



# FTP23N10A

## N-Channel MOSFET

Lead Free Package and Finish

### Applications:

- Automotive
- DC Motor Control

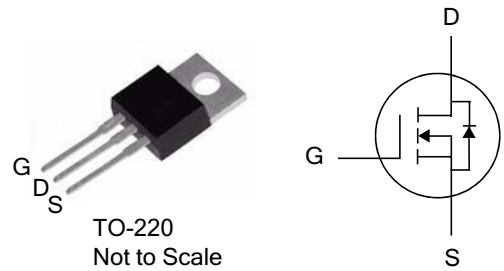
|           |                     |       |
|-----------|---------------------|-------|
| $V_{DSS}$ | $R_{DS(ON)}$ (Max.) | $I_D$ |
| 100V      | 23 m $\Omega$       | 57A   |

### Features:

- RoHS Compliant
- Low ON Resistance
- Low Gate Charge
- Peak Current vs Pulse Width Curve
- Inductive Switching Curves

### Ordering Information

| PART NUMBER | PACKAGE | BRAND     |
|-------------|---------|-----------|
| FTP23N10A   | TO-220  | FTP23N10A |



TO-220  
Not to Scale

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

| Symbol                     | Parameter  | FTP23N10A  | Units               |
|----------------------------|--|------------|---------------------|
| $V_{DSS}$                  | Drain-to-Source Voltage (NOTE *1)  | 100        | V                   |
| $I_D$                      | Continuous Drain Current   | 57         | A                   |
| $I_{D@ 100^\circ\text{C}}$ | Continuous Drain Current   | Figure 3*  |                     |
| $I_{DM}$                   | Pulsed Drain Current, $V_{GS}@ 10\text{V}$ (NOTE *2)                                   | Figure 6*  |                     |
| $P_D$                      | Power Dissipation  | 200        | W                   |
|                            | Derating Factor above $25^\circ\text{C}$   | 1.3        | W/ $^\circ\text{C}$ |
| $V_{GS}$                   | Gate-to-Source Voltage   | $\pm 20$   | V                   |
| $E_{AS}$                   | Single Pulse Avalanche Energy<br>$L=1.0\text{ mH}$ , $I_D=32\text{ Amps}$              | 512        | mJ                  |
| $I_{AS}$                   | Pulsed Avalanche Rating  | Figure 8   |                     |
| $dv/dt$                    | Peak Diode Recovery $dv/dt$ (NOTE *3)  | 5.0        | V/ns                |
| $T_L$<br>$T_{PKG}$         | Maximum Temperature for Soldering<br>Leads at 0.063in (1.6mm) from Case for 10 seconds | 300        | $^\circ\text{C}$    |
|                            | Package Body for 10 seconds  | 260        |                     |
| $T_J$ and $T_{STG}$        | Operating Junction and Storage Temperature Range                                       | -55 to 175 | $^\circ\text{C}$    |

\*Drain Current limited by Maximum Package Current Rating, 75 Amps

**Caution:** Stresses greater than those listed in the "Absolute Maximum Ratings" Table may cause permanent damage to the device.

### Thermal Resistance

| Symbol          | Parameter           | Min. | Typ. | Max. | Units                     | Test Conditions   |
|-----------------|---------------------|------|------|------|---------------------------|---|
| $R_{\theta JC}$ | Junction-to-Case    | --   | --   | 0.75 | $^\circ\text{C}/\text{W}$ | Water cooled heatsink, $P_D$ adjusted for a peak junction temperature of $+175^\circ\text{C}$ . |
| $R_{\theta JA}$ | Junction-to-Ambient | --   | --   | 65   |                           | 1 cubic foot chamber, free air.   |

**OFF Characteristics**  $T_J=25^\circ\text{C}$  unless otherwise specified

| Symbol                       | Parameter   | Min. | Typ. | Max. | Units               | Test Conditions                                     |
|------------------------------|---|------|------|------|---------------------|---|
| $BV_{DSS}$                   | Drain-to-Source Breakdown Voltage                     | 100  | --   | --   | V                   | $V_{GS}=0V, I_D=250\mu A$                           |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient, Figure 11. | --   | 0.11 | --   | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ ,<br>$I_D=250\mu A$ |
| $I_{DSS}$                    | Drain-to-Source Leakage Current                       | --   | --   | 25   | $\mu A$             | $V_{DS}=100V, V_{GS}=0V$                            |
|                              |   | --   | --   | 250  |                     | $V_{DS}=80V, V_{GS}=0V$<br>$T_J=150^\circ\text{C}$  |
| $I_{GSS}$                    | Gate-to-Source Forward Leakage                        | --   | --   | 100  | nA                  | $V_{GS}=+20V$                                       |
|                              | Gate-to-Source Reverse Leakage                        | --   | --   | -100 |                     | $V_{GS}=-20V$                                       |

