

| | |
|--------------------|------|
| V_{DSS} | 45V |
| $R_{DS(on)}(Max.)$ | 53mΩ |
| I_D | ±4A |
| P_D | 1.5W |

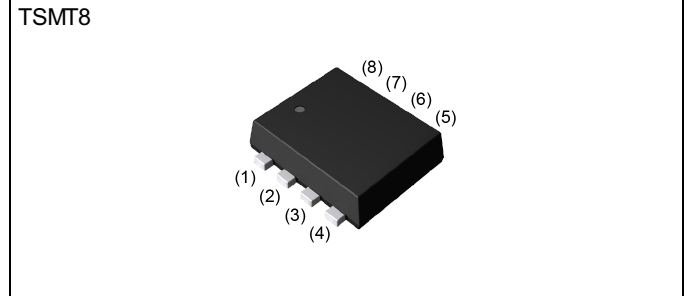
●Features

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

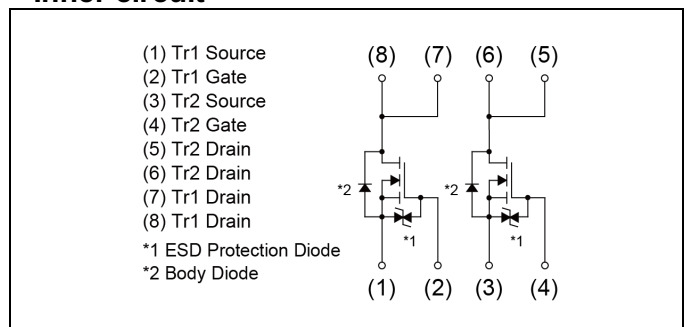
●Application

Switching

●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 | K21 |

●Absolute maximum ratings ($T_a = 25^\circ\text{C}$) <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 | ±4 | A |
| Pulsed drain current | $I_{D,pulse}^{*1}$ | ±12 | A |
| Gate - Source voltage | V_{GSS} | ±20 | V |
| Power dissipation | total | P_D^{*2} | 1.5 |
| | element | | 1.25 |
| | total | P_D^{*3} | 0.7 |
| Junction temperature | T_j | 150 | °C |
| Range of storage temperature | T_{stg} | -55 to +150 | °C |

● Thermal resistance

| Parameter | Symbol | Values | | | Unit | |
|--|---------|-----------------|------|------|------|------|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - ambient | total | R_{thJA}^{*2} | - | - | 83.3 | °C/W |
| | element | | - | - | 100 | |
| | total | R_{thJA}^{*3} | - | - | 178 | |

● Electrical characteristics ($T_a = 25^{\circ}C$) <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°C | - | 46.8 | - | mV/°C |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 45V, V_{GS} = 0V$ | - | - | 1 | μA |
| Gate - Source leakage current | I_{GSS} | $V_{DS} = 0V, V_{GS} = \pm 20V$ | - | - | ±10 | μA |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS} = 10V, I_D = 1mA$ | 1.0 | - | 2.5 | V |
| Gate threshold voltage temperature coefficient | $\frac{\Delta V_{GS(th)}}{\Delta T_j}$ | $I_D = 1mA$ referenced to 25°C | - | -3.9 | - | mV/°C |
| Static drain - source on - state resistance | $R_{DS(on)}^{*4}$ | $V_{GS} = 10V, I_D = 4A$ | - | 38 | 53 | mΩ |
| | | $V_{GS} = 4.5V, I_D = 4A$ | - | 48 | 67 | |
| | | $V_{GS} = 4V, I_D = 4A$ | - | 53 | 75 | |
| Gate input resistance | R_G | $f = 1MHz, \text{open drain}$ | - | 6 | - | Ω |
| Forward Transfer Admittance | $ Y_{fs} ^{*4}$ | $V_{DS} = 10V, I_D = 4A$ | 2 | - | - | S |

