

|                    |       |
|--------------------|-------|
| $V_{DSS}$          | -30V  |
| $R_{DS(on)}(Max.)$ | 50mΩ  |
| $I_D$              | ±3.5A |
| $P_D$              | 1.25W |

## ●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

## ●Application

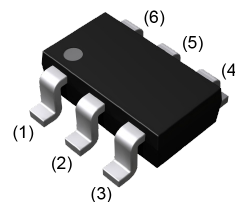
Switching

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

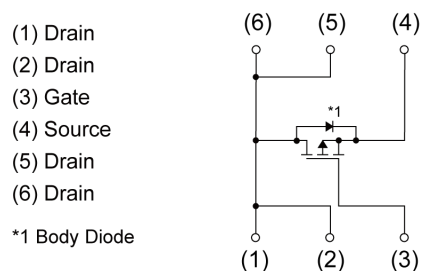
| Parameter                      | Symbol             | Value       | Unit |
|--------------------------------|--------------------|-------------|------|
| Drain - Source voltage         | $V_{DSS}$          | -30         | V    |
| Continuous drain current       | $I_D$              | ±3.5        | A    |
| Pulsed drain current           | $I_{D,pulse}^{*2}$ | ±12         | A    |
| Gate - Source voltage          | $V_{GSS}$          | ±20         | V    |
| Avalanche energy, single pulse | $E_{AS}^{*3}$      | 9.0         | mJ   |
| Avalanche current              | $I_{AS}^{*3}$      | -3.5        | A    |
| Power dissipation              | $P_D^{*4}$         | 1.25        | W    |
| Junction temperature           | $T_j$              | 150         | °C   |
| Range of storage temperature   | $T_{stg}$          | -55 to +150 | °C   |

## ●Outline

TSMT6



## ●Inner circuit



## ●Packaging specifications

| Type | Packing                   | Embossed Tape |
|------|---------------------------|---------------|
|      | Reel size (mm)            | 180           |
|      | Tape width (mm)           | 8             |
|      | Basic ordering unit (pcs) | 3000          |
|      | Taping code               | TCR           |
|      | Marking                   | JR            |

### ● Thermal resistance

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

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

| Parameter                                      | Symbol                                  | Conditions                                       | Values |      |      | Unit  |
|------------------------------------------------|-----------------------------------------|--------------------------------------------------|--------|------|------|-------|
|                                                |                                         |                                                  | Min.   | Typ. | Max. |       |
| Drain - Source breakdown voltage               | $V_{(BR)DSS}$                           | $V_{GS} = 0V, I_D = -1mA$                        | -30    | -    | -    | V     |
| Breakdown voltage temperature coefficient      | $\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$ | $I_D = -1mA$<br>referenced to $25^\circ\text{C}$ | -      | -22  | -    | mV/°C |
| Zero gate voltage drain current                | $I_{DSS}$                               | $V_{DS} = -30V, V_{GS} = 0V$                     | -      | -    | -1   | μA    |
| Gate - Source leakage current                  | $I_{GSS}$                               | $V_{GS} = \pm 20V, V_{DS} = 0V$                  | -      | -    | ±100 | nA    |
| Gate threshold voltage                         | $V_{GS(th)}$                            | $V_{DS} = V_{GS}, I_D = -1mA$                    | -1.0   | -    | -2.5 | V     |
| Gate threshold voltage temperature coefficient | $\frac{\Delta V_{GS(th)}}{\Delta T_j}$  | $I_D = -1mA$<br>referenced to $25^\circ\text{C}$ | -      | 2.9  | -    | mV/°C |
| Static drain - source on - state resistance    | $R_{DS(on)}^{*5}$                       | $V_{GS} = -10V, I_D = -3.5A$                     | -      | 38   | 50   | mΩ    |
|                                                |                                         | $V_{GS} = -4.5V, I_D = -3.5A$                    | -      | 54   | 70   |       |
| Transconductance                               | $g_{fs}^{*5}$                           | $V_{DS} = -5V, I_D = -3.5A$                      | 3.2    | -    | -    | S     |

\*1 Limited only by maximum temperature allowed.

\*2  $P_w \leq 10\mu s$ , Duty cycle  $\leq 1\%$

\*3  $L \approx 1mH$ ,  $V_{DD} = -15V$ ,  $R_G = 25\Omega$ , STARTING  $T_{ch} = 25^\circ\text{C}$  Fig.3-1,3-2

\*4 Mounted on a ceramic board (30×30×0.8mm)

\*5 Pulsed

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

| Parameter                    | Symbol            | Conditions                           | Values |      |      | Unit |
|------------------------------|-------------------|--------------------------------------|--------|------|------|------|
|                              |                   |                                      | Min.   | Typ. | Max. |      |
| Input capacitance            | $C_{iss}$         | $V_{GS} = 0V$                        | -      | 475  | -    | pF   |
| Output capacitance           | $C_{oss}$         | $V_{DS} = -15V$                      | -      | 85   | -    |      |
| Reverse transfer capacitance | $C_{rss}$         | $f = 1\text{MHz}$                    | -      | 65   | -    |      |
| Turn - on delay time         | $t_{d(on)}^{*5}$  | $V_{DD} \approx -15V, V_{GS} = -10V$ | -      | 8    | -    | ns   |
| Rise time                    | $t_r^{*5}$        | $I_D = -1.8A$                        | -      | 12   | -    |      |
| Turn - off delay time        | $t_{d(off)}^{*5}$ | $R_L = 8.2\Omega$                    | -      | 40   | -    |      |
| Fall time                    | $t_f^{*5}$        | $R_G = 10\Omega$                     | -      | 20   | -    |      |