**ON Characteristics**  $T_J=25^\circ\text{C}$  unless otherwise specified

| Symbol       | Parameter  | Min. | Typ. | Max. | Units     | Test Conditions                    |
|--------------|--|------|------|------|-----------|------------------------------------|
| $R_{DS(ON)}$ | Static Drain-to-Source On-Resistance<br>Figure 9 and 10. | --   | --   | 23.0 | $m\Omega$ | $V_{GS}=10V, I_D=28A$<br>(NOTE *4) |
| $V_{GS(TH)}$ | Gate Threshold Voltage, Figure 12.                       | 2.0  | --   | 4.0  | V         | $V_{DS}=V_{GS}, I_D=250\mu A$      |
| gfs          | Forward Transconductance                                 | --   | 80   | --   | S         | $V_{DS}=15V, I_D=28A$<br>(NOTE *4) |

**Dynamic Characteristics** Essentially independent of operating temperature

| Symbol    | Parameter                       | Min. | Typ. | Max. | Units | Test Conditions   |
|-----------|---------------------------------|------|------|------|-------|---|
| $C_{iss}$ | Input Capacitance               | --   | 4563 | --   | pF    | $V_{GS}=0V$<br>$V_{DS}=25V$<br>$f=1.0\text{MHz}$<br>Figure 14 |
| $C_{oss}$ | Output Capacitance              | --   | 620  | --   |       |   |
| $C_{rss}$ | Reverse Transfer Capacitance    | --   | 32   | --   |       |   |
| $Q_g$     | Total Gate Charge               | --   | 114  | --   | nC    | $V_{DD}=50V$<br>$I_D=28A$<br>$V_{GS}=10V$<br>Figure 15        |
| $Q_{gs}$  | Gate-to-Source Charge           | --   | 26   | --   |       |   |
| $Q_{gd}$  | Gate-to-Drain ("Miller") Charge | --   | 24   | --   |       |   |

**Resistive Switching Characteristics** Essentially independent of operating temperature

| Symbol       | Parameter           | Min. | Typ. | Max. | Units | Test Conditions  |
|--------------|---------------------|------|------|------|-------|--|
| $t_{d(ON)}$  | Turn-on Delay Time  | --   | 15   | --   | ns    | $V_{DD}=50V$<br>$I_D=28A$<br>$V_{GS}=10V$<br>$R_G=2.5\Omega$ |
| $t_{rise}$   | Rise Time           | --   | 30   | --   |       |  |
| $t_{d(OFF)}$ | Turn-Off Delay Time | --   | 66   | --   |       |  |
| $t_{fall}$   | Fall Time           | --   | 11   | --   |       |  |

**Source-Drain Diode Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise specified

| Symbol   | Parameter                              | Min. | Typ. | Max. | Units | Test Conditions                                    |
|----------|--|------|------|------|-------|--|
| $I_S$    | Continuous Source Current (Body Diode) | --   | --   | 57   | A     | Integral pn-diode<br>in MOSFET                     |
| $I_{SM}$ | Maximum Pulsed Current (Body Diode)    | --   | --   | 230  | A     |  |
| $V_{SD}$ | Diode Forward Voltage                  | --   | --   | 1.5  | V     | $I_S=28\text{A}$ , $V_{GS}=0\text{V}$              |
| $t_{rr}$ | Reverse Recovery Time                  | --   | 140  | --   | ns    | $V_{GS}=0\text{V}$                                 |
| $Q_{rr}$ | Reverse Recovery Charge                | --   | 555  | --   | nC    | $I_F=28\text{A}$ , $di/dt=100\text{A}/\mu\text{s}$ |

