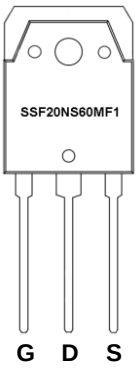
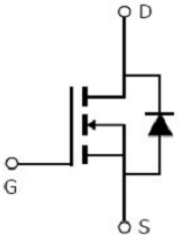
## Main Product Characteristics:

| | |
|---|---|
| $V_{DSS}$ | 600V |
| $R_{DS}$(on) | 0.14Ω (typ.) |
| $I_D$ | 20A ① |


TO-3P




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

## Description:

The SSF20NS60MF1 series MOSFETs is a new technology, which combines an innovative technology and advance process. This new technology achieves low Rdson, energy saving, high reliability and uniformity, superior power density and space saving.

## Absolute Max Rating:

| Symbol | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ TC = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V ① | 20 | A |
| $I_{DM}$ | Pulsed Drain Current ② | 60 | |
| $P_D$ @TC = 25°C | Power Dissipation ③ | 151 | W |
| $V_{DS}$ | Drain-Source Voltage | 600 | V |
| $V_{GS}$ | Gate-to-Source Voltage | ± 30 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy | 3.4 | mJ |
| $I_{AR}$ | Avalanche Current | 418 | A |
| $T_J$ $T_{STG}$ | Operating Junction and Storage Temperature Range | -55 to +150 | °C |

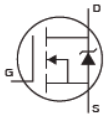
## Thermal Resistance

| Symbol | Characteristics | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-case ③ | — | 0.83 | ℃/W |
| $R_{\theta JA}$ | Junction-to-ambient (t ≤ 10s) ④ | — | 62 | ℃/W |

## Electrical Characteristics @$T_A$=25℃ unless otherwise specified

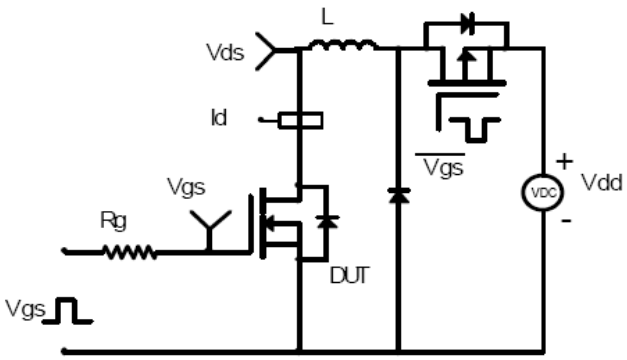
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source breakdown voltage | 600 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250μA |
| $R_{DS(on)}$ | Static Drain-to-Source on-resistance | — | 0.14 | 0.16 | Ω | $V_{GS}$=10V,$I_D$ =10A |
| $V_{GS(th)}$ | Gate threshold voltage | 2.5 | — | 4 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA |
| $I_{DSS}$ | Drain-to-Source leakage current | — | — | 1 | μA | $V_{DS}$ =600V,$V_{GS}$ = 0V |
| $I_{GSS}$ | Gate-to-Source forward leakage | — | — | 100 | nA | $V_{GS}$ =30V |
| | | — | — | -100 | | $V_{GS}$ = -30V |
| $Q_g$ | Total gate charge | — | 38 | — | nC | $I_D$ = 20A, |
| $Q_{gs}$ | Gate-to-Source charge | — | 8 | — | | $V_{DS}$=480V, |
| $Q_{gd}$ | Gate-to-Drain("Miller") charge | — | 14.5 | — | | $V_{GS}$ = 10V |
| $t_{d(on)}$ | Turn-on delay time | — | 31 | — | ns | $V_{GS}$=10V, $V_{DS}$ =400V, $R_{GEN}$=25Ω,$I_D$ =20A |
| $t_r$ | Rise time | — | 69 | — | | |
| $t_{d(off)}$ | Turn-Off delay time | — | 124 | — | | |
| $t_f$ | Fall time | — | 48 | — | | |
| $C_{iss}$ | Input capacitance | — | 1726 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output capacitance | — | 71 | — | | $V_{DS}$ =100V |
| $C_{rss}$ | Reverse transfer capacitance | — | 5 | — | | $f$ = 1MHz |

