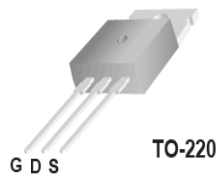


TSP65R190S1

650V 20A N-Channel SJ-MOSFET

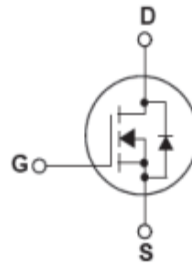
General Description

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

- 700V @TJ = 150 °C
- Typ. RDS(on) = 0.16Ω
- Ultra Low gate charge (typ. Qg = 70nC)
- 100% avalanche tested



Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V _{DSS}	Drain-Source Voltage	650	V
I _D	Drain Current -Continuous (TC = 25°C) -Continuous (TC = 100°C)	20* 12.6*	A
I _{DM}	Drain Current – Pulsed (Note 1)	62	A
V _{GSS}	Gate-Source voltage	±30	V
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	485	mJ
I _{AR}	Avalanche Current (Note 1)	3.5	A
E _{AR}	Repetitive Avalanche Energy (Note 1)	1	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15	V/ns
P _D	Power Dissipation (TC = 25°C) -Derate above 25°C	151 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	0.83	°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

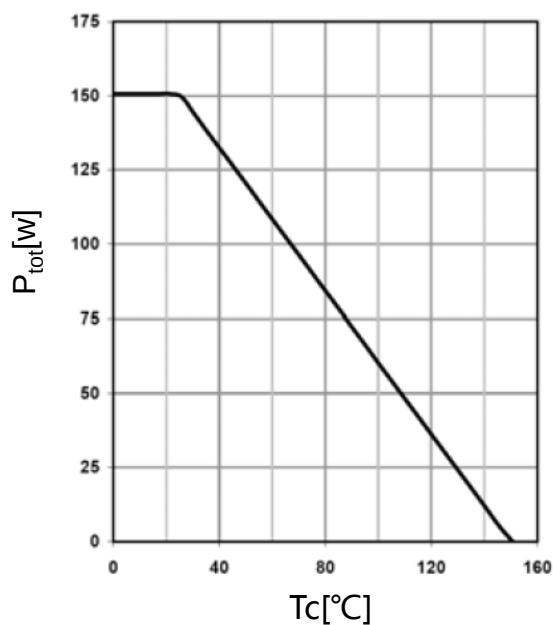
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0V, I _D = 250μA, T _J = 25℃	650	--	--	V
		V _{GS} = 0V, I _D = 250μA, T _J = 150℃	--	700	--	V
ΔBV _{DSS} / ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 250μA, Referenced to 25℃	--	0.6	--	V/℃
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650V, V _{GS} = 0V T _C = 25℃	--	--	1	μA
		V _{DS} = 480V, V _{GS} = 0V T _C = 150℃		10	--	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	--	0.16	0.19	Ω
g _{FS}	Forward Trans conductance	V _{DS} = 40V, I _D = 5A (Note 4)	--	16	--	S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz	--	1440	--	pF
C _{oss}	Output Capacitance		--	370	--	pF
C _{rss}	Reverse Transfer Capacitance		--	11	--	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		--	11	--	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 = 10A V _{GS} = 10V (Note 4, 5)	--	70	90	nC
Q _{gs}	Gate-Source Charge		--	7.8	--	nC
Q _{gd}	Gate-Drain Charge		--	9	--	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 _F = 10A	--	1	1.5	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _F = 10A di _F /dt =100A/μs (Note 4)	--	475	--	ns
Q _{rr}	Reverse Recovery Charge		--	5.8	--	μC
I _{rrm}	Peak reverse recovery Current				35	--

NOTES:

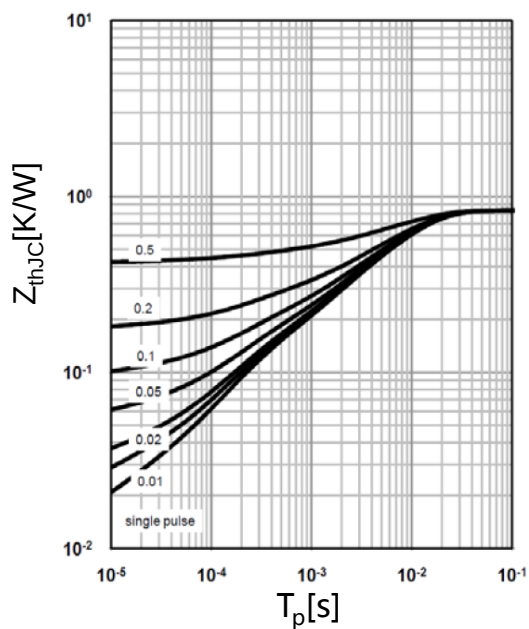
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_{AS}=3.5A, V_{DD}=50V$, Starting $T_J=25^\circ C$
3. $I_{SD}\leq 20A, di/dt \leq 200A/\mu s, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ C$
4. Pulse Test: Pulse width $\leq 300\mu s$, Duty Cycle $\leq 2\%$
5. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

