# QS6K21

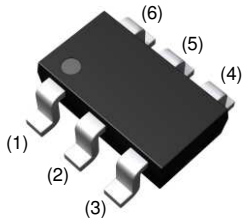
**Nch 45V 1A Power MOSFET**

Datasheet

| | |
|---|---|
| $V_{DSS}$ | 45V |
| $R_{DS(on)}$ (Max.) | 420mΩ |
| $I_D$ | 1A |
| $P_D$ | 1.25W |

## ●Outline

TSMT6




## ●Features

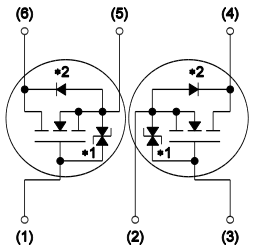
1) Low on - resistance.

2) Built-in G-S Protection Diode.

3) Small Surface Mount Package (TSMT6).

4) Pb-free lead plating ; RoHS compliant

## ●Inner circuit




(1) Tr1 Gate
(2) Tr2 Source
(3) Tr2 Gate
(4) Tr2 Drain
(5) Tr1 Source
(6) Tr1 Drain

∗1 ESD PROTECTION DIODE
∗2 BODY DIODE

## ●Application

DC/DC converters

## ●Packaging specifications

| | | |
|---|---|---|
| Type | Packaging | Taping |
| | Reel size (mm) | 180 |
| | Tape width (mm) | 8 |
| | Basic ordering unit (pcs) | 3,000 |
| | Taping code | TR |
| | Marking | K21 |

## ●Absolute maximum ratings($T_a$ = 25℃) <It is the same ratings for the Tr1 and Tr2>

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain - Source voltage | $V_{DSS}$ | 45 | V |
| Continuous drain current | $I_D$ *1 | ±1.0 | A |
| Pulsed drain current | $I_{D,pulse}$ *2 | ±2.0 | A |
| Gate - Source voltage | $V_{GSS}$ | ±12 | V |
| Power dissipation | $P_D$ *3 | 1.25 | W / total |
| | | 0.9 | W / element |
| | $P_D$ *4 | 0.6 | W / total |
| Junction temperature | $T_j$ | 150 | ℃ |
| Range of storage temperature | $T_{stg}$ | −55 to +150 | ℃ |

## ●Thermal resistance

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Thermal resistance, junction - ambient | $R_{thJA}$ *3 | - | - | 100 | ℃/W |
| | $R_{thJA}$ *4 | - | - | 208 | ℃/W |

## ●Electrical characteristics($T_a$ = 25℃) ,unless otherwise specified

<It is the same characteristics for the Tr1 and Tr2>

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Drain - Source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0V, $I_D$ = 1mA | 45 | - | - | V |
| Breakdown voltage temperature coefficient | $\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$ | $I_D$=1mA referenced to 25℃ | - | 41 | - | mV/℃ |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ = 45V, $V_{GS}$ = 0V | - | - | 1 | μA |
| Gate - Source leakage current | $I_{GSS}$ | $V_{GS}$ = ±12V, $V_{DS}$ = 0V | - | - | ±10 | μA |
| Gate threshold voltage | $V_{GS\ (th)}$ | $V_{DS}$ = 10V, $I_D$ = 1mA | 0.5 | - | 1.5 | V |
| Gate threshold voltage temperature coefficient | $\frac{\Delta V_{(GS)th}}{\Delta T_j}$ | $I_D$=1mA referenced to 25℃ | - | −2.5 | - | mV/℃ |
| Static drain - source on - state resistance | $R_{DS(on)}$ *5 | $V_{GS}$=4.5V, $I_D$=1.0A | - | 300 | 420 | mΩ |
| | | $V_{GS}$=4.0V, $I_D$=1.0A | - | 310 | 435 | |
| | | $V_{GS}$=2.5V, $I_D$=1.0A | - | 415 | 585 | |
| | | $V_{GS}$=4.5V, $I_D$=1.0A, $T_j$=125℃ | - | 530 | 745 | |
| Gate input resistannce | $R_G$ | f = 1MHz, open drain | - | 11 | - | Ω |
| Transconductance | $g_{fs}$ *5 | $V_{DS}$=10V, $I_D$=1A | 1.2 | 2.4 | - | S |

*1 Limited only by maximum temperature allowed.

