September, 2012

SJ-FET

SSP20N60S / SSF20N60S
600V N-Channel MOSFET

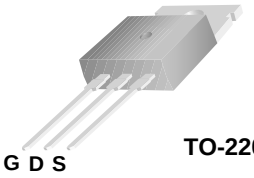
Description

SJ-FET is new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.

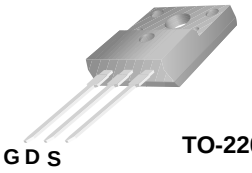
This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. SJ-FET is suitable for various AC/DC power conversion in switching mode operation for higher efficiency.

Features

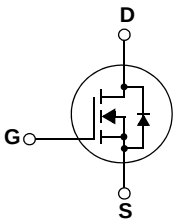
- 650V @T_J = 150°C
- Typ. $R_{DS(on)}$ = 0.155Ω
- Ultra Low Gate Charge (typ. Q_g = 70nC)
- 100% avalanche tested



TO-220



TO-220F



Absolute Maximum Ratings

Symbol	Parameter	SSP20N60S	SSF20N60S	Unit
V_{DSS}	Drain-Source Voltage	600		V
I_D	Drain Current - Continuous (T_C = 25°C) - Continuous (T_C = 100°C)	20 12	20* 12*	A A
I_{DM}	Drain Current - Pulsed (Note 1)	60	60*	A
V_{GSS}	Gate-Source voltage	± 30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	600		mJ
I_{AR}	Avalanche Current (Note 1)	20		A
E_{AR}	Repetitive Avalanche Energy (Note 1)	20.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P_D	Power Dissipation (T_C = 25°C) - Derate above 25°C	205 1.67	35 0.3	W W/°C
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150		°C
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		°C

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	SSP20N60S	SSF20N60S	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.6	3.6	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	62	°C/W

Electrical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250μA, T_J = 25°C	600	--	--	V
		V_{GS} = 0V, I_D = 250μA, T_J = 150°C	--	650	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250μA, Referenced to 25°C	--	0.6	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600V, V_{GS} = 0V V_{DS} = 480V, T_C = 125°C	-- --	-- --	1 10	μA μA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 30V, V_{DS} = 0V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -30V, V_{DS} = 0V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250μA	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10V, I_D = 10A	--	0.155	0.19	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40V, I_D = 10A (Note 4)	--	16	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz	--	1440	1870	pF
C_{oss}	Output Capacitance		--	345	450	pF
C_{rss}	Reverse Transfer Capacitance		--	70	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400V, I_D = 10A R_G = 20Ω	--	25	--	ns
t_r	Turn-On Rise Time		--	55	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	70	--	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	40	--	ns
Q_g	Total Gate Charge	V_{DS} = 480V, I_D = 20A V_{GS} = 10V	--	70	90	nC
Q_{gs}	Gate-Source Charge		--	9.5	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	35	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	20	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	60	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0V, I_S = 20A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0V, I_S = 20A dI_F/dt =100A/μs (Note 4)	--	475	--	ns
Q_{rr}	Reverse Recovery Charge		--	5.8	--	μC

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_{AS} = 10A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3. $I_{SD} \leq$ 20A, di/dt ≤ 200A/μs, $V_{DD} \leq BV_{DSS}$, Starting T_J = 25°C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

