

$V_{DSS}$	-20V
$R_{DS(on)}(Max.)$	245mΩ
$I_D$	±2.0A
$P_D$	1.25W

### ●Features

- 1) The QS5U28 combines Pch MOSFET with a Schottky barrier diode in a single TSMT5 package.
- 2) Low on-state resistance with fast switching
- 3) Low voltage drive (2.5V drive).
- 4) Built-in Low  $V_F$  schottky barrier diode.
- 5) Pb-free lead plating ; RoHS compliant.

### ●Application

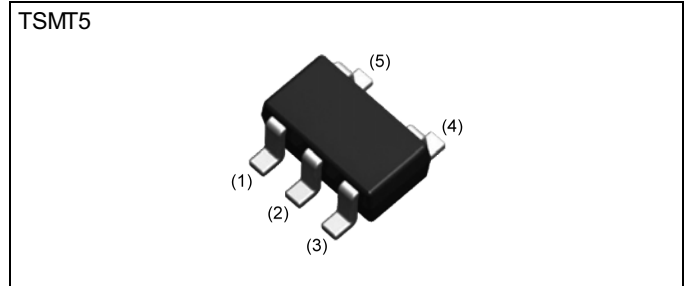
Load switch, DC/ DC conversion

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

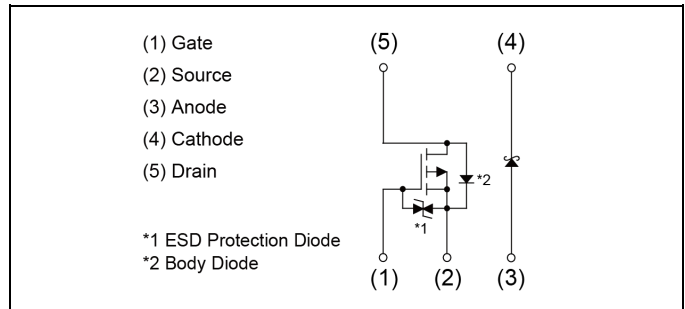
#### <MOSFET>

Parameter	Symbol	Value	Unit
Drain - Source voltage	$V_{DSS}$	-20	V
Gate - Source voltage	$V_{GSS}$	±12	V
Continuous drain current	$I_D$	±2.0	A
Pulsed drain current	$I_{D,pulse}^{*1}$	±8.0	A
Continuous source current (body diode)	$I_S$	-1.0	A
Pulsed source current (body diode)	$I_{S,pulse}^{*1}$	-8.0	A
Power dissipation	$P_D^{*3}$	0.9	W/element
Junction temperature	$T_j$	150	°C

### ●Outline



### ●Inner circuit



### ●Packaging specifications

Type	Packing	Embossed Tape
	Reel size (mm)	180
	Tape width (mm)	8
	Basic ordering unit (pcs)	3000
	Taping code	TR
	Marking	U28

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

<SBD>

Parameter	Symbol	Value	Unit
Repetitive peak reverse voltage	$V_{RM}$	25	V
Reverse voltage	$V_R$	20	V
Forward current	$I_F$	1.0	A
Forward current surge peak	$I_{FSM}^{*2}$	3.0	A
Power dissipation	$P_D^{*3}$	0.7	W/element
Junction temperature	$T_j$	150	$^\circ\text{C}$

<MOSFET + SBD>

Parameter	Symbol	Value	Unit
Power dissipation	$P_D^{*3}$	1.25	W/total
Range of storage temperature	$T_{stg}$	-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	$R_{DS(on)}^{*4}$	$V_{GS} = -4.5\text{V}, I_D = -2.0\text{A}$	-	90	125	m $\Omega$
		$V_{GS} = -4\text{V}, I_D = -2.0\text{A}$	-	97	135	
		$V_{GS} = -2.5\text{V}, I_D = -1.0\text{A}$	-	175	245	
Transconductance	$g_{fs}^{*4}$	$V_{DS} = -10\text{V}, I_D = -1.0\text{A}$	1.6	-	-	S

