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December 2015

# FCP290N80

## N-Channel SuperFET<sup>®</sup> II MOSFET

800 V, 17 A, 0.29  $\Omega$



### Features

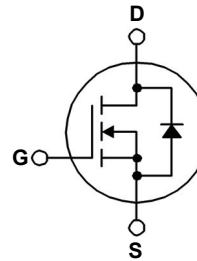
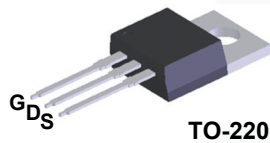
- Typ.  $R_{DS(on)} = 0.245 \Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 58 \text{ nC}$ )
- Low  $E_{OSS}$  (Typ.  $5.6 \mu\text{J @ } 400 \text{ V}$ )
- Low Effective Output Capacitance (Typ.  $C_{OSS(eff.)} = 240 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Description

SuperFET<sup>®</sup> II MOSFET is Fairchild Semiconductor's brand-new 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 II MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.

### Applications

- AC-DC Power Supply
- LED Lighting



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

| Symbol         | Parameter  |  | FCP290N80   | Unit                |
|----------------|--|--|-------------|---------------------|
| $V_{DSS}$      | Drain to Source Voltage  |  | 800         | V                   |
| $V_{GSS}$      | Gate to Source Voltage   | - DC                                       | $\pm 20$    | V                   |
|                |  | - AC ( $f > 1 \text{ Hz}$ )                | $\pm 30$    |                     |
| $I_D$          | Drain Current  | - Continuous ( $T_C = 25^\circ\text{C}$ )  | 17          | A                   |
|                |  | - Continuous ( $T_C = 100^\circ\text{C}$ ) | 10.8        |                     |
| $I_{DM}$       | Drain Current  | - Pulsed (Note 1)                          | 42          | A                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy                                       | (Note 2)                                   | 882         | mJ                  |
| $I_{AR}$       | Avalanche Current  | (Note 1)                                   | 3.4         | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy  | (Note 1)                                   | 2.12        | mJ                  |
| $dv/dt$        | MOSFET $dv/dt$   |  | 100         | V/ns                |
|                | Peak Diode Recovery $dv/dt$  | (Note 3)                                   | 20          |                     |
| $P_D$          | Power Dissipation  | ( $T_C = 25^\circ\text{C}$ )               | 212         | W                   |
|                |  | - Derate Above $25^\circ\text{C}$          | 1.7         | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | 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                                     | FCP290N80 | Unit               |
|-----------------|---|-----------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max.    | 0.59      | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5      |                    |

## Package Marking and Ordering Information

| Part Number | Top Mark  | Package | Packing Method | Reel Size | Tape Width | Quantity |
|-------------|-----------|---------|----------------|-----------|------------|----------|
| FCP290N80   | FCP290N80 | TO-220  | Tube           | N/A       | N/A        | 50 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         | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$                                 | 800 | -   | -         | V                  |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$   | -   | 0.8 | -         | $V/^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}$<br>$V_{DS} = 640\text{ V}, T_C = 125^\circ\text{C}$ | -   | -   | 25<br>250 | $\mu\text{A}$      |
| $I_{GSS}$                      | Gate to Body Leakage Current              | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$  | -   | -   | $\pm 100$ | nA                 |

### On Characteristics

|              |                                      |  |     |       |       |          |
|--------------|--------------------------------------|--|-----|-------|-------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage               | $V_{GS} = V_{DS}, I_D = 1.7\text{ mA}$     | 2.5 | -     | 4.5   | V        |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}, I_D = 8.5\text{ A}$ | -   | 0.245 | 0.290 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 20\text{ V}, I_D = 8.5\text{ A}$ | -   | 20    | -     | S        |