● **Electrical characteristics** ($T_a = 25^\circ\text{C}$) <It is the same characteristics for the Tr1 and Tr2>

| Parameter | Symbol | Conditions | Values | | | Unit |
|------------------------------|-------------------|------------------------------------|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Input capacitance | C_{iss} | $V_{GS} = 0V$ | - | 460 | - | pF |
| Output capacitance | C_{oss} | $V_{DS} = 10V$ | - | 110 | - | |
| Reverse transfer capacitance | C_{rss} | $f = 1\text{MHz}$ | - | 55 | - | |
| Turn - on delay time | $t_{d(on)}^{*4}$ | $V_{DD} \approx 25V, V_{GS} = 10V$ | - | 9 | - | ns |
| Rise time | t_r^{*4} | $I_D = 2A$ | - | 25 | - | |
| Turn - off delay time | $t_{d(off)}^{*4}$ | $R_L = 12.5\Omega$ | - | 30 | - | |
| Fall time | t_f^{*4} | $R_G = 10\Omega$ | - | 7 | - | |

● **Gate charge characteristics** ($T_a = 25^\circ\text{C}$) <It is the same characteristics for the Tr1 and Tr2>

| Parameter | Symbol | Conditions | Values | | | Unit | |
|----------------------|---------------|------------------------------------|----------------|------|------|------|----|
| | | | Min. | Typ. | Max. | | |
| Total gate charge | Q_g^{*4} | $V_{DD} \approx 25V$ $I_D = 4A$ | $V_{GS} = 10V$ | - | 10 | - | nC |
| Gate - Source charge | Q_{gs}^{*4} | | $V_{GS} = 5V$ | - | 5.4 | - | |
| Gate - Drain charge | Q_{gd}^{*4} | | | - | 1.6 | - | |

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

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

| 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} | | - | - | 12 | |
| Forward voltage | V_{SD}^{*4} | $V_{GS} = 0V, I_S = 4A$ | - | - | 1.2 | V |

*1 $P_w \leq 10\mu\text{s}$, 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 characteristic curves

