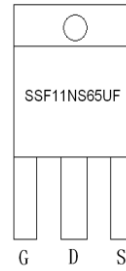


Main Product Characteristics

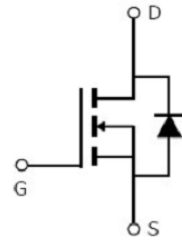
V_{DS}	650V
$R_{DS(on)}$	0.32 Ω (typ.)
I_D	11A



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 SSF11NS65UF combines an innovative super junction technology and advanced process. This technology achieves low $R_{ds(on)}$, energy savings, high reliability and uniformity, superior power density and space saving.

Absolute Max Ratings

Symbol	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ ①	11	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ ①	7	
I_{DM}	Pulsed Drain Current②	44	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation③	31	W
	Linear Derating Factor	0.25	W/°C
V_{DS}	Drain-Source Voltage	650	V
V_{GS}	Gate-to-Source Voltage	± 30	V
E_{AS}	Single Pulse Avalanche Energy @ L=133mH	250	mJ
I_{AS}	Avalanche Current @ L=133mH	1.94	A
T_J, T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C

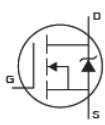
Thermal Resistance

Symbol	Characteristics	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ^③	—	4.0	$^{\circ}C/W$
$R_{\theta JA}$	Junction-to-Ambient ($t \leq 10s$) ^④	—	80	$^{\circ}C/W$

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

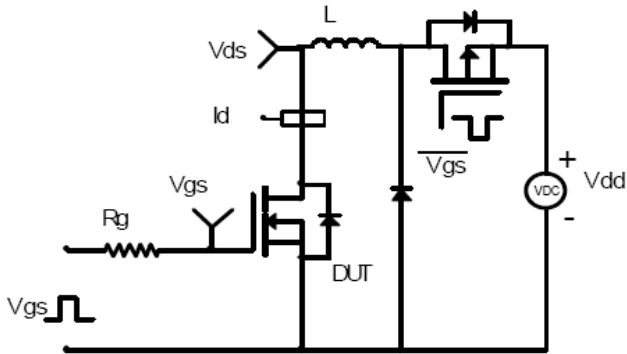
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	650	—	—	V	$V_{GS} = 0V, I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-resistance	—	0.32	0.38	Ω	$V_{GS}=10V, I_D = 3.2A$
		—	0.72	—		$T_J = 125^{\circ}C$
$V_{GS(th)}$	Gate Threshold Voltage	2	—	4	V	$V_{DS} = V_{GS}, I_D = 0.32mA$
		—	2.1	—		$T_J = 125^{\circ}C$
I_{DSS}	Drain-to-Source Leakage Current	—	—	1	μA	$V_{DS} = 650V, V_{GS} = 0V$
		—	—	50		$T_J = 125^{\circ}C$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
		—	—	-100		$V_{GS} = -30V$
Q_g	Total Gate Charge	—	22	—	nC	$I_D = 6A,$
Q_{gs}	Gate-to-Source Charge	—	4.3	—		$V_{DS} = 200V,$
Q_{gd}	Gate-to-Drain("Miller") Charge	—	8	—		$V_{GS} = 10V$
$t_{d(on)}$	Turn-on Delay Time	—	11	—	ns	$V_{GS}=10V, V_{DS}=400V,$ $R_L=81.6\Omega, R_{GEN}=3.4\Omega$ $I_D=4.9A$
t_r	Rise Time	—	6	—		
$t_{d(off)}$	Turn-Off Delay Time	—	29	—		
t_f	Fall Time	—	6	—		
C_{iss}	Input Capacitance	—	804	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	34	—		$V_{DS} = 100V$
C_{rss}	Reverse Transfer Capacitance	—	3.4	—		$f = 600KHz$

