



# THE DATASHEET OF QS5U23TR



$V_{DSS}$	-20V
$R_{DS(on)(Max.)}$	200mΩ
$I_D$	±1.5A
$P_D$	1.25W

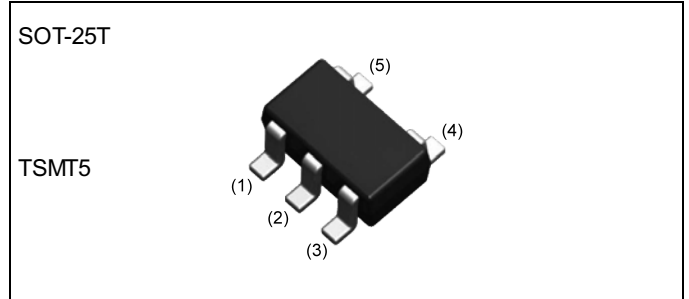
### ●Features

- 1) The QS5U23 combines Pch MOSFET with a Schottky barrier diode in a single TSMT5 package.
- 2) Low on-state resistance with fast swicthing
- 3) Low voltage drive (2.5V drive).
- 4) Built-in Low  $V_F$  schottky barrier diode.
- 5) Pb-free lead plating ; RoHS compliant.

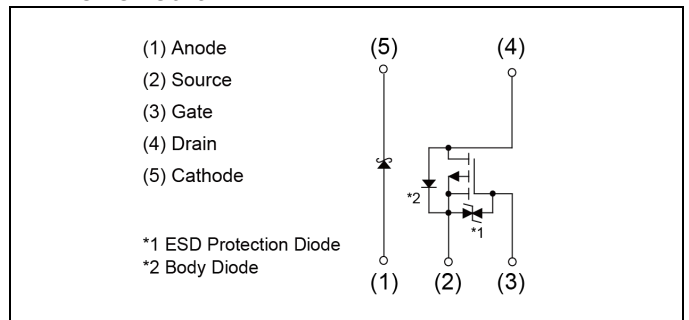
### ●Application

Load switch, DC/ DC conversion

### ●Outline



### ●Inner circuit



### ●Packaging specifications

Type	Packing	Embossed Tape
	Reel size (mm)	180
	Tape width (mm)	8
	Quantity (pcs)	3000
	Taping code	TR
	Marking	U23

### ●Absolute maximum ratings ( $T_a = 25^\circ\text{C}$ ,unless otherwise specified)

#### <MOSFET>

Parameter	Symbol	Value	Unit
Drain - Source voltage	$V_{DSS}$	-20	V
Gate - Source voltage	$V_{GSS}$	±12	V
Continuous drain current	$I_D$	±1.5	A
Pulsed drain current	$I_{DP}^{*1}$	±6.0	A
Continuous source current (body diode)	$I_S$	-0.75	A
Pulsed source current (body diode)	$I_{SP}^{*1}$	-3.0	A
Power dissipation	$P_D^{*3}$	0.9	W/element
Junction temperature	$T_j$	150	°C

● **Absolute maximum ratings** ( $T_a = 25^\circ\text{C}$ )

<Di>

Parameter	Symbol	Value	Unit
Repetitive peak reverse voltage	$V_{RM}$	30	V
Reverse voltage	$V_R$	20	V
Forward current	$I_F$	0.5	A
Forward current surge peak	$I_{FSM}^{*2}$	2.0	A
Power dissipation	$P_D^{*3}$	0.7	W/element
Junction temperature	$T_j$	150	$^\circ\text{C}$

<MOSFET + Di>

Parameter	Symbol	Value	Unit
Power dissipation	$P_D^{*3}$	1.25	W/total
Operating junction and storage temperature range	$T_{stg}$	-55 to +150	$^\circ\text{C}$

● **Electrical characteristics** ( $T_a = 25^\circ\text{C}$ )

