GOOD-ARK
SEMICONDUCTOR

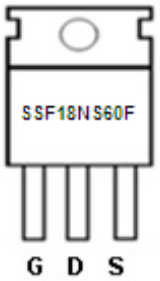
# SSF18NS60F

**610V N-Channel MOSFET**

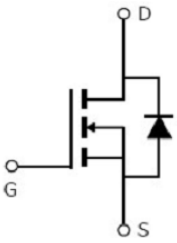
## Main Product Characteristics

| | |
|---|---|
| $V_{DSS}$ | 610V |
| $R_{DS(on)}$ | 0.27Ω (typ.) |
| $I_D$ | 15A ① |

TO-220F




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 SSF18NS60F combines an innovative super junction technology and advance process. This technology achieves low $R_{dson}$, energy savings, high reliability and uniformity, superior power density and space saving.

## Absolute Max Ratings

| Symbol | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V | 15 ① | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V | 9.4 ① | |
| $I_{DM}$ | Pulsed Drain Current ② | 60 | |
| $P_D$ @$T_C$ = 25°C | Power Dissipation ③ | 32.8 | W |
| | Linear Derating Factor | 0.26 | W/°C |
| $V_{DS}$ | Drain-Source Voltage | 610 | V |
| $V_{GS}$ | Gate-to-Source Voltage | ±30 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy @ L=22.5mH | 180 | mJ |
| $I_{AS}$ | Avalanche Current @ L=22.5mH | 4 | A |
| $T_J$, $T_{STG}$ | Operating Junction and Storage Temperature Range | -55 to + 150 | °C |

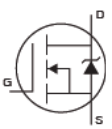
## Thermal Resistance

| Symbol | Characteristics | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case ③ | — | 3.8 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient (t ≤ 10s) ④ | — | 80 | °C/W |

## Electrical Characteristics @$T_A$=25°C unless otherwise specified

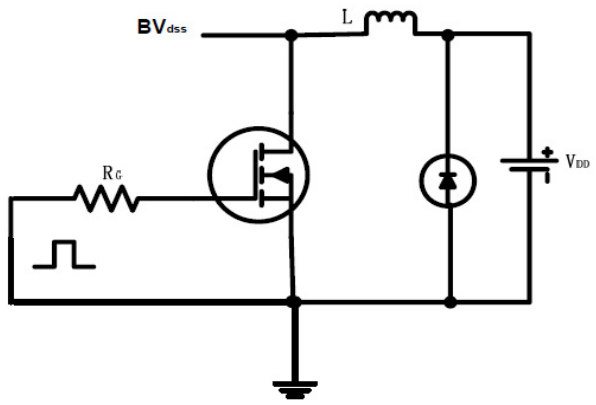
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 610 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250μA |
| $R_{DS(on)}$ | Static Drain-to-Source On-resistance | — | 0.27 | 0.35 | Ω | $V_{GS}$=10V,$I_D$ = 9.4A |
| | | — | 0.73 | — | | $T_J$ = 125°C |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2 | — | 4 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA |
| | | — | 2.66 | — | | $T_J$ = 125°C |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 1 | μA | $V_{DS}$ = 600V,$V_{GS}$ = 0V |
| | | — | — | 50 | | $T_J$ = 125°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS}$ =30V |
| | | — | — | -100 | | $V_{GS}$ = -30V |
| $Q_g$ | Total Gate Charge | — | 27.0 | — | nC | $I_D$ = 10A, |
| $Q_{gs}$ | Gate-to-Source Charge | — | 6.3 | — | | $V_{DS}$=480V, |
| $Q_{gd}$ | Gate-to-Drain("Miller") Charge | — | 13.7 | — | | $V_{GS}$ = 10V |
| $t_{d(on)}$ | Turn-on Delay Time | — | 12.3 | — | nS | $V_{GS}$=10V, $V_{DS}$ =480V, |
| $t_r$ | Rise Time | — | 24.3 | — | | $R_L$=40Ω, |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 27.1 | — | | $R_{GEN}$=4.1Ω |
| $t_f$ | Fall Time | — | 19.7 | — | | $I_D$ =12A |
| $C_{iss}$ | Input Capacitance | — | 949 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 783 | — | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 11 | — | | $f$ = 400KHz |