Fig.1 Power Dissipation Derating Curve



Fig.2 Maximum Safe Operating Area

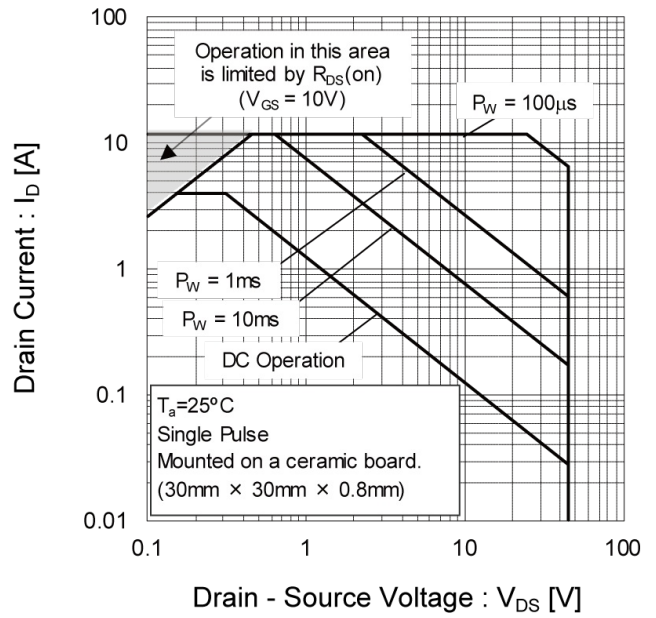


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

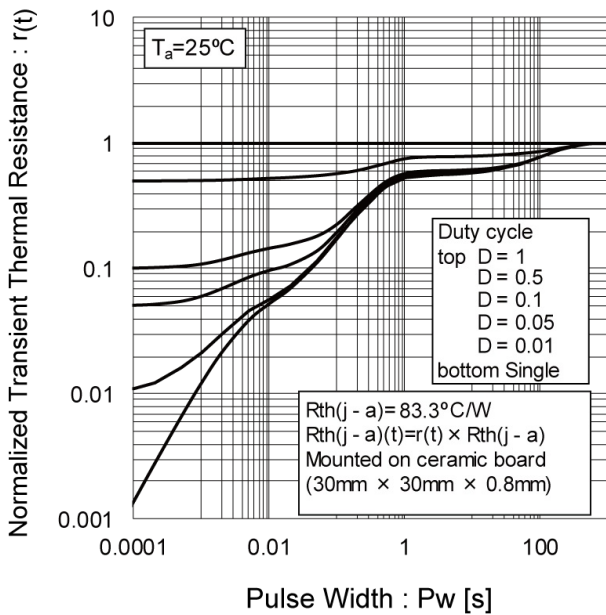
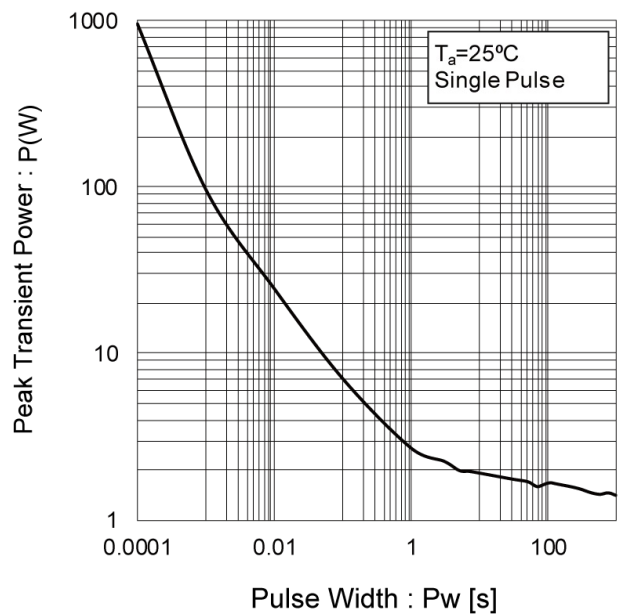


Fig.4 Single Pulse Maximum Power dissipation



● Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

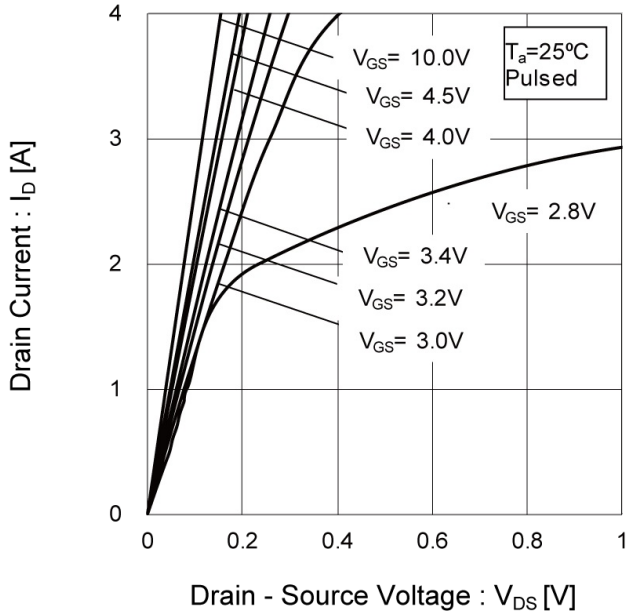


Fig.6 Typical Output Characteristics(II)