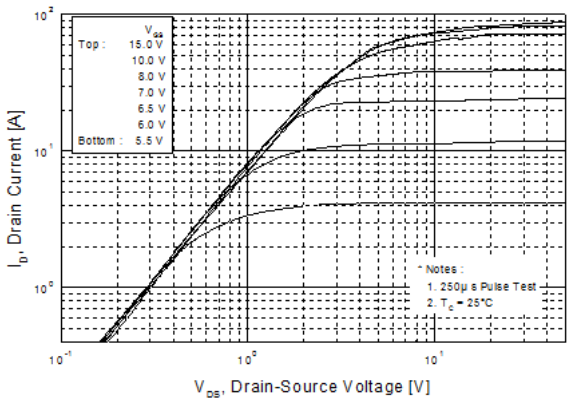


Figure 2. Transfer Characteristics

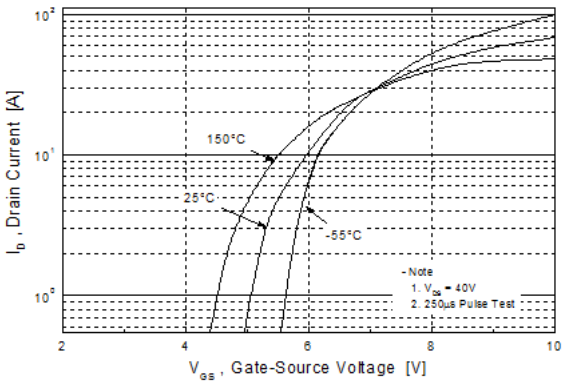


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

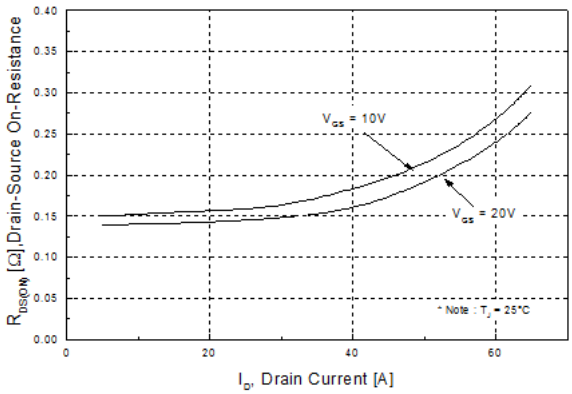


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue

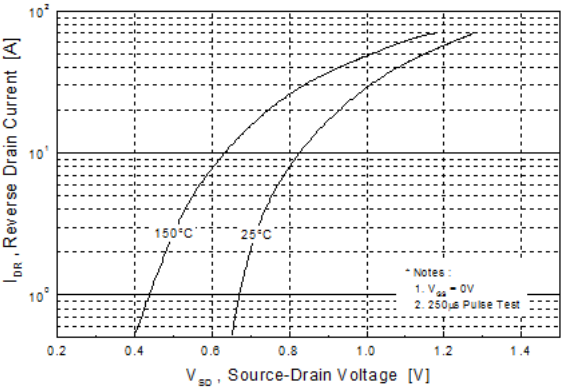


Figure 5. Capacitance Characteristics

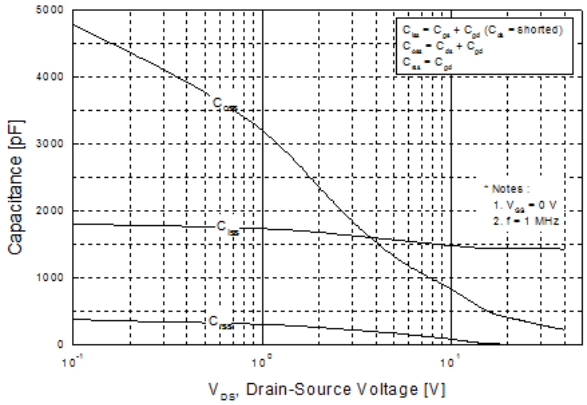
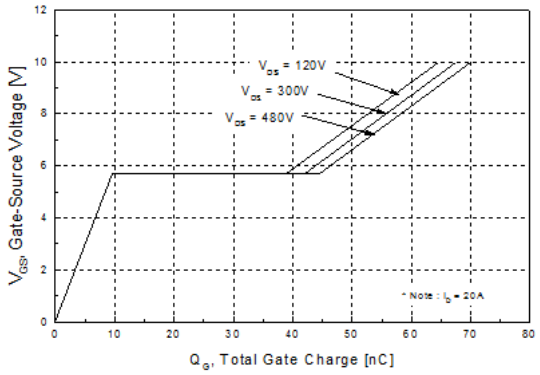


