

**N Channel MOSFET**

Lead Free Package and Finish

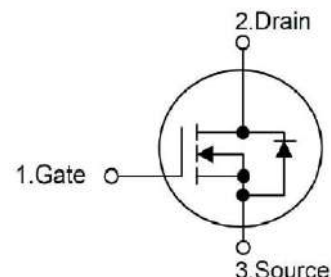
**Applications:**

- Adapter & Charger
- SMPS Standby Power
- AC-DC Switching Power Supply
- LED driving power

|       |                    |           |
|-------|--------------------|-----------|
| $I_D$ | $R_{DS(ON)}(Typ.)$ | $V_{DSS}$ |
| 20A   | 0.39Ω              | 650V      |

**Features:**

- Low On Resistance
- Low Gate Charge
- Peak Current vs Pulse Width Curve
- RoHS Compliant



Not to Scale

## Ordering Information

| Part Number | Package | Marking  |
|-------------|---------|----------|
| RS20N65F    | TO-220F | RS20N65F |

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

| Symbol                    | Parameter   | RS20N65F   | Units               |
|---------------------------|---|------------|---------------------|
| $V_{DSS}$                 | Drain-to-Source Voltage (Note*1)  | 650        | V                   |
| $I_D$                     | Continuous Drain Current  | 20         | A                   |
| $I_{D@100^\circ\text{C}}$ | Continuous Drain Current  | 12         |                     |
| $I_{DM}$                  | Pulsed Drain Current (Note*2)   | 80         |                     |
| PD                        | Power Dissipation   | 90         | W                   |
|                           | Derating Factor above $25^\circ\text{C}$  | 0.74       | W/ $^\circ\text{C}$ |
| $V_{GS}$                  | Gate-to-Source Voltage  | $\pm 30$   | V                   |
| EAS                       | Single Pulse Avalanche Energy<br>L=10mH VDD=50V $R_G=25\Omega$ $T_J=25^\circ\text{C}$ | 640        | mJ                  |
| TL<br>TPKG                | Maximum Temperature for Soldering   | 300<br>260 | $^\circ\text{C}$    |
|                           | Leads at 0.063in(1.6mm)from Case for 10 seconds                                       |            |                     |
|                           | Package Body for 10 seconds   |            |                     |
| $T_J$ and $T_{STG}$       | Operating Junction and Storage Temperature Range                                      | -55 to 150 |                     |

\*Drain Current Limited by Maximum Junction Temperature

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

**Thermal Resistance**

| Symbol          | Parameter           | RS20N65F | Units                     | Test Conditions  |
|-----------------|---------------------|----------|---------------------------|--|
| $R_{\theta JC}$ | Junction-to-Case    | 1.42     | $^\circ\text{C}/\text{W}$ | Drain lead soldered to water cooled heatsink,PD adjusted for a peak junction temperature of $+150^\circ\text{C}$ . |
| $R_{\theta JA}$ | Junction-to-Ambient | 62.5     |                           | 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 | 650  | --   | --   | v       | $V_{GS}=0V, I_D=250\mu A$ |
| $I_{DSS}$  | Drain-to-Source Leakage Current   | --   | --   | 1.0  | $\mu A$ | $V_{DS}=650V, V_{GS}=0V$  |
| $I_{GSS}$  | Gate-to-Source Forward Leakage    | --   | --   | 100  | nA      | $V_{GS}=+30V, V_{DS}=0V$  |
|            | Gate-to-Source Reverse Leakage    | --   | --   | -100 |         | $V_{GS}=-30V, V_{DS}=0V$  |

**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 | --   | 0.39 | 0.47 | $\Omega$ | $V_{GS}=10V, I_D=10A$         |
| $V_{GS(TH)}$ | Gate Threshold Voltage               | 2.0  | --   | 4.0  | V        | $V_{GS}=V_{DS}, I_D=250\mu A$ |
| gfs          | Forward Trans conductance            |      | --   | 9.7  | S        | $V_{DS}=15V, I_D=8A$          |

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

| Symbol       | Parameter           | Min. | Typ. | Max. | Units | Test Conditions  |
|--------------|---------------------|------|------|------|-------|--|
| $t_{d(ON)}$  | Turn-on Delay Time  | --   | 31   | --   | nS    | $V_{DS}=325V$<br>$I_D=20A$<br>$R_G=25\Omega$<br>(Note:3,4) |
| $t_{rise}$   | Rise Time           | --   | 25   | --   |       |  |
| $t_{d(OFF)}$ | Turn-OFF Delay Time | --   | 93   | --   |       |  |
| $t_{fall}$   | Fall Time           | --   | 25   | --   |       |  |

