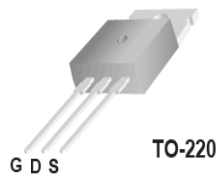


TSP60R460S1

600V 9.5A N-Channel SJ-MOSFET

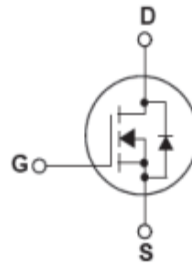
General Description

Truesemi 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 @TJ = 150 °C
- Typ. RDS(on) = 0.42Ω
- Ultra Low gate charge (typ. Qg = 35nC)
- 100% avalanche tested



Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V _{DSS}	Drain-Source Voltage	600	V
I _D	Drain Current -Continuous (TC = 25°C) -Continuous (TC = 100°C)	9.5 6	A
I _{DM}	Drain Current – Pulsed (Note 1)	30	A
V _{GSS}	Gate-Source voltage	±30	V
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	120	mJ
I _{AR}	Avalanche Current (Note 1)	2	A
E _{AR}	Repetitive Avalanche Energy (Note 1)	0.32	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15	V/ns
P _D	Power Dissipation (TC = 25°C) -Derate above 25°C	83 1.67	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	Value	Unit
R _{θJC}	Thermal Resistance, Junction-to-Case	1.5	°C/W
R _{θCS}	Thermal Resistance, Case-to-Sink Typ.	0.5	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient	62	°C/W

Electrical Characteristics TC = 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℃	600	--	--	V
		V _{GS} = 0V, I _D = 250μA, T _J = 150℃	--	650	--	V
ΔBV _{DSS} / ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 250μA, Referenced to 25℃	--	0.6	--	V/℃
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 600V, V _{GS} = 0V -T _J = 150℃	--	-- 10	1 --	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	2.5	--	4.5	V
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10V, I _D = 5A	--	0.42	0.46	Ω
g _{FS}	Forward Trans conductance	V _{DS} = 40V, I _D = 5A (Note 4)	--	16	--	S
R _g	Gate resistance	f=1 MHz, open drain	--	4.5	--	Ω
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz	--	550	--	pF
C _{oss}	Output Capacitance		--	140	--	pF
C _{rss}	Reverse Transfer Capacitance		--	7	--	pF
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time	V _{DD} = 400V, I _D = 5A R _G = 20Ω(Note 4, 5)	--	15	--	ns
t _r	Turn-On Rise Time		--	10	--	ns
t _{d(off)}	Turn-Off Delay Time		--	110	--	ns
t _f	Turn-Off Fall Time		--	9	--	ns
Q _g	Total Gate Charge	V _{DS} = 480V, I _D = 5A V _{GS} = 10V (Note 4, 5)	--	35	--	nC
Q _{gs}	Gate-Source Charge		--	3.8	--	nC
Q _{gd}	Gate-Drain Charge		--	4	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	9.5	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	38	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0V, I _F = 5A	--	0.9	1.5	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _F = 5A di _F /dt =100A/μs (Note 4)	--	240	--	ns
Q _{rr}	Reverse Recovery Charge		--	3.1	--	μC

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L=60mH, $I_{AS}=2A, V_{DD}=50V$, Starting $T_J=25^\circ C$
3. $I_{SD} \leq 10A, di/dt \leq 200A/\mu s, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ C$
4. Pulse Test: Pulse width $\leq 300\mu s$, Duty Cycle $\leq 2\%$
5. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