## Source-Drain Ratings and Characteristics

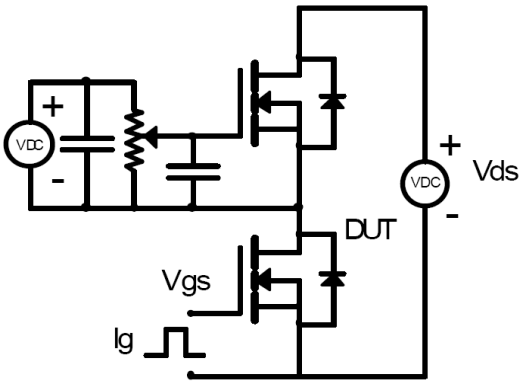
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) ① | — | — | 20 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) | — | — | 60 | A | |
| $V_{sd}$ | Diode Forward Voltage | — | 0.9 | 1.2 | V | $I_S$=20A, $V_{GS}$=0V |
| $t_{rr}$ | Reverse Recovery Time | — | 460 | — | ns | $T_J$ = 25°C, $I_F$ =20A, di/dt = 100A/μs |
| $Q_{rr}$ | Reverse Recovery Charge | — | 5500 | — | nc | |

## Test circuits and Waveforms

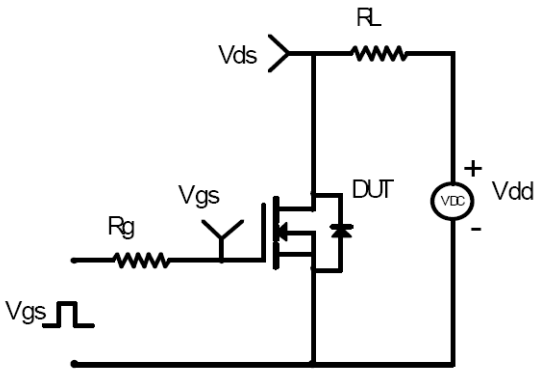
**EAS Test Circuit:**



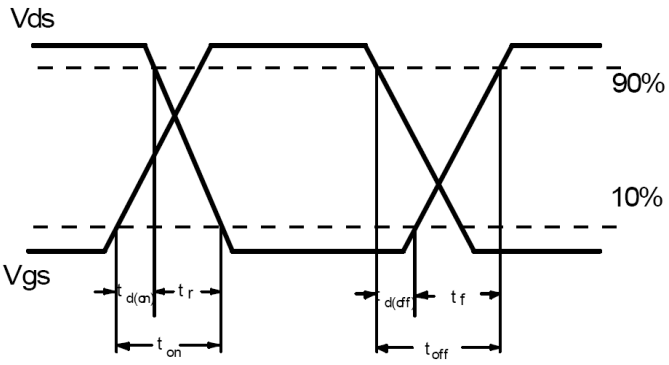

**Gate charge test circuit:**




**Switching Time Test Circuit:**




**Switching Waveforms:**




## Notes:

①Calculated continuous current based on maximum allowable junction temperature.

②Repetitive rating; pulse width limited by max. junction temperature.

③The power dissipation PD is based on max. junction temperature, using junction-to-case thermal resistance.

④The value of $R_{\theta JA}$ is measured with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with TA =25°C