Source-Drain Ratings and Characteristics

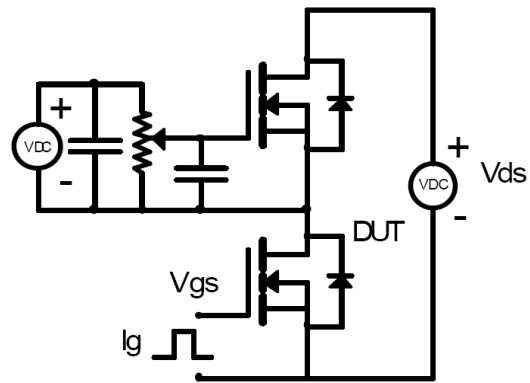
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	11	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode)	—	—	44	A	
V_{SD}	Diode Forward Voltage	—	0.82	1.2	V	$I_S=4.9A, V_{GS}=0V$
t_{rr}	Reverse Recovery Time	—	247	—	ns	$T_J = 25^{\circ}C, I_F = 11A,$ $di/dt = 100A/\mu s$
Q_{rr}	Reverse Recovery Charge	—	2.46	—	μC	

Test Circuits and Waveforms

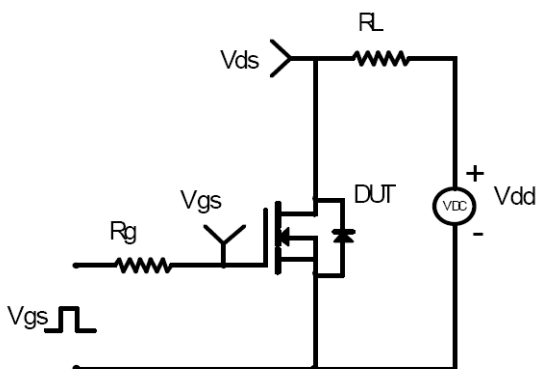
E_{AS} Test Circuit:



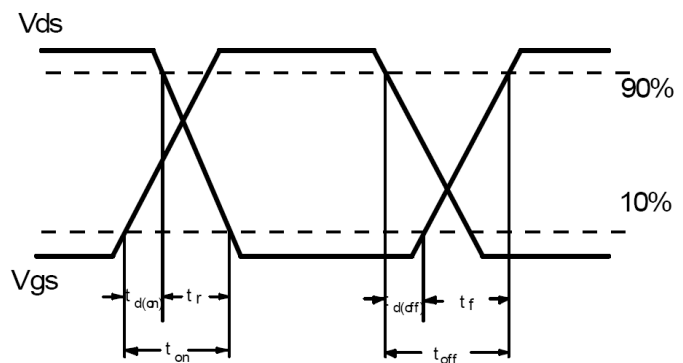
Gate Charge Test Circuit:



Switching Time Test Circuit:



Switching Waveforms:



Notes:

- ① Calculated continuous current based on maximum allowable junction temperature.
- ② Repetitive rating; pulse width limited by max. junction temperature.
- ③ The power dissipation P_D 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 1 in² FR-4 board with 2oz. Copper, in a still air environment with $T_A = 25^\circ\text{C}$