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

| Parameter            | Symbol        | Conditions                             |                  | Values |      |      | Unit |
|----------------------|---------------|----------------------------------------|------------------|--------|------|------|------|
|                      |               |                                        |                  | Min.   | Typ. | Max. |      |
| Total gate charge    | $Q_g^{*5}$    | $V_{DD} \approx -15V$<br>$I_D = -3.5A$ | $V_{GS} = -10V$  | -      | 10   | -    | nC   |
| Gate - Source charge | $Q_{gs}^{*5}$ |                                        | $V_{GS} = -4.5V$ | -      | 5.2  | -    |      |
| Gate - Drain charge  | $Q_{gd}^{*5}$ |                                        |                  | -      | 1.6  | -    |      |
|                      |               |                                        |                  | -      | 1.9  | -    |      |

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

| Parameter                             | Symbol        | Conditions                 | Values |      |      | Unit |
|---------------------------------------|---------------|----------------------------|--------|------|------|------|
|                                       |               |                            | Min.   | Typ. | Max. |      |
| Body diode continuous forward current | $I_S^{*1}$    | $T_a = 25^\circ\text{C}$   | -      | -    | -1.0 | A    |
| Body diode pulse current              | $I_{SP}^{*2}$ |                            | -      | -    | -12  |      |
| Forward voltage                       | $V_{SD}^{*5}$ | $V_{GS} = 0V, I_S = -1.0A$ | -      | -    | -1.2 | V    |

