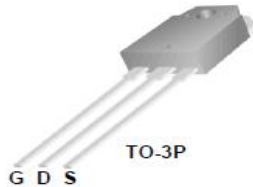


# TSA60R070SFD

## 600V 47A N-Channel SJ-MOSFET

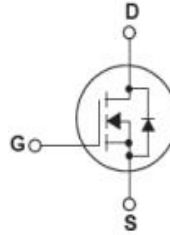
### General Description

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

- Fast-Recovery body diode
- Extremely Low Reverse Recovery Charge
- 650V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 60\text{m}\Omega$
- Ultra Low gate charge (typ.  $Q_g = 170\text{nC}$ )
- 100% avalanche tested



### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain-Source Voltage	600	V
$I_D$	Drain Current -Continuous ( $T_C = 25^\circ\text{C}$ )	47*	A
	-Continuous ( $T_C = 100^\circ\text{C}$ )	29*	A
$I_{DM}$	Drain Current – Pulsed (Note 1)	140	A
$V_{GSS}$	Gate-Source voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	1135	mJ
$I_{AR}$	Avalanche Current (Note 1)	9.3	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	1.72	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)	40	V/ns
$dv_{ds}/dt$	Drain Source voltage slope ( $V_{ds}=480\text{V}$ )	80	V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	391	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	0.32	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	$^\circ\text{C}/\text{W}$

## Electrical Characteristics TC = 25°C unless otherwise noted

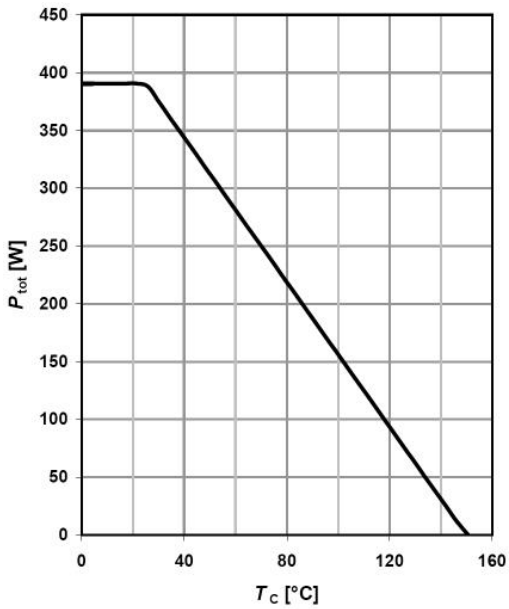
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 25°C	600	--	--	V
		V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 150°C	--	650	--	V
ΔBV <sub>DSS</sub> / 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 -T <sub>J</sub> = 150°C	--	1 10	5 --	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
On Characteristics						
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> = 23A	--	60	70	mΩ
g <sub>FS</sub>	Forward Trans conductance	V <sub>DS</sub> = 40V, I <sub>D</sub> = 25A	--	30	--	S
Dynamic Characteristics						
C <sub>ISS</sub>	Input Capacitance	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz	--	3100	--	pF
C <sub>OSS</sub>	Output Capacitance		--	610	--	pF
C <sub>RSS</sub>	Reverse Transfer Capacitance		--	15	--	pF
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 480V, I <sub>D</sub> = 23A R <sub>G</sub> = 20Ω (Note 4)	--	16	--	ns
t <sub>r</sub>	Turn-On Rise Time		--	12	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	83	--	ns
t <sub>f</sub>	Turn-Off Fall Time		--	5	--	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 480V, I <sub>D</sub> = 23A V <sub>GS</sub> = 10V (Note 4)	--	170	--	nC
Q <sub>gs</sub>	Gate-Source Charge		--	21	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	87	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	47	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	140	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>F</sub> = 23A	--	0.9	1.5	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0V, V <sub>R</sub> = 480V I <sub>F</sub> = 23A, di <sub>F</sub> /dt = 100A/μs	--	230	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	3	--	μC
I <sub>rrm</sub>	Peak Reverse Recovery Current		--	23	--	A

## NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub>=9.3A, V<sub>DD</sub>=50V, Starting T<sub>J</sub>=25°C
3. I<sub>SD</sub>≤23A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Essentially Independent of Operating Temperature Typical Characteristics

