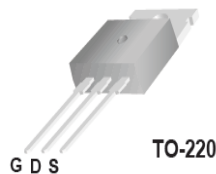


TSP60R460S1

600V 9.5A N-Channel SJ-MOSFET

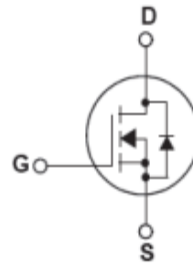
General Description

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 @T_J = 150 °C
- Typ. RDS(on) = 0.42Ω
- Ultra Low gate charge (typ. Q_g = 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℃ 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

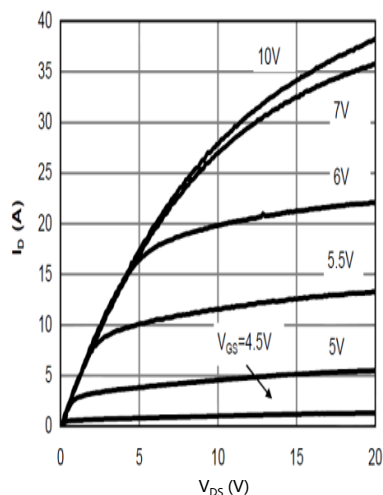


Figure 1: On-Region Characteristics@25°C

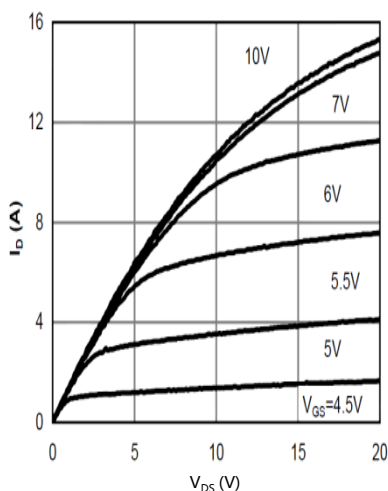


Figure 2: On-Region Characteristics@125°C

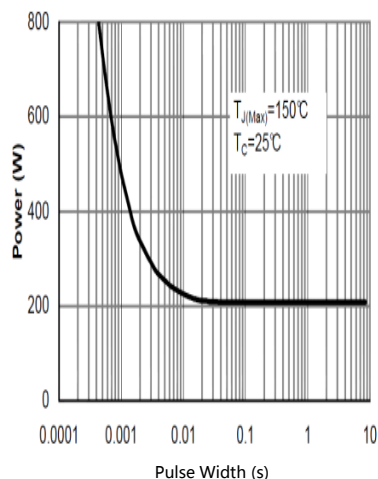


Figure 3: Single Pulse Power Rating Junction-to-Case

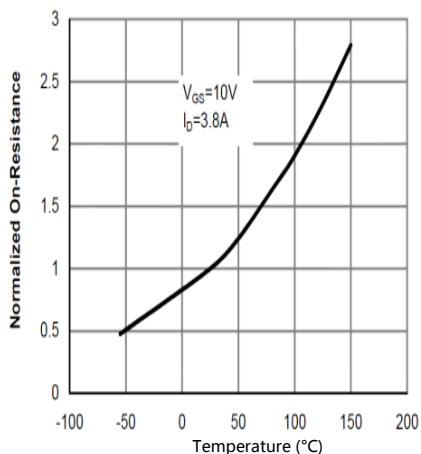


Figure 4: On-Resistance vs. Junction Temperature

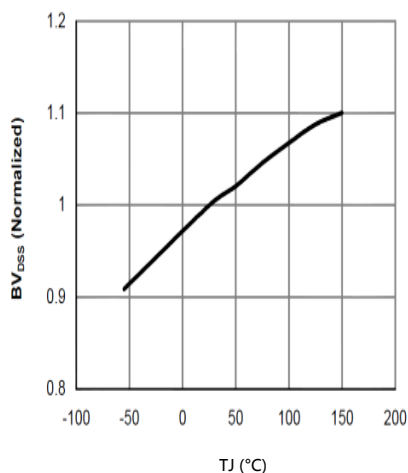


Figure 5: Break Down vs. Junction Temperature

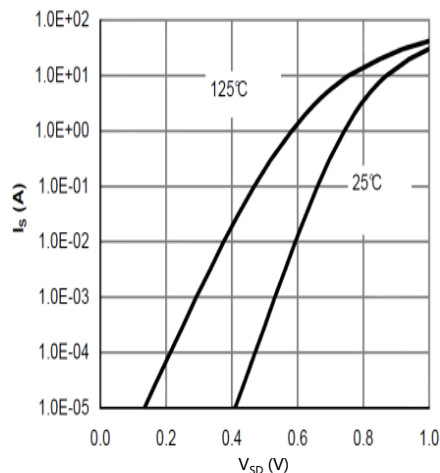


Figure 6: Body-Diode Characteristics