*2 Pw ≤ 10μs, Duty cycle ≤ 1%

*3 Mounted on a ceramic board (30×30×0.8mm)

*4 Mounted on a FR4 (15×20×0.8mm)

*5 Pulsed

## ●Electrical characteristics($T_a$ = 25℃)

<It is the same characteristics for the Tr1 and Tr2>

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Input capacitance | $C_{iss}$ | $V_{GS}$ = 0V | - | 95 | - | pF |
| Output capacitance | $C_{oss}$ | $V_{DS}$ = 10V | - | 20 | - | |
| Reverse transfer capacitance | $C_{rss}$ | f = 1MHz | - | 10 | - | |
| Turn - on delay time | $t_{d(on)}$ *5 | $V_{DD} \simeq$ 25V, $V_{GS}$ = 4.5V | - | 6 | - | ns |
| Rise time | $t_r$ *5 | $I_D$ = 0.5A | - | 8 | - | |
| Turn - off delay time | $t_{d(off)}$ *5 | $R_L$ = 50Ω | - | 16 | - | |
| Fall time | $t_f$ *5 | $R_G$ = 10Ω | - | 7 | - | |

## ●Gate Charge characteristics($T_a$ = 25℃)

<It is the same characteristics for the Tr1 and Tr2>

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Total gate charge | $Q_g$ *5 | $V_{DD} \simeq$ 25V, $I_D$=1A<br>$V_{GS}$ = 4.5V | - | 1.5 | 2.1 | nC |
| Gate - Source charge | $Q_{gs}$ *5 | | - | 0.4 | - | |
| Gate - Drain charge | $Q_{gd}$ *5 | | - | 0.4 | - | |

## ●Body diode electrical characteristics (Source-Drain)($T_a$ = 25℃)

<It is the same characteristics for the Tr1 and Tr2>

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Inverse diode continuous, forward current | $I_S$ *1 | $T_a$ = 25℃ | - | - | 0.8 | A |
| Forward voltage | $V_{SD}$ *5 | $V_{GS}$ = 0V, $I_s$ = 0.8A | - | - | 1.2 | V |