## ●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

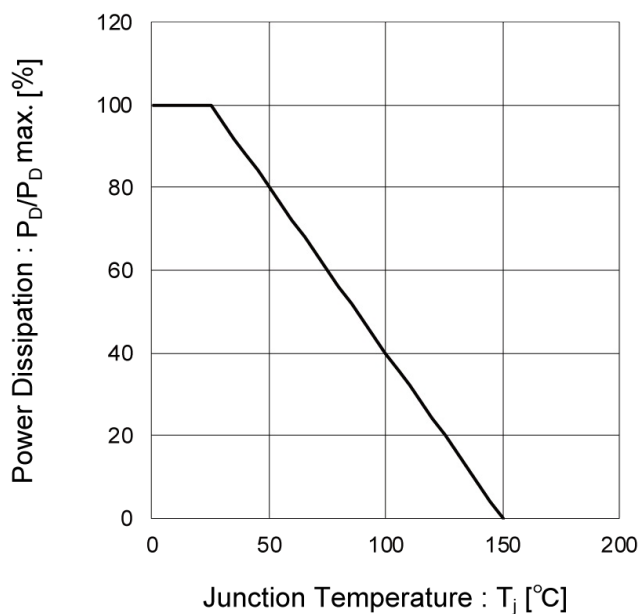


Fig.2 Maximum Safe Operating Area

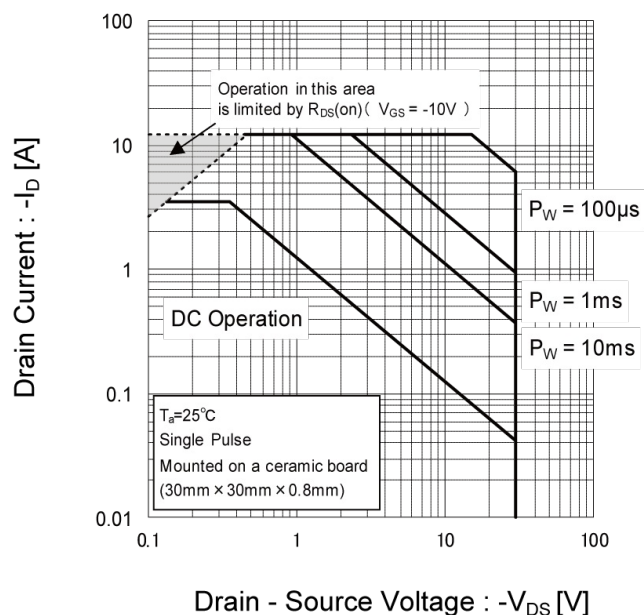


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

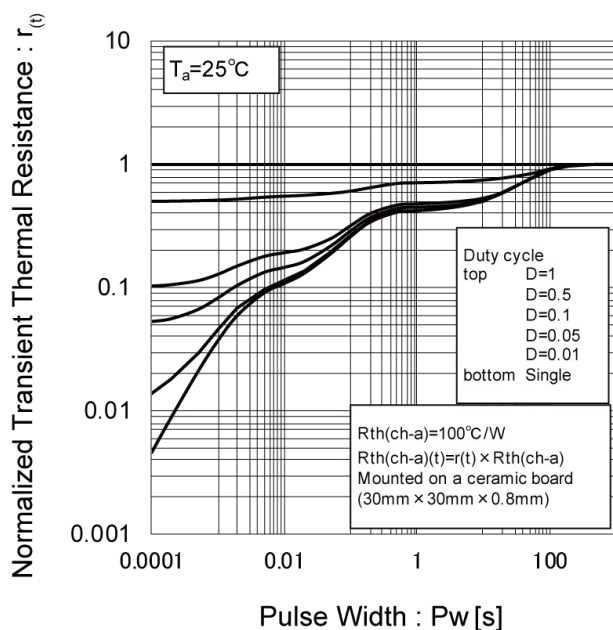
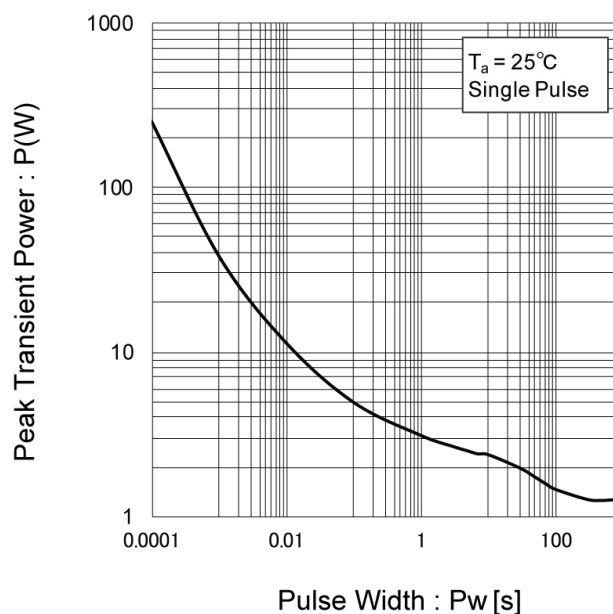


Fig.4 Single Pulse Maximum Power dissipation



# ●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

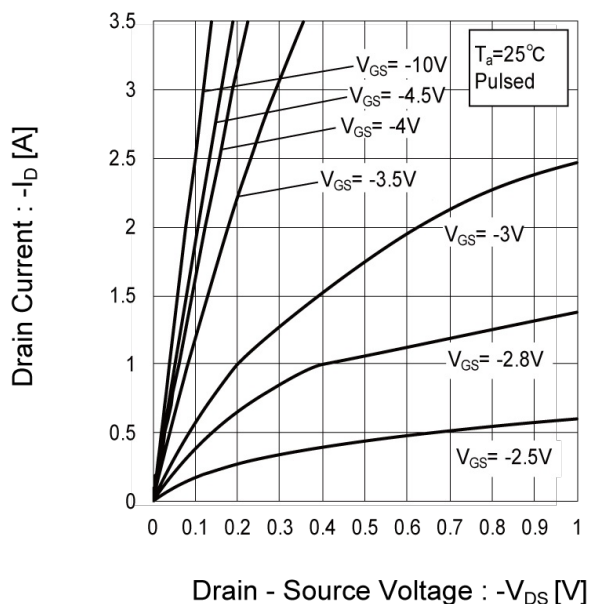


Fig.6 Typical Output Characteristics(II)

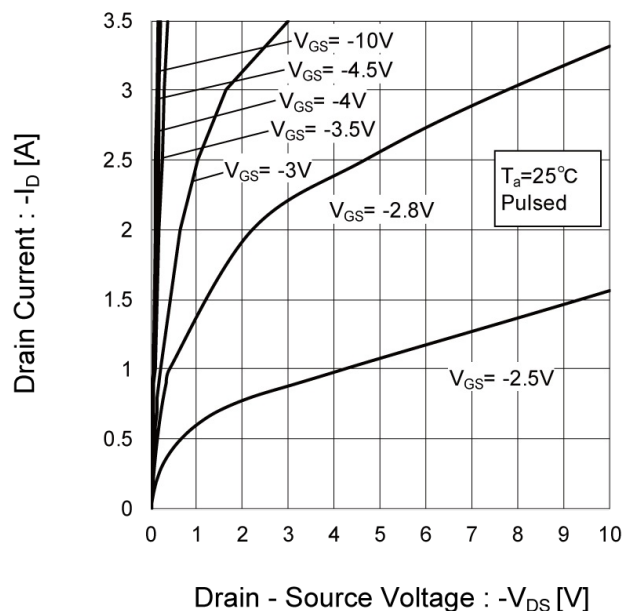
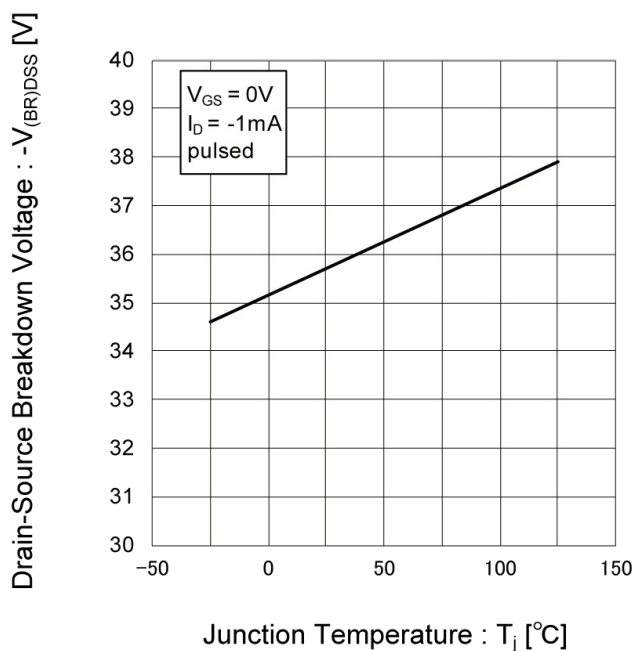


