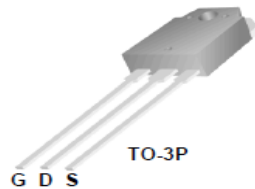


TSA60R280S1

600V 15A N-Channel SJ-MOSFET

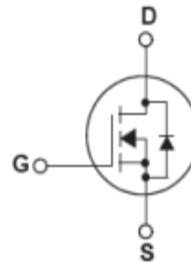
General Description

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 @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 0.24\Omega$
- Ultra Low gate charge (typ. $Q_g = 43\text{nC}$)
- 100% avalanche tested



Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{DSS}	Drain-Source Voltage	600	V
I_D	Drain Current	-Continuous ($TC = 25^\circ\text{C}$)	15
		-Continuous ($TC = 100^\circ\text{C}$)	9.4
I_{DM}	Drain Current – Pulsed (Note 1)	45	A
V_{GSS}	Gate-Source voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	284	mJ
I_{AR}	Avalanche Current (Note 1)	2.4	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	0.43	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15	V/ns
P_D	Power Dissipation ($TC = 25^\circ\text{C}$)	104	W
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.2	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	$^\circ\text{C/W}$

Electrical Characteristics TC = 25 °C unless otherwise noted

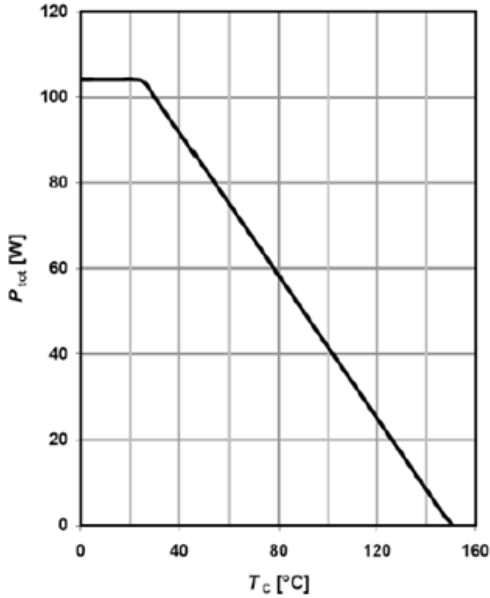
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0V, I _D = 250μA, T _J = 25 °C	600	--	--	V
		V _{GS} = 0V, I _D = 250μA, T _J = 150 °C	--	650	--	V
ΔBV _{DSS} / ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 250μA, Referenced to 25 °C	--	0.6	--	V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 600V, V _{GS} = 0V -T _J = 150 °C	--	-- 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 = 7.5A	--	0.24	0.28	Ω
g _{FS}	Forward Trans conductance	V _{DS} = 40V, I _D = 15A (Note 4)	--	16	--	S
R _g	Gate resistance	f=1 MHz, open drain	--	3.5	--	Ω
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz	--	800	--	pF
C _{oss}	Output Capacitance		--	340	--	pF
C _{rss}	Reverse Transfer Capacitance		--	10	--	pF
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time	V _{DD} = 400V, I _D = 7.5A R _G = 20Ω(Note 4, 5)	--	13	--	ns
t _r	Turn-On Rise Time		--	11	--	ns
t _{d(off)}	Turn-Off Delay Time		--	100	--	ns
t _f	Turn-Off Fall Time		--	12	--	ns
Q _g	Total Gate Charge	V _{DS} = 480V, I _D = 7.5A V _{GS} = 10V (Note 4, 5)	--	43	--	nC
Q _{gs}	Gate-Source Charge		--	5	--	nC
Q _{gd}	Gate-Drain Charge		--	22	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	15	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	45	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0V, I _F = 7.5A	--	0.9	1.5	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _F = 7.5A di _F /dt = 100A/μs (Note 4)	--	345	--	ns
Q _{rr}	Reverse Recovery Charge		--	4.5	--	μC

