

Main Product Characteristics

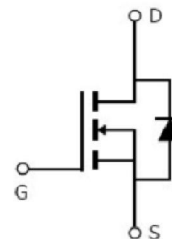
| | |
|--------------|-------------|
| V_{DSS} | 600V |
| $R_{DS(on)}$ | 170mΩ(typ.) |
| I_D | 20A |



TO220F



Marking and Pin Assignment



Schematic Diagram

Features and Benefits

- High dv/dt and avalanche capabilities
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Lead free product



Description

The SSF20NS60F series MOSFET is a new technology, which combines an innovative super junction technology and advance process. This new technology achieves low $R_{DS(ON)}$, energy saving, high reliability and uniformity, superior power density and space saving.

Absolute Max Rating

| Symbol | Parameter | Max. | Units |
|--------------------------|---|--------------|-------|
| $I_D @ TC = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ ^① | 20 | A |
| $I_D @ TC = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ ^① | 13 | |
| I_{DM} | Pulsed Drain Current ^② | 80 | |
| $P_D @ TC = 25^\circ C$ | Power Dissipation ^③ | 34.7 | W |
| | Linear Derating Factor | 0.27 | W/°C |
| V_{DS} | Drain-Source Voltage | 600 | V |
| V_{GS} | Gate-to-Source Voltage | ± 30 | V |
| E_{AS} | Single Pulse Avalanche Energy @ L=13.8mH | 248 | mJ |
| I_{AR} | Avalanche Current @ L=13.8mH | 6 | A |
| $T_J \quad T_{STG}$ | Operating Junction and Storage Temperature Range | -55 to + 150 | °C |

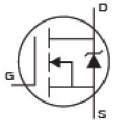
Thermal Resistance

| Symbol | Characteristics | Typ. | Max. | Units |
|-----------------|---|------|------|-------|
| $R_{\theta JC}$ | Junction-to-case ^③ | — | 3.6 | °C/W |
| $R_{\theta JA}$ | Junction-to-ambient ($t \leq 10s$) ^④ | — | 80 | °C/W |

Electrical Characteristics @ $T_A=25^\circ C$ unless otherwise specified

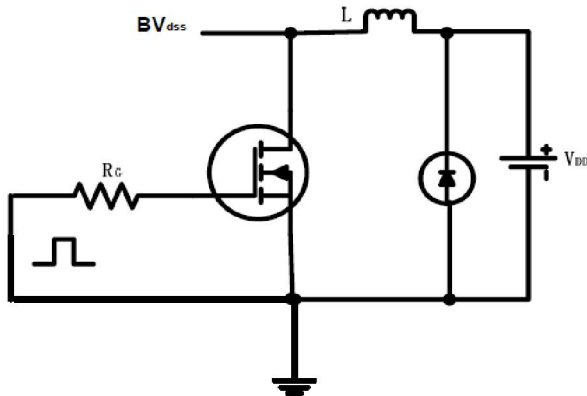
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---------------|--------------------------------------|------|-------|------|------------|--|
| $V_{(BR)DSS}$ | Drain-to-Source breakdown voltage | 600 | — | — | V | $V_{GS} = 0V, I_D = 250\mu A$ |
| $R_{DS(on)}$ | Static Drain-to-Source on-resistance | — | 170 | 190 | m Ω | $V_{GS}=10V, I_D = 13A$ $T_J = 125^\circ C$ |
| | | — | 475 | — | | |
| $V_{GS(th)}$ | Gate threshold voltage | 2 | — | 4 | V | $V_{DS} = V_{GS}, I_D = 250\mu A$ $T_J = 125^\circ C$ |
| | | — | 2.40 | — | | |
| I_{DSS} | Drain-to-Source leakage current | — | — | 1 | μA | $V_{DS} = 600V, V_{GS} = 0V$ $T_J = 125^\circ C$ |
| | | — | — | 50 | | |
| I_{GSS} | Gate-to-Source forward leakage | — | — | 100 | nA | $V_{GS} = 30V$ $V_{GS} = -30V$ |
| | | — | — | -100 | | |
| Q_g | Total gate charge | — | 50.58 | — | nC | $I_D = 20A,$ $V_{DS}=480V,$ $V_{GS} = 10V$ |
| Q_{gs} | Gate-to-Source charge | — | 11.71 | — | | |
| Q_{gd} | Gate-to-Drain("Miller") charge | — | 21.63 | — | | |
| $t_{d(on)}$ | Turn-on delay time | — | 15.42 | — | ns | $V_{GS}=10V, V_{DS}=380V,$ $R_L=18\Omega,$ $R_{GEN}=3.38\Omega$ $I_D=18A$ |
| t_r | Rise time | — | 44.80 | — | | |
| $t_{d(off)}$ | Turn-Off delay time | — | 30.92 | — | | |
| t_f | Fall time | — | 40.36 | — | | |
| C_{iss} | Input capacitance | — | 1514 | — | pF | $V_{GS} = 0V$ $V_{DS} = 25V$ $f = 500KHz$ |
| C_{oss} | Output capacitance | — | 57.44 | — | | |
| C_{rss} | Reverse transfer capacitance | — | 8.43 | — | | |

