

# TSD70R2K4S1/TSU70R2K4S1

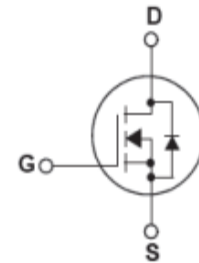
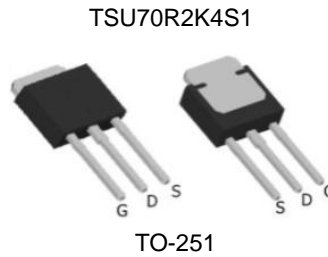
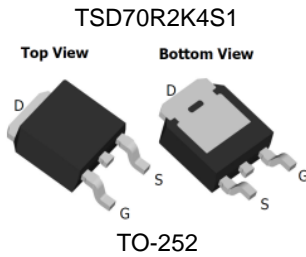
## 700V 2A N-Channel SJ-MOSFET

### 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

- 750V @T<sub>J</sub> = 150 °C
- Typ. R<sub>DS(on)</sub> = 2.1Ω
- Ultra Low gate charge (typ. Q<sub>g</sub> = 7nC)
- 100% avalanche tested



### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V <sub>DSS</sub>	Drain-Source Voltage	700	V
I <sub>D</sub>	Drain Current -Continuous (TC = 25°C) -Continuous (TC = 100°C)	2* 1.3*	A
I <sub>DM</sub>	Drain Current – Pulsed (Note 1)	6	A
V <sub>GSS</sub>	Gate-Source voltage	±30	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	11	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	0.4	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	0.06	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15	V/ns
P <sub>D</sub>	Power Dissipation (TC = 25°C)	22.5	W
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150	°C
T <sub>L</sub>	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 <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	5.6	°C/W
R <sub>θCS</sub>	Thermal Resistance, Case-to-Sink Typ.	0.5	°C/W
R <sub>θJA</sub>	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	$V_{GS} = 0V, I_D = 250\mu A, T_J = 25^\circ C$	700	--	--	V
		$V_{GS} = 0V, I_D = 250\mu A, T_J = 150^\circ C$	--	750	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$ , Referenced to 25°C	--	0.6	--	V/°C
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 700V, V_{GS} = 0V, -T_J = 150^\circ C$	--	-- 10	1 --	$\mu A$ $\mu A$
$I_{GSSF}$	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	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5	3.5	4.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 1A$	--	2.1	2.4	$\Omega$
$g_{FS}$	Forward Trans conductance	$V_{DS} = 40V, I_D = 2A$ (Note 4)	--	2	--	S
$R_g$	Gate resistance	f=1MHz, open drain	--	3	--	$\Omega$
Dynamic Characteristics						
$C_{iss}$	Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz$	--	130	--	pF
$C_{oss}$	Output Capacitance		--	40	--	pF
$C_{rss}$	Reverse Transfer Capacitance		--	4	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 400V, I_D = 1A, R_G = 20\Omega$ (Note 4, 5)	--	7	--	ns
$t_r$	Turn-On Rise Time		--	7	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	30	--	ns
$t_f$	Turn-Off Fall Time		--	50	--	ns
$Q_g$	Total Gate Charge	$V_{DS} = 480V, I_D = 1A, V_{GS} = 10V$ (Note 4, 5)	--	7	--	nC
$Q_{gs}$	Gate-Source Charge		--	0.8	--	nC
$Q_{gd}$	Gate-Drain Charge		--	3.6	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		--	--	2	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		--	--	6	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0V, I_F = 1A$	--	0.9	1.5	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0V, I_F = 1A, di_F/dt = 100A/\mu s$ (Note 4)	--	150	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	1.2	--	$\mu C$

## NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS}=0.4A, V_{DD}=50V$ , Starting  $T_J=25^\circ C$
3.  $I_{SD}\leq 2A, di/dt \leq 200A/\mu s, V_{DD} \leq BV_{DSS}$ , 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