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

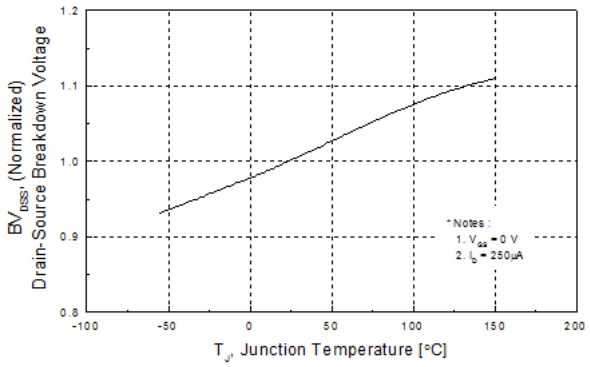


Figure 8. On-Resistance Variation vs. Temperature

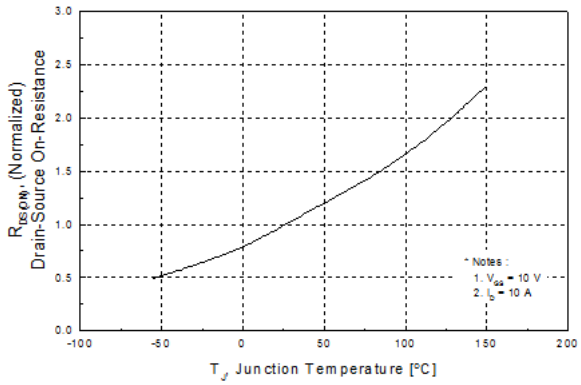


Figure 9-1. Safe Operating Area of SSP20N60S

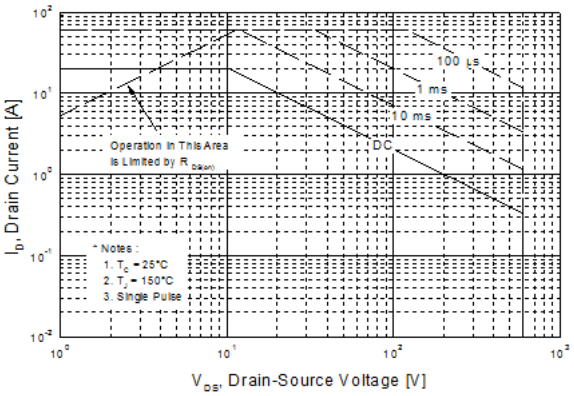


Figure 9-2. Safe Operating Area of SSF20N60S

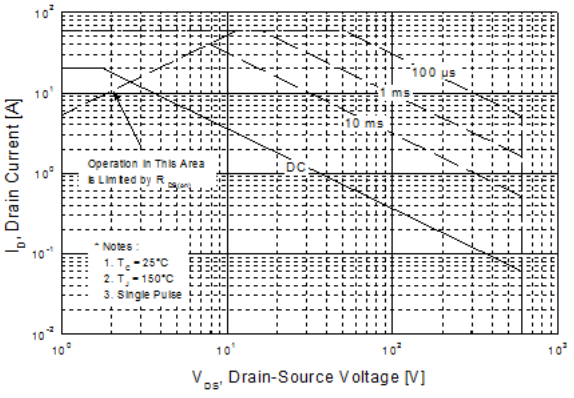
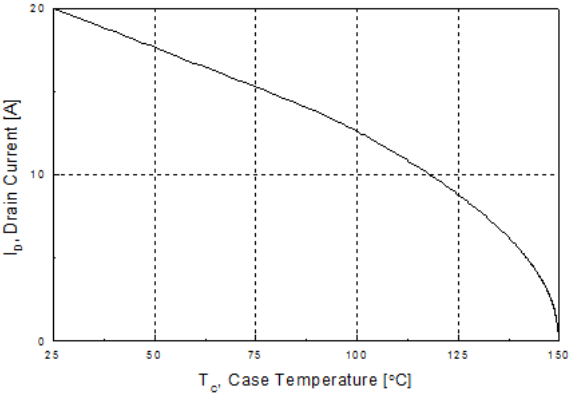


Figure 10. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics (Continued)

Figure 10-1. Transient Thermal Response Curve of SSP20N60S

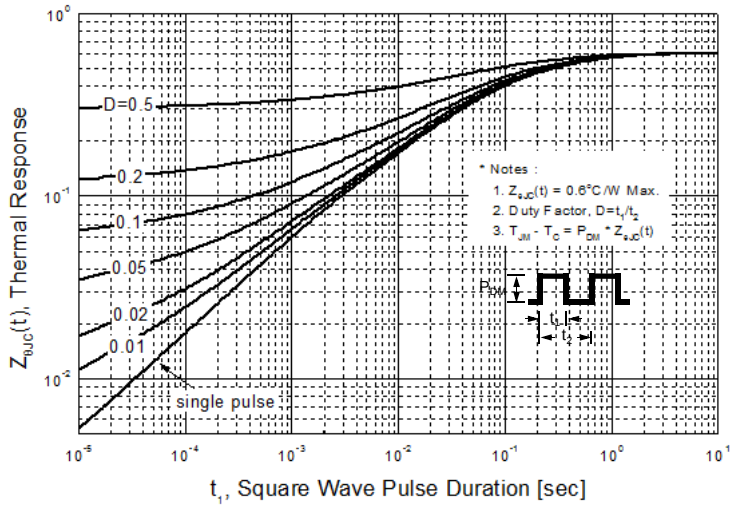
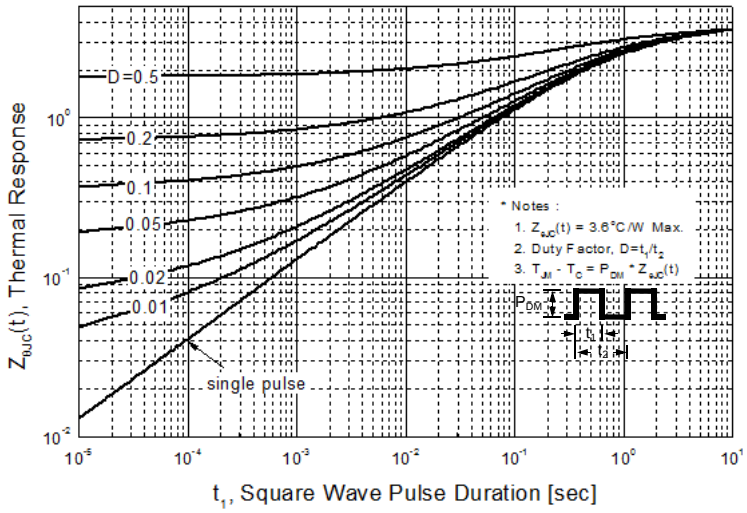
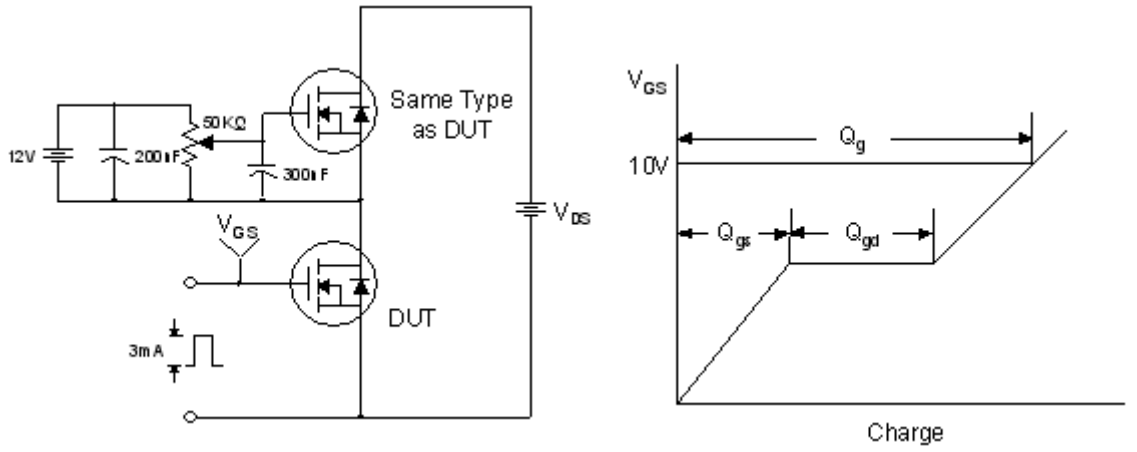


