

Main Product Characteristics

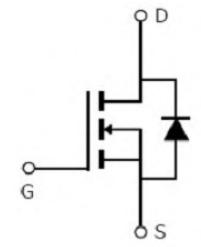
V_{DSS}	600V
$R_{DS(on)}$	0.36Ω (typ.)
I_D	11A



TO-220



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 SSF11NS60 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	
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ ①	7	A
I_{DM}	Pulsed Drain Current②	44	
P_D @ $T_C = 25^\circ\text{C}$	Power Dissipation③	162	W
	Linear Derating Factor	1.5	W/ $^\circ\text{C}$
V_{DS}	Drain-Source Voltage	600	V
V_{GS}	Gate-to-Source Voltage	± 30	V
E_{AS}	Single Pulse Avalanche Energy @ $L=22.5\text{mH}$	281	mJ
I_{AS}	Avalanche Current @ $L=22.5\text{mH}$	5	A
T_J, T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ\text{C}$

Thermal Resistance

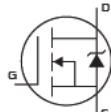
Symbol	Characteristics	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case③	—	0.77	°C/W
$R_{\theta JA}$	Junction-to-Ambient ($t \leq 10s$) ④	—	62	°C/W

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	—	0.36	0.41	Ω	$V_{GS}=10V, I_D = 5.5A$
		—	0.88	—		$T_J = 125^\circ C$
$V_{GS(th)}$	Gate Threshold Voltage	2	—	4	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
		—	2.46	—		$T_J = 125^\circ C$
I_{DSS}	Drain-to-Source Leakage Current	—	—	1	μA	$V_{DS} = 600V, V_{GS} = 0V$
		—	—	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	—	28.41	—	nC	$I_D = 11A,$ $V_{DS}=480V,$ $V_{GS} = 10V$
Q_{gs}	Gate-to-Source Charge	—	6.64	—		
Q_{gd}	Gate-to-Drain("Miller") Charge	—	12.34	—		
$t_{d(on)}$	Turn-on Delay Time	—	12.85	—	ns	$V_{GS}=10V, V_{DS}=300V,$ $R_L=54.5\Omega,$ $R_{GEN}=4.7\Omega$ $I_D=5.5A$
t_r	Rise Time	—	9.45	—		
$t_{d(off)}$	Turn-Off Delay Time	—	30.40	—		
t_f	Fall Time	—	6.30	—		
C_{iss}	Input Capacitance	—	824.8	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	78.06	—		$V_{DS} = 50V$
C_{rss}	Reverse Transfer Capacitance	—	2.75	—		$f = 600KHz$

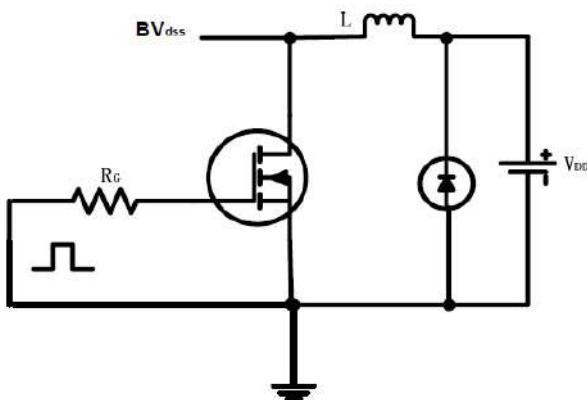
Source-Drain Ratings and Characteristics

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	—	—	1.5	V	$I_S=11A, V_{GS}=0V$
t_{rr}	Reverse Recovery Time	—	313	—	ns	$T_J = 25^\circ C, I_F = 11A, dI/dt = 100A/\mu s$
Q_{rr}	Reverse Recovery Charge	—	2.97	—	uC	