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

<MOSFET>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Input capacitance	$C_{iss}$	$V_{GS} = 0V$	-	450	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = -10V$	-	70	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	52	-	
Turn - on delay time	$t_{d(on)}^{*4}$	$V_{DD} \approx -15V, V_{GS} = -4.5V$	-	10	-	ns
Rise time	$t_r^{*4}$	$I_D = -1.0A$	-	16	-	
Turn - off delay time	$t_{d(off)}^{*4}$	$R_L = 15\Omega$	-	32	-	
Fall time	$t_f^{*4}$	$R_G = 10\Omega$	-	15	-	

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

<MOSFET>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	$Q_g^{*4}$	$V_{DD} \approx -15V, I_D = -2.0A$ $V_{GS} = -4.5V$	-	4.8	-	nC
Gate - Source charge	$Q_{gs}^{*4}$		-	1.0	-	
Gate - Drain charge	$Q_{gd}^{*4}$		-	1.3	-	

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

<MOSFET>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	$V_{SD}^{*4}$	$V_{GS} = 0V, I_S = -1.0A$	-	-	-1.2	V

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

<SBD>

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	$V_F$	$I_F = 1.0\text{A}$	-	-	0.45	V
Reverse current	$I_R$	$V_R = 20\text{V}$	-	-	200	$\mu\text{A}$

