

|                    |      |
|--------------------|------|
| $V_{DSS}$          | -12V |
| $R_{DS(on)}(Max.)$ | 23mΩ |
| $I_D$              | ±6A  |
| $P_D$              | 1.5W |

## ●Features

- 1) Low on - resistance.
- 2) -1.5V Drive
- 3) Built-in G-S protection diode.
- 4) Small surface mount package(TSMT8).
- 5) Pb-free lead plating ; RoHS compliant

## ●Application

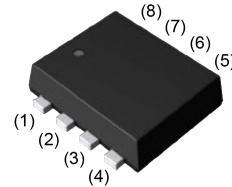
Switching

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

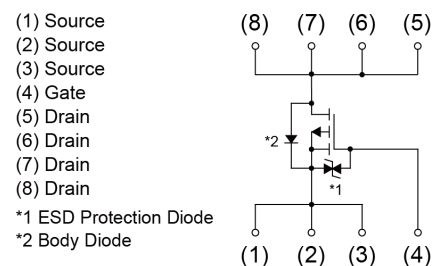
| Parameter                    | Symbol             | Value       | Unit |
|------------------------------|--------------------|-------------|------|
| Drain - Source voltage       | $V_{DSS}$          | -12         | V    |
| Continuous drain current     | $I_D$              | ±6          | A    |
| Pulsed drain current         | $I_{D,pulse}^{*1}$ | ±24         | A    |
| Gate - Source voltage        | $V_{GSS}$          | ±10         | V    |
| Power dissipation            | $P_D^{*2}$         | 1.5         | W    |
|                              | $P_D^{*3}$         | 0.7         | W    |
| Junction temperature         | $T_j$              | 150         | °C   |
| Range of storage temperature | $T_{stg}$          | -55 to +150 | °C   |

## ●Outline

TSMT8



## ●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                   | YH            |

## ● Thermal resistance

| Parameter                              | Symbol          | Values |      |      | Unit |
|----------------------------------------|-----------------|--------|------|------|------|
|                                        |                 | Min.   | Typ. | Max. |      |
| Thermal resistance, junction - ambient | $R_{thJA}^{*2}$ | -      | -    | 83.3 | °C/W |
|                                        | $R_{thJA}^{*3}$ | -      | -    | 178  | °C/W |

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

| Parameter                                      | Symbol                                  | Conditions                                       | Values |       |      | Unit  |
|------------------------------------------------|-----------------------------------------|--------------------------------------------------|--------|-------|------|-------|
|                                                |                                         |                                                  | Min.   | Typ.  | Max. |       |
| Drain - Source breakdown voltage               | $V_{(BR)DSS}$                           | $V_{GS} = 0V, I_D = -1mA$                        | -12    | -     | -    | V     |
| Breakdown voltage temperature coefficient      | $\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$ | $I_D = -1mA$<br>referenced to $25^\circ\text{C}$ | -      | -21.9 | -    | mV/°C |
| Zero gate voltage drain current                | $I_{DSS}$                               | $V_{DS} = -12V, V_{GS} = 0V$                     | -      | -     | -1   | μA    |
| Gate - Source leakage current                  | $I_{GSS}$                               | $V_{GS} = \pm 10V, V_{DS} = 0V$                  | -      | -     | ±10  | μA    |
| Gate threshold voltage                         | $V_{GS(th)}$                            | $V_{DS} = -6V, I_D = -1mA$                       | -0.3   | -     | -1.0 | V     |
| Gate threshold voltage temperature coefficient | $\frac{\Delta V_{GS(th)}}{\Delta T_j}$  | $I_D = -1mA$<br>referenced to $25^\circ\text{C}$ | -      | 2.4   | -    | mV/°C |
| Static drain - source on - state resistance    | $R_{DS(on)}^{*4}$                       | $V_{GS} = -4.5V, I_D = -6A$                      | -      | 16    | 23   | mΩ    |
|                                                |                                         | $V_{GS} = -2.5V, I_D = -3A$                      | -      | 22    | 31   |       |
|                                                |                                         | $V_{GS} = -1.8V, I_D = -3A$                      | -      | 28    | 42   |       |
|                                                |                                         | $V_{GS} = -1.5V, I_D = -1.2A$                    | -      | 39    | 78   |       |
| Gate input resistance                          | $R_G$                                   | $f = 1MHz, \text{open drain}$                    | -      | 20    | -    | Ω     |
| Forward Transfer Admittance                    | $ Y_{fs} ^{*4}$                         | $V_{DS} = -6V, I_D = -6A$                        | 7.5    | -     | -    | S     |

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

\*2 Mounted on a ceramic board (30×30×0.8mm)

\*3 Mounted on a FR4 (20×20×0.8mm)

\*4 Pulsed

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

| Parameter                    | Symbol            | Conditions                           | Values |      |      | Unit |
|------------------------------|-------------------|--------------------------------------|--------|------|------|------|
|                              |                   |                                      | Min.   | Typ. | Max. |      |
| Input capacitance            | $C_{iss}$         | $V_{GS} = 0V$                        | -      | 2800 | -    | pF   |
| Output capacitance           | $C_{oss}$         | $V_{DS} = -6V$                       | -      | 340  | -    |      |
| Reverse transfer capacitance | $C_{rss}$         | $f = 1\text{MHz}$                    | -      | 310  | -    |      |
| Turn - on delay time         | $t_{d(on)}^{*4}$  | $V_{DD} \approx -6V, V_{GS} = -4.5V$ | -      | 12   | -    | ns   |
| Rise time                    | $t_r^{*4}$        | $I_D = -3A$                          | -      | 105  | -    |      |
| Turn - off delay time        | $t_{d(off)}^{*4}$ | $R_L \approx 2\Omega$                | -      | 400  | -    |      |
| Fall time                    | $t_f^{*4}$        | $R_G = 10\Omega$                     | -      | 230  | -    |      |

