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# FCP067N65S3

## N-Channel SuperFET® III MOSFET

### 650 V, 44 A, 67 mΩ

#### Features

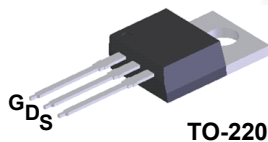
- 700 V @  $T_J = 150\text{ }^\circ\text{C}$
- Typ.  $R_{DS(on)} = 59\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 78\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 715\text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

#### Applications

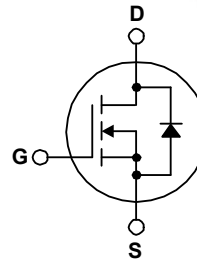
- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar

#### Description

SuperFET® III MOSFET is ON 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 advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate. Consequently, SuperFET III MOSFET is very suitable for various power system for miniaturization and higher efficiency.



TO-220



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

| Symbol         | Parameter  | FCP067N65S3                                | Unit             |
|----------------|--|--|------------------|
| $V_{DSS}$      | Drain to Source Voltage  | 650  | V                |
| $V_{GSS}$      | Gate to Source Voltage   | - DC                                       | $\pm 30$         |
|                |  | - AC ( $f > 1\text{ Hz}$ )                 | $\pm 30$         |
| $I_D$          | Drain Current  | - Continuous ( $T_C = 25^\circ\text{C}$ )  | 44               |
|                |  | - Continuous ( $T_C = 100^\circ\text{C}$ ) | 28               |
| $I_{DM}$       | Drain Current  | - Pulsed (Note 1)                          | 110              |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                              | 214  | mJ               |
| $I_{AS}$       | Avalanche Current (Note 1)   | 4.8  | A                |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                 | 3.12                                       | mJ               |
| dv/dt          | MOSFET dv/dt   | 100  | V/ns             |
|                | Peak Diode Recovery dv/dt (Note 3)                                   | 20   |                  |
| $P_D$          | Power Dissipation  | ( $T_C = 25^\circ\text{C}$ )               | 312              |
|                |  | - Derate Above $25^\circ\text{C}$          | 2.5              |
| $T_J, T_{STG}$ | 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                                     | FCP067N65S3 | Unit               |
|-----------------|---|-------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max.    | 0.4         | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | 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 |
|-------------|-------------|---------|----------------|-----------|------------|----------|
| FCP067N65S3 | FCP067N65S3 | 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         | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$  | 650 | -    | -         | V                         |
|                                |   | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$ | 700 | -    | -         | V                         |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$            | -   | 0.72 | -         | $\text{V}/^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$                      | -   | -    | 1         | $\mu\text{A}$             |
|                                |   | $V_{DS} = 520\text{ V}, T_C = 125^\circ\text{C}$                  | -   | 2.2  | -         |                           |
| $I_{GSS}$                      | 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               | $V_{GS} = V_{DS}, I_D = 4.4\text{ mA}$    | 2.5 | -  | 4.5 | V                |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}, I_D = 22\text{ A}$ | -   | 59 | 67  | $\text{m}\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 20\text{ V}, I_D = 22\text{ A}$ | -   | 29 | -   | S                |

### Dynamic Characteristics

|                 |                                   |   |          |      |    |          |
|-----------------|-----------------------------------|---|----------|------|----|----------|
| $C_{iss}$       | Input Capacitance                 | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$   | -        | 3090 | -  | pF       |
| $C_{oss}$       | Output Capacitance                |   | -        | 68   | -  | pF       |
| $C_{oss(eff.)}$ | Effective Output Capacitance      | $V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$           | -        | 715  | -  | pF       |
| $C_{oss(er.)}$  | Energy Related Output Capacitance | $V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$           | -        | 104  | -  | pF       |
| $Q_{g(tot)}$    | Total Gate Charge at 10V          | $V_{DS} = 400\text{ V}, I_D = 22\text{ A},$<br>$V_{GS} = 10\text{ V}$ | -        | 78   | -  | nC       |
| $Q_{gs}$        | Gate to Source Gate Charge        |   | -        | 18   | -  | nC       |
| $Q_{gd}$        | Gate to Drain "Miller" Charge     |   | (Note 4) | -    | 30 | -        |
| ESR             | Equivalent Series Resistance      | $f = 1\text{ MHz}$  | -        | 0.6  | -  | $\Omega$ |