**Notes:**

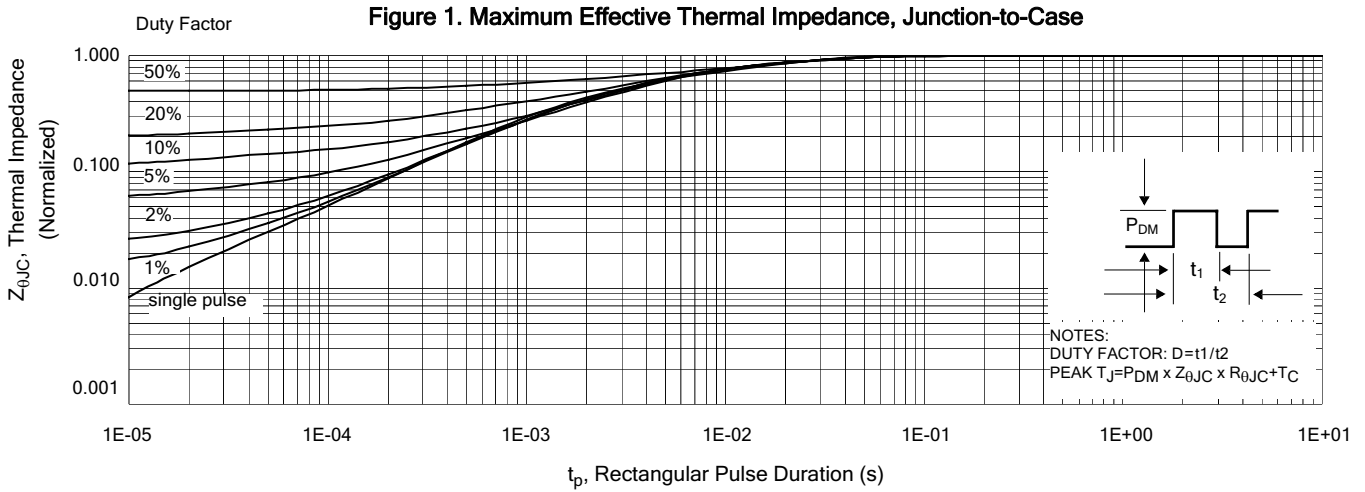
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\*1.  $T_J = +25^\circ\text{C}$  to  $+175^\circ\text{C}$ .

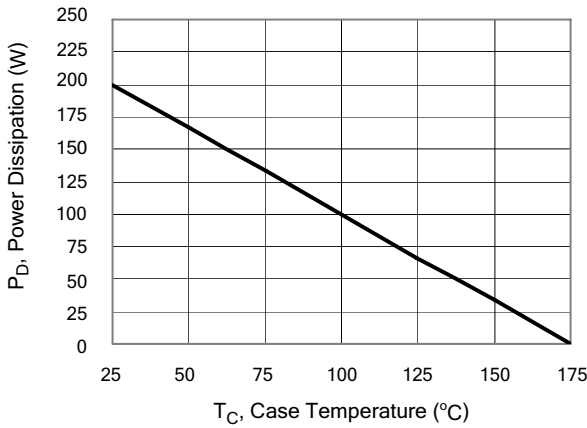
\*2. Repetitive rating; pulse width limited by maximum junction temperature.

\*3.  $I_{SD}=28\text{A}$   $di/dt \leq 100\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ ,  $T_J=+175^\circ\text{C}$ .

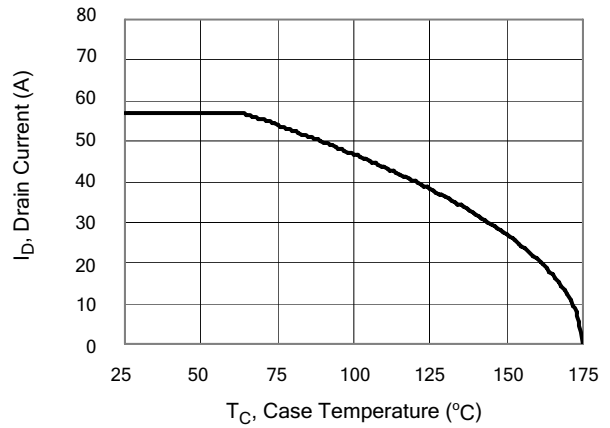
\*4. Pulse width  $\leq 380\mu\text{s}$ ; duty cycle  $\leq 2\%$ .