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

| Parameter            | Symbol        | Conditions            | Values |      |      | Unit |
|----------------------|---------------|-----------------------|--------|------|------|------|
|                      |               |                       | Min.   | Typ. | Max. |      |
| Total gate charge    | $Q_g^{*4}$    | $V_{DD} \approx -6V,$ | -      | 34   | -    | nC   |
| Gate - Source charge | $Q_{gs}^{*4}$ | $I_D = -6A,$          | -      | 6.0  | -    |      |
| Gate - Drain charge  | $Q_{gd}^{*4}$ | $V_{GS} = -4.5V$      | -      | 5.0  | -    |      |

**●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 | $I_S$         | $T_a = 25^\circ\text{C}$ | -      | -    | -1   | A    |
| Body diode pulse current              | $I_{SP}^{*1}$ |                          | -      | -    | -24  | A    |
| Forward voltage                       | $V_{SD}^{*4}$ | $V_{GS} = 0V, I_S = -6A$ | -      | -    | -1.2 | V    |

## ●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

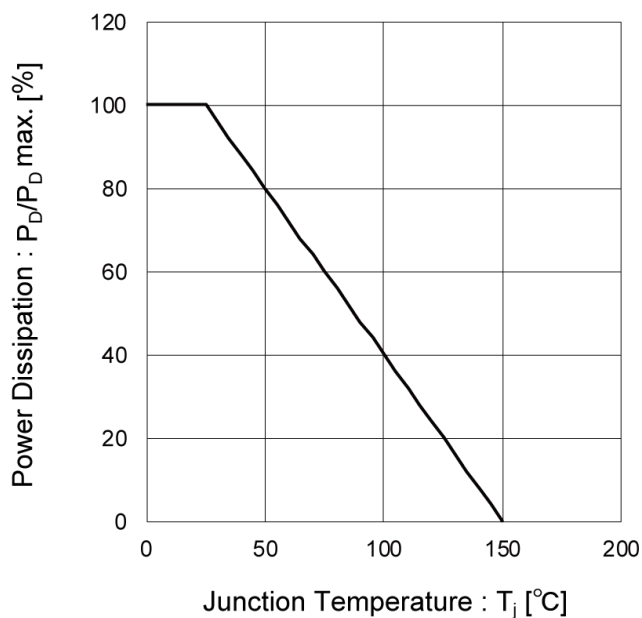


Fig.2 Maximum Safe Operating Area

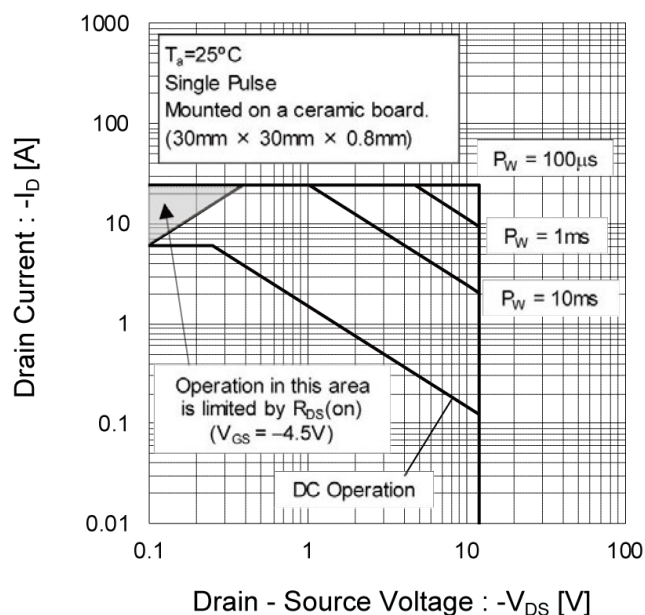


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

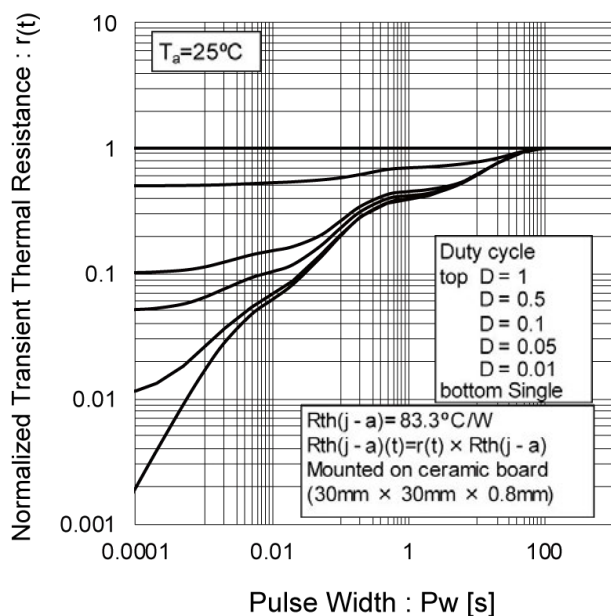
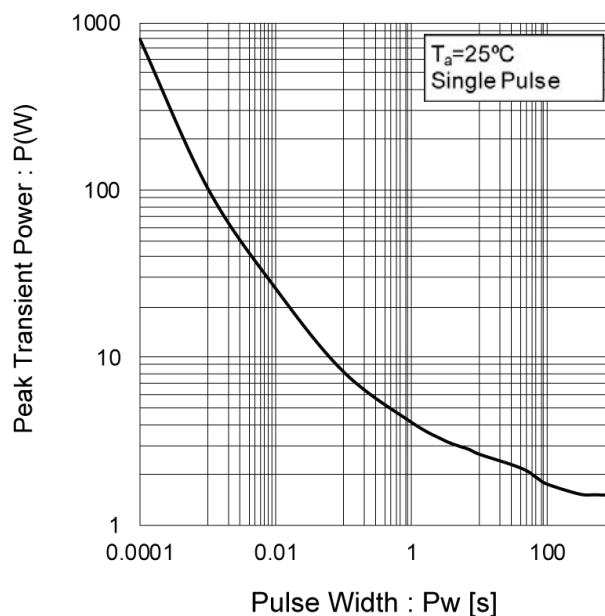