### Switching Characteristics

|              |                     |  |          |    |    |    |
|--------------|---------------------|--|----------|----|----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 400\text{ V}, I_D = 22\text{ A},$<br>$V_{GS} = 10\text{ V}, R_G = 4.7\ \Omega$ | -        | 26 | -  | ns |
| $t_r$        | Turn-On Rise Time   |  | -        | 52 | -  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |  | -        | 89 | -  | ns |
| $t_f$        | Turn-Off Fall Time  |  | (Note 4) | -  | 16 | -  |

### Source-Drain Diode Characteristics

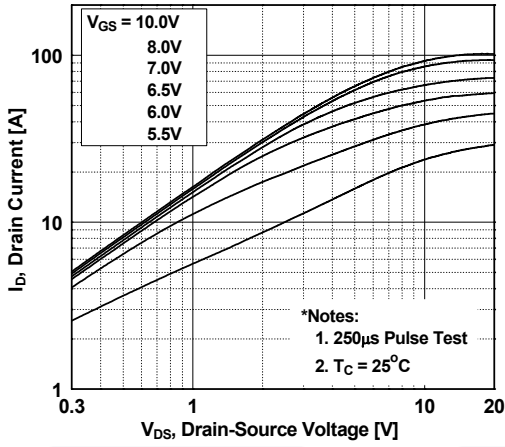
|          |  |  |   |     |     |               |
|----------|--|--|---|-----|-----|---------------|
| $I_S$    | Maximum Continuous Drain to Source Diode Forward Current | -  | - | 44  | A   |               |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current     | -  | - | 110 | A   |               |
| $V_{SD}$ | Drain to Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_{SD} = 22\text{ A}$  | - | -   | 1.2 | V             |
| $t_{rr}$ | Reverse Recovery Time                                    | $V_{GS} = 0\text{ V}, I_{SD} = 22\text{ A},$<br>$di_F/dt = 100\text{ A}/\mu\text{s}$ | - | 435 | -   | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                                  |  | - | 9.2 | -   | $\mu\text{C}$ |

#### Notes:

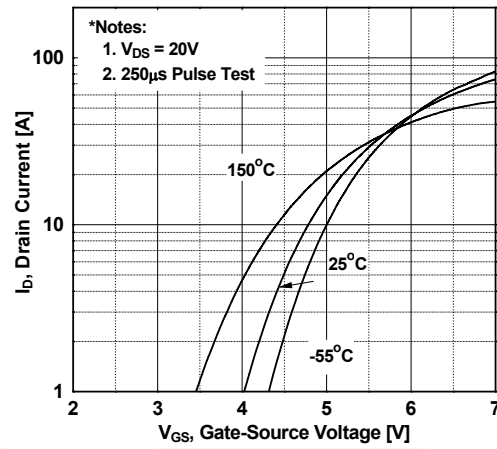
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 4.8\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 22\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 380\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