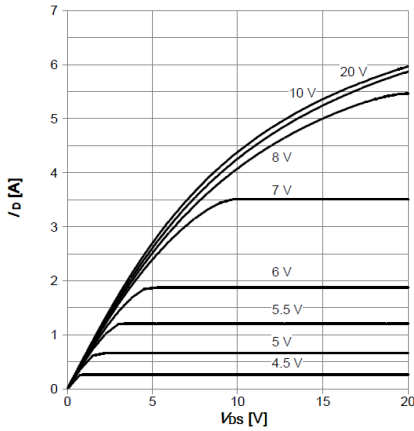


Figure 1: On-Region Characteristics@25°C

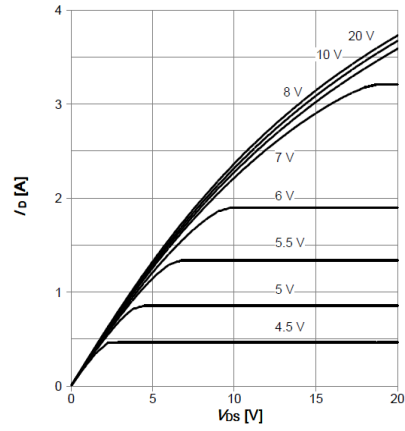


Figure 2: On-Region Characteristics@125°C

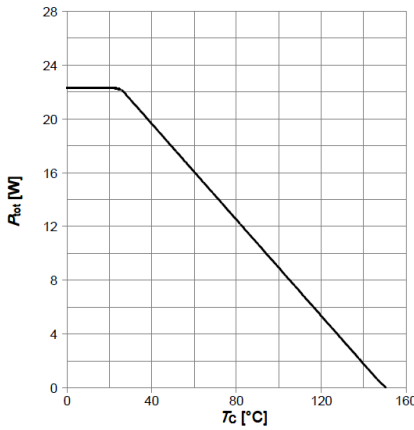


Figure 3: Power Dissipation

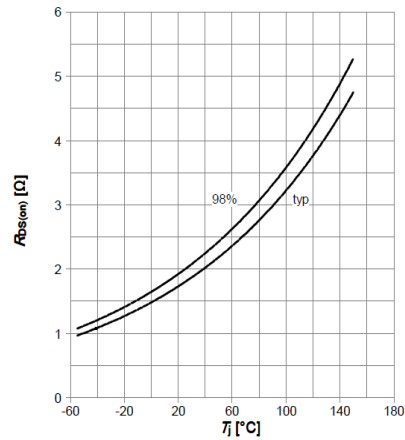


Figure 4: On-Resistance vs. Junction Temperature

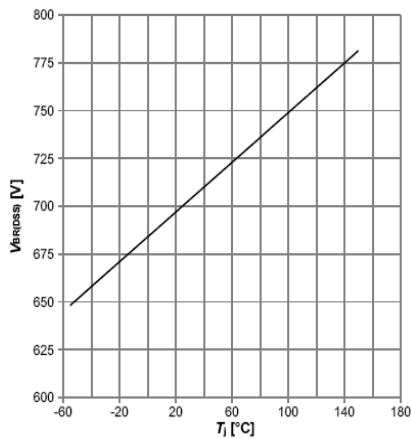


Figure 5: Break Down vs. Junction Temperature

