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# FCP11N60N / FCPF11N60NT

## N-Channel SupreMOS® MOSFET

600 V, 10.8 A, 299 mΩ

### Features

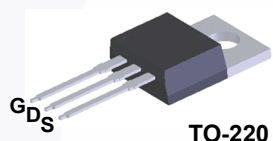
- $R_{DS(on)} = 255 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 5.4 \text{ A}$
- Ultra Low Gate Charge (Typ.  $Q_g = 27.4 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 130 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Application

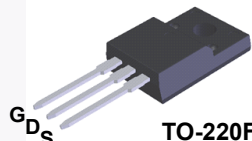
- LCD/LED/PDP TV
- Lighting
- Solar Inverter
- AC-DC Power Supply

### Description

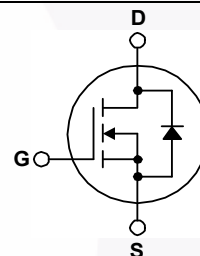
The SupreMOS® MOSFET is Fairchild Semiconductor's next generation of high voltage super-junction (SJ) technology employing a deep trench filling process that differentiates it from the conventional SJ MOSFETs. This advanced technology and precise process control provides lowest  $R_{sp}$  on-resistance, 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.



TO-220



TO-220F



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

| Symbol         | Parameter                                                            | FCP11N60N                                  | FCPF11N60NT | Unit             |
|----------------|----------------------------------------------------------------------|--------------------------------------------|-------------|------------------|
| $V_{DSS}$      | Drain to Source Voltage                                              | 600                                        |             | V                |
| $V_{GSS}$      | Gate to Source Voltage                                               | ±30                                        |             | V                |
| $I_D$          | Drain Current                                                        | - Continuous ( $T_C = 25^\circ\text{C}$ )  | 10.8        | 10.8*            |
|                |                                                                      | - Continuous ( $T_C = 100^\circ\text{C}$ ) | 6.8         | 6.8*             |
| $I_{DM}$       | Drain Current                                                        | - Pulsed (Note 1)                          | 32.4        | 32.4*            |
| $E_{AS}$       | Single Pulsed Avalanche Energy                                       | (Note 2)                                   | 201.7       | mJ               |
| $I_{AR}$       | Avalanche Current                                                    | (Note 1)                                   | 3.7         | A                |
| $E_{AR}$       | Repetitive Avalanche Energy                                          | (Note 1)                                   | 0.94        | mJ               |
| $dv/dt$        | MOSFET $dv/dt$                                                       |                                            | 100         | V/ns             |
|                | Peak Diode Recovery $dv/dt$                                          | (Note 3)                                   | 20          | V/ns             |
| $P_D$          | Power Dissipation                                                    | ( $T_C = 25^\circ\text{C}$ )               | 94.0        | 32.1             |
|                |                                                                      | - Derate Above $25^\circ\text{C}$          | 0.75        | 0.26             |
| $T_J, T_{STG}$ | 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         | $^\circ\text{C}$ |

\*Drain current limited by maximum junction temperature.

### Thermal Characteristics

| Symbol          | Parameter                                     | FCP11N60N | FCPF11N60NT | Unit               |
|-----------------|-----------------------------------------------|-----------|-------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max.    | 1.33      | 3.9         | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5      | 62.5        |                    |

## Package Marking and Ordering Information

| Part Number | Top Mark    | Package | Packing Method | Reel Size | Tape Width | Quantity |
|-------------|-------------|---------|----------------|-----------|------------|----------|
| FCP11N60N   | FCP11N60N   | TO-220  | Tube           | N/A       | N/A        | 50 units |
| FCPF11N60NT | FCPF11N60NT | TO-220F | 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         | $I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$ , $T_C = 25^\circ\text{C}$      | 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               | $V_{GS} = V_{DS}$ , $I_D = 250\text{ }\mu\text{A}$ | 2.0 | -     | 4.0   | V        |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}$ , $I_D = 5.4\text{ A}$      | -   | 0.255 | 0.299 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 40\text{ V}$ , $I_D = 5.4\text{ A}$      | -   | 13.5  | -     | S        |