**Dynamic Characteristics** Essentially independent of operating temperature

| Symbol    | Parameter                      | Min. | Typ. | Max. | Units | Test Conditions            |
|-----------|--------------------------------|------|------|------|-------|----------------------------|
| $C_{iss}$ | Input Capacitance              | --   | 2810 | --   | pF    | $V_{GS}=0V$                |
| $C_{oss}$ | Output Capacitance             | --   | 235  | --   |       | $V_{DS}=25V$               |
| $C_{rss}$ | Reverse Transfer Capacitance   | --   | 8.9  | --   |       | $f=1.0MHz$                 |
| $Q_g$     | Total Gate Charge              | --   | 50.2 | --   | nC    | $V_{DS}=520V$              |
| $Q_{gs}$  | Gate-to-Source Charge          | --   | 1634 | --   |       | $I_D=20A$                  |
| $Q_{gd}$  | Gate-to-Drain("Miller") Charge | --   | 17.5 | --   |       | $V_{GS}=10V$<br>(Note:3,4) |

### Source-Drain Diode Characteristics

| Symbol          | Parameter                 | Min. | Typ. | Max. | Units | Test Conditions                          |
|-----------------|---------------------------|------|------|------|-------|--|
| I <sub>S</sub>  | Continuous Source Current | --   | --   | 20   | A     | Integral pn-diode<br>in MOSFET           |
| I <sub>SM</sub> | Maximum Pulsed Current    | --   | --   | 80   | A     |  |
| V <sub>SD</sub> | Diode Forward Voltage     | --   | --   | 1    | V     | I <sub>S</sub> =20A, V <sub>GS</sub> =0V |
| t <sub>rr</sub> | Reverse Recovery Time     | --   | 486  | --   | nS    | V <sub>GS</sub> =0V                      |
| Q <sub>rr</sub> | Reverse Recovery Charge   | --   | 5.5  | --   | μC    | I <sub>S</sub> =20A, di/dt=100A/μs       |

### Notes:

- \*1. T<sub>J</sub>=±25°C to +150°C.
- \*2. Repetitive rating; pulse width limited by maximum junction temperature.
- \*3. Pulse width ≤ 300μs; duty cycle ≤ 1%.
- \*4. Basically not affected by temperature.