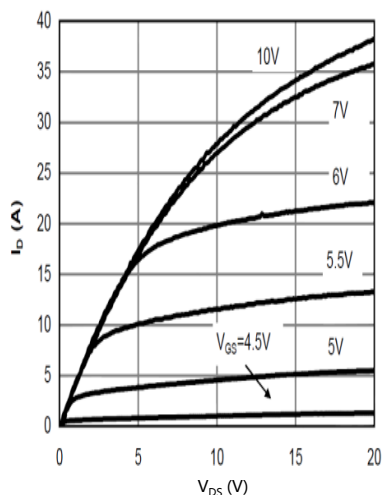


Figure 1: On-Region Characteristics@25°C

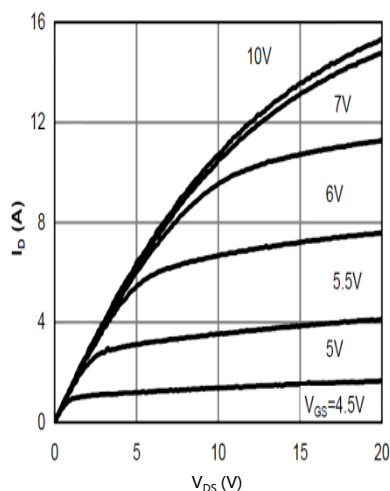


Figure 2: On-Region Characteristics@125°C

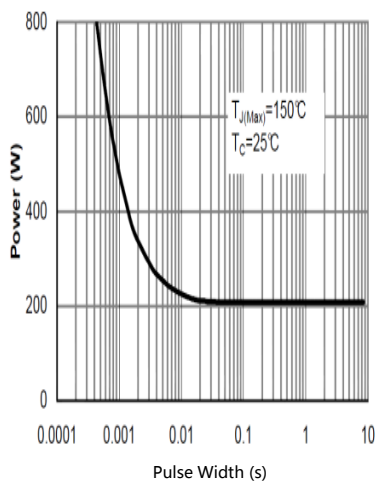


Figure 3: Single Pulse Power Rating Junction-to-Case

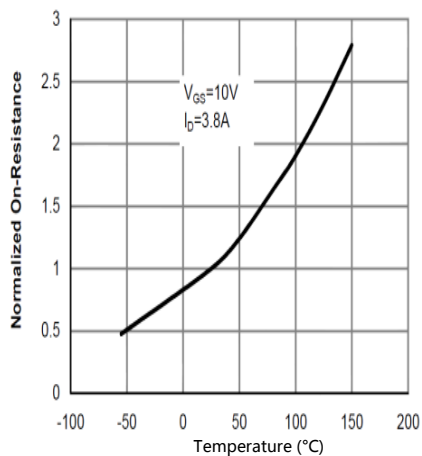