Fig.7 Breakdown Voltage vs. Junction Temperature



## ●Electrical characteristic curves

Fig.8 Typical Transfer Characteristics

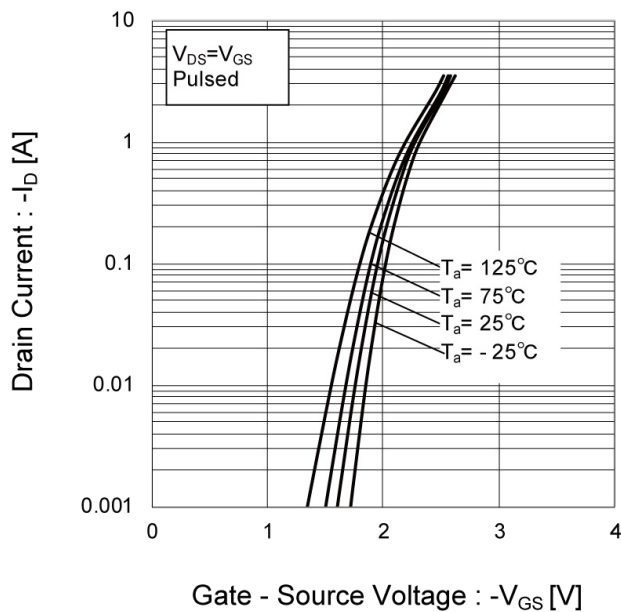


Fig.9 Gate Threshold Voltage vs. Junction Temperature

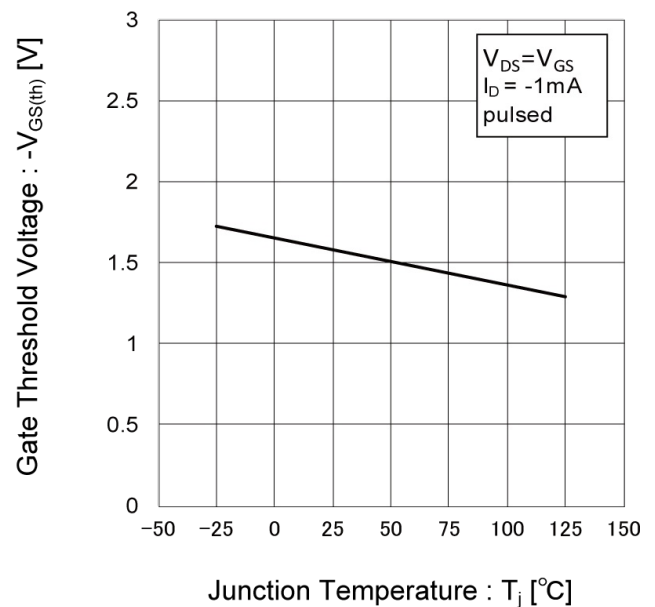
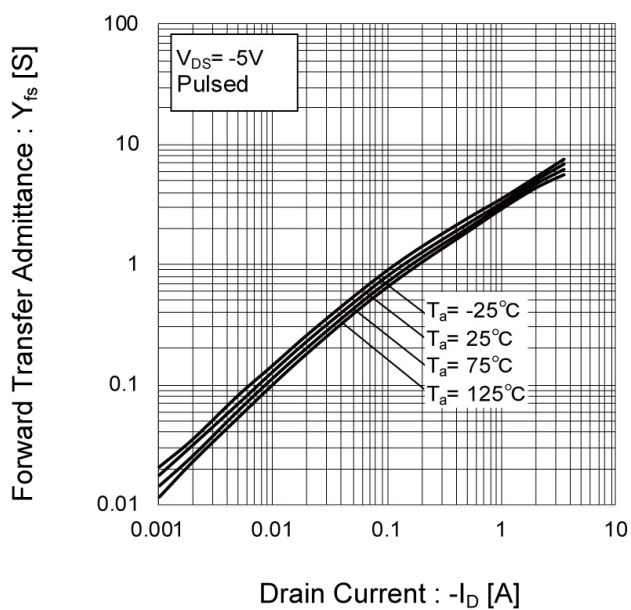