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_{AS}=2.4A, V_{DD}=50V, Starting T_J=25 °C
3. I_{SD}≤15A, di/dt ≤ 200A/us, V_{DD} ≤ BV_{DSS}, Starting T_J = 25 °C
4. Pulse Test: Pulse width ≤ 300us, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

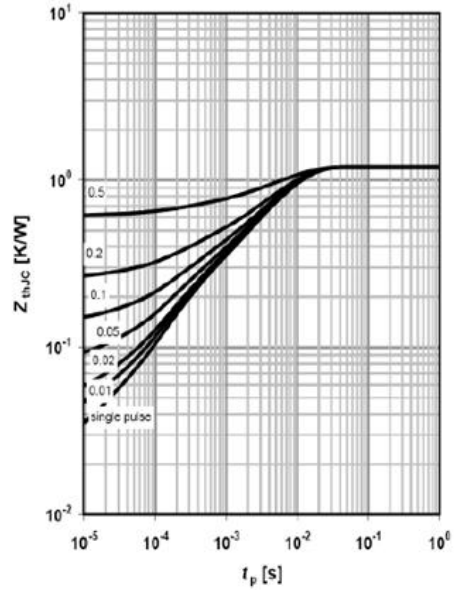
Typical Performance Characteristics

Power dissipation



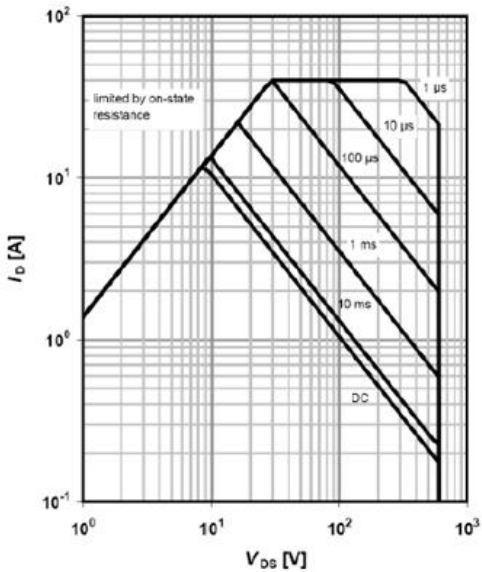
$$P_{\text{tot}} = f(T_C)$$

Max. transient thermal impedance



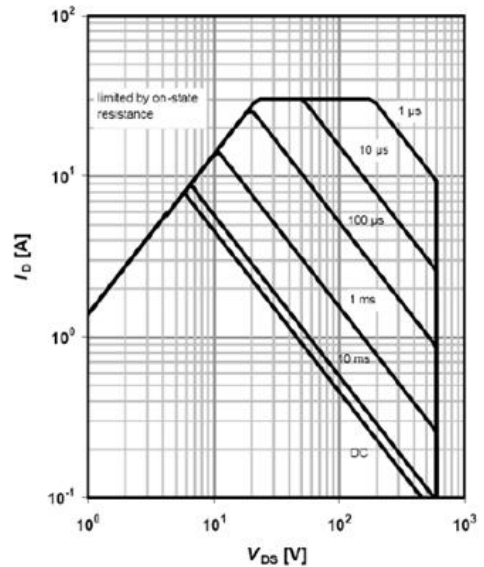
$$Z_{\text{thJC}} = f(t_p)$$

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



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

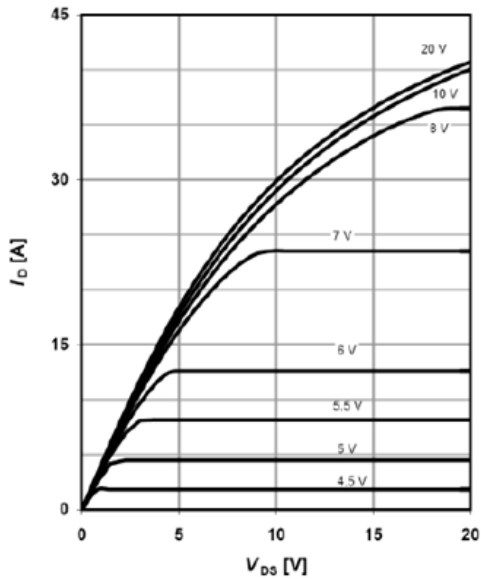
Safe operating area $T_C=80\text{ }^\circ\text{C}$