### Dynamic Characteristics

|                 |                               |   |          |      |      |          |
|-----------------|-------------------------------|---|----------|------|------|----------|
| $C_{iss}$       | Input Capacitance             | $V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$   | -        | 2410 | 3205 | pF       |
| $C_{oss}$       | Output Capacitance            |   | -        | 75   | 100  | pF       |
| $C_{rss}$       | Reverse Transfer Capacitance  |   | -        | 0.36 | -    | pF       |
| $C_{oss}$       | Output Capacitance            | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$        | -        | 35   | -    | pF       |
| $C_{oss(eff.)}$ | Effective Output Capacitance  | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$           | -        | 240  | -    | pF       |
| $Q_{g(tot)}$    | Total Gate Charge at 10V      | $V_{DS} = 640\text{ V}, I_D = 17\text{ A},$<br>$V_{GS} = 10\text{ V}$ | -        | 58   | 75   | nC       |
| $Q_{gs}$        | Gate to Source Gate Charge    |   | -        | 11   | -    | nC       |
| $Q_{gd}$        | Gate to Drain "Miller" Charge |   | (Note 4) | -    | 22   | -        |
| ESR             | Equivalent Series Resistance  | $f = 1\text{ MHz}$  | -        | 0.75 | -    | $\Omega$ |

### Switching Characteristics

|              |                     |  |          |    |     |    |
|--------------|---------------------|--|----------|----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 400\text{ V}, I_D = 17\text{ A},$<br>$V_{GS} = 10\text{ V}, R_G = 4.7\text{ }\Omega$ | -        | 22 | 54  | ns |
| $t_r$        | Turn-On Rise Time   |  | -        | 14 | 38  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |  | -        | 61 | 132 | ns |
| $t_f$        | Turn-Off Fall Time  |  | (Note 4) | -  | 2.6 | 15 |

### Drain-Source Diode Characteristics

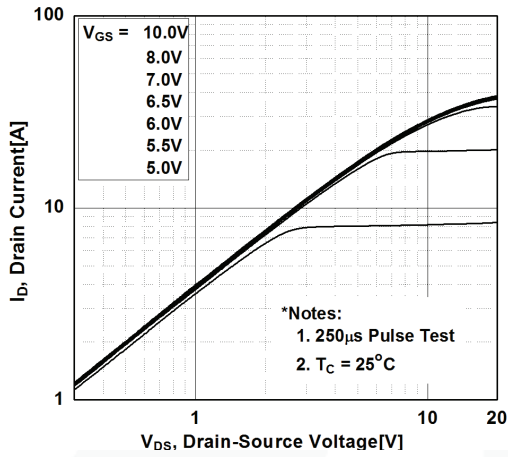
|          |  |  |   |     |     |               |
|----------|--|--|---|-----|-----|---------------|
| $I_S$    | Maximum Continuous Drain to Source Diode Forward Current | -  | - | 17  | A   |               |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current     | -  | - | 42  | A   |               |
| $V_{SD}$ | Drain to Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_{SD} = 17\text{ A}$  | - | -   | 1.2 | V             |
| $t_{rr}$ | Reverse Recovery Time                                    | $V_{GS} = 0\text{ V}, I_{SD} = 17\text{ A},$<br>$di_F/dt = 100\text{ A}/\mu\text{s}$ | - | 511 | -   | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                                  |  | - | 12  | -   | $\mu\text{C}$ |

#### Notes:

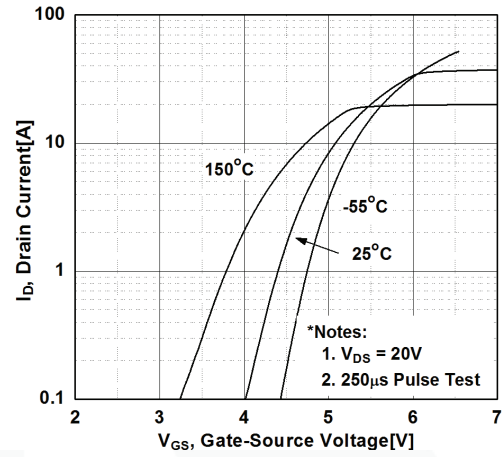
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 3.4\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 17\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