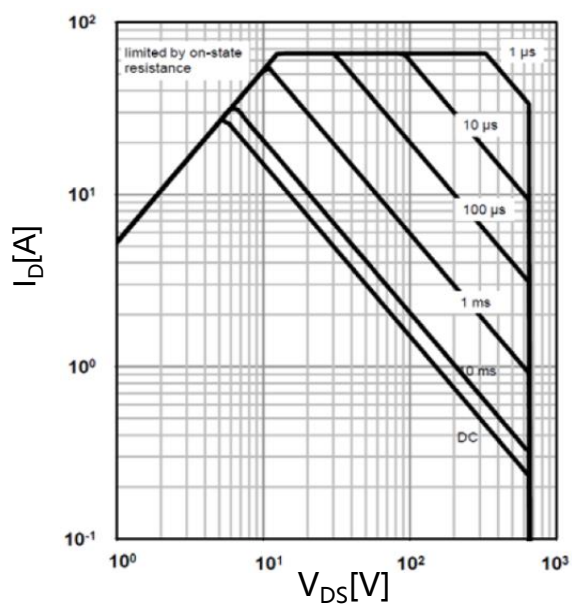
Power dissipation



Max. transient thermal impedance

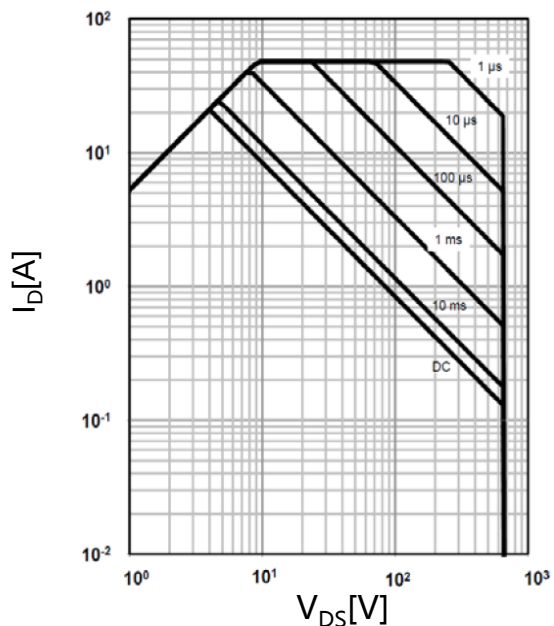


Safe operating area $T_C=25\text{ }^{\circ}\text{C}$



$I_D=f(V_{DS})$; $T_C=25\text{ }^{\circ}\text{C}$; $V_{GS} > 7\text{V}$;
 $D=0$; parameter t_p

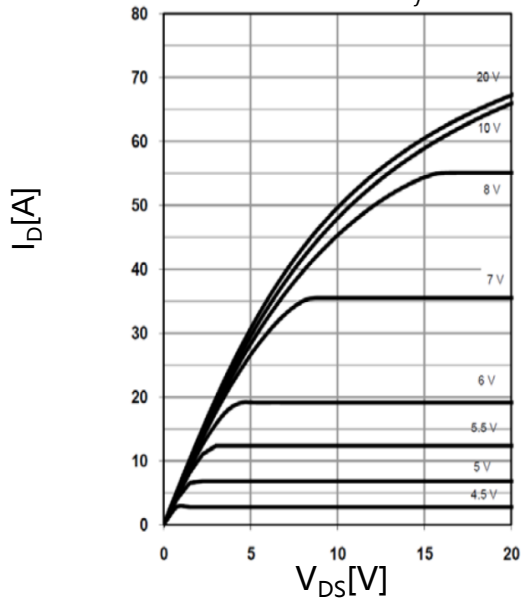
Safe operating area $T_C=80\text{ }^{\circ}\text{C}$



