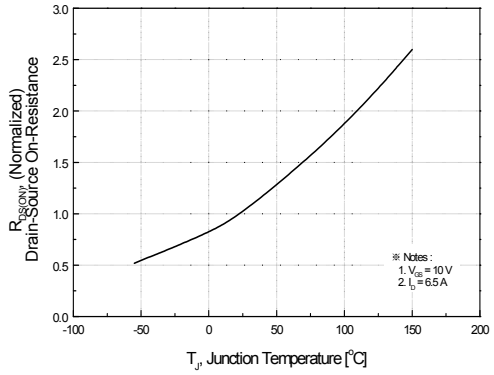



**Figure 8. On-Resistance Variation vs Temperature**

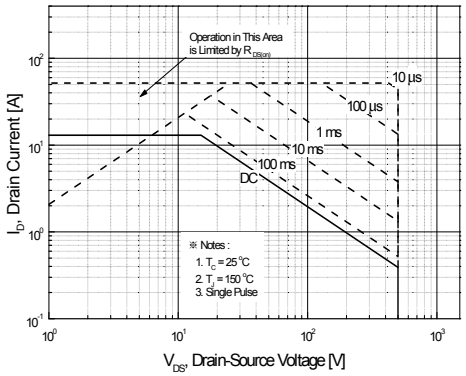



**Figure 9. Maximum Safe Operating Area**

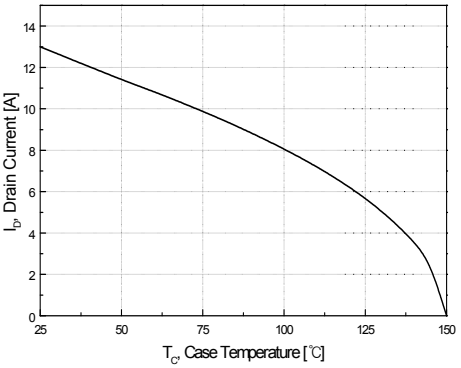



**Figure 10. Maximum Drain Current vs Case Temperature**

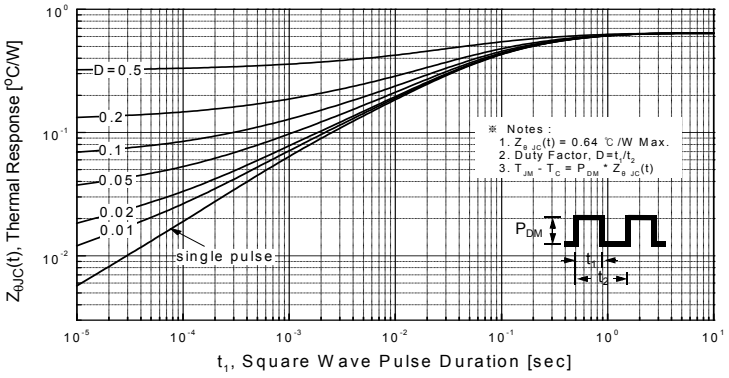



**Figure 11. Transient Thermal Response Curve**

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