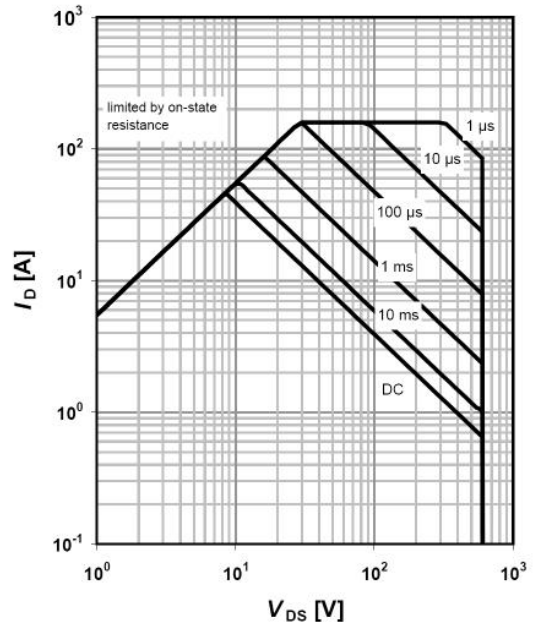
# Typical Performance Characteristics

Power dissipation



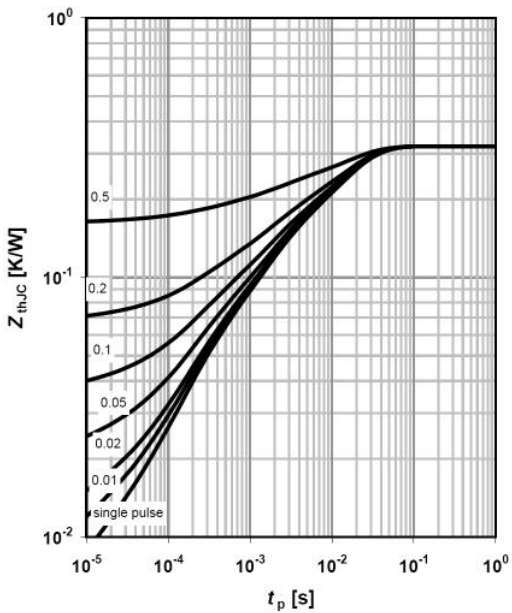
$$P_{tot} = f(T_C)$$

Safe operating area TC=25 °C



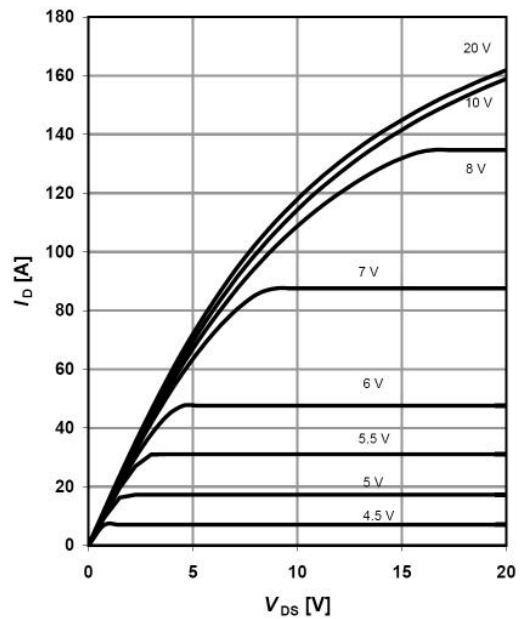
$$I_D = f(V_{DS}); T_C = 25\text{ °C}; D = 0; \text{ parameter } t_p$$