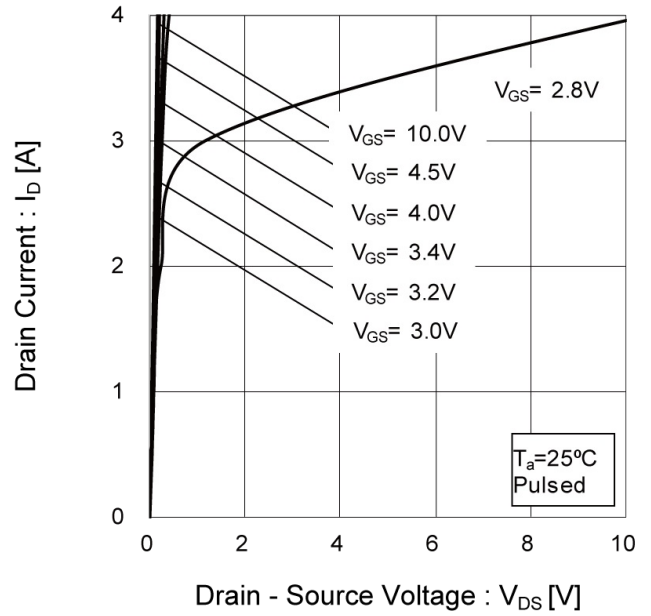


Fig.7 Breakdown Voltage vs. Junction Temperature

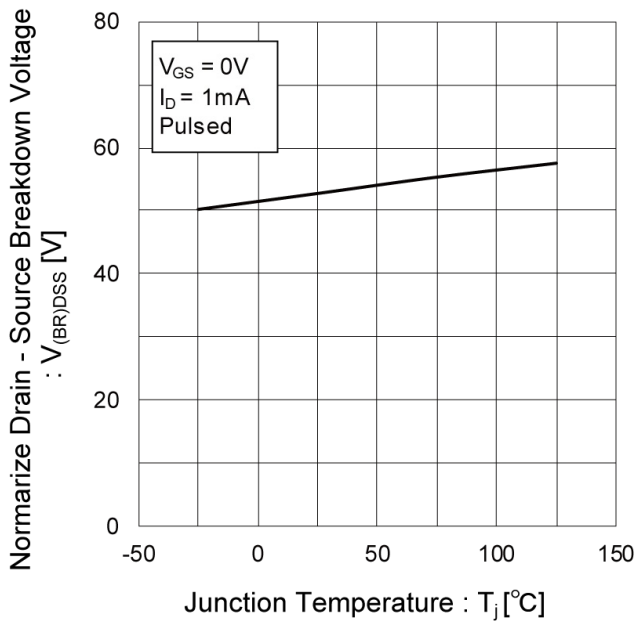
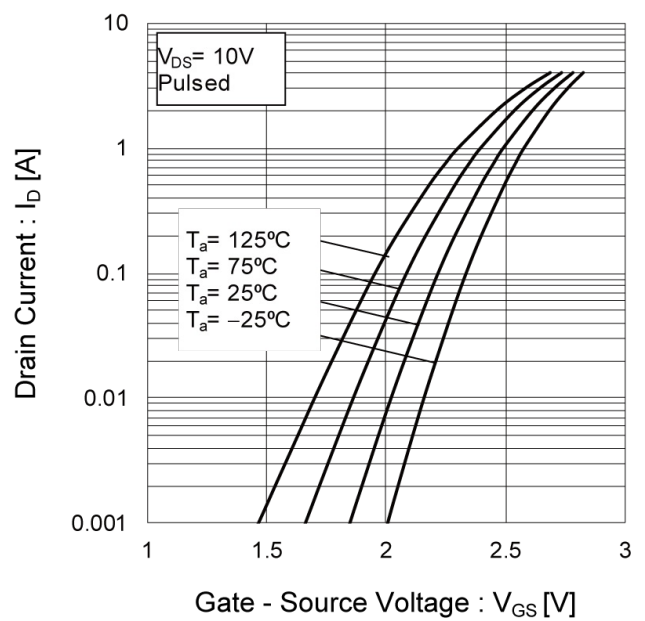