\*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

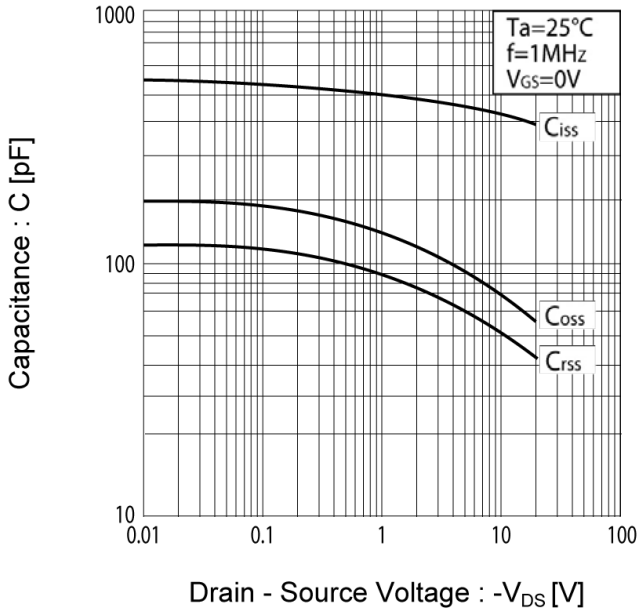


Fig.2 Switching Characteristics

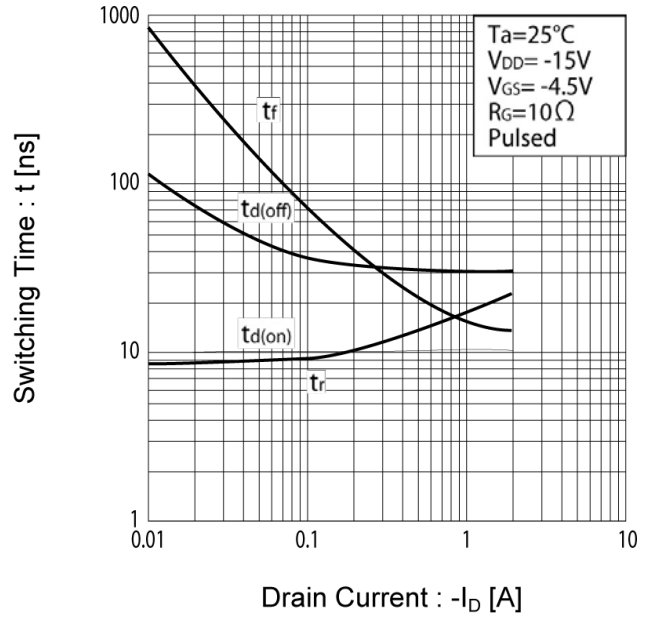


Fig.3 Dynamic Input Characteristics

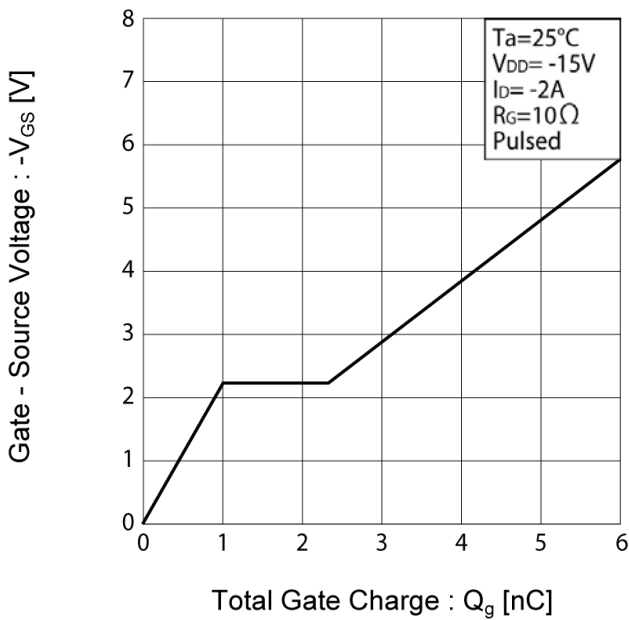
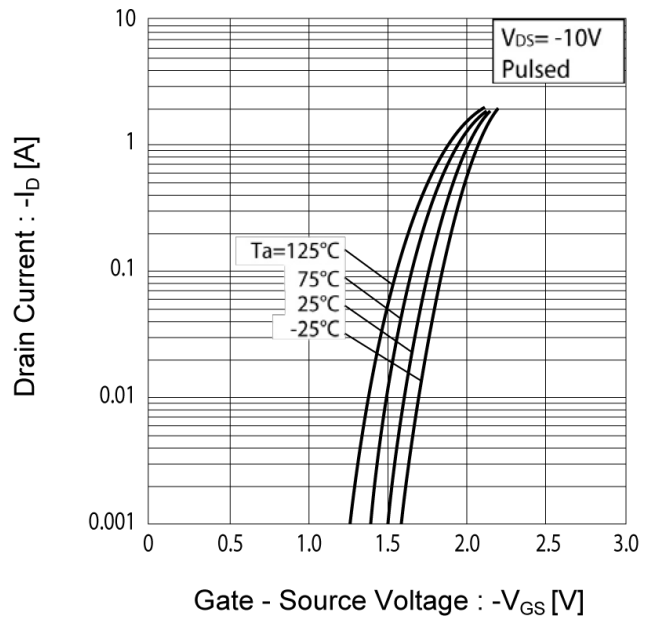