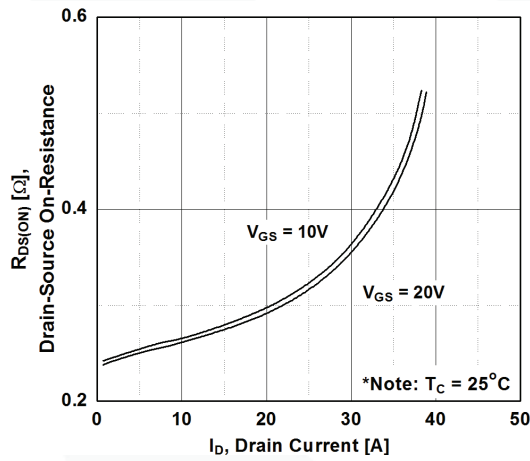
**Figure 1. On-Region Characteristics**



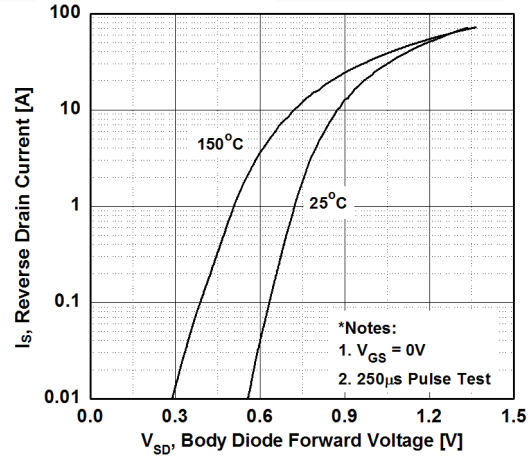
**Figure 2. Transfer Characteristics**



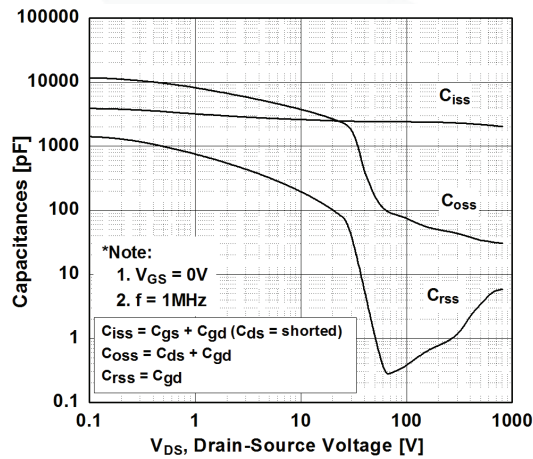
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



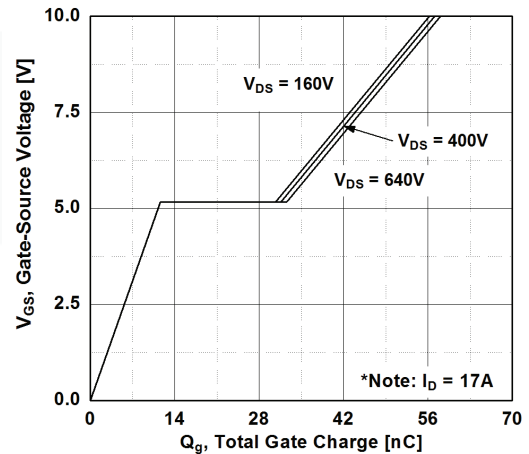
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