Source-Drain Ratings and Characteristics

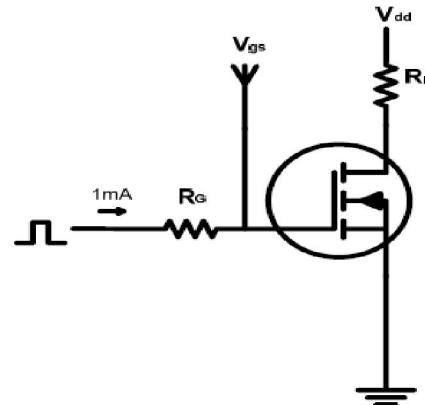
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|----------|---|------|------|------|---------|--|
| I_S | Continuous Source Current (Body Diode) | — | — | 20 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I_{SM} | Pulsed Source Current (Body Diode) | — | — | 80 | A | |
| V_{SD} | Diode Forward Voltage | — | 0.87 | 1.3 | V | $I_S=20A, V_{GS}=0V$ |
| t_{rr} | Reverse Recovery Time | — | 370 | — | ns | $T_J = 25^\circ C, I_F = 20A, di/dt = 100A/\mu s$ |
| Q_{rr} | Reverse Recovery Charge | — | 5 | — | μC | |

Test Circuits and Waveforms

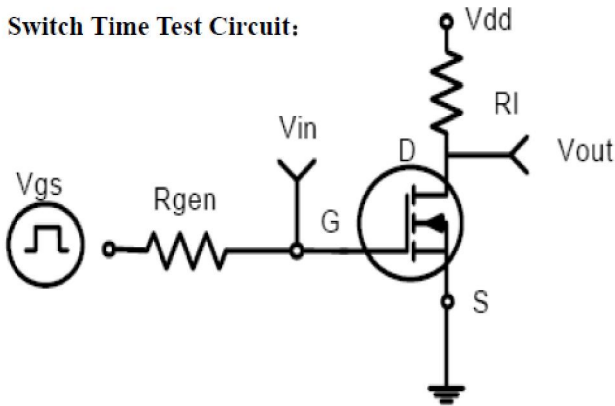
EAS test circuits:



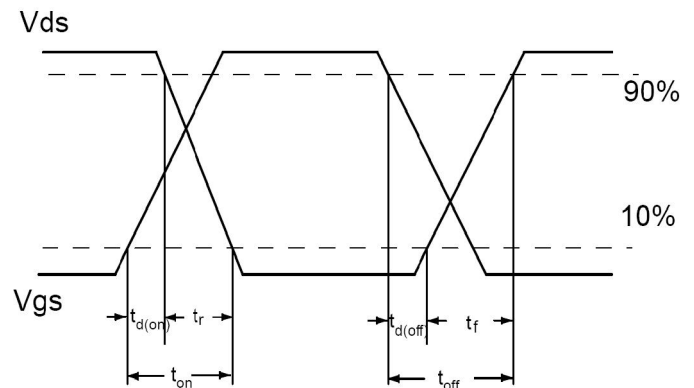
Gate charge test circuit:



Switch Time Test Circuit:



Waveforms:



Notes:

- ① The maximum current rating is limited by bond-wires.
- ② Repetitive rating; pulse width limited by max. junction temperature.
- ③ The power dissipation PD is based on max. junction temperature, using junction-to-case thermal resistance.
- ④ The value of $R_{\theta JA}$ is measured with the device mounted on 1in 2 FR-4 board with 2oz. Copper, in a still air environment with $T_A = 25^\circ\text{C}$
- ⑤ These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)} = 150^\circ\text{C}$.

Typical Electrical and Thermal Characteristics

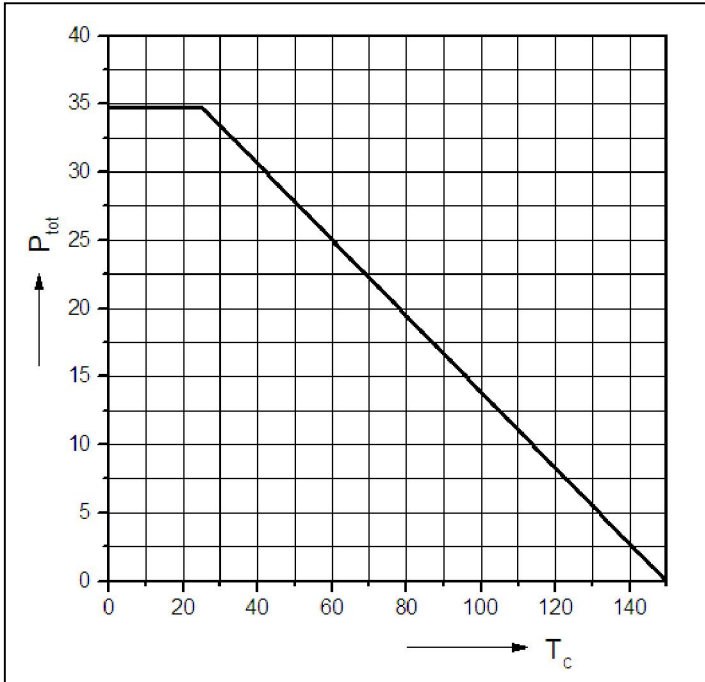


Figure 1: Power dissipation

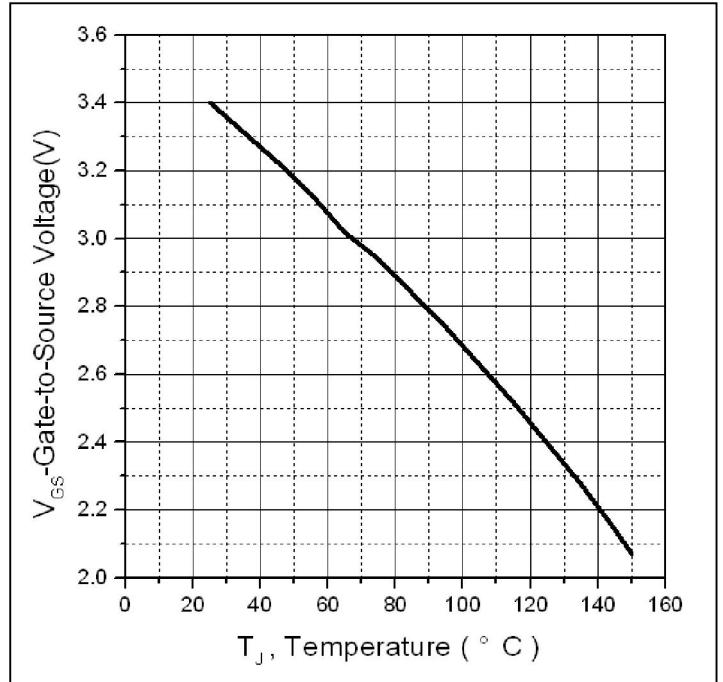


Figure 2: Typ. Gate to source cut-off voltage