Max. transient thermal impedance



$$Z_{(th)JC} = f(t_p); \text{ parameter } D = t_p/T$$

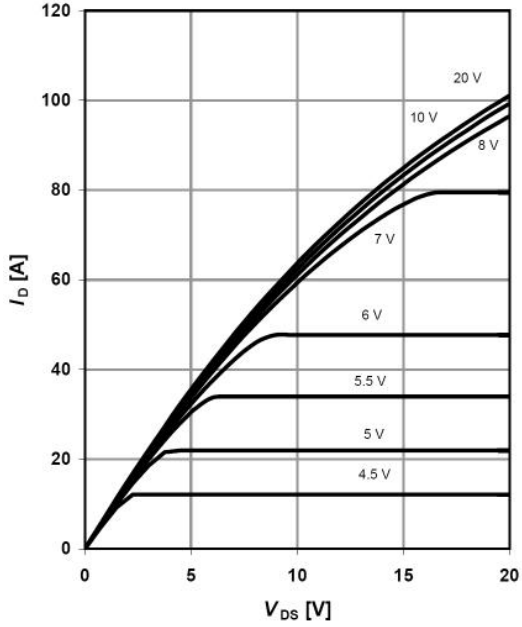
Typ. output characteristics  $T_j = 25\text{ °C}$



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

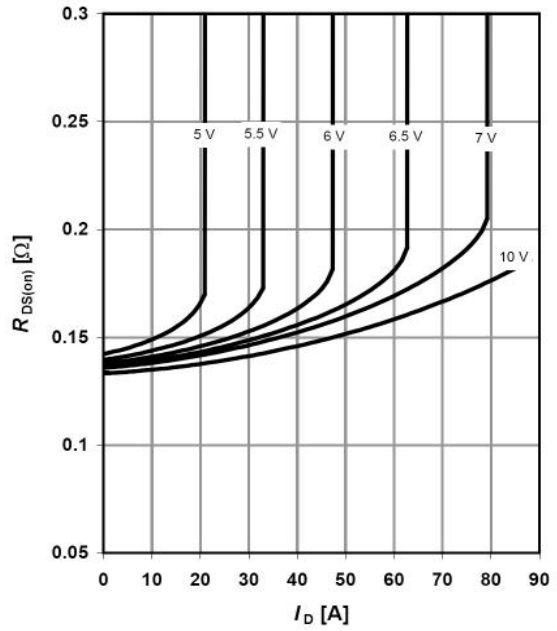
# Typical Performance Characteristics

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



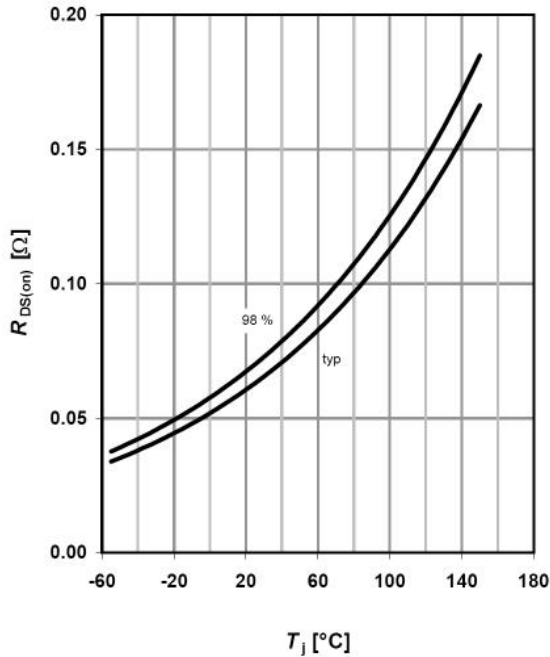
$$I_D = f(V_{DS}); T_j = 125\text{ }^\circ\text{C}; \text{ parameter: } V_{GS}$$

Typ. drain-source on-state resistance



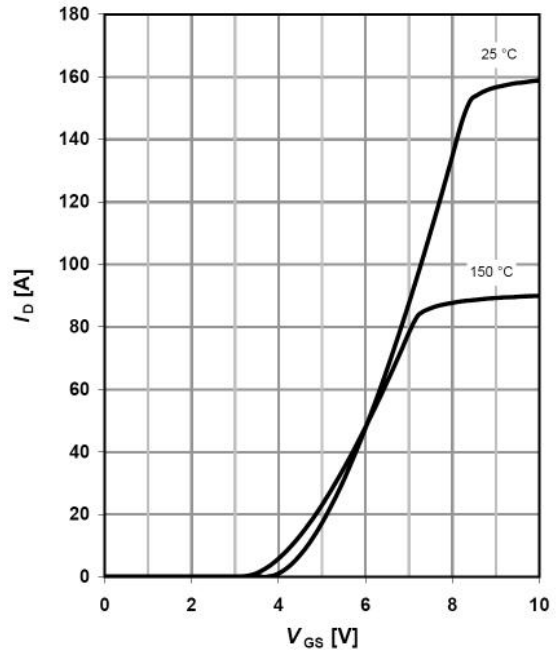
$$R_{DS(on)} = f(I_D); T_j = 125\text{ }^\circ\text{C}; \text{ parameter: } V_{GS}$$

