



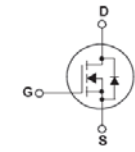
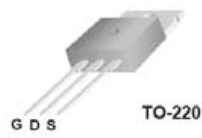
# TSP12N60MS / TSF12N60MS 600V N-Channel MOSFET

## 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<sub>J</sub> = 150 °C
- Typ. R<sub>DS(on)</sub> = 0.4Ω
- Ultra Low Gate Charge (typ. Q<sub>g</sub> = 30nC)
- 100% avalanche tested



## Absolute Maximum Ratings

Symbol	Parameter	TSP12N60MS	TSF12N60MS	Unit
V <sub>DSS</sub>	Drain-Source Voltage	600		V
I <sub>D</sub>	Drain Current	-Continuous (TC = 25°C)	12	12*
		-Continuous (TC = 100°C)	8.5	8.5*
I <sub>DM</sub>	Drain Current - Pulsed (Note 1)	40	40*	A
V <sub>GSS</sub>	Gate-Source voltage	±30		V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	120		mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	2		A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	60		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P <sub>D</sub>	Power Dissipation (TC = 25°C)	205	35	W
		-Derate above 25°C		0.3
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150		°C
T <sub>L</sub>	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	TSP12N60MS	TSF12N60MS	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	0.6	6	°C/W
R <sub>θCS</sub>	Thermal Resistance, Case-to-Sink Typ.	0.5	--	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	62	62	°C/W

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# Electrical Characteristics TC = 25°C unless otherwise noted

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 25°C	600	--	--	V
		V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 150°C	--	650	--	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250μA, Referenced to 25°C	--	0.6	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V V <sub>DS</sub> = 480V, T <sub>C</sub> = 125°C	--	--	1 10	μA μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V	--	--	-100	nA
<b>On Characteristics</b>						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.5	--	4.5	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 5A	--	0.4	0.43	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40V, I <sub>D</sub> = 5A (Note 4)	--	16	--	S
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz	--	600	800	pF
C <sub>oss</sub>	Output Capacitance		--	120	200	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	55	--	pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400V, I <sub>D</sub> = 5A R <sub>G</sub> = 20Ω (Note 4, 5)	--	25	--	ns
t <sub>r</sub>	Turn-On Rise Time		--	55	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	70	--	ns
t <sub>f</sub>	Turn-Off Fall Time		--	40	--	ns
Q <sub>g</sub>	Total Gate Charge		V <sub>DS</sub> = 480V, I <sub>D</sub> = 10A V <sub>GS</sub> = 10V (Note 4, 5)	--	35	45
Q <sub>gs</sub>	Gate-Source Charge		--	5	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	18	--	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	11	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	40	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>S</sub> = 12A	--	--	1.5	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0V, I <sub>S</sub> = 12A dI <sub>F</sub> /dt = 100A/μs	--	240	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge	(Note 4)	--	3.1	--	μC

## NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L=60mH, I<sub>AS</sub>=2A, V<sub>DD</sub>=150V, Starting T<sub>J</sub>=25 °C
3. I<sub>SD</sub>≤12A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25 °C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