### Typical Feature curve

Figure1. Typical Output Characteristics

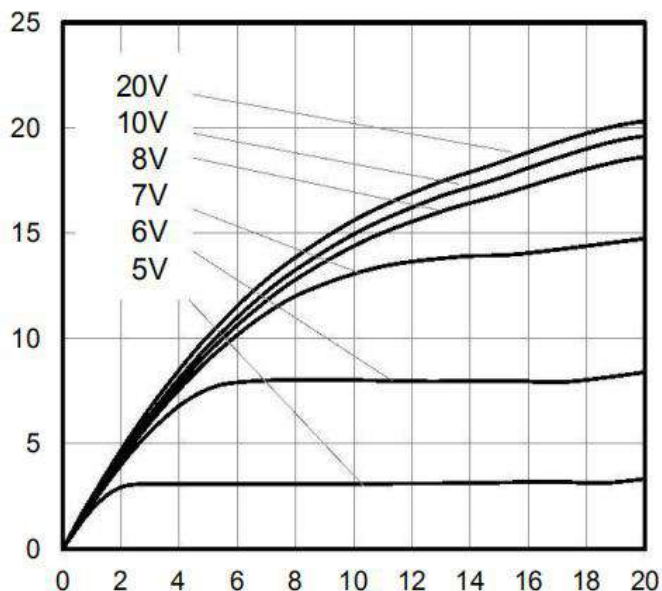
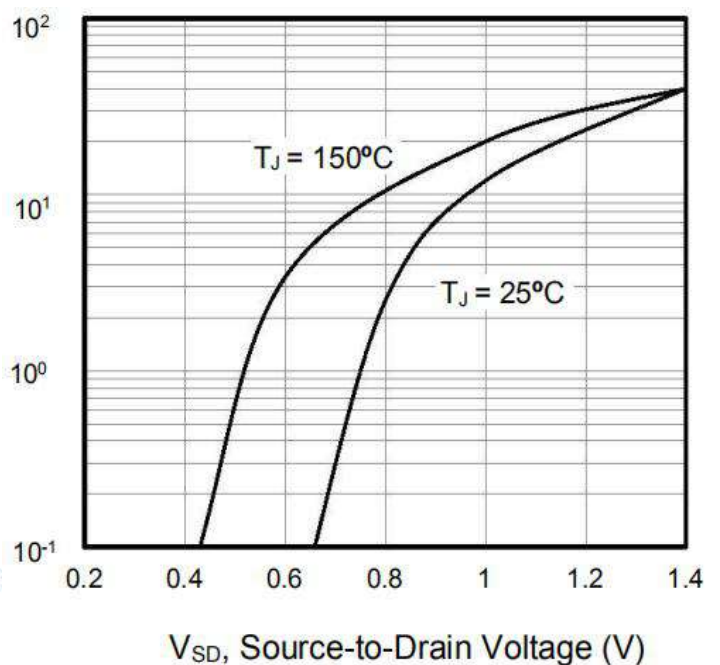
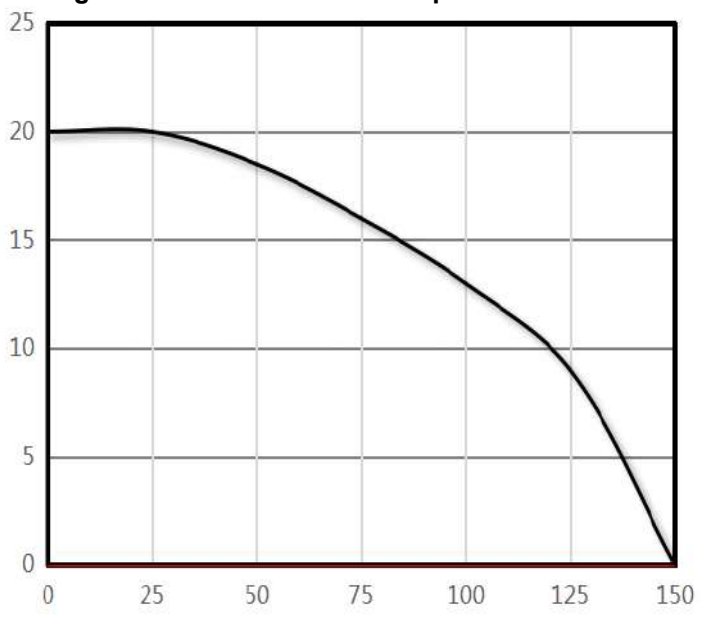