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

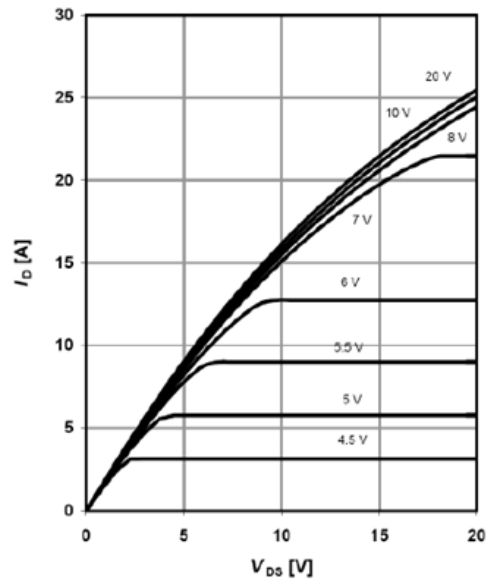
Typical Performance Characteristics

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



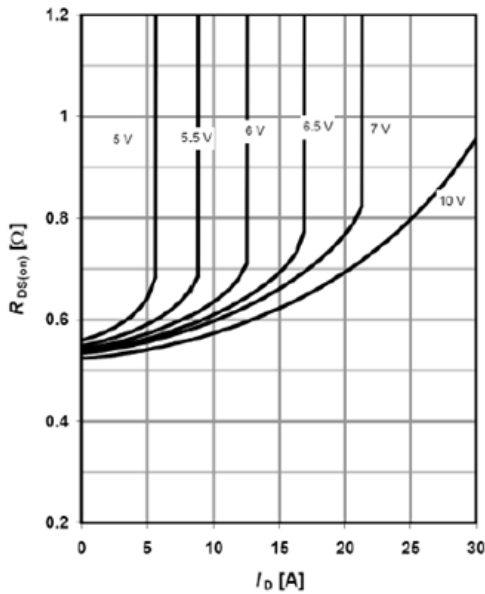
$I_D=f(V_{DS}); T_j=25^\circ\text{C}$; parameter: V_{GS}

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



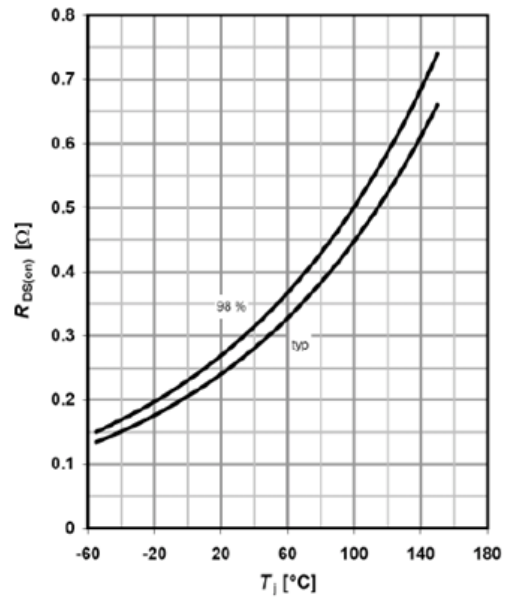
$I_D=f(V_{DS}); T_j=125^\circ\text{C}$; parameter: V_{GS}