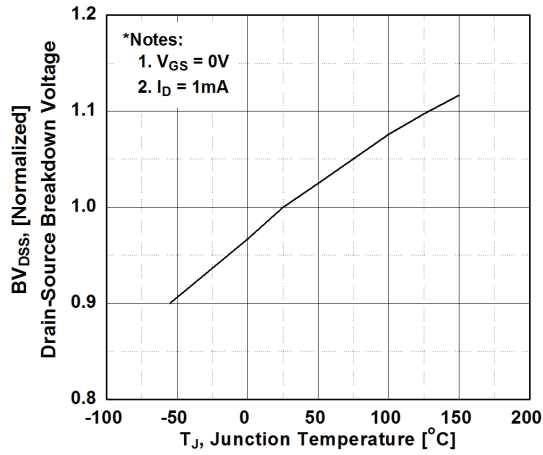


Figure 8. On-Resistance Variation vs. Temperature

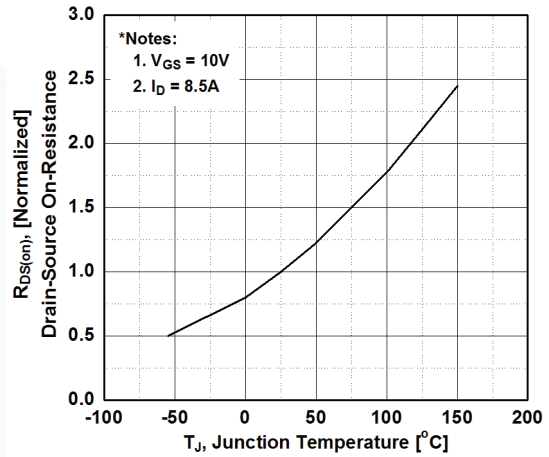


Figure 9. Maximum Safe Operating Area

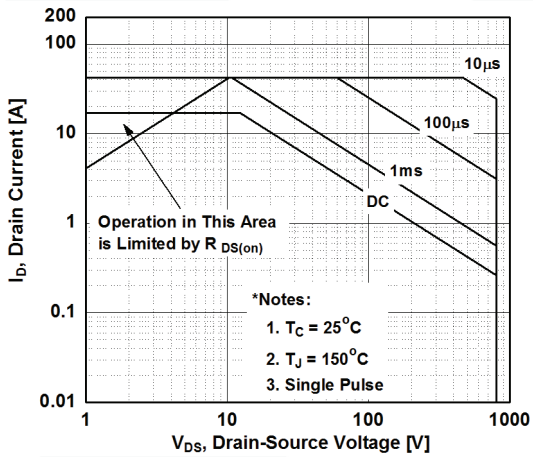


Figure 10. Maximum Drain Current vs. Case Temperature

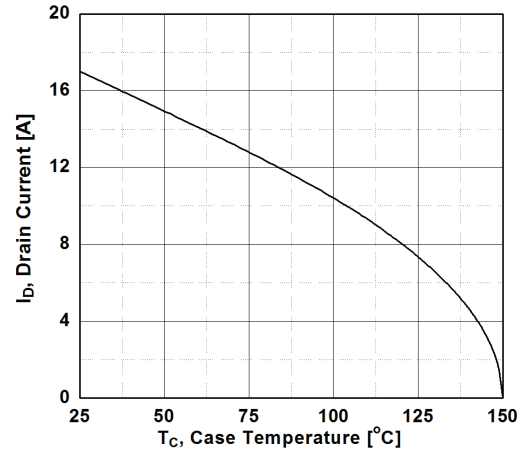
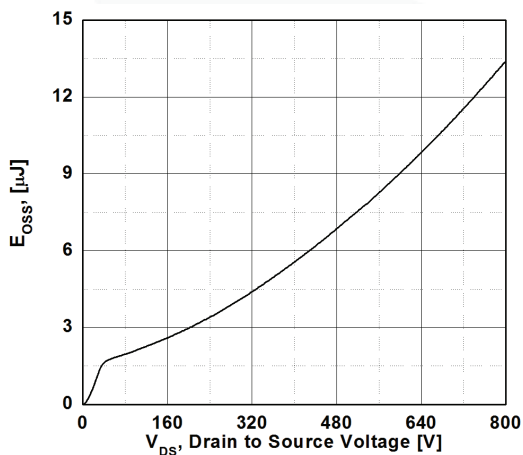
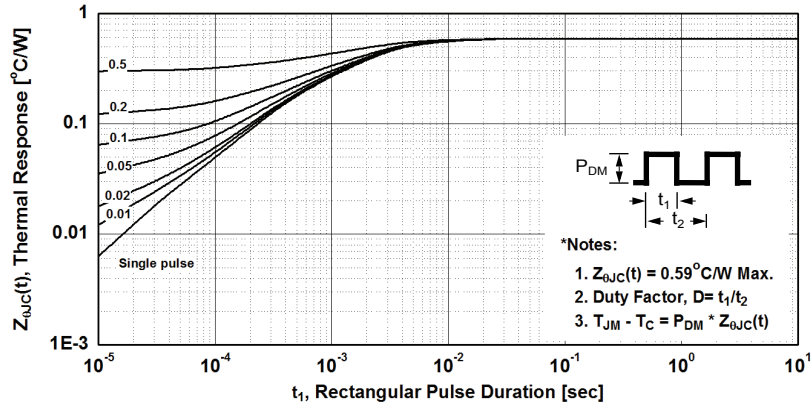


