

## N-Channel MOSFET

**Lead Free Package and Finish**

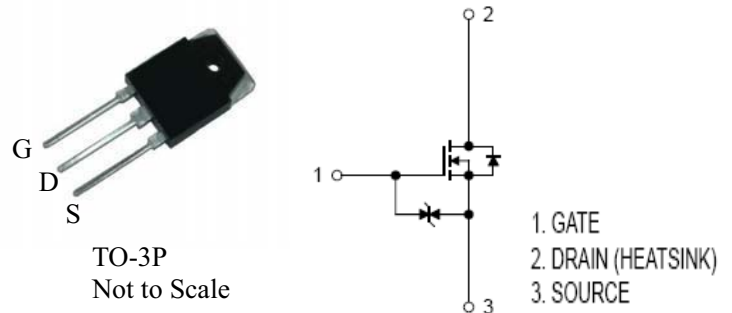
### Applications:

- ATX Power
- LCD Panel Power

|                  |                           |                      |
|------------------|---------------------------|----------------------|
| V <sub>DSS</sub> | R <sub>DS(on)</sub> (Typ) | I <sub>D</sub> (Max) |
| 900V             | 0.31Ω                     | 20A                  |

### Features:

- RoHS Compliant & Halogen Free
- Low ON Resistance
- Low Gate Charge
- ESD Capability Improved



### Ordering Information

| Part Number | Package Type | Marking   |
|-------------|--------------|-----------|
| ISW20N90A   | TO-3P        | ISW20N90A |

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

| Symbol                              | Parameter  | Maximum         | Units |
|-------------------------------------|--|-----------------|-------|
| V <sub>DSS</sub>                    | Drain-to-Source Voltage (NOTE *1)  | 900             | V     |
| I <sub>D</sub>                      | Continuous Drain Current   | 20              | A     |
| I <sub>D@ 100 °C</sub>              | Continuous Drain Current   | Figure3         |       |
| I <sub>DM</sub>                     | Pulsed Drain Current, V <sub>GS@ 10V</sub> (NOTE *2)   | Figure6         |       |
| P <sub>D</sub>                      | Power Dissipation  | 250             | W     |
|                                     | Derating Factor above 25°C   | 2.0             | W/°C  |
| V <sub>GS</sub>                     | Gate-to-Source Voltage   | ± 20            | V     |
| EAS                                 | Single Pulse Avalanche Energy;   | 1000            | mJ    |
| V <sub>ESD(GS)</sub>                | Gate Source ESD Voltage(HBM,c=100pF,R=1.5K Ω )   | 6000            | V     |
| dv/dt                               | Peak Diode Recovery dv/dt (NOTE *3)  | 5.0             | V/ns  |
| T <sub>L</sub><br>T <sub>PKG</sub>  | Maximum Temperature for Soldering<br>Leads at 0.063in(1.6mm) from Case for 10 seconds<br>Package Body for 10 seconds | 300<br>260      | °C    |
| T <sub>J</sub> and T <sub>STG</sub> | Operation Junction and Storage Temperature Range   | 150, -55 to 150 | °C    |

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

### Thermal Resistance

| Symbol           | Parameter           | Maximum | Units | Test Condition   |
|------------------|---------------------|---------|-------|--|
| R <sub>θJC</sub> | Junction-to-Case    | 0.5     | °C/W  | Drain lead soldered to water cooled heatsink, PD ad-justed for a peak junction temperature of +150oC.<br>1 cubic foot chamber, free air. |
| R <sub>θJA</sub> | Junction-to-Ambient | 62      |       |  |

**Electrical Characteristics** TJ= 25 °C unless otherwise specified:

| <b>OFF Characteristics</b>          |                                   |        |      |      |       |   |
|-------------------------------------|-----------------------------------|--------|------|------|-------|---|
| Symbol                              | Parameter                         | Rating |      |      | Units | Test Conditions   |
|                                     |                                   | Min.   | Typ. | Max. |       |   |
| V <sub>DSS</sub>                    | Drain-to-Source Breakdown Voltage | 900    | --   | --   | V     | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | Bvdss Temperature Coefficient     | --     | 0.5  | --   | V/°C  | Reference to 25 °C,<br>ID=250uA   |
| I <sub>DS(off)</sub>                | Off-State Drain-to-Source Current | --     | --   | 1.0  | uA    | V <sub>DS</sub> = 900V, V <sub>GS</sub> =0V,<br>T <sub>a</sub> = 25 °C    |
|                                     |                                   | --     | --   | 100  |       | V <sub>DS</sub> = 720V, V <sub>GS</sub> = 0 V,<br>T <sub>a</sub> = 125 °C |
| I <sub>GSS(F)</sub>                 | Gate-to-Source Forward Leakage    | --     | --   | 1.0  | uA    | V <sub>GS</sub> = +20V  |
| I <sub>GSS(R)</sub>                 | Gate-to-Source Reverse Leakage    | --     | --   | -1.0 |       | V <sub>GS</sub> = -20V  |