Fig.4 Typical Transfer Characteristics



● Electrical characteristic curves <MOSFET>

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

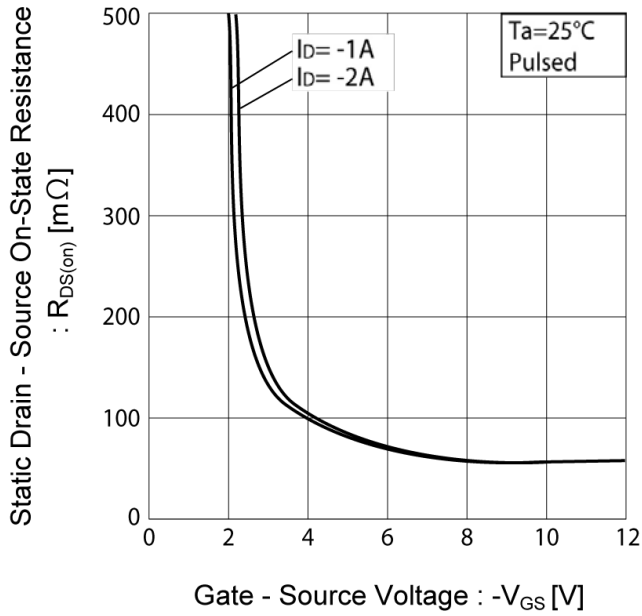


Fig.6 Source Current vs. Source Drain Voltage

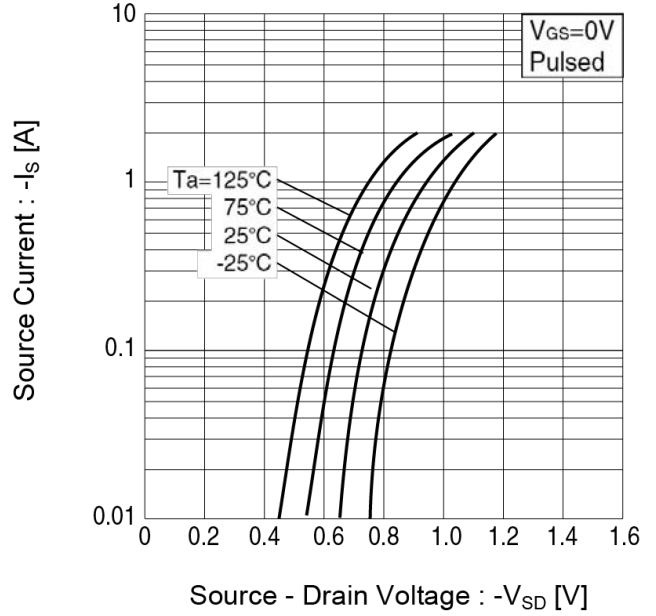


Fig.7 Static Drain - Source On - State Resistance vs. Drain Current (I)

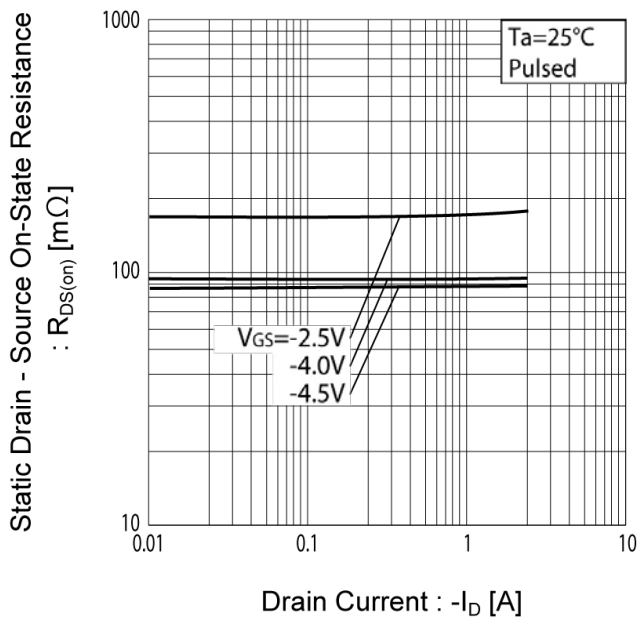
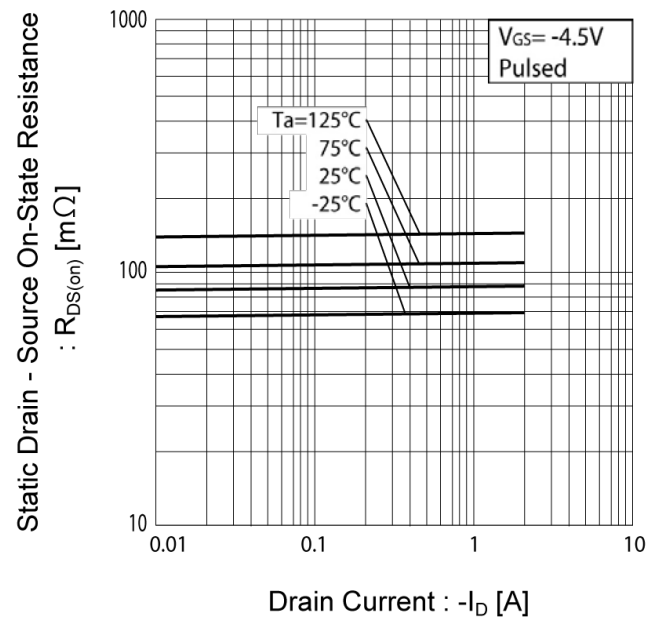