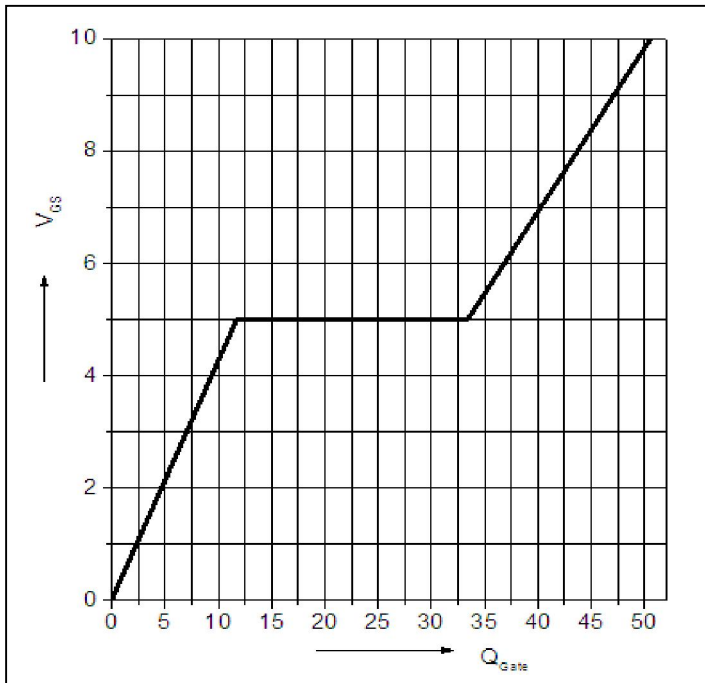


Figure 3: Typ. gate charge

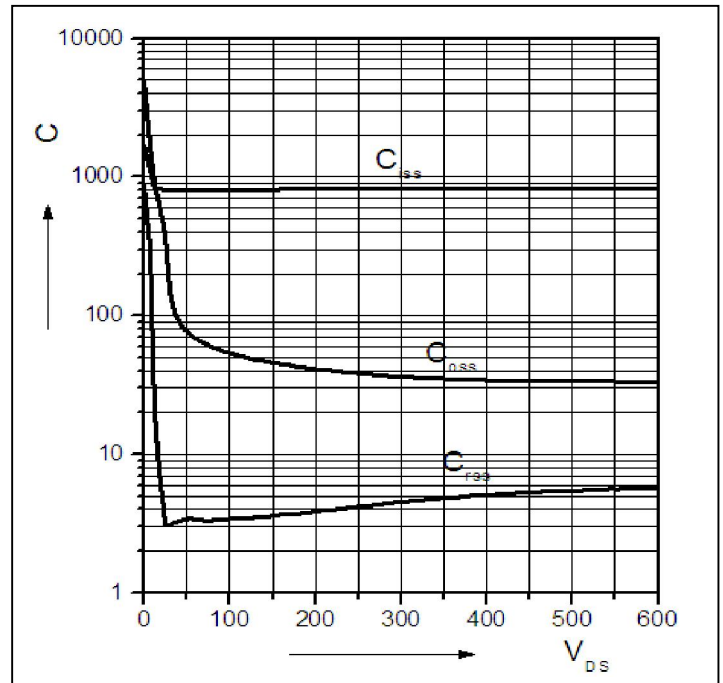


Figure 4: Typ. Capacitances

Typical Electrical and Thermal Characteristics

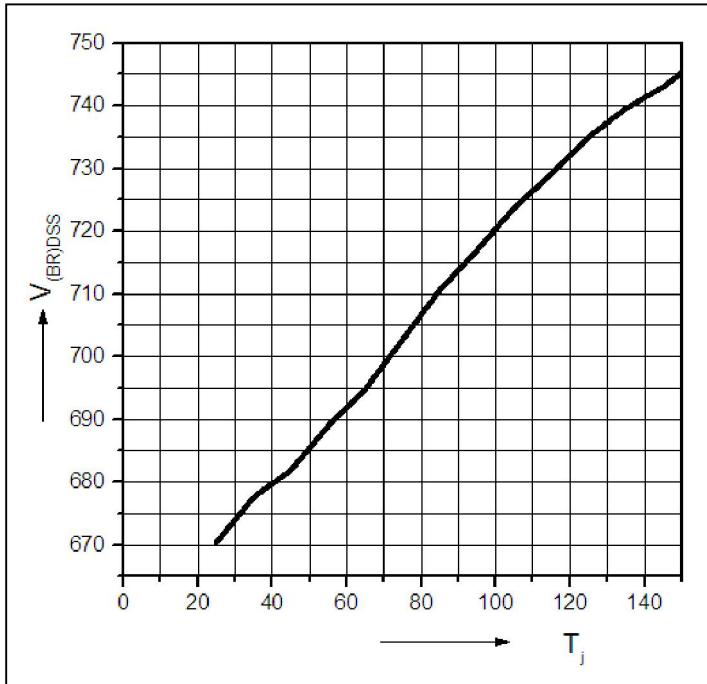


Figure 5. Drain-source breakdown voltage

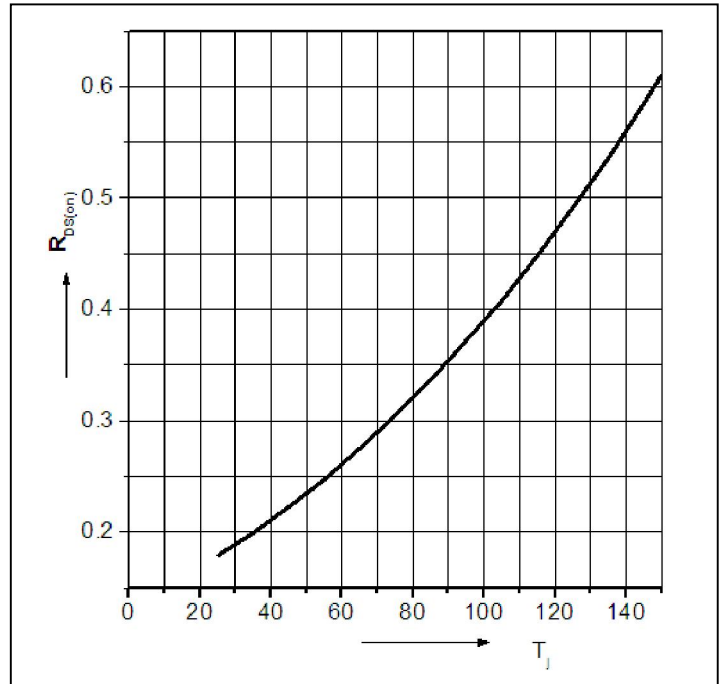
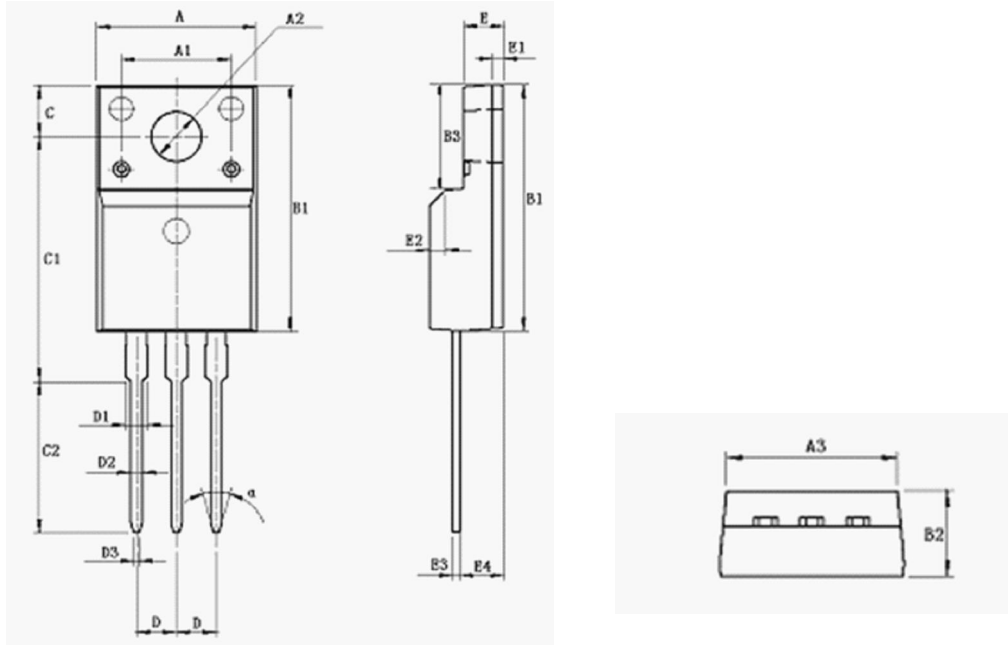