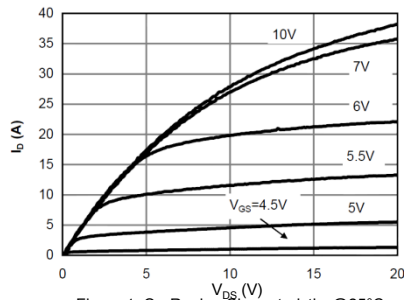


Figure 1: On-Region Characteristics@25°C

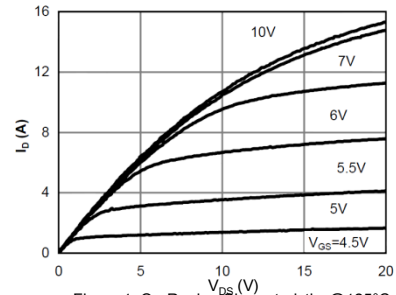


Figure 1: On-Region Characteristics@125°C

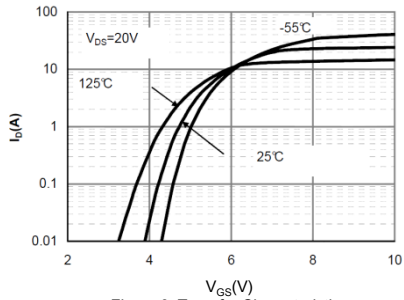


Figure 3: Transfer Characteristics

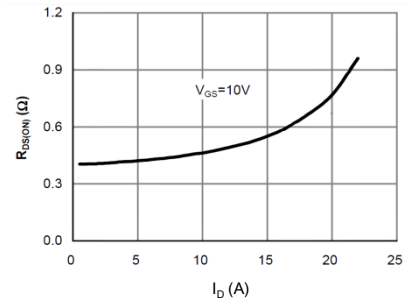


Figure 4: On-Resistance vs. Drain Current and Gate Voltage

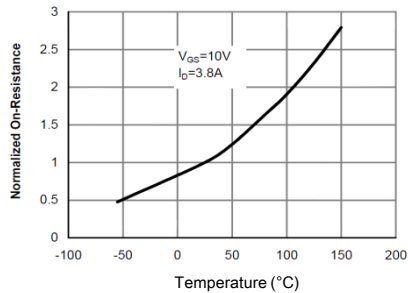


Figure 5: On-Resistance vs. Junction Temperature

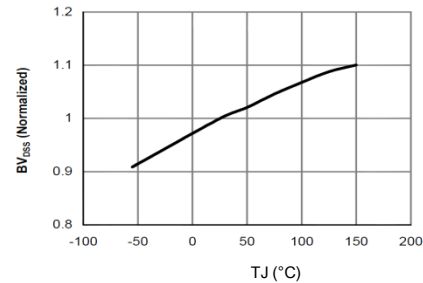


Figure 6: Break Down vs. Junction Temperature

## Typical Performance Characteristics

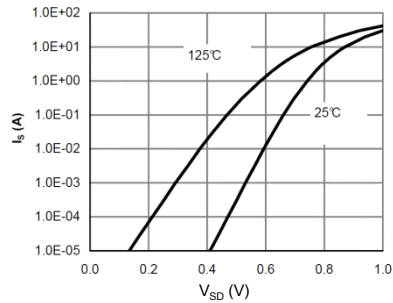


Figure 7: Body-Diode Characteristics

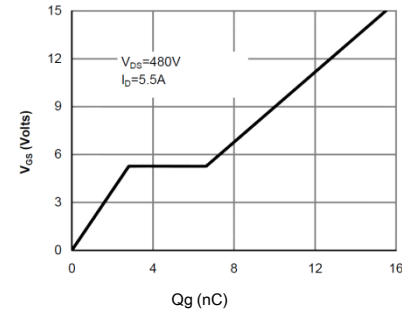


Figure 8: Gate-Charge Characteristics

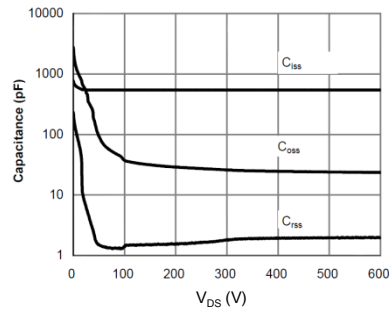


Figure 9: Capacitance Characteristics

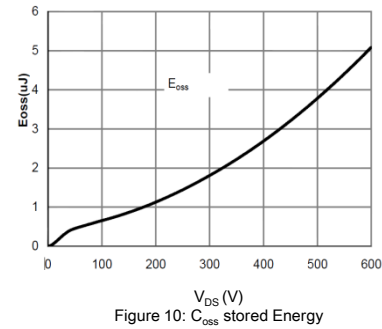


Figure 10:  $C_{oss}$  stored Energy

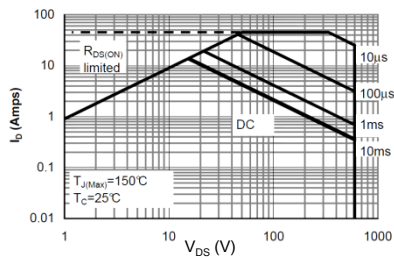


Figure 11: Maximum Forward Biased Safe Operating Area

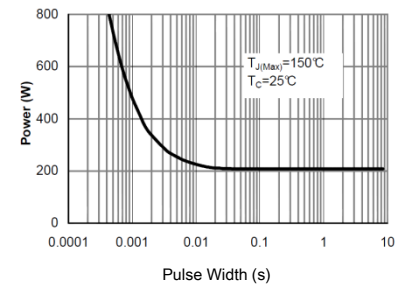


Figure 12: Single Pulse Power Rating Junction-to-Case

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Typical Performance Characteristics