<MOSFET>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Gate - Source leakage current	$I_{GSS}$	$V_{GS} = \pm 12\text{V}, V_{DS} = 0\text{V}$	-	-	$\pm 10$	$\mu\text{A}$
Drain - Source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{V}, I_D = -1\text{mA}$	-20	-	-	V
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = -20\text{V}, V_{GS} = 0\text{V}$	-	-	-1	$\mu\text{A}$
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = -10\text{V}, I_D = -1\text{mA}$	-0.7	-	-2.0	V
Static drain - source on - state resistance	$R_{DS(on)}^{*4}$	$V_{GS} = -4.5\text{V}, I_D = -1.5\text{A}$	-	160	200	m $\Omega$
		$V_{GS} = -4\text{V}, I_D = -1.5\text{A}$	-	180	240	
		$V_{GS} = -2.5\text{V}, I_D = -0.75\text{A}$	-	260	340	
Forward Transfer Admittance	$ Y_{fs} ^{*4}$	$V_{DS} = -10\text{V}, I_D = -0.75\text{A}$	1.0	-	-	S

● **Electrical characteristics** ( $T_a = 25^\circ\text{C}$ )

<MOSFET>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Input capacitance	$C_{iss}$	$V_{GS} = 0V$	-	325	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = -10V$	-	60	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	40	-	
Turn - on delay time	$t_{d(on)}^{*4}$	$V_{DD} \approx -15V, V_{GS} = -4.5V$	-	10	-	ns
Rise time	$t_r^{*4}$	$I_D = -0.75A$	-	10	-	
Turn - off delay time	$t_{d(off)}^{*4}$	$R_L = 20\Omega$	-	35	-	
Fall time	$t_f^{*4}$	$R_G = 10\Omega$	-	10	-	

● **Gate charge characteristics** ( $T_a = 25^\circ\text{C}$ )

<MOSFET>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	$Q_g^{*4}$	$V_{DD} \approx -15V, I_D = -1.5A$ $V_{GS} = -4.5V$	-	4.2	-	nC
Gate - Source charge	$Q_{gs}^{*4}$		-	1.0	-	
Gate - Drain charge	$Q_{gd}^{*4}$		-	1.1	-	

● **Body diode electrical characteristics** (Source-Drain) ( $T_a = 25^\circ\text{C}$ )

<MOSFET>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	$V_{SD}^{*4}$	$V_{GS} = 0V, I_S = -0.75A$	-	-	-1.2	V

● **Electrical characteristics** ( $T_a = 25^\circ\text{C}$ )

<Di>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	$V_F$	$I_F = 0.1\text{A}$	-	-	0.36	V
		$I_F = 0.5\text{A}$	-	-	0.47	V
Reverse current	$I_R$	$V_R = 20\text{V}$	-	-	100	$\mu\text{A}$