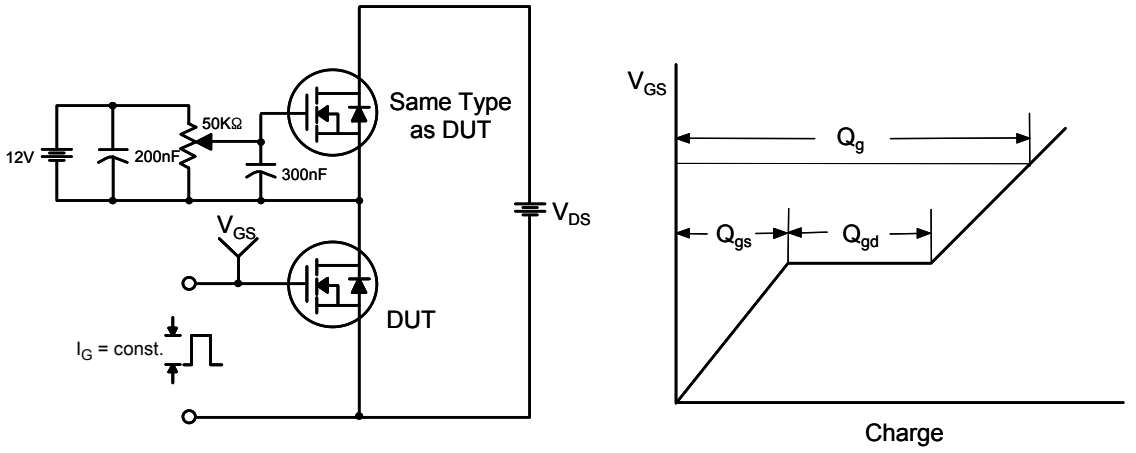



**Figure 13. Resistive Switching Test Circuit & Waveforms**

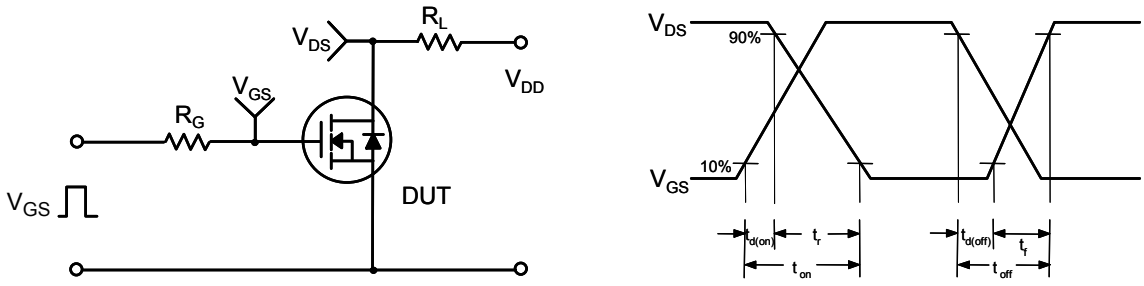



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

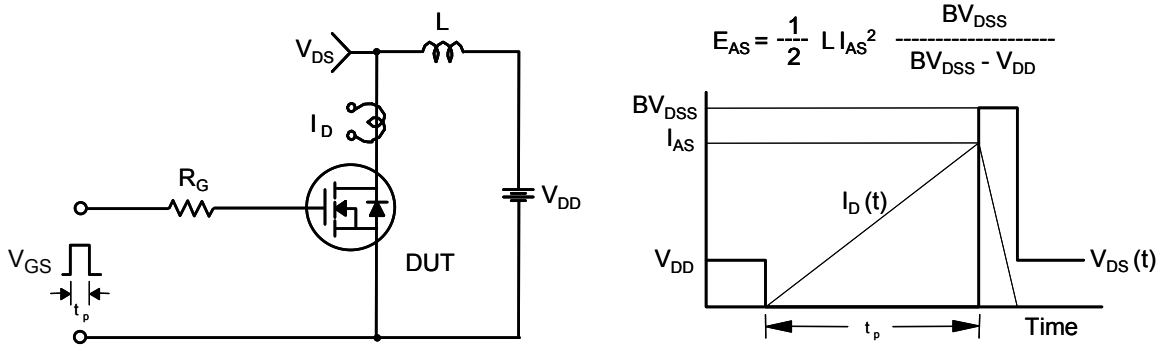
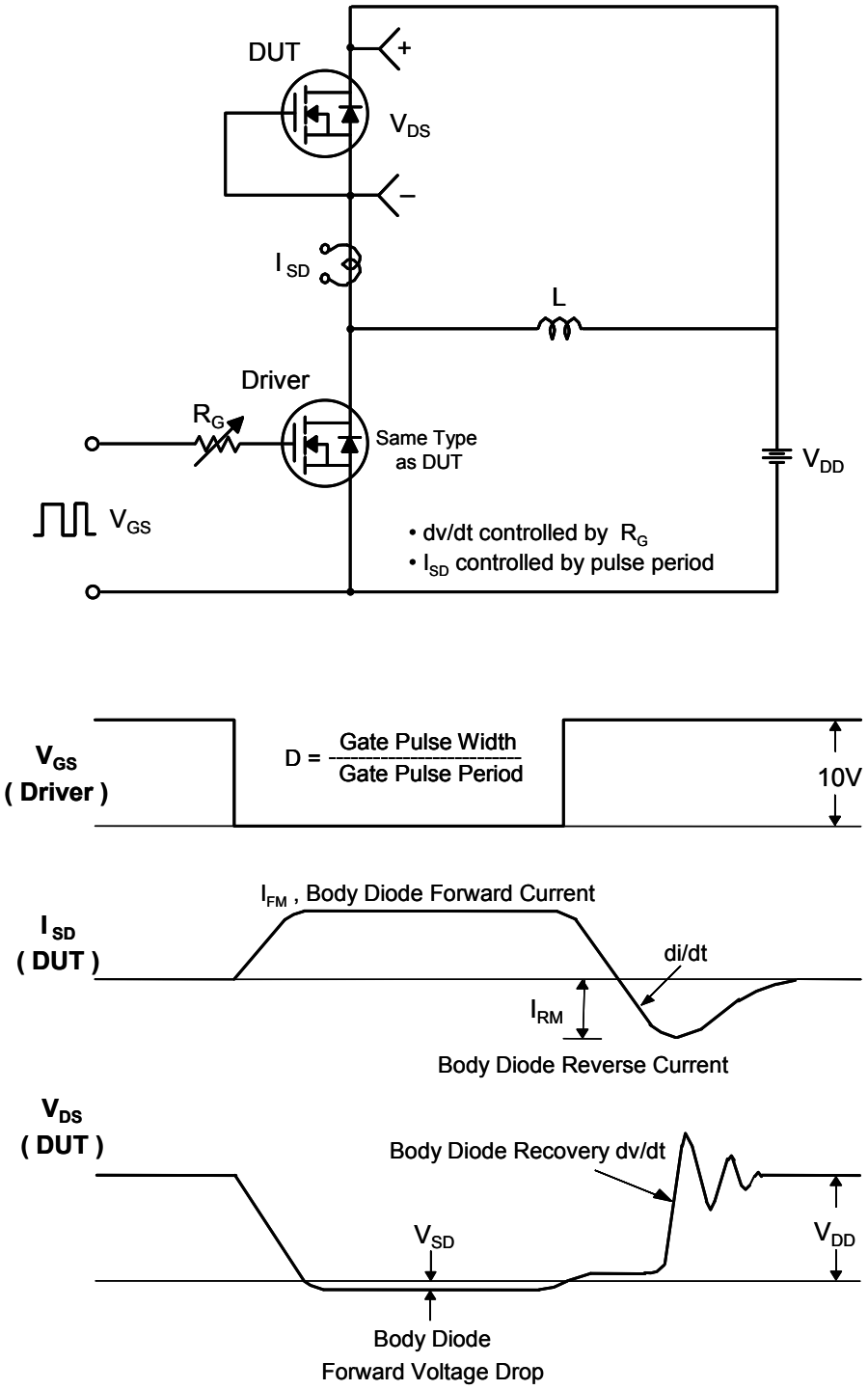
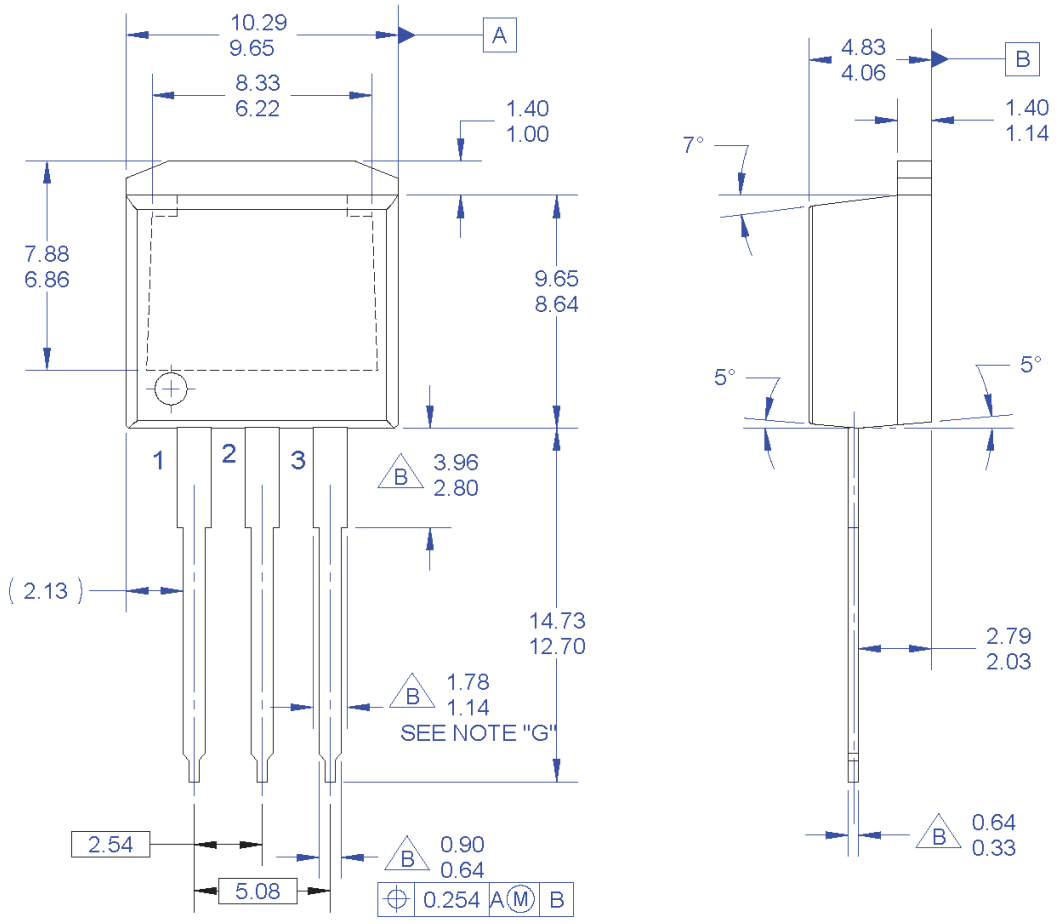


**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**



## Mechanical Dimensions




NOTES:

A. EXCEPT WHERE NOTED CONFORMS TO TO262 JEDEC VARIATION AA.
B. DOES NOT COMPLY JEDEC 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 ANSI Y14.5-1994.
F. LOCATION OF PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF PACKAGE)
G. MAXIMUM WIDTH FOR F102 DEVICE = 1.35 MAX.
H. DRAWING FILE NAME: TO262A03REV5

**Figure 16. TO262 ($I^2PAK$), Molded, 3-Lead, Jedec Variation AA**

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