| <b>ON Characteristics</b> |                               |        |      |      |       |  |
|---------------------------|-------------------------------|--------|------|------|-------|--|
| Symbol                    | Parameter                     | Rating |      |      | Units | Test Conditions  |
|                           |                               | Min.   | Typ. | Max. |       |  |
| R <sub>DS(ON)</sub>       | Drain-to-Source On-Resistance | --     | 0.31 | 0.4  | Ω     | V <sub>GS</sub> =10V, I <sub>D</sub> =10A<br>(NOTE*4)  |
| g <sub>fs</sub>           | Forward Transconductance      | --     | 20   | --   | S     | V <sub>DS</sub>  >2I <sub>D</sub> *R <sub>DS(on)</sub> max<br>I <sub>D</sub> = 10A<br>(NOTE*4) |
| V <sub>GS(TH)</sub>       | Gate Threshold Voltage        | 2.0    | --   | 4.0  | V     | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                     |

| <b>Dynamic Characteristics</b> |                                 |        |      |      |       |   |
|--------------------------------|---------------------------------|--------|------|------|-------|---|
| Symbol                         | Parameter                       | Rating |      |      | Units | Test Conditions   |
|                                |                                 | Min.   | Typ. | Max. |       |   |
| C <sub>iss</sub>               | Input Capacitance               | --     | 7560 | --   | pF    | V <sub>GS</sub> = 0V<br>V <sub>DS</sub> = 25V<br>f = 1.0MHz             |
| C <sub>oss</sub>               | Output Capacitance              | --     | 480  | --   |       |   |
| C <sub>rss</sub>               | Reverse Transfer Capacitance    | --     | 60   | --   |       |   |
| Q <sub>g</sub>                 | Total Gate Charge               | --     | 160  | --   | nC    | V <sub>DD</sub> = 300V<br>I <sub>D</sub> = 20A<br>V <sub>GS</sub> = 10V |
| Q <sub>gs</sub>                | Gate-to-Source Charge           | --     | 25   | --   |       |   |
| Q <sub>gd</sub>                | Gate-to-Drain ("Miller") Charge | --     | 55   | --   |       |   |

| <b>Resistive Switching Characteristics</b> |                     |        |      |      |       |  |
|--|---------------------|--------|------|------|-------|--|
| Symbol                                     | Parameter           | Rating |      |      | Units | Test Conditions  |
|  |                     | Min.   | Typ. | Max. |       |  |
| t <sub>d(ON)</sub>                         | Turn-on Delay Time  | --     | 22   | --   | ns    | V <sub>DD</sub> = 300V<br>I <sub>D</sub> = 20A<br>V <sub>GS</sub> = 10V<br>R <sub>G</sub> = 4.7Ω |
| trise                                      | Rise Time           | --     | 42   | --   |       |  |
| t <sub>d(OFF)</sub>                        | Turn-Off Delay Time | --     | 153  | --   |       |  |
| t <sub>fall</sub>                          | Fall Time           | --     | 97   | --   |       |  |