$I_D=f(V_{DS})$; $T_C=80\text{ }^{\circ}\text{C}$; $V_{GS} > 7\text{V}$;
 $D=0$; parameter t_p

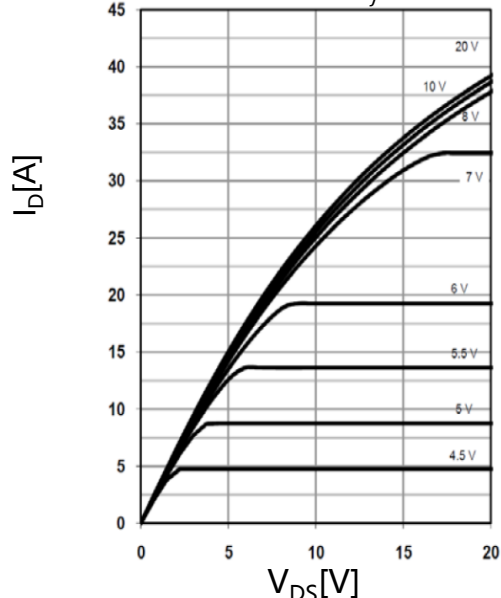
Typical Performance Characteristics

Typ. output characteristics $T_j=25^\circ\text{C}$



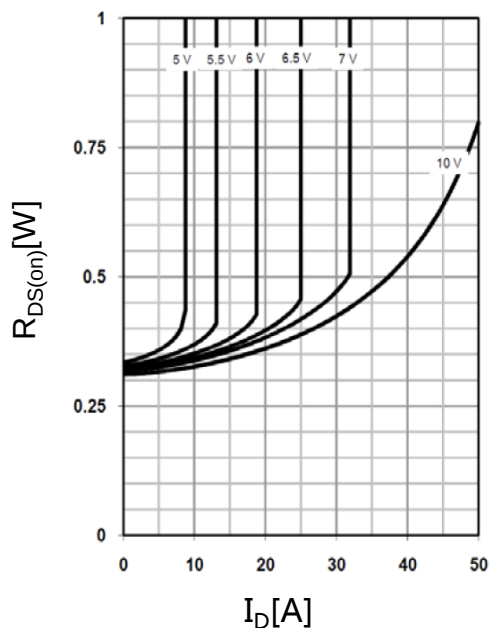
$I_D=f(V_{DS}); T_j=25^\circ\text{C}$; parameter: V_{GS}

Typ. output characteristics $T_j=125^\circ\text{C}$



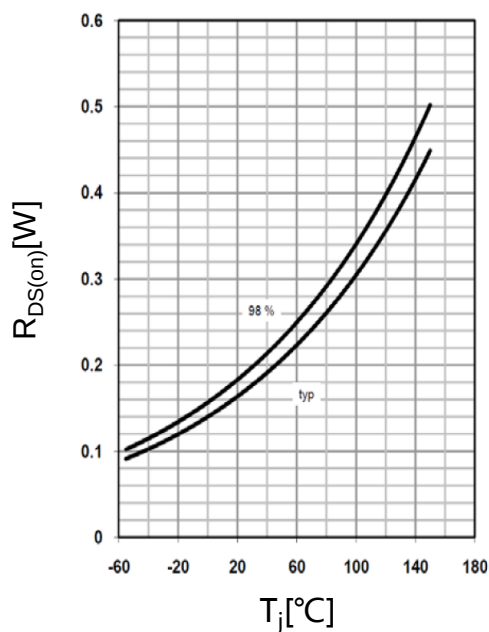
$I_D=f(V_{DS}); T_j=125^\circ\text{C}$; parameter: V_{GS}