### Dynamic Characteristics

|                 |                                    |                                                                                        |   |      |      |          |
|-----------------|------------------------------------|----------------------------------------------------------------------------------------|---|------|------|----------|
| $C_{iss}$       | Input Capacitance                  | $V_{DS} = 100\text{ V}$ , $V_{GS} = 0\text{ V}$ ,<br>$f = 1\text{ MHz}$                | - | 1130 | 1505 | pF       |
| $C_{oss}$       | Output Capacitance                 |                                                                                        | - | 45   | 60   | pF       |
| $C_{rss}$       | Reverse Transfer Capacitance       |                                                                                        | - | 3    | 5    | pF       |
| $C_{oss}$       | Output Capacitance                 | $V_{DS} = 380\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$                   | - | 25   | -    | pF       |
| $C_{oss(eff.)}$ | Effective Output Capacitance       | $V_{DS} = 0\text{ V to } 480\text{ V}$ , $V_{GS} = 0\text{ V}$                         | - | 130  | -    | pF       |
| $Q_{g(tot)}$    | Total Gate Charge at 10V           | $V_{DS} = 380\text{ V}$ , $I_D = 5.4\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$<br>(Note 4) | - | 27.4 | 35.6 | nC       |
| $Q_{gs}$        | Gate to Source Gate Charge         |                                                                                        | - | 4.9  | -    | nC       |
| $Q_{gd}$        | Gate to Drain "Miller" Charge      |                                                                                        | - | 8.8  | -    | nC       |
| ESR             | Equivalent Series Resistance (G-S) | $f = 1\text{ MHz}$                                                                     | - | 2.0  | -    | $\Omega$ |

### Switching Characteristics

|              |                     |                                                                                                                    |   |      |      |    |
|--------------|---------------------|--------------------------------------------------------------------------------------------------------------------|---|------|------|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 380\text{ V}$ , $I_D = 5.4\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_G = 4.7\text{ }\Omega$<br>(Note 4) | - | 13.6 | 37.2 | ns |
| $t_r$        | Turn-On Rise Time   |                                                                                                                    | - | 9.1  | 28.2 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                                                    | - | 42.0 | 94.0 | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                                                                    | - | 10.0 | 30.0 | ns |

### Drain-Source Diode Characteristics

|                 |                                                          |                                                 |   |      |     |    |
|-----------------|----------------------------------------------------------|-------------------------------------------------|---|------|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain to Source Diode Forward Current | -                                               | - | 10.8 | A   |    |
| I <sub>SM</sub> | Maximum Pulsed Drain to Source Diode Forward Current     | -                                               | - | 32.4 | A   |    |
| V <sub>SD</sub> | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 5.4 A  | - | -    | 1.2 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 5.4 A, | - | 268  | -   | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                                  | dI <sub>F</sub> /dt = 100 A/μs                  | - | 3.1  | -   | μC |

#### Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 3.7\text{ A}$ ,  $R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 10.8\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} = 380\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