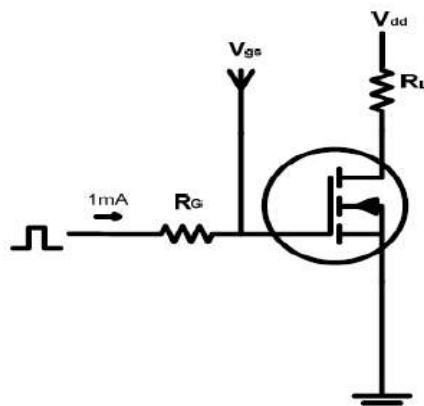


Test Circuits and Waveforms

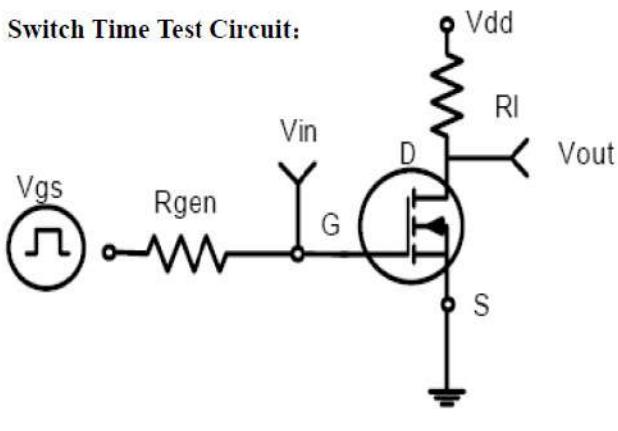
EAS test circuits:



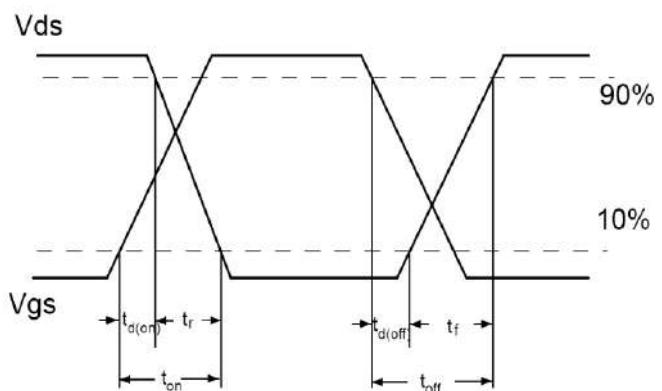
Gate charge test circuit:



Switch Time Test Circuit:



Switching Waveforms:



Notes:

- ①The maximum current rating is limited by bond-wires.
- 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 1in² FR-4 board with 2oz. Copper, in a still air environment with $T_A = 25^\circ C$