Typ. drain-source on-state resistance



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

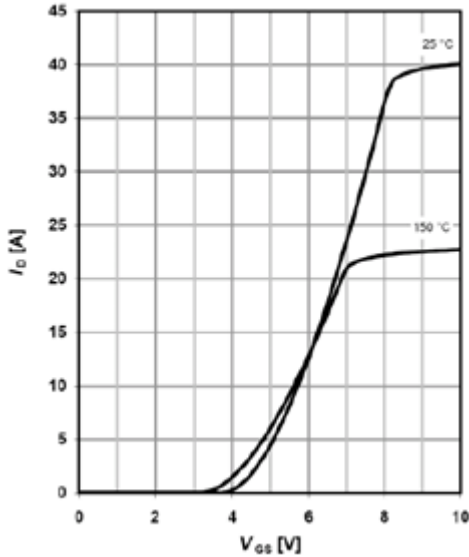
Typ. drain-source on-state resistance



$R_{DS(on)}=f(T_j); I_D=6.5\text{ A}; V_{GS}=10\text{ V}$

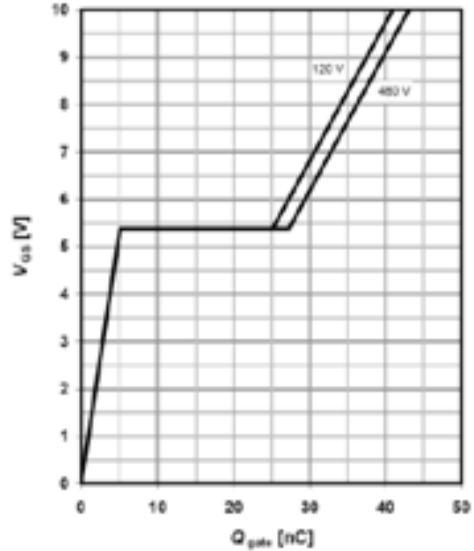
Typical Performance Characteristics

Typ. transfer characteristics



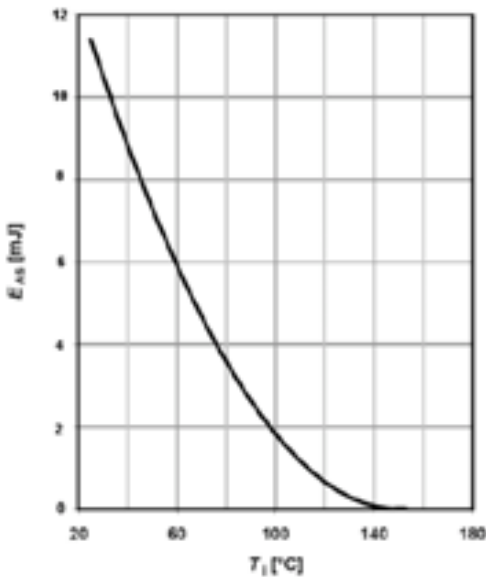
$$I_D = f(V_{GS}); V_{DS} = 20V$$

Typ. gate charge



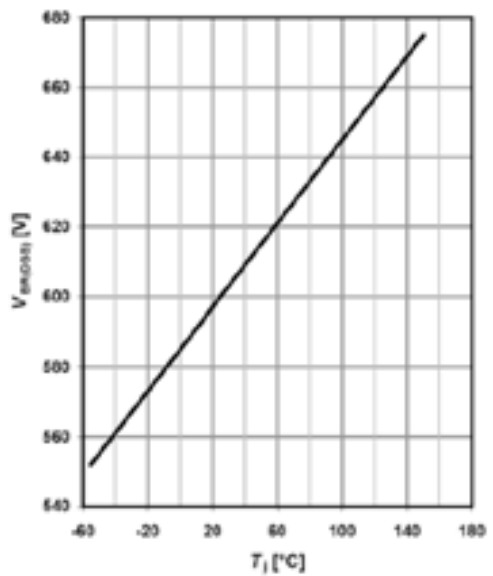
$$V_{GS} = f(Q_g), I_D = 6.5 A \text{ pulsed}$$