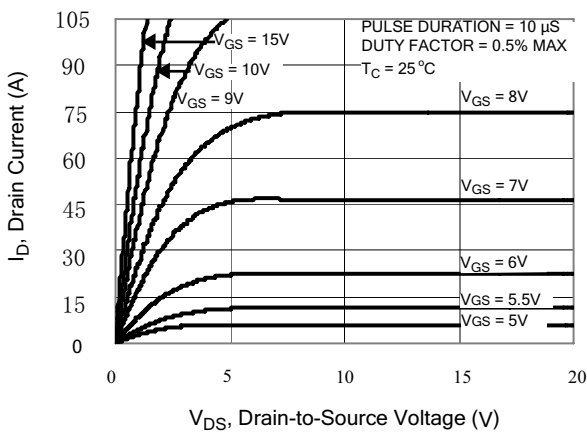
**Figure 2. Maximum Power Dissipation vs Case Temperature**



**Figure 3. Maximum Continuous Drain Current vs Case Temperature**



**Figure 4. Typical Output Characteristics**



**Figure 5. Typical Drain-to-Source ON Resistance vs Gate Voltage and Drain Current**

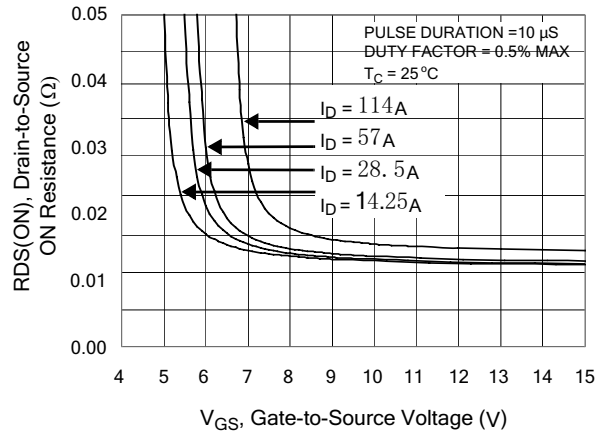


Figure 6. Maximum Peak Current Capability

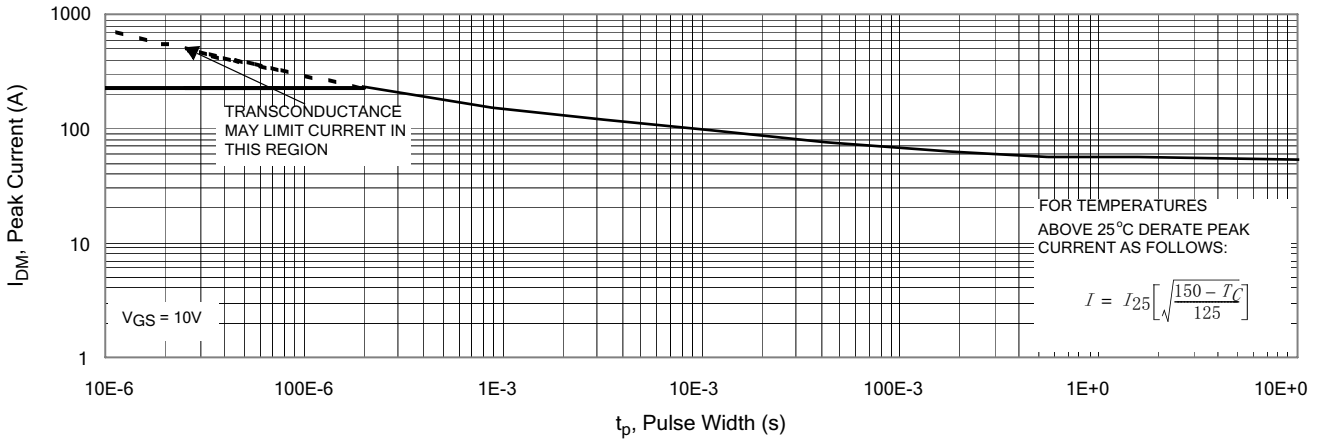