## Typical electrical and thermal characteristics

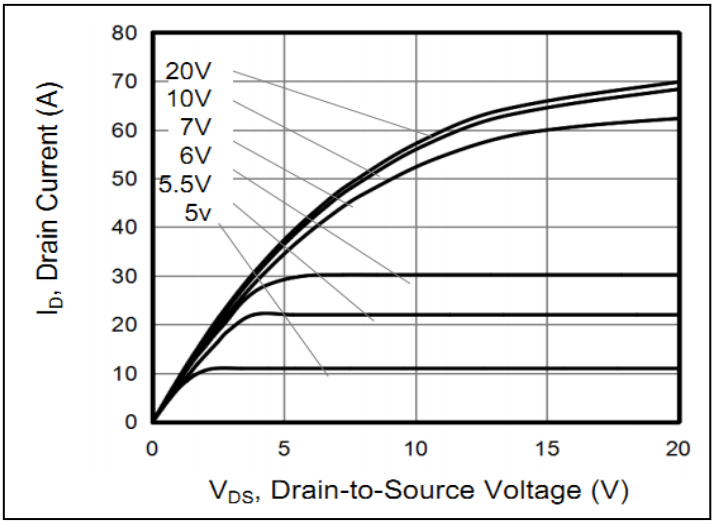



Figure 1: Typical Output Characteristics

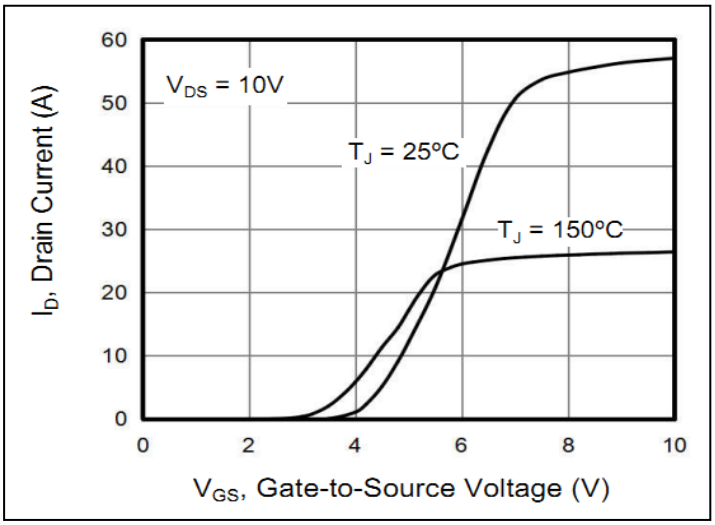



Figure 2: Transfer Characteristics

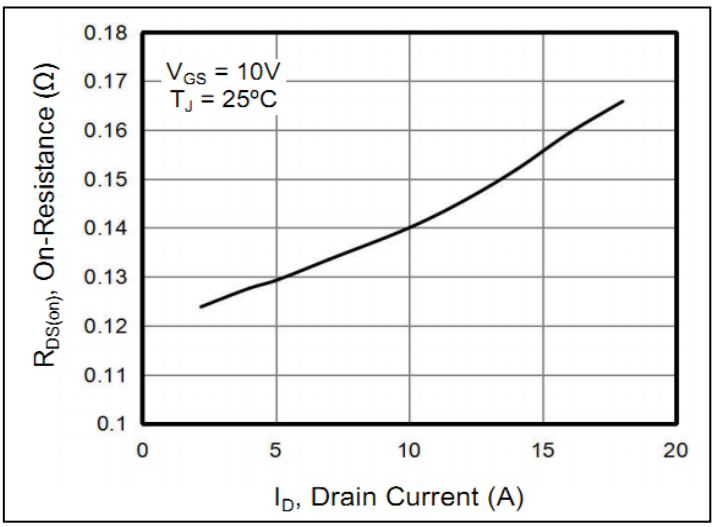



Figure 3: On-Resistance vs. Drain Current