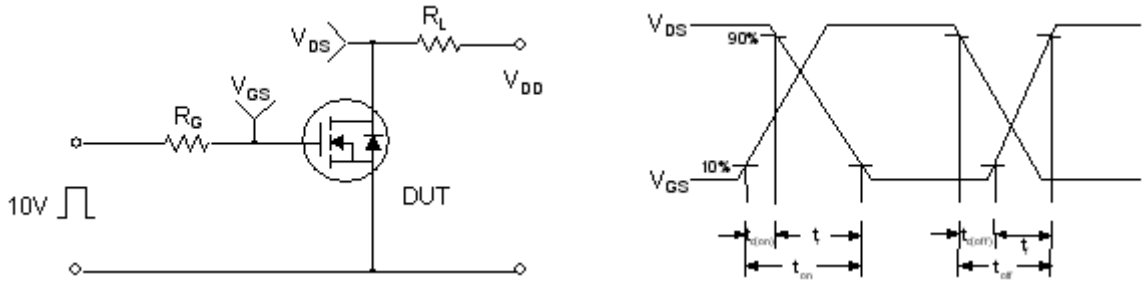
Figure 10-2. Transient Thermal Response Curve of SSF20N60S



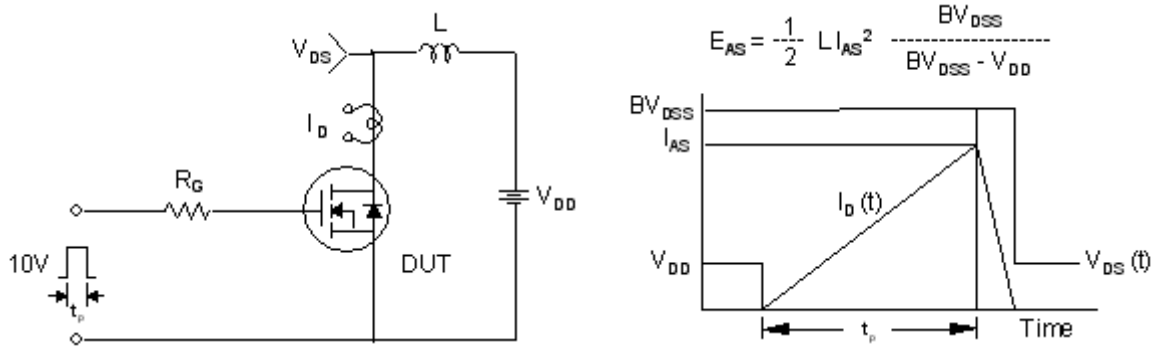
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



Peak Diode Recovery dv/dt Test Circuit & Waveforms