Avalanche energy



$$E_{AS} = f(T_j); I_D = 6.5 A; V_{DD} = 50 V$$

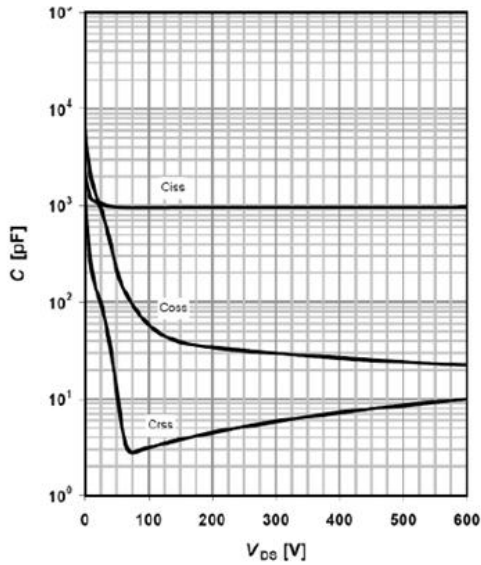
Drain-source breakdown voltage



$$V_{BR(DSS)} = f(T_j); I_D = 0.25 mA$$

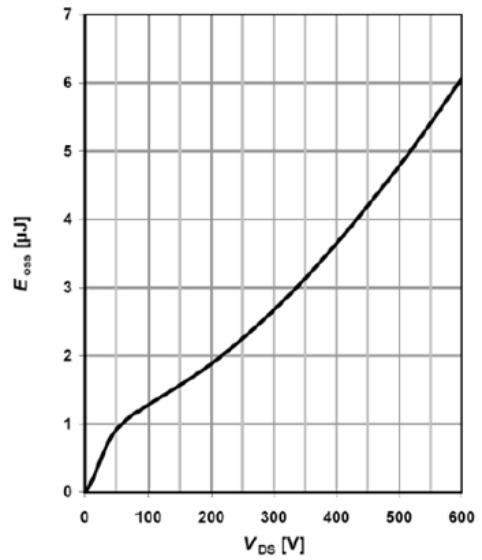
Typical Performance Characteristics

Typ. capacitances



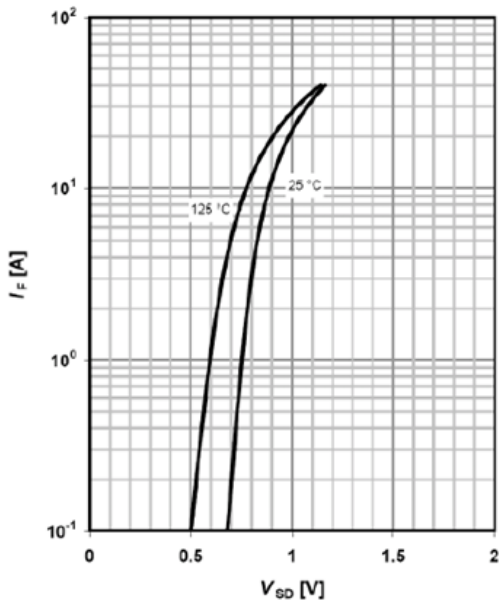