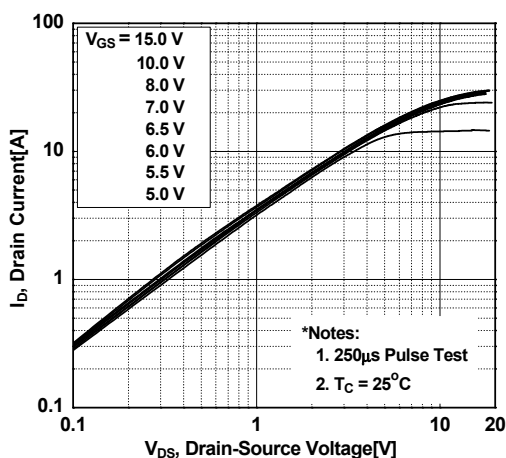


Figure 2. Transfer Characteristics

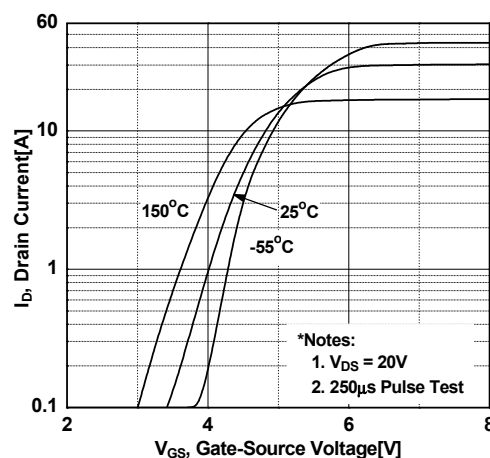


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

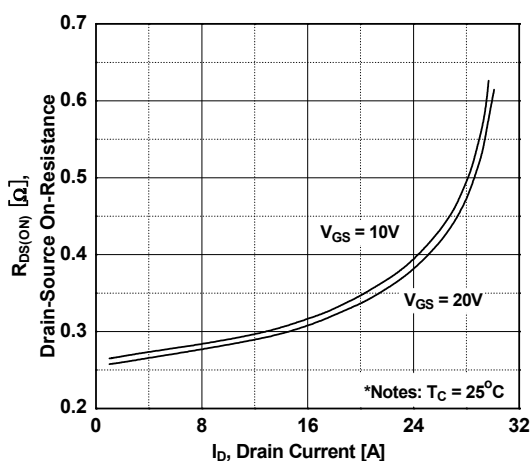


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

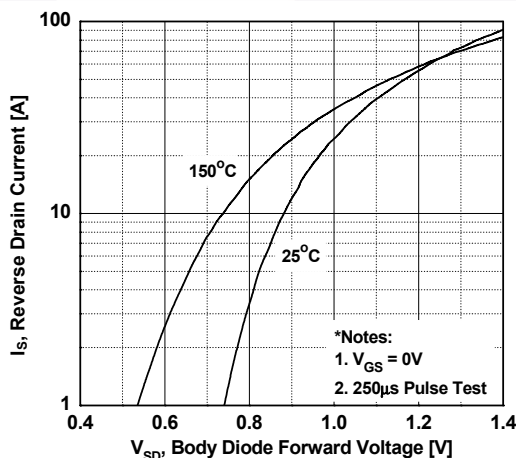


Figure 5. Capacitance Characteristics

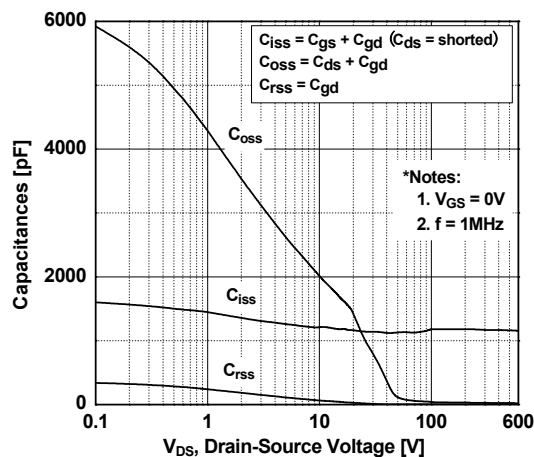
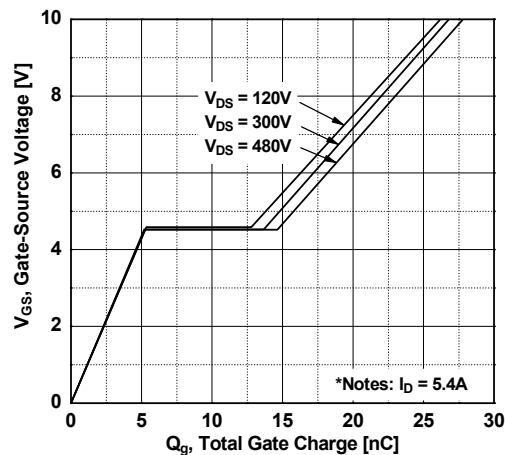
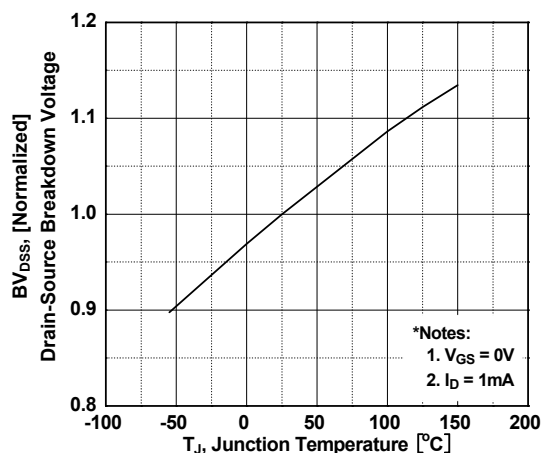