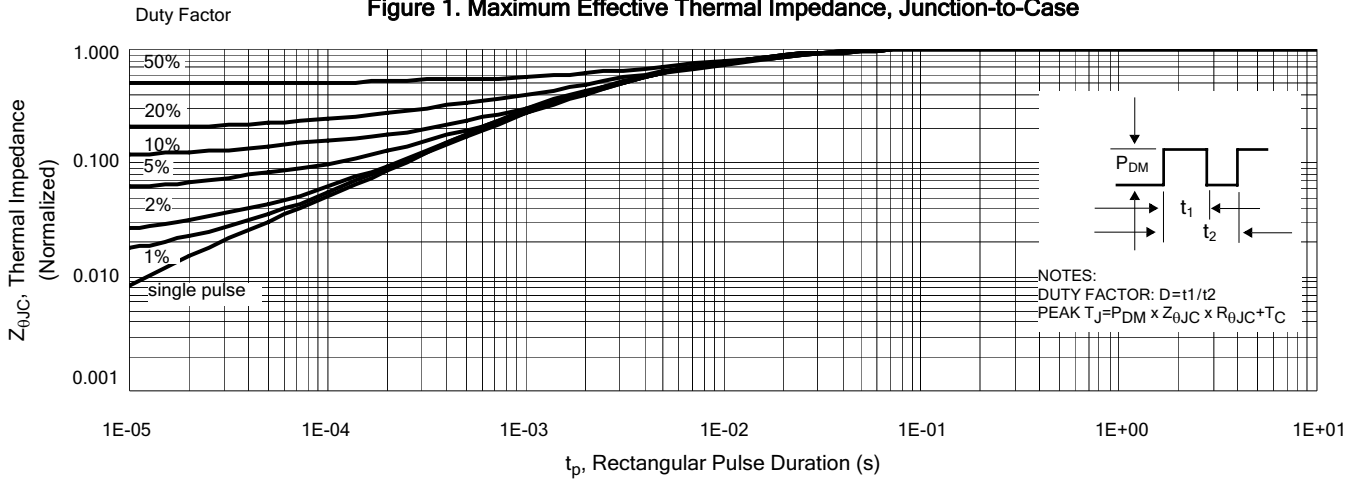
| Source-Drain Diode Characteristics |  |        |      |      |         |   |
|------------------------------------|--|--------|------|------|---------|---|
| Symbol                             | Parameter                              | Rating |      |      | Units   | Test Conditions                                     |
|                                    |  | Min.   | Typ. | Max. |         |   |
| $I_S$                              | Continuous Source Current (Body Diode) | --     | --   | 20   | A       | Integral pn-diode in MOSFET                         |
| $I_{SM}$                           | Maximum Pulsed Current (Body Diode)    | --     | --   | 80   | A       |   |
| $V_{SD}$                           | Diode Forward Voltage                  | --     | --   | 1.5  | V       | $I_S=20A, V_{GS}=0V$                                |
| $t_{rr}$                           | Reverse Recovery Time                  | --     | 434  | --   | nS      | $I_F=20A,$<br>$T_j = 25^\circ C$<br>$di/dt=100A/us$ |
| $Q_{rr}$                           | Reverse Recovery Charge                | --     | 3.9  | --   | $\mu C$ |   |

### Notes:

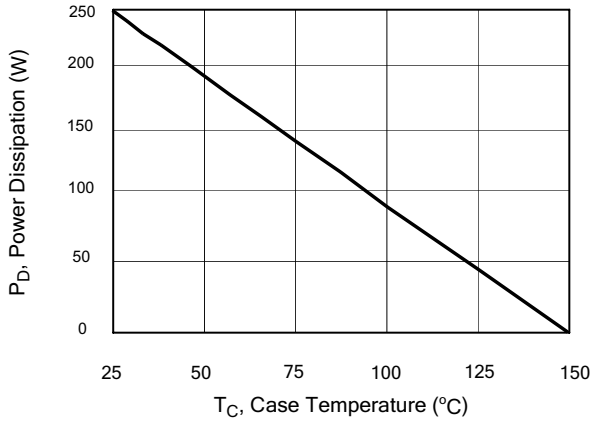
- 
- \*1.  $T_J=+25^\circ C$  to  $+150^\circ C$ .
  - \*2. Repetitive rating; pulse width limited by maximum junction temperature.
  - \*3.  $I_{SD}=20A$   $di/dt \leq 100A/us$ ,  $V_{DD} \leq BV_{DSS}$ ,  $T_{Jmax}=+150^\circ C$ .
  - \*4. Pulse width  $\leq 380us$ ; duty cycle  $\leq 2\%$ .

# Characteristics Curve:

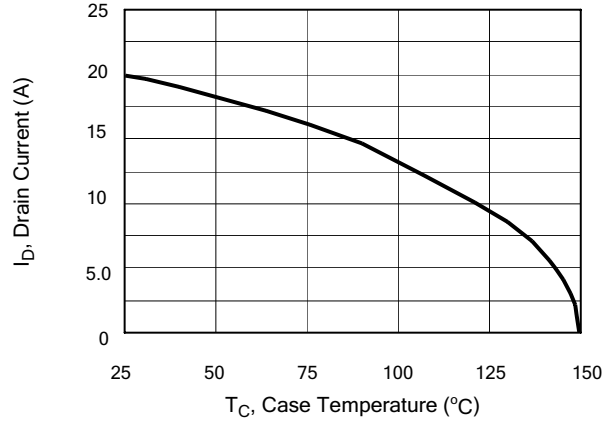
**Figure 1. Maximum Effective Thermal Impedance, Junction-to-Case**