Figure2. Typical Transfer Characteristics

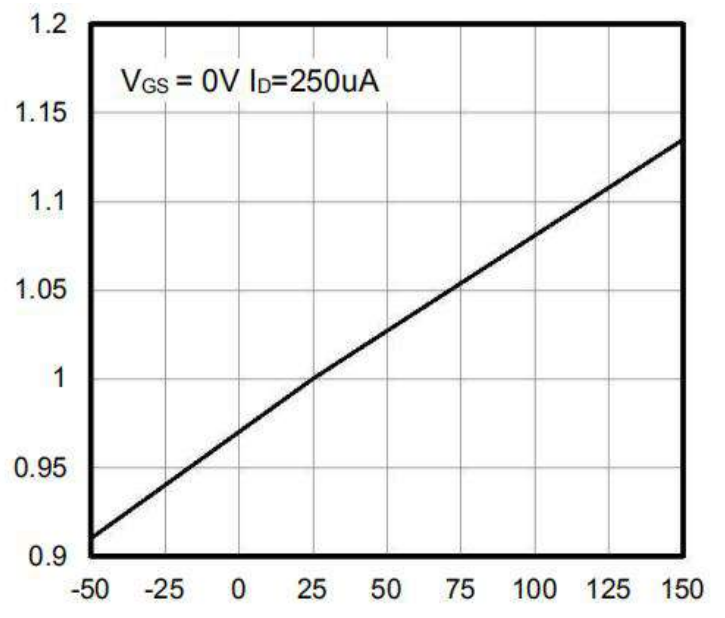


Figuer3.Drain Current vs. Temperature



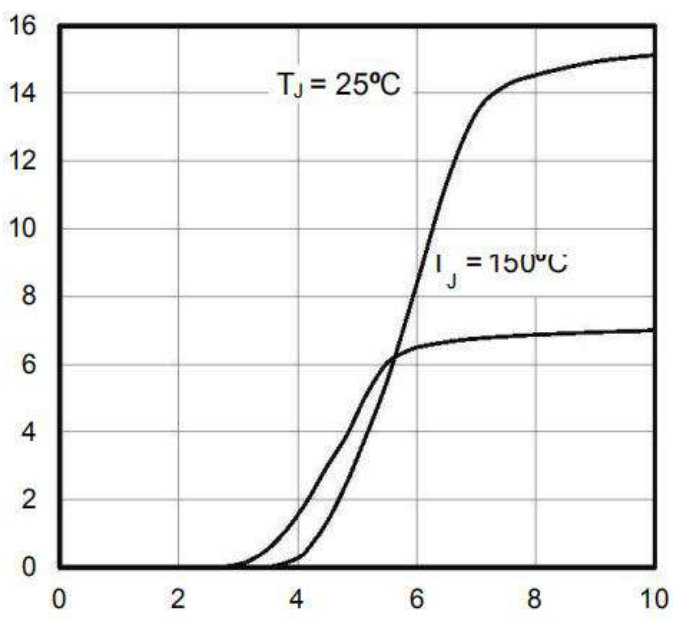
T<sub>C</sub>, Case Temperature (A)

Figuer4. Figure 4. BVDSS Variation vs. Temperature



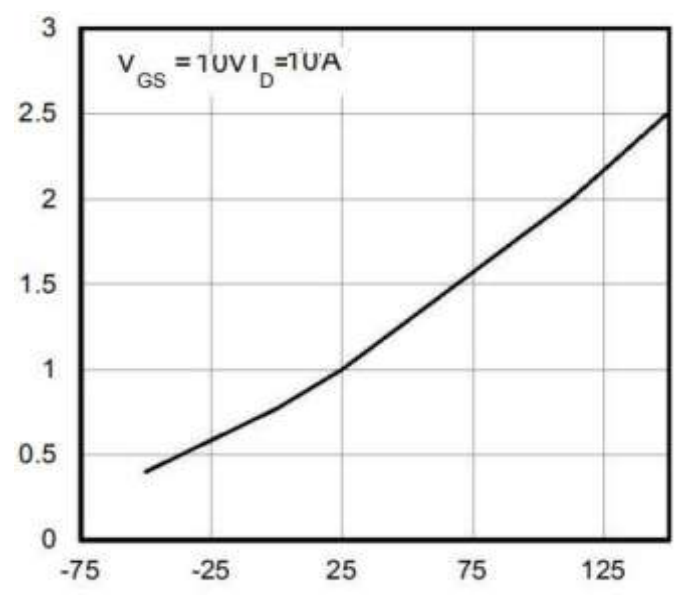
T<sub>C</sub>, Case Temperature (°C)

Figure5.Transfer Characteristics



V<sub>GS</sub>, Gate-to-Source Voltage (V)

Figure 6. On-Resistance vs. Temperature



T<sub>J</sub>, Junction Temperature (°C)