## Source-Drain Ratings and Characteristics

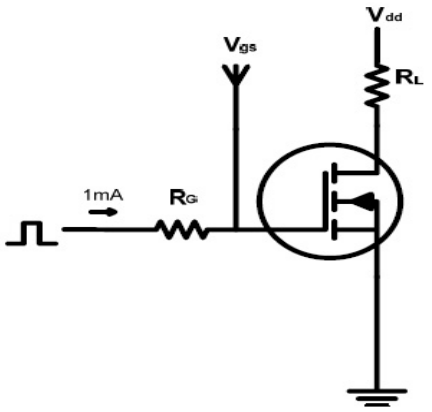
| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 15 ① | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) | — | — | 60 | A | |
| $V_{sd}$ | Diode Forward Voltage | — | 0.89 | 1.3 | V | $I_S$=15A, $V_{GS}$=0V |
| $t_{rr}$ | Reverse Recovery Time | — | 313 | — | nS | $T_J$ = 25°C, $I_F$ =15A, di/dt = 100A/μs |
| $Q_{rr}$ | Reverse Recovery Charge | — | 3 | — | μC | |

## Test Circuits and Waveforms

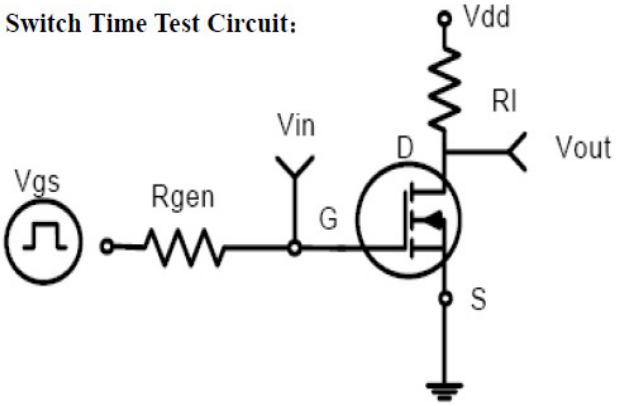
**EAS test circuits:**



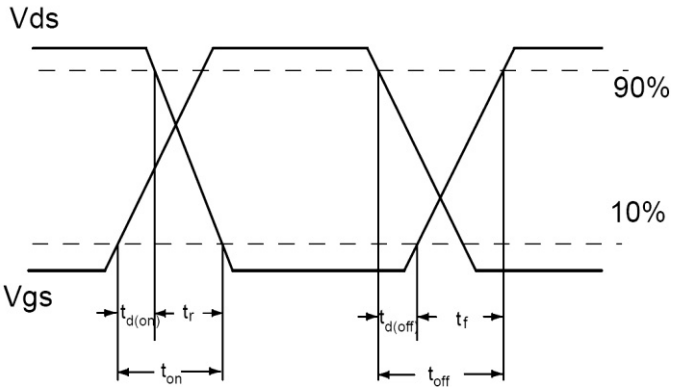

**Gate charge test circuit:**




**Switch 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 $P_D$ 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 $T_A$ =25°C

