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**FAIRCHILD**™

**April 2014**

# FQA19N60

## N-Channel QFET® MOSFET

### 600 V, 18.5 A, 380 mΩ

### 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

- 18.5 A, 600 V, $R_{DS(on)}$ = 380 mΩ (Max.) @ $V_{GS}$ = 10 V, $I_D$ = 9.3 A
- Low Gate Charge (Typ. 70 nC)
- Low Crss (Typ.  35 pF)
- 100% Avalanche Tested



TO-3PN
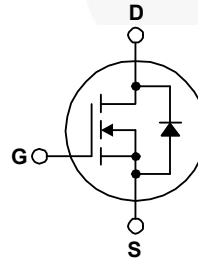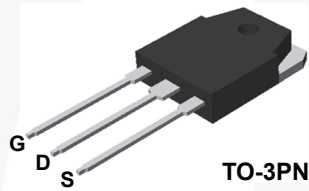
## Absolute Maximum Ratings $T_C$ = 25°C unless otherwise noted.

| Symbol | Parameter | | | FQA19N60 | Unit |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | | 600 | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C) | | 18.5 | A |
| | | - Continuous ($T_C$ = 100°C) | | 11.7 | A |
| $I_{DM}$ | Drain Current | - Pulsed | (Note 1) | 74 | A |
| $V_{GSS}$ | Gate-Source Voltage | | | ± 30 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy | | (Note 2) | 1150 | mJ |
| $I_{AR}$ | Avalanche Current | | (Note 1) | 18.5 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | (Note 1) | 30 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | | (Note 3) | 4.5 | V/ns |
| $P_D$ | Power Dissipation  ($T_C$ = 25°C) | | | 300 | W |
| | - Derate above 25°C | | | 2.38 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | | -55 to +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | | | 300 | °C |

## Thermal Characteristics

| Symbol | Parameter | FQA19N60 | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max. | 0.42 | °C/W |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink, Typ. | 0.24 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 40 | °C/W |

www.fairchildsemi.com

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FQA19N60 | FQA19N60 | TO-3PN | Tube | N/A | N/A | 30 units |

## Electrical Characteristics $T_C = 25^\circ C$ 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 | 600 | -- | -- | V |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250$ μA, Referenced to 25°C | -- | 0.65 | -- | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS} = 600$ V, $V_{GS} = 0$ V | -- | -- | 10 | μA |
| | | $V_{DS} = 480$ V, $T_C = 125$°C | -- | -- | 100 | 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, $I_D = 9.3$ A | -- | 0.3 | 0.38 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS} = 50$ V, $I_D = 9.3$ A | -- | 16 | -- | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS} = 25$ V, $V_{GS} = 0$ V, f = 1.0 MHz | -- | 2800 | 3600 | pF |
| $C_{oss}$ | Output Capacitance | | -- | 350 | 450 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 35 | 45 | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 300$ V, $I_D = 18.5$ A, $R_G = 25$ Ω | -- | 65 | 140 | ns |
| $t_r$ | Turn-On Rise Time | | -- | 210 | 430 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 150 | 310 | ns |
| $t_f$ | Turn-Off Fall Time | (Note 4) | -- | 135 | 280 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS} = 480$ V, $I_D = 18.5$ A, $V_{GS} = 10$ V | -- | 70 | 90 | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 17 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | (Note 4) | -- | 33 | -- | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 18.5 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 74 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS} = 0$ V, $I_S = 18.5$ A | -- | -- | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS} = 0$ V, $I_S = 18.5$ A, $dI_F/dt = 100$ A/μs | -- | 420 | -- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 4.7 | -- | μC |

**Notes:**
1. Repetitive rating : pulse-width limited by maximum junction temperature.
2. L = 6.2 mH, $I_{AS} = 18.5$ A, $V_{DD} = 50$ V, $R_G = 25$ Ω, starting $T_J = 25$°C.
3. $I_{SD} \leq 18.5$ A, di/dt ≤ 200 A/μs, $V_{DD} \leq BV_{DSS}$, starting $T_J = 25$°C.
4. Essentially independent of operating temperature.