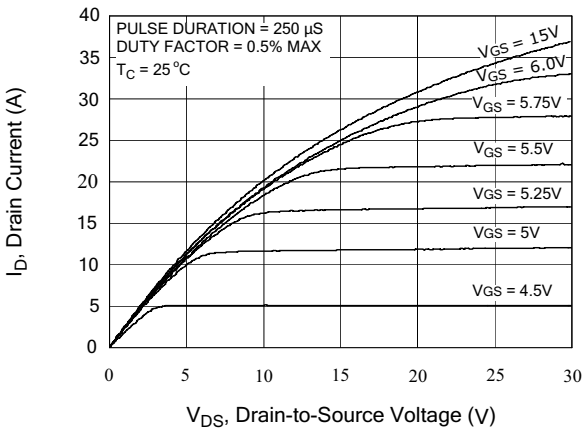
**Figure 2. Maximum Power Dissipation vs Case Temperature**



**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**

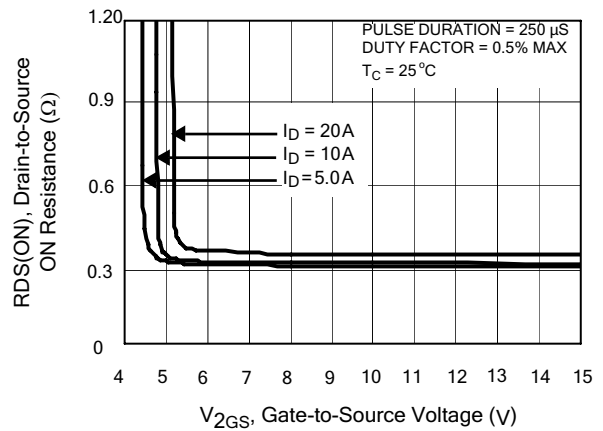


Figure 6. Maximum Peak Current Capability

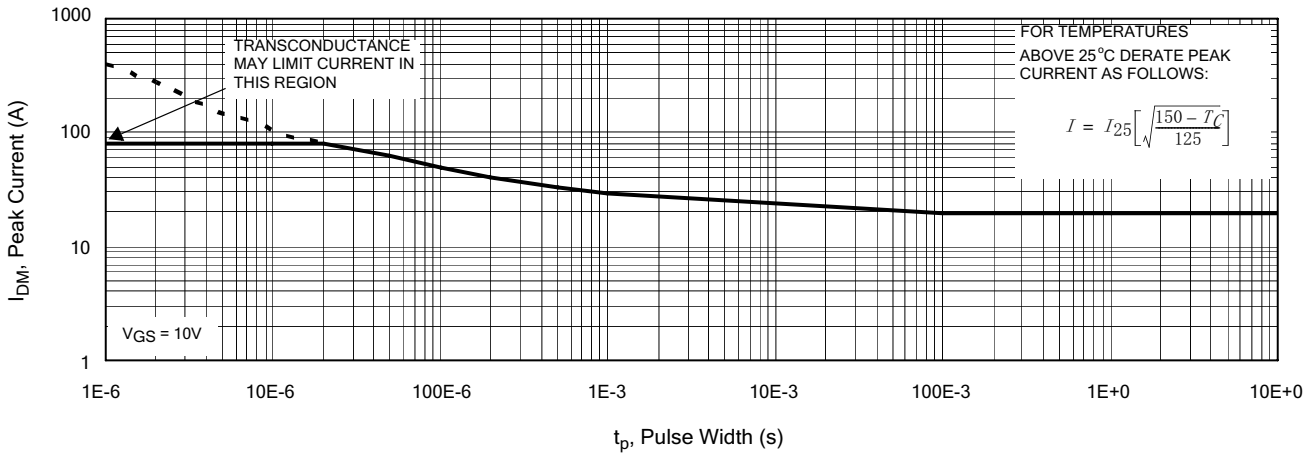


Figure 7. Typical Transfer Characteristics

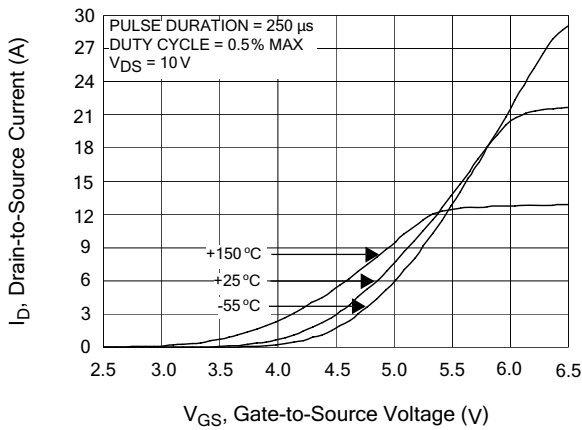