Typical Performance Characteristics

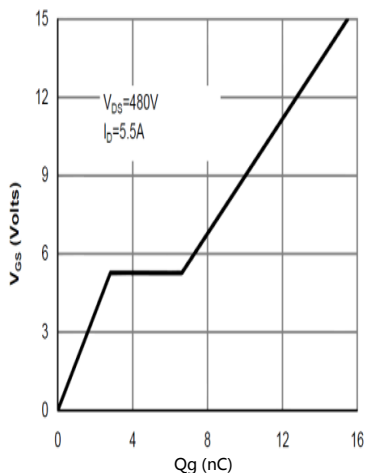


Figure 7: Gate-Charge Characteristics

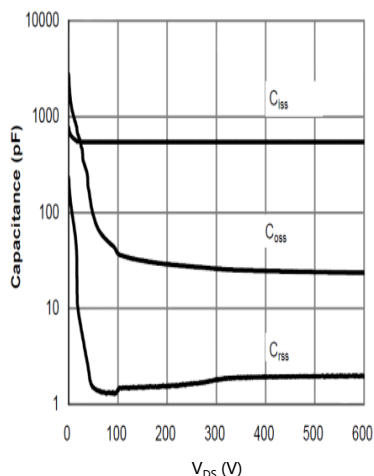


Figure 8: Capacitance Characteristics

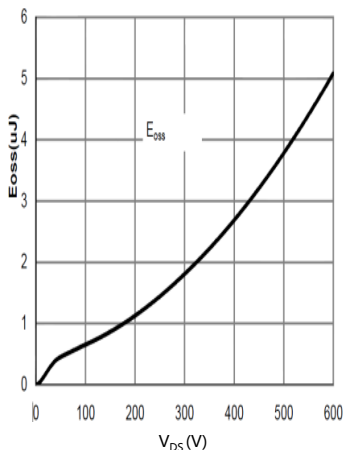


Figure 9: C_{oss} stored Energy

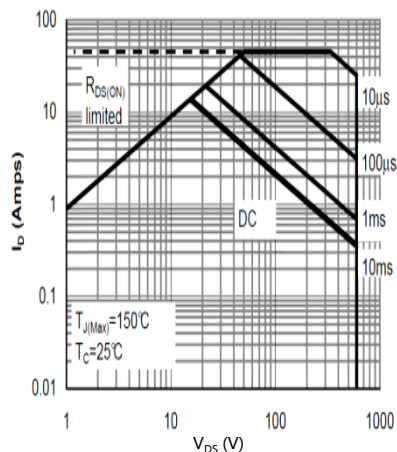


Figure 10: Maximum Forward Biased Safe Operating Area $T_c=25^\circ\text{C}$,

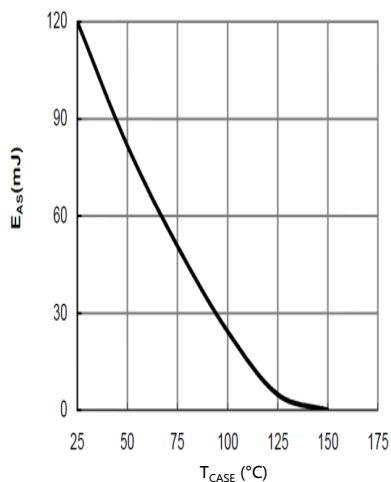