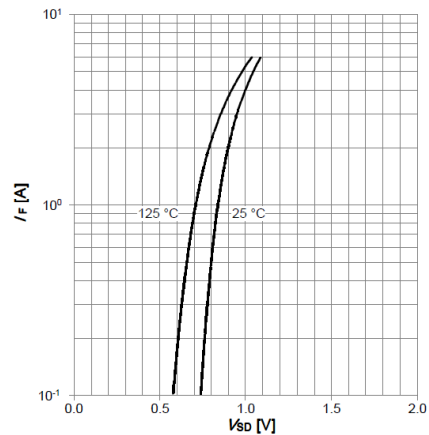


Figure 6: Body-Diode Characteristics

# Typical Performance Characteristics

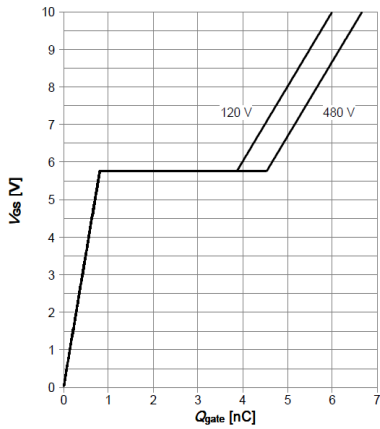


Figure 7: Gate-Charge Characteristics

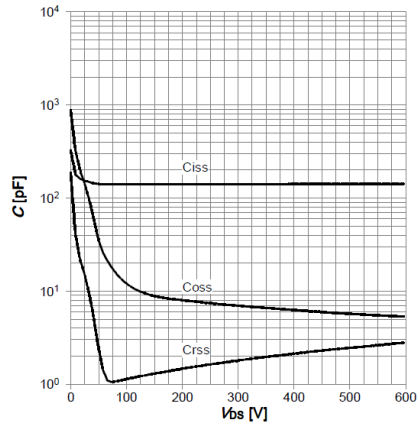


Figure 8: Capacitance Characteristics

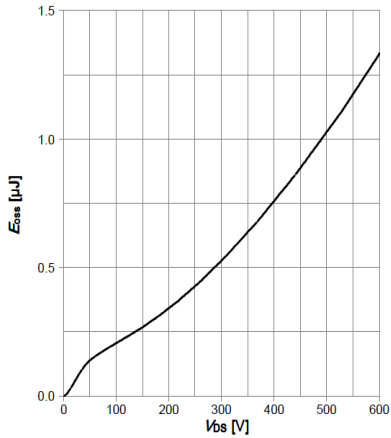


Figure 9:  $C_{oss}$  stored Energy

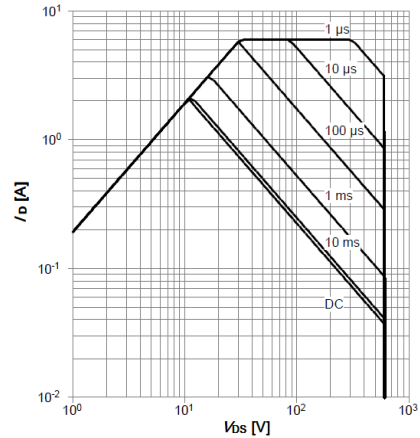


Figure 10: Maximum Forward Biased Safe Operating Area  $T_c=25^\circ\text{C}$ ,