Figure 7. Capacitance

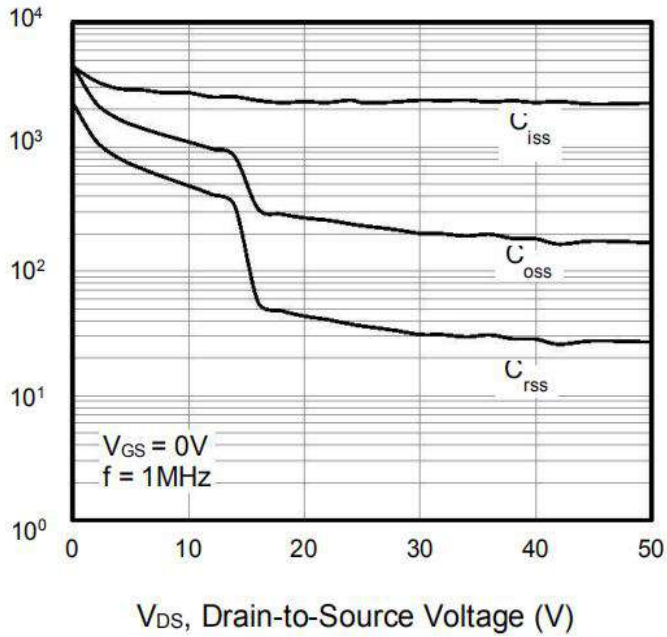


Figure 8. Gate Charge

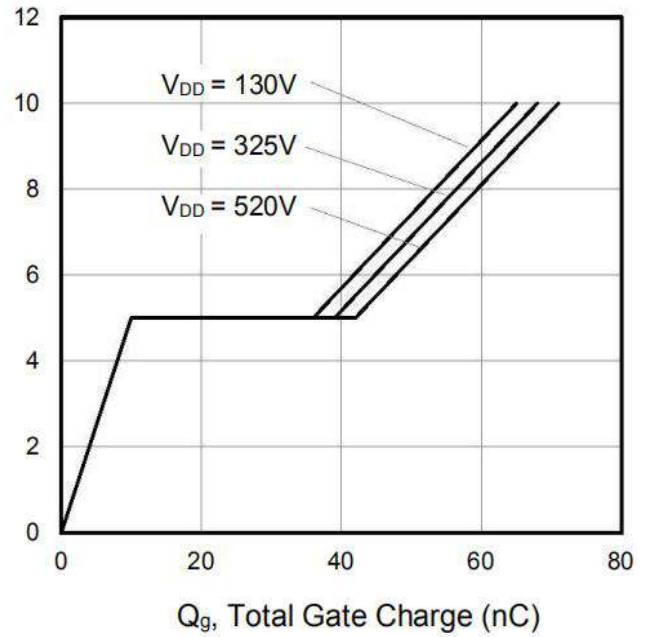
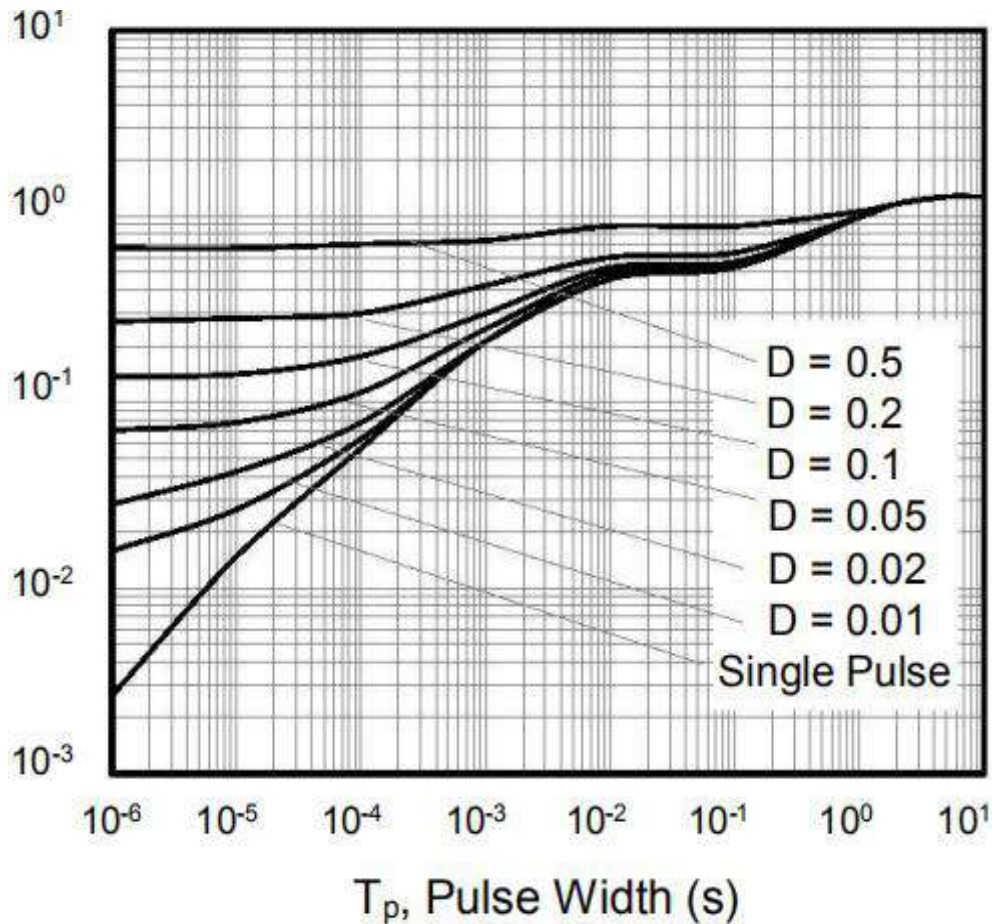


