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May 2014

# FCA16N60N

## N-Channel SupreMOS<sup>®</sup> MOSFET

600 V, 16 A, 199 mΩ

### Features

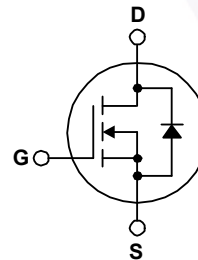
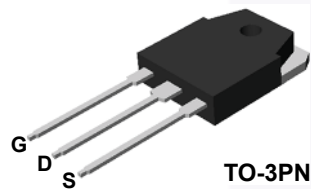
- $R_{DS(on)} = 170\text{ m}\Omega$  (Typ.) @  $V_{GS} = 10\text{V}$ ,  $I_D = 8\text{ A}$
- Ultra Low Gate Charge (Typ.  $Q_g = 40.2\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 176\text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Application

- PDP TV
- AC-DC Power Supply

### Description

The SupreMOS<sup>®</sup> MOSFET is Fairchild Semiconductor's next generation of high voltage super-junction (SJ) technology employing a deep trench filling process that differentiates it from the conventional SJ MOSFETs. This advanced technology and precise process control provides lowest  $R_{sp}$  on-resistance, superior switching performance and ruggedness. SupreMOS MOSFET is suitable for high frequency switching power converter applications such as PFC, server/telecom power, FPD TV power, ATX power, and industrial power applications.



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

| Symbol         | Parameter  | FCA16N60N                                  | Unit             |
|----------------|--|--|------------------|
| $V_{DSS}$      | Drain to Source Voltage  | 600  | V                |
| $V_{GSS}$      | Gate to Source Voltage   | $\pm 30$                                   | V                |
| $I_D$          | Drain Current  | - Continuous ( $T_C = 25^\circ\text{C}$ )  | 16.0             |
|                |  | - Continuous ( $T_C = 100^\circ\text{C}$ ) | 10.1             |
| $I_{DM}$       | Drain Current  | - Pulsed (Note 1)                          | 48.0             |
| $E_{AS}$       | Single Pulsed Avalanche Energy                                       | (Note 2)                                   | 355              |
| $I_{AR}$       | Avalanche Current  | (Note 1)                                   | 5.3              |
| $E_{AR}$       | Repetitive Avalanche Energy  | (Note 1)                                   | 1.34             |
| dv/dt          | MOSFET dv/dt   |  | 100              |
|                | Peak Diode Recovery dv/dt  | (Note 3)                                   | 20               |
| $P_D$          | Power Dissipation  | ( $T_C = 25^\circ\text{C}$ )               | 134.4            |
|                |  | - Derate Above $25^\circ\text{C}$          | 1.08             |
| $T_J, T_{STG}$ | 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  | $^\circ\text{C}$ |

### Thermal Characteristics

| Symbol          | Parameter                                     | FCA16N60N | Unit               |
|-----------------|---|-----------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max.    | 0.93      | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 40        |                    |

## Package Marking and Ordering Information

| Part Number | Top Mark  | Package | Packing Method | Reel Size | Tape Width | Quantity |
|-------------|-----------|---------|----------------|-----------|------------|----------|
| FCA16N60N   | FCA16N60N | TO-3PN  | Tube           | N/A       | N/A        | 30 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 to Source Breakdown Voltage         | $I_D = 1\text{ mA}, V_{GS} = 0\text{ V}, T_C = 25^\circ\text{C}$      | 600 | -    | -         | V                  |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$                | -   | 0.73 | -         | $V/^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}$                          | -   | -    | 10        | $\mu\text{A}$      |
|                                |   | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$ | -   | -    | 100       |                    |
| $I_{GSS}$                      | Gate to Body Leakage Current              | $V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$                       | -   | -    | $\pm 100$ | nA                 |

### On Characteristics

|              |                                      |   |     |       |       |          |
|--------------|--------------------------------------|---|-----|-------|-------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage               | $V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$ | 2.0 | -     | 4.0   | V        |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}, I_D = 8\text{ A}$  | -   | 0.170 | 0.199 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 40\text{ V}, I_D = 8\text{ A}$  | -   | 20    | -     | S        |