## Typical Electrical and Thermal Characteristics

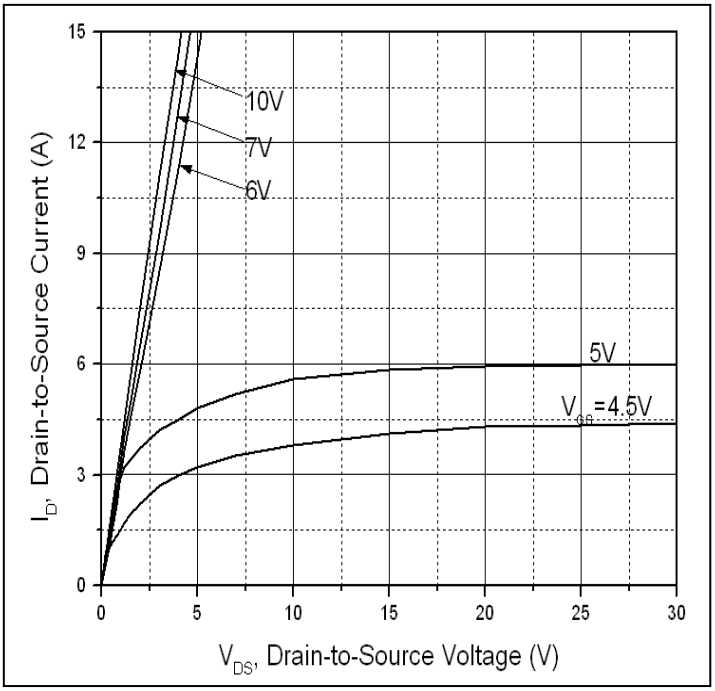



Figure 1. Typical Output Characteristics

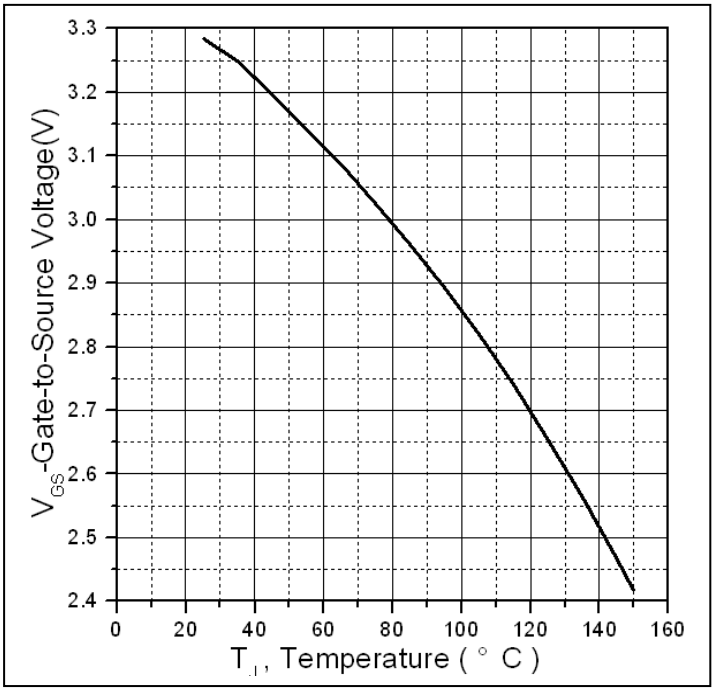



Figure 2. Gate to Source Cut-off Voltage

