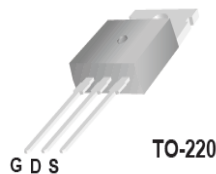


# TSP60R2K3S1

## 600V 2.3A N-Channel SJ-MOSFET

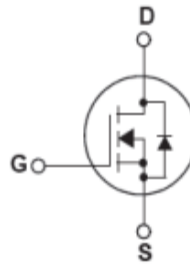
### General Description

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.  $R_{DS(on)} = 1.9\Omega$
- Ultra Low gate charge (typ.  $Q_g = 7\text{nC}$ )
- 100% avalanche tested



### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain-Source Voltage	600	V
$I_D$	Drain Current -Continuous ( $T_C = 25^\circ\text{C}$ )	2.3*	A
	-Continuous ( $T_C = 100^\circ\text{C}$ )	1.4*	A
$I_{DM}$	Drain Current – Pulsed (Note 1)	6*	A
$V_{GSS}$	Gate-Source voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	11	mJ
$I_{AR}$	Avalanche Current (Note 1)	0.4	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	0.06	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)	15	V/ns
$dvds/dt$	Drain Source voltage slope ( $V_{ds}=480\text{V}$ )	50	V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	22.5	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	5.6	$^\circ\text{C/W}$
$R_{\theta CS}$	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 <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	--	-- 10	1 --	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> = 1A	--	1.9	2.3	Ω
g <sub>FS</sub>	Forward Trans conductance	V <sub>DS</sub> = 40V, I <sub>D</sub> = 2A (Note 4)	--	2	--	S
R <sub>g</sub>	Gate resistance	f=1 MHz, open drain	-	3	-	Ω
Dynamic Characteristics						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz	--	130	--	pF
C <sub>oss</sub>	Output Capacitance		--	40	--	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	4	--	pF
Switching Characteristics						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400V, I <sub>D</sub> = 1A R <sub>G</sub> = 20Ω (Note 4, 5)	--	7	--	ns
t <sub>r</sub>	Turn-On Rise Time		--	7	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	30	--	ns
t <sub>f</sub>	Turn-Off Fall Time		--	50	--	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 480V, I <sub>D</sub> = 1A V <sub>GS</sub> = 10V (Note 4, 5)	--	7	--	nC
Q <sub>gs</sub>	Gate-Source Charge		--	0.8	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	3.6	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	2	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	6	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>F</sub> = 1A	--	0.9	1.5	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0V, I <sub>F</sub> = 1A di <sub>F</sub> /dt = 100A/μs (Note 4)	--	150	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	1.2	--	μC

## NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub>=0.4A, V<sub>DD</sub>=50V, Starting T<sub>J</sub>=25 °C
3. I<sub>SD</sub>≤2.3A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25 °C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