### Dynamic Characteristics

|                 |                                    |   |   |      |      |          |
|-----------------|------------------------------------|---|---|------|------|----------|
| $C_{iss}$       | Input Capacitance                  | $V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$              | - | 1630 | 2170 | pF       |
| $C_{oss}$       | Output Capacitance                 |   | - | 70   | 95   | pF       |
| $C_{rss}$       | Reverse Transfer Capacitance       |   | - | 5    | 10   | pF       |
| $C_{oss}$       | Output Capacitance                 | $V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$              | - | 40   | 60   | pF       |
| $C_{oss(eff.)}$ | Effective Output Capacitance       | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$                 | - | 176  | -    | pF       |
| $Q_{g(tot)}$    | Total Gate Charge at 10V           | $V_{DS} = 380\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}$<br>(Note 4) | - | 40.2 | 52.3 | nC       |
| $Q_{gs}$        | Gate to Source Gate Charge         |   | - | 6.7  | -    | nC       |
| $Q_{gd}$        | Gate to Drain "Miller" Charge      |   | - | 12.9 | -    | nC       |
| ESR             | Equivalent Series Resistance (G-S) | $f = 1\text{ MHz}$  | - | 2.9  | -    | $\Omega$ |

### Switching Characteristics

|              |                     |  |   |      |       |    |
|--------------|---------------------|--|---|------|-------|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 380\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}, R_G = 4.7\ \Omega$<br>(Note 4) | - | 15.8 | 41.6  | ns |
| $t_r$        | Turn-On Rise Time   |  | - | 15.5 | 41.0  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |  | - | 60.3 | 130.6 | ns |
| $t_f$        | Turn-Off Fall Time  |  | - | 20.2 | 50.4  | ns |

### Drain-Source Diode Characteristics

|          |  |  |   |     |     |               |
|----------|--|--|---|-----|-----|---------------|
| $I_S$    | Maximum Continuous Drain to Source Diode Forward Current | -  | - | 16  | A   |               |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current     | -  | - | 48  | A   |               |
| $V_{SD}$ | Drain to Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_{SD} = 8\text{ A}$                                     | - | -   | 1.2 | V             |
| $t_{rr}$ | Reverse Recovery Time                                    | $V_{GS} = 0\text{ V}, I_{SD} = 8\text{ A}, di_F/dt = 100\text{ A}/\mu\text{s}$ | - | 319 | -   | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                                  |  | - | 4.4 | -   | $\mu\text{C}$ |

#### Notes:

1. Repetitive rating; pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 5.3\text{ A}, R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 16\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} = 380\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