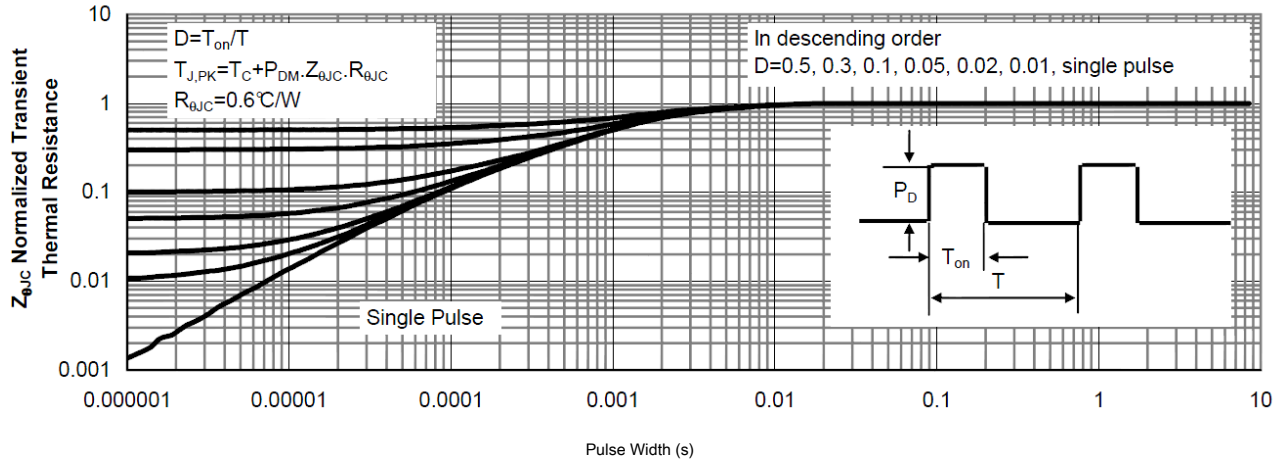


Figure 13: Normalized Maximum Transient Thermal Impedance

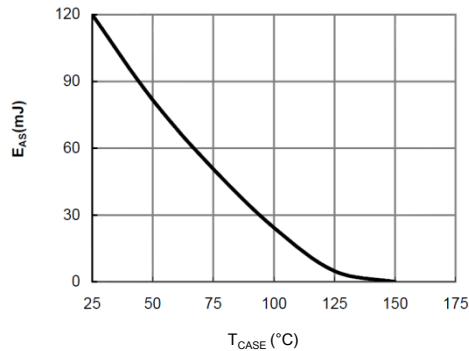


Figure 14: Avalanche energy

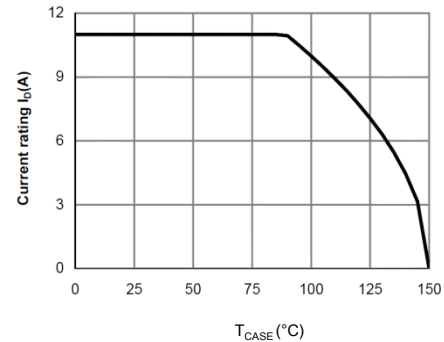


Figure 15: Current De-rating