Fig.10 Transconductance vs. Drain Current



# ●Electrical characteristic curves

Fig.11 Drain Current Derating Curve

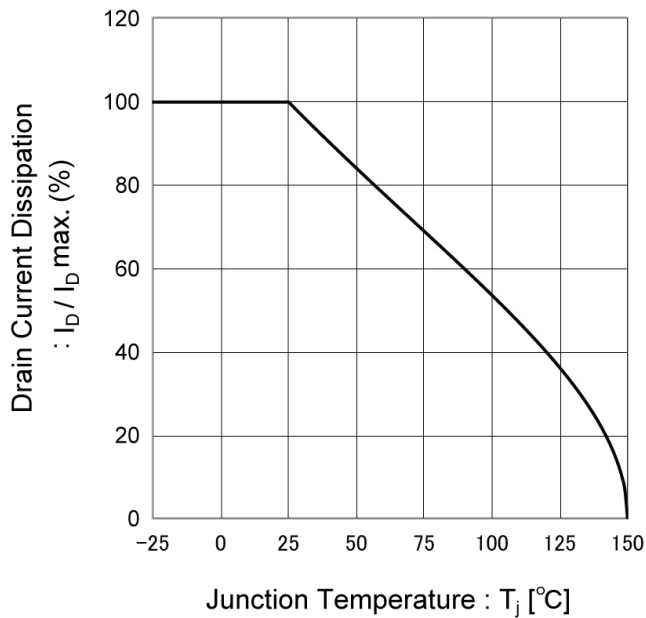


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

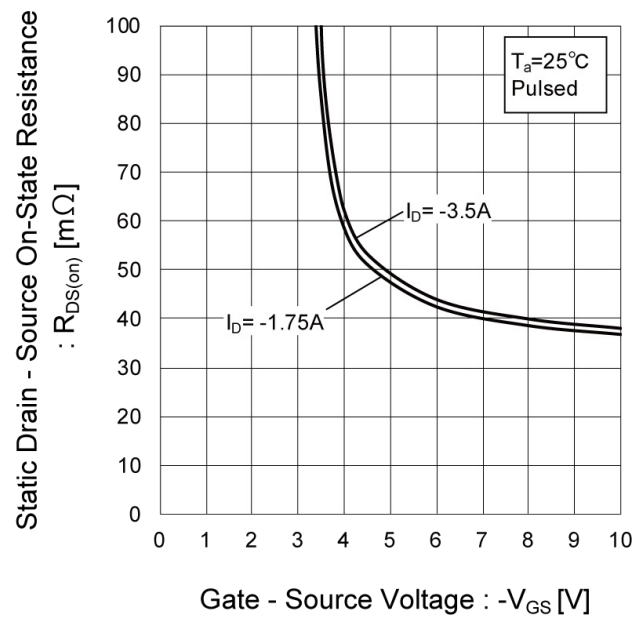
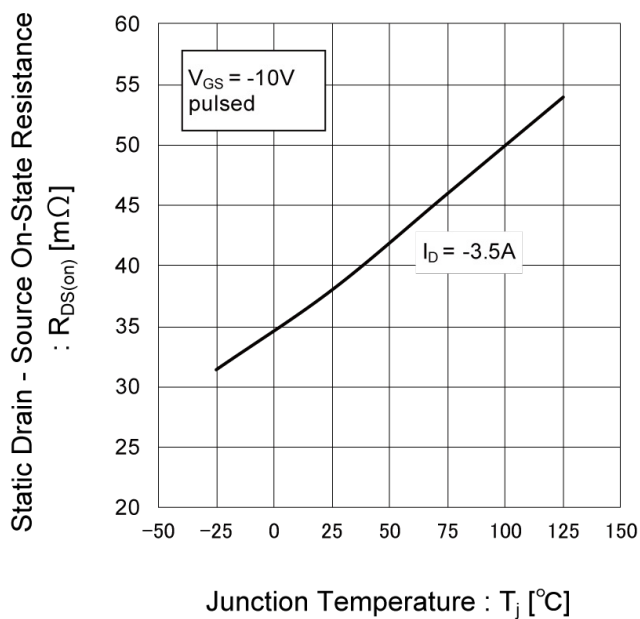


Fig.13 Static Drain - Source On - State Resistance vs. Junction Temperature



# ●Electrical characteristic curves

Fig.14 Static Drain - Source On - State Resistance vs. Drain Current(I)

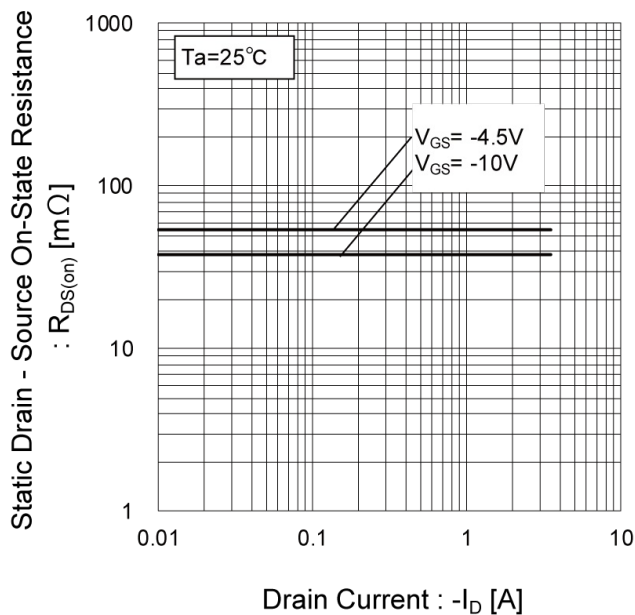


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current(II)