Figure 4: On-Resistance vs. Junction Temperature

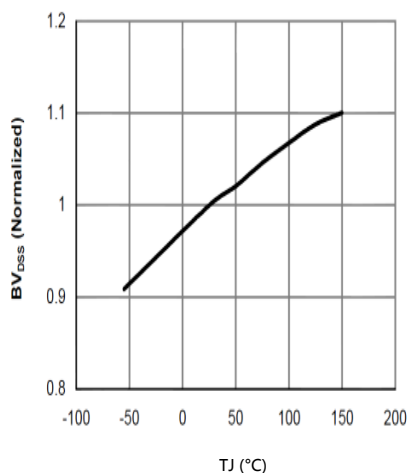


Figure 5: Break Down vs. Junction Temperature

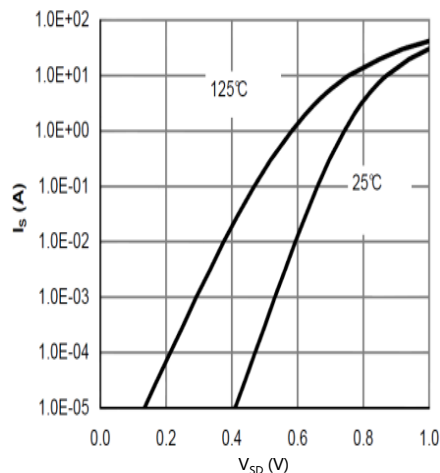


Figure 6: Body-Diode Characteristics

Typical Performance Characteristics

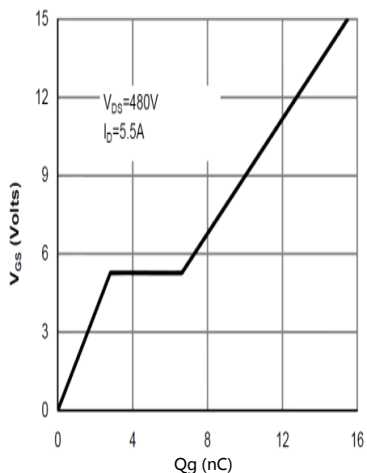


Figure 7: Gate-Charge Characteristics