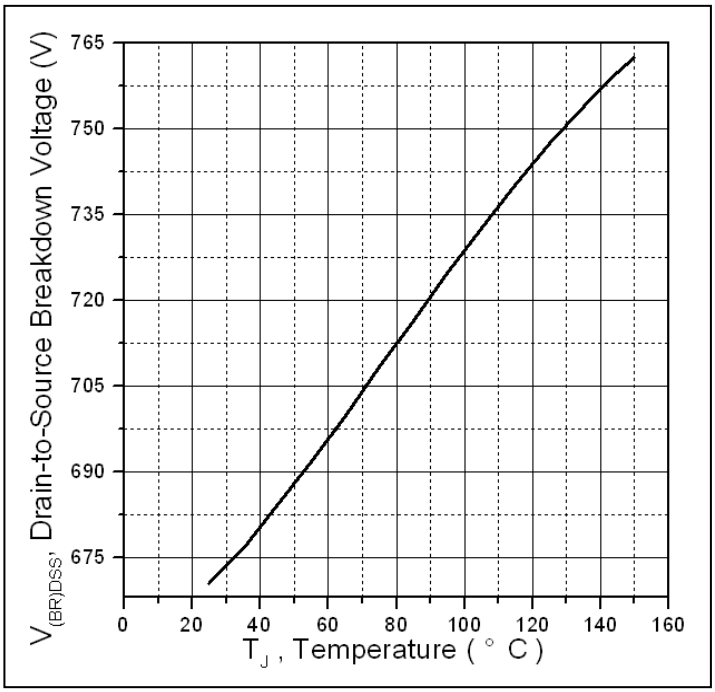



Figure 3. Drain-to-Source Breakdown Voltage vs. Temperature

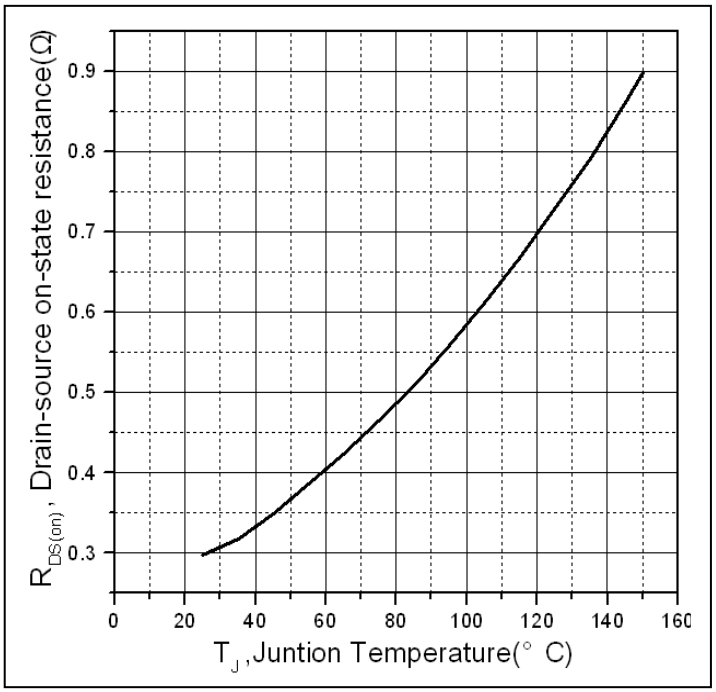



Figure 4. Normalized On-Resistance Vs. Case Temperature