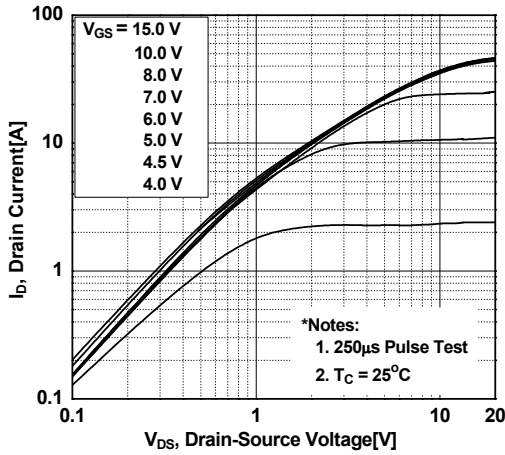


Figure 2. Transfer Characteristics

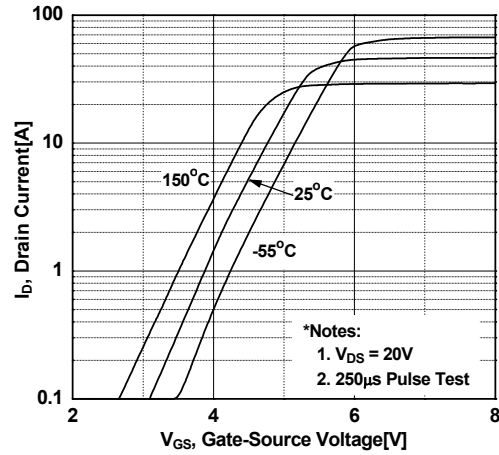


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

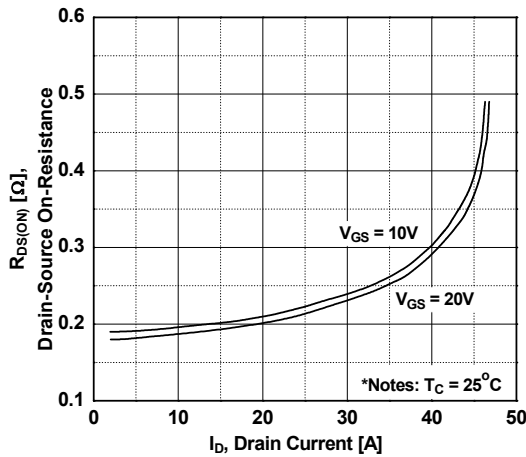


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

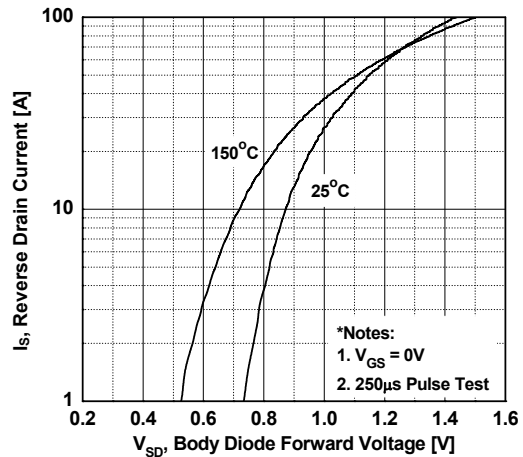


Figure 5. Capacitance Characteristics

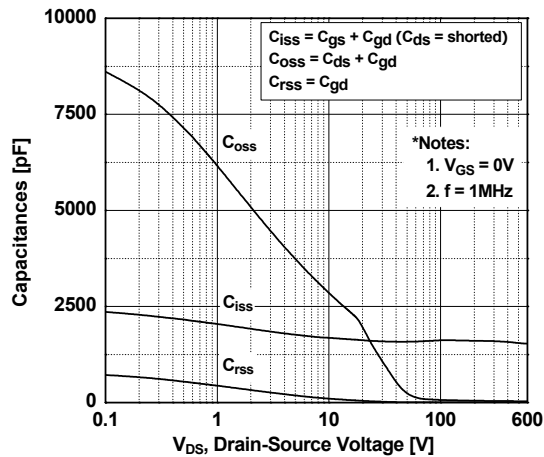
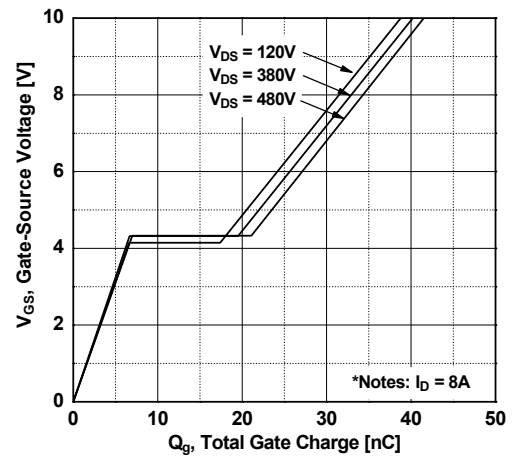