Fig.8 Typical Transfer Characteristics



● Electrical characteristic curves

Fig.9 Gate Threshold Voltage vs. Junction Temperature

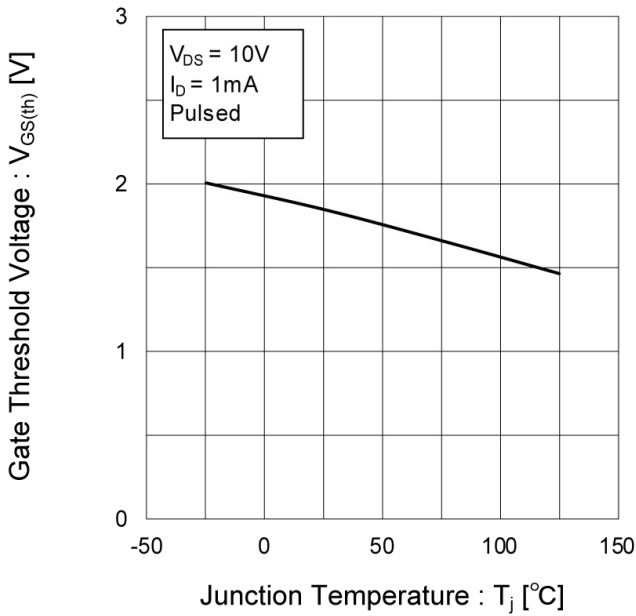


Fig.10 Forward Transfer Admittance vs. Drain Current

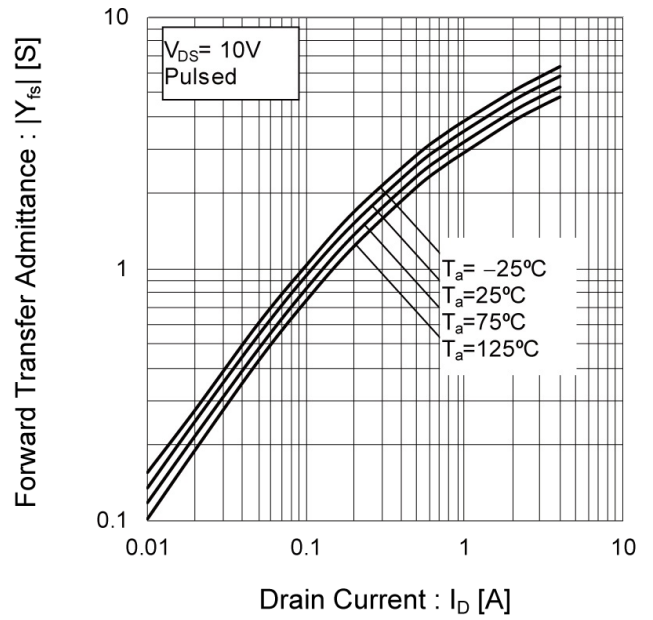


Fig.11 Drain Current Derating Curve

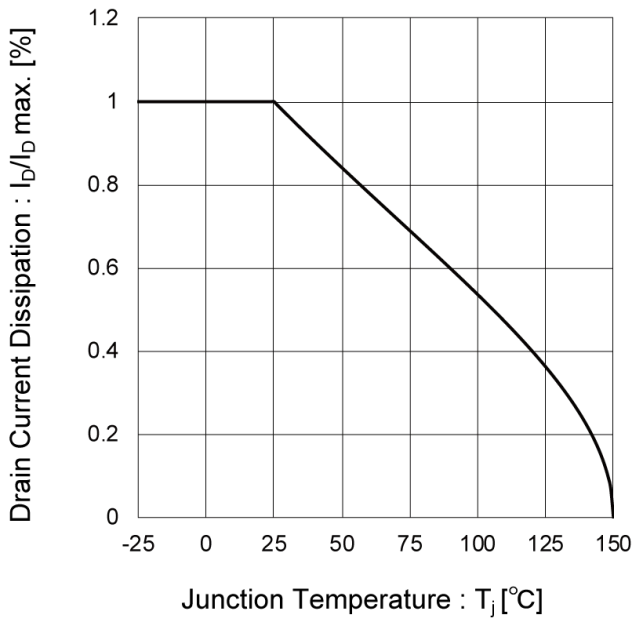
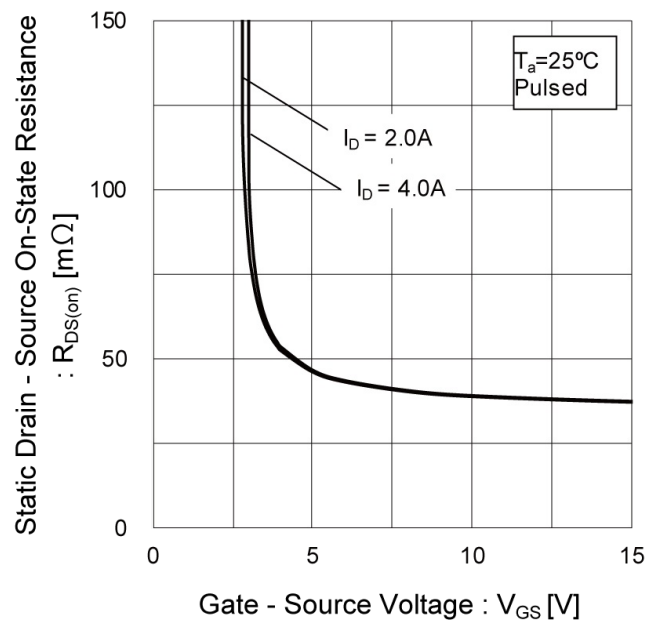