Typ. drain-source on-state resistance



$R_{DS(on)}=f(I_D); T_j=125^\circ\text{C}$;
parameter: V_{GS}

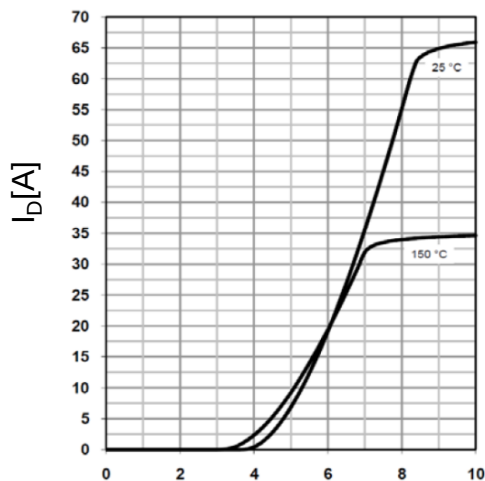
Typ. drain-source on-state resistance



$R_{DS(on)}=f(T_j); I_D=7.3\text{ A}; V_{GS}=10\text{ V}$

Typical Performance Characteristics

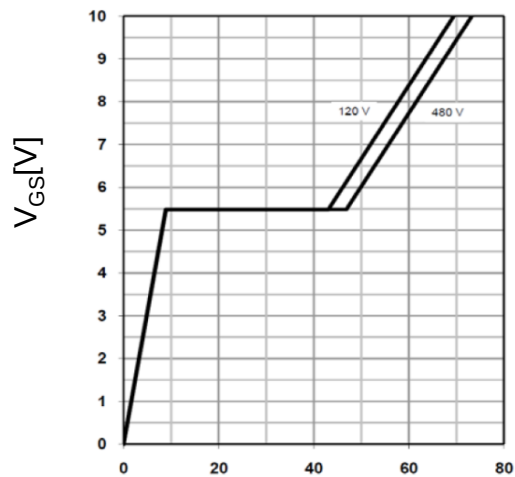
Typ. transfer characteristics



$V_{GS}[V]$

$I_D = f(V_{GS}); V_{DS} = 20V$

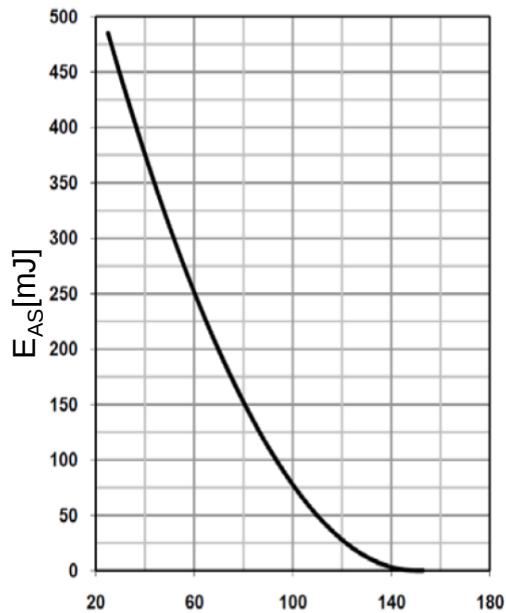
Typ. gate charge



$QV_G[nC]$

$V_{GS} = f(Q_g), I_D = 11A$ pulsed

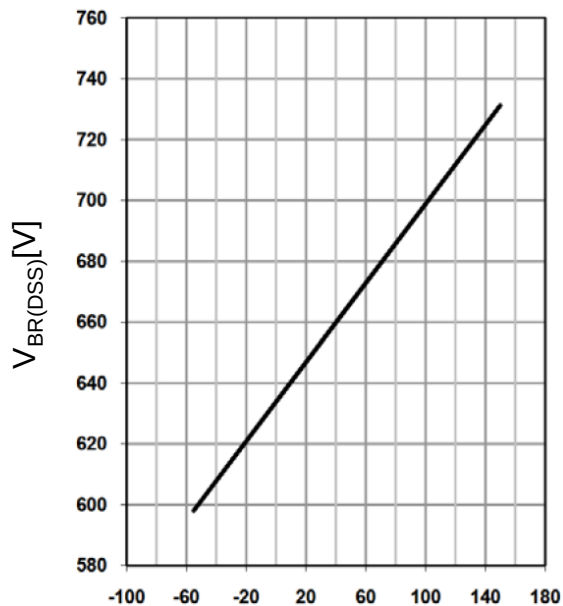
Avalanche energy



$T_j[^\circ C]$

$E_{AS} = f(T_j); I_D = 3.5A; V_{DD} = 50V$

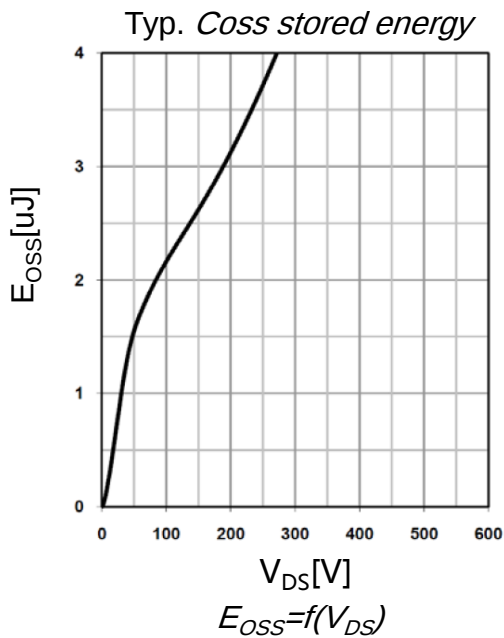
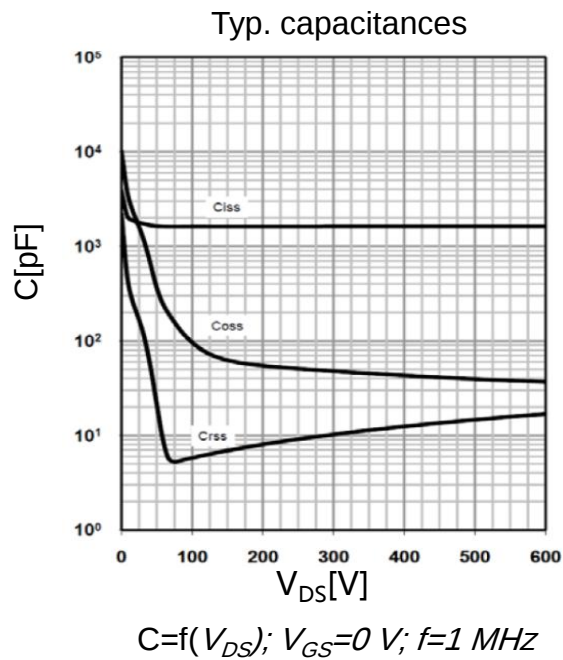
Drain-source breakdown voltage