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

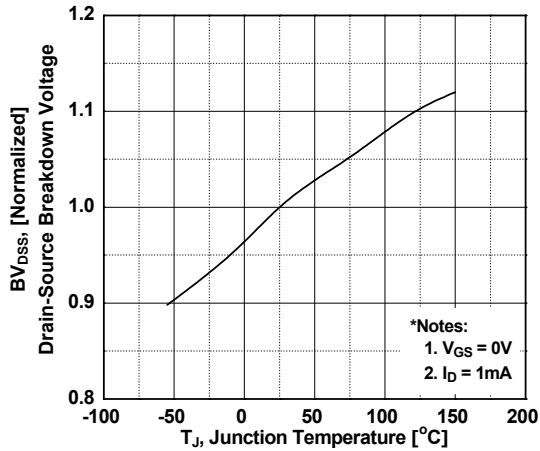


Figure 8. On-Resistance Variation vs. Temperature

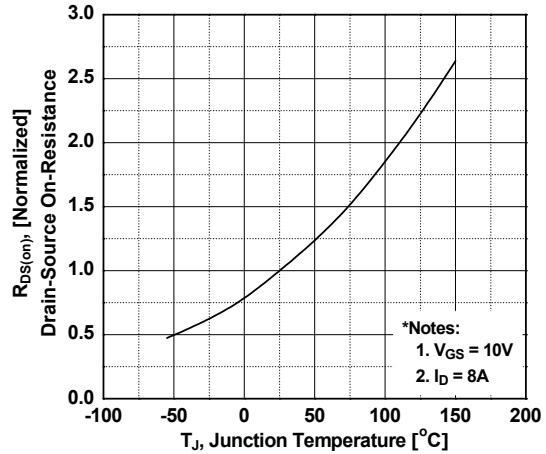


Figure 9. Maximum Safe Operating Area

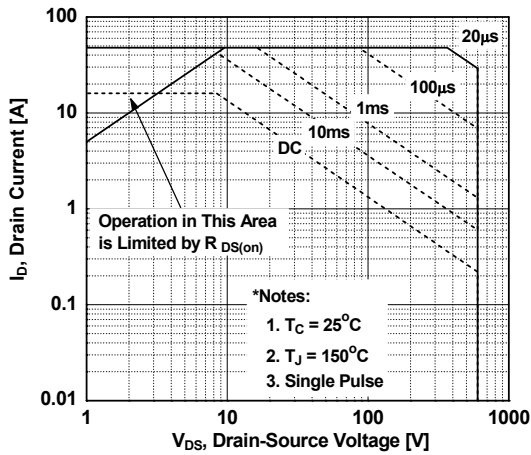


Figure 10. Maximum Drain Current vs. Case Temperature

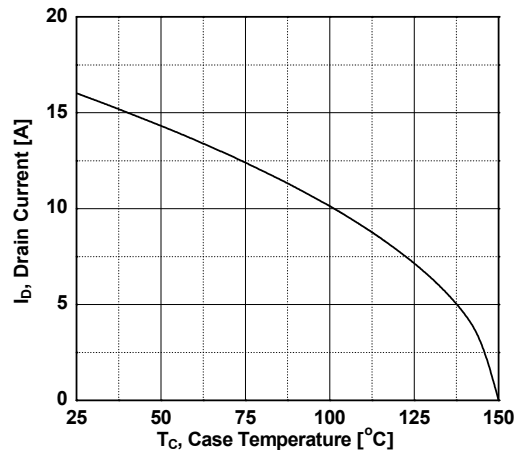
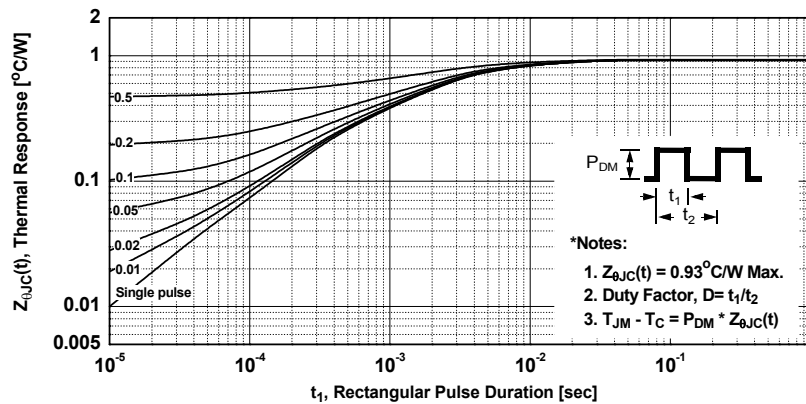