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage



● Electrical characteristic curves

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

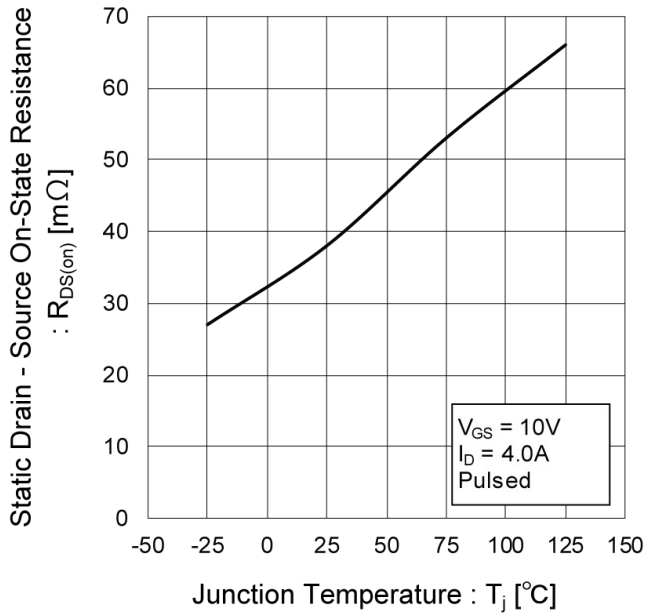
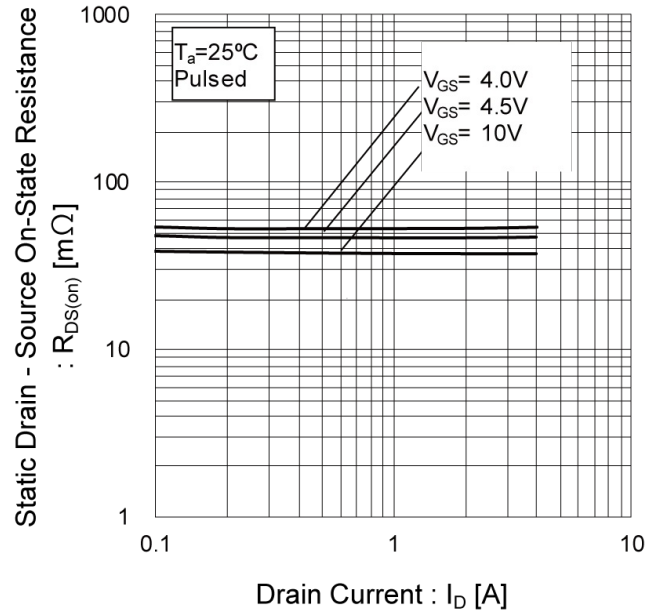


Fig.14 Static Drain - Source On - State Resistance vs. Drain Current (I)