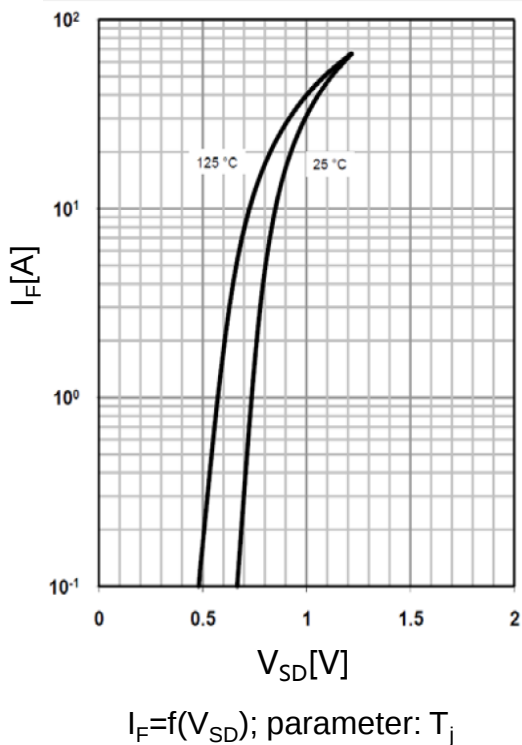
$T_j[^\circ C]$

$V_{BR(DSS)} = f(T_j); I_D = 1.0mA$

Typical Performance Characteristics

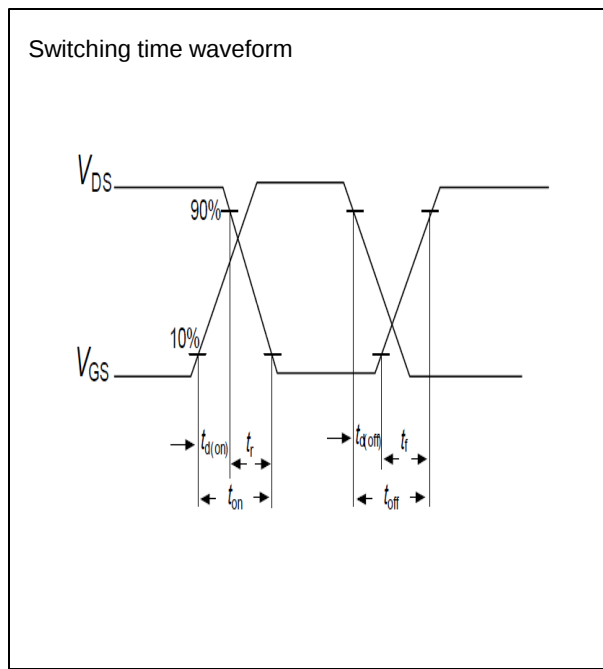