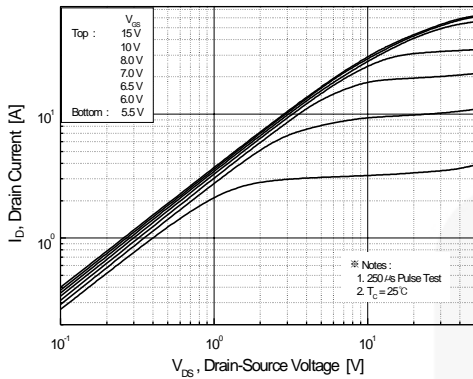**Typical Characteristics**

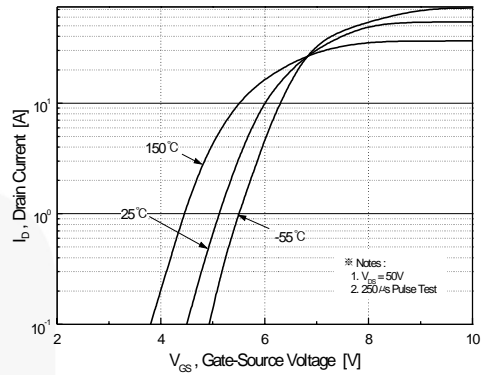Figure 1. On-Region Characteristics
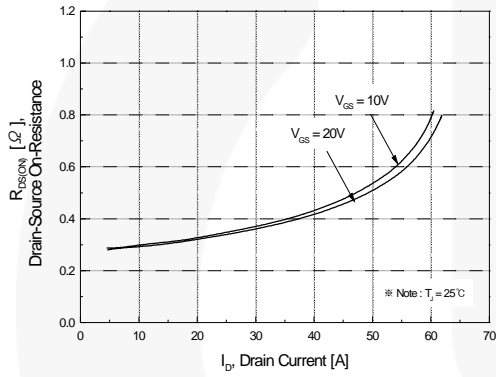
Figure 2. Transfer Characteristics

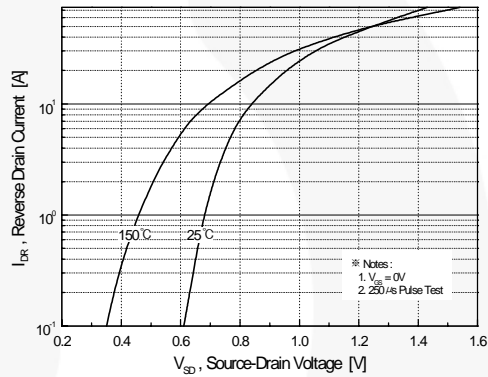Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

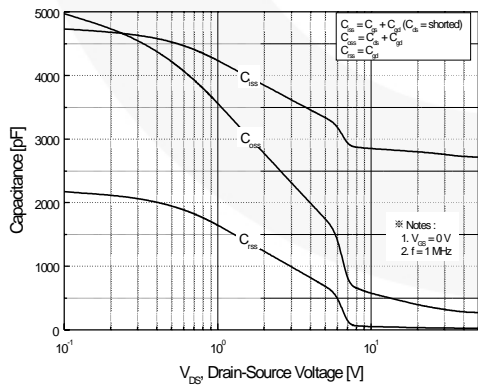Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

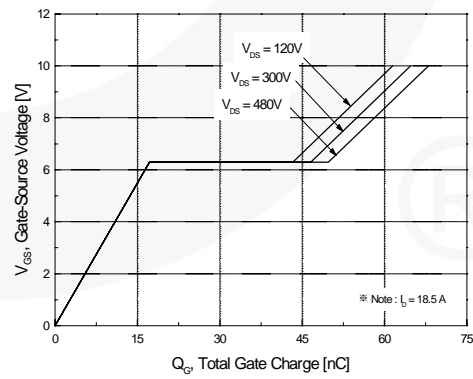Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics
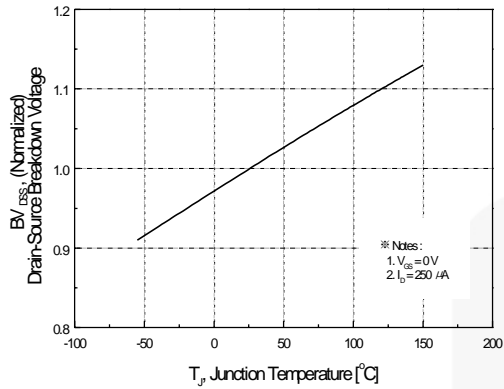
## Typical Characteristics (Continued)