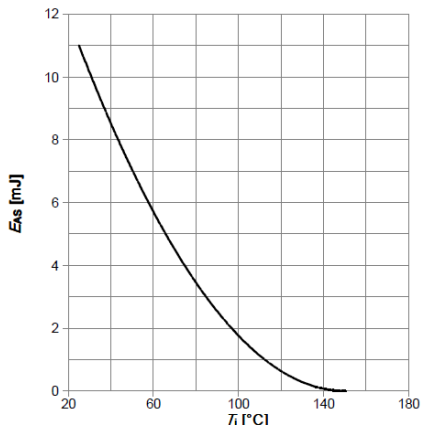


Figure 11: Avalanche energy

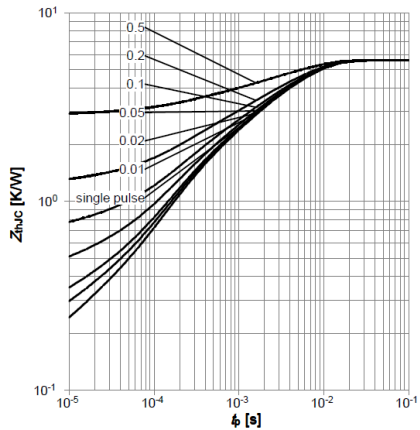


Figure 12: Maximum Transient Thermal Impedance

# Typical Performance Characteristics

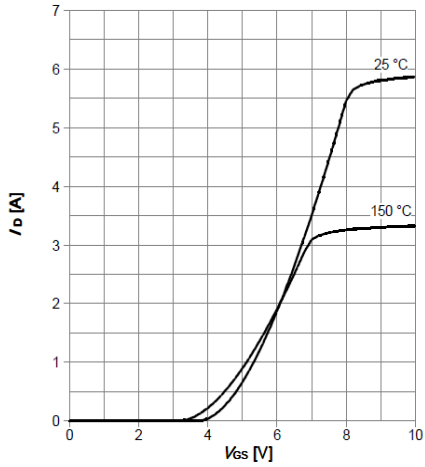


Figure 13: Typ. transfer characteristics

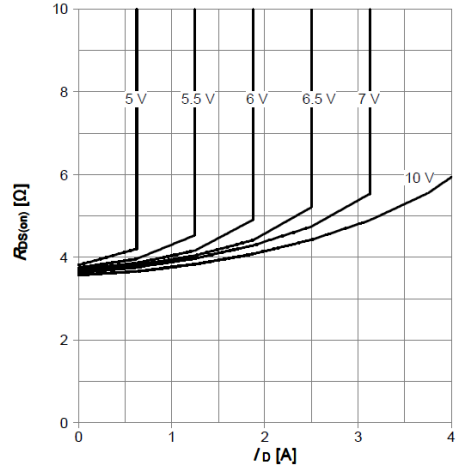
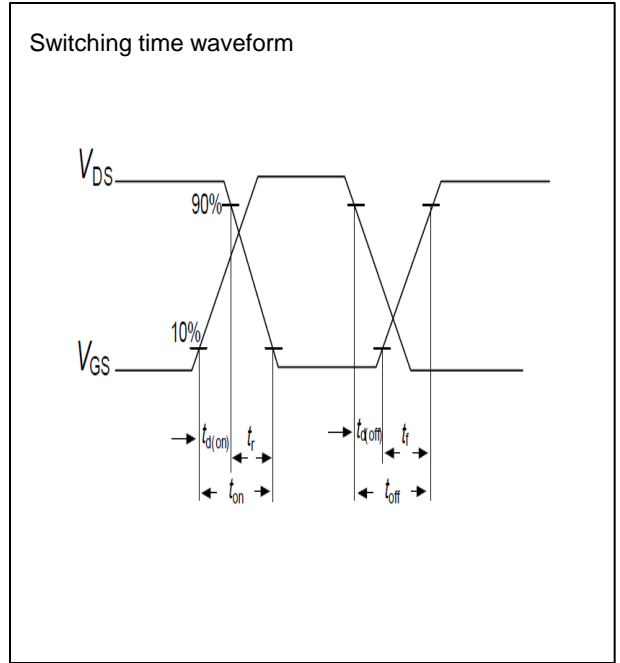
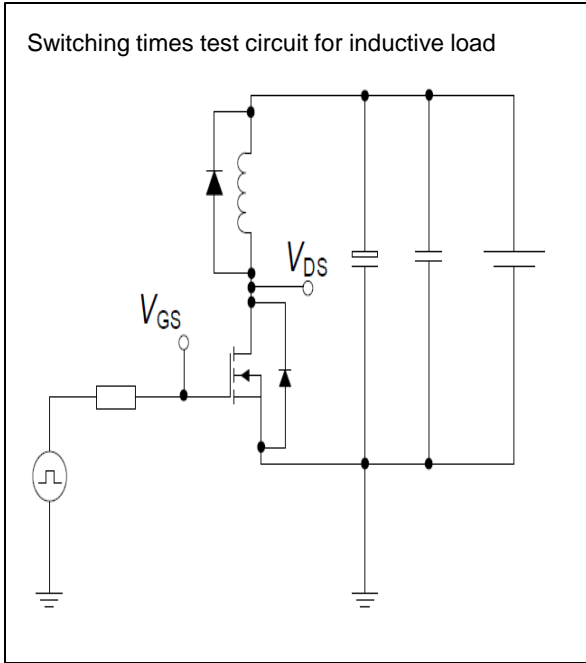