## ●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

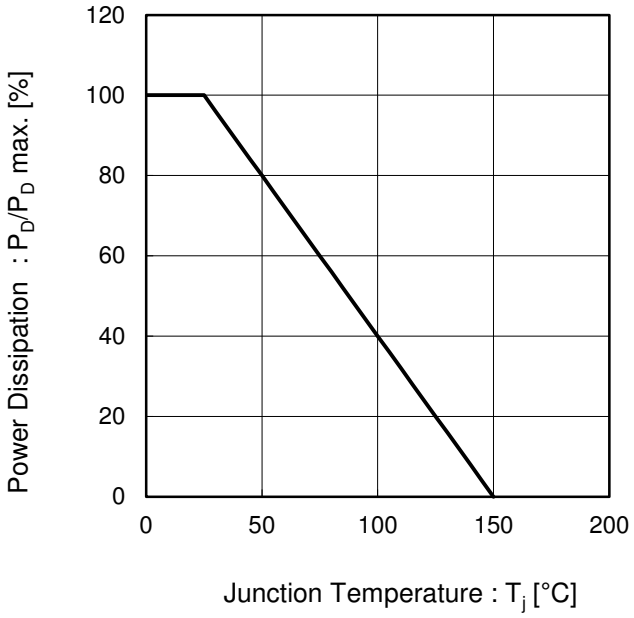



Fig.2 Maximum Safe Operating Area

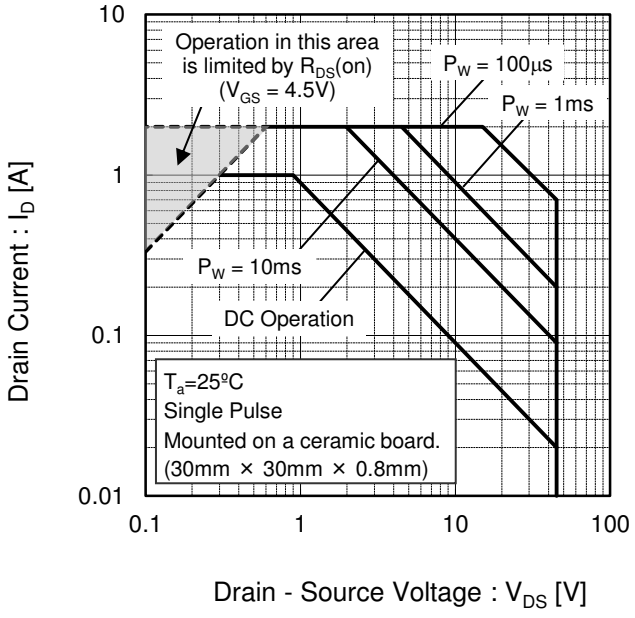



Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

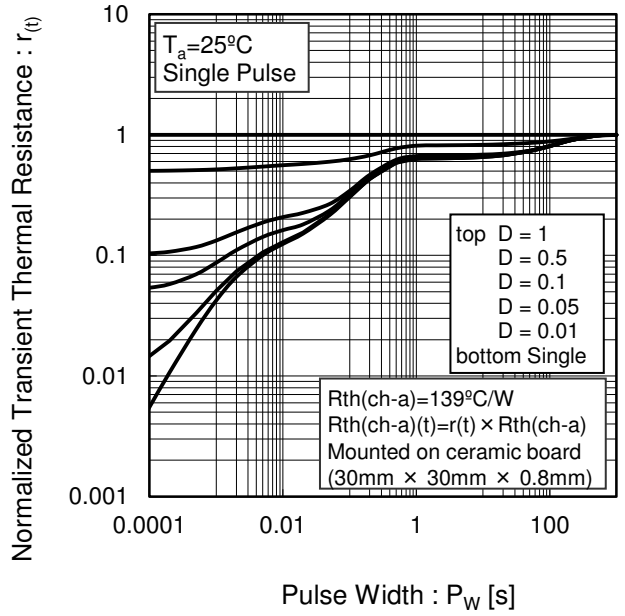
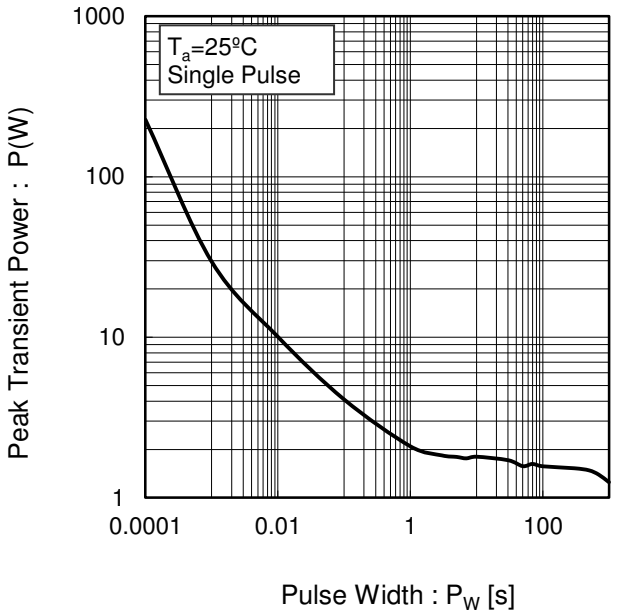



Fig.4 Single Pulse Maximum Power dissipation



## ●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

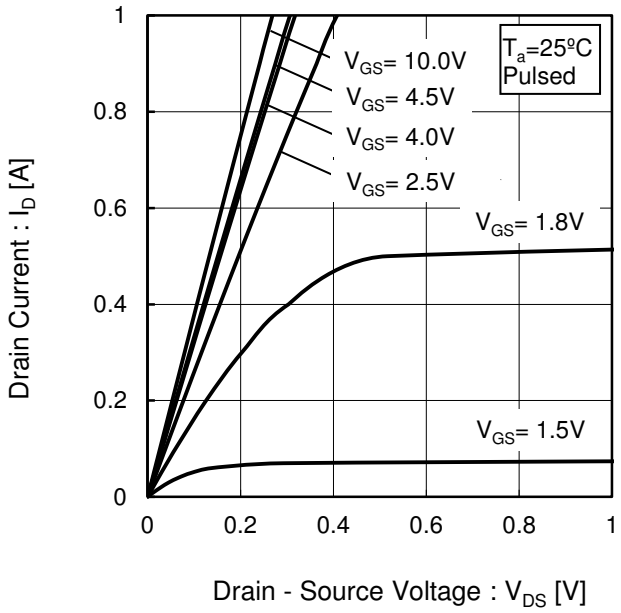



Fig.6 Typical Output Characteristics(II)