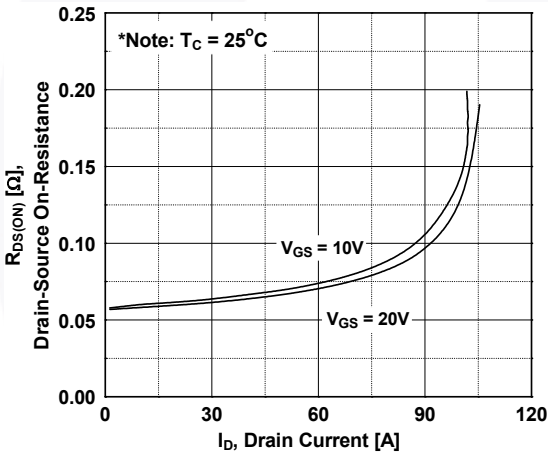
**Figure 1. On-Region Characteristics**



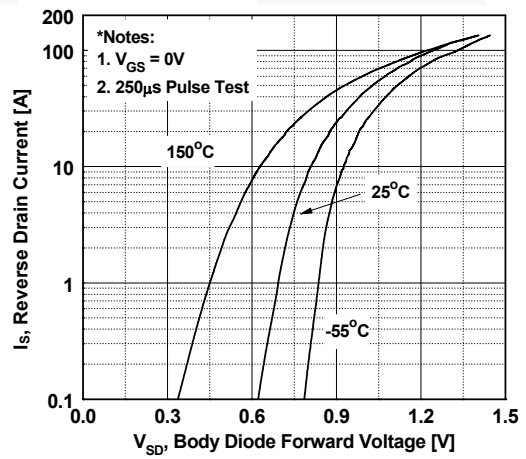
**Figure 2. Transfer Characteristics**



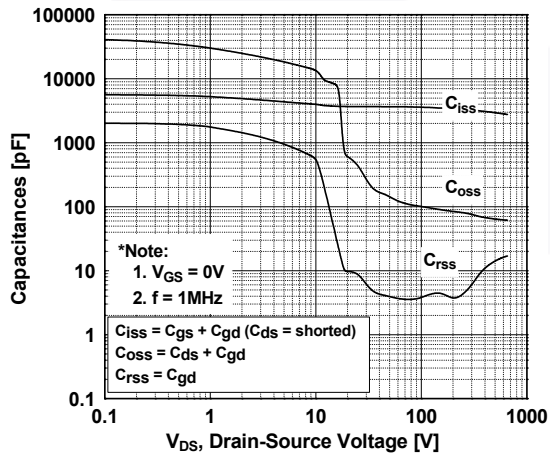
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



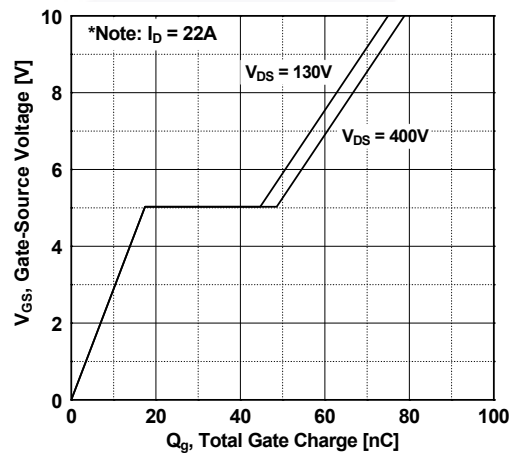
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