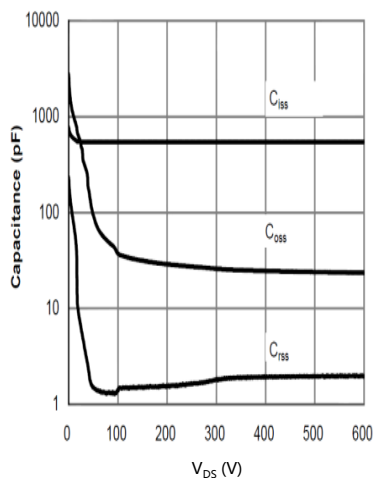


Figure 8: Capacitance Characteristics

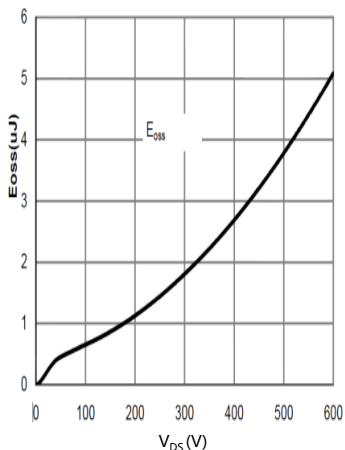


Figure 9: C_{oss} stored Energy

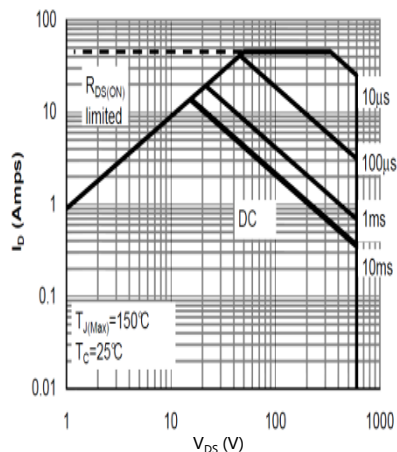


Figure 10: Maximum Forward Biased Safe Operating Area $T_c=25^{\circ}\text{C}$,

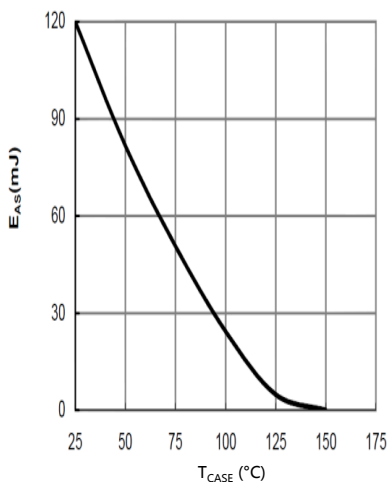


Figure 11: Avalanche energy