Typ. drain-source on-state resistance



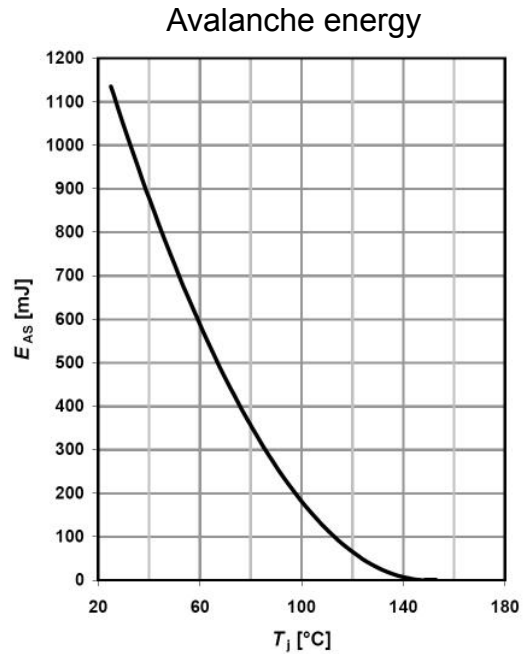
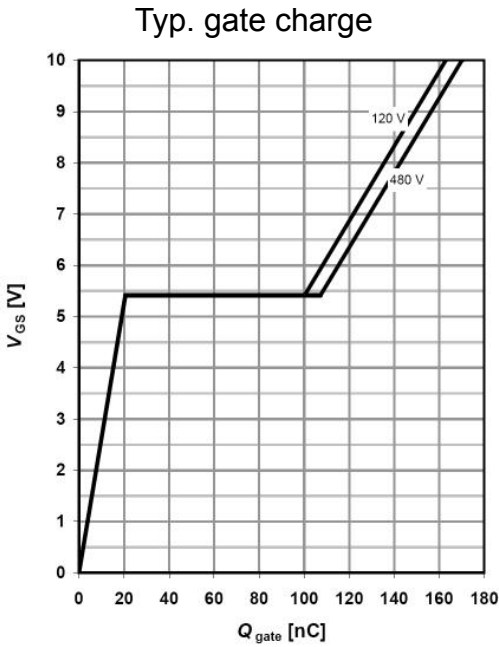
$$R_{DS(on)} = f(T_j); I_D = 23\text{ A}; V_{GS} = 10\text{ V}$$