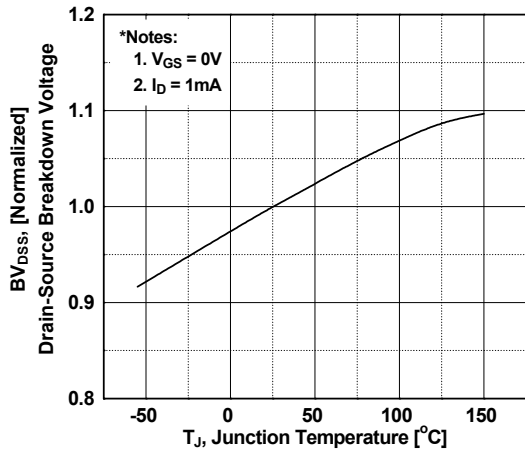


Figure 8. On-Resistance Variation vs. Temperature

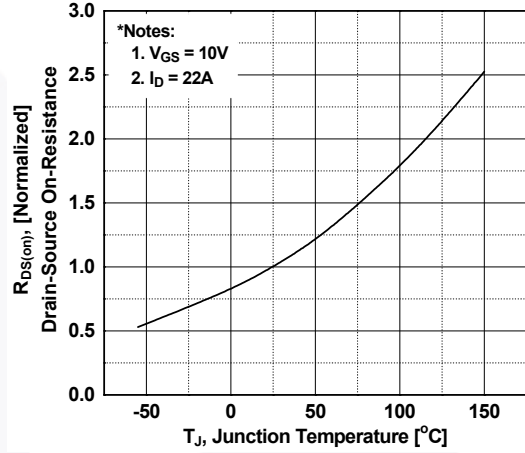


Figure 9. Maximum Safe Operating Area

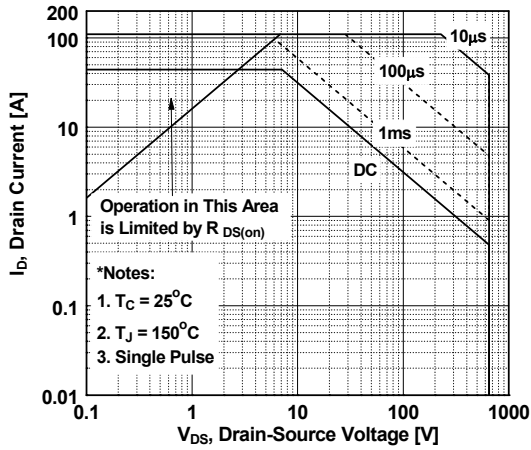


Figure 10. Maximum Drain Current vs. Case Temperature

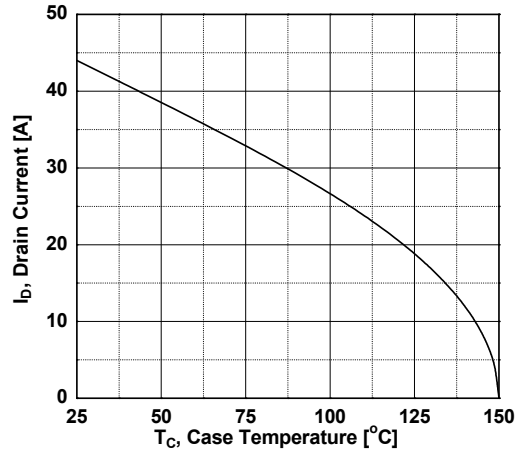
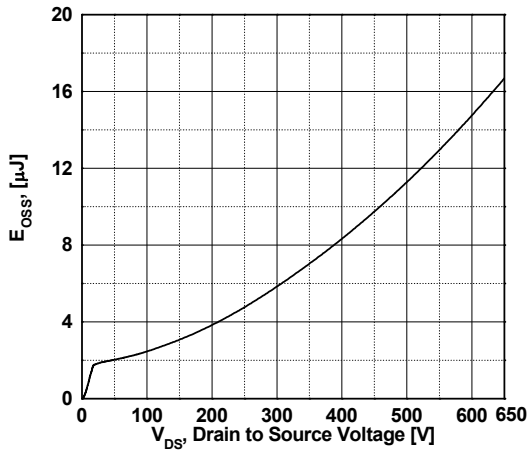
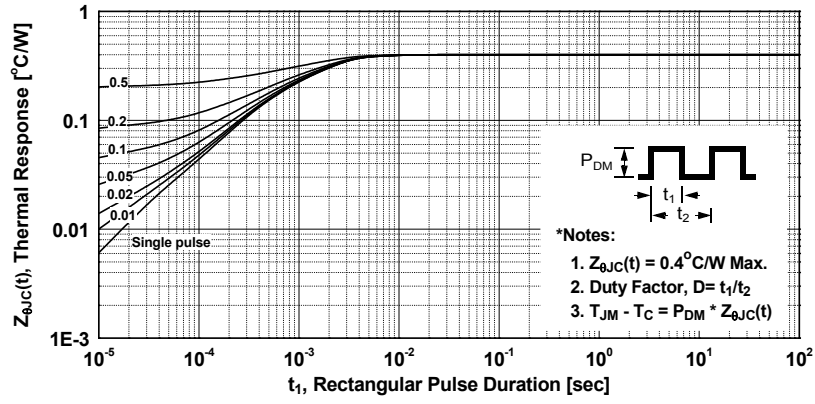