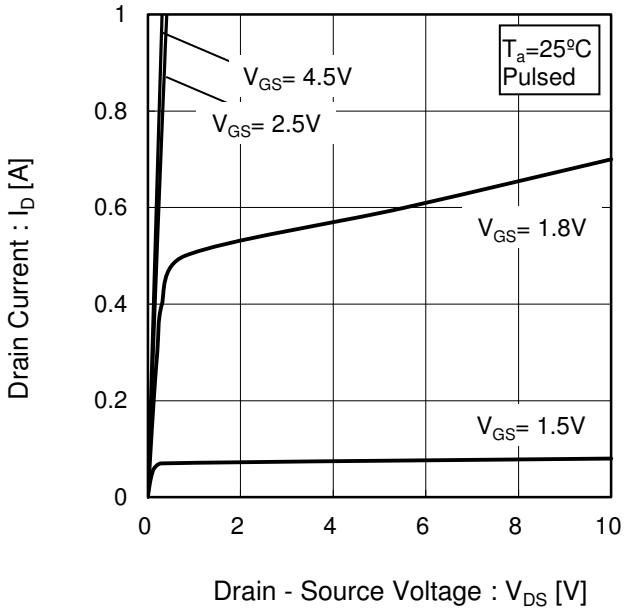



Fig.7 Breakdown Voltage vs. Junction Temperature

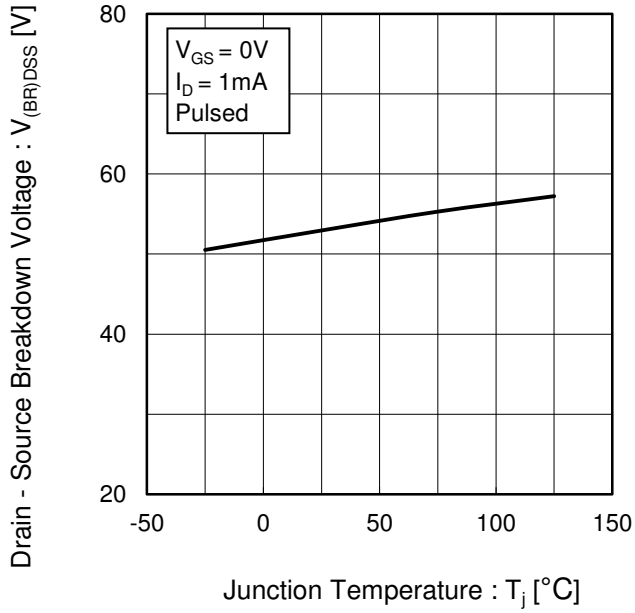
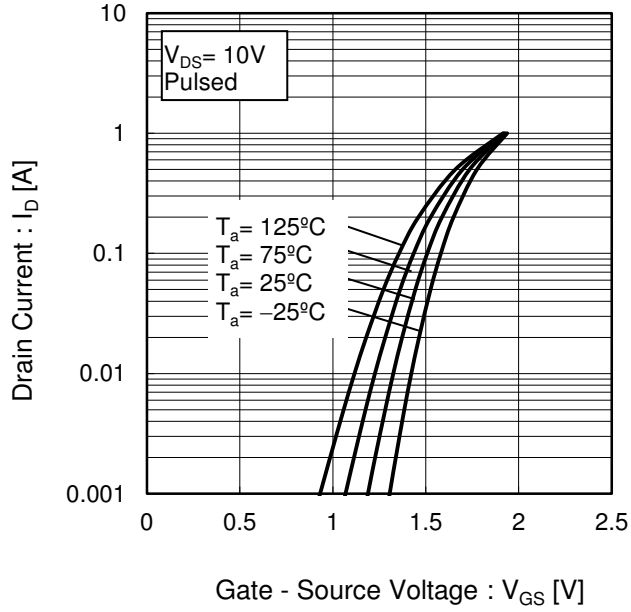