# Typical Performance Characteristics

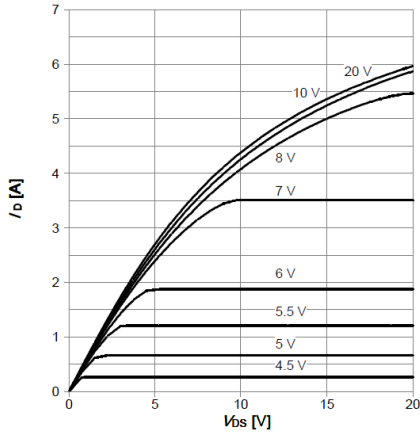


Figure 1: On-Region Characteristics@25°C

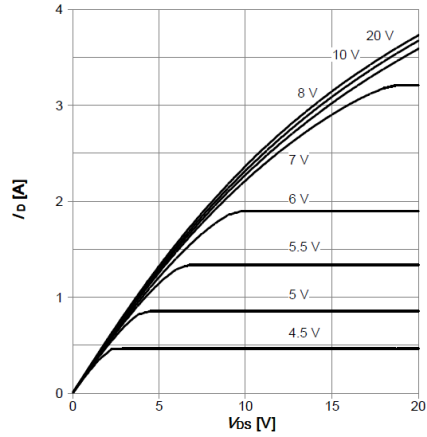


Figure 2: On-Region Characteristics@125°C

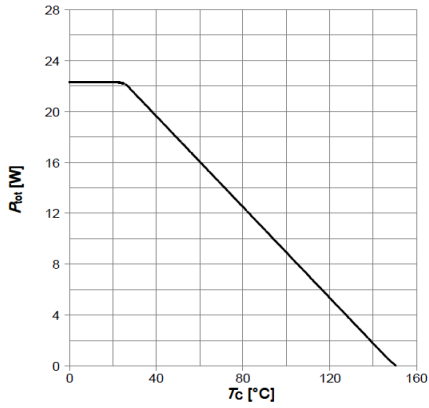


Figure 3: Power Dissipation

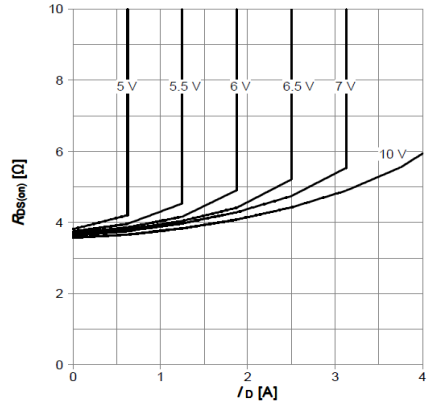


Figure 4: On-Resistance vs. Drain Current and Gate Voltage@125°C

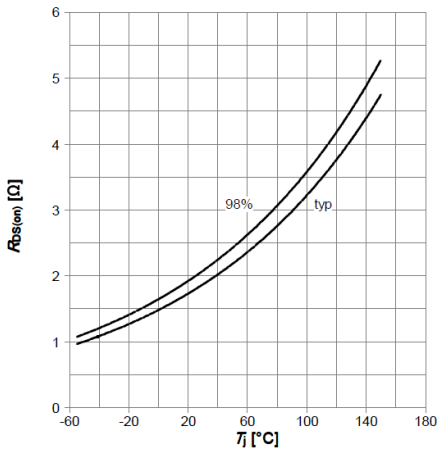


Figure 5: On-Resistance vs. Junction Temperature

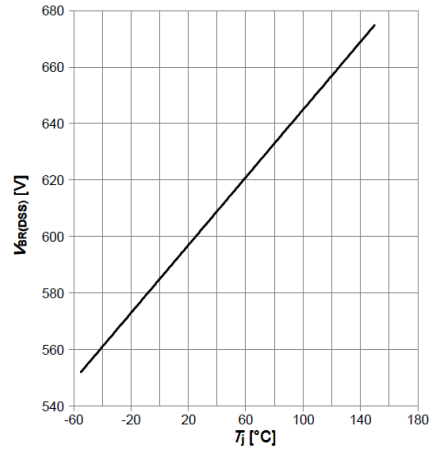