Figure 8. Unclamped Inductive Switching Capability

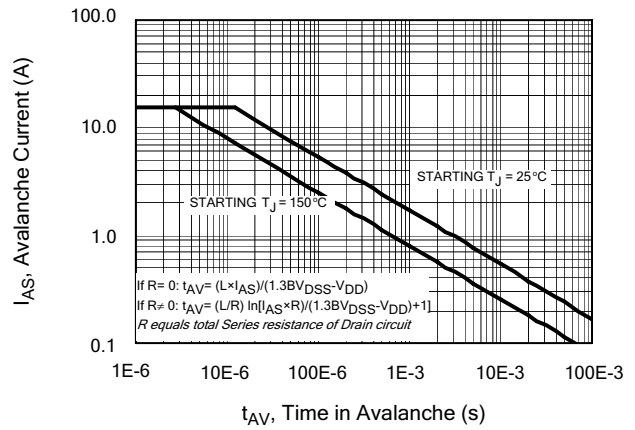


Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current

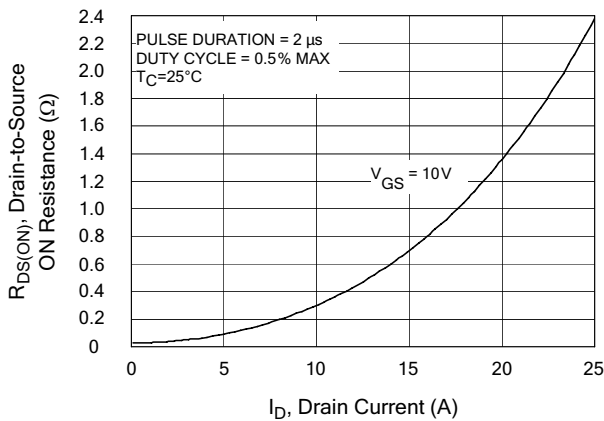
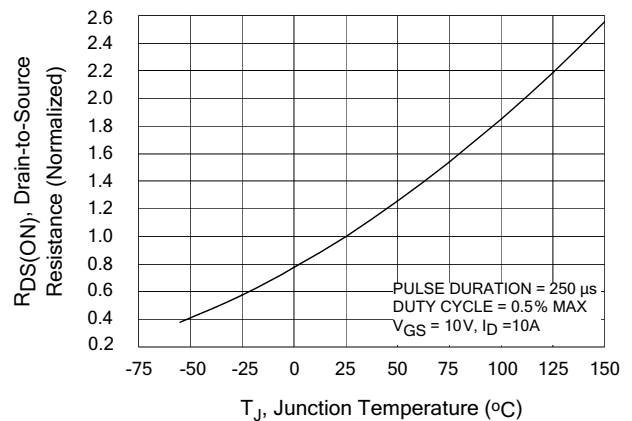
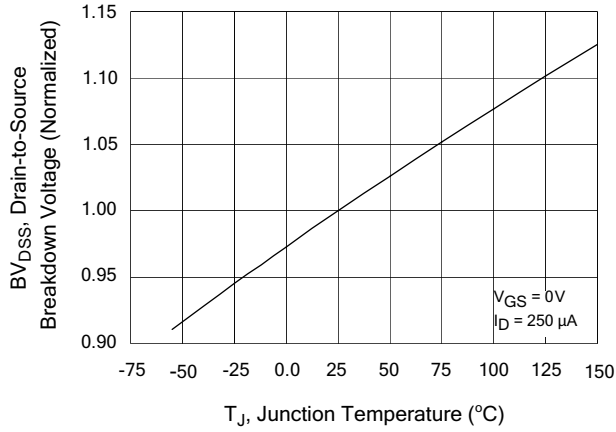


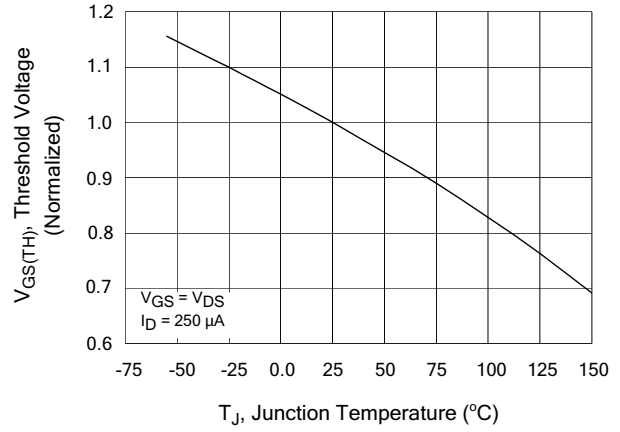
Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature



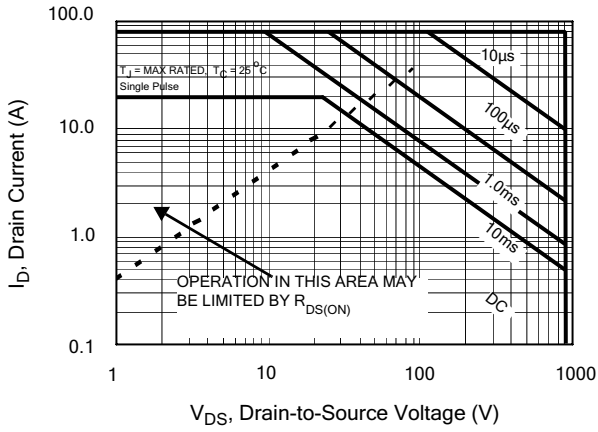
**Figure 11. Typical Breakdown Voltage vs Junction Temperature**



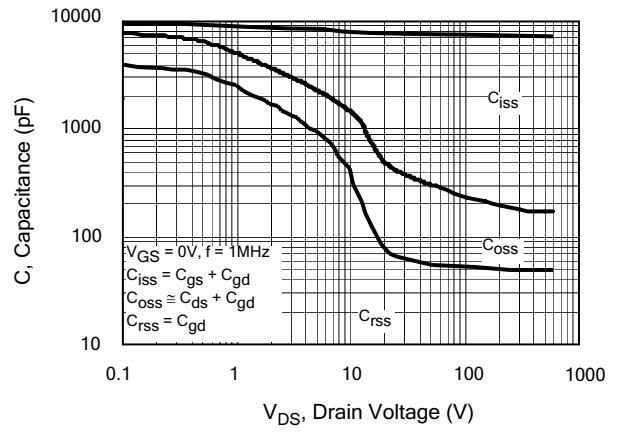
**Figure 12. Typical Threshold Voltage vs Junction Temperature**



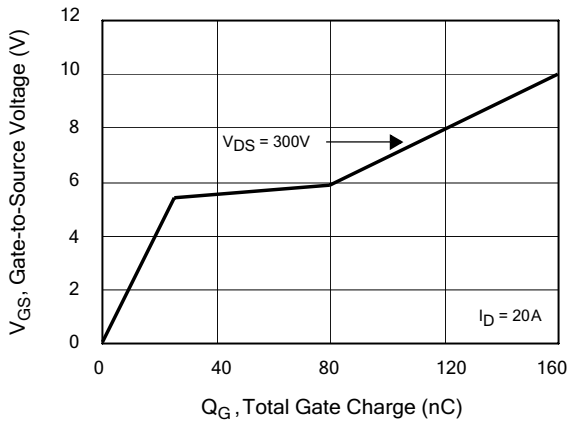
**Figure 13. Maximum Forward Bias Safe Operating Area**



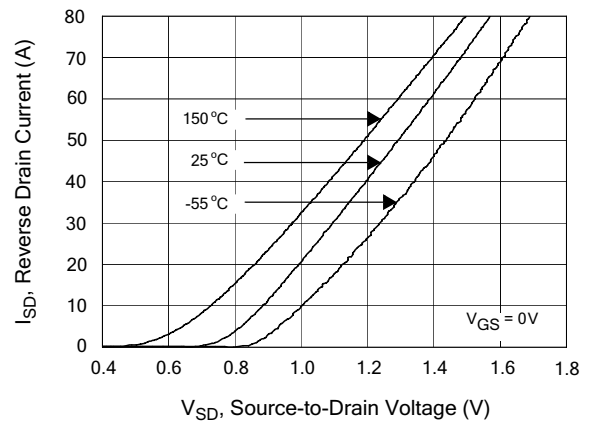
**Figure 14. Typical Capacitance vs Drain-to-Source Voltage**