## Typical Electrical and Thermal Characteristics

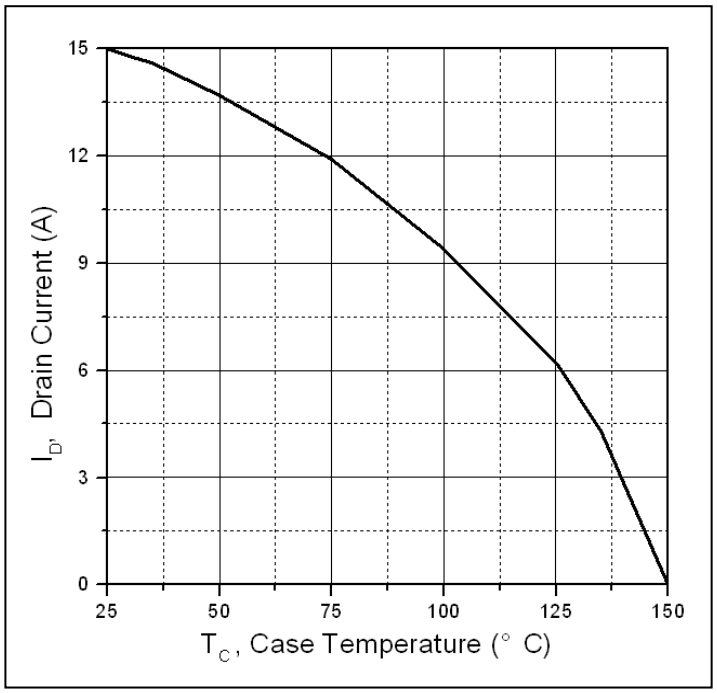



**Figure 5. Maximum Drain Current Vs. Case Temperature**

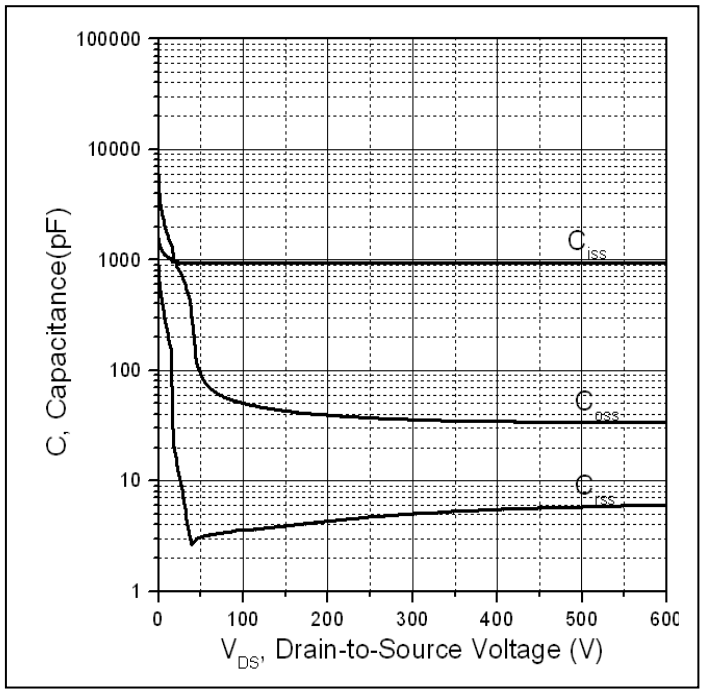
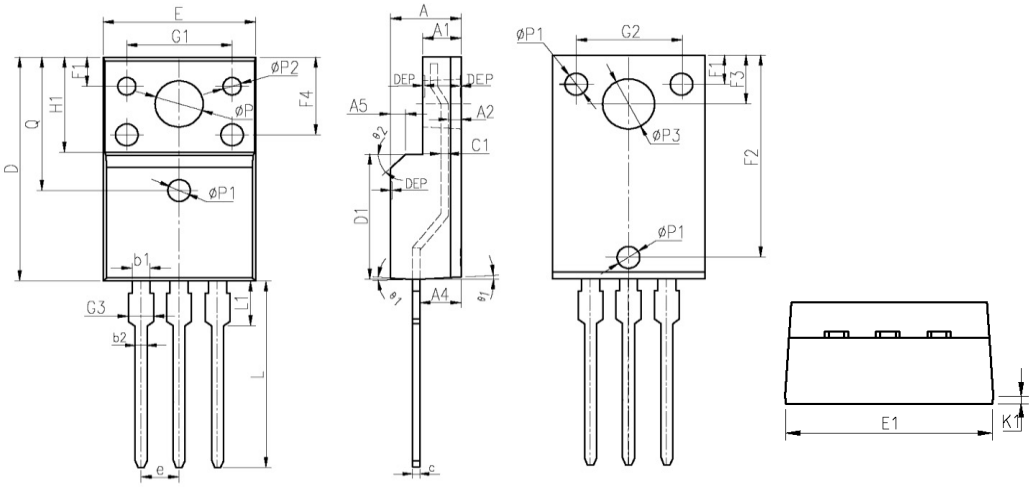