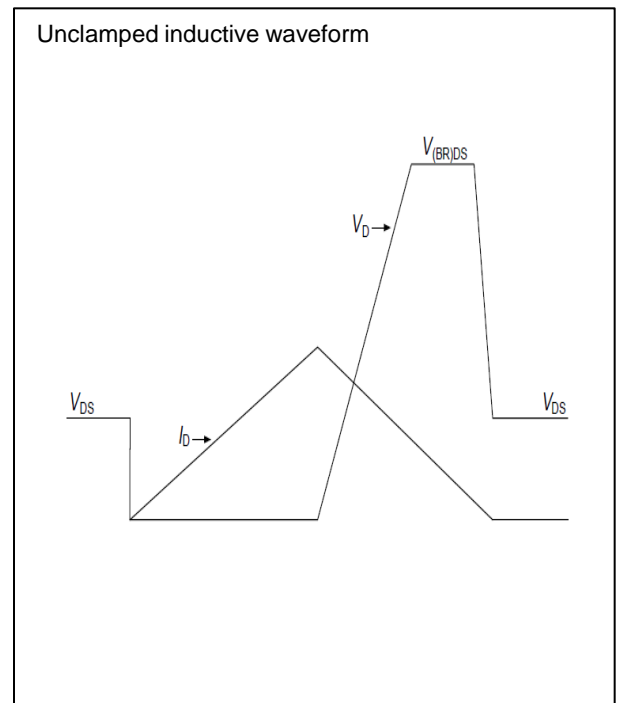
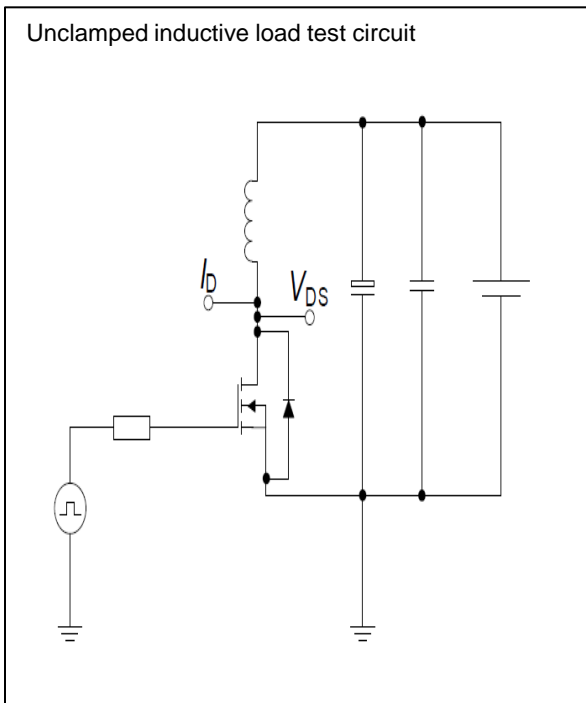
Figure 14 On-Resistance vs. Drain Current,  $T_J = 125^\circ\text{C}$