Figure 6. Gate Charge Characteristics

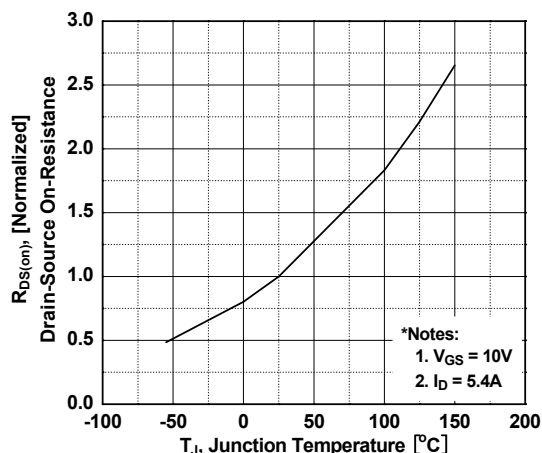


# Typical Performance Characteristics (Continued)

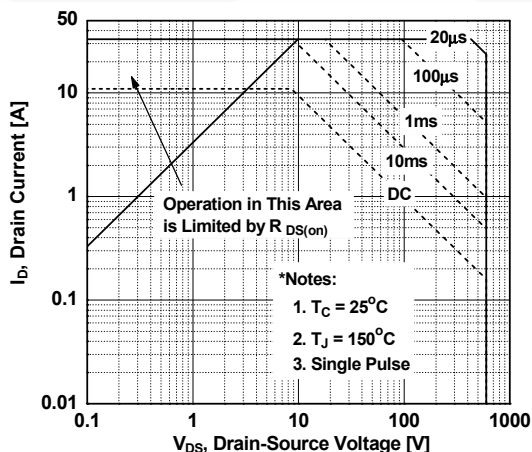
**Figure 7. Breakdown Voltage Variation vs. Temperature**



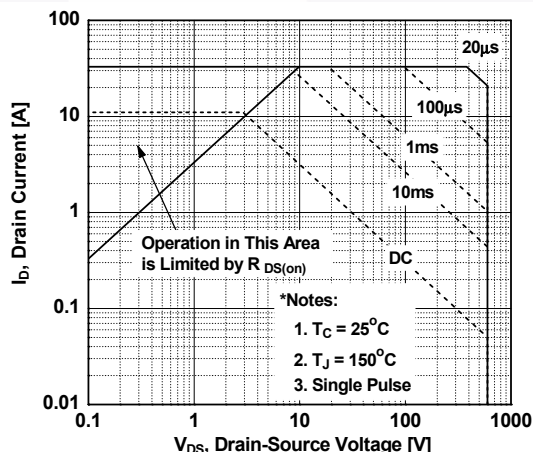
**Figure 8. On-Resistance Variation vs. Temperature**