Figure 9. Transient Thermal Impedance



### Test Circuits and Waveforms

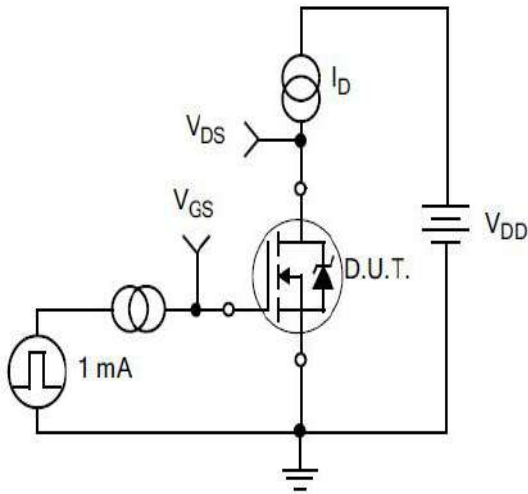


Figure 11.  
Gate Charge Test Circuit

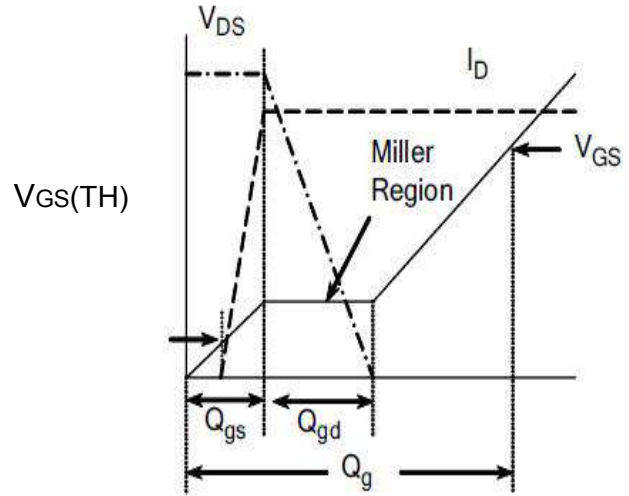


Figure 12.  
Gate Charge Waveform

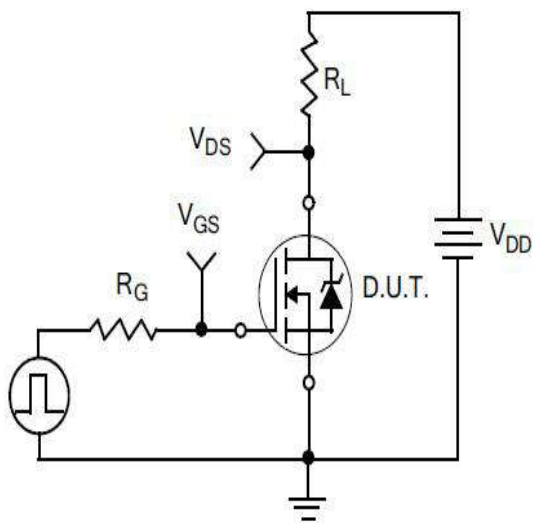


Figure 13.  
Resistive Switching Test Circuit

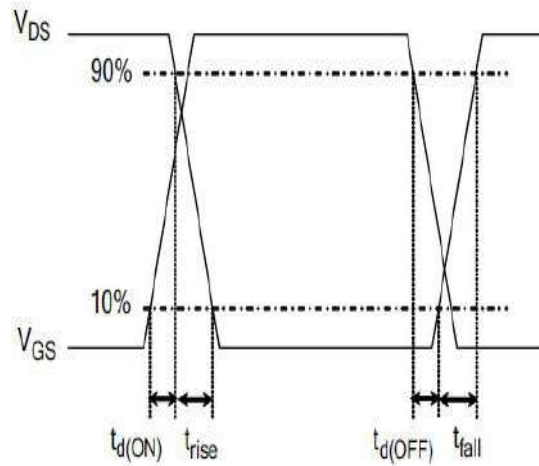