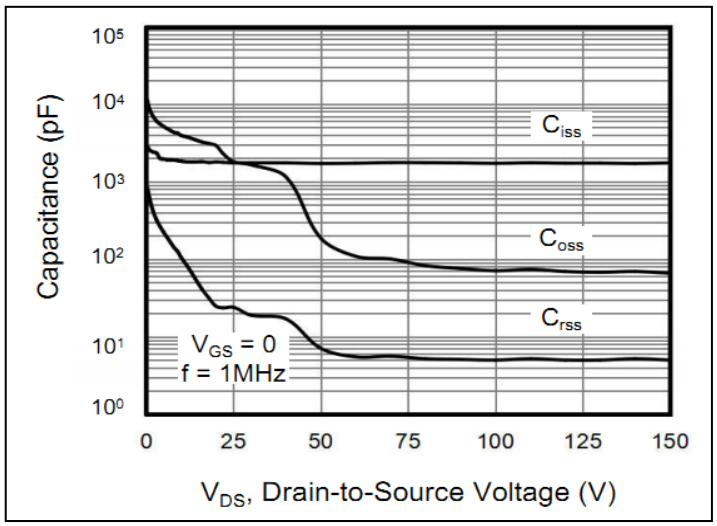



Figure 4: Capacitance

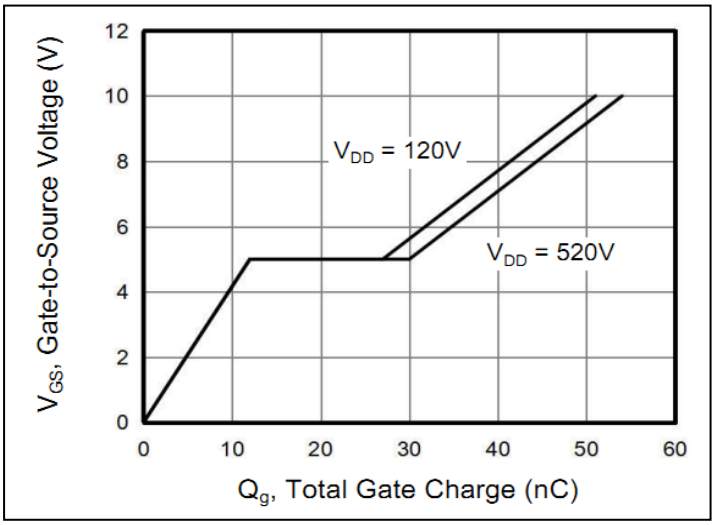



Figure 5: Gate Charge

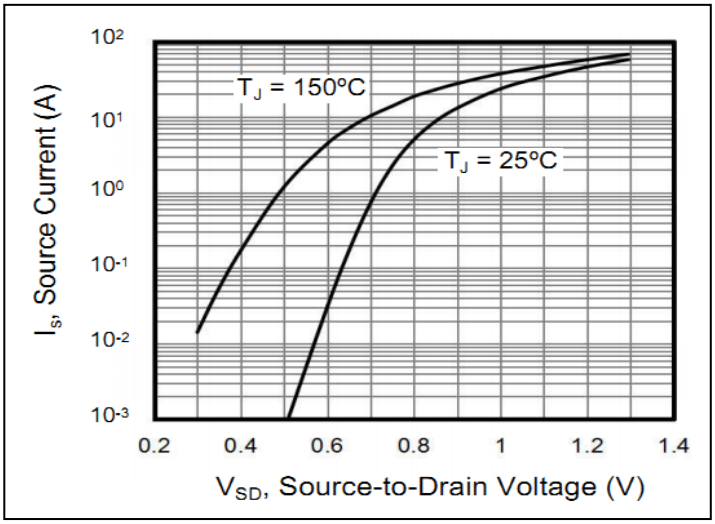



Figure 6: Body Diode Forward Voltage

## Typical electrical and thermal characteristics

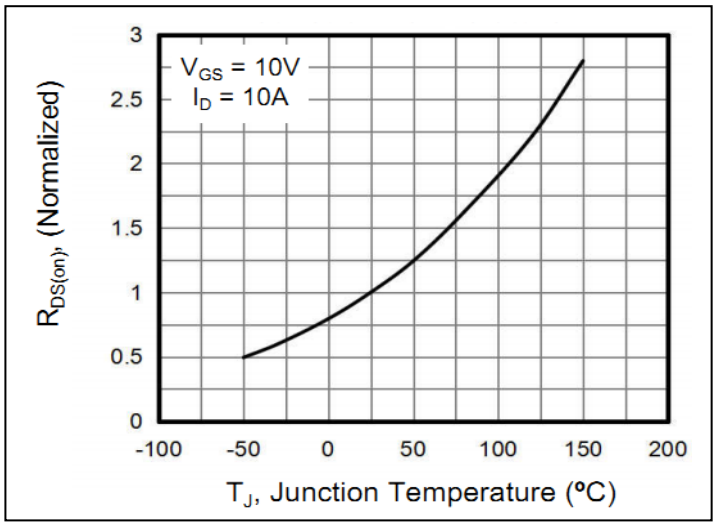