Fig.4 Single Pulse Maximum Power dissipation



# ●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

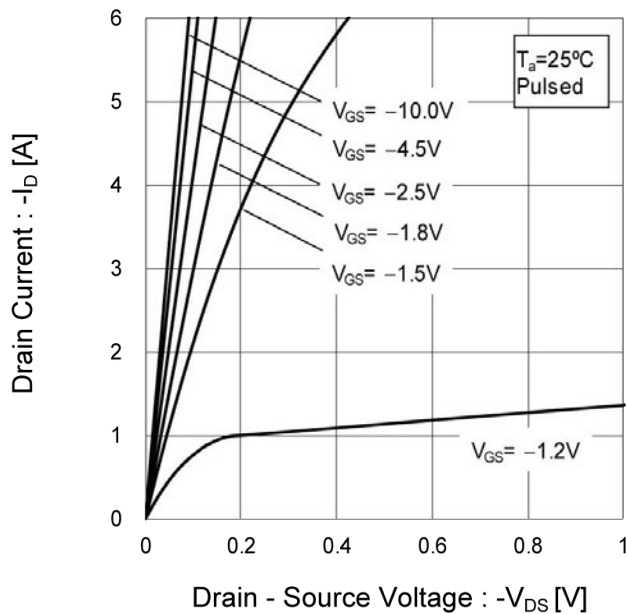


Fig.6 Typical Output Characteristics(II)

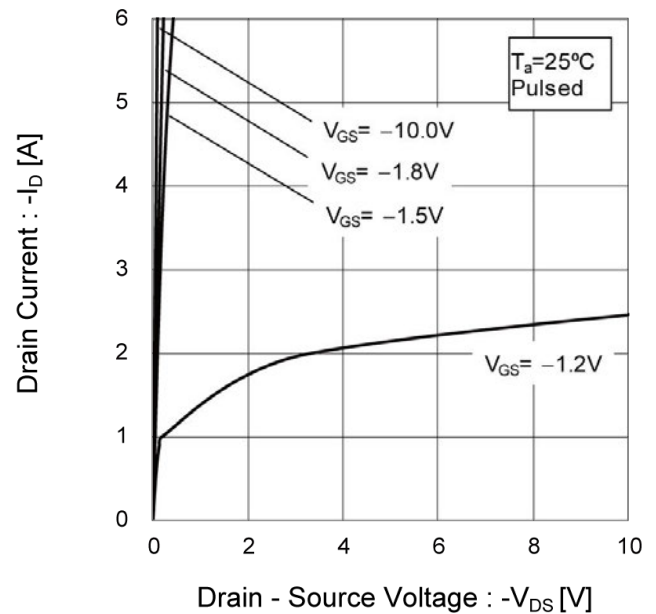


Fig.7 Breakdown Voltage vs. Junction Temperature

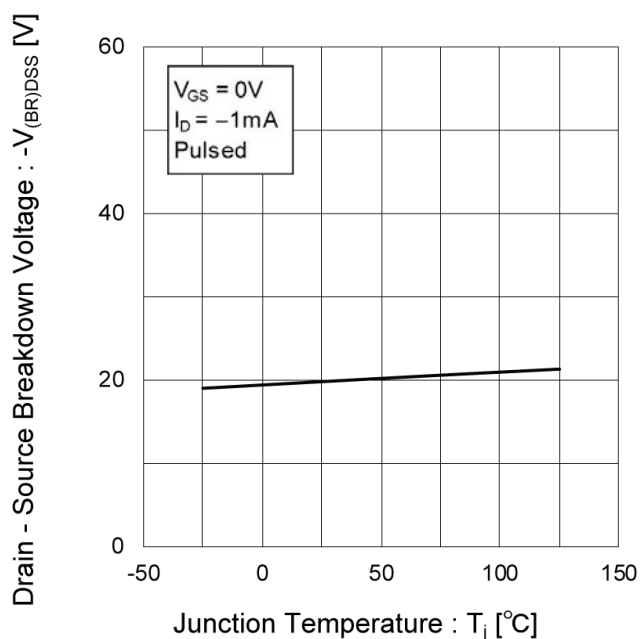
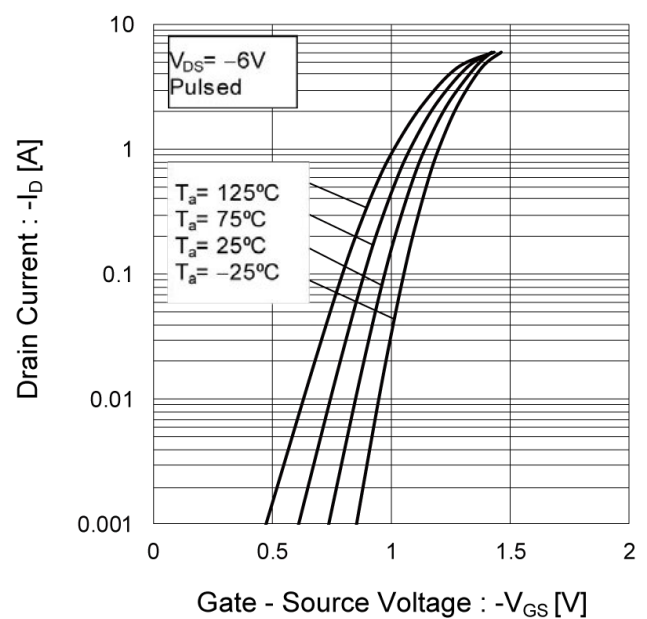