**Figure 6. Typical Capacitance Vs. Drain-to-Source Voltage**

## Mechanical Data

**TO-220F PACKAGE OUTLINE DIMENSION**




| Symbol | Dimensions In Millimeters | | | Dimensions In Inches | | |
|---|---|---|---|---|---|---|
| | Min | Nom | Max | Min | Nom | Max |
| E | 10.040 | 10.200 | 10.360 | 0.395 | 0.402 | 0.408 |
| A | 4.500 | 4.700 | 4.900 | 0.177 | 0.185 | 0.193 |
| A1 | 2.340 | 2.540 | 2.740 | 0.092 | 0.100 | 0.108 |
| A2 | 0.950 | 1.050 | 1.150 | 0.037 | 0.041 | 0.045 |
| A4 | 2.650 | 2.750 | 2.850 | 0.104 | 0.108 | 0.112 |
| A5 | | 1.00REF | | | 0.039REF | |
| c | 0.420 | 0.500 | 0.580 | 0.017 | 0.020 | 0.023 |
| c1 | 0.420 | 0.500 | 0.580 | 0.017 | 0.020 | 0.023 |
| D | 15.670 | 15.870 | 16.070 | 0.617 | 0.625 | 0.633 |
| Q | | 9.20REF | | | 0.362REF | |
| H1 | | 6.70REF | | | 0.264REF | |
| e | | 2.54BSC | | | 0.10BSC | |
| ΦP | | 3.183REF | | | 0.125REF | |
| L | 12.780 | 12.980 | 13.180 | 0.503 | 0.511 | 0.519 |
| L1 | 3.250 | 3.450 | 3.650 | 0.128 | 0.136 | 0.144 |
| D1 | | 9.17REF | | | 0.362REF | |
| ΦP1 | 1.400 | 1.500 | 1.600 | 0.055 | 0.059 | 0.063 |
| ΦP2 | 1.150 | 1.200 | 1.250 | 0.045 | 0.047 | 0.049 |
| ΦP3 | | 3.45REF | | | 0.136REF | |
| Θ1 | 5° | 7° | 9° | 5° | 7° | 9° |
| Θ2 | - | 45° | - | - | 45° | - |
| DEP | 0.050 | 0.100 | 0.150 | 0.002 | 0.004 | 0.006 |
| F1 | 1.900 | 2.000 | 2.100 | 0.075 | 0.079 | 0.083 |
| F2 | 13.800 | 13.900 | 14.000 | 0.543 | 0.547 | 0.551 |
| F3 | 3.200 | 3.300 | 3.400 | 0.126 | 0.130 | 0.134 |
| F4 | 5.300 | 5.400 | 5.500 | 0.209 | 0.213 | 0.217 |
| G1 | 6.600 | 6.700 | 6.800 | 0.260 | 0.264 | 0.268 |
| G2 | 6.900 | 7.000 | 7.100 | 0.272 | 0.276 | 0.280 |
| G3 | 1.100 | 1.300 | 1.500 | 0.043 | 0.051 | 0.059 |
| E1 | 9.900 | 10.000 | 10.100 | 0.390 | 0.394 | 0.398 |
| K1 | 0.650 | 0.700 | 0.750 | 0.026 | 0.028 | 0.030 |
| b1 | 1.050 | 1.200 | 1.350 | 0.041 | 0.047 | 0.053 |
| b2 | 0.700 | 0.800 | 0.850 | 0.028 | 0.031 | 0.033 |

## Ordering and Marking Information

**Device Marking: SSF18NS60F**

**Package (Available)**

**TO-220F**

**Operating Temperature Range**

**C : -55 to 150 ºC**

## Devices per Unit

| Package Type | Units/ Tube | Tubes/Inner Box | Units/Inner Box | InnerBoxes/ CartonBox | Units/Carton Box |
|---|---|---|---|---|---|
| TO-220F | 50 | 20 | 1000 | 10 | 10000 |

## Reliability Test Program

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