Typical Electrical and Thermal Characteristics

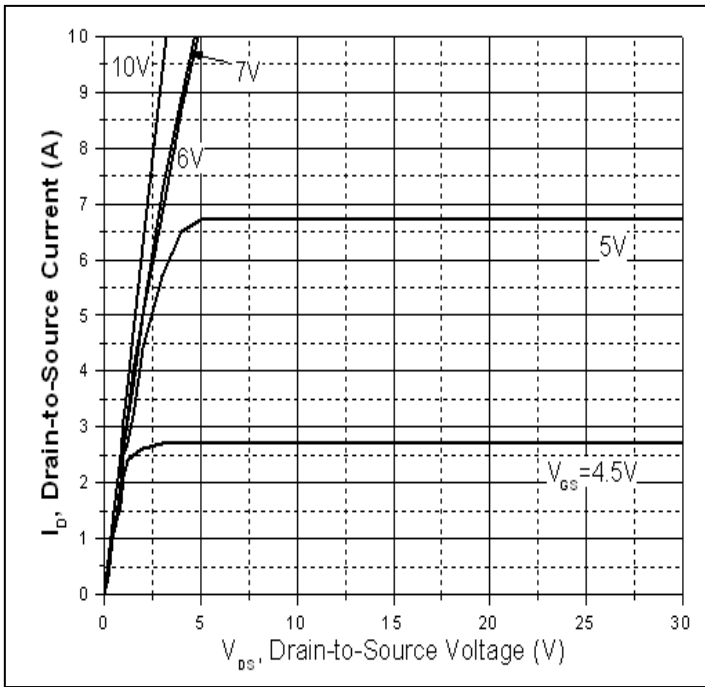


Figure 1. Typical Output Characteristics

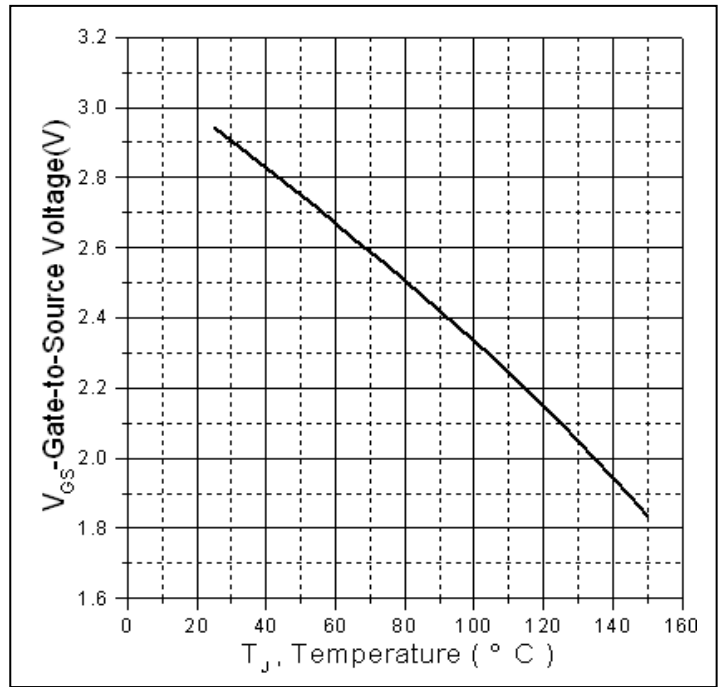


Figure 2. Gate to Source Cut-off Voltage

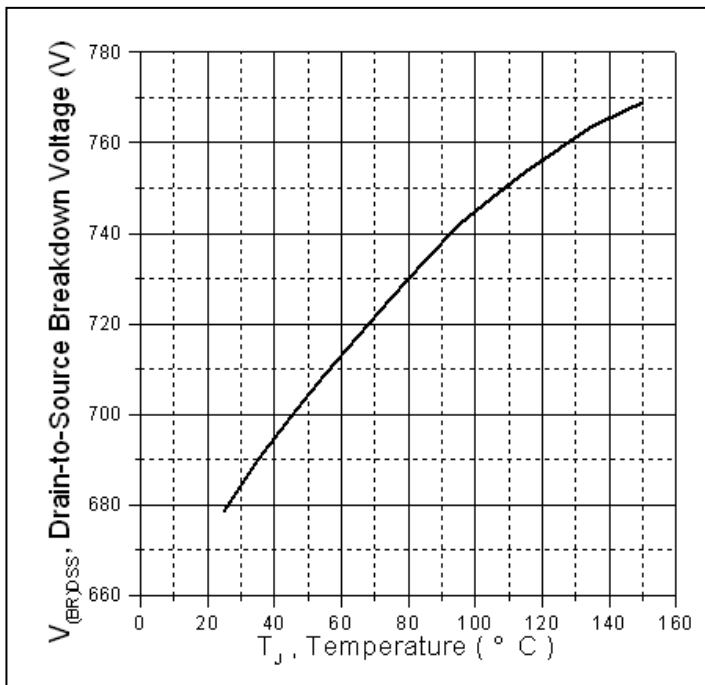


Figure 3. Drain-to-Source Breakdown Voltage Vs. Case Temperature

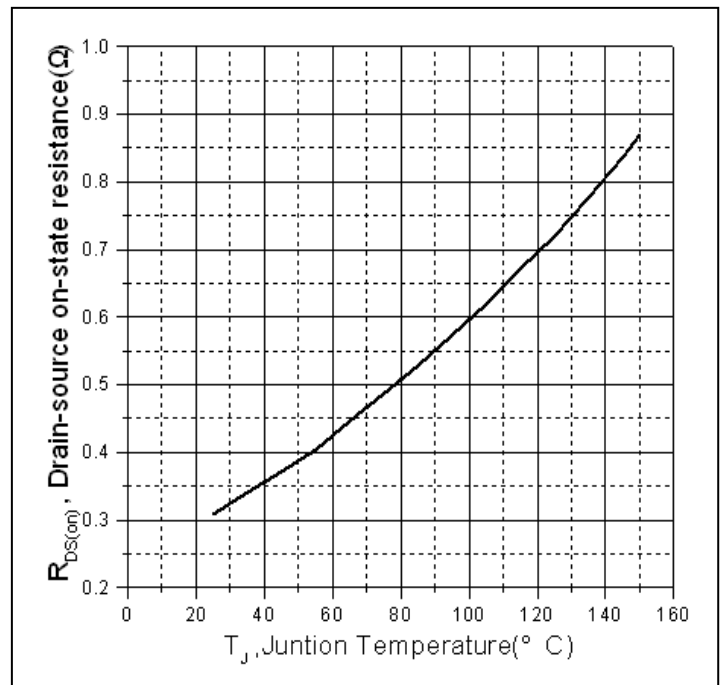


Figure 4: Normalized On-Resistance Vs. Case Temperature

Typical Electrical and Thermal Characteristics

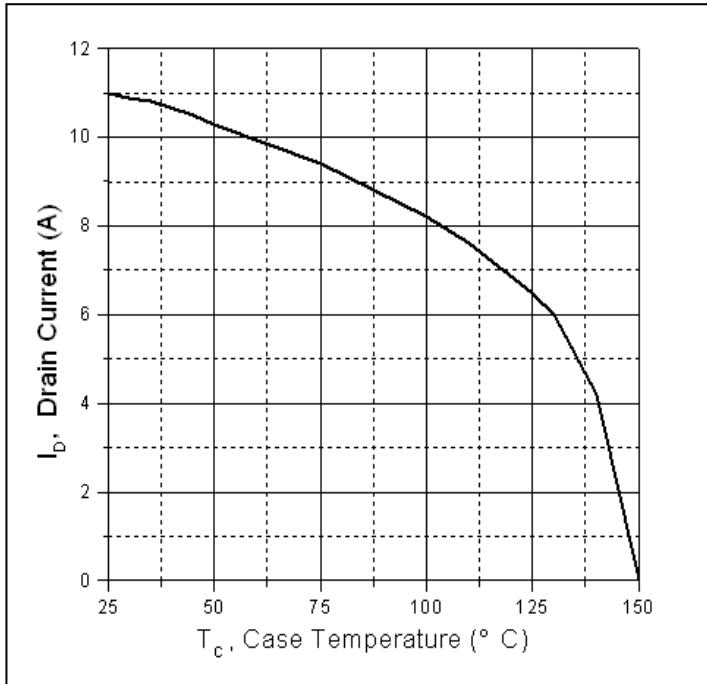