\*1  $P_w \leq 10\mu\text{s}$ , Duty cycle  $\leq 1\%$

\*2 60Hz·1 cycle

\*3 Mounted on a ceramic board

\*4 Pulsed



● Electrical characteristic curves <MOSFET>

Fig.1 Typical Capacitance vs. Drain - Source Voltage

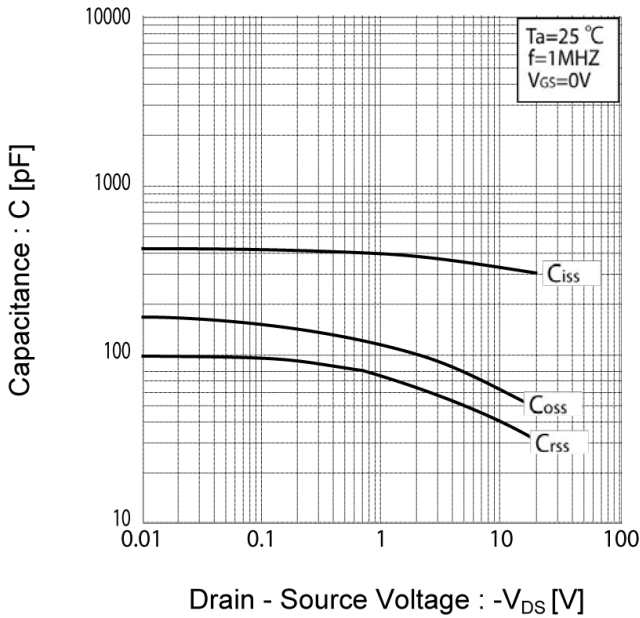


Fig.2 Switching Characteristics

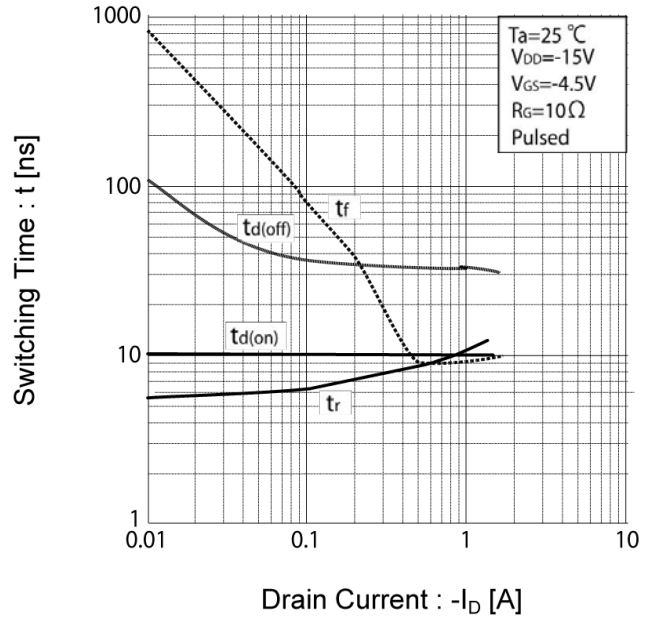


Fig.3 Dynamic Input Characteristics

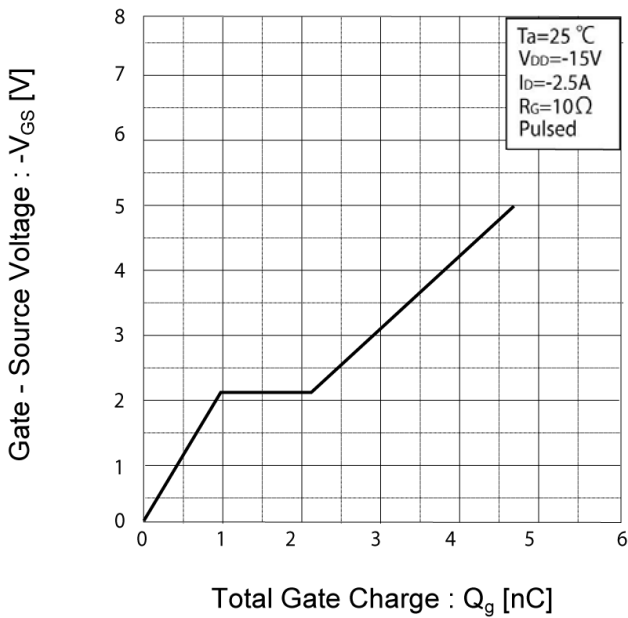
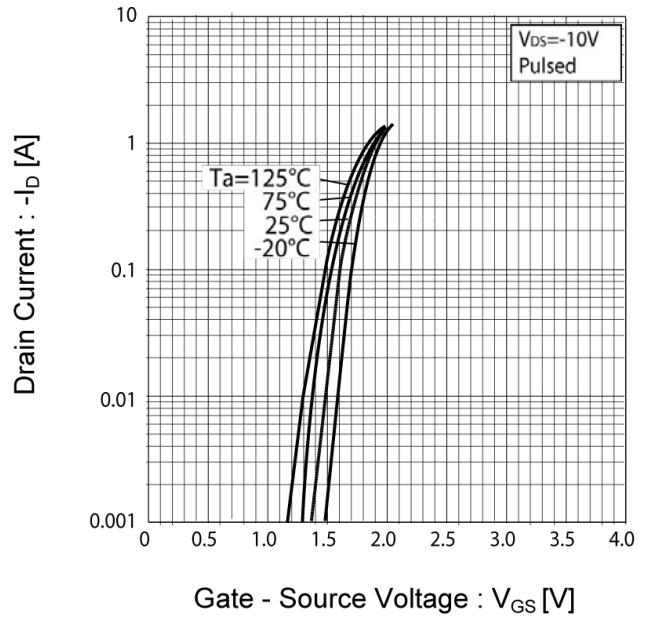