Figure 7. Typical Transfer Characteristics

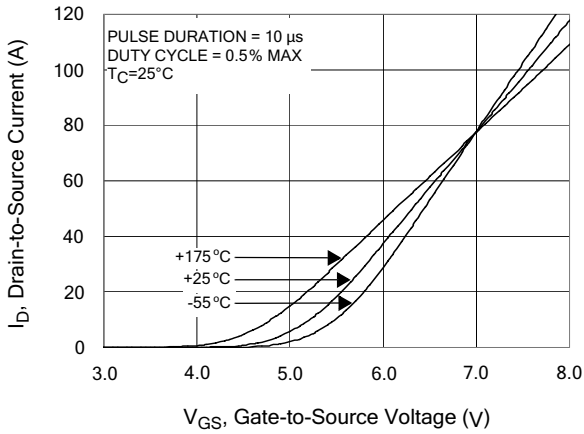


Figure 8. Unclamped Inductive Switching Capability

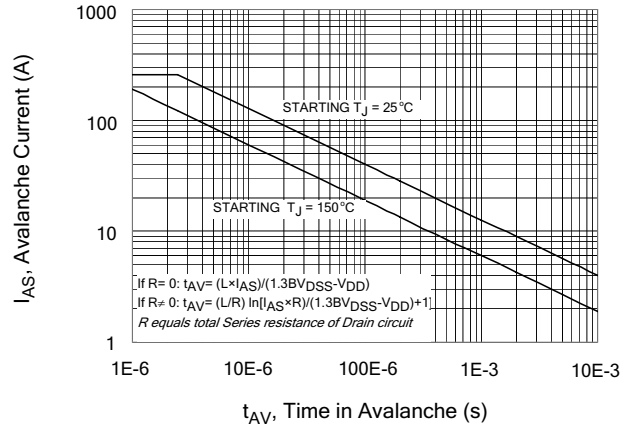


Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current

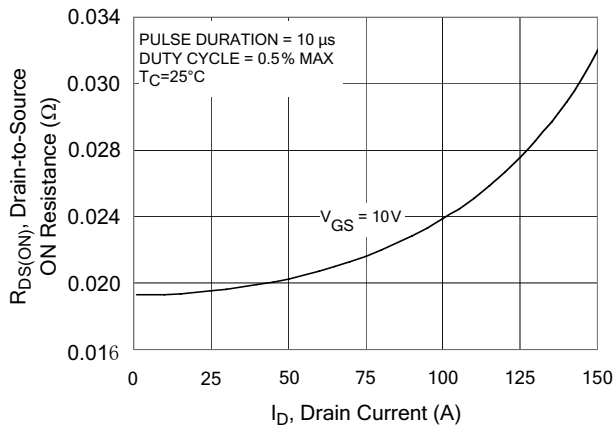
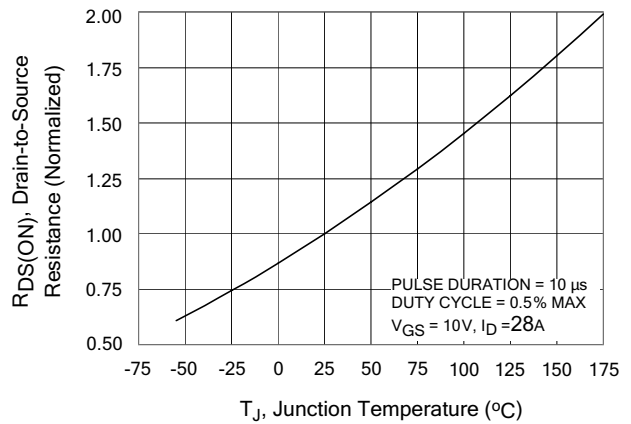
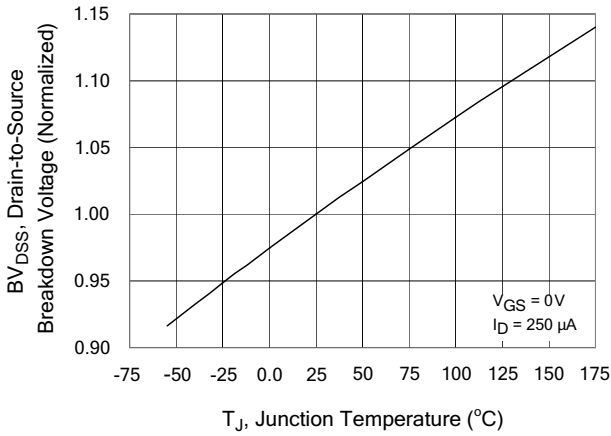


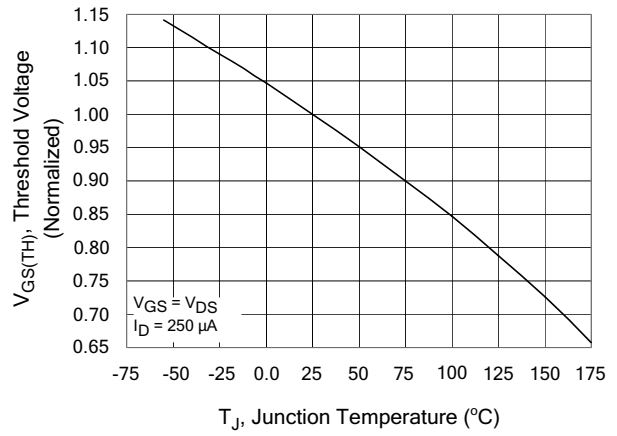
Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature



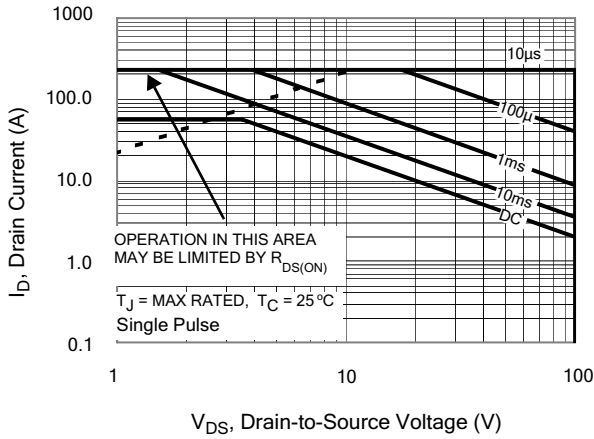
**Figure 11. Typical Breakdown Voltage vs Junction Temperature**



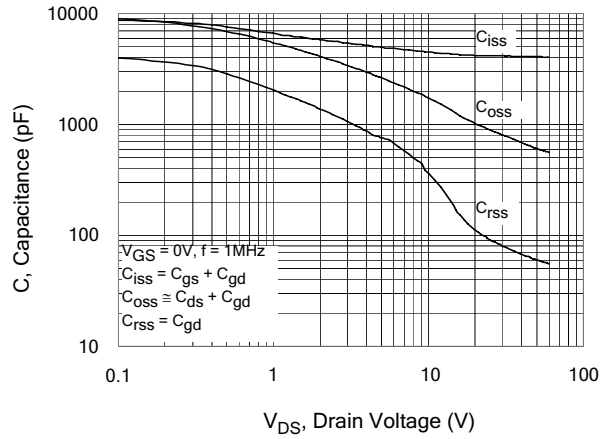
**Figure 12. Typical Threshold Voltage vs Junction Temperature**



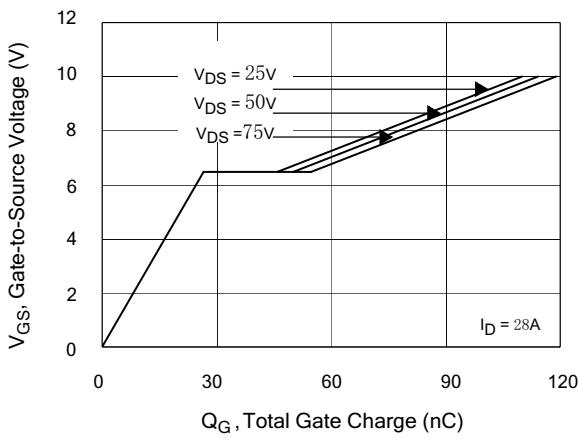
**Figure 13. Maximum Forward Bias Safe Operating Area**



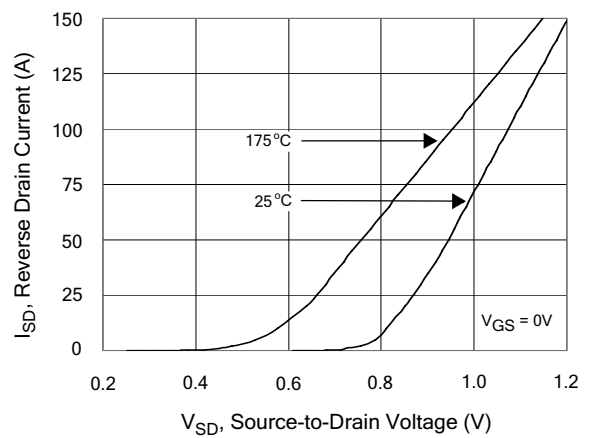
**Figure 14. Typical Capacitance vs Drain-to-Source Voltage**