Figure 11. E\_oss vs. Drain to Source Voltage



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve



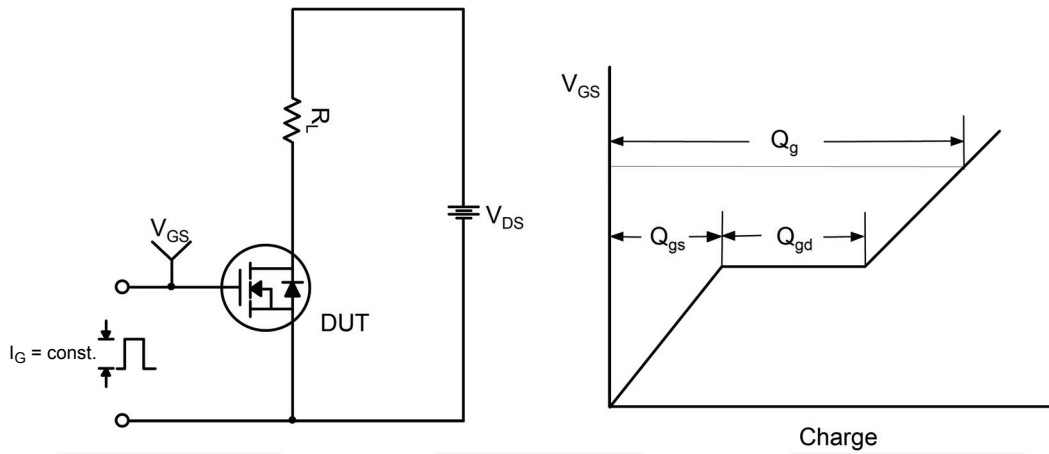


Figure 13. Gate Charge Test Circuit & Waveform

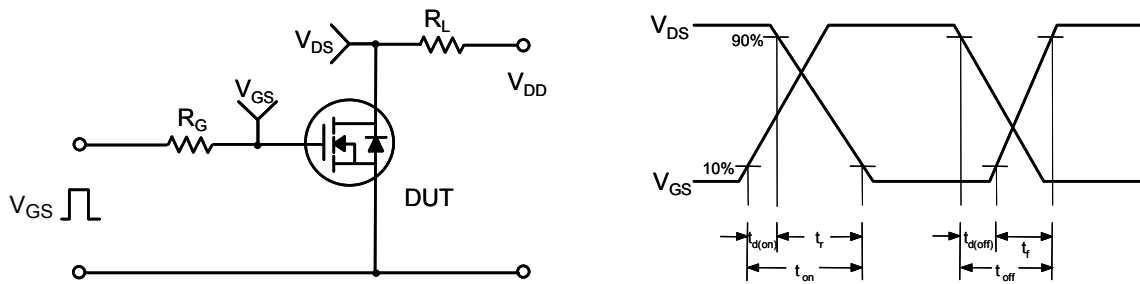


Figure 14. Resistive Switching Test Circuit & Waveforms