Fig.4 Typical Transfer Characteristics



● Electrical characteristic curves <MOSFET>

Fig.5 Static Drain - Source On - State Resistance vs. Gate Source Voltage

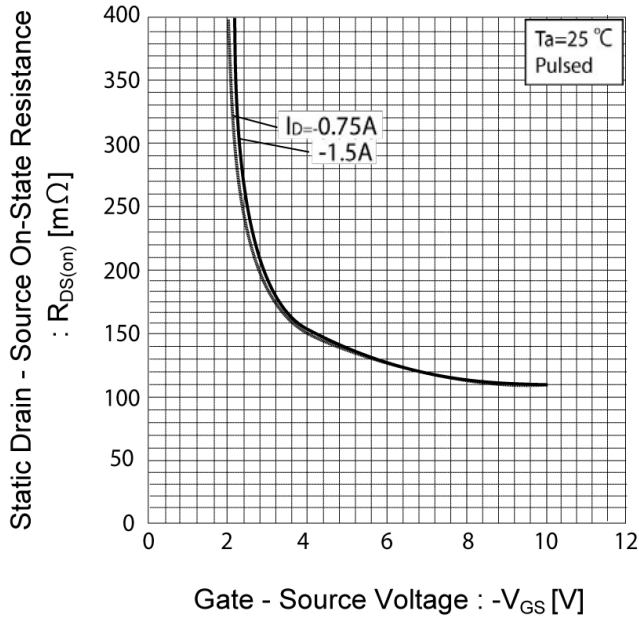


Fig.6 Source Current vs. Source Drain Voltage

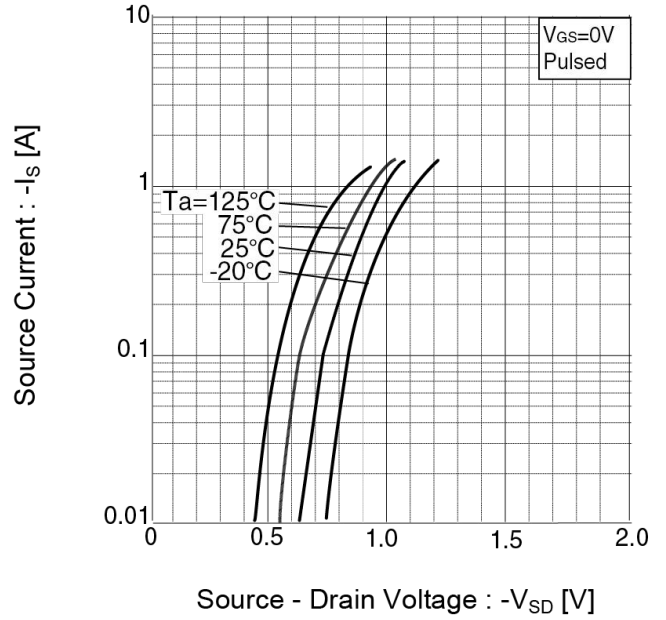


Fig.7 Static Drain - Source On - State Resistance vs. Drain Current (I)