● Electrical characteristic curves

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

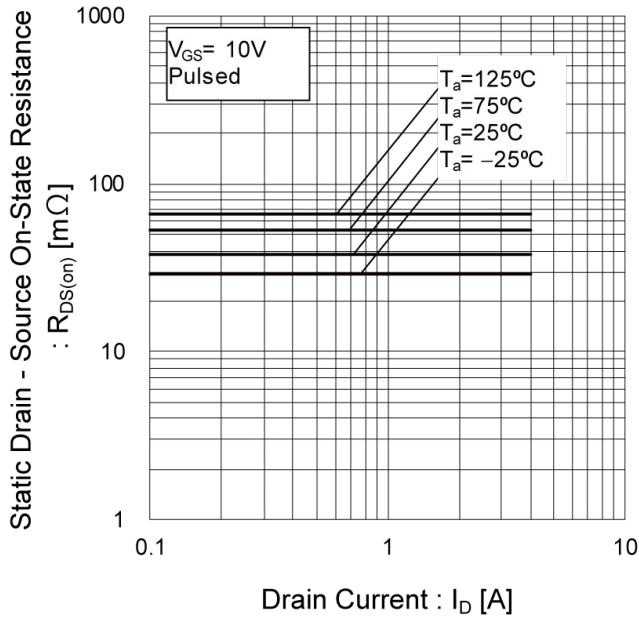


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current (III)

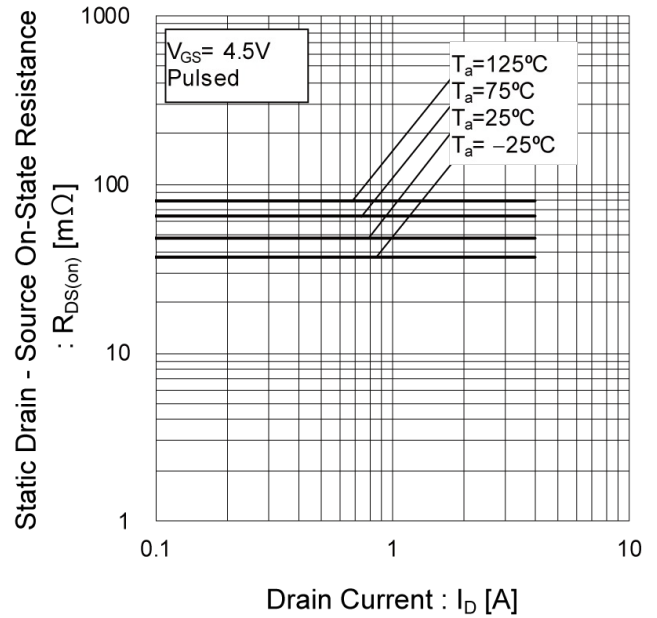
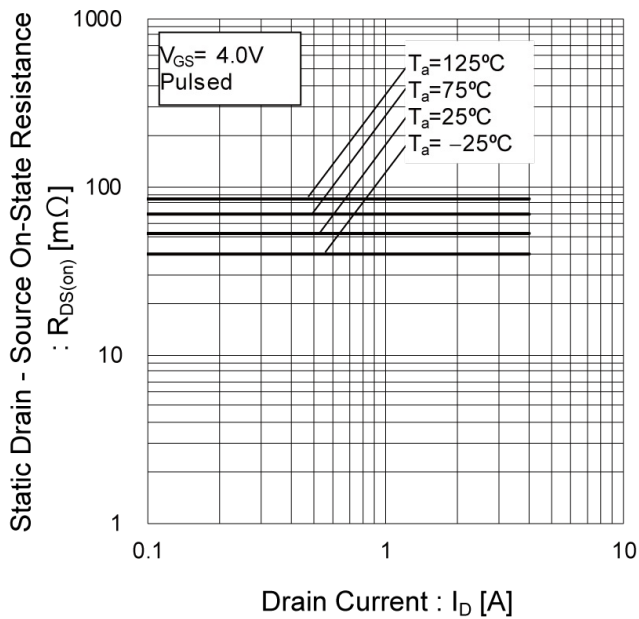


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current (IV)



● Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

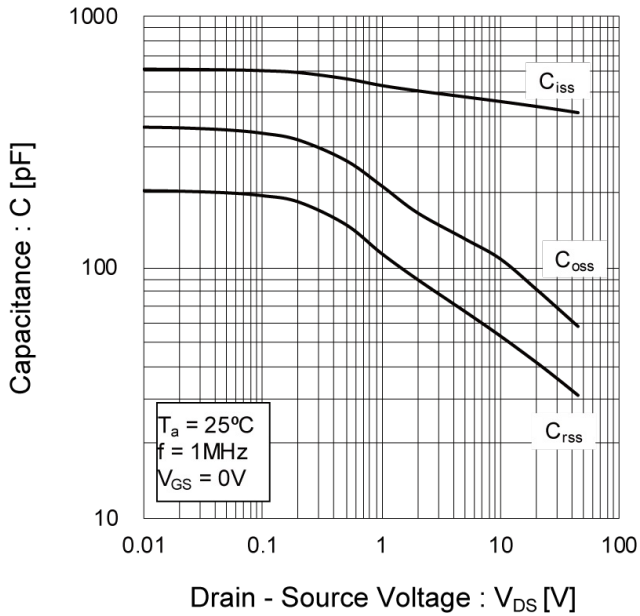


Fig.19 Switching Characteristics

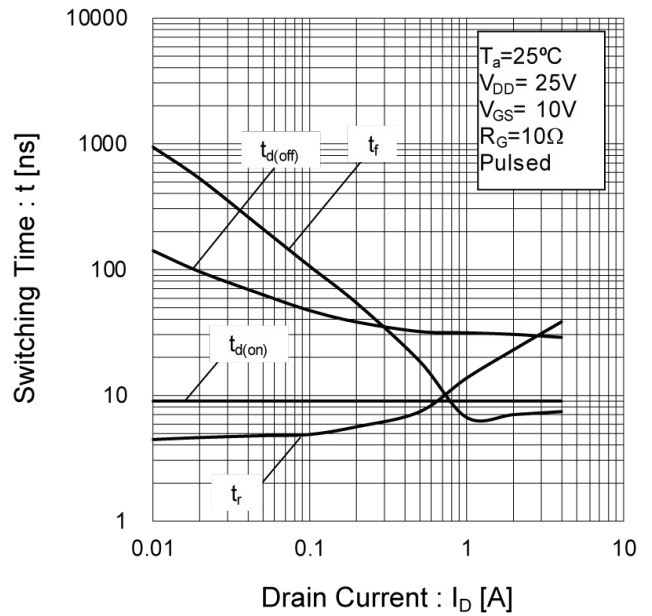


Fig.20 Dynamic Input Characteristics

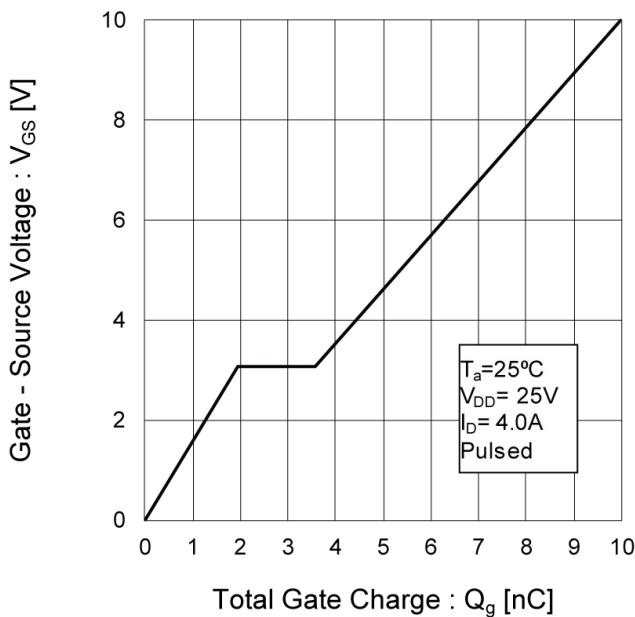