**Figure 15. Typical Gate Charge vs Gate-to-Source Voltage**



**Figure 16. Typical Body Diode Transfer Characteristics**



Test Circuits and Waveforms

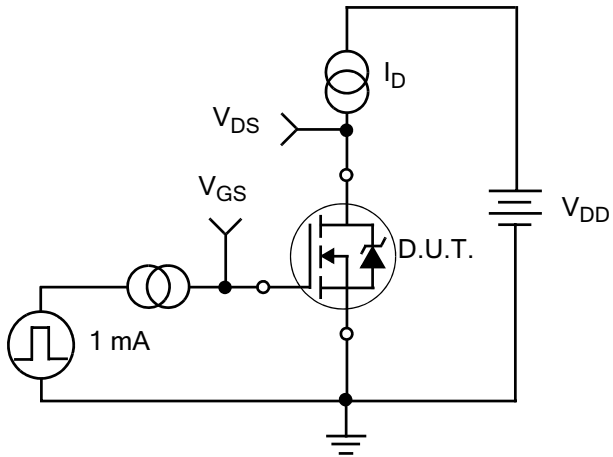


Figure 17. Gate Charge Test Circuit

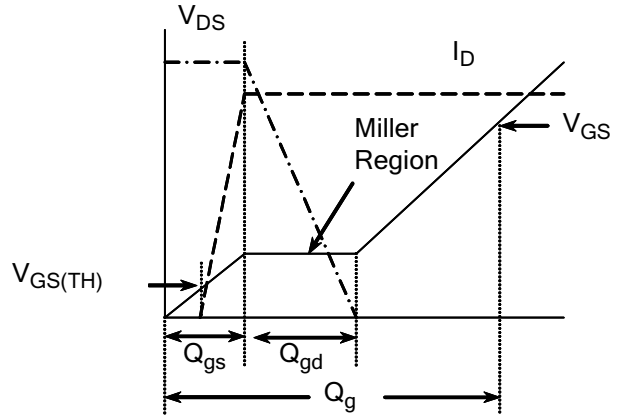


Figure 18. Gate Charge Waveform

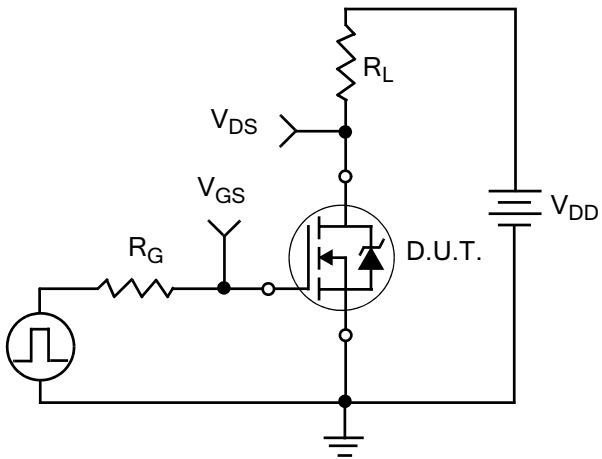


Figure 19. Resistive Switching Test Circuit

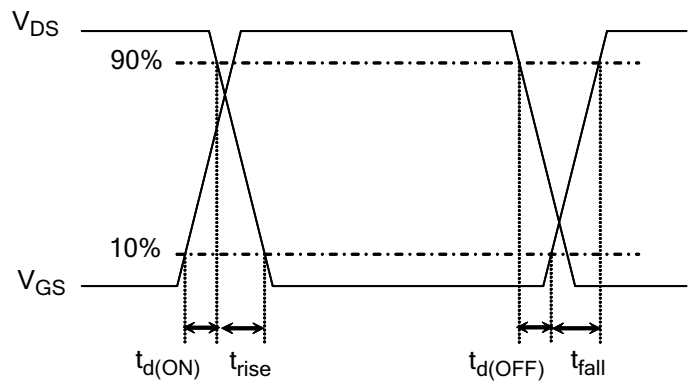


Figure 20. Resistive Switching Waveforms