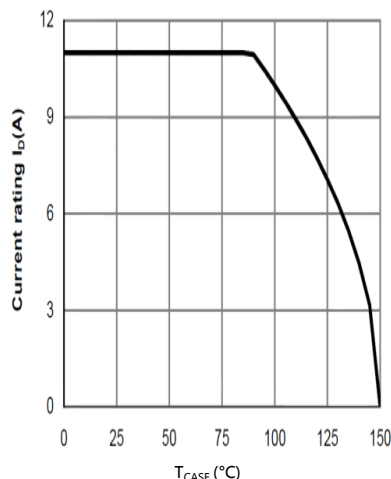


Figure 12: Current De-rating

Typical Performance Characteristics

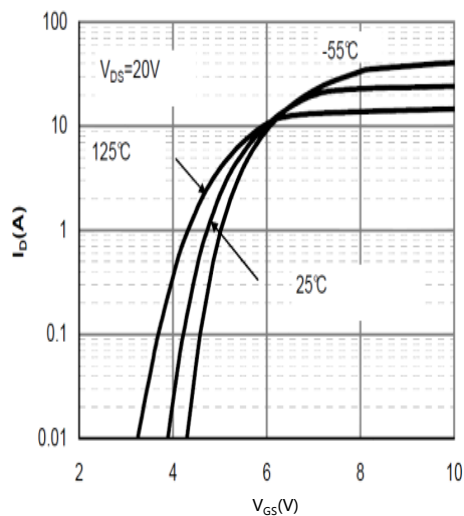


Figure 13: Typ. transfer characteristics

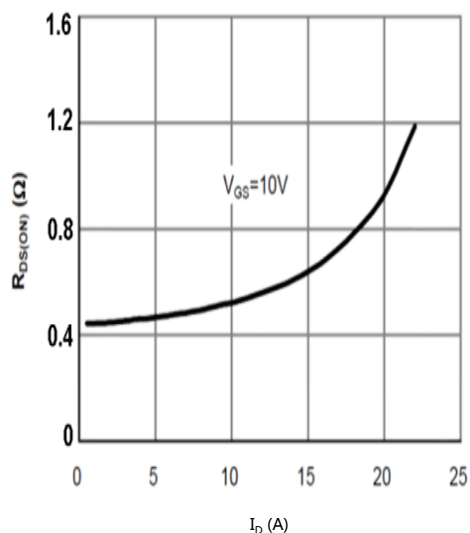


Figure 14 On-Resistance vs. Drain Current and Gate Voltage

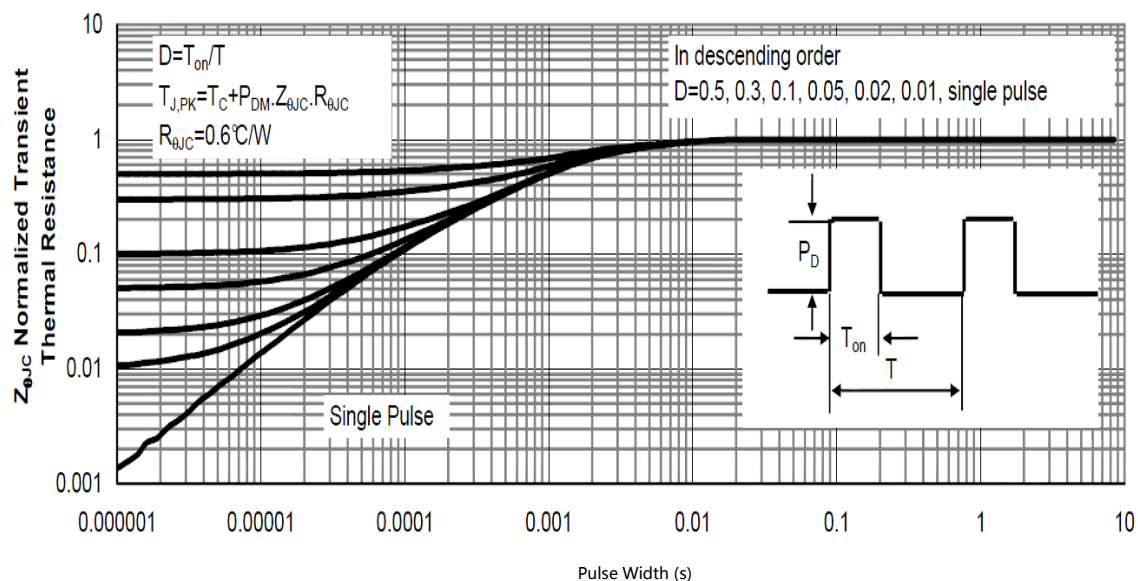