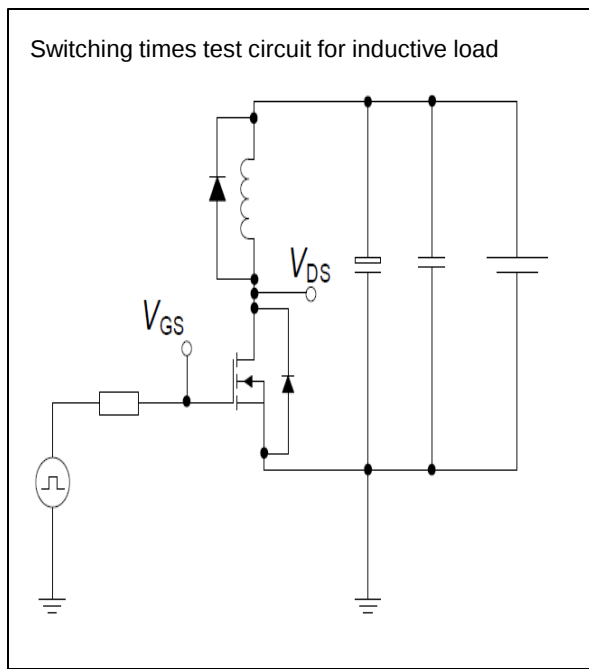


Forward characteristics of reverse diode

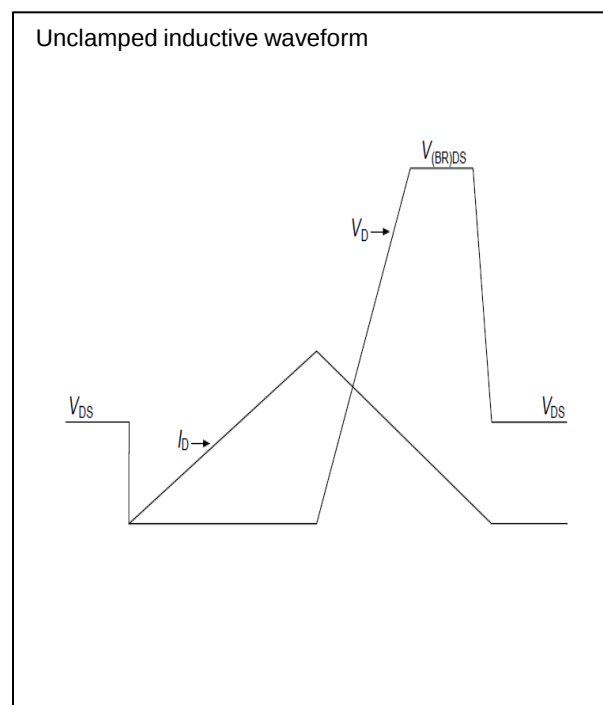
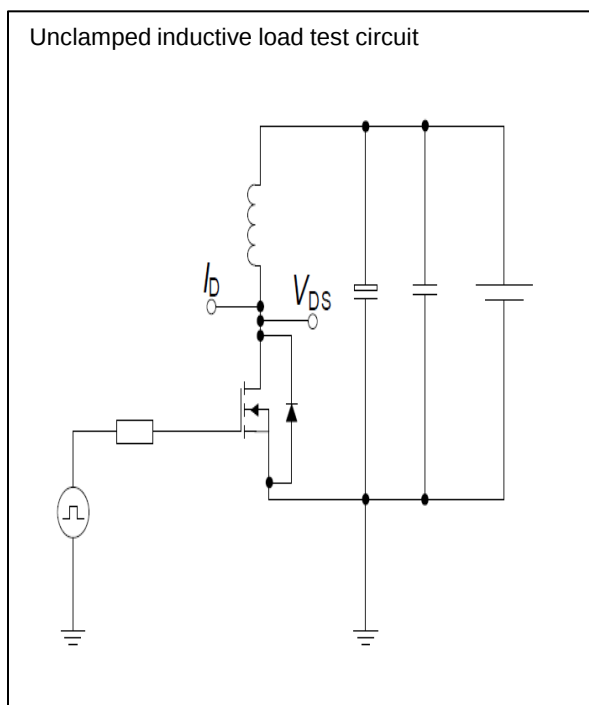