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



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



## Test Circuits and Waveforms

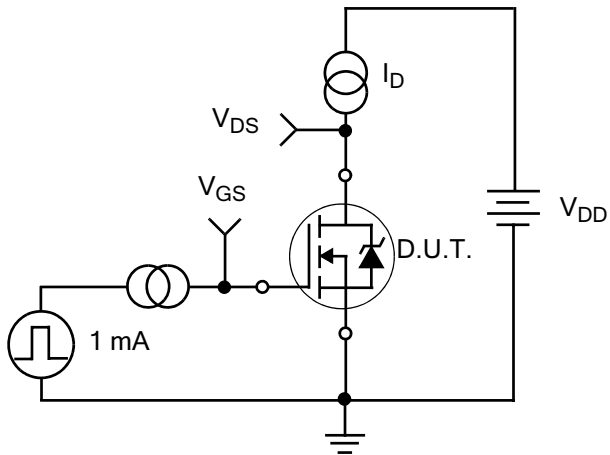


Figure 17. Gate Charge Test Circuit

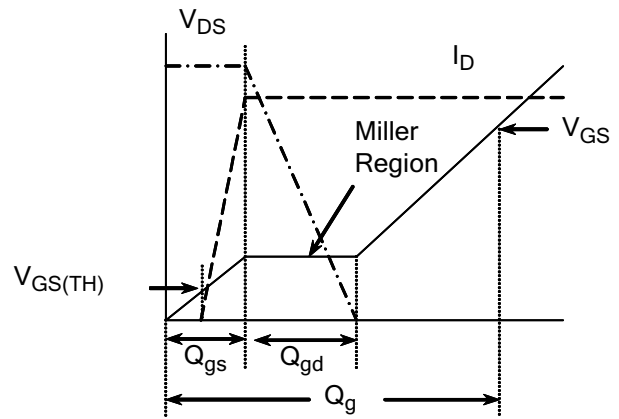


Figure 18. Gate Charge Waveform

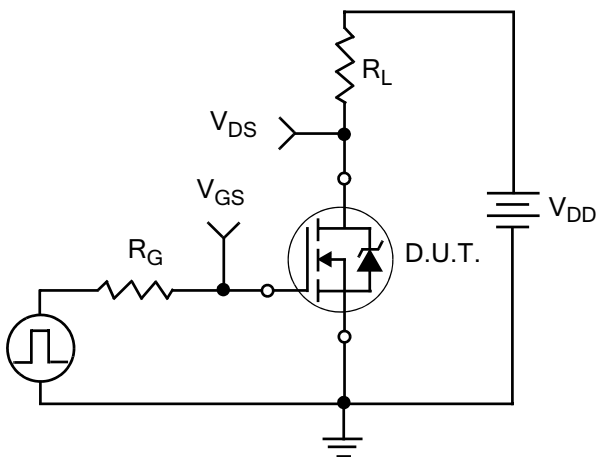


Figure 19. Resistive Switching Test Circuit

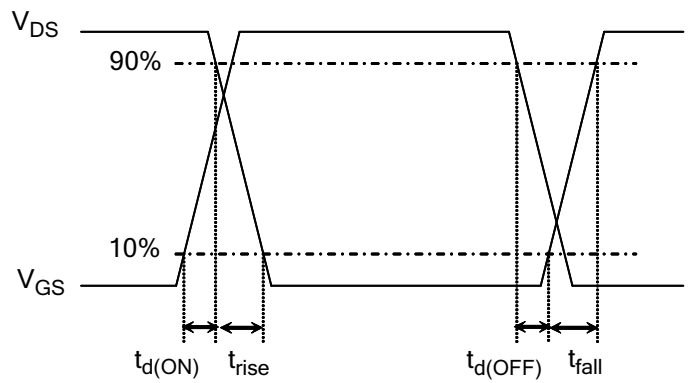


Figure 20. Resistive Switching Waveforms

Test Circuits and Waveforms

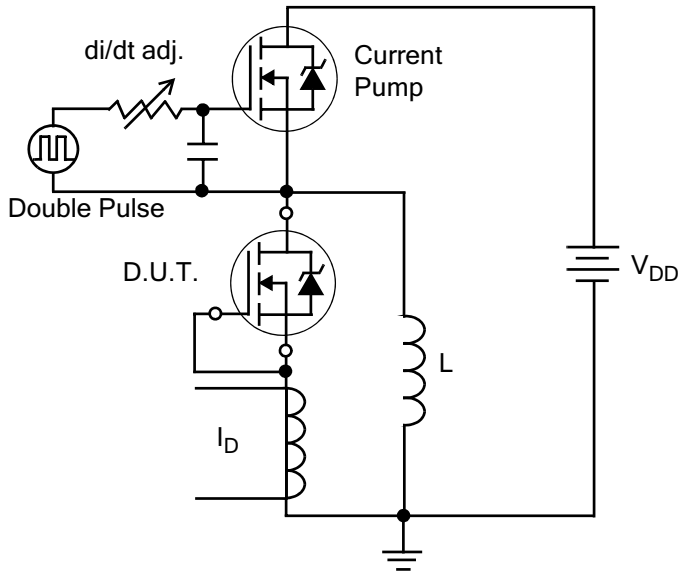


Figure 21. Diode Reverse Recovery Test Circuit

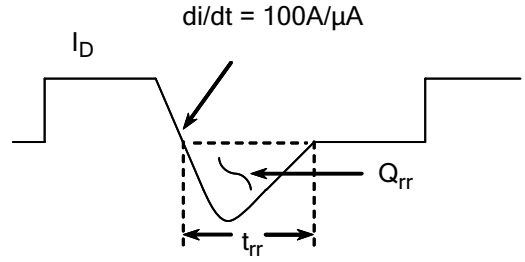


Figure 22. Diode Reverse Recovery Waveform