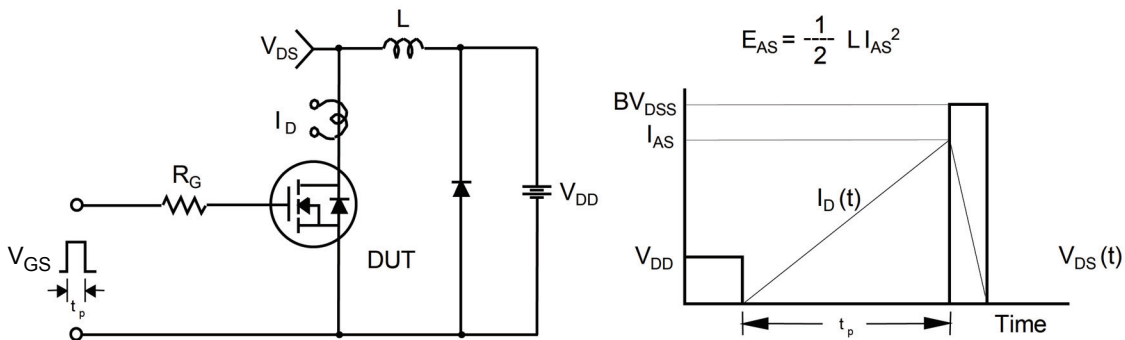


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

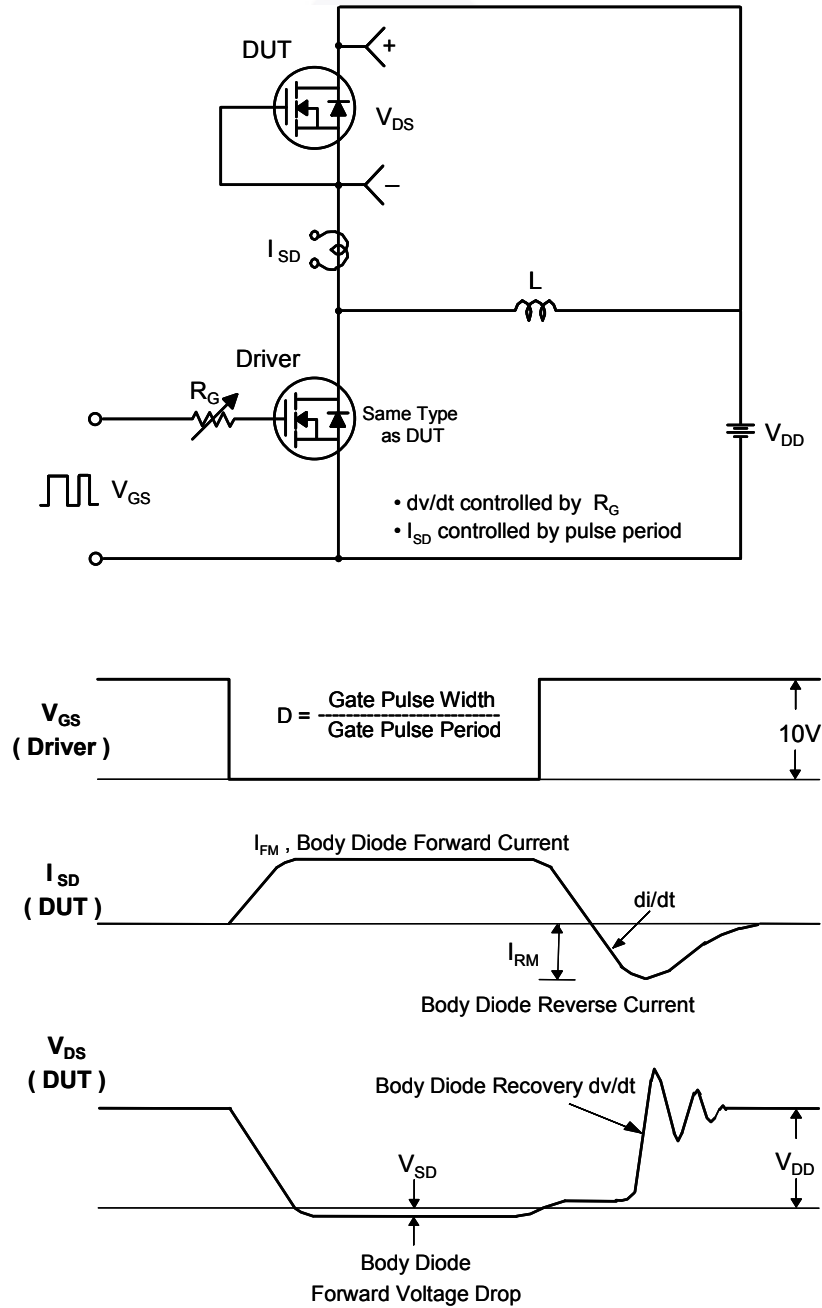


Figure 16. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms





- 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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