Figure 11: Avalanche energy

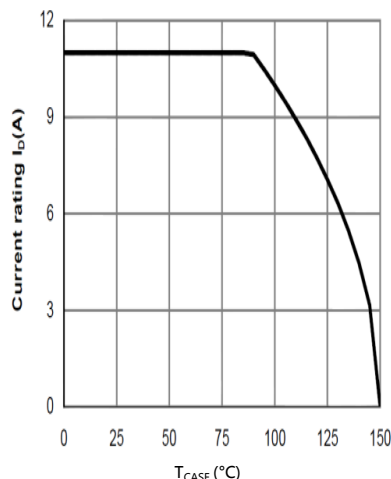


Figure 12: Current De-rating

Typical Performance Characteristics

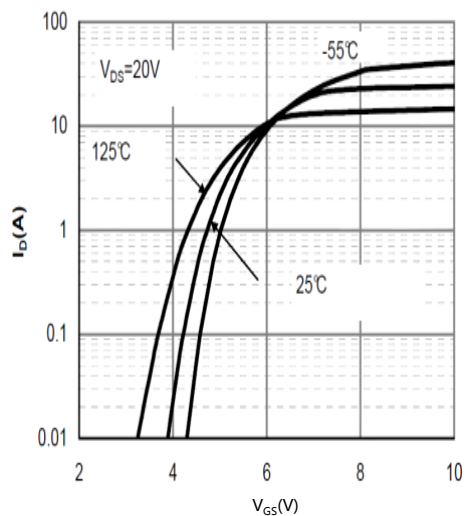


Figure 13: Typ. transfer characteristics

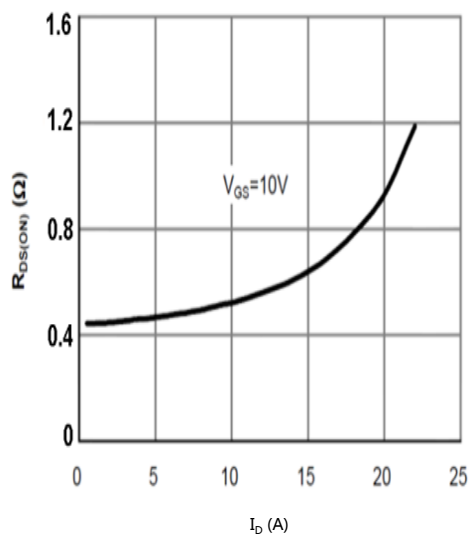


Figure 14 On-Resistance vs. Drain Current and Gate Voltage

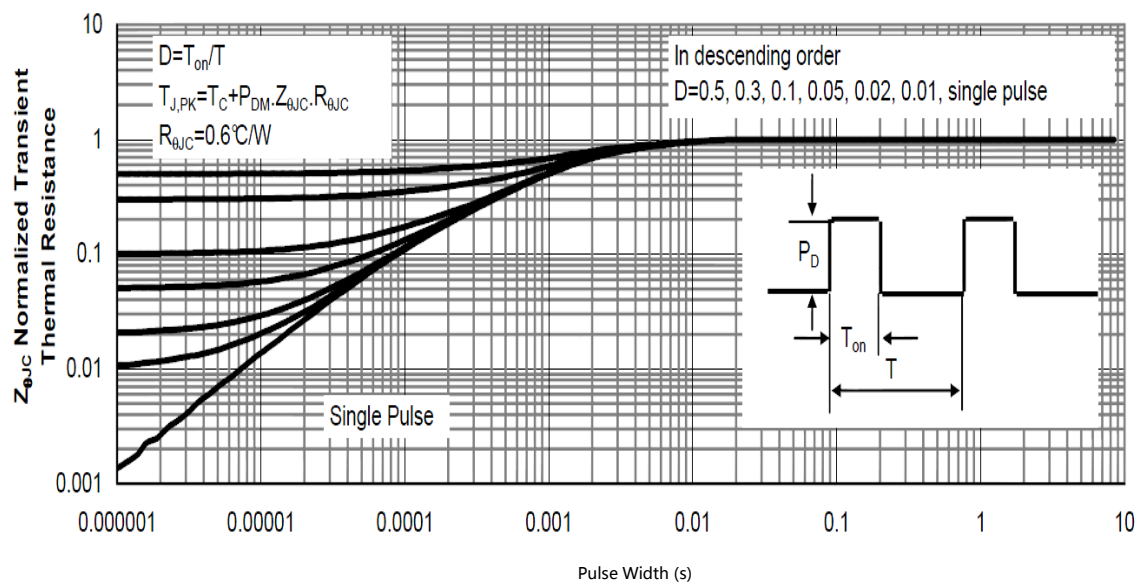
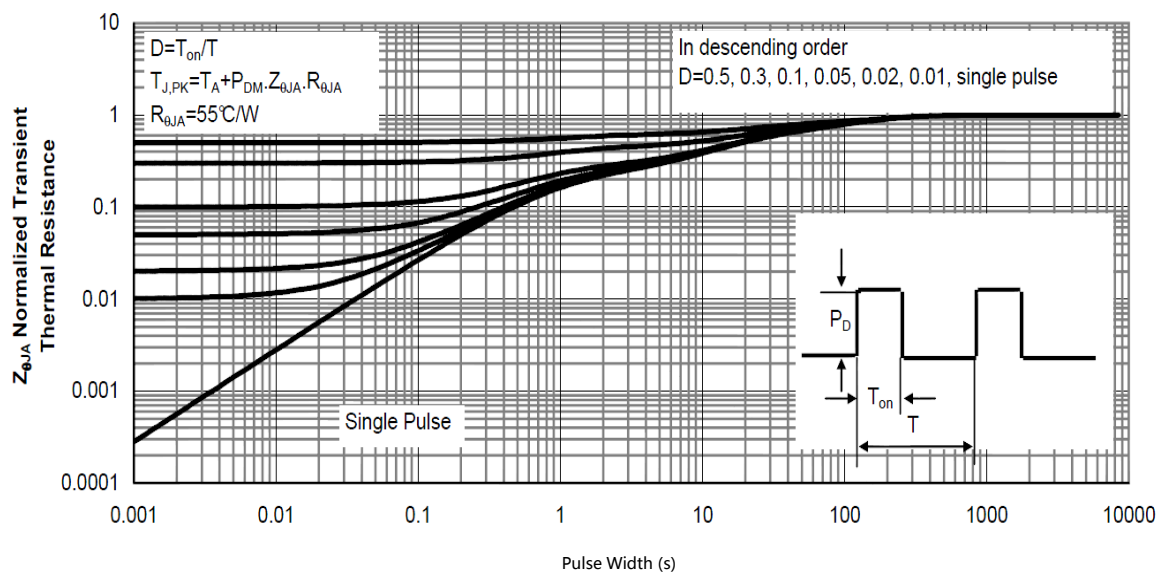
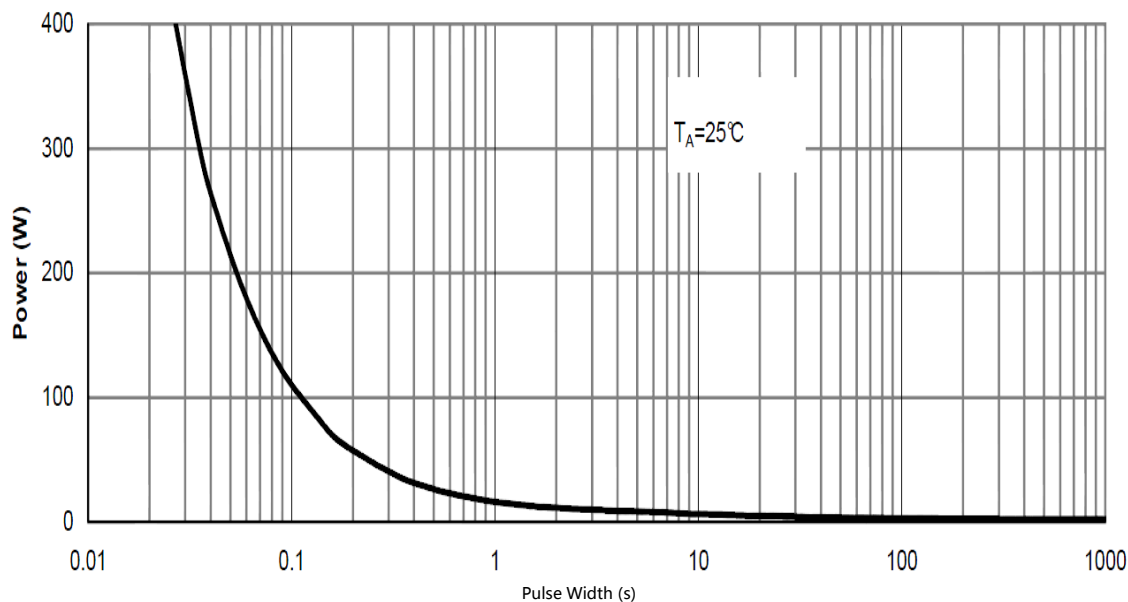