Test circuits

Switching times test circuit and waveform for inductive load

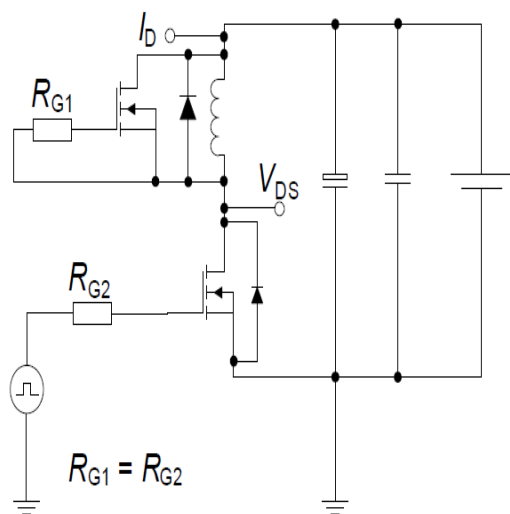


Unclamped inductive load test circuit and waveform



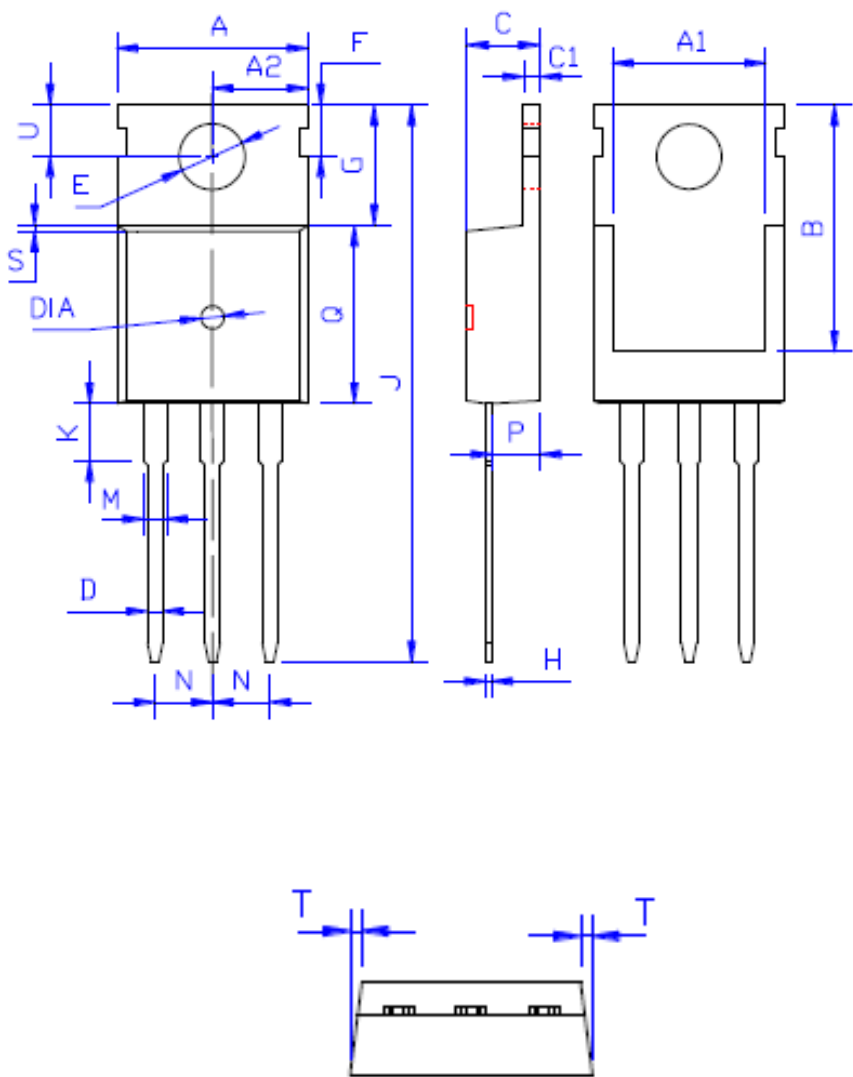
TS65R190S1 650V 20A N-Channel S-J-MOSFET

Test circuit for diode characteristics



Package Outline TO-220

TSP65R190S1 650V 20A 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