Figure 6: Break Down vs. Junction Temperature

# Typical Performance Characteristics

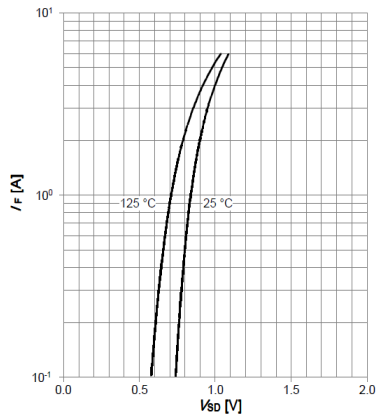


Figure 7: Body-Diode Characteristics

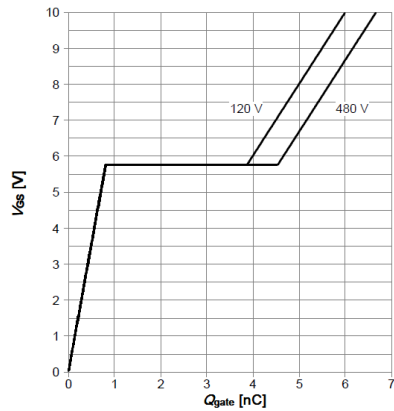


Figure 8: Gate-Charge Characteristics

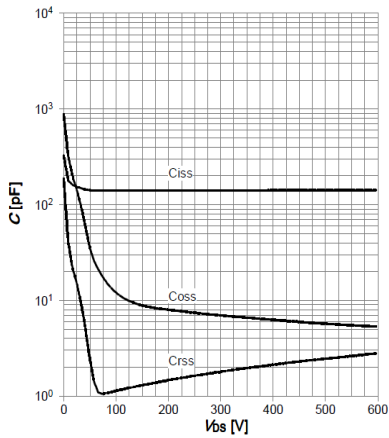


Figure 9: Capacitance Characteristics

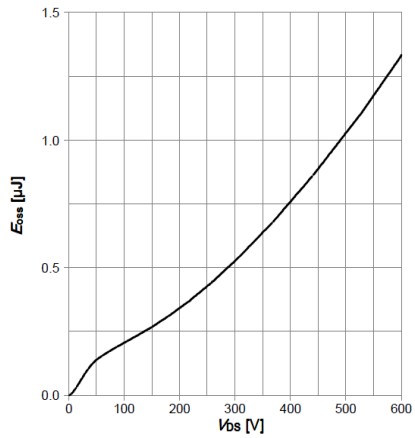


Figure 10: C<sub>oss</sub> stored Energy

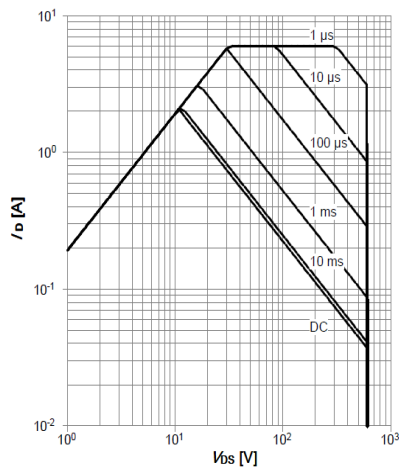


Figure 11: Maximum Forward Biased Safe Operating Area (@25°C)