Figure 15: Normalized Maximum Transient Thermal Impedance

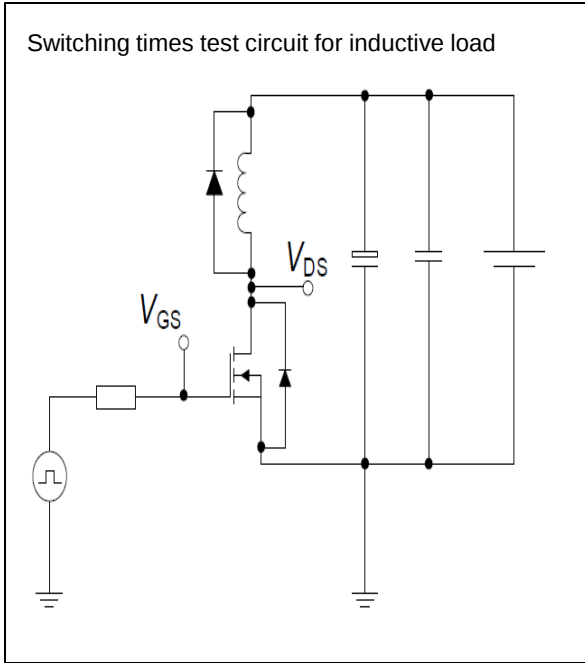
Typical Performance Characteristics



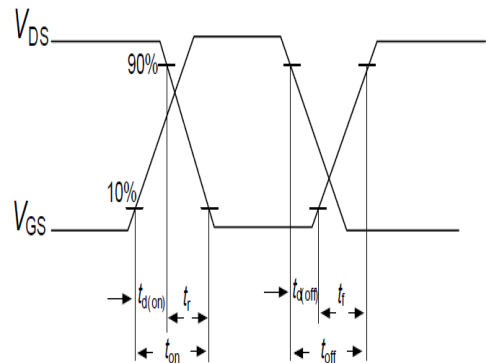
Test circuits

Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load

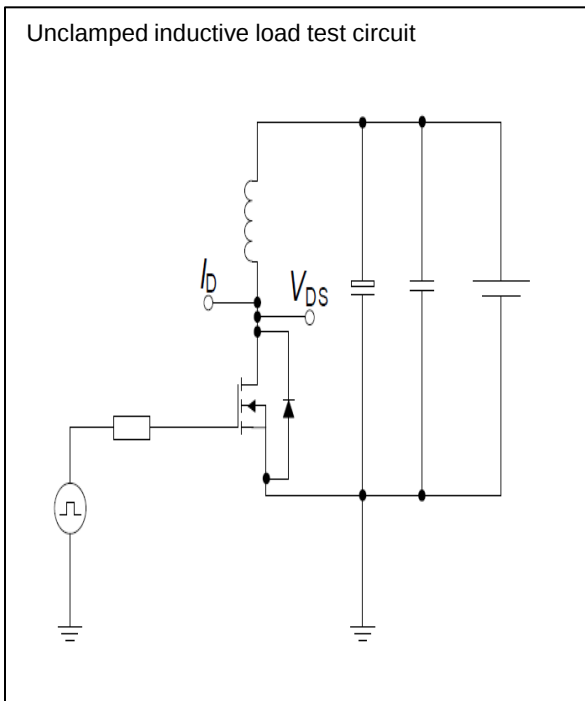


Switching time waveform

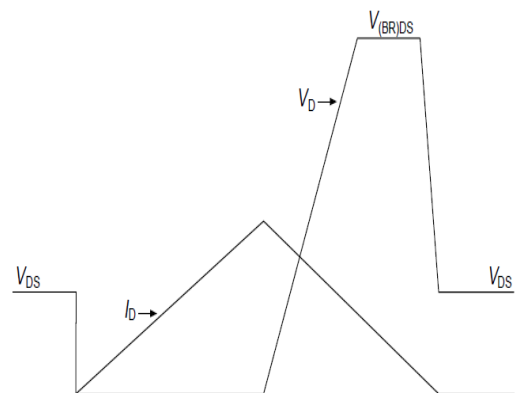


Unclamped inductive load test circuit and waveform