Figure 5. Maximum Drain Current Vs. Case Temperature

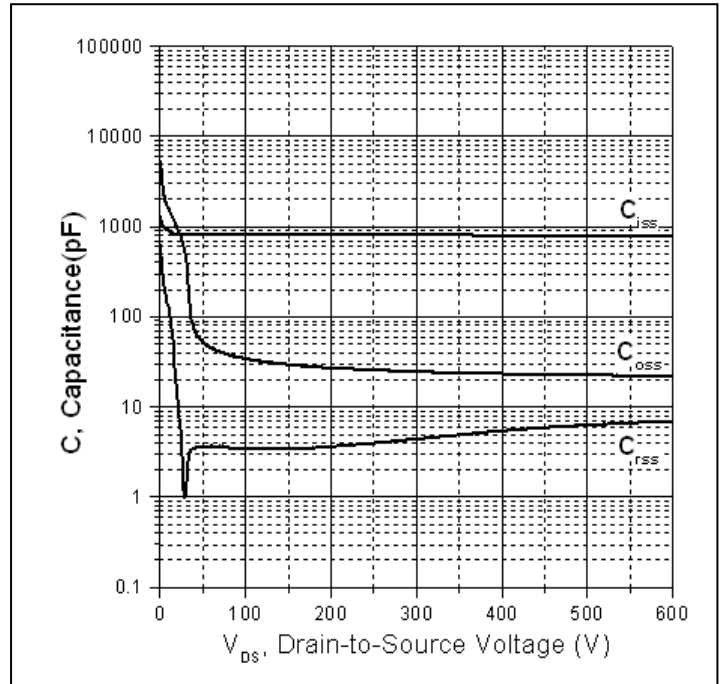


Figure 6. Typical Capacitance Vs. Drain-to-Source Voltage

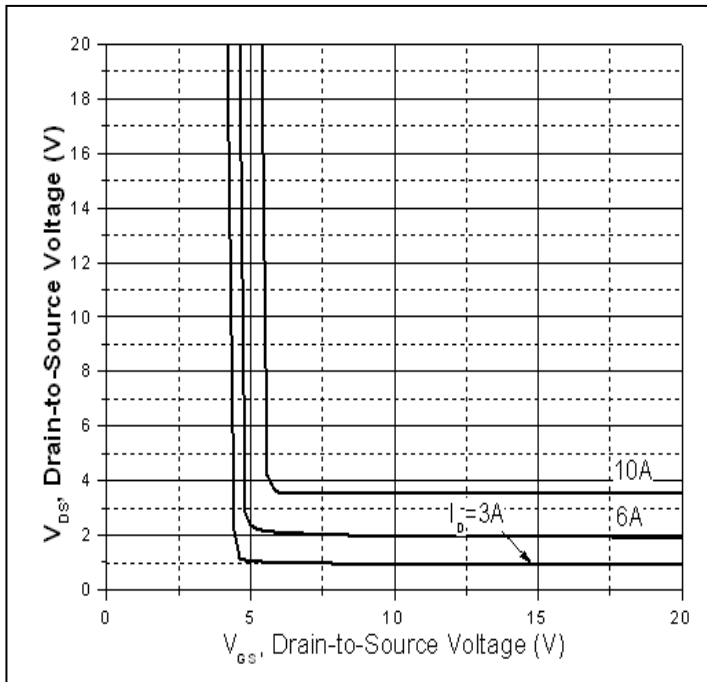


Figure 7. Drain-to-Source Voltage Vs. Gate-to-Source Voltage

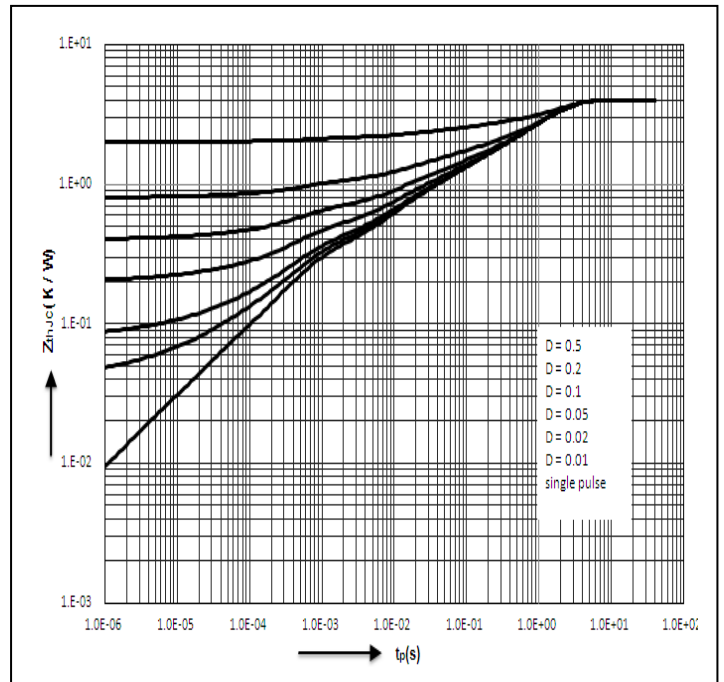
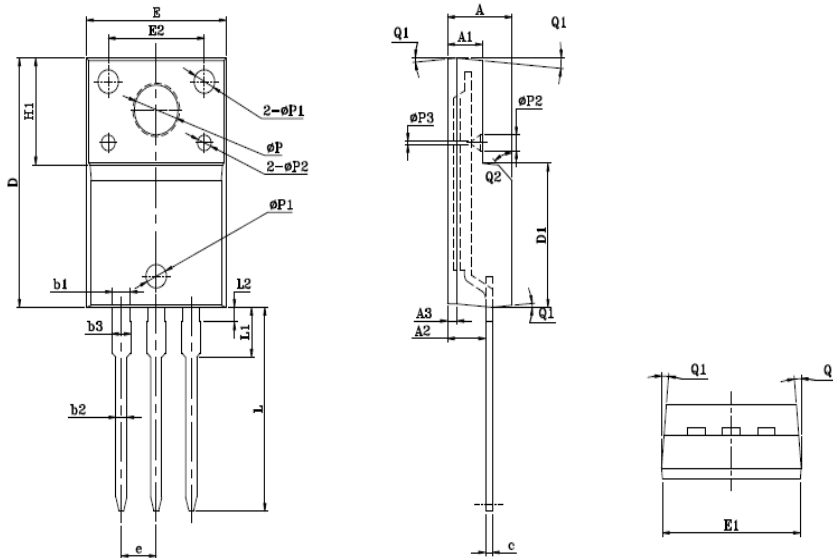


Figure 8. Maximum Effective Transient Thermal Impedance, Junction-to-Case

Mechanical Data

TO-220F PACKAGE OUTLINE DIMENSION



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min	Nom	Max	Min	Nom	Max