Typ. transfer characteristics

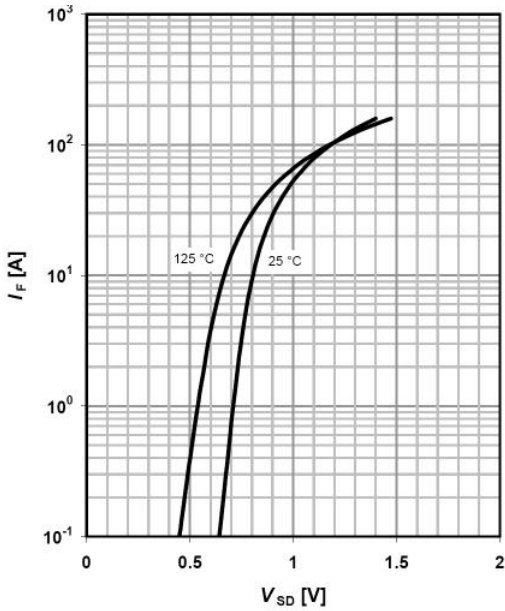


$$I_D = f(V_{GS}); V_{DS} = 40\text{ V}$$

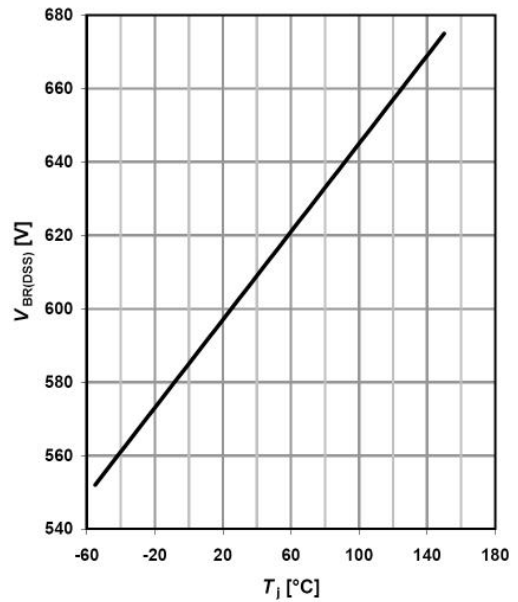
# Typical Performance Characteristics



Forward characteristics of reverse diode

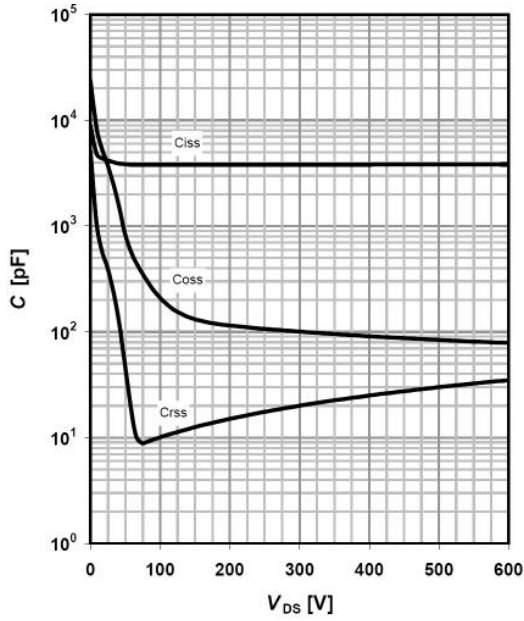


Drain-source breakdown voltage



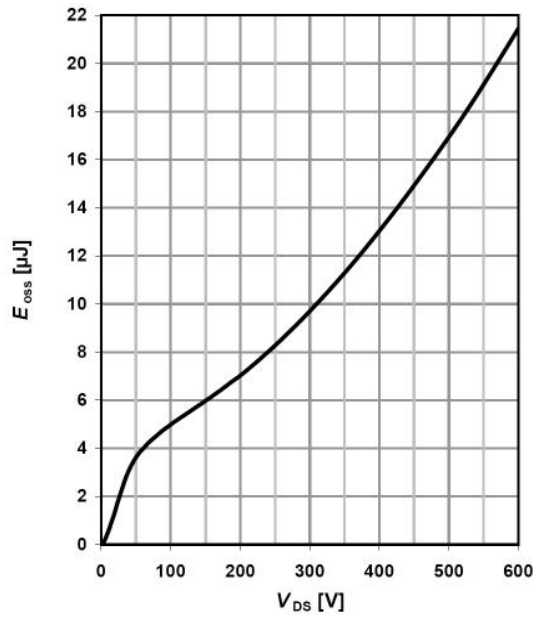
# Typical Performance Characteristics

Typ. capacitances



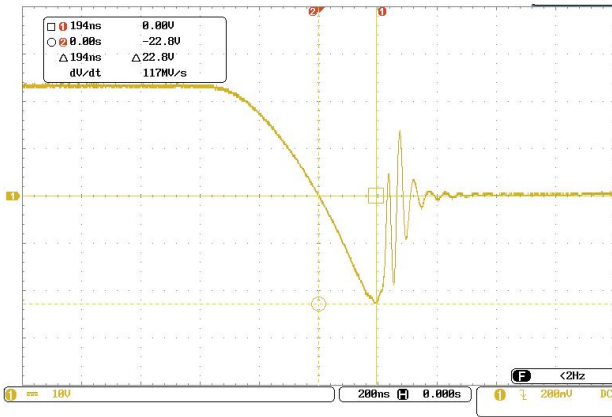
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$