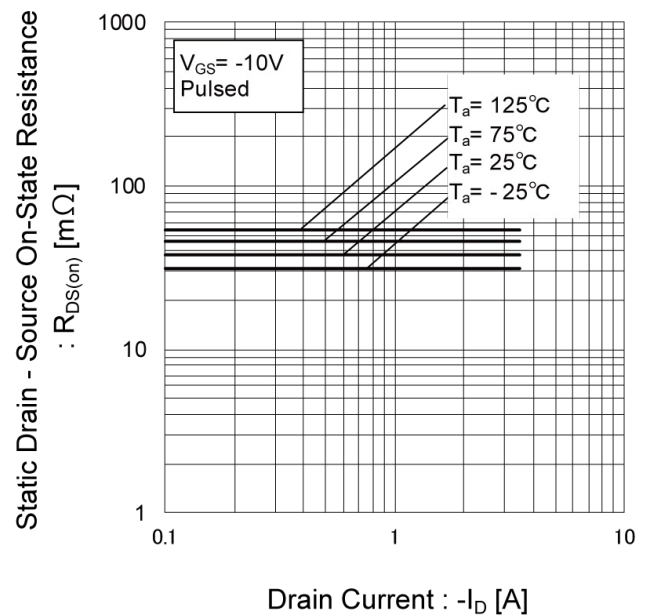
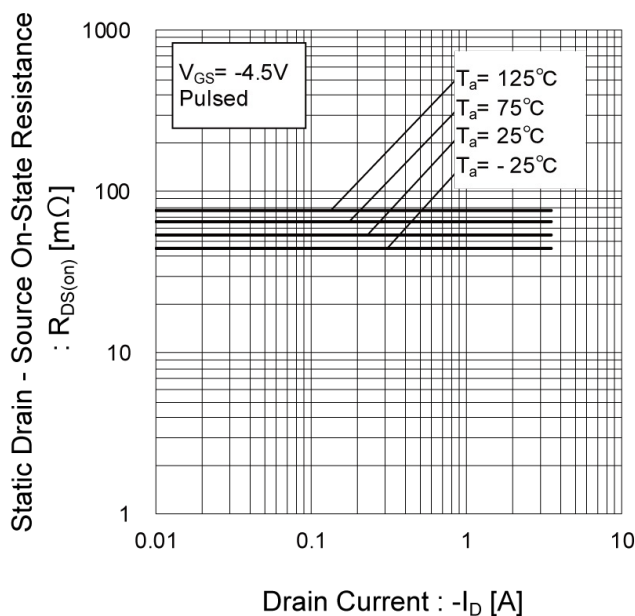


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current(III)