Fig.8 Typical Transfer Characteristics



## ●Electrical characteristic curves

Fig.9 Gate Threshold Voltage vs. Junction Temperature

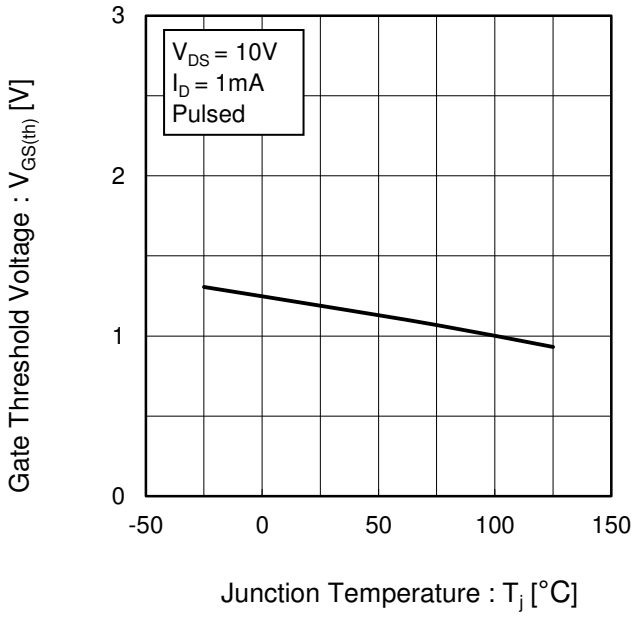



Fig.10 Transconductance vs. Drain Current

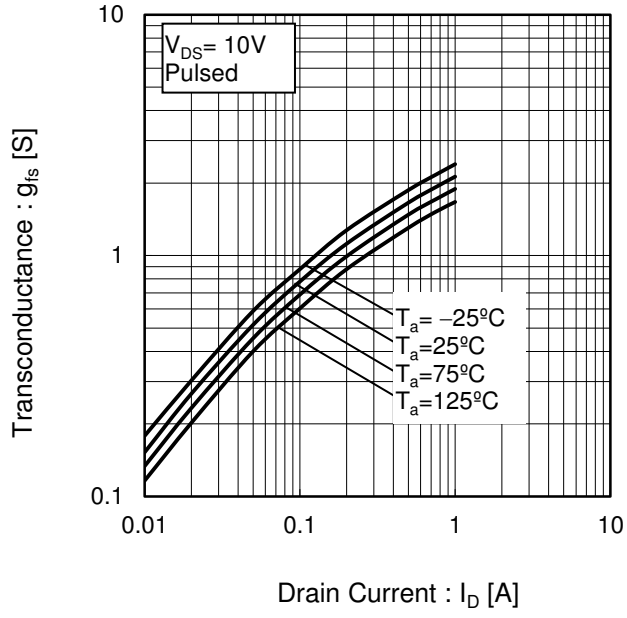



Fig.11 Drain CurrentDerating Curve

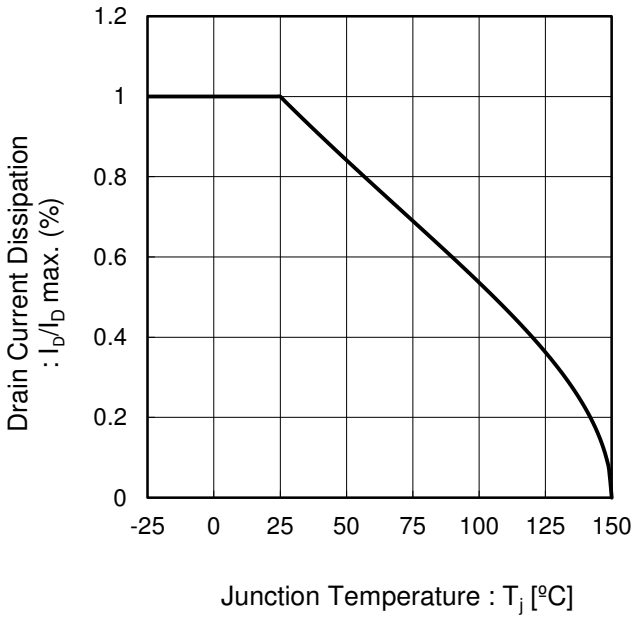
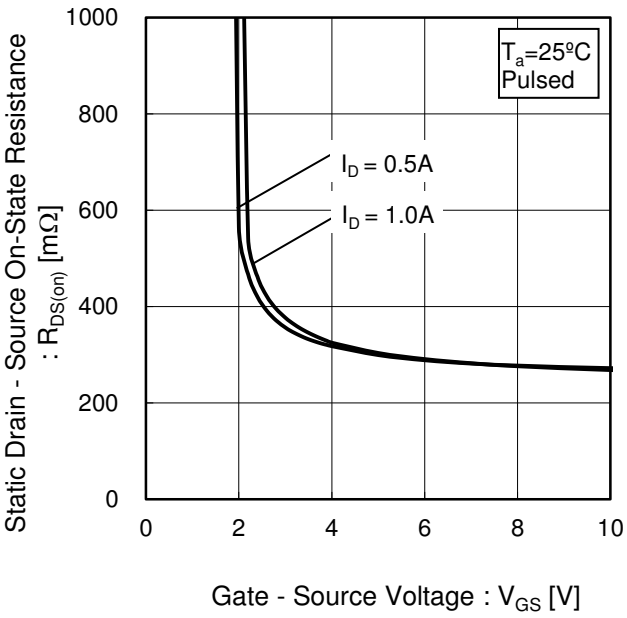



Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage



## ●Electrical characteristic curves

Fig.13 Static Drain - Source On - State Resistance vs. Drain Current(I)

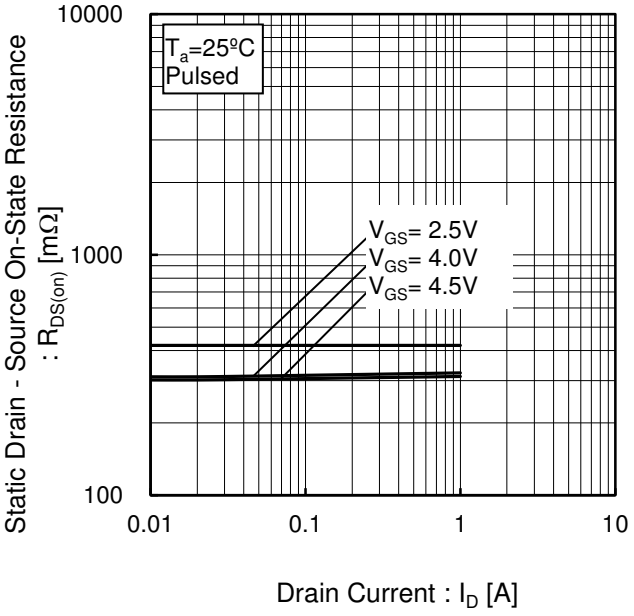



Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature

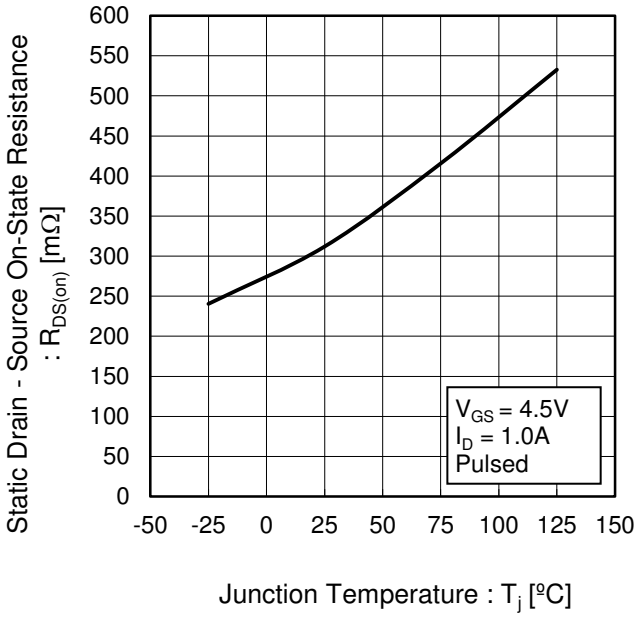



Fig.15 Static Drain - Source On - State Resistance vs. Drain Current(II)