Fig.8 Typical Transfer Characteristics



## ●Electrical characteristic curves

Fig.9 Gate Threshold Voltage vs.  
Junction Temperature

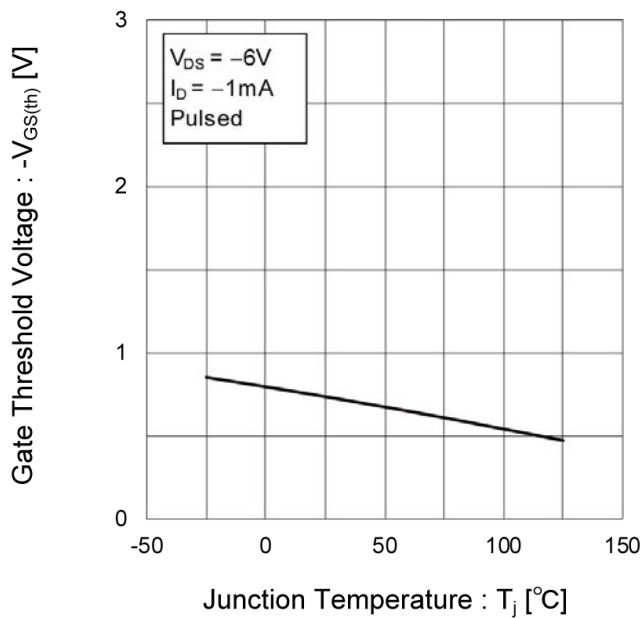


Fig.10 Forward Transfer Admittance vs.  
Drain Current

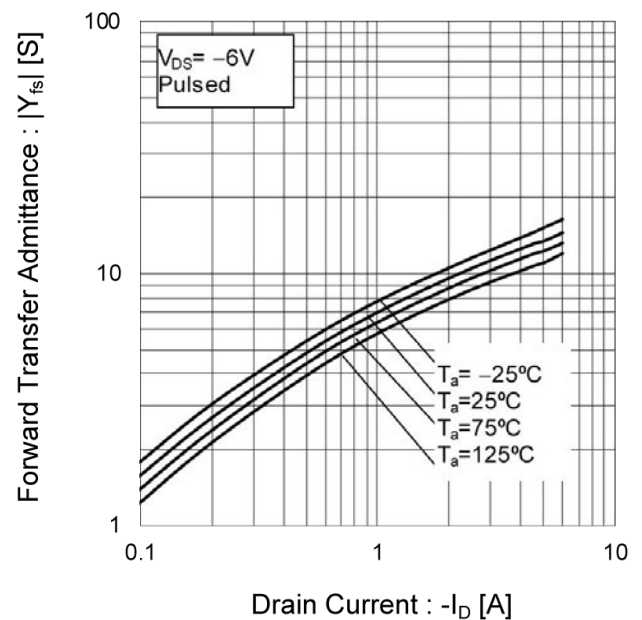


Fig.11 Drain Current Derating Curve

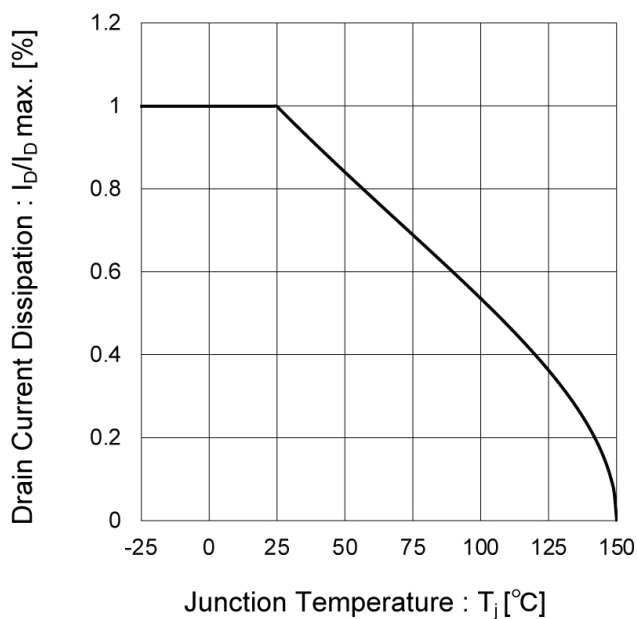
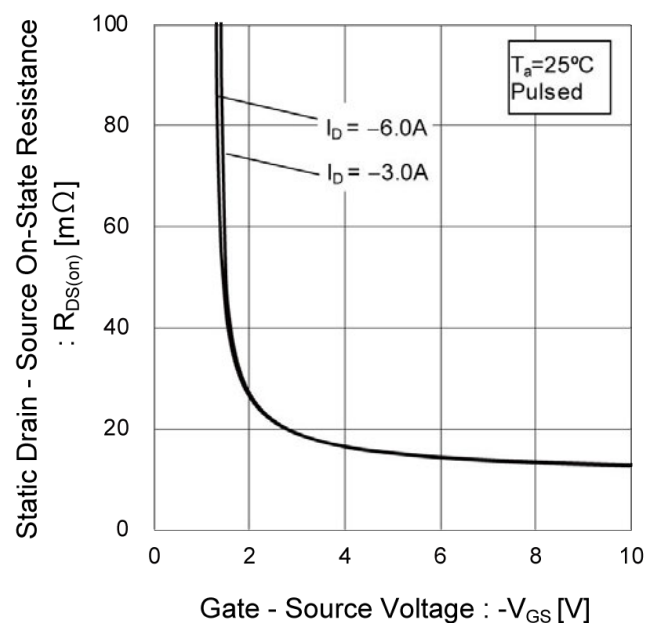