Figure 15: Normalized Maximum Transient Thermal Impedance

Typical Performance Characteristics

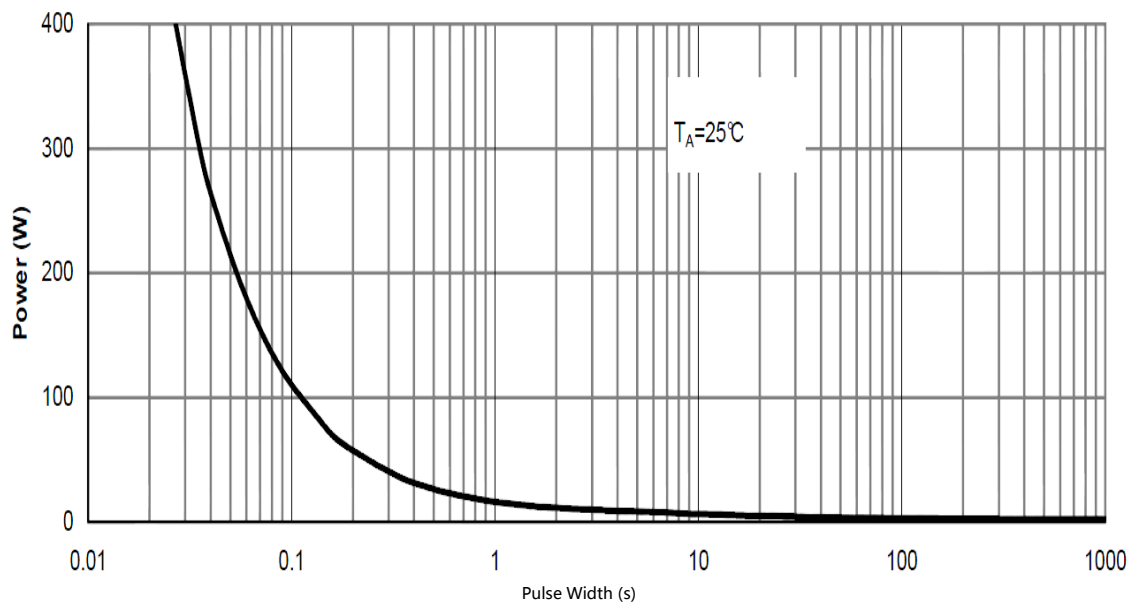


Figure 16: Single Pulse Power Rating Junction-to-Ambient

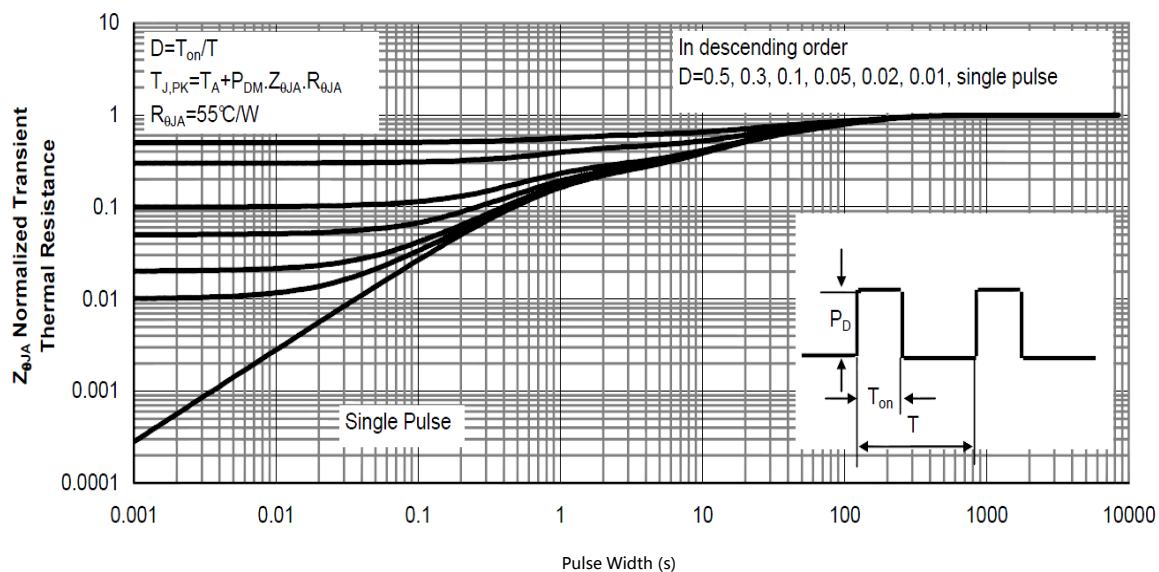
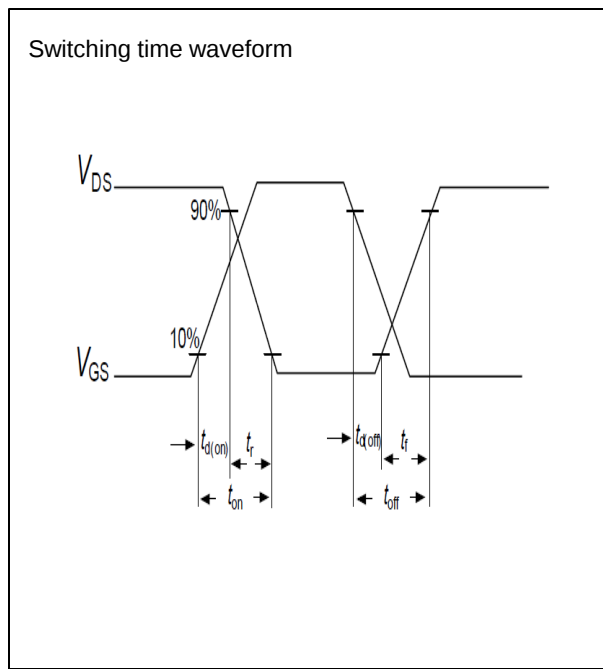
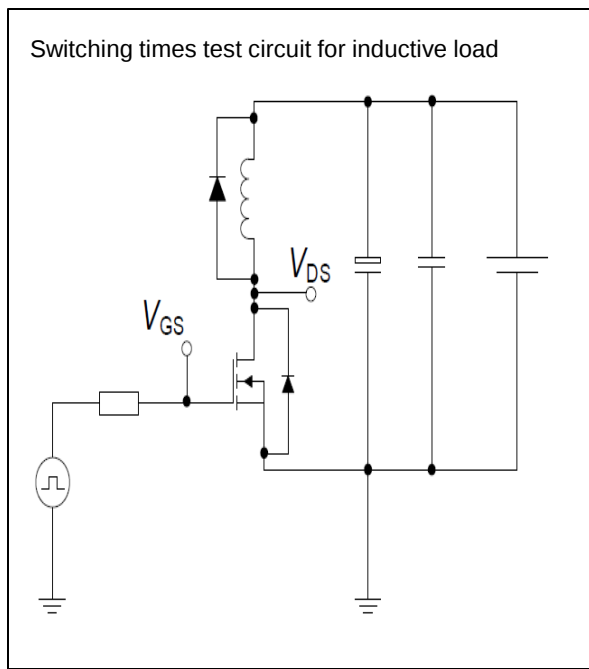