Figure 11. E\_oss vs. Drain to Source Voltage



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve



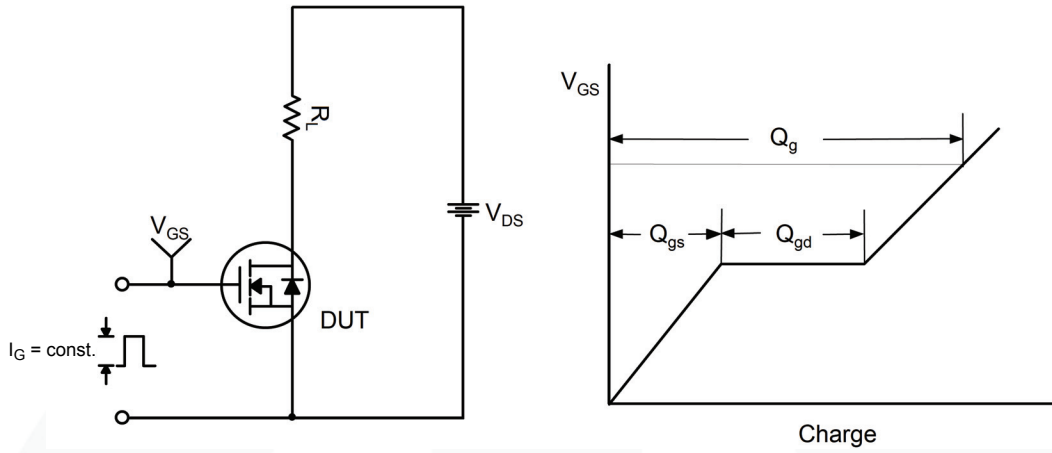


Figure 13. Gate Charge Test Circuit & Waveform

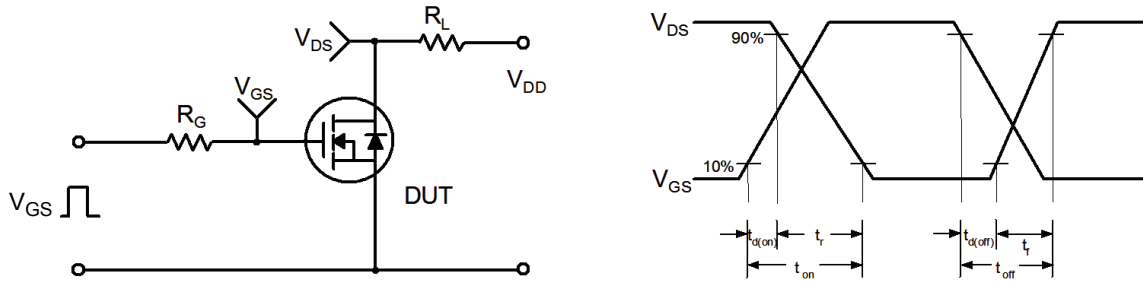


Figure 14. Resistive Switching Test Circuit & Waveforms

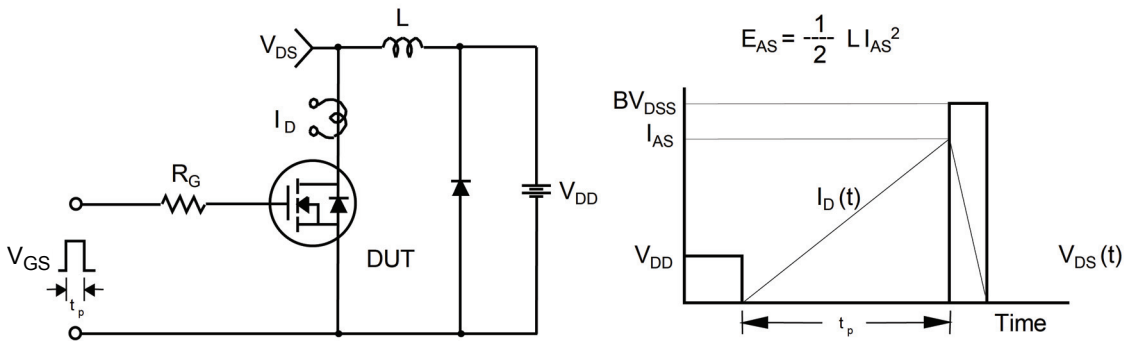


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

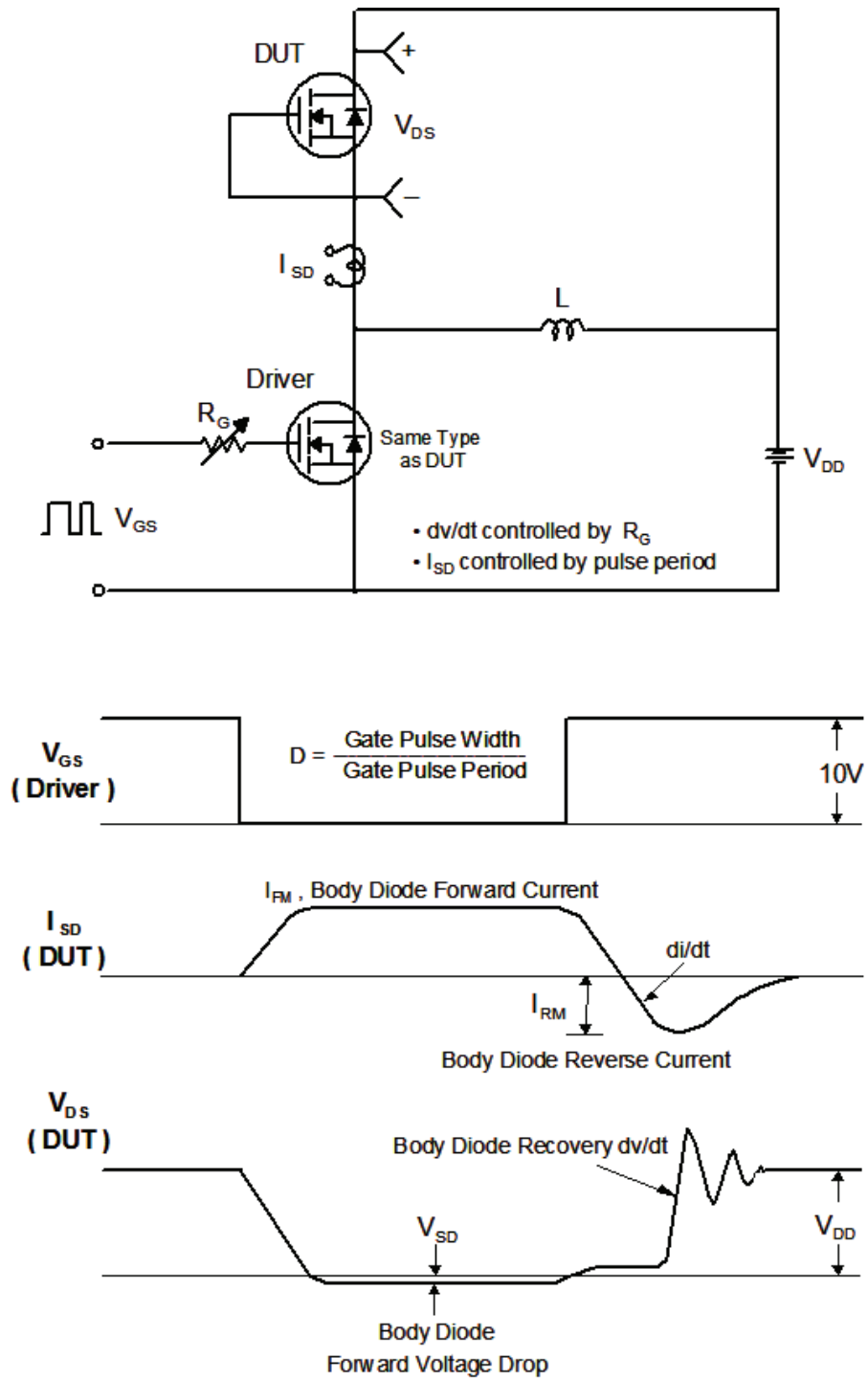


Figure 16. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms





- NOTES:
- A) REFERENCE JEDEC, TO-220, VARIATION AB
  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
  - D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
  - E) DOES NOT COMPLY JEDEC STANDARD VALUE.
  - F) "A1" DIMENSIONS AS BELOW:  
 SINGLE GAUGE = 0.51 - 0.61  
 DUAL GAUGE = 1.10 - 1.45
  - G) DRAWING FILE NAME: TO220B03REV9
  - H) PRESENCE IS SUPPLIER DEPENDENT
  - I) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

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