Typ. Coss stored energy



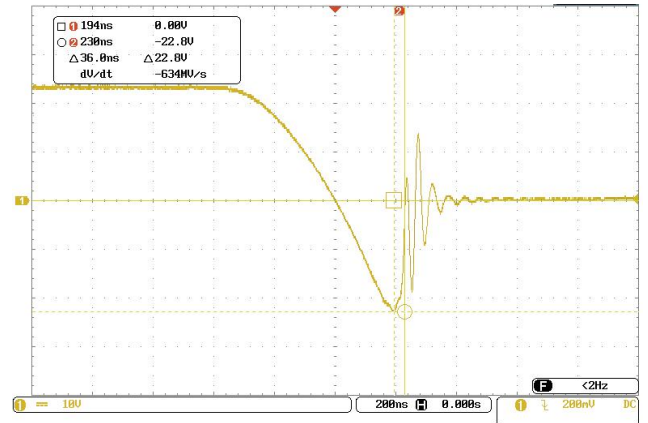
$E_{OSS}=f(V_{DS})$

Typ. Recovery Time(Ts)



$V_R=480V, I_s = 23A, dI/dt = 100A/\mu s$

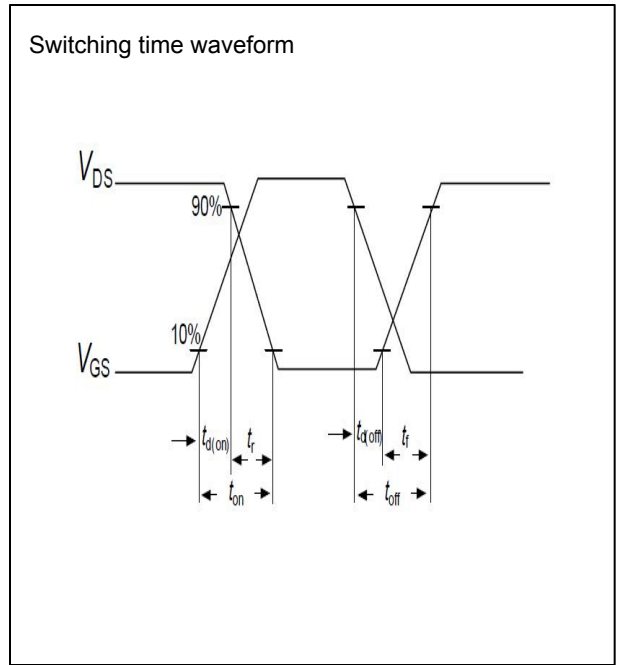
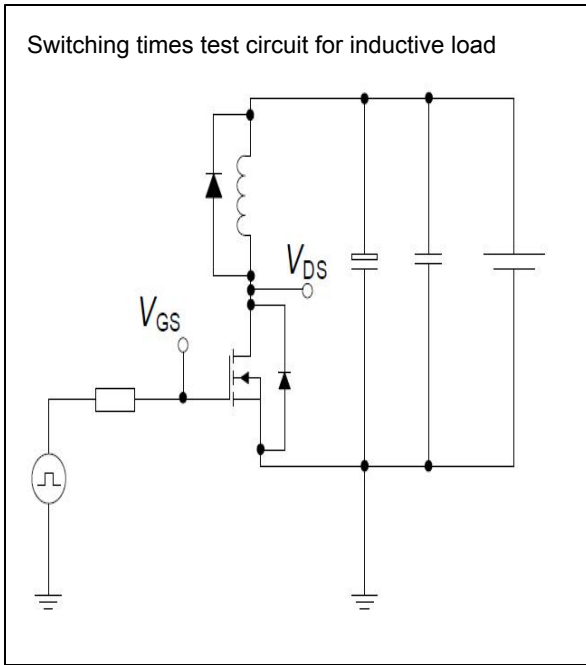
Typ. Recovery Time(Tf)