Fig.12 Static Drain - Source On - State  
Resistance vs. Gate Source Voltage



# ●Electrical characteristic curves

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

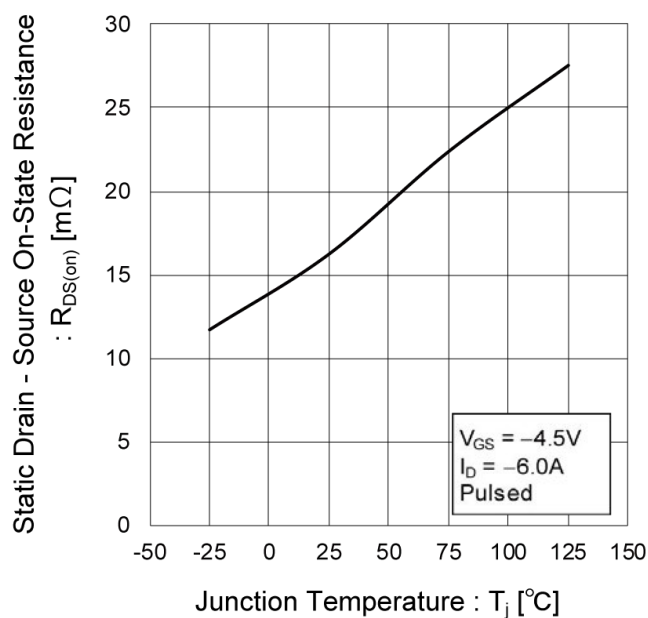
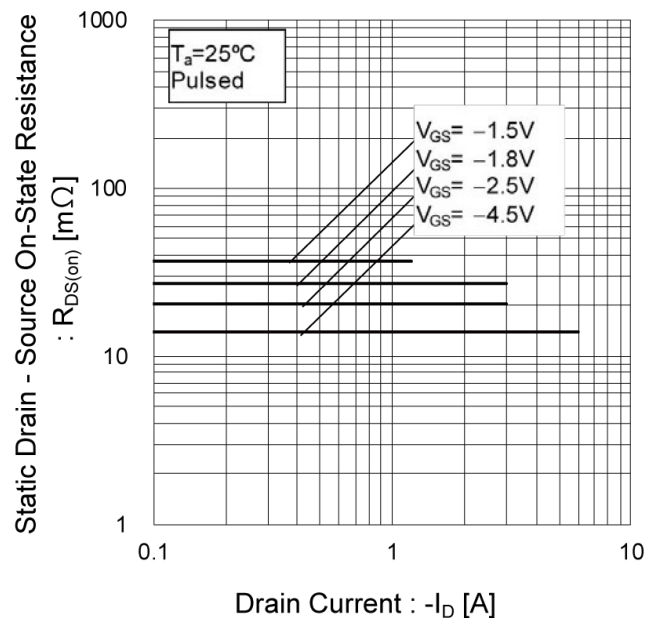


Fig.14 Static Drain - Source On - State Resistance vs. Drain Current (I)



# ●Electrical characteristic curves

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

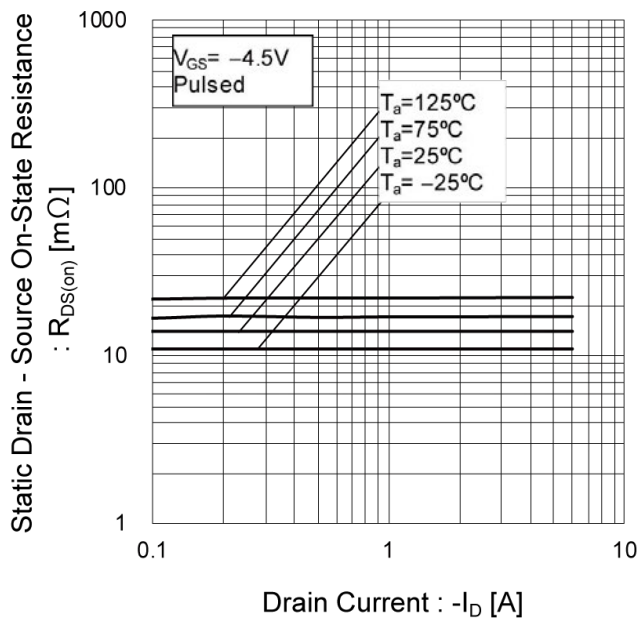


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current (III)