# Test circuits

## Switching times test circuit and waveform for inductive load

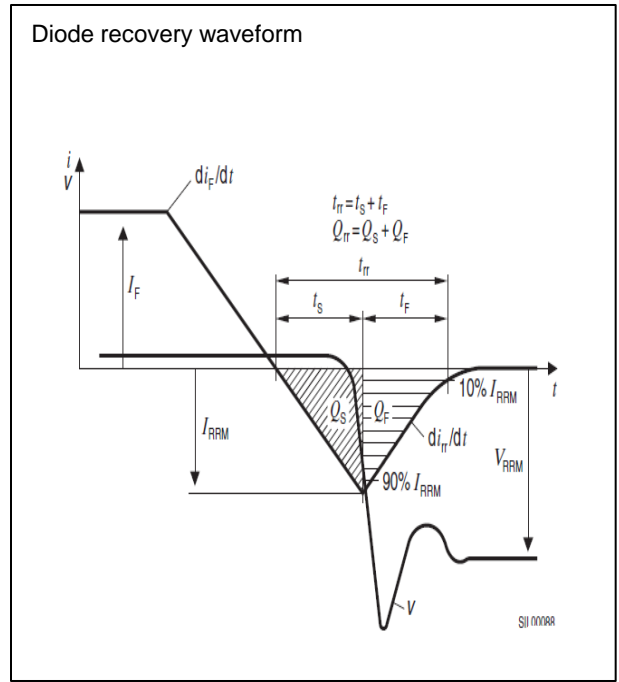
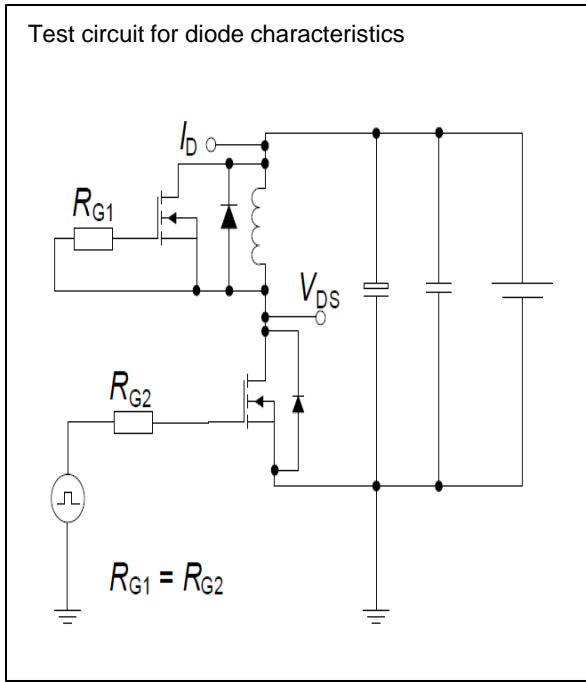