## ●Electrical characteristic curves

Fig.17 Typical Capacitance vs. Drain - Source Voltage

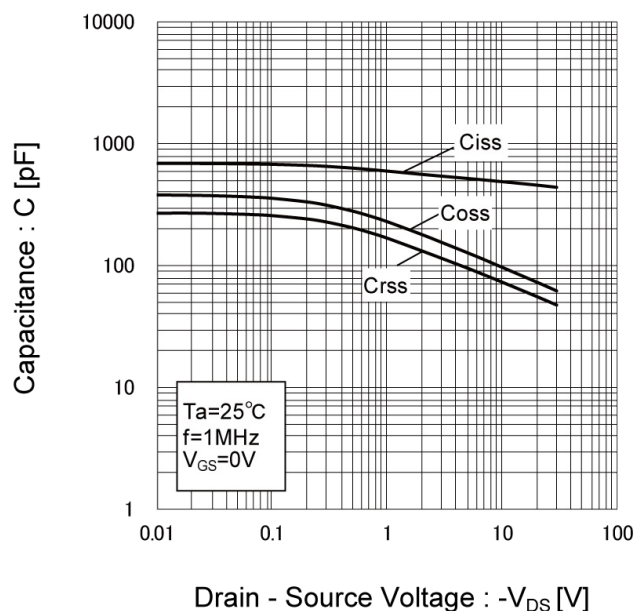


Fig.18 Switching Characteristics

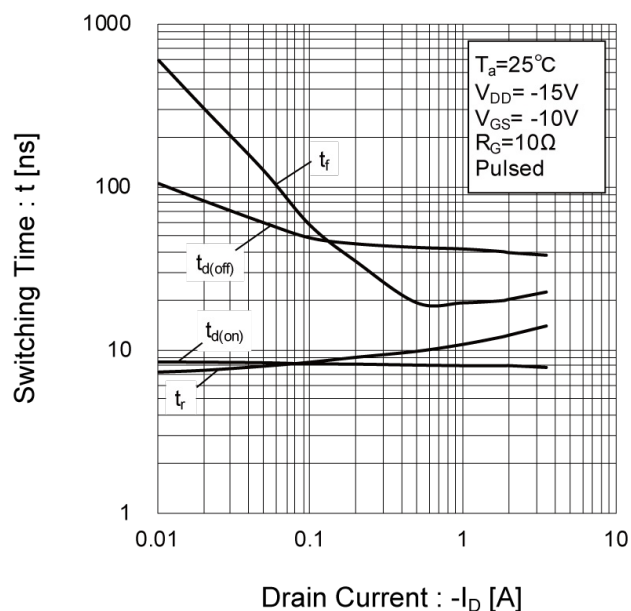


Fig.19 Dynamic Input Characteristics

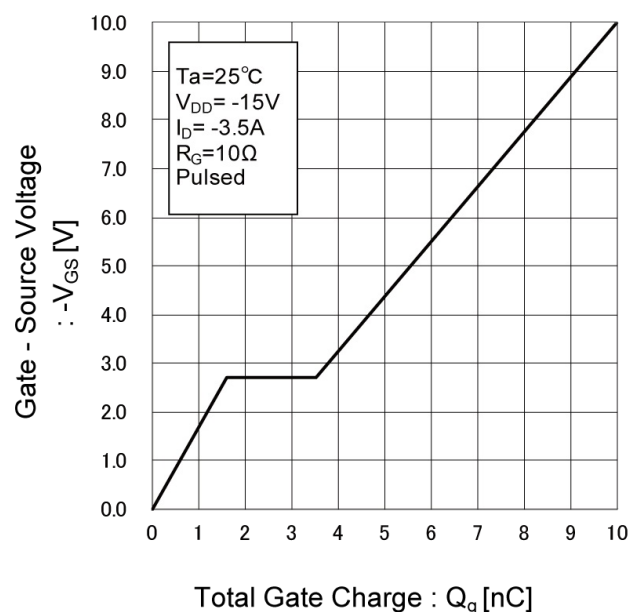
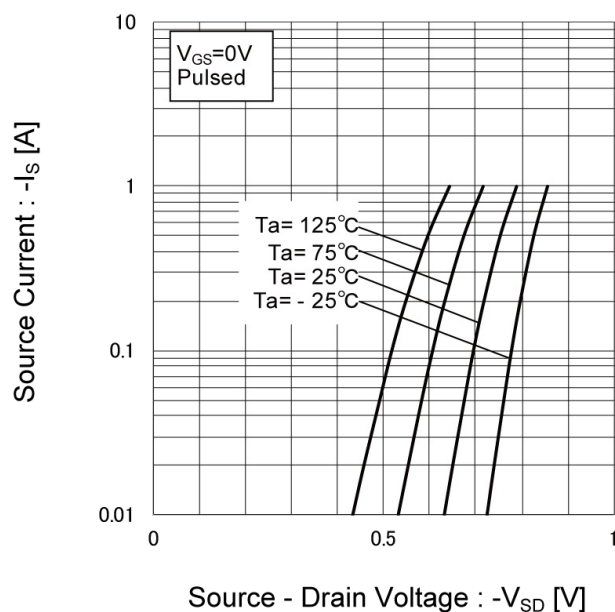