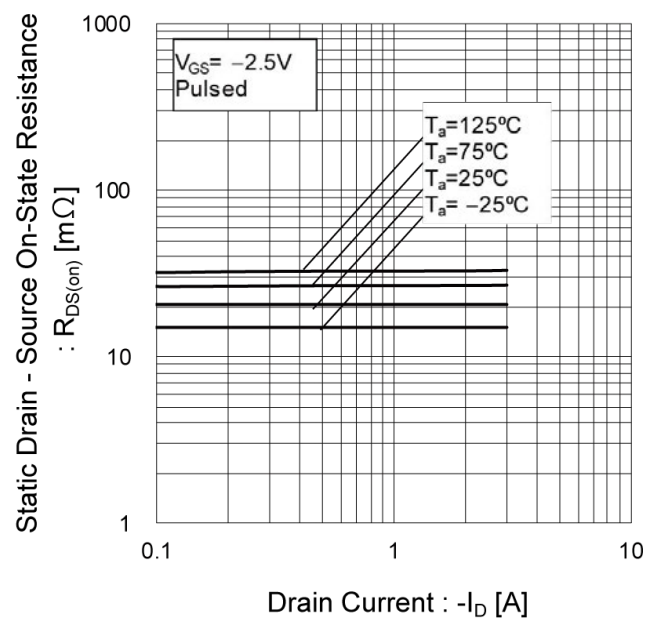


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current (IV)

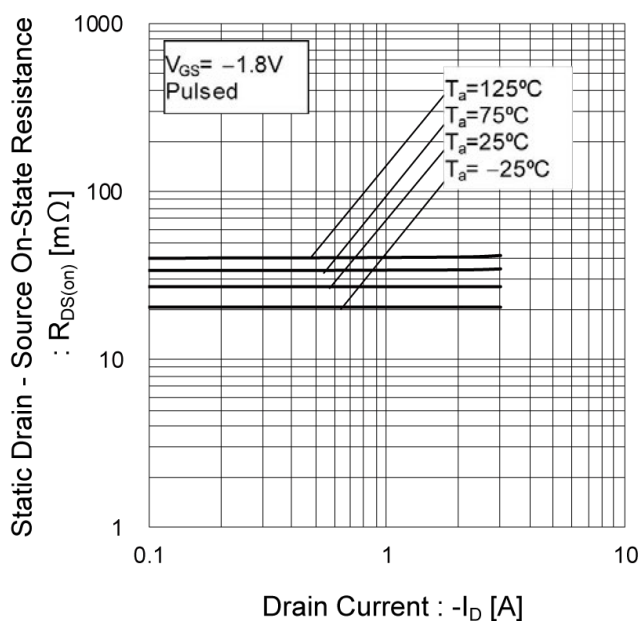
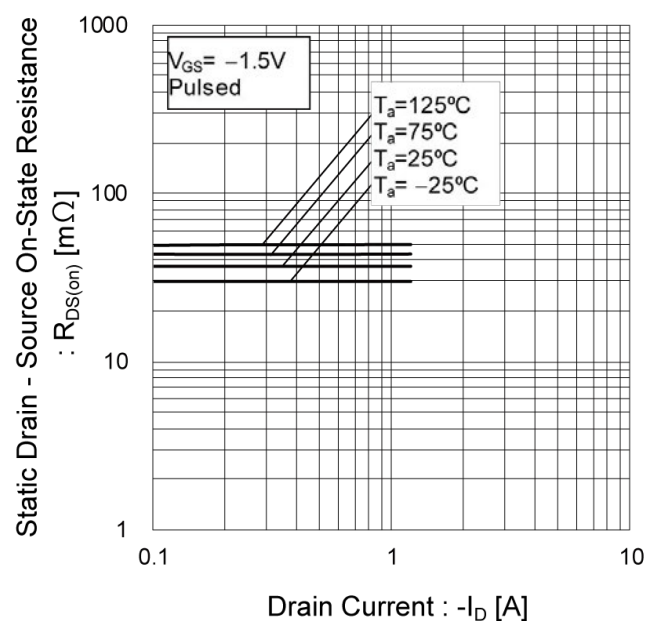


Fig.18 Static Drain - Source On - State Resistance vs. Drain Current (V)