Figure 11. Transient Thermal Response Curve



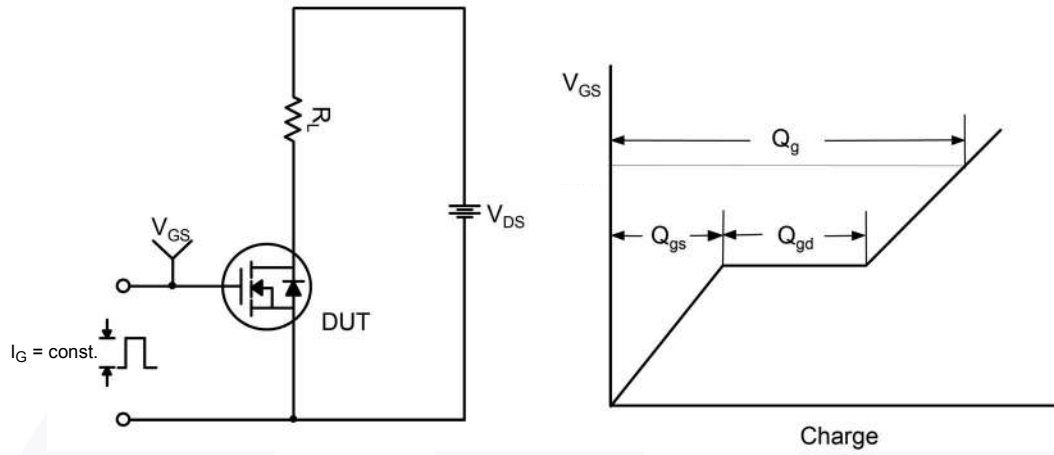


Figure 12. Gate Charge Test Circuit & Waveform

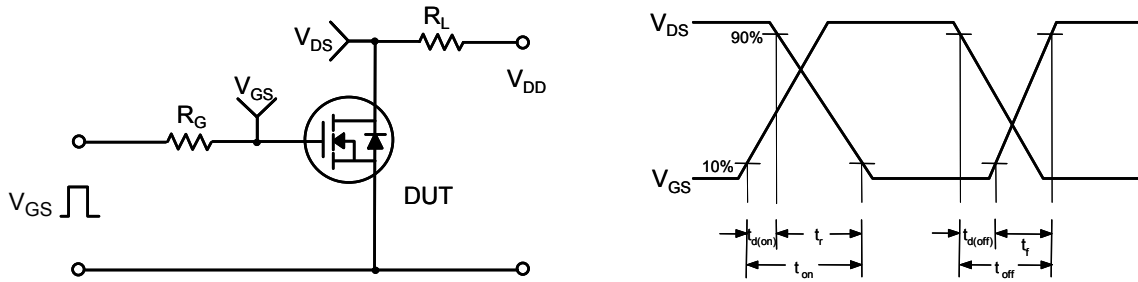