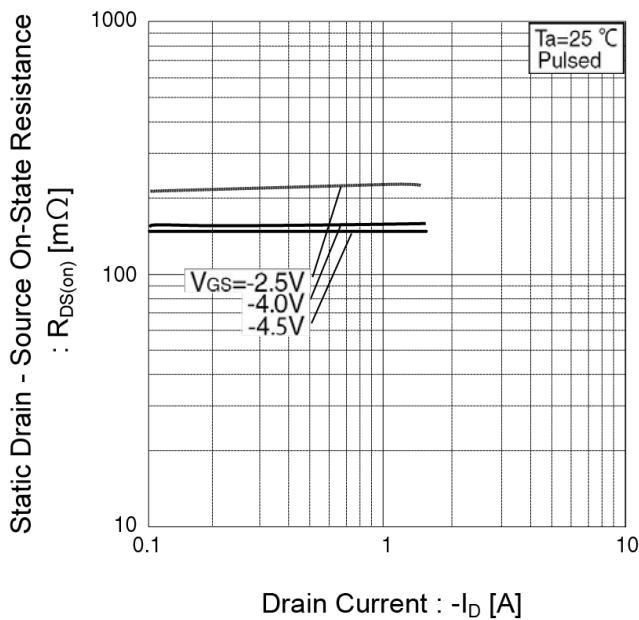
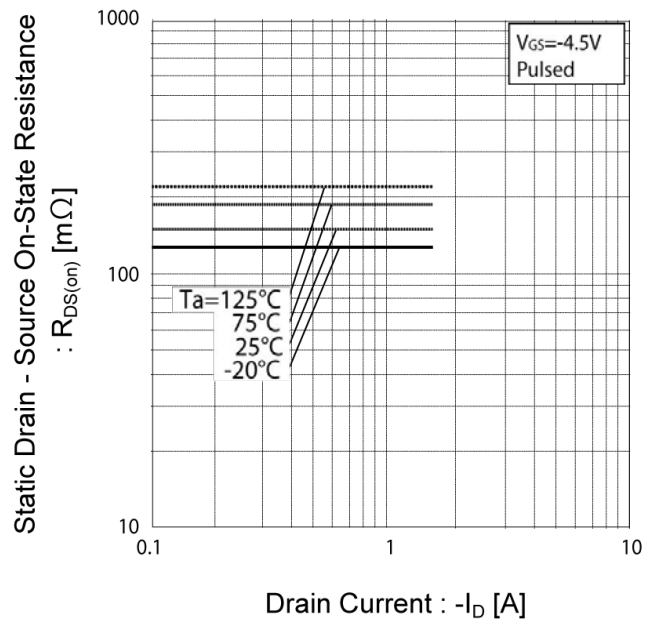


Fig.8 Static Drain - Source On - State Resistance vs. Drain Current (II)



● Electrical characteristic curves <MOSFET>

Fig.9 Static Drain - Source On - State Resistance vs. Drain Current (III)