$$C=f(V_{DS}); V_{GS}=0 V; f=1 MHz$$

Typ. *Coss* stored energy



$$E_{OSS}=f(V_{DS})$$

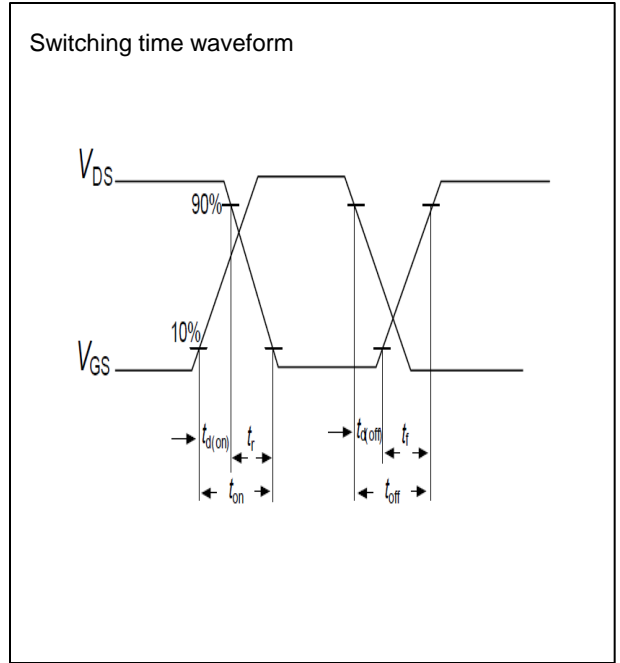
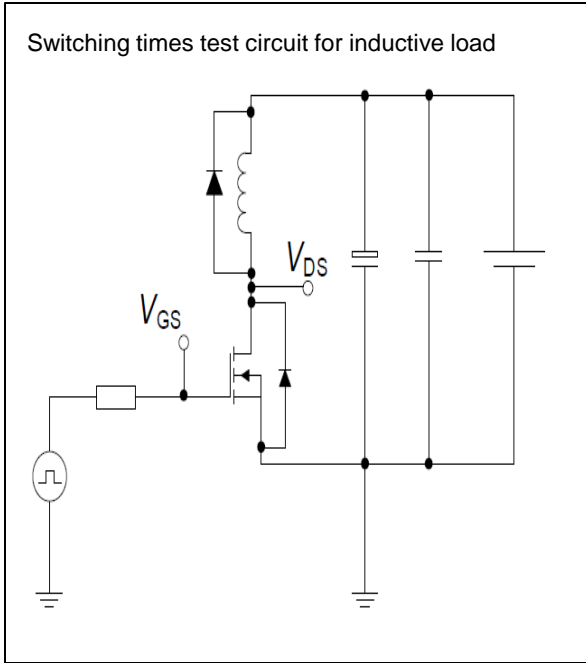
Forward characteristics of reverse diode



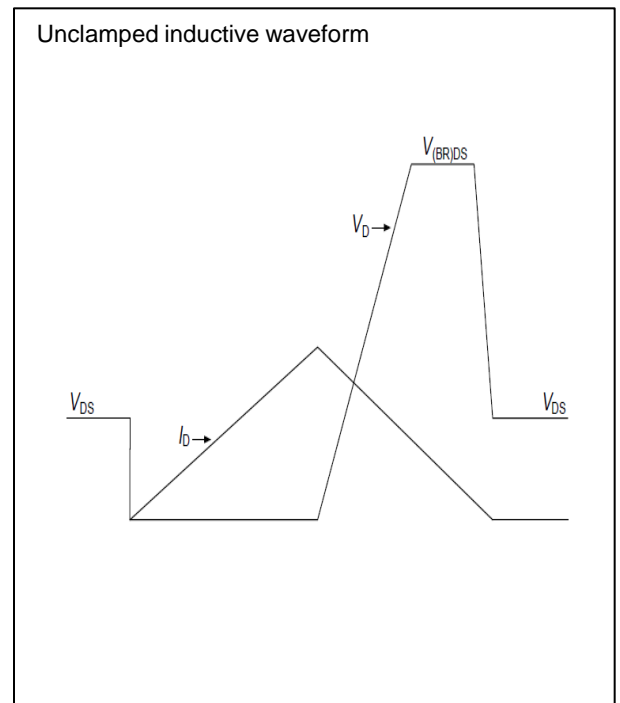
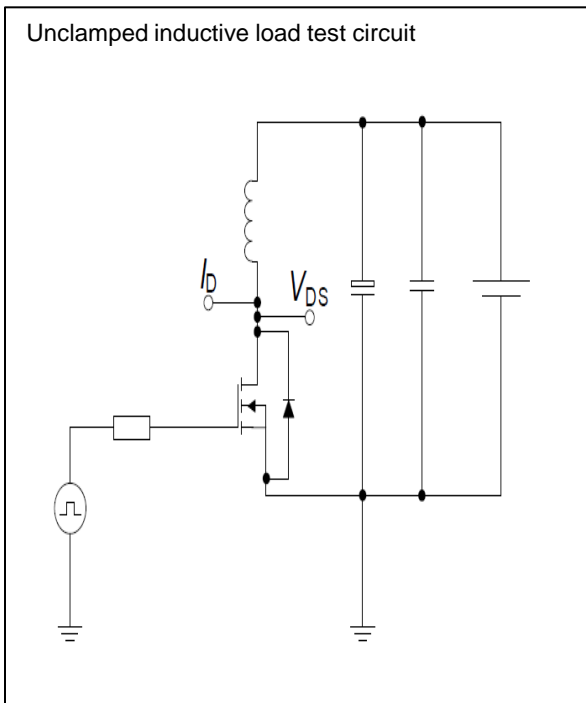
$$I_F=f(V_{SD}); \text{parameter: } T_j$$