Fig.8 Static Drain - Source On - State Resistance vs. Drain Current (II)



● Electrical characteristic curves <MOSFET>

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

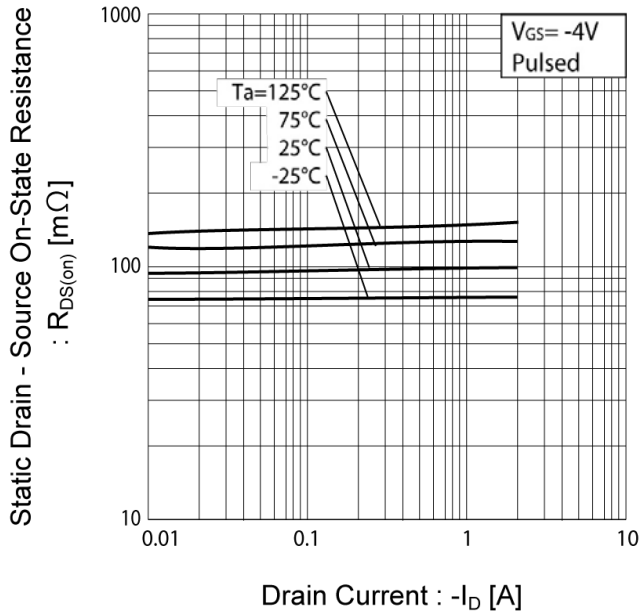
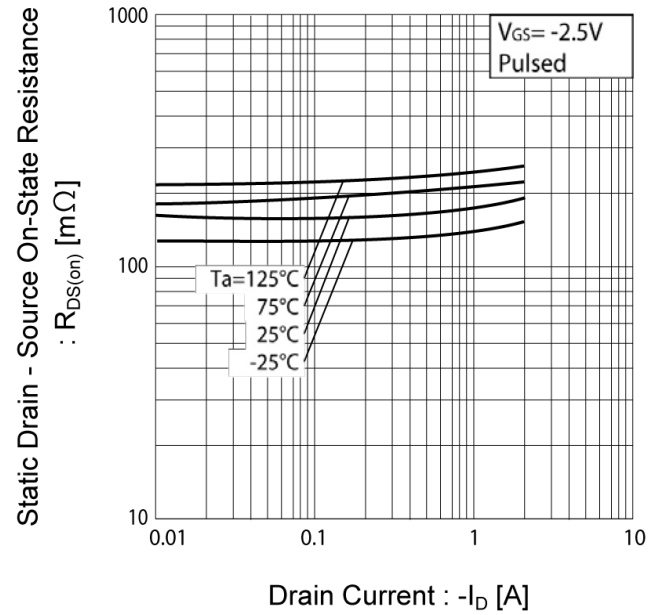


Fig.10 Static Drain - Source On - State Resistance vs. Drain Current (IV)