Figure 6. Drain-source on-state resistance

Mechanical Data

TO220F PACKAGE OUTLINE DIMENSION



| Symbol | Dimension In Millimeters | | | Dimension In Inches | | |
|--------|--------------------------|--------|--------|---------------------|-------|-------|
| | Min | Nom | Max | Min | Nom | Max |
| A | 9.960 | 10.160 | 10.360 | 0.392 | 0.400 | 0.408 |
| A1 | 7.000 | | | 0.276 | 0.000 | 0.000 |
| A2 | 3.080 | 3.180 | 3.280 | 0.121 | 0.125 | 0.129 |
| A3 | 9.260 | 9.460 | 9.660 | 0.365 | 0.372 | 0.380 |
| B1 | 15.670 | 15.870 | 16.070 | 0.617 | 0.625 | 0.633 |
| B2 | 4.500 | 4.700 | 4.900 | 0.177 | 0.185 | 0.193 |
| B3 | 6.480 | 6.680 | 6.880 | 0.255 | 0.263 | 0.271 |
| C | 3.200 | 3.300 | 3.400 | 0.126 | 0.130 | 0.134 |
| C1 | 15.600 | 15.800 | 16.000 | 0.614 | 0.622 | 0.630 |
| C2 | 9.550 | 9.750 | 9.950 | 0.376 | 0.384 | 0.392 |
| D | 2.54 (TYP) | | | 1.00 (TYP) | | |
| D1 | - | - | 1.470 | - | - | 0.058 |
| D2 | 0.700 | 0.800 | 0.900 | 0.028 | 0.031 | 0.035 |
| D3 | 0.250 | 0.350 | 0.450 | 0.010 | 0.014 | 0.018 |
| E | 2.340 | 2.540 | 2.740 | 0.092 | 0.100 | 0.108 |
| E1 | 0.700 | | | 0.028 | | |
| E2 | 1.0*45 ⁰ | | | 1.0*45 ⁰ | | |
| E3 | 0.450 | 0.500 | 0.600 | 0.018 | 0.020 | 0.024 |
| E4 | 2.560 | 2.760 | 2.960 | 0.101 | 0.109 | 0.117 |
| □ | 30 ⁰ | | | 30 ⁰ | | |



Ordering and Marking Information

Device Marking: SSF20NS60F

Package (Available)
TO220F
Operating Temperature Range
C : -55 to 150 °C

Devices per Unit

| Package Type | Units/Tube | Tubes/Inner Box | Units/Inner Box | Inner Boxes/Carton Box | Units/Carton Box |
|--------------|------------|-----------------|-----------------|------------------------|------------------|
| TO220F | 50 | 20 | 1000 | 6 | 6000 |

Reliability Test Program

| Test Item | Conditions | Duration | Sample Size |
|-------------------------------------|---|--------------------------------------|---------------------|
| High Temperature Reverse Bias(HTRB) | $T_j=125^{\circ}\text{C}$ to 150°C @ 80% of Max $V_{DSS}/V_{CES}/V_R$ | 168 hours 500 hours 1000 hours | 3 lots x 77 devices |
| High Temperature Gate Bias(HTGB) | $T_j=150^{\circ}\text{C}$ @ 100% of Max V_{GSS} | 168 hours 500 hours 1000 hours | 3 lots x 77 devices |