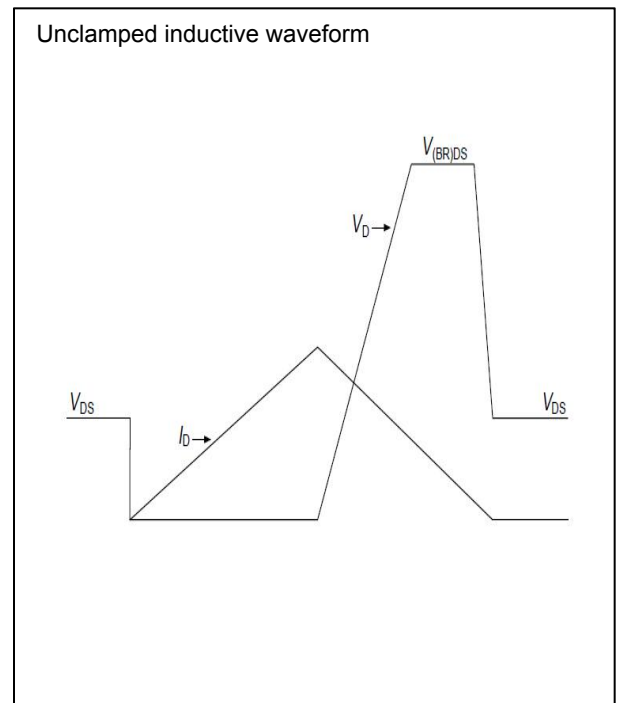
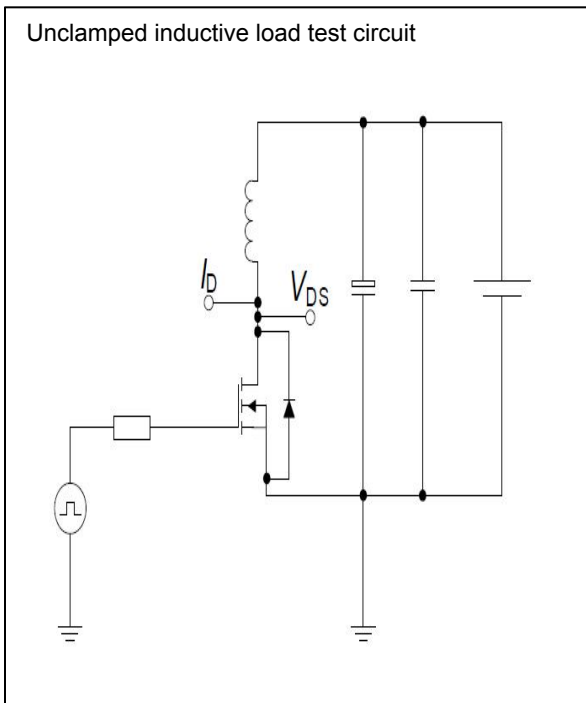
$V_R=480V, I_s = 23A, dI/dt = 100A/\mu s$

# Test circuits

## Switching times test circuit and waveform for inductive load

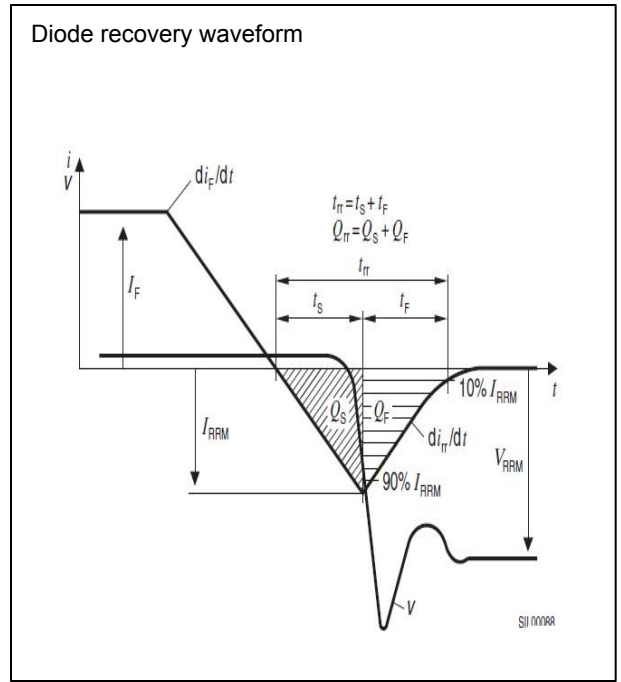
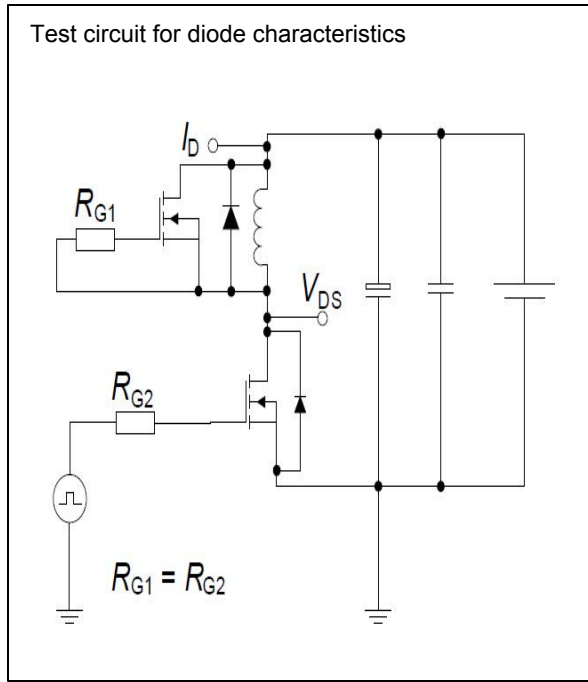