● Electrical characteristic curves <SBD>

Fig.11 Forward Current vs. Forward Voltage

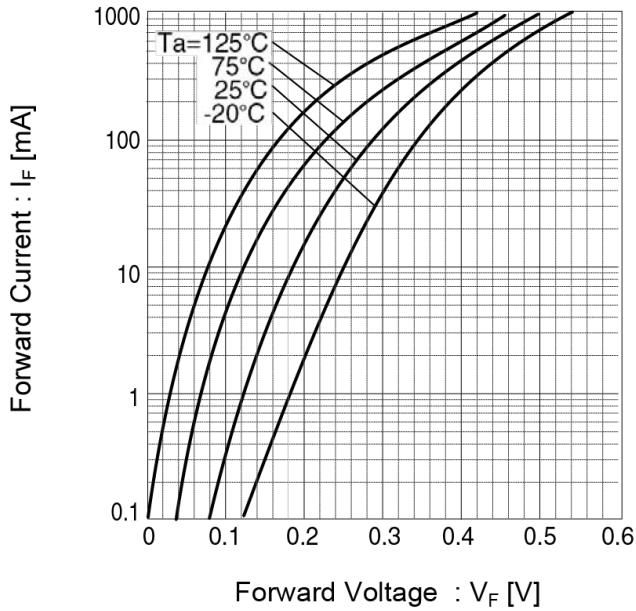
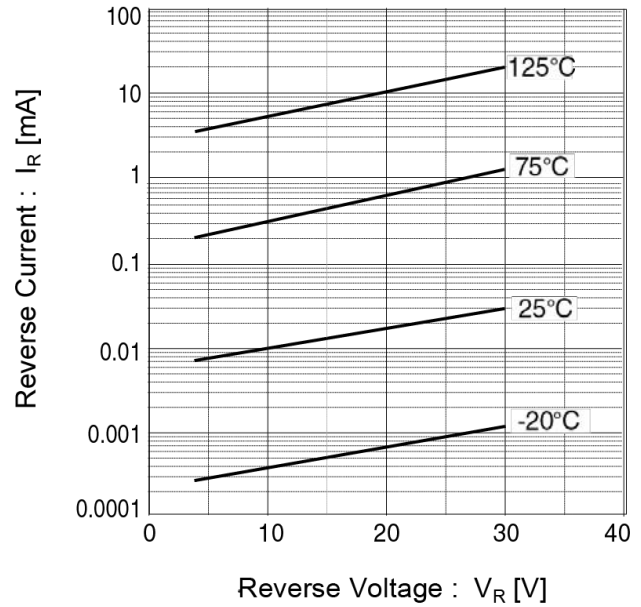


Fig.12 Reverse Current vs. Reverse Voltage



● 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.