Figure 13. Resistive Switching Test Circuit & Waveforms

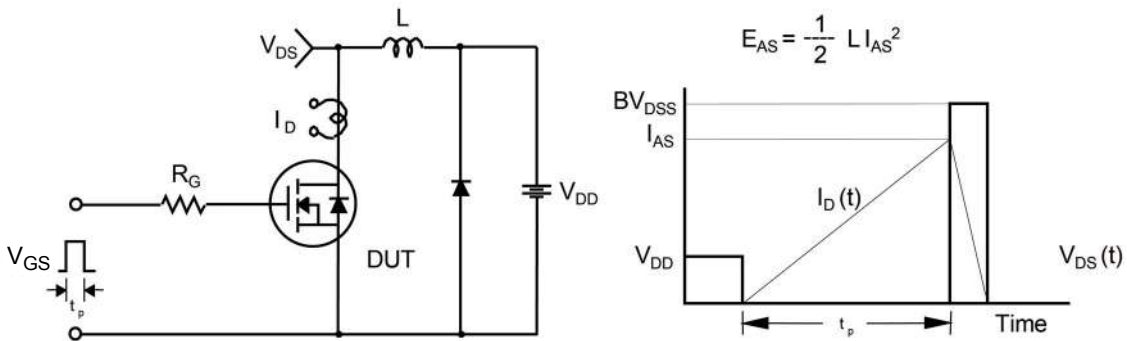


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

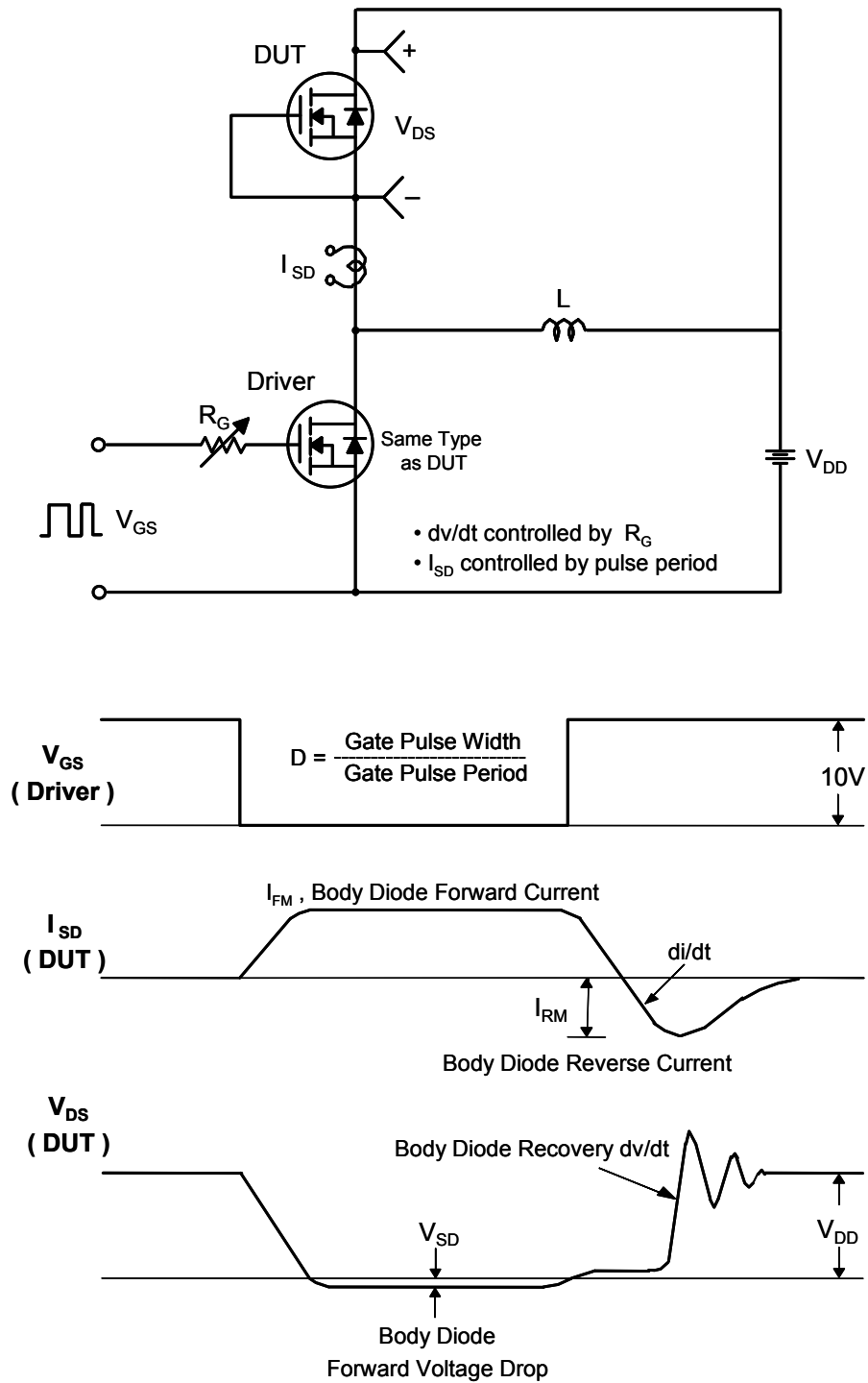
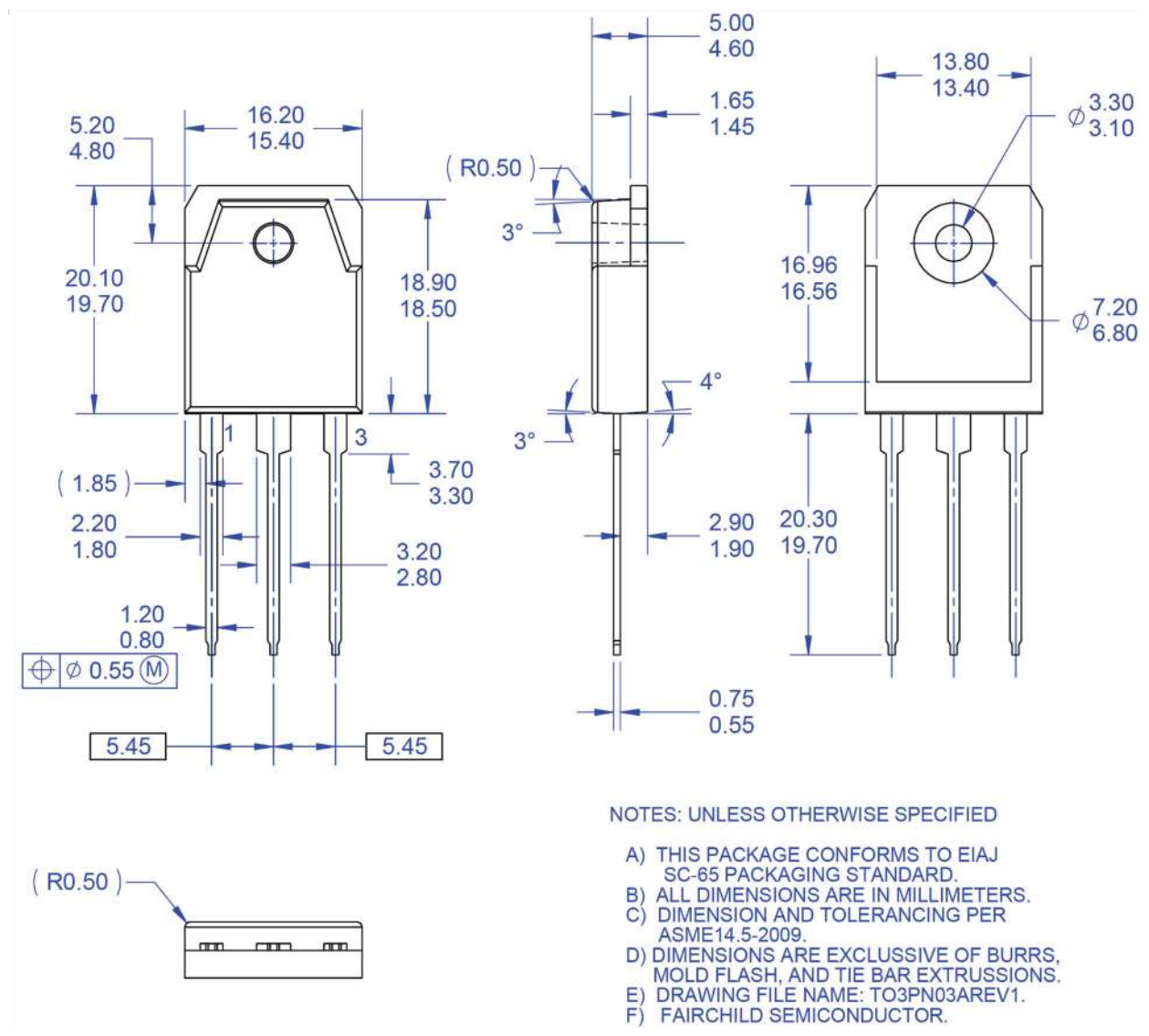


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

## Mechanical Dimensions



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

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