Fig.20 Source Current vs. Source Drain Voltage



## ● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

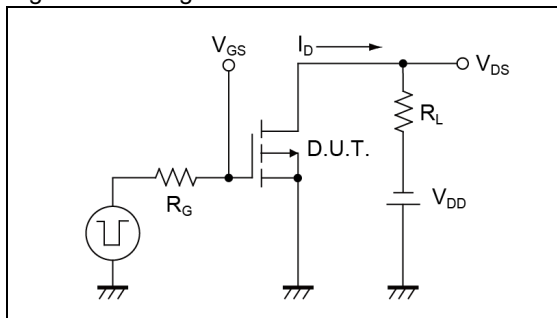


Fig.1-2 Switching Waveforms

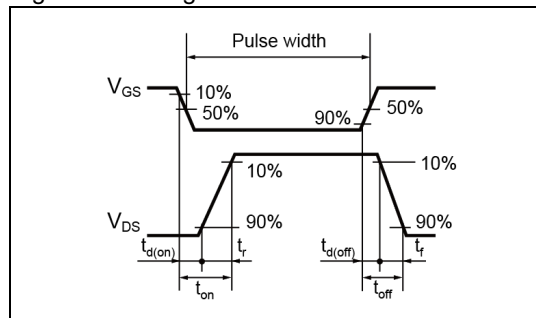


Fig.2-1 Gate Charge Measurement Circuit

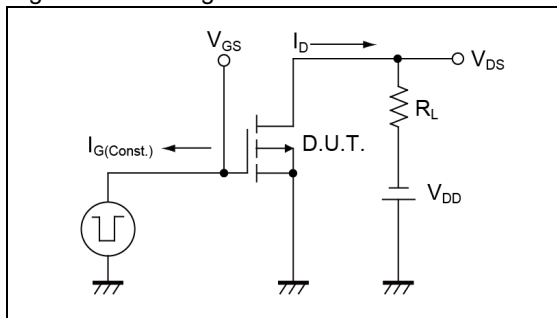


Fig.2-2 Gate Charge Waveform

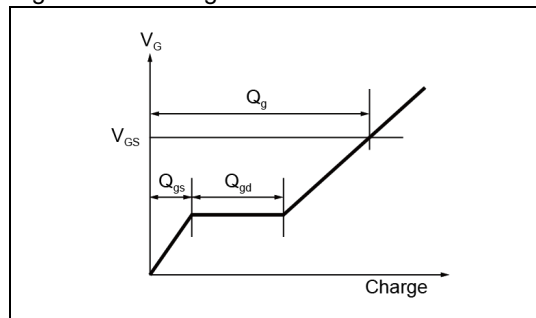


Fig.3-1 AVALANCHE MEASUREMENT CIRCUIT

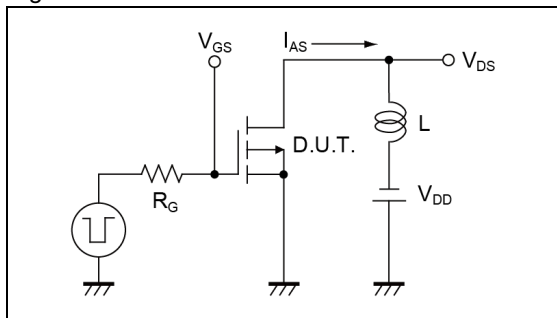
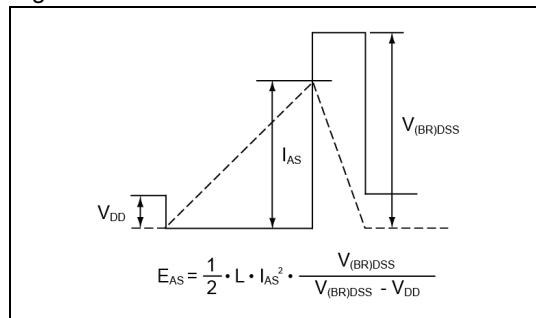
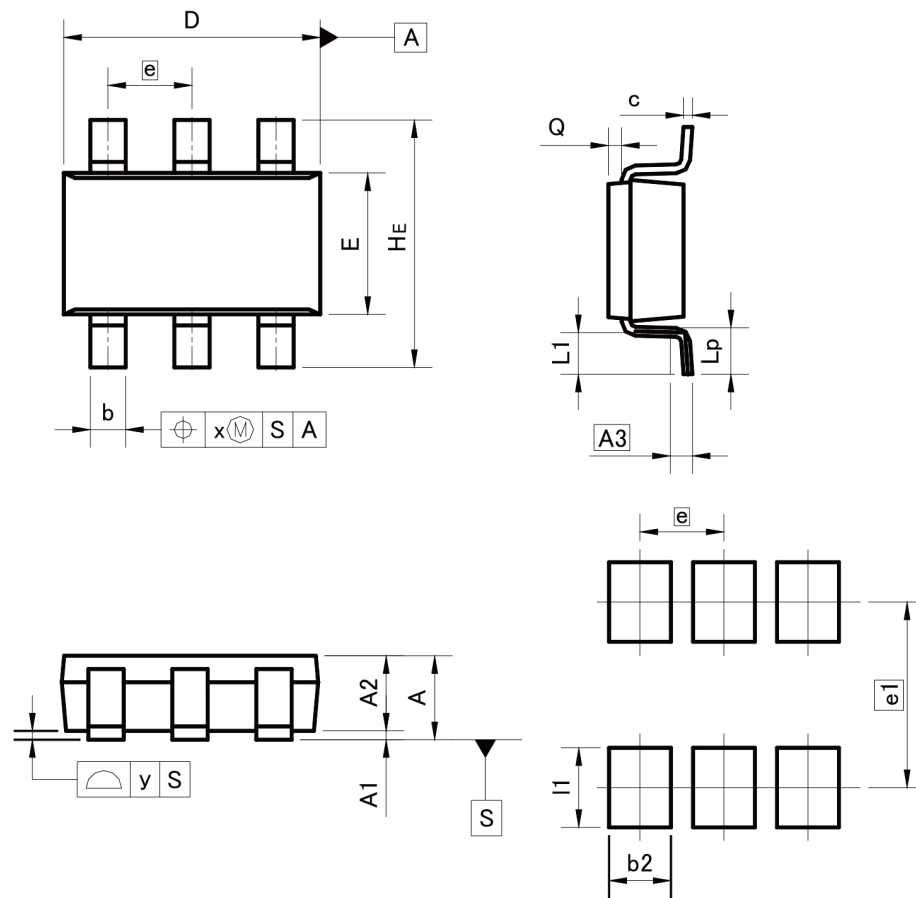


Fig.3-2 AVALANCHE WAVEFORM



## ●Dimensions

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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