Test Circuits and Waveforms

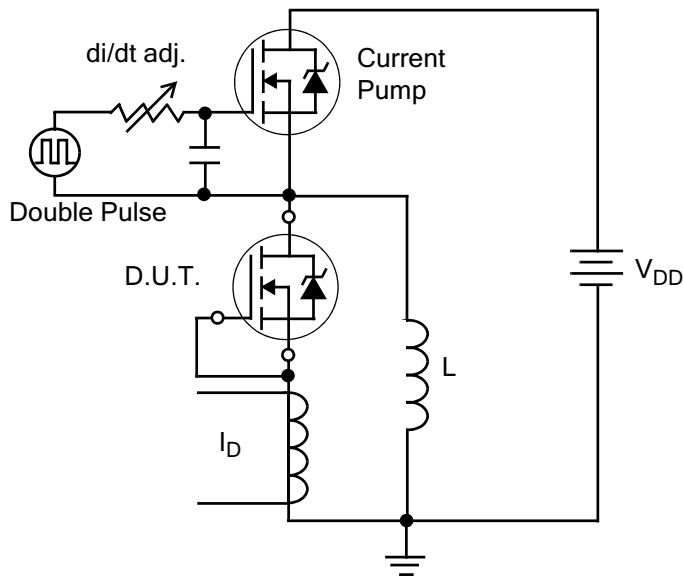


Figure 21. Diode Reverse Recovery Test Circuit

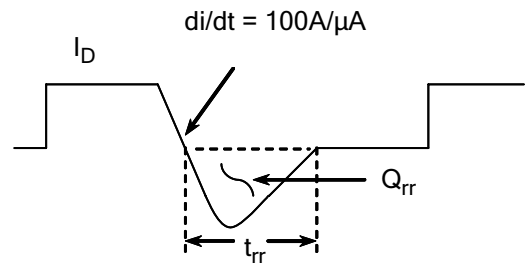


Figure 22. Diode Reverse Recovery Waveform

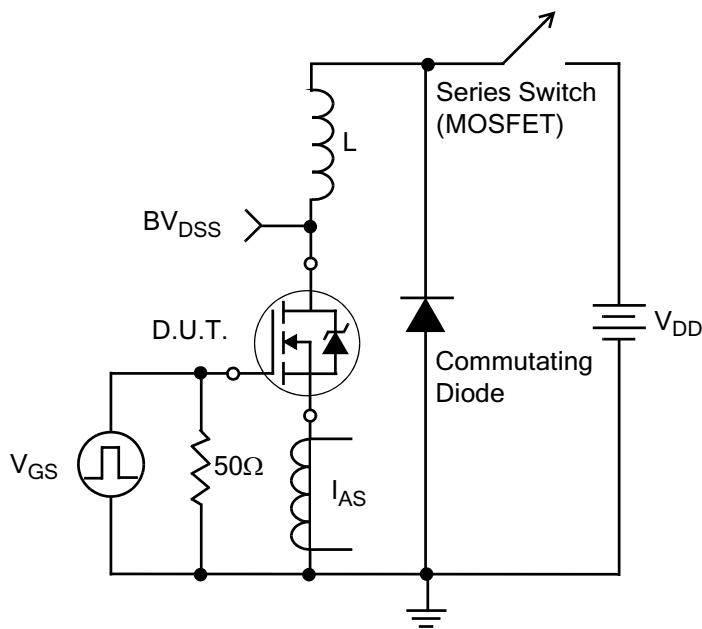


Figure 23. Unclamped Inductive Switching Test Circuit

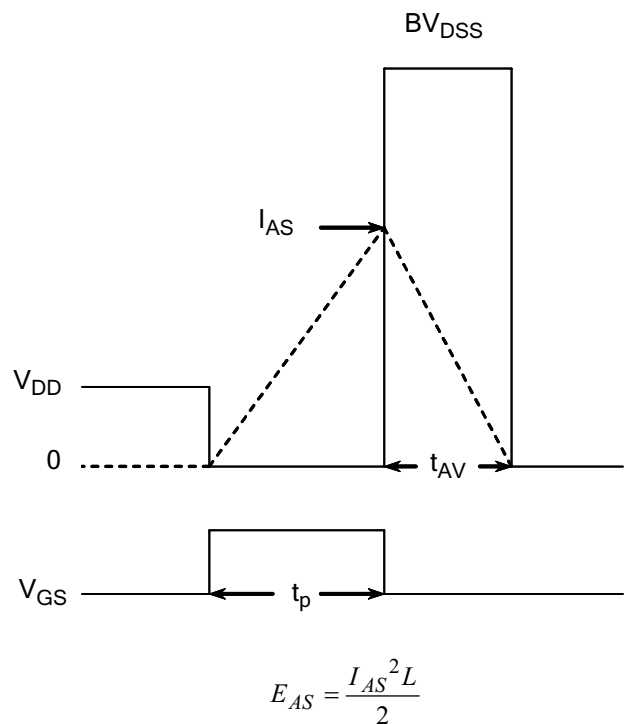


Figure 24. Unclamped Inductive Switching Waveforms



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