Typical Electrical and Thermal Characteristics

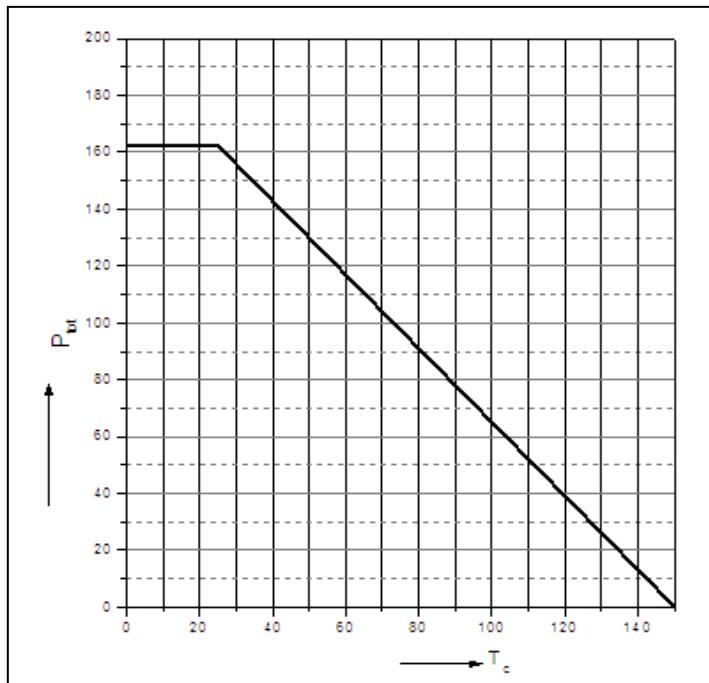


Figure 1. Power Dissipation

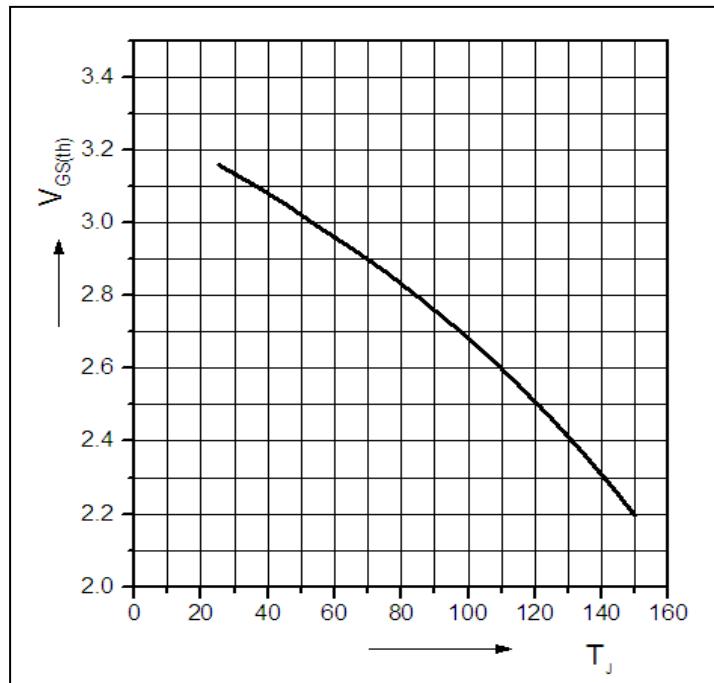


Figure 2. Typ. Gate to Source Cut-off Voltage

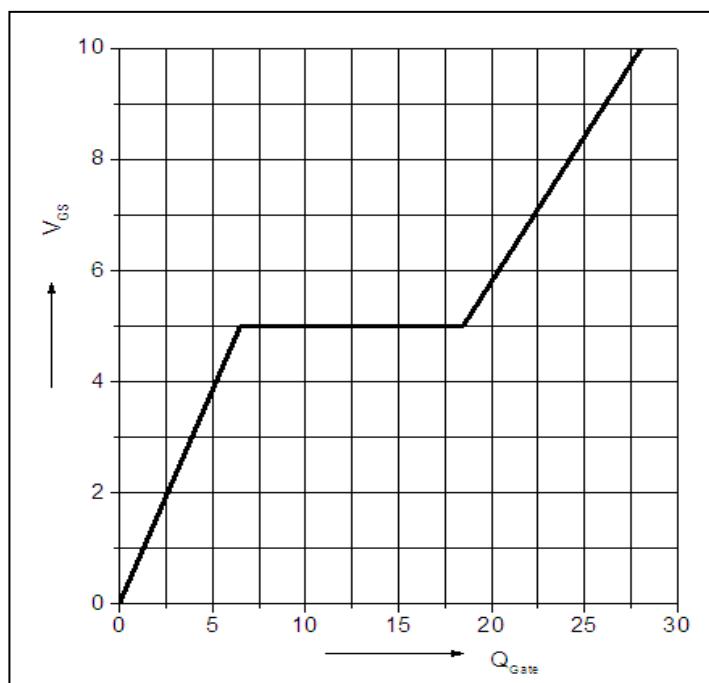


Figure 3. Typ. Gate Charge

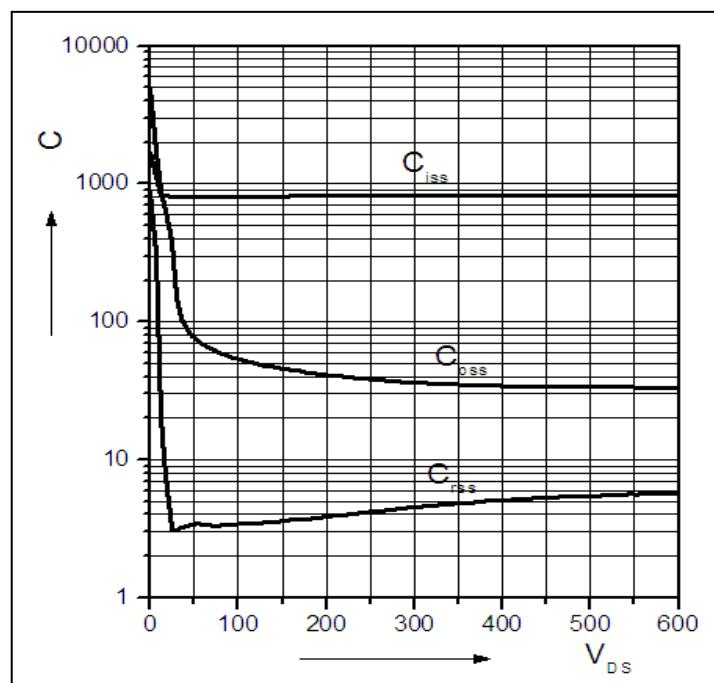


Figure 4. Typ. Capacitances

Typical Electrical and Thermal Characteristics

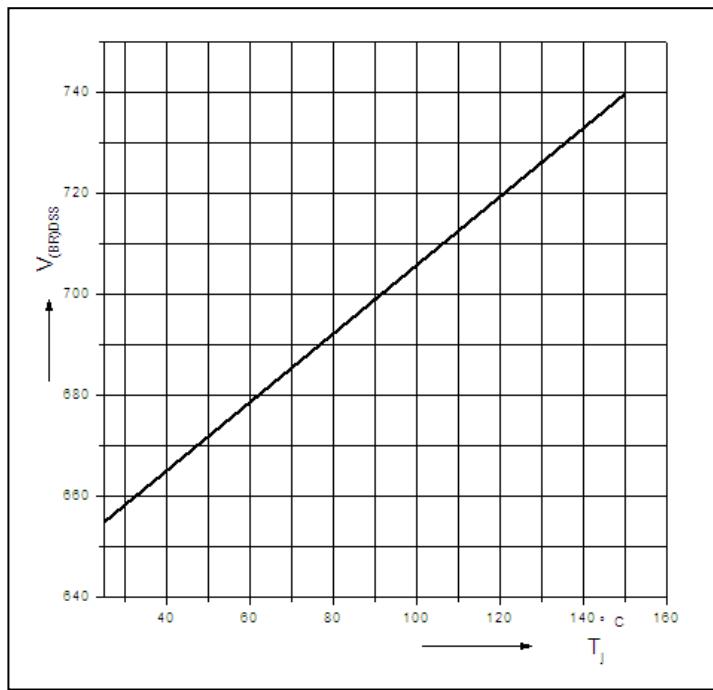


Figure 5. Drain-source Breakdown Voltage

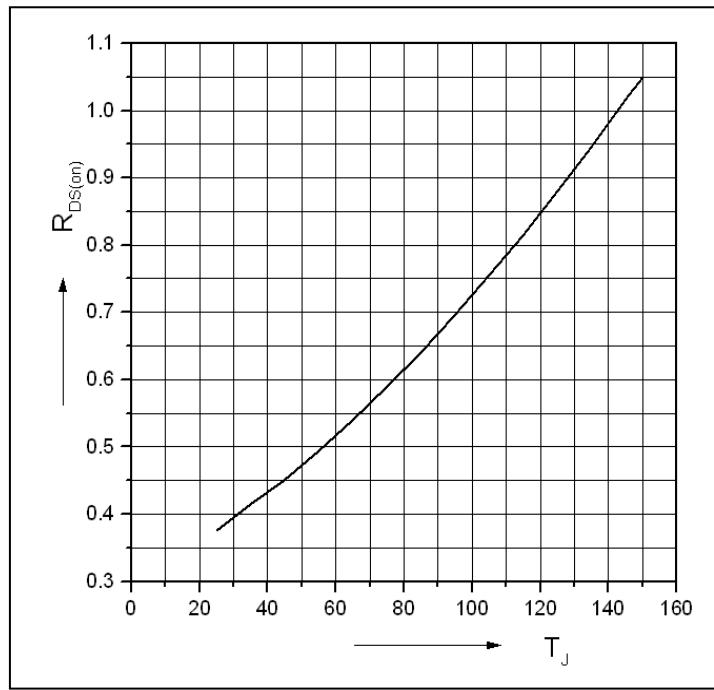


Figure 6. Drain-source On-state Resistance

Mechanical Data

TO-220 PACKAGE OUTLINE DIMENSION						
Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min	Nom	Max	Min	Nom	Max
A	4.400	4.550	4.700	0.173	0.179	0.185
A1	1.270	1.300	1.330	0.050	0.051	0.052
A2	2.240	2.340	2.440	0.088	0.092	0.096
b	-	1.270	-	-	0.050	-
b1	1.270	1.370	1.470	0.050	0.054	0.058