Figure 14.  
Resistive Switching Waveforms

### Test Circuits and Waveforms

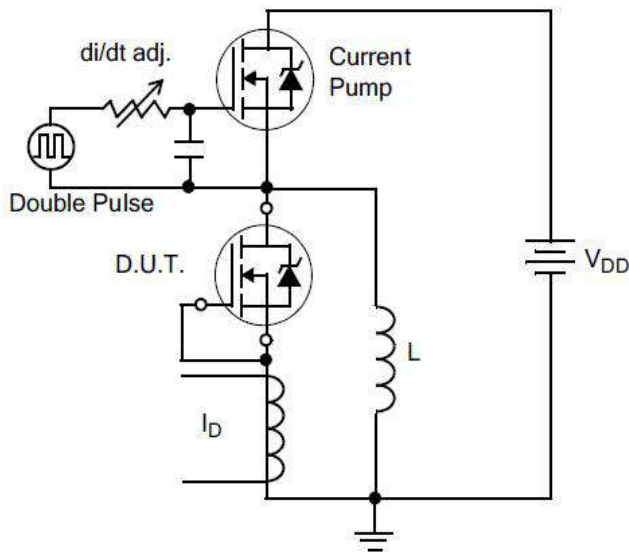


Figure 15. Diode Reverse Recovery Test Circuit

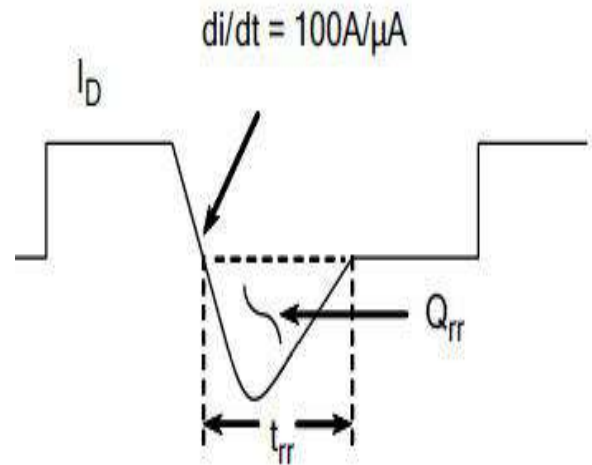


Figure 16. Diode Reverse Recovery Waveform

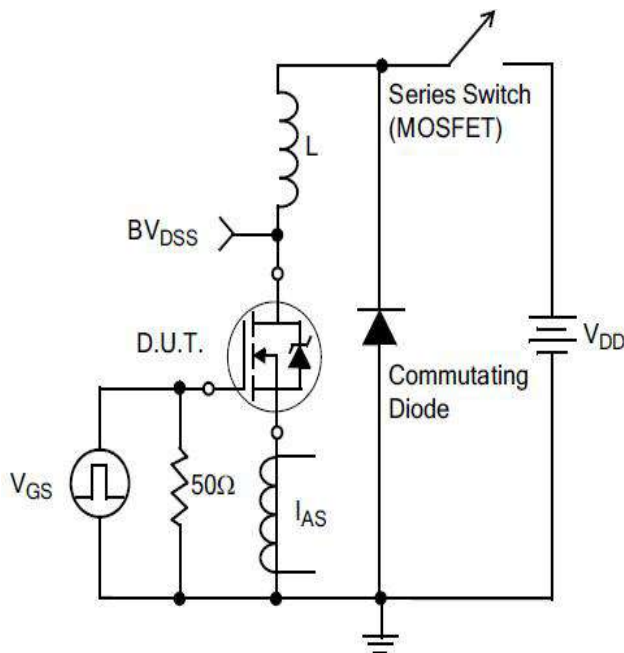
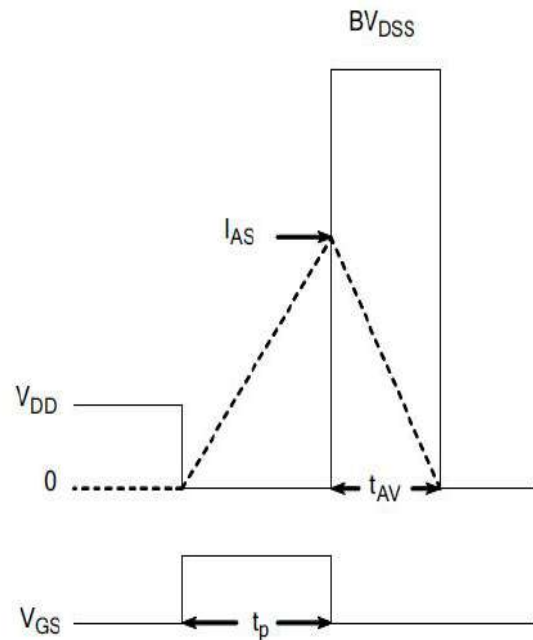