## Unclamped inductive load test circuit and waveform



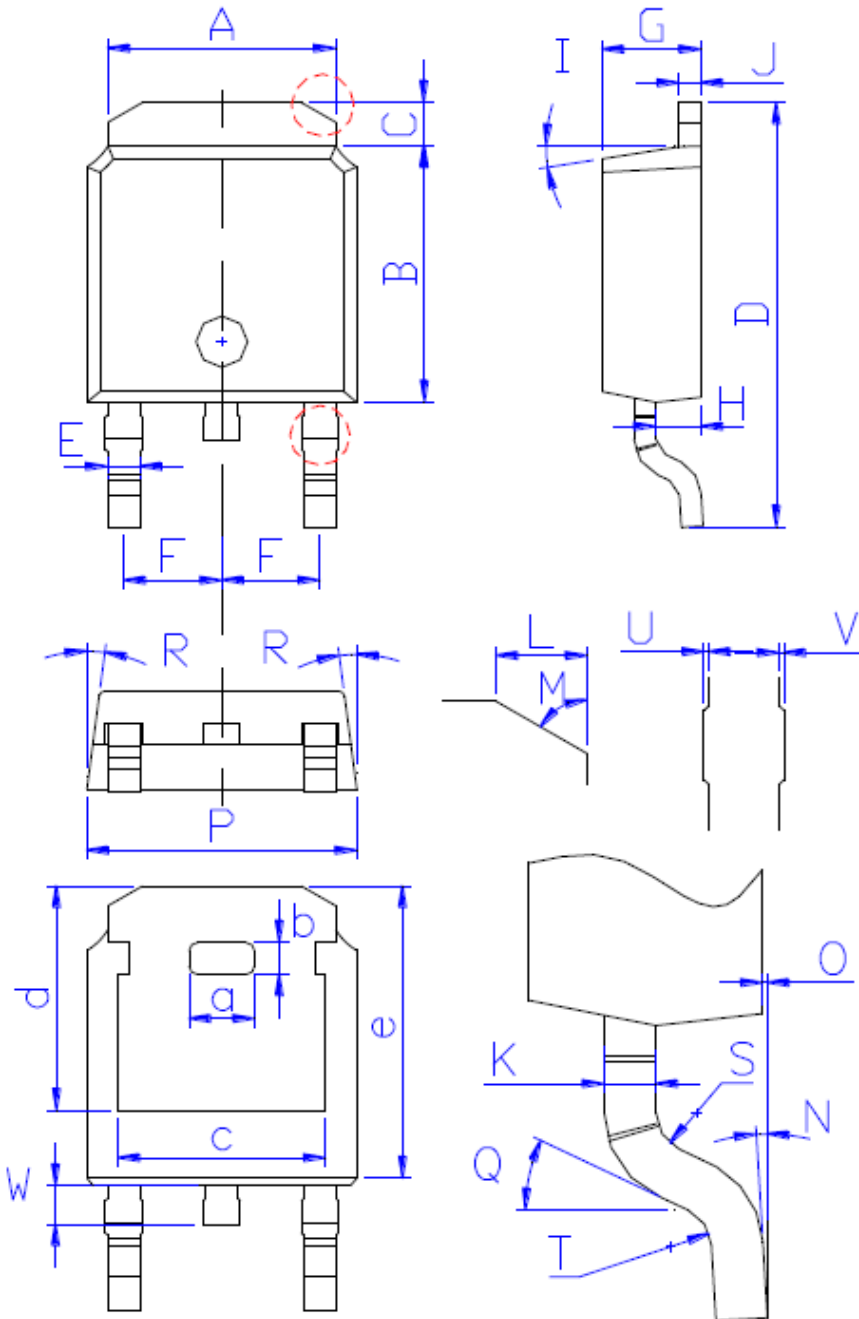
# Test circuits

## Test circuit and waveform for diode characteristics



# Package Outline TO-252

TSD70R2K4S1/TSU70R2K4S1 700V 2A N-Channel SJ-MOSFET

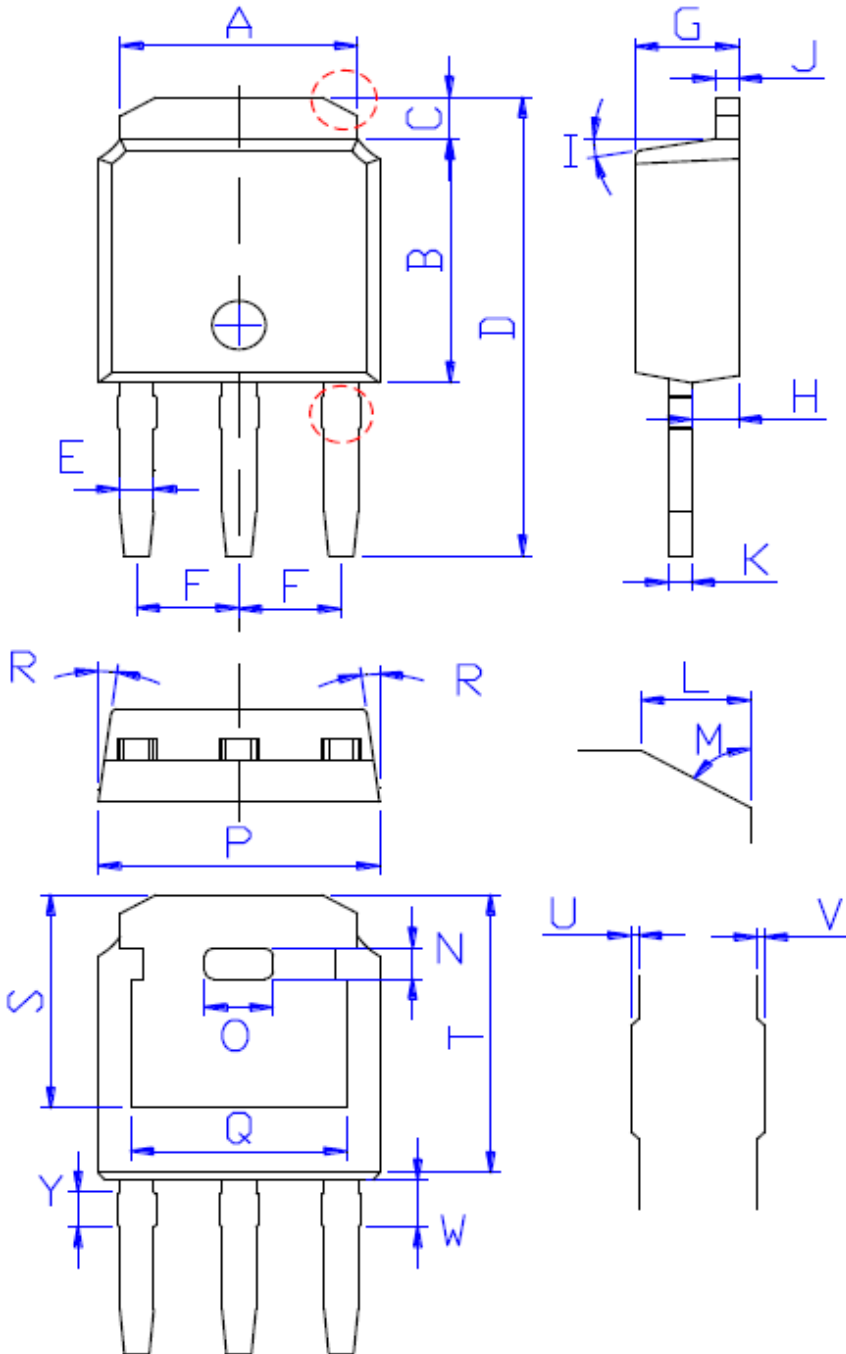


DIM	MILLIMETERS
A	5.34±0.30
B	6.00±0.30
C	1.05±0.30
D	9.95±0.30
E	0.76±0.15
F	2.28±0.15
G	2.30±0.30
H	1.06±0.30
I	(4-10)°
J	0.51±0.15
K	0.52±0.15
L	0.80±0.30
M	60°
N	(0-10)°
O	0.05±0.05
P	6.60±0.30
Q	25°
R	(4-8.5)°
S	R0.40
T	R0.40
U	0.05±0.05
V	0.05±0.05
W	0.90±0.30
a	1.80±0.30
b	0.75±0.30
c	4.85±0.30
d	5.30±0.30
e	6.90±0.30



# Package Outline TO-251

TSD70R2K4S1/TSU70R2K4S1 700V 2A N-Channel SJ-MOSFET



DIM	MILLIMETERS
A	5.34±0.30
B	6.00±0.30
C	1.05±0.30
D	11.31±0.30
E	0.76±0.15
F	2.28±0.15
G	2.30±0.30
H	1.06±0.30
I	(4-10)°
J	0.51±0.15
K	0.52±0.15
L	0.80±0.30
M	60°
N	0.75±0.30
O	1.80±0.30
P	6.60±0.30
Q	4.85±0.30
R	(4-8.5)°
S	5.30±0.30
T	6.90±0.30
U	0.05±0.05
V	0.05±0.05
W	1.15±0.25
Y	0.85±0.25