## ●Electrical characteristic curves

Fig.19 Typical Capacitance vs.  
Drain - Source Voltage

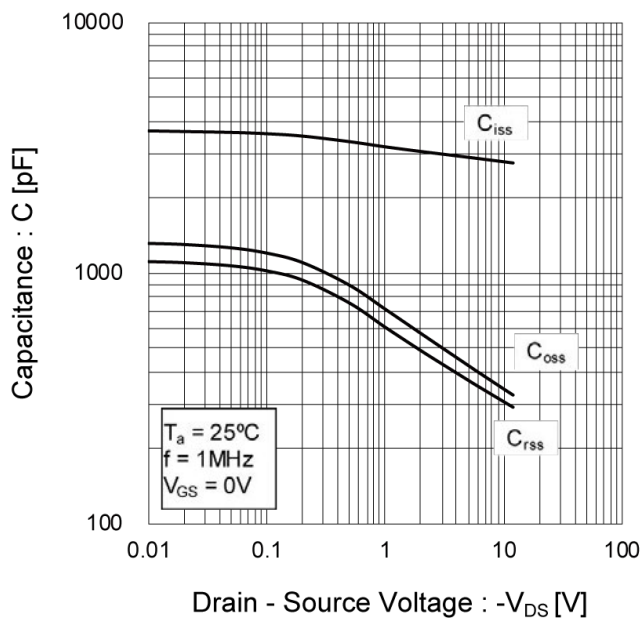


Fig.20 Switching Characteristics

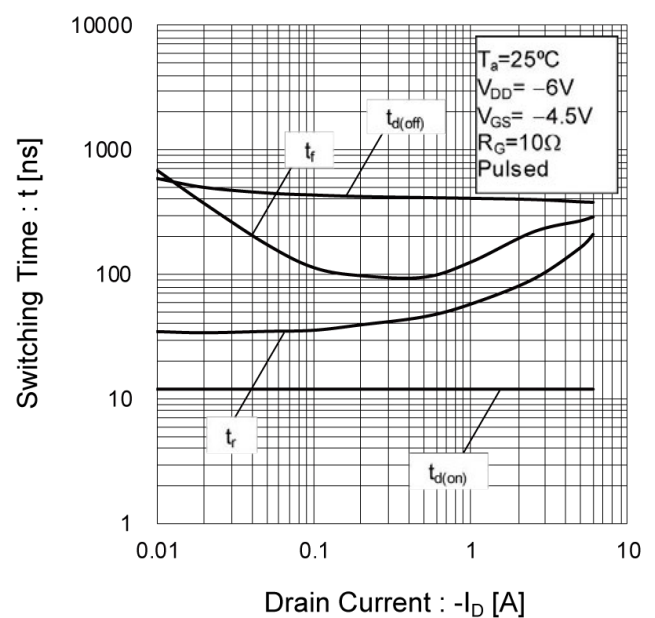


Fig.21 Dynamic Input Characteristics

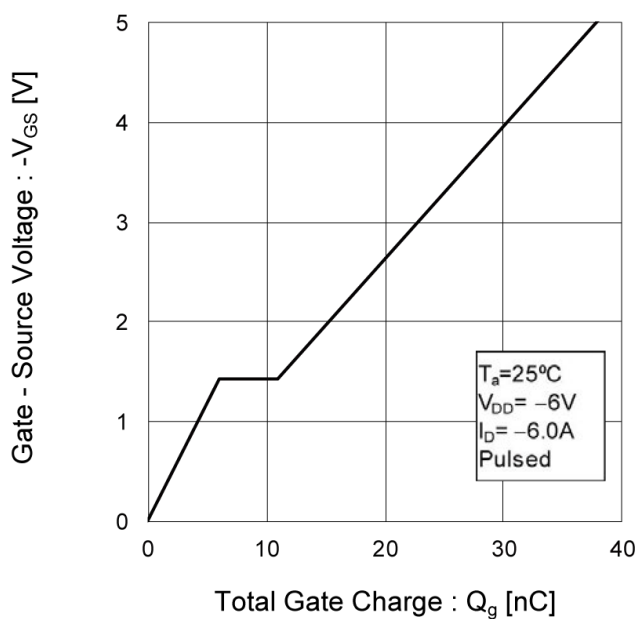
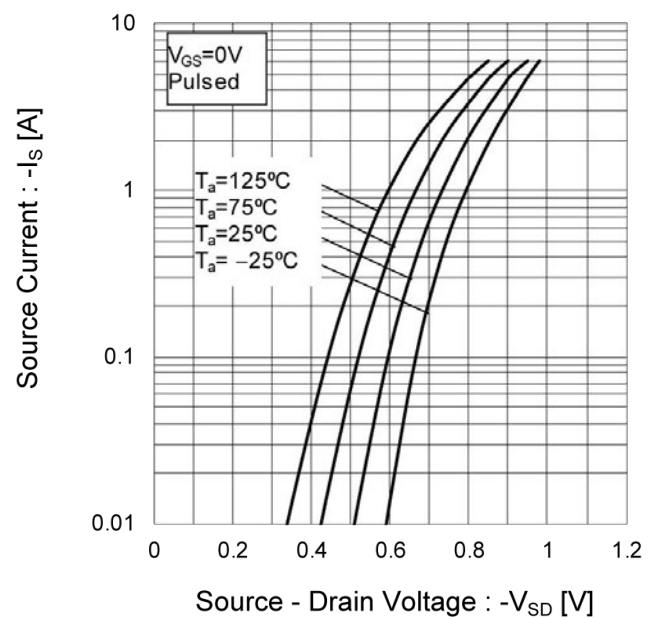