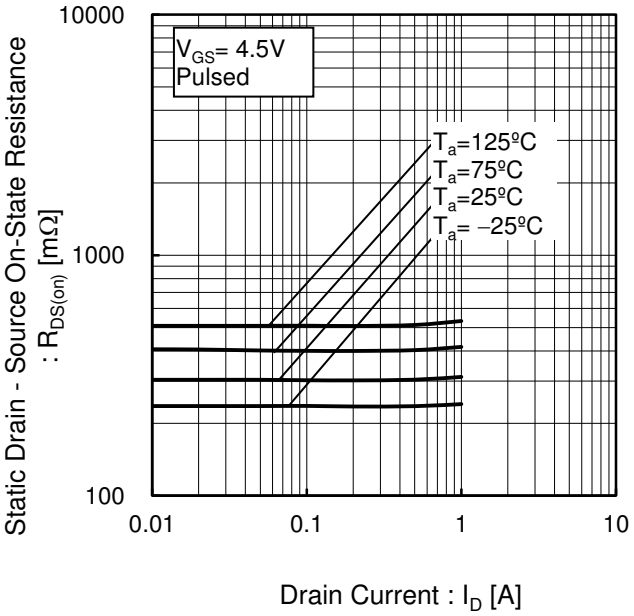
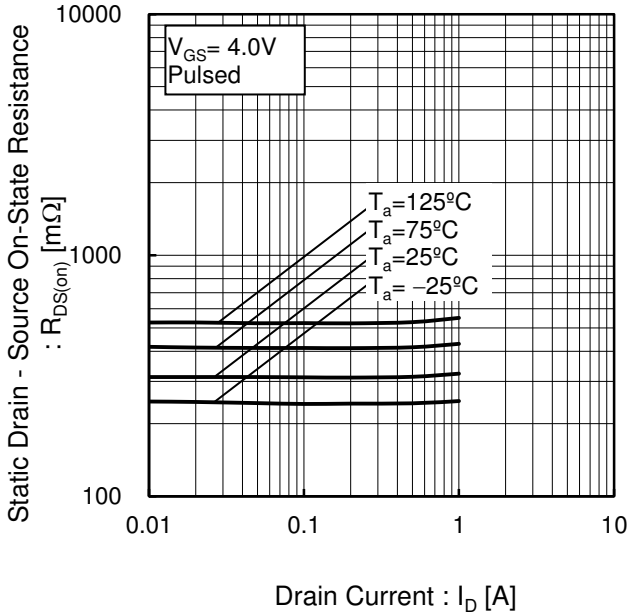



Fig.16 Static Drain-Source On-State Resistance vs. Drain Current(III)



## ●Electrical characteristic curves

Fig.17 Static Drain - Source On - State Resistance vs. Drain Current(IV)