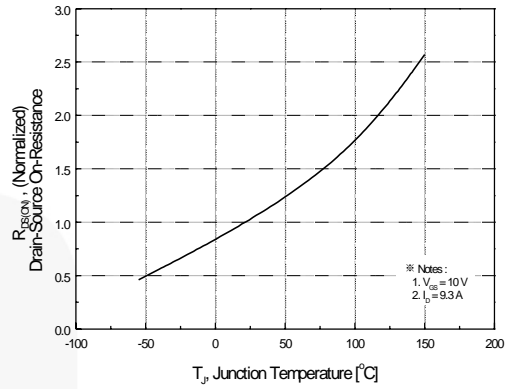**Figure 7. Breakdown Voltage Variation vs. Temperature**
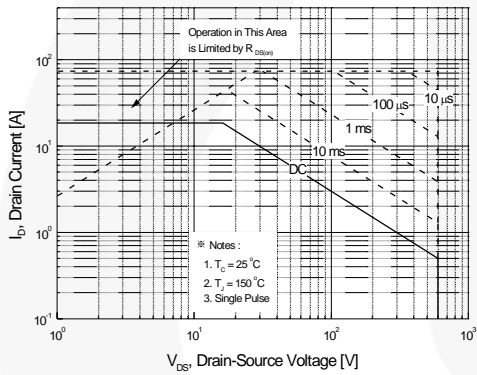


**Figure 8. On-Resistance Variation vs. Temperature**
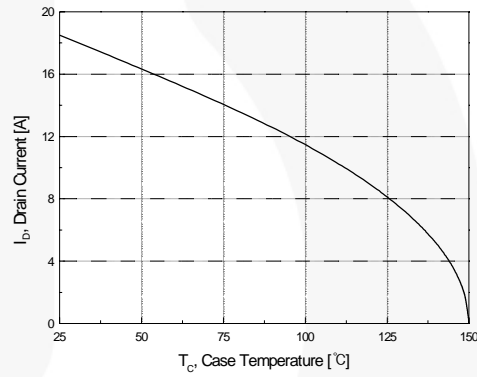


**Figure 9. Maximum Safe Operating Area**



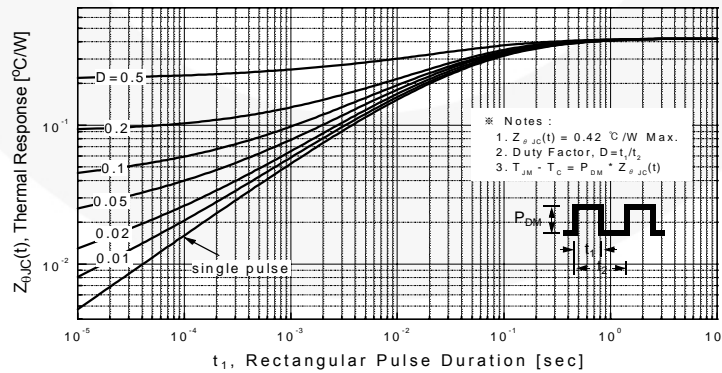**Figure 10. Maximum Drain Current vs. Case Temperature**



**Figure 11. Transient Thermal Response Curve**

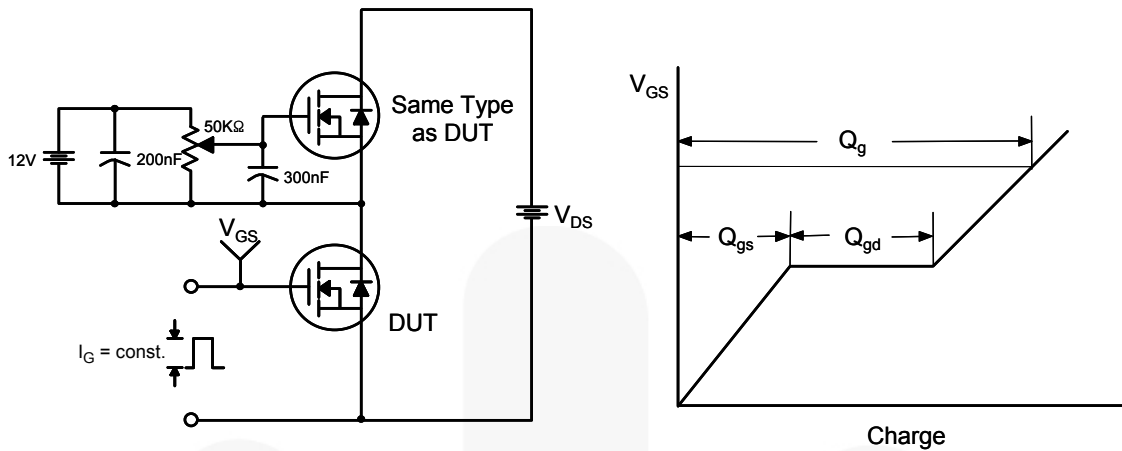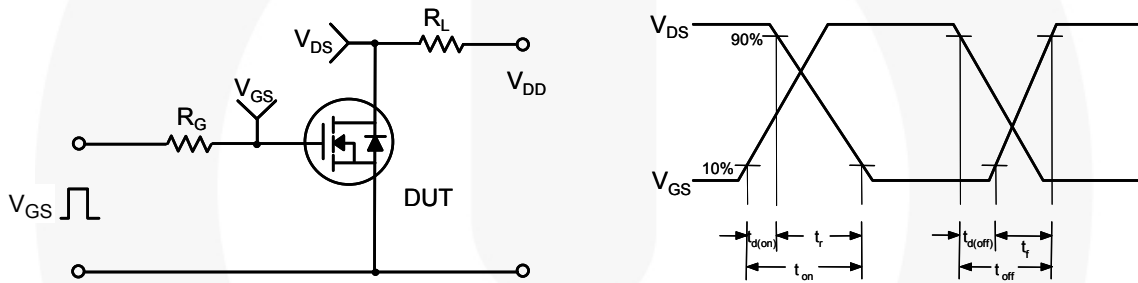**Figure 12. Gate Charge Test Circuit & Waveform**



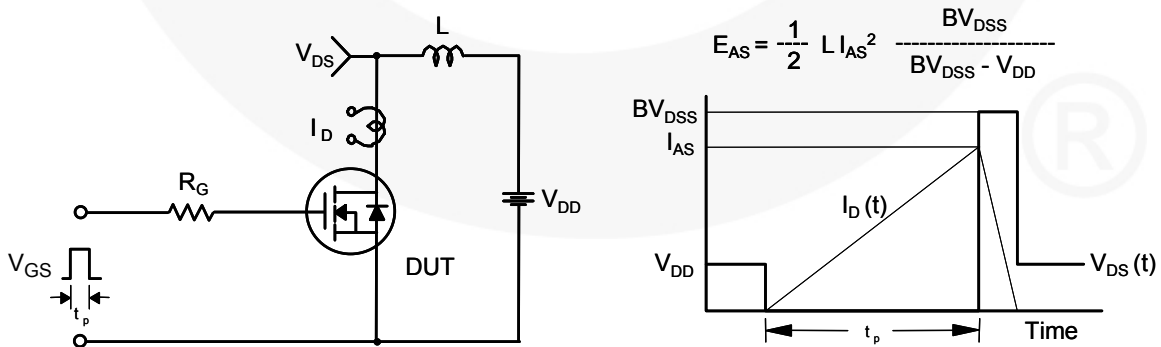**Figure 13. Resistive Switching Test Circuit & Waveforms**

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



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

DUT

$V_{DS}$

$I_{SD}$

L

Driver

$R_G$

Same Type
as DUT

$V_{DD}$

$V_{GS}$

• dv/dt controlled by $R_G$
• $I_{SD}$ controlled by pulse period

$V_{GS}$
( Driver )

$D = \dfrac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$

10V

$I_{SD}$
( DUT )

$I_{FM}$ , Body Diode Forward Current

di/dt

$I_{RM}$

Body Diode Reverse Current

$V_{DS}$
( DUT )

Body Diode Recovery dv/dt

$V_{SD}$

$V_{DD}$

Body Diode
Forward Voltage Drop
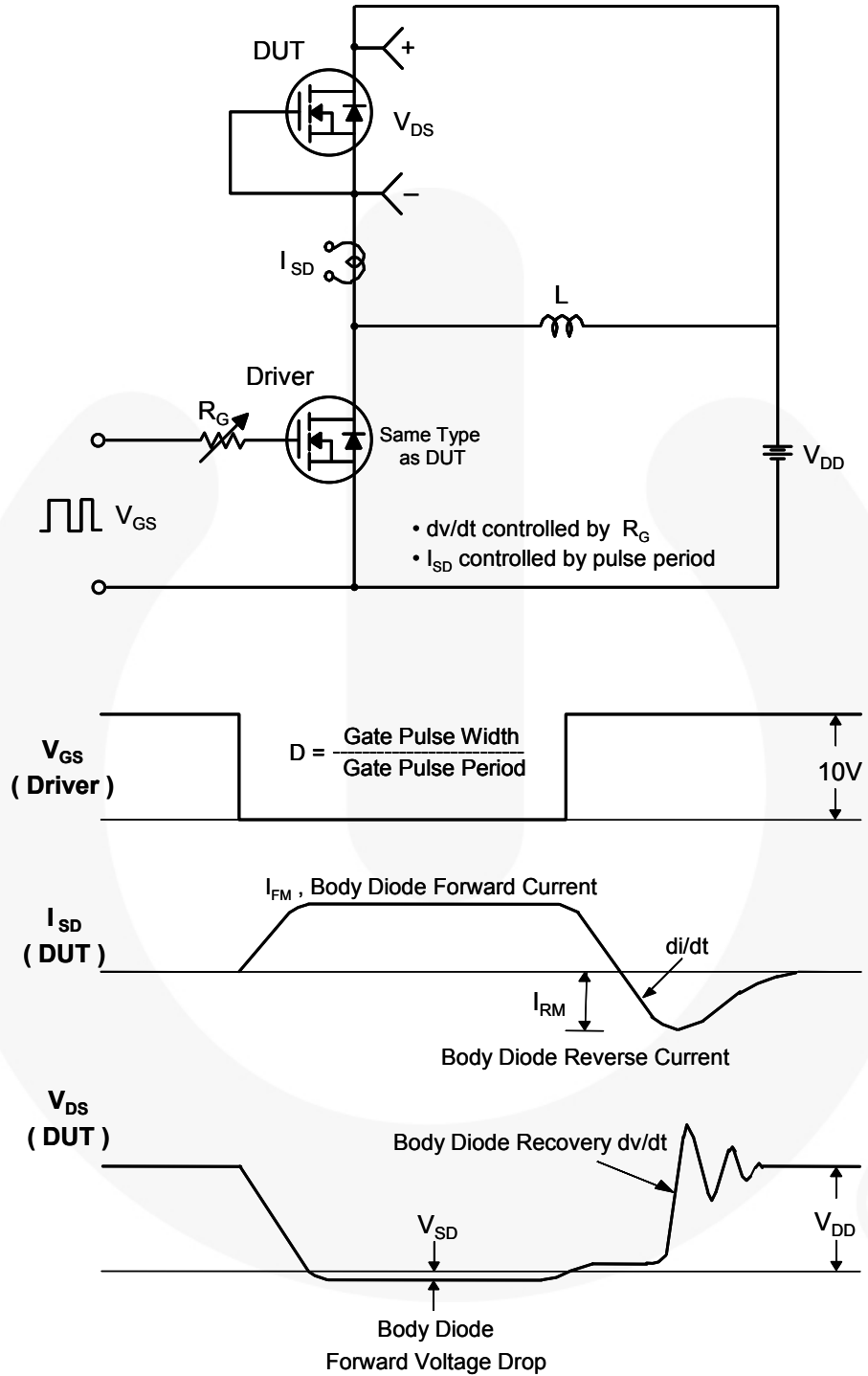
**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

# Mechanical Dimensions



**Figure 16. TO3PN, 3-Lead, Plastic, EIAJ SC-65**
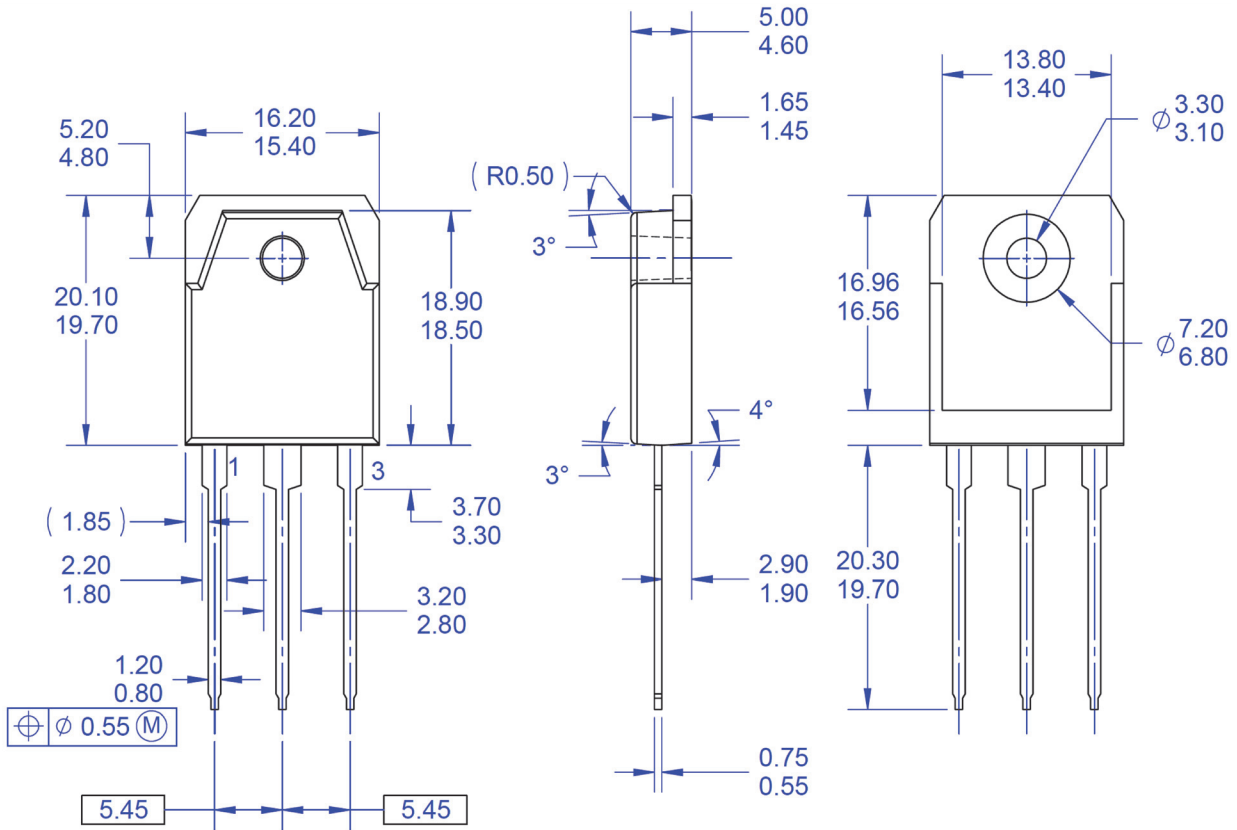
NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO EIAJ SC-65 PACKAGING STANDARD.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSION AND TOLERANCING PER ASME14.5-2009.
D) DIMENSIONS ARE EXCLUSSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSSIONS.
E) DRAWING FILE NAME: TO3PN03AREV1.
F) FAIRCHILD SEMICONDUCTOR.

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