Test circuits

Switching times test circuit and waveform for inductive load

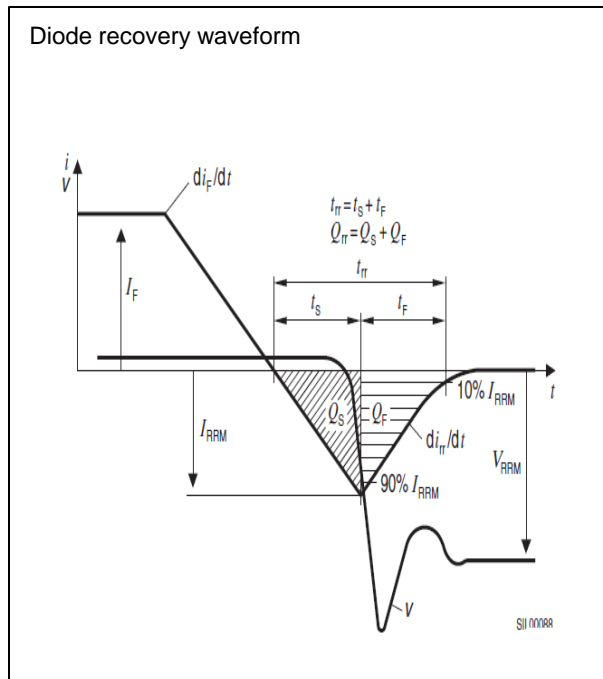
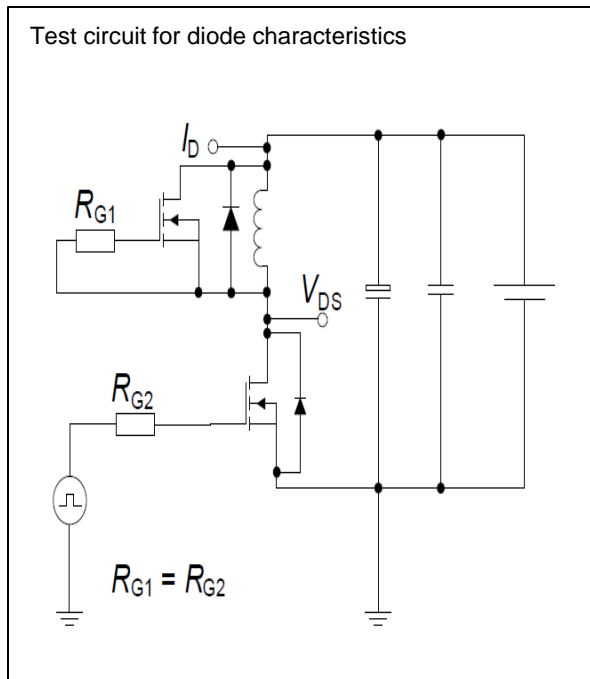