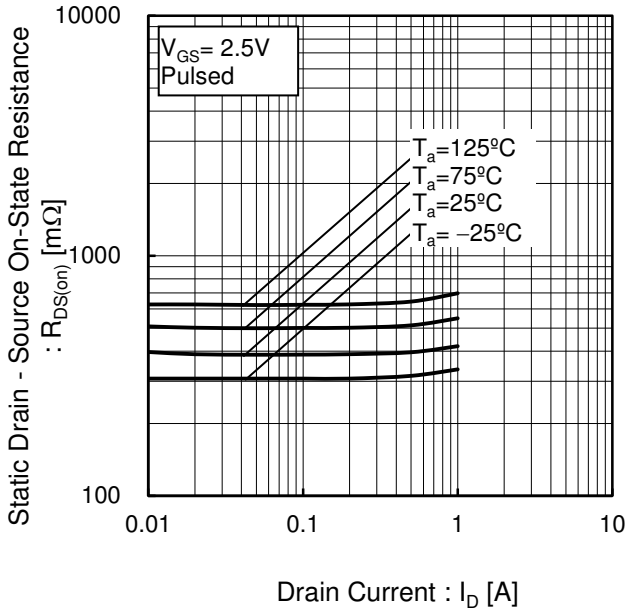



Fig.18 Typical Capacitance vs. Drain - Source Voltage

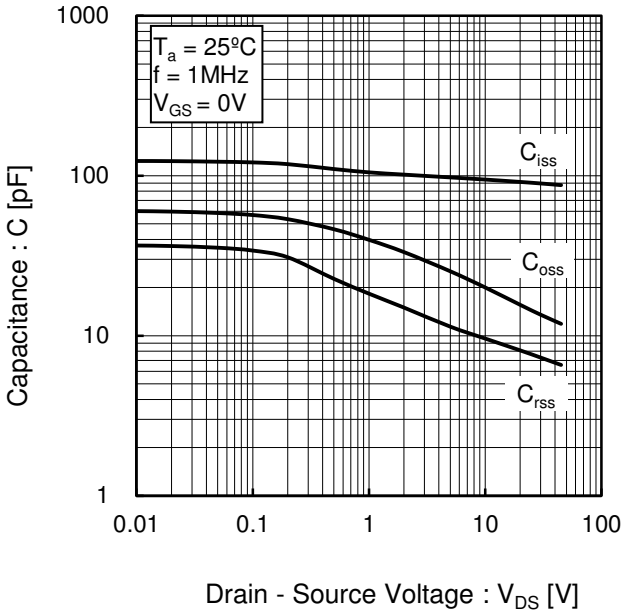



Fig.19 Switching Characteristics

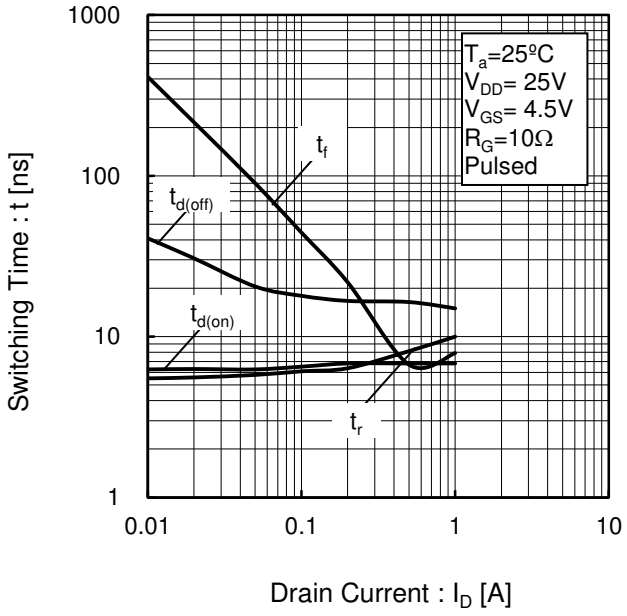
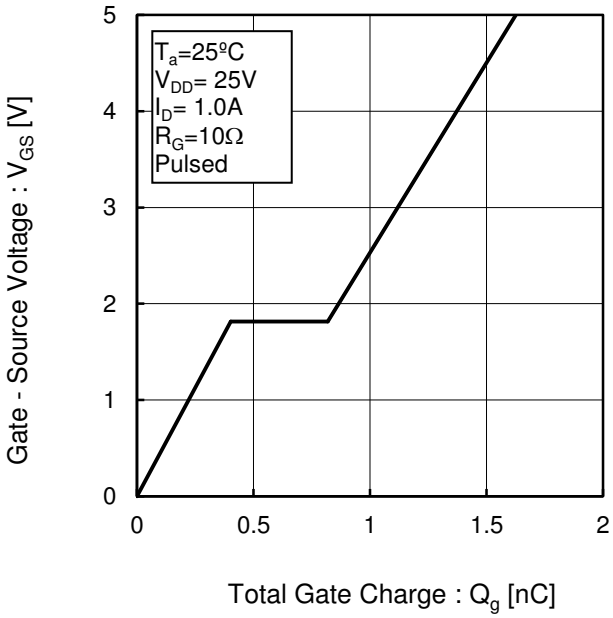
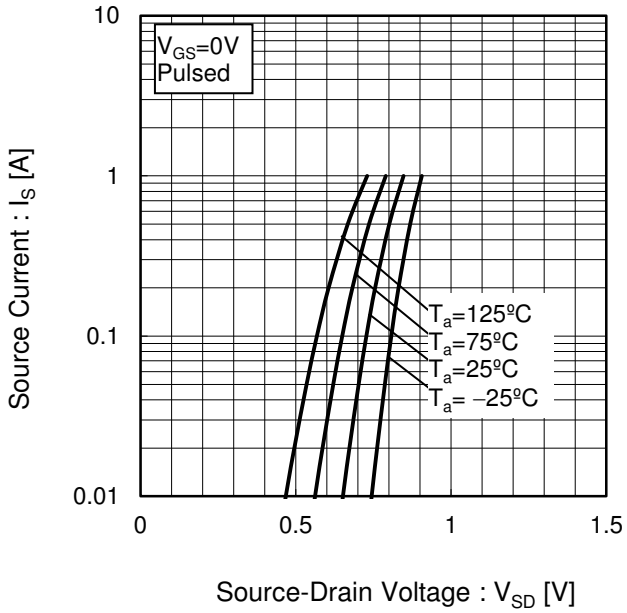