Unclamped inductive load test circuit



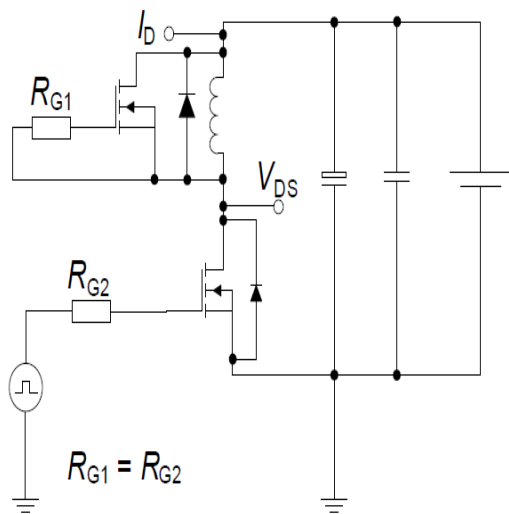
Unclamped inductive waveform



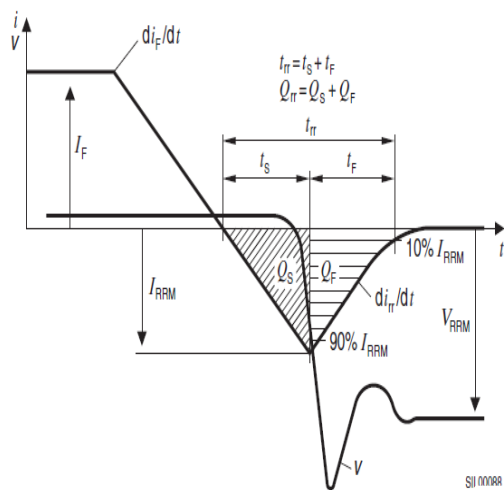
Test circuits

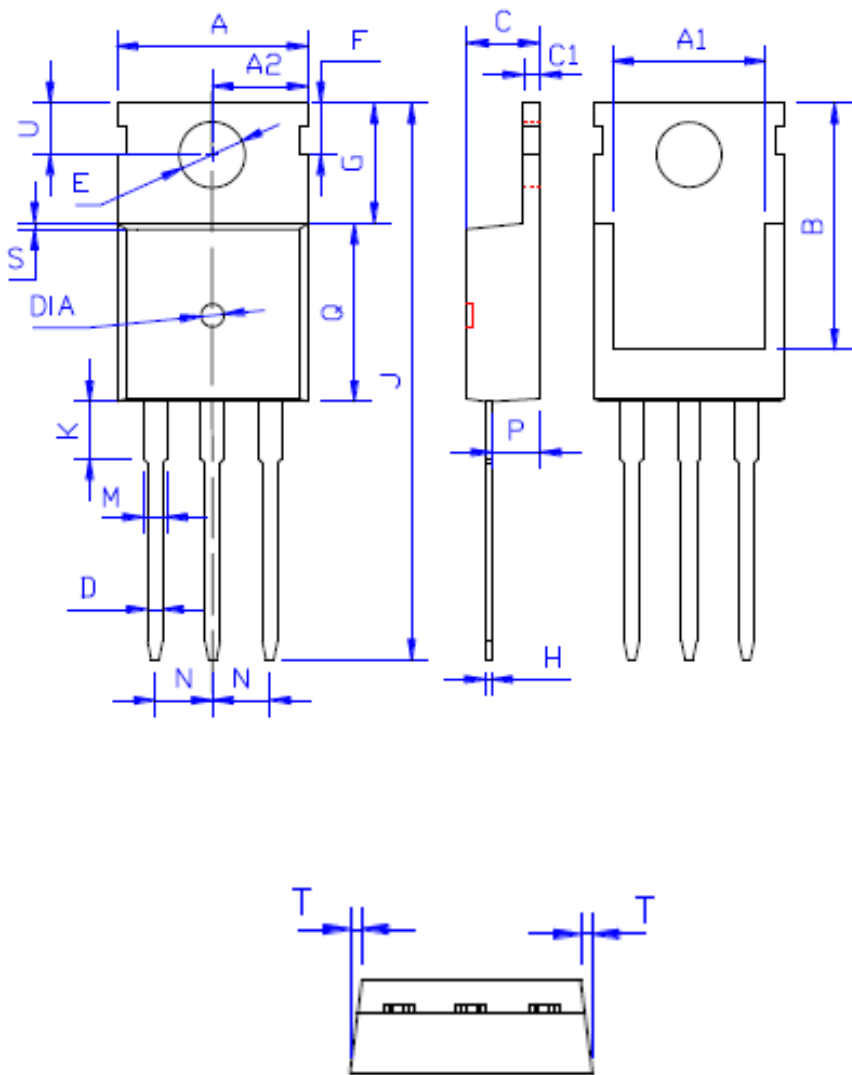
Test circuit and waveform for diode characteristics

Test circuit for diode characteristics



Diode recovery waveform





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