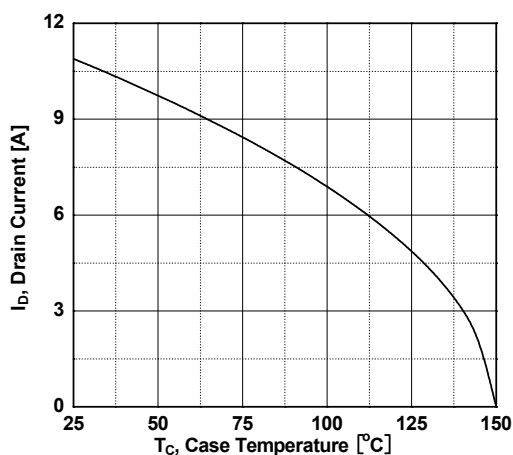
**Figure 9. Maximum Safe Operating Area for FCP11N60N**



**Figure 10. Maximum Safe Operating Area for FCPF11N60NT**



**Figure 11. Maximum Drain Current vs. Case Temperature**



# Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve for FCP11N60N

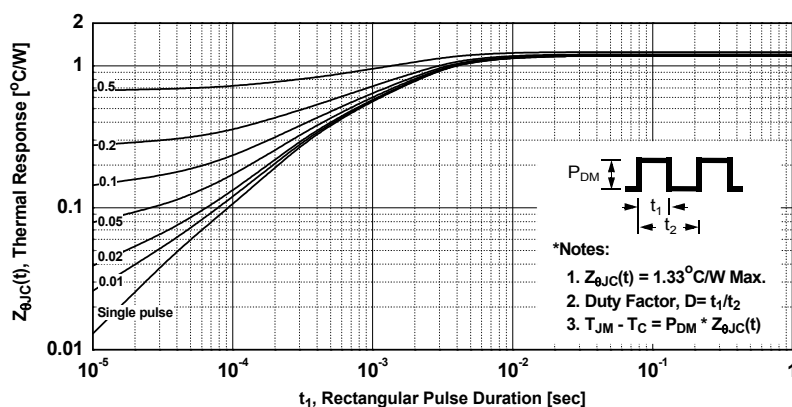
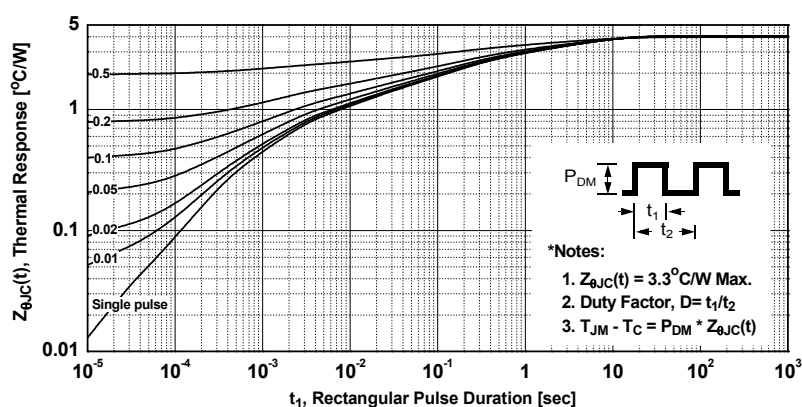