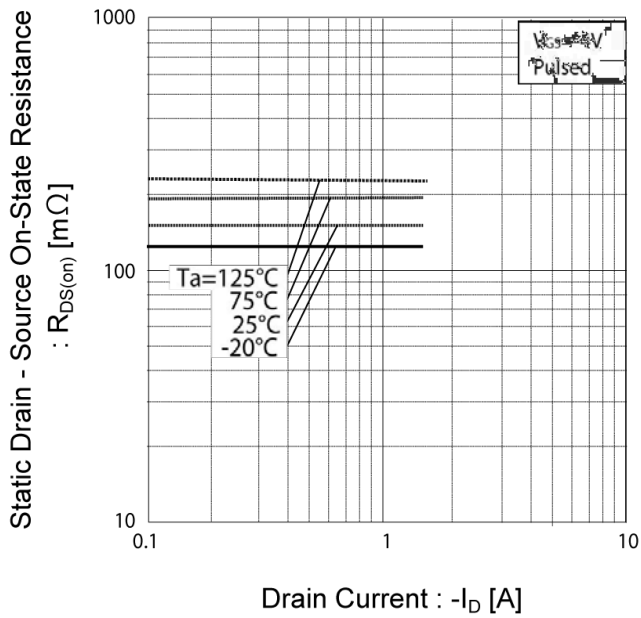
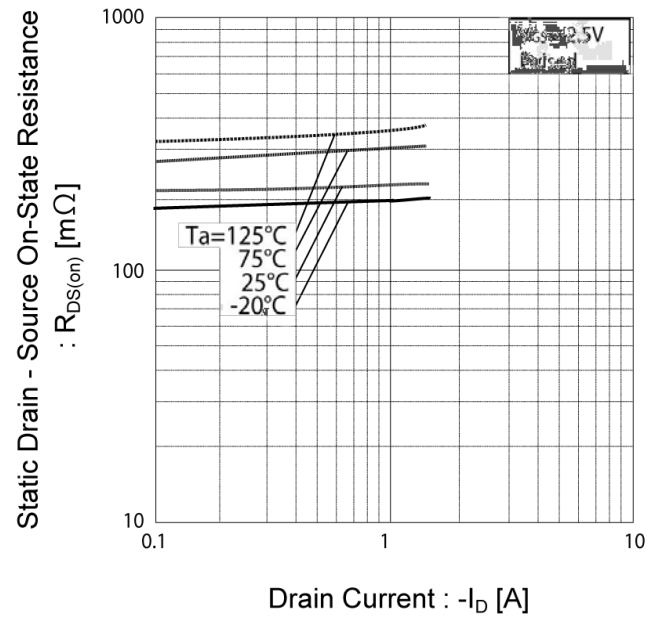


Fig.10 Static Drain - Source On - State Resistance vs. Drain Current (IV)



● Electrical characteristic curves < Diode >

Fig.11 Forward Current vs. Forward Voltage

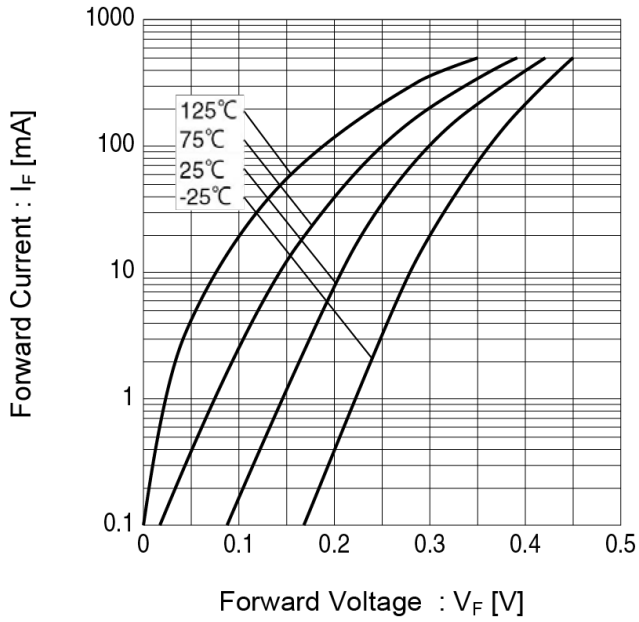
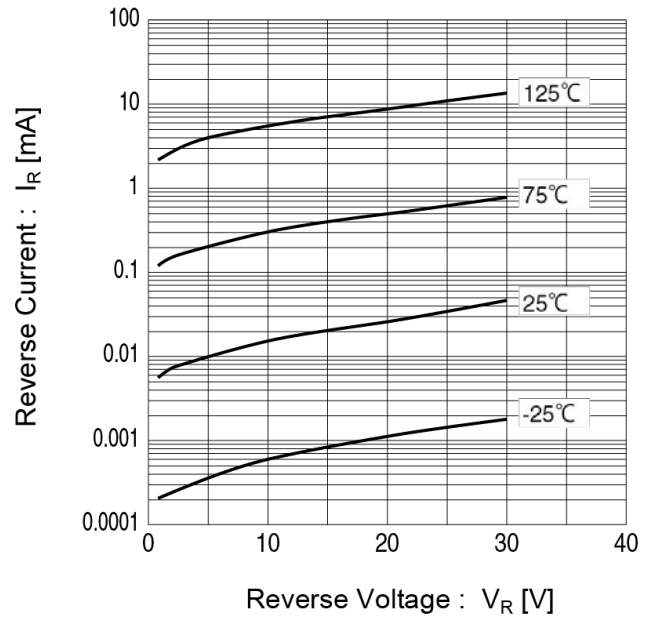