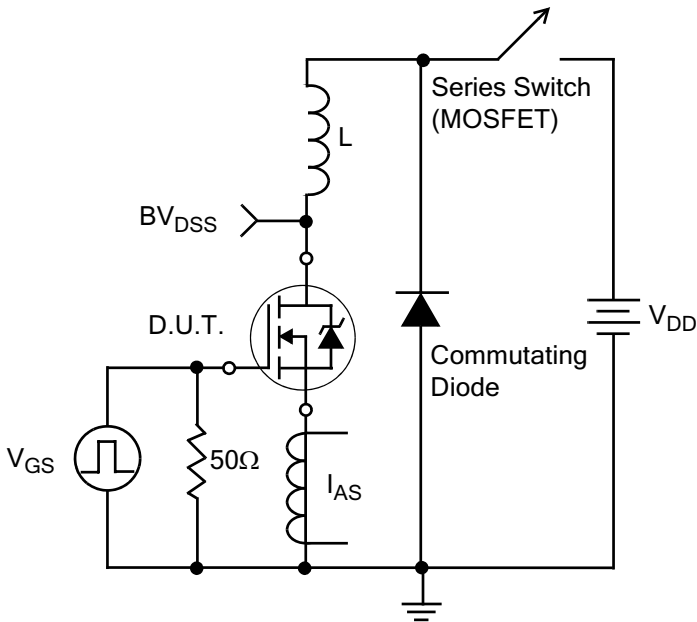


Figure 23. Unclamped Inductive Switching Test Circuit

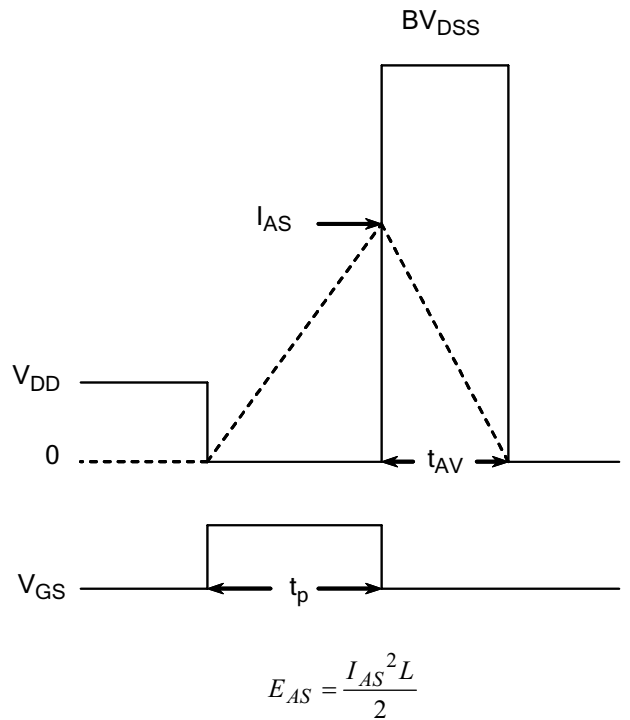


Figure 24. Unclamped Inductive Switching Waveforms



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The MOSFET device is electrostatic sensitive. Proper electrostatic discharge (ESD) protection shall be implemented to avoid damaging the device.

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  - b. support or sustain life,
  - c. whose failure to perform when properly used in accordance with instructions for used provided in the labeling, can be reasonably expected to result in significant injury to the user.
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