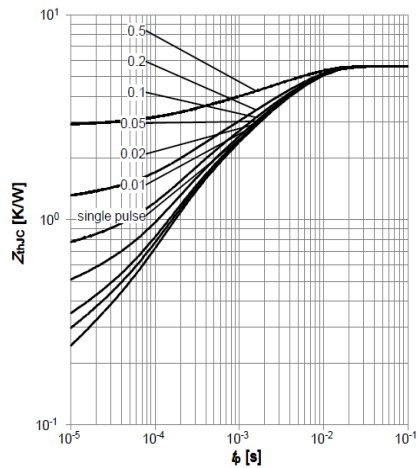


Figure 12: Single Pulse Power Rating Junction-to-Case

# Typical Performance Characteristics

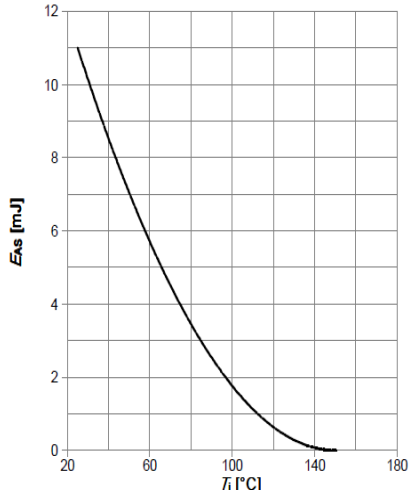


Figure 13: Avalanche energy

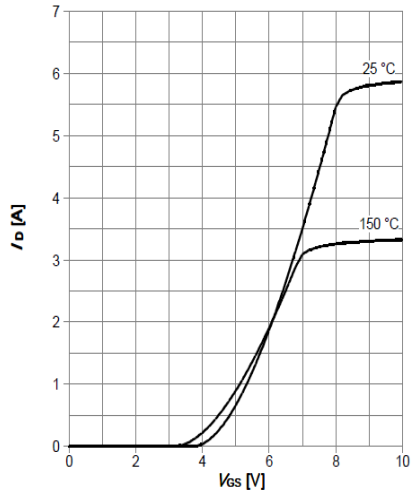
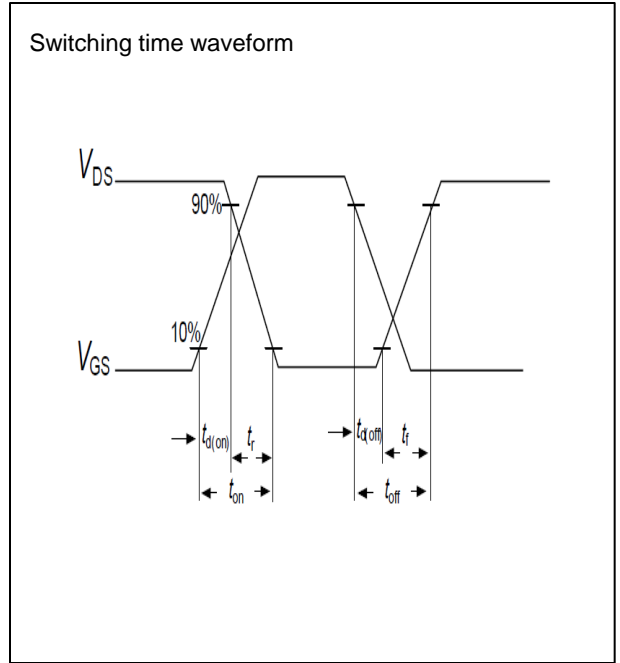
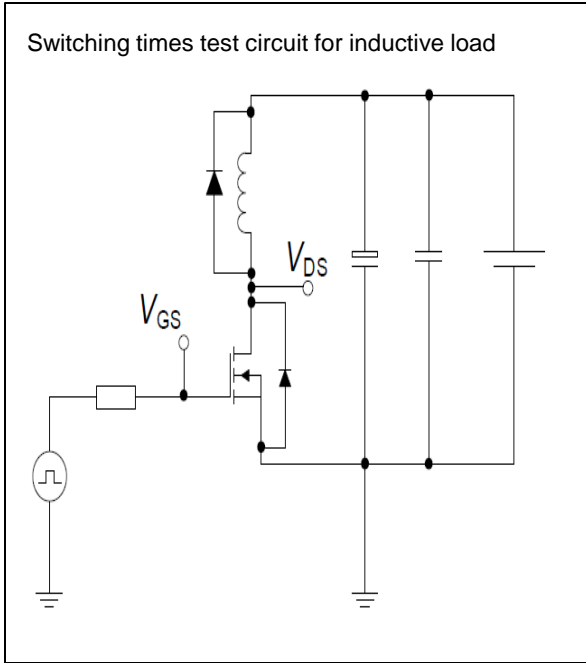