Figure 7: On-Resistance vs. Junction Temperature

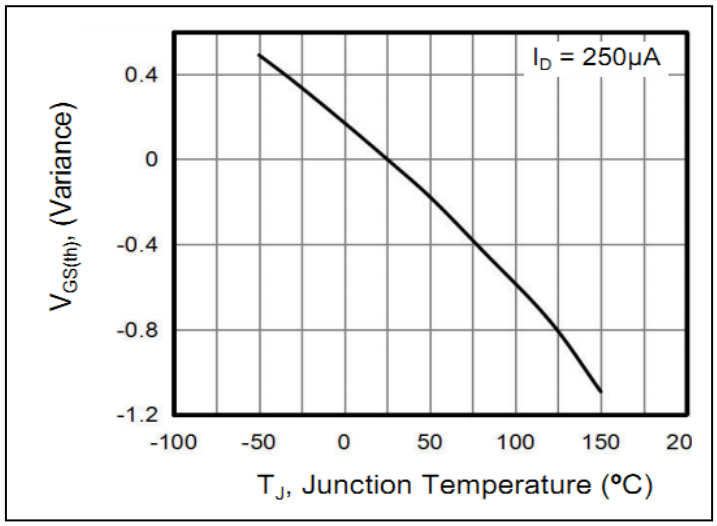



Figure 8: Threshold Voltage vs. Junction Temperature

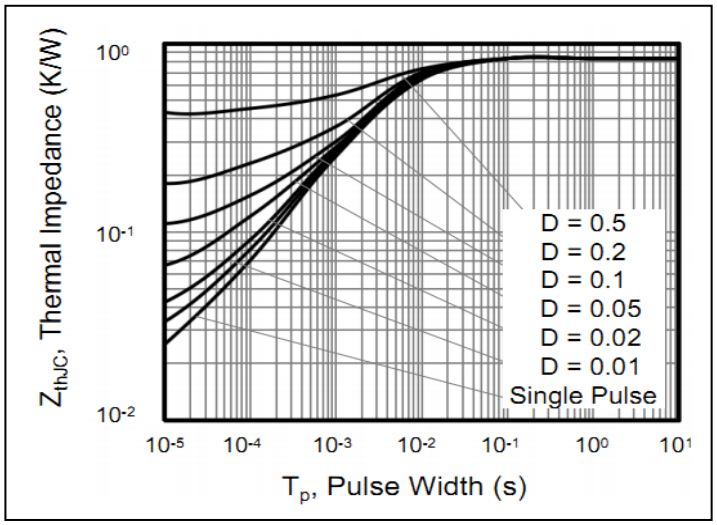



Figure 9: Transient Thermal Impedance

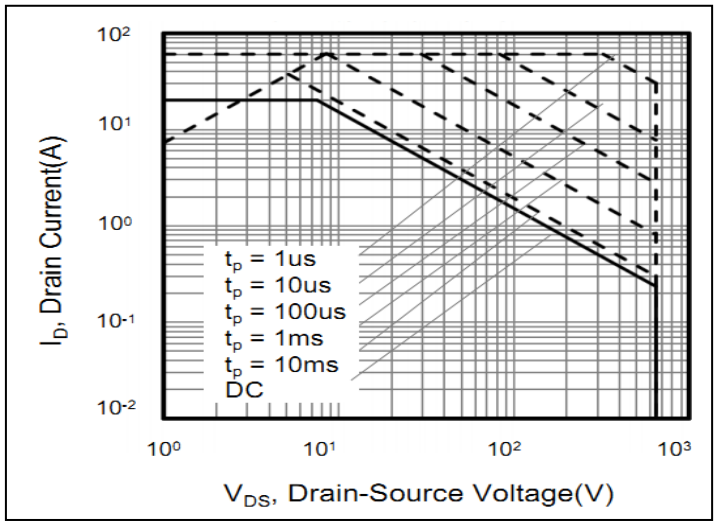
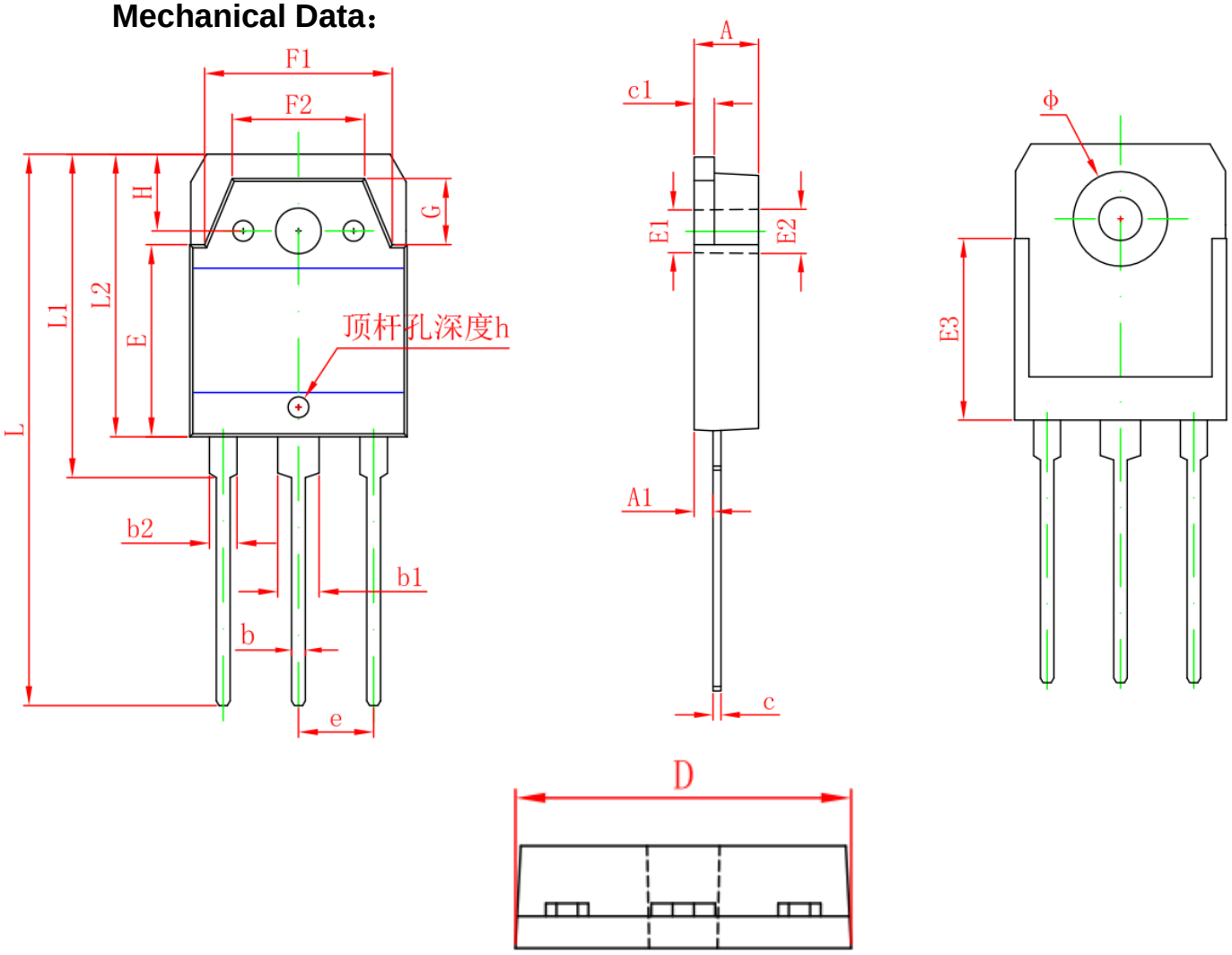