Fig.12 Reverse Current vs. Reverse Voltage



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

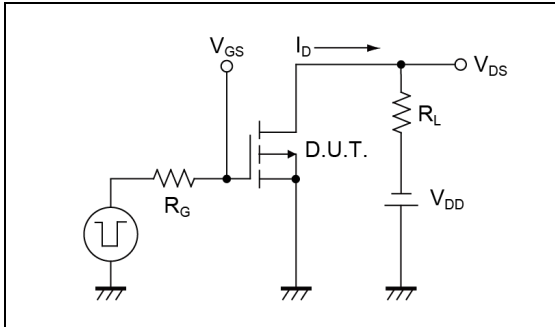


Fig.1-2 Switching Waveforms

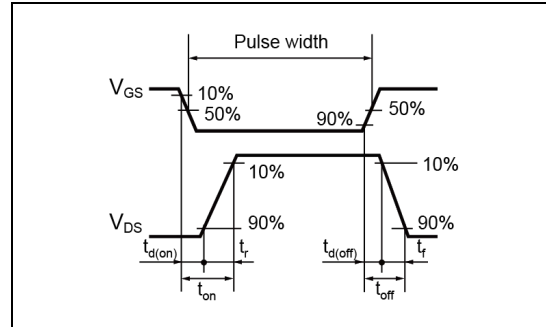


Fig.2-1 Gate Charge Measurement Circuit

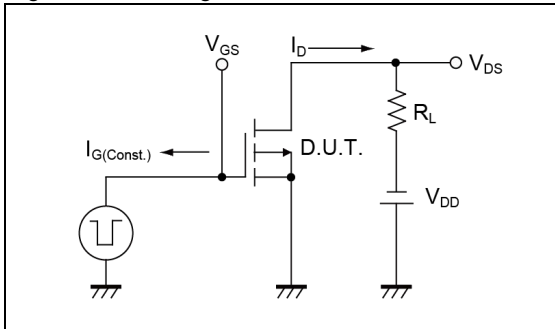
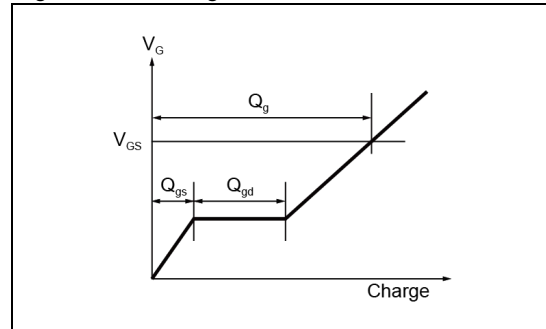