Unclamped inductive load test circuit and waveform

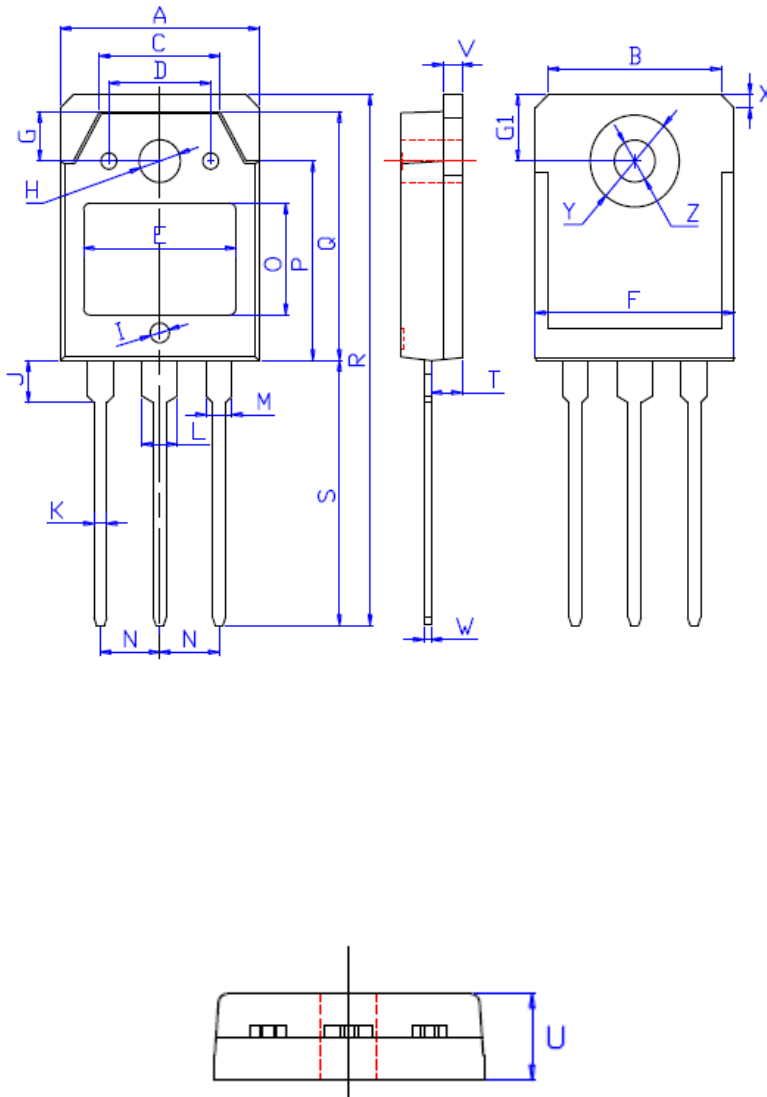


Test circuits

Test circuit and waveform for diode characteristics



Package Outline TO-3P



DIM	MILLIMETERS
A	15.60±0.30
B	13.60±0.30
C	9.50±0.30
D	8.00±0.30
E	11.85±0.30
F	15.65±0.30
G	3.80±0.30
G1	5.00±0.30
H	Φ 3.50±0.30
I	Φ 1.50±0.30 深 0.15±0.15
J	3.20±0.30
K	1.00±0.15
L	3.10±0.15
M	2.10±0.15
N	5.45±0.30
O	8.40±0.30
P	13.90±0.30
Q	18.70±0.30
R	40.00±0.60
S	20.00±0.40
T	2.40±0.30
U	4.80±0.30
V	1.50±0.15
W	0.60±0.15
X	1.80±0.40
Y	7.00±0.30
Z	3.20±0.30