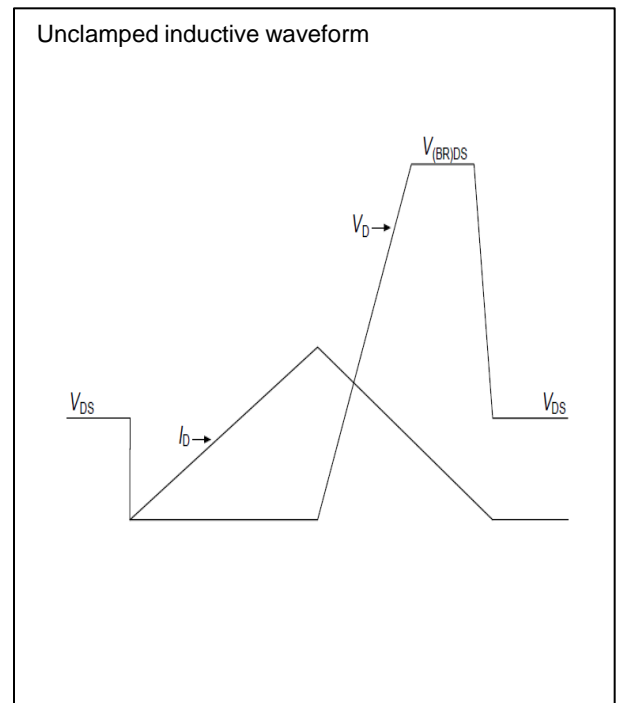
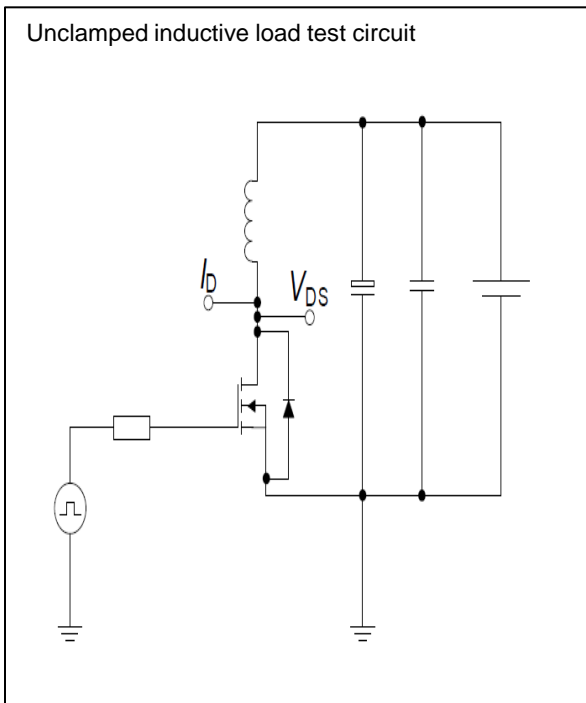
Figure 14: Transfer Characteristics @  $V_{DS} = 20V$

# Test circuits

## Switching times test circuit and waveform for inductive load

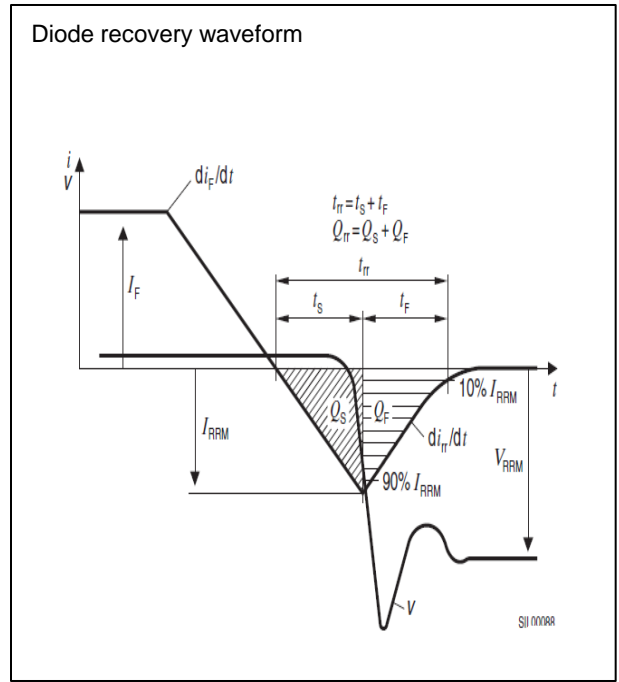
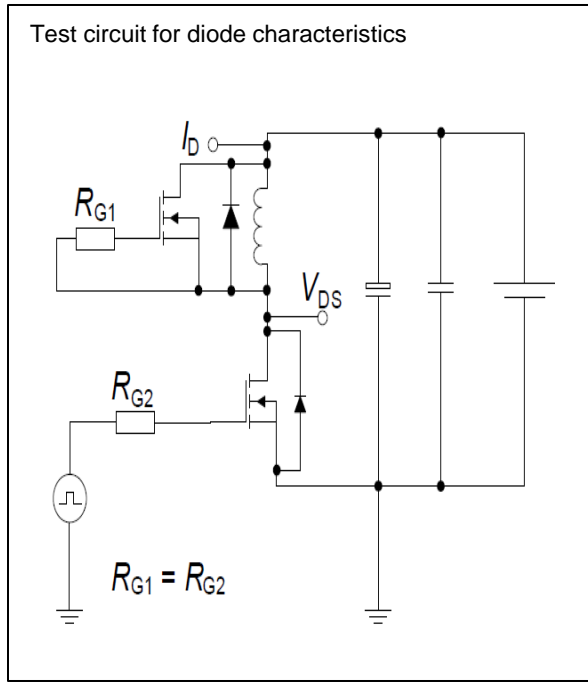