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

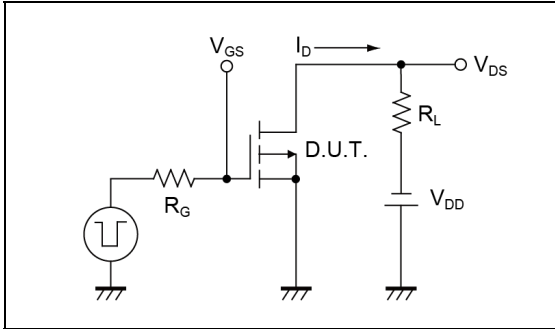


Fig.1-2 Switching Waveforms

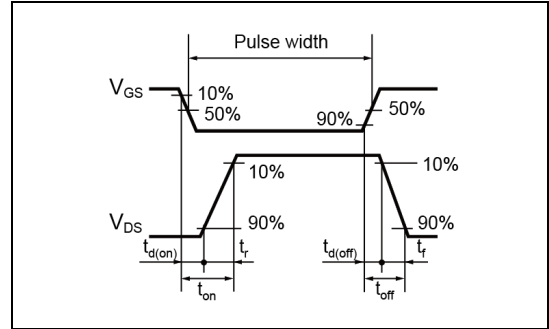


Fig.2-1 Gate Charge Measurement Circuit

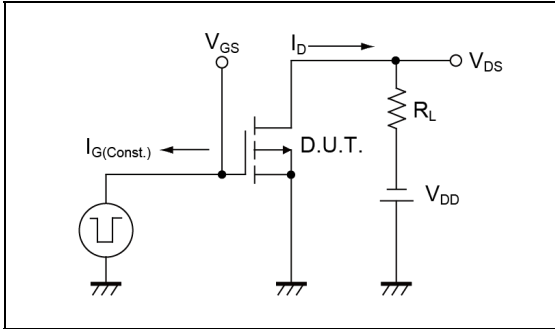
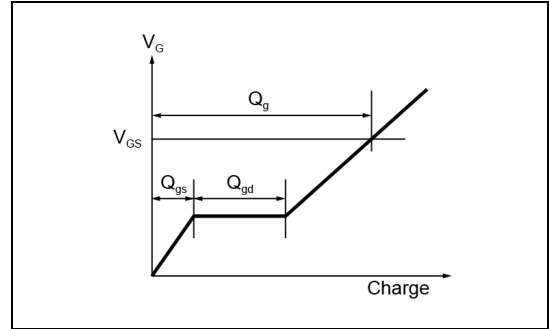
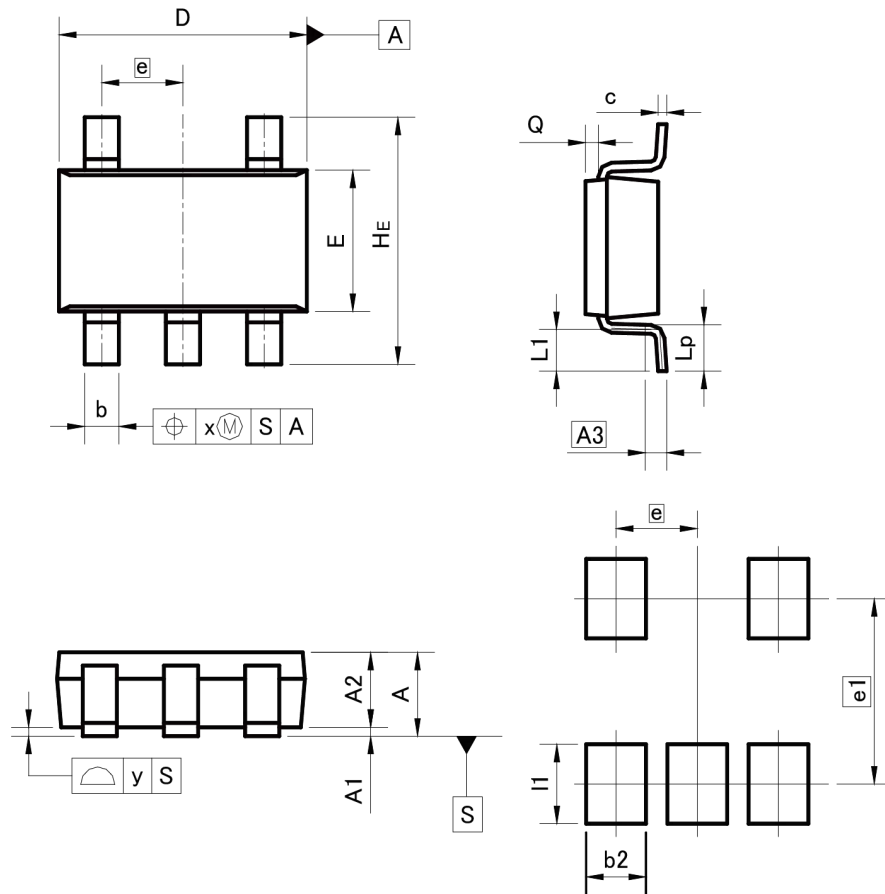


Fig.2-2 Gate Charge Waveform



●Dimensions

TSMT5



Pattern of terminal position areas  
[Not a recommended pattern of soldering pads]

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

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