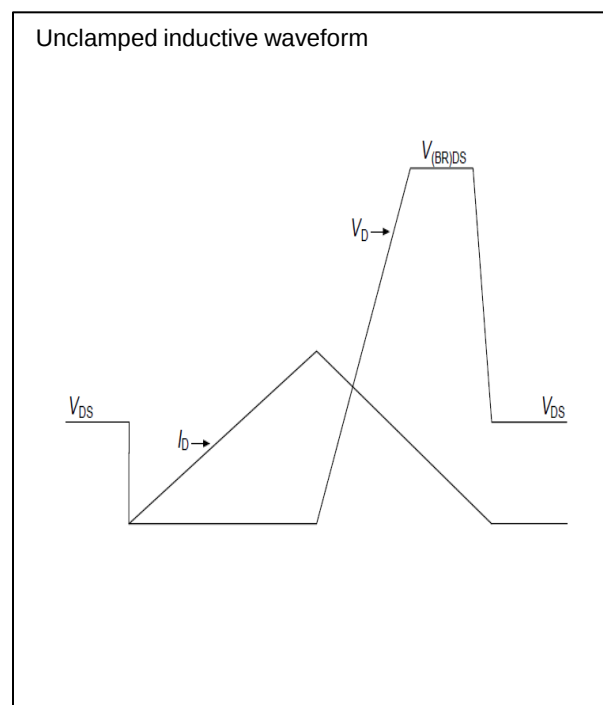
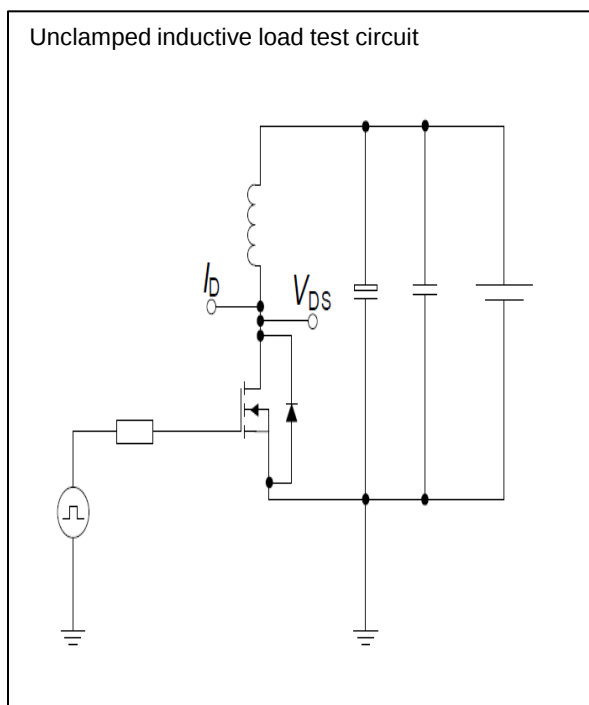
Figure 17: Normalized Maximum Transient Thermal Impedance