E	9.960	10.160	10.360	0.392	0.400	0.408
E1	9.840	10.040	10.240	0.387	0.395	0.403
E2	6.800	7.000	7.200	0.268	0.276	0.283
A	4.600	4.700	4.800	0.181	0.185	0.189
A1	2.440	2.540	2.640	0.096	0.100	0.104
A2	2.660	2.760	2.860	0.105	0.109	0.113
A3	0.600	0.700	0.800	0.024	0.028	0.031
c	-	0.500	-	-	0.020	-
D	15.780	15.870	15.980	0.621	0.625	0.629
D1	8.970	9.170	9.370	0.353	0.361	0.369
H1	6.500	6.700	6.800	0.256	0.264	0.268
e	2.54BSC			0.10BSC		
phi P	3.080	3.180	3.280	0.121	0.125	0.129
phi P1	1.400	1.500	1.600	0.055	0.059	0.063
phi P2	0.900	1.000	1.100	0.035	0.039	0.043
phi P3	0.100	0.200	0.300	0.004	0.008	0.012
L	12.780	12.980	13.180	0.503	0.511	0.519
L1	2.970	3.170	3.370	0.117	0.125	0.133
L2	0.830	0.930	1.030	0.033	0.037	0.041
Q1	3°	5°	7°	3°	5°	7°
Q2	43°	45°	47°	43°	45°	47°
b1	1.180	1.280	1.380	0.046	0.050	0.054
b2	0.760	0.800	0.840	0.030	0.031	0.033
b3	-	-	1.420	-	-	0.056

Ordering and Marking Information

Device Marking: SSF11NS65UF

Package (Available)

TO-220F

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
TO-220F	50	20	1000	10	10000

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