Fig.22 Source Current vs.  
Source Drain Voltage



## ● Measurement circuits

Fig. 1-1 SWITCHING TIME MEASUREMENT CIRCUIT

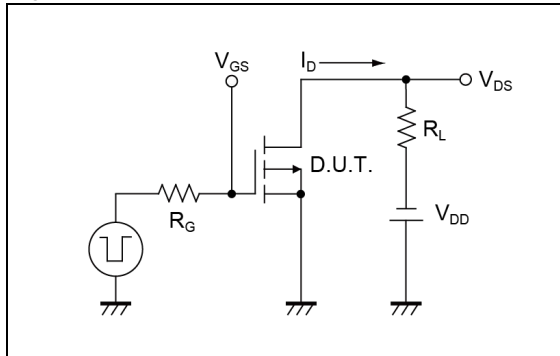


Fig. 1-2 SWITCHING WAVEFORMS

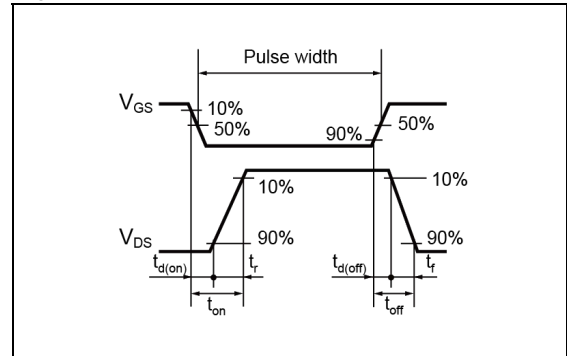


Fig. 2-1 GATE CHARGE MEASUREMENT CIRCUIT

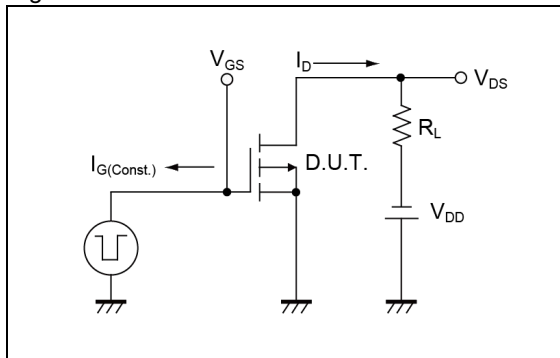
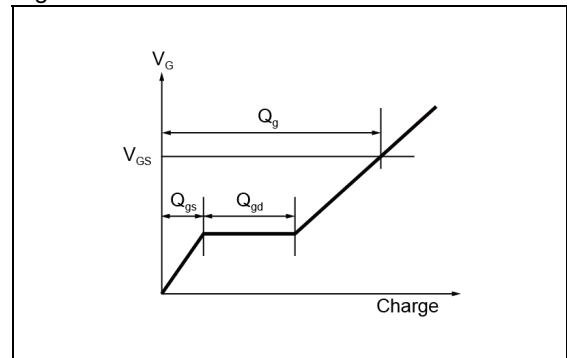


Fig. 2-2 GATE CHARGE WAVEFORM

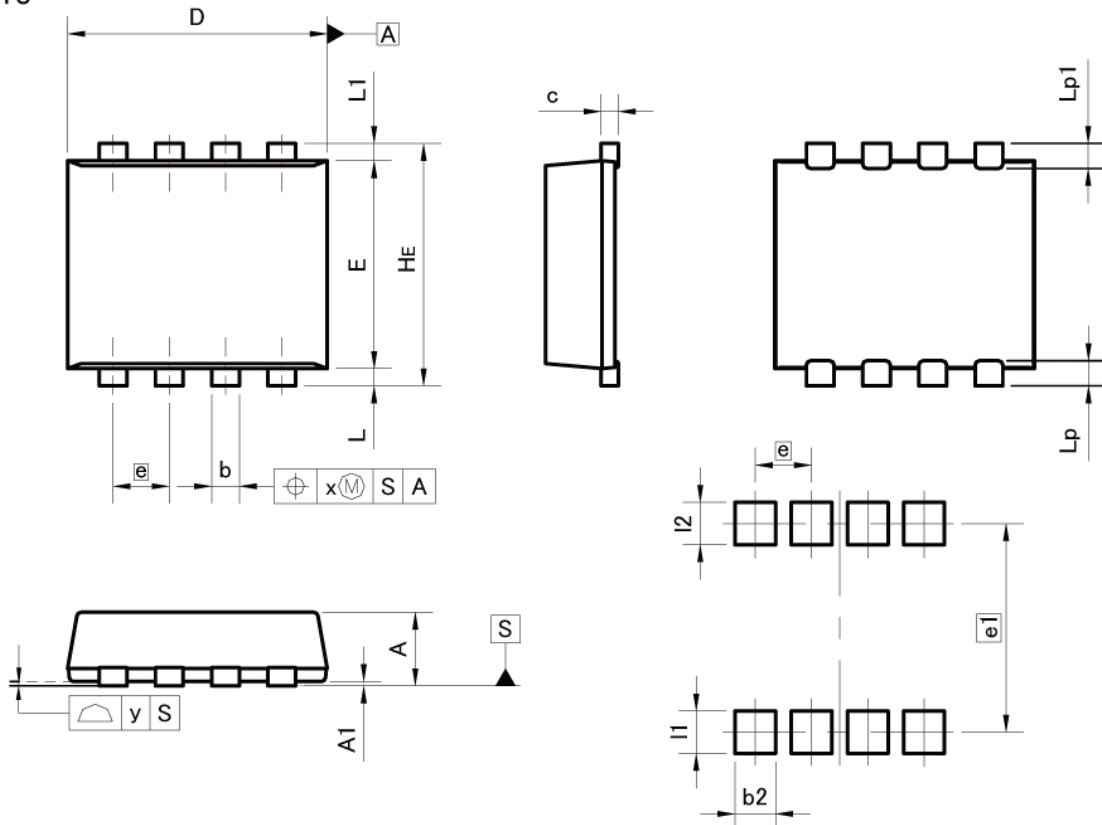


## ● Notice

This product might cause chip aging and breakdown under the large electrified environment.  
Please consider to design ESD protection circuit.

## ●Dimensions

TSMT8



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

| DIM | MILIMETERS |      | INCHES |       |
|-----|------------|------|--------|-------|
|     | MIN        | MAX  | MIN    | MAX   |
| A   | 0.75       | 0.85 | 0.030  | 0.033 |
| A1  | 0.00       | 0.05 | 0.000  | 0.002 |
| b   | 0.27       | 0.37 | 0.011  | 0.015 |
| c   | 0.12       | 0.22 | 0.005  | 0.009 |
| D   | 2.90       | 3.10 | 0.114  | 0.122 |
| E   | 2.30       | 2.50 | 0.091  | 0.098 |
| e   | 0.65       |      | 0.026  |       |
| HE  | 2.70       | 2.90 | 0.106  | 0.114 |
| L   | 0.10       | 0.30 | 0.004  | 0.012 |
| L1  | 0.10       | 0.30 | 0.004  | 0.012 |
| Lp  | 0.19       | 0.39 | 0.007  | 0.015 |
| Lp1 | 0.19       | 0.39 | 0.007  | 0.015 |
| x   | -          | 0.10 | -      | 0.004 |
| y   | -          | 0.10 | -      | 0.004 |

| DIM | MILIMETERS |      | INCHES |       |
|-----|------------|------|--------|-------|
|     | MIN        | MAX  | MIN    | MAX   |
| b2  | -          | 0.47 | -      | 0.019 |
| e1  | 2.41       |      | 0.095  |       |
| I1  | -          | 0.49 | -      | 0.019 |
| I2  | -          | 0.49 | -      | 0.019 |

Dimension in mm/inches

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