Test circuits

Switching times test circuit and waveform for inductive load



Unclamped inductive load test circuit and waveform



TSP60R460S1 600V 9.5A N-Channel S-J-MOSFET

Test circuit for diode characteristics

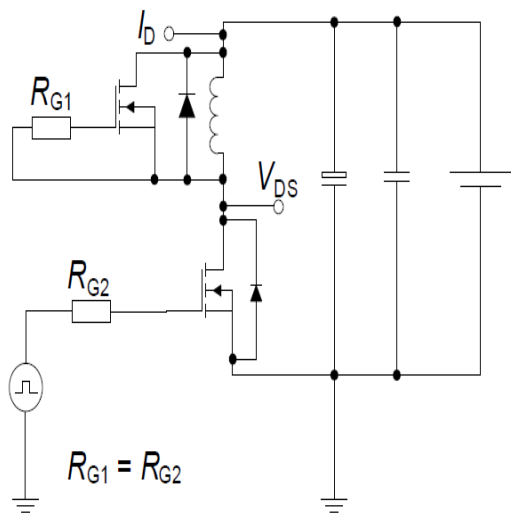
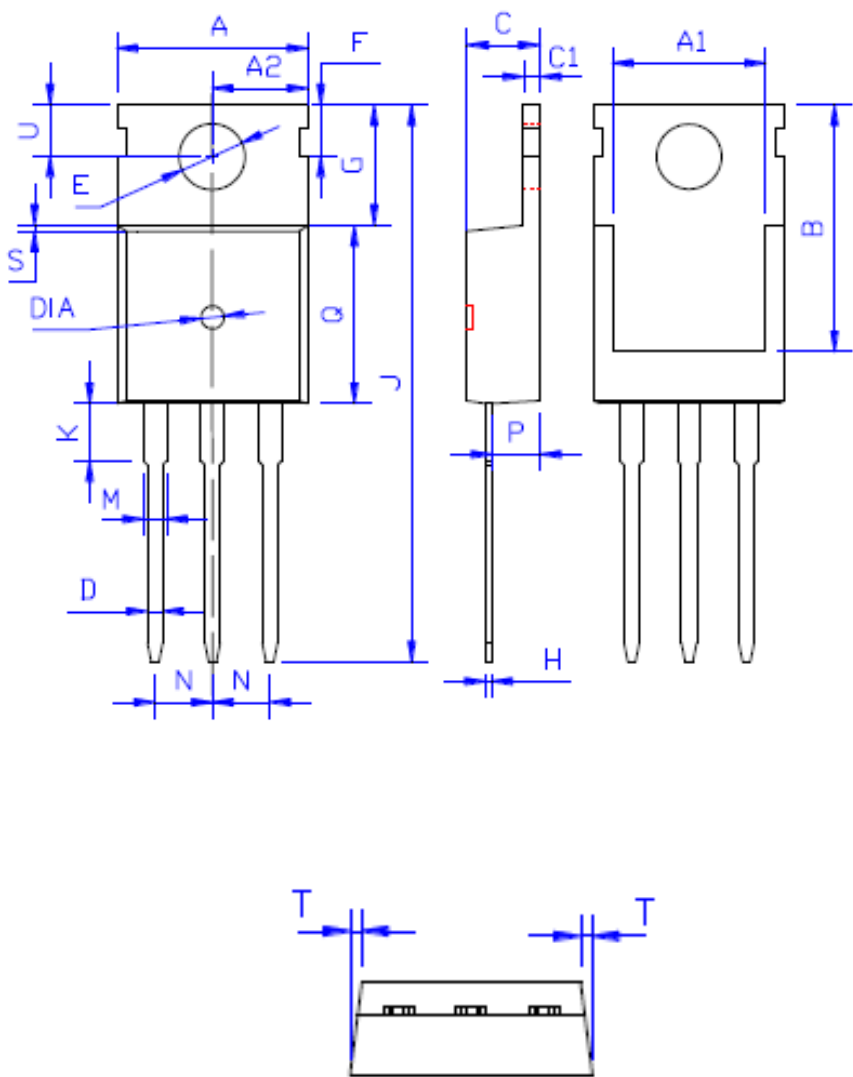


Figure 1 illustrates the waveforms of the current i_T and voltage V during the turn-on of a thyristor. The top graph shows the current i_T versus time t . The current starts at I_F , then decreases linearly to zero over time t_η . The voltage V starts at V_{RRM} , then decreases to a minimum value and finally settles at a steady-state value. The turn-on time t_η is divided into delay time t_s and fall time t_F . The fall time t_F is further divided into times for 10% and 90% of I_{RRM} . The area under the current waveform is divided into Q_s (shaded) and Q_F (hatched). The total turn-on time is $t_\eta = t_s + t_F$ and the total charge is $Q_\eta = Q_s + Q_F$.

Package Outline TO-220

TS60R460S1 600V 9.5A N-Channel SJ-MOSFET



DIM	MILLIMETERS
A	10.00±0.30
A1	8.00±0.30
A2	5.00±0.30
B	13.20±0.40
C	4.50±0.20
C1	1.30±0.20
D	0.80±0.20
E	3.60±0.20
F	3.00±0.30
G	6.60±0.40
H	0.50±0.20
J	28.88±0.50
K	3.00±0.30
M	1.30±0.30
N	Typical 2.54
P	2.40±0.40
Q	9.20±0.40
S	0.25±0.15
T	0.25±0.15
U	2.80±0.30
DIA	宽 1.50±0.10 深 0.50 MAX