## Unclamped inductive load test circuit and waveform

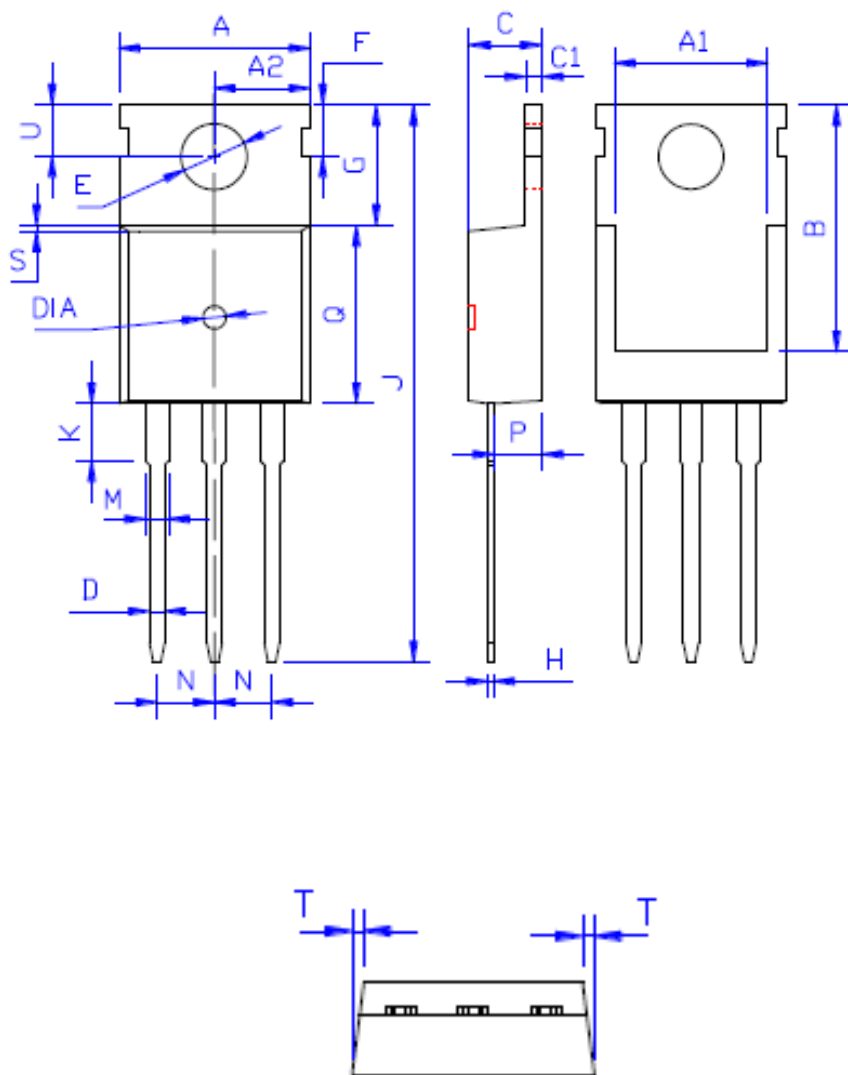


# Test circuits

## Test circuit and waveform for diode characteristics



# Package Outline TO-220



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 <b>MAX</b>