Typical Performance Characteristics

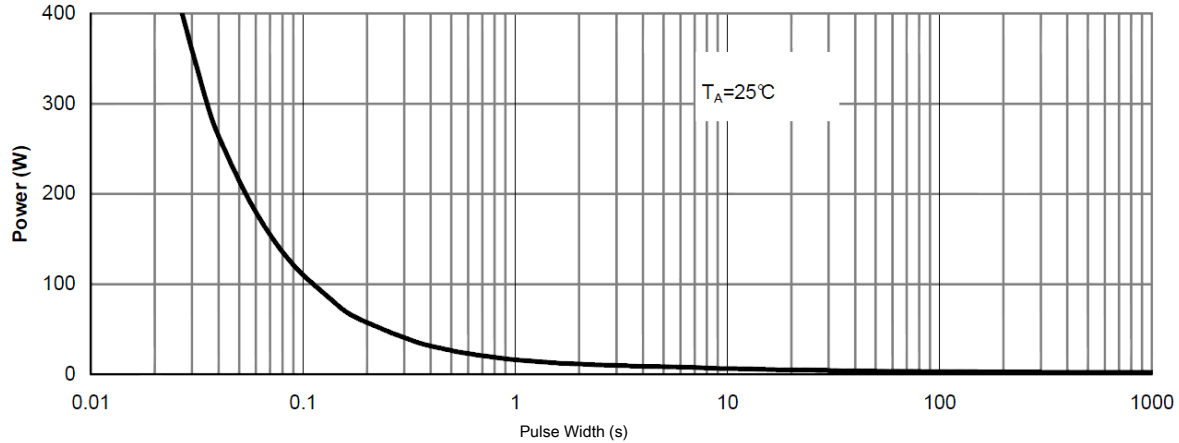


Figure 16: Single Pulse Power Rating Junction-to-Ambient

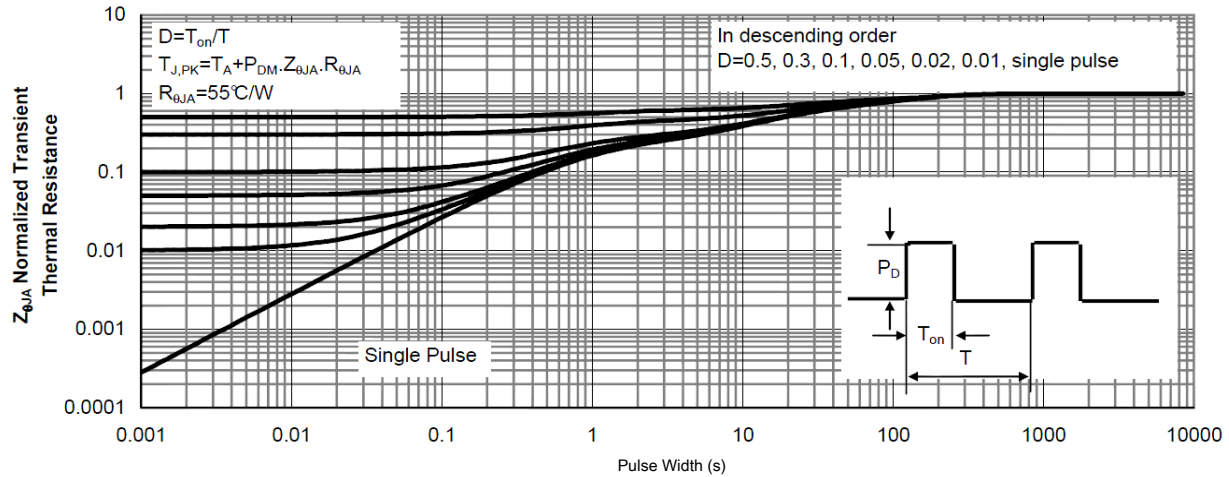


Figure 17: Normalized Maximum Transient Thermal Impedance