Figure 13. Transient Thermal Response Curve for FCPF11N60NT



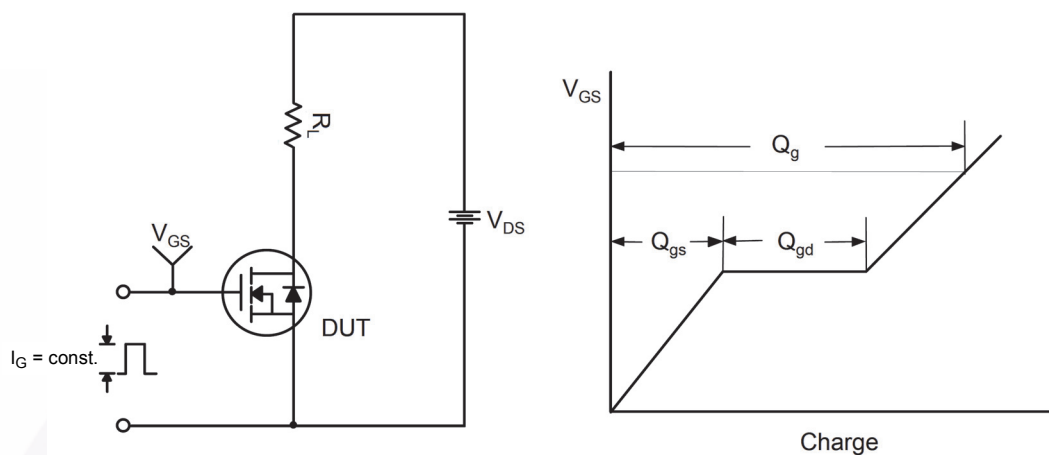


Figure 14. Gate Charge Test Circuit & Waveform

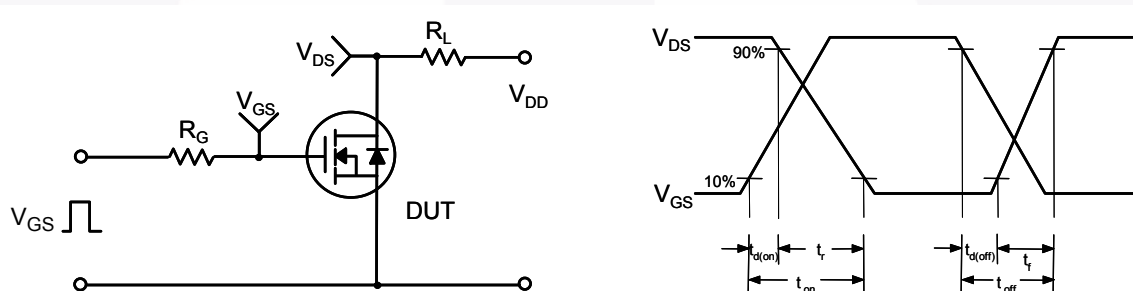