Figure 10: Safe Operation Area

## Mechanical Data：




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 4.600 | 5.000 | 0.181 | 0.197 |
| A1 | 1.200 | 1.600 | 0.047 | 0.063 |
| b | 0.800 | 1.200 | 0.031 | 0.047 |
| b1 | 2.800 | 3.200 | 0.110 | 0.126 |
| b2 | 1.800 | 2.200 | 0.071 | 0.087 |
| c | 0.500 | 0.700 | 0.020 | 0.028 |
| c1 | 1.450 | 1.650 | 0.057 | 0.065 |
| D | 15.450 | 15.850 | 0.608 | 0.624 |
| E | 13.700 | 14.100 | 0.539 | 0.555 |
| E1 | 3.200 REF | | 0.126 REF | |
| E2 | 3.300 REF | | 0.130 REF | |
| E3 | 13.450 REF | | 0.530 REF | |
| F1 | 13.400 | 13.800 | 0.528 | 0.543 |
| F2 | 9.400 | 9.800 | 0.370 | 0.386 |
| L | 39.900 | 40.300 | 1.571 | 1.587 |
| L1 | 23.200 | 23.600 | 0.913 | 0.929 |
| L2 | 20.300 | 20.600 | 0.799 | 0.811 |
| Φ | 6.900 | 7.100 | 0.272 | 0.280 |
| G | 5.150 | 5.550 | 0.203 | 0.219 |
| e | 5.450 TYP | | 0.215 TYP | |
| H | 5.000 REF | | 0.197 REF | |
| h | 0.000 | 0.300 | 0.000 | 0.012 |

## Ordering and Marking Information

**Device Marking: SSF20NS60MF1**

**Package (Available)**

**TO-3P**

**Operating Temperature Range**

**C : -55 to 150 ºC**

## Reliability Test Program

| Test Item | Conditions | Duration | Sample Size |
|---|---|---|---|
| High Temperature Reverse Bias(HTRB) | $T_j$=150℃ @ 80% of Max $V_{DSS}$/$V_{CES}$/VR | 168 hours<br>500 hours<br>1000 hours | 3 lots x 77 devices |
| High Temperature Gate Bias(HTGB) | $T_j$=150℃ @ 100% of Max $V_{GSS}$ | 168 hours<br>500 hours<br>1000 hours | 3 lots x 77 devices |

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