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September 2017

# FCA47N60 / FCA47N60_F109

## N-Channel SuperFET® MOSFET

### 600 V, 47 A, 70 mΩ

## Features

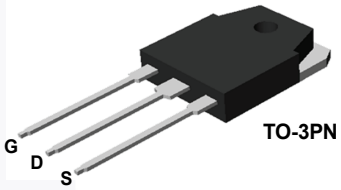
- 650 V @ $T_J$ = 150°C
- Typ. $R_{DS(on)}$ = 58 mΩ
- Ultra Low Gate Charge (Typ. $Q_g$= 210 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 420 pF)
- 100% Avalanche Tested

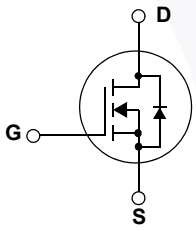
## Application

- Solar Invertor
- AC-DC Power Supply

## Description

SuperFET® 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 technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.




## Absolute Maximum Ratings

| Symbol | Parameter | | FCA47N60 | FCA47N60_F109 | Unit |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 600 | | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C)<br>- Continuous ($T_C$ = 100°C) | 47<br>29.7 | | A<br>A |
| $I_{DM}$ | Drain Current | - Pulsed (Note 1) | 141 | | A |
| $V_{GSS}$ | Gate-Source voltage | | ± 30 | | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note 2) | 1800 | | mJ |
| $I_{AR}$ | Avalanche Current | (Note 1) | 47 | | A |
| $E_{AR}$ | Repetitive Avalanche Energy | (Note 1) | 41.7 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 4.5 | | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C)<br>- Derate above 25°C | 417<br>3.33 | | W<br>W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +150 | | °C |
| $T_L$ | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | | 300 | | °C |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max. | -- | 0.3 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | -- | 41.7 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FCA47N60 | FCA47N60 | TO-3PN | - | - | 30 |
| FCA47N60 | FCA47N60_F109 | TO-3PN | - | - | 30 |

## Electrical Characteristics $T_C$ = 25°C unless otherwise noted.

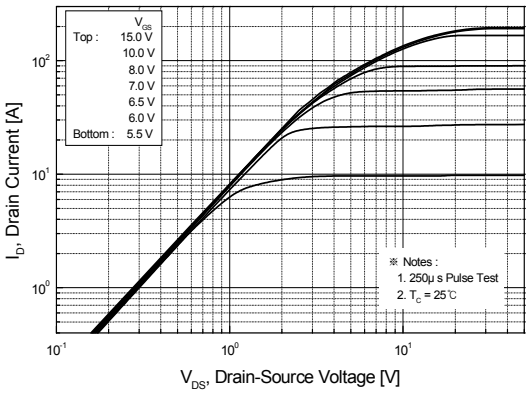
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA, $T_J$ = 25°C | 600 | -- | -- | V |
| | | $V_{GS}$ = 0 V, $I_D$ = 250 μA, $T_J$ = 150°C | -- | 650 | -- | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | -- | 0.6 | -- | V/°C |
| $BV_{DS}$ | Drain-Source Avalanche Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 47 A | -- | 700 | -- | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | -- | -- | 1 | μA |
| | | $V_{DS}$ = 480 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 | |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 23.5 A | -- | 0.058 | 0.07 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 20 V, $I_D$ = 23.5 A | -- | 40 | -- | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | 3.0 | -- | 5.0 | |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | -- | 5900 | 8000 | pF |
| $C_{oss}$ | Output Capacitance | | -- | 3200 | 4200 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 250 | -- | pF |
| $C_{oss}$ | Output Capacitance | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, f = 1.0 MHz | -- | 160 | -- | pF |
| $C_{oss}$ eff. | Effective Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | -- | 420 | -- | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 300 V, $I_D$ = 47 A, $R_G$ = 25 Ω (Note 4) | -- | 185 | 430 | ns |
| $t_r$ | Turn-On Rise Time | | -- | 210 | 450 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 520 | 1100 | ns |
| $t_f$ | Turn-Off Fall Time | | -- | 75 | 160 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 480 V, $I_D$ = 47 A, $V_{GS}$ = 10 V (Note 4) | -- | 210 | 270 | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 38 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 110 | -- | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 47 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 141 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 47 A | -- | -- | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_S$ = 47 A, $dI_F/dt$ =100 A/μs (Note 4) | -- | 590 | -- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 25 | -- | μC |