Fig.2-2 Gate Charge Waveform

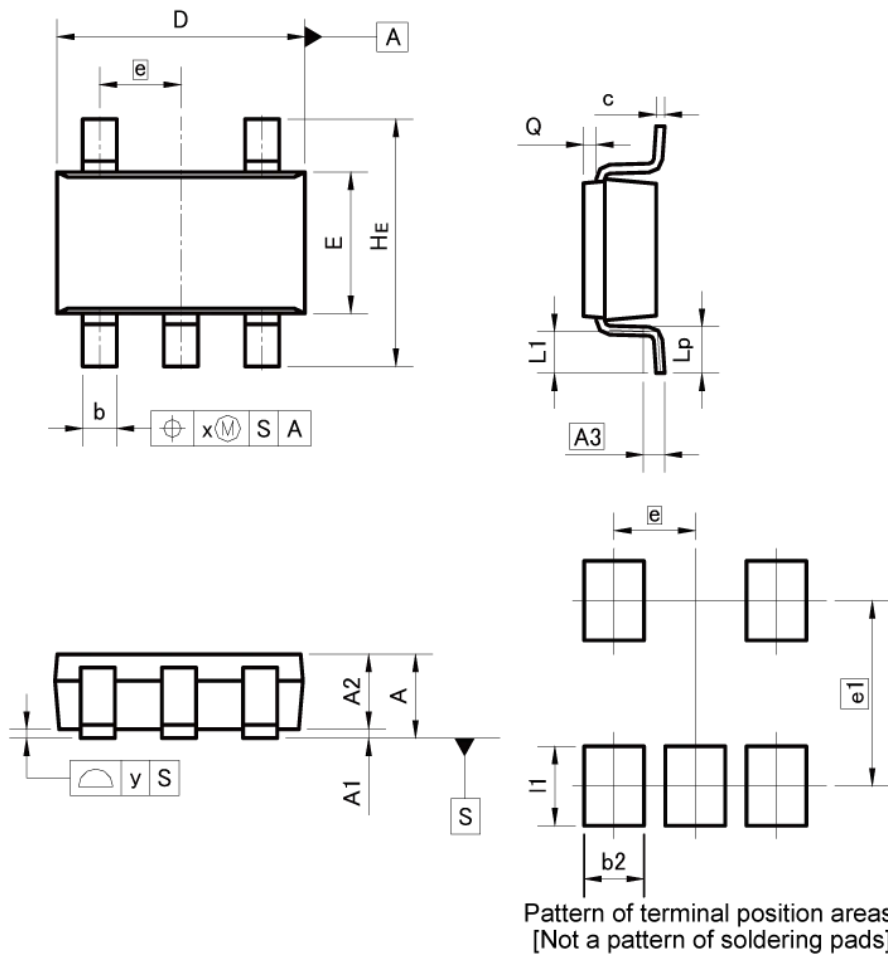


● Notice

1. SBD has a large reverse leak current compared to other type of diode. Therefore, it would raise a junction temperature, and increase a reverse power loss. Further rise of inside temperature would cause a thermal runaway. This built-in SBD has low  $V_F$  characteristics and therefore, higher leak current. Please consider enough the surrounding temperature, generating heat of MOSFET and the reverse current.
2. This product might cause chip aging and breakdown under the large electrified environment. Please consider to design ESD protection circuit.

●Dimensions

TSMT5  
< SOT-25T >



DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	-	1.00	-	0.039
A1	0.00	0.10	0.000	0.004
A2	0.75	0.95	0.030	0.037
A3	0.25		0.010	
b	0.35	0.50	0.014	0.020
c	0.10	0.26	0.004	0.010
D	2.80	3.00	0.110	0.118
E	1.50	1.80	0.059	0.071
e	0.95		0.037	
HE	2.60	3.00	0.102	0.118
L1	0.30	0.60	0.012	0.024
Lp	0.40	0.70	0.016	0.028
Q	0.05	0.25	0.002	0.010
x	-	0.20	-	0.008
y	-	0.10	-	0.004

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
b2	-	0.70	-	0.028
e1	2.10		0.083	
I1	-	0.90	-	0.035

Dimension in mm/inches

# Notice

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JAPAN	USA	EU	CHINA
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

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  - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
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  - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
  - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
  - Sealing or coating our Products with resin or other coating materials
  - Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.) ; or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
  - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse, is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

## Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

**Precautions Regarding Application Examples and External Circuits**

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
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**Precaution for Electrostatic**

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

**Precaution for Storage / Transportation**

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
  - [a] the Products are exposed to sea winds or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [b] the temperature or humidity exceeds those recommended by ROHM
  - [c] the Products are exposed to direct sunshine or condensation
  - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

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