Figure 15. Resistive Switching Test Circuit & Waveforms

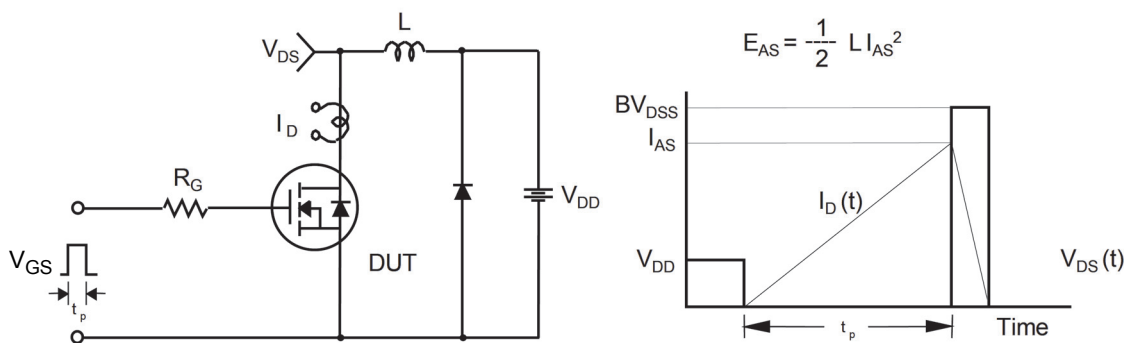


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

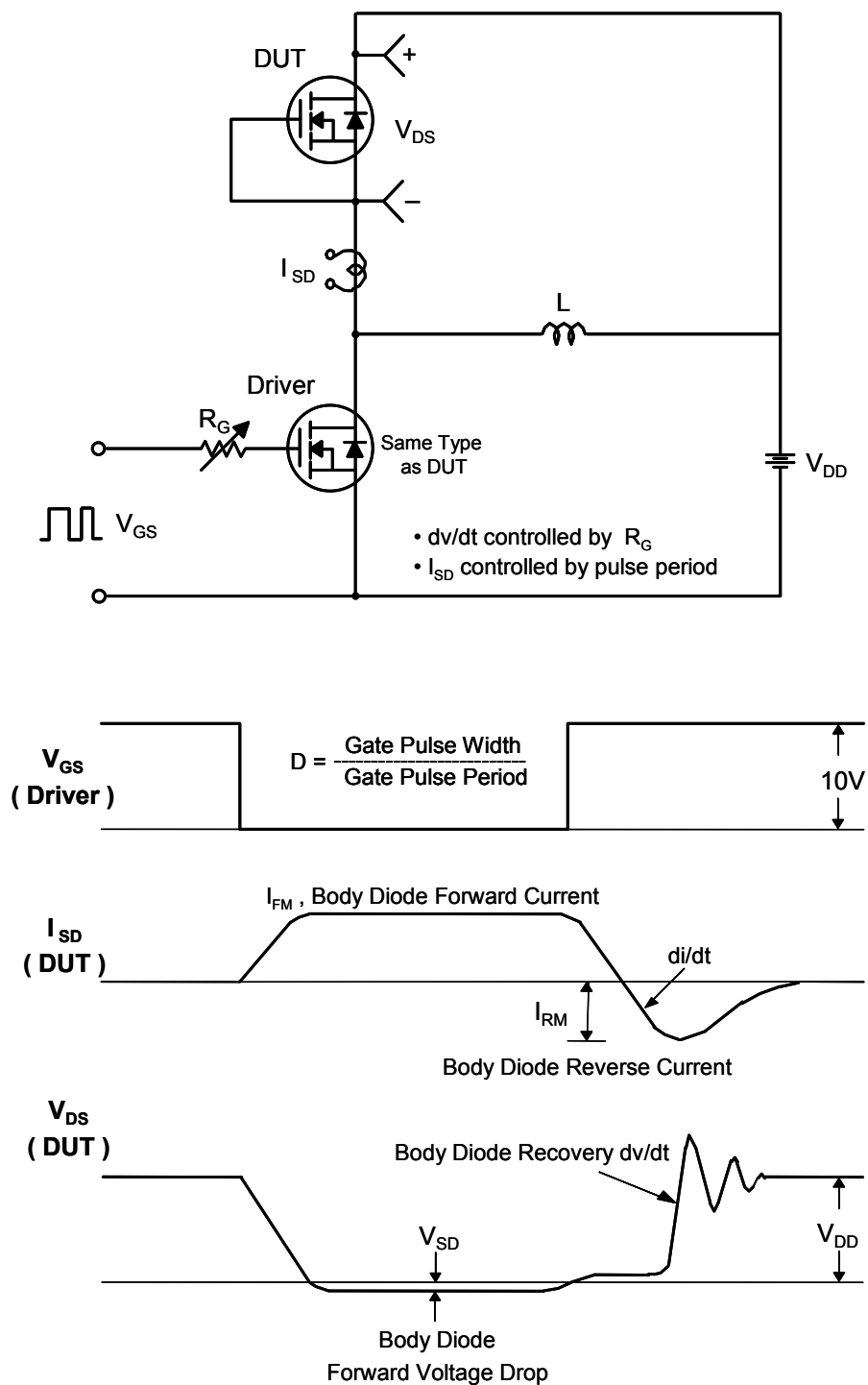


Figure 17. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms



## Mechanical Dimensions

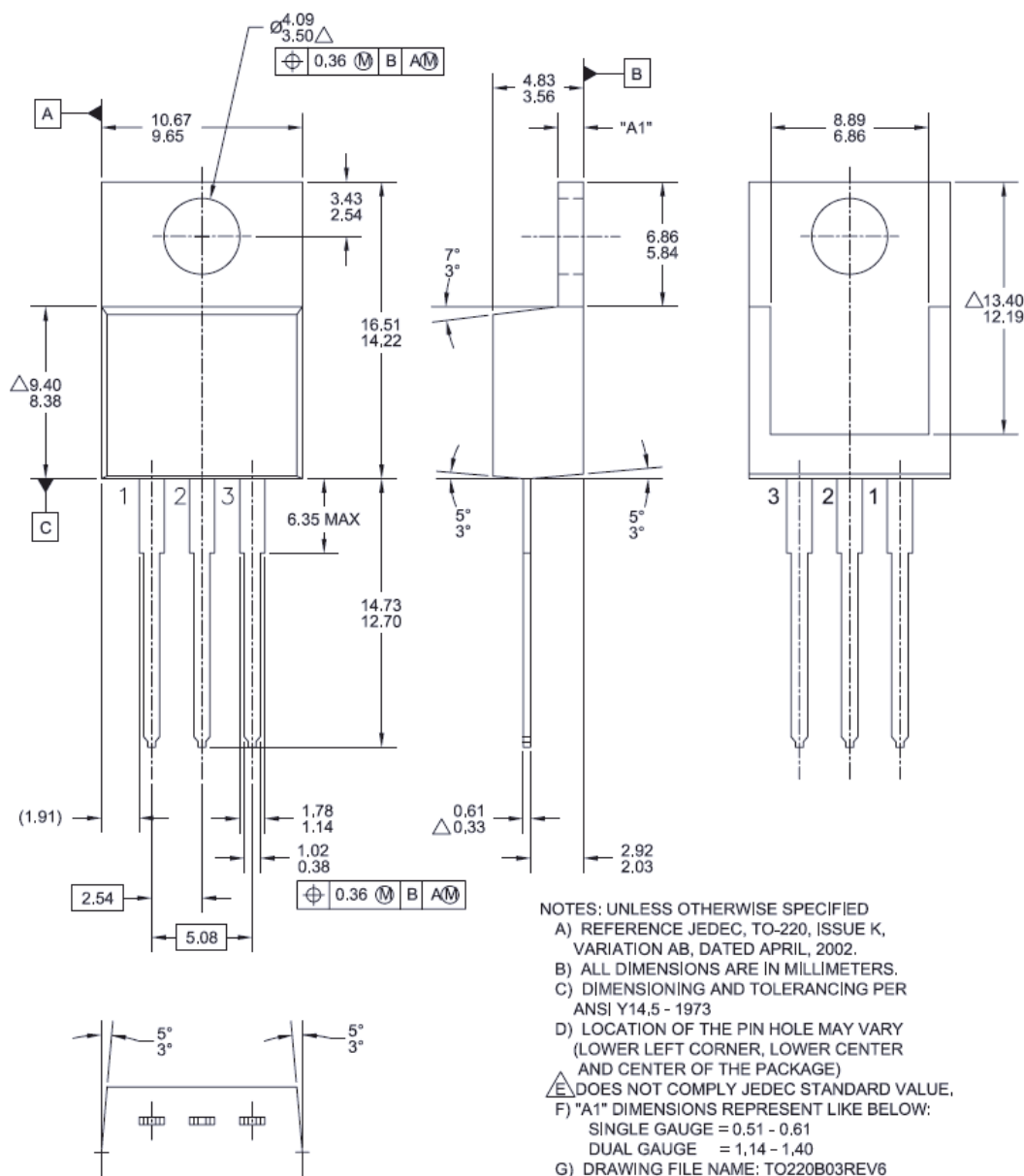


Figure 18. TO-220, Molded, 3-Lead, Jedec Variation AB

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