## Unclamped inductive load test circuit and waveform



# Test circuits

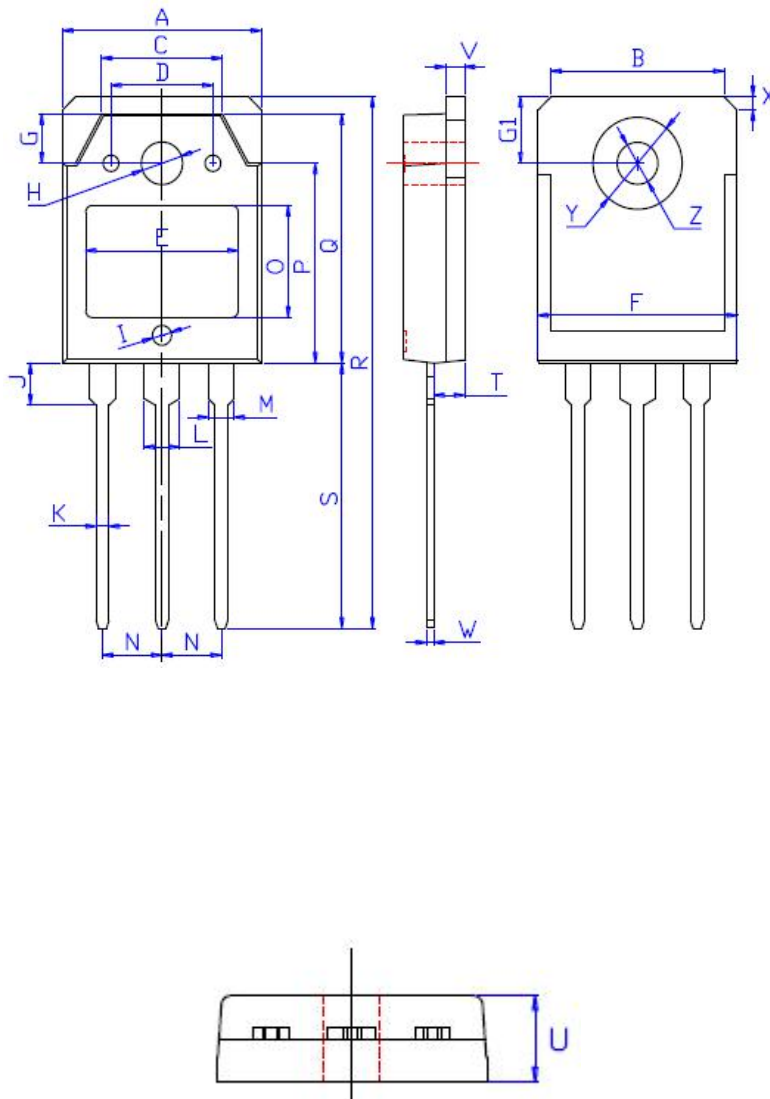
## Test circuit and waveform for diode characteristics





# Package Outline TO-3P

TSA60R070SFD 600V 47A N-Channel SJ-MOSFET



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