Figure 17. Unclamped Inductive Switching Test Circuit



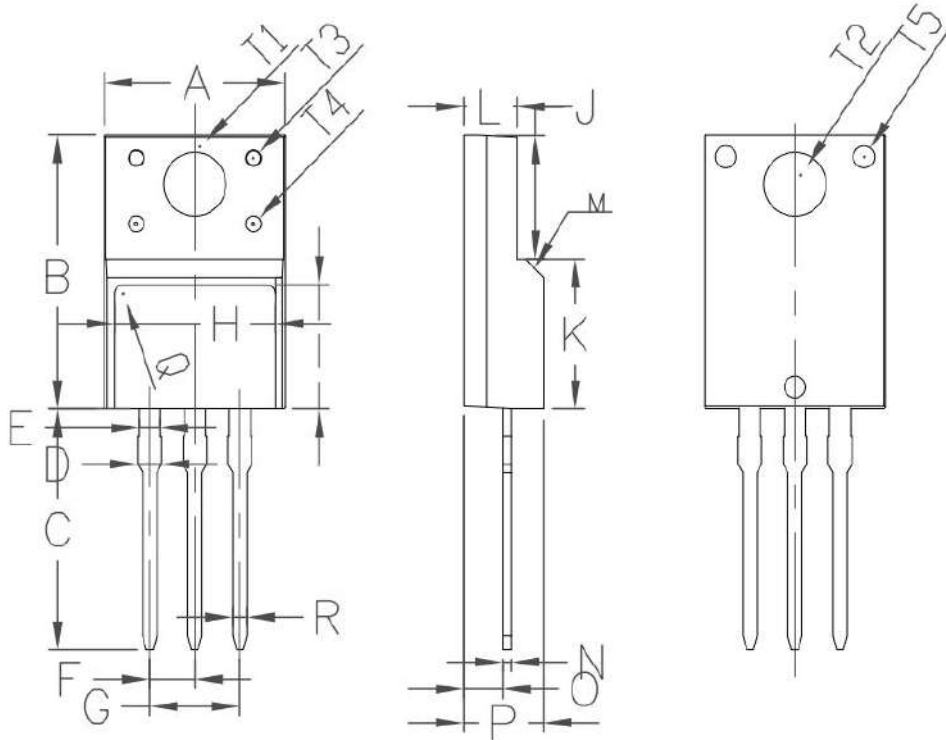
$$E_{AS} = \frac{I_{AS}^2 L}{2}$$

Figure 18. Unclamped Inductive Switching Waveforms

### Package outline drawing

Unit: mm

### TO-220F



| Symbol | Min   | Non   | Max   |
|--------|-------|-------|-------|
| A      | 9.96  | 10.16 | 10.36 |
| B      | 15.67 | 15.87 | 16.07 |
| C      | 13.14 | 13.34 | 13.54 |
| D      | 1.20  | 1.30  | 1.40  |
| E      |       | 1.20  |       |
| F      |       | 2.54  |       |
| G      |       | 5.08  |       |
| H      | 7.60  | 7.80  | 8.00  |
| I      | 7.10  | 7.30  | 7.50  |
| J      | 6.48  | 6.68  | 6.88  |
| K      | 8.99  | 9.19  | 9.39  |
| L      | 2.34  | 2.54  | 2.74  |
| M      |       | 45°   |       |
| N      | 0.49  | 0.50  | 0.52  |
| O      | 2.15  | 2.35  | 2.55  |
| P      | 4.50  | 4.70  | 4.90  |
| Q      |       | 0.50  |       |
| S      | 4°    | 4.5°  | 5°    |
| T1     |       | 3.45  |       |
| T2     |       | 3.18  |       |
| T3     |       | 1.50  |       |
| T4     |       | 1.20  |       |
| T5     |       | 1.50  |       |
| R      | 0.77  | 0.8   | 0.83  |



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