b2	0.750	0.800	0.850	0.030	0.031	0.033
C	0.480	0.500	0.520	0.019	0.020	0.021
D	15.100	15.400	15.700	0.594	0.606	0.618
D1	8.800	8.900	9.000	0.346	0.350	0.354
D2	2.730	2.800	2.870	0.107	0.110	0.113
E	9.900	10.000	10.100	0.390	0.394	0.398
E1	-	8.700	-	-	0.343	-
ΦP	3.570	3.600	3.630	0.141	0.142	0.143
ΦP1	1.400	1.500	1.600	0.055	0.059	0.063
e	2.54BSC			0.1BSC		
e1	5.08BSC			0.2BSC		
L	13.150	13.360	13.570	0.518	0.526	0.534
L1	7.35REF			0.29REF		
L2	2.900	3.000	3.100	0.114	0.118	0.122
L3	1.650	1.750	1.850	0.065	0.069	0.073
L4	0.900	1.000	1.100	0.035	0.039	0.043
Q1	5°	7°	9°	5°	7°	9°
Q2	5°	7°	9°	5°	7°	9°
Q3	5°	7°	9°	5°	7°	9°
Q4	1°	3°	5°	1°	3°	5°

Ordering and Marking Information

Device Marking: SSF11NS60

Package (Available)

TO-220

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-220	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