Fig.20 Dynamic Input Characteristics



## ●Electrical characteristic curves

Fig.21 Source Current
vs. Source Drain Voltage



## ●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

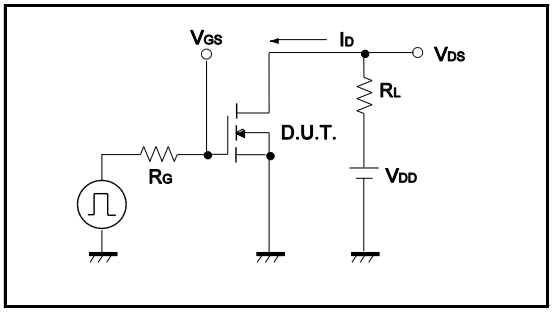



Fig.1-2 Switching Waveforms

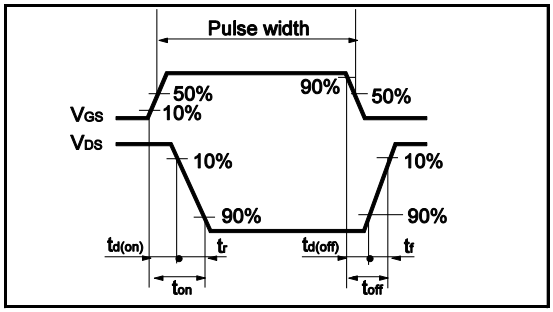



Fig.2-1 Gate Charge Measurement Circuit

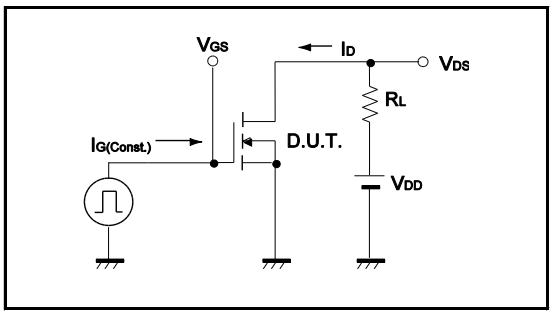
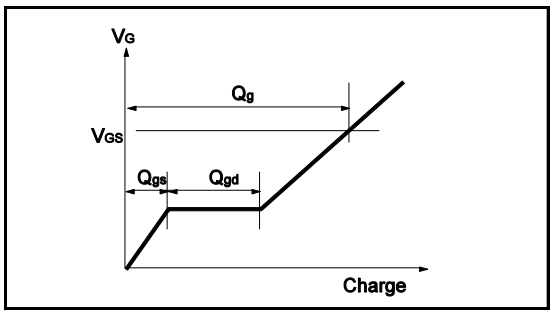
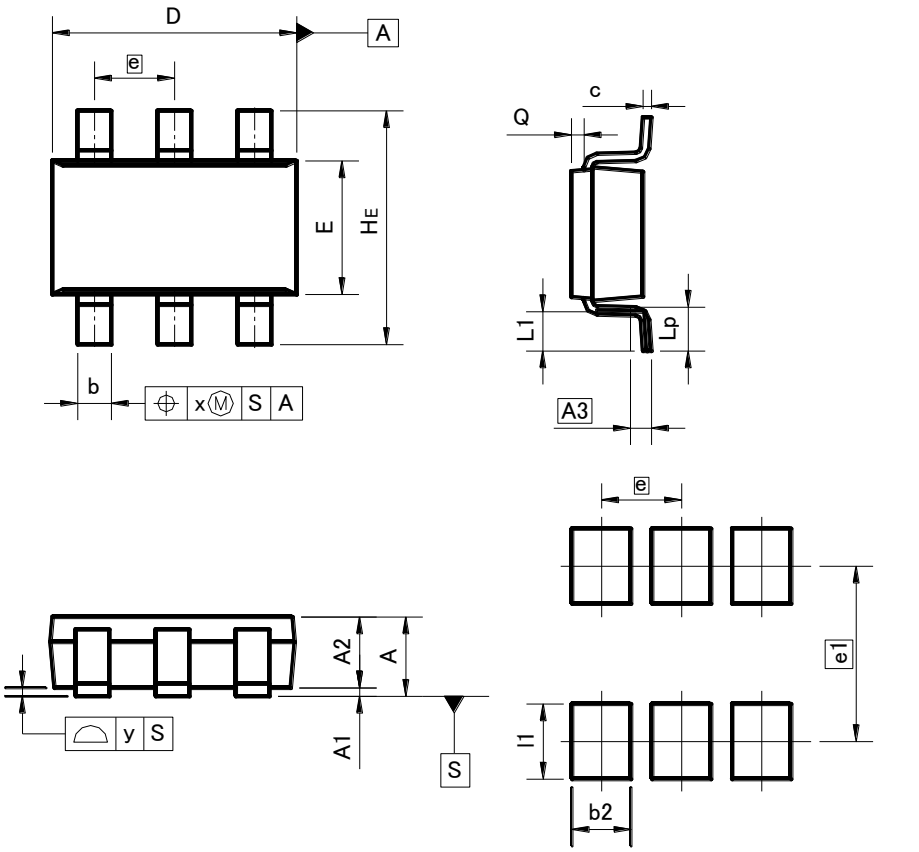



Fig.2-2 Gate Charge Waveform



●**Dimensions** (Unit : mm)

**TSMT6**




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 | |
| l1 | – | 0.90 | – | 0.035 |

Dimension in mm / inches

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