**Notes:**

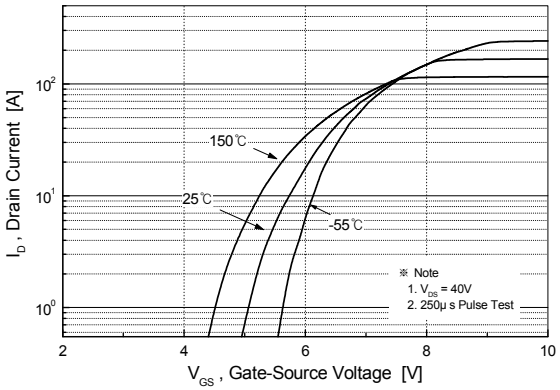
1. Repetitive Rating: Pulse-width limited by maximum junction temperature.
2. $I_{AS}$ = 18 A, $R_G$ = 25 Ω, starting $T_J$ = 25°C
3. $I_{SD}$ ≤ 47 A, di/dt ≤ 200 A/μs, $V_{DD}$ = 380 V, starting $T_J$ = 25°C
4. Essentially independent of operating temperature typical characteristics.

## Typical Characteristics

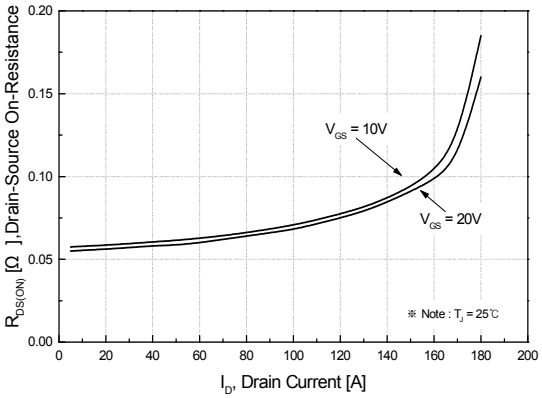
### Figure 1. On-Region Characteristics



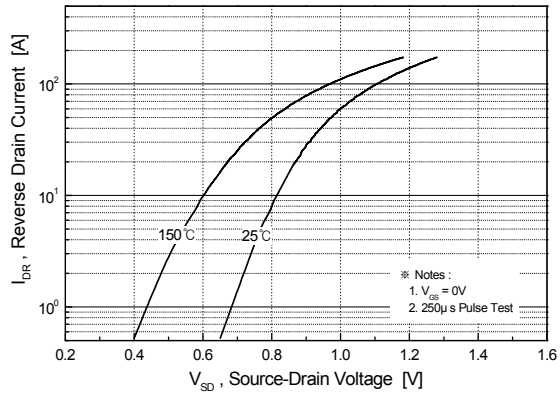

### Figure 2. Transfer Characteristics



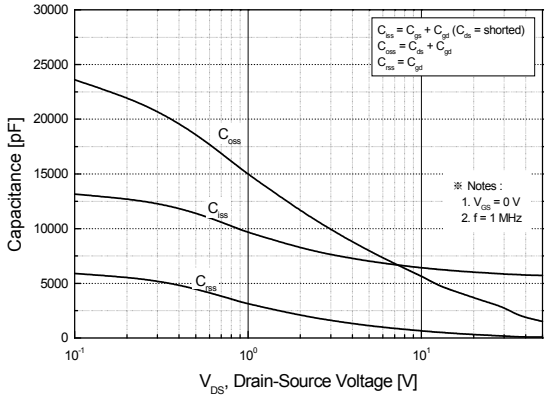

### Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage



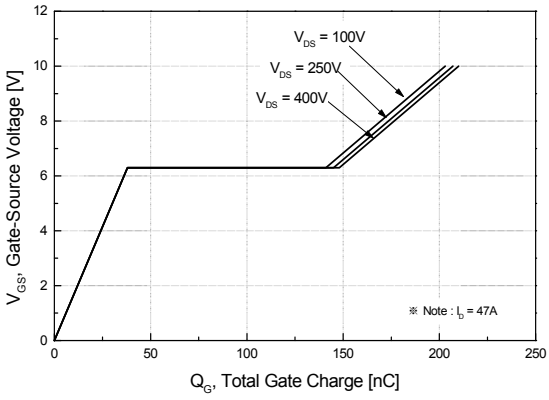

### Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue




### Figure 5. Capacitance Characteristics




### Figure 6. Gate Charge Characteristics



## Typical Characteristics (Continued)

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

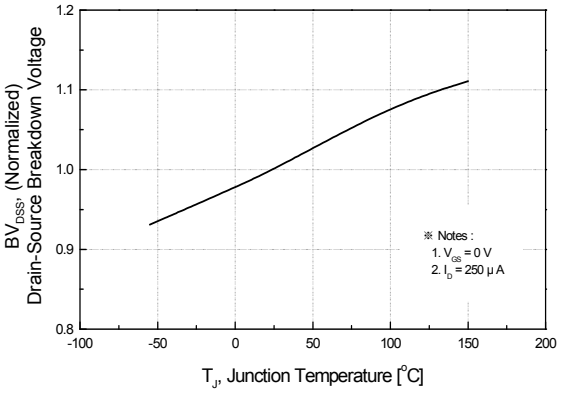



**Figure 8. On-Resistance Variation vs. Temperature**

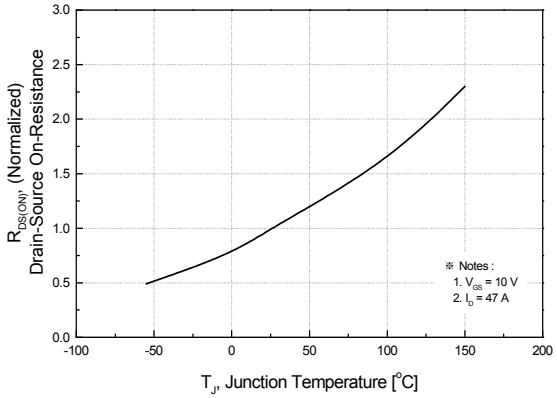



**Figure 9. Safe Operating Area**

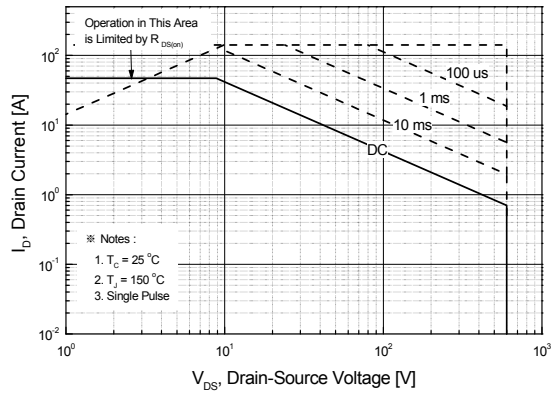



**Figure 10. Maximum Drain Current vs. Case Temperature**

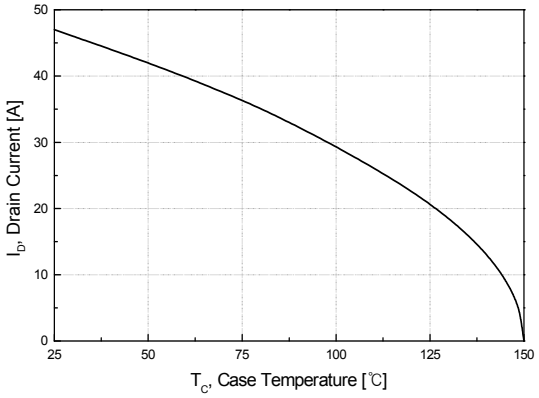



**Figure 11. Transient Thermal Response Curve**

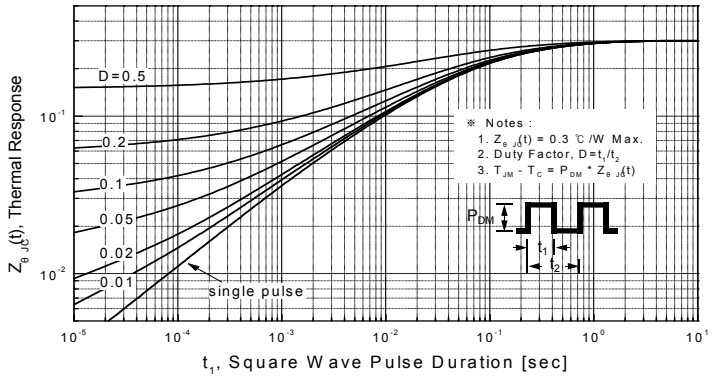


**Figure 12. Gate Charge Test Circuit & Waveform**

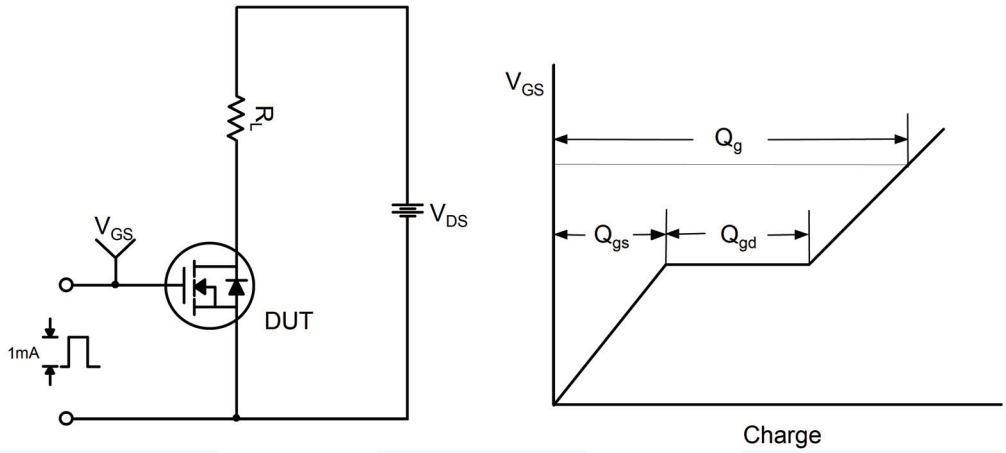



**Figure 13. Resistive Switching Test Circuit & Waveforms**

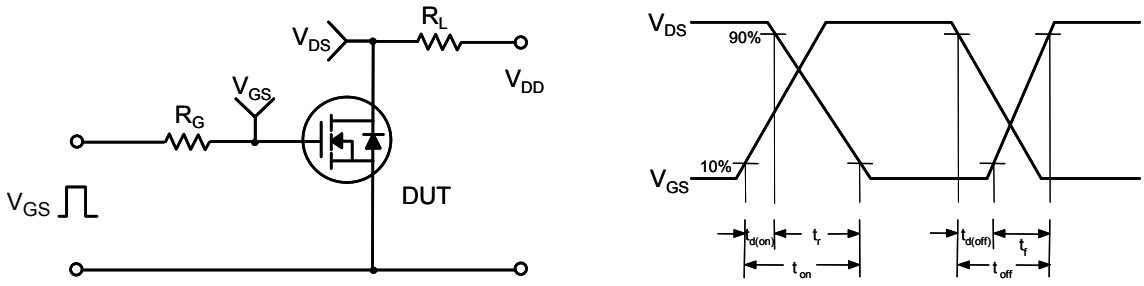



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

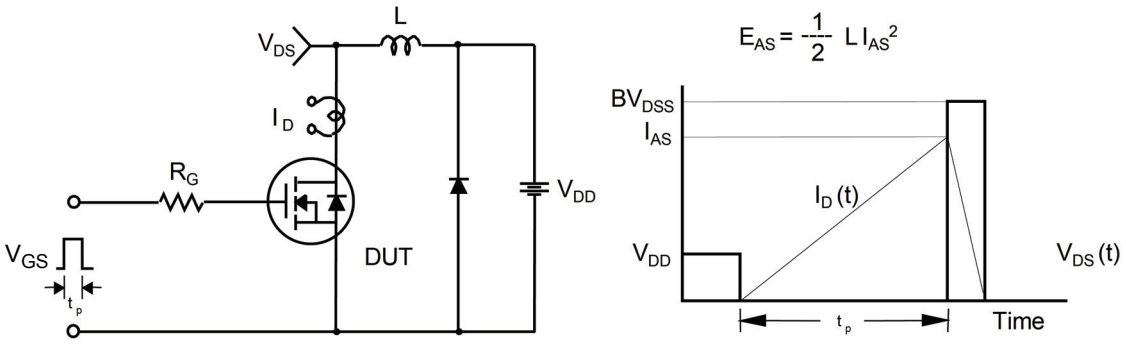
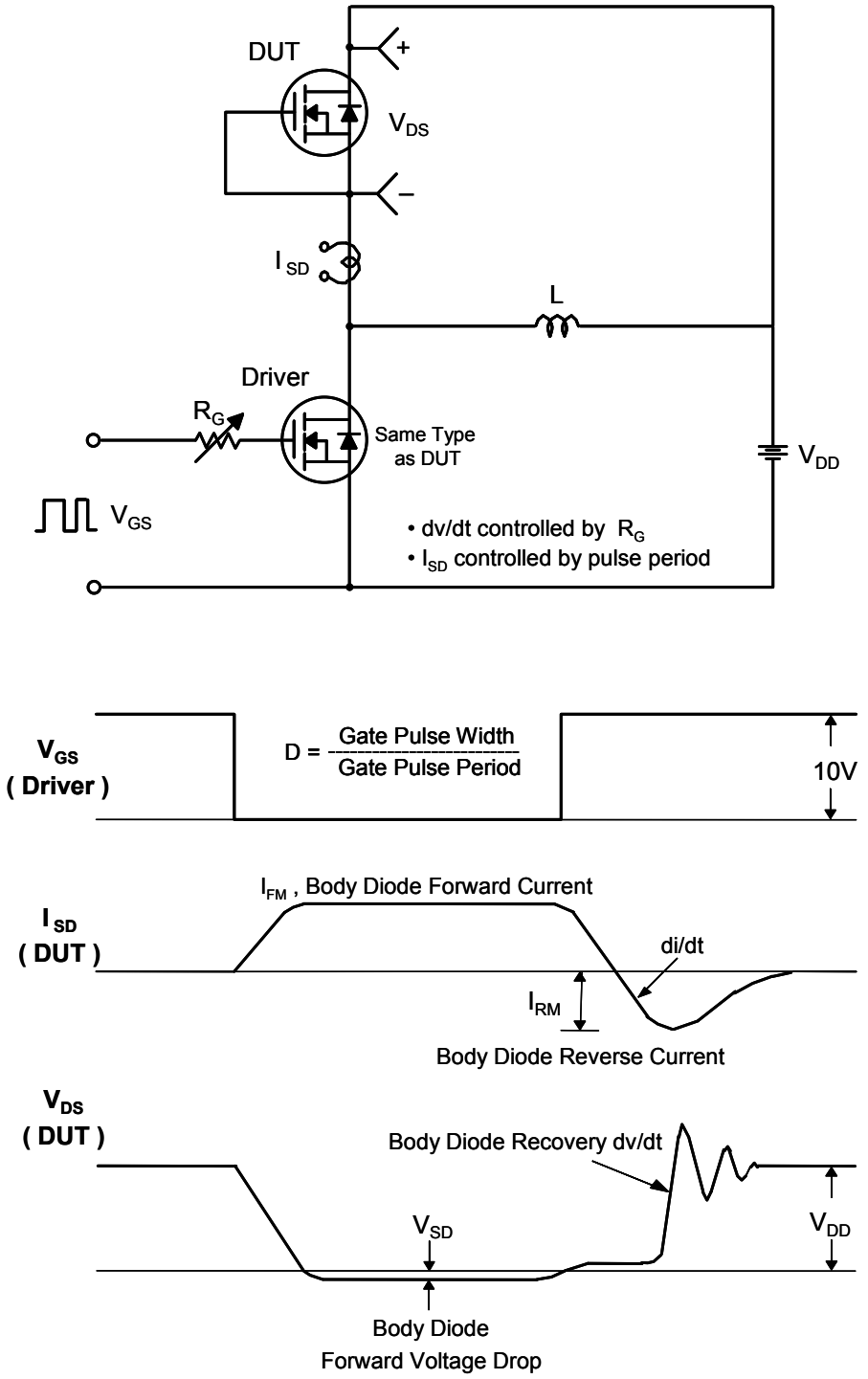


**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**



## Mechanical Dimensions

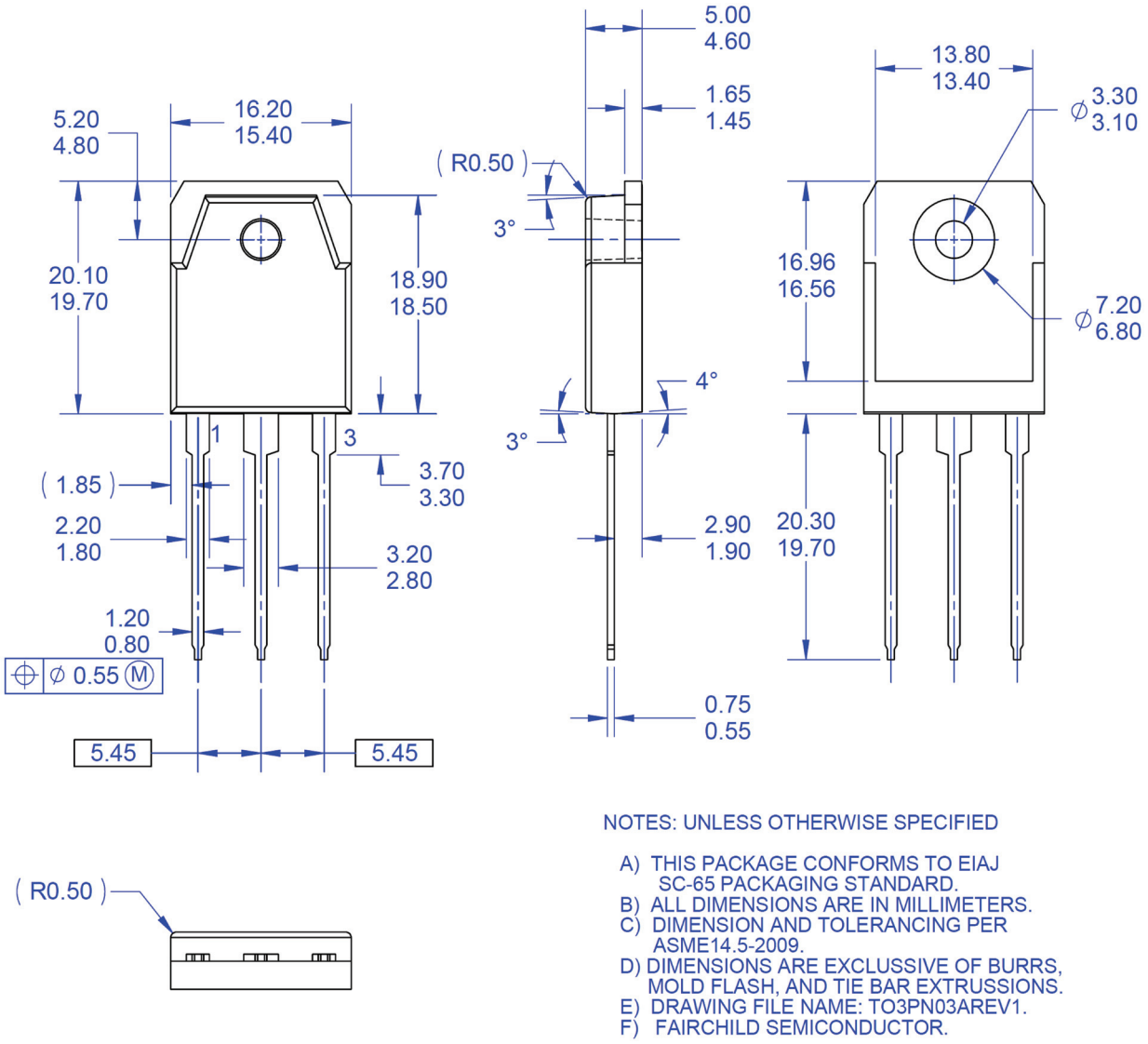



**Figure 16. TO3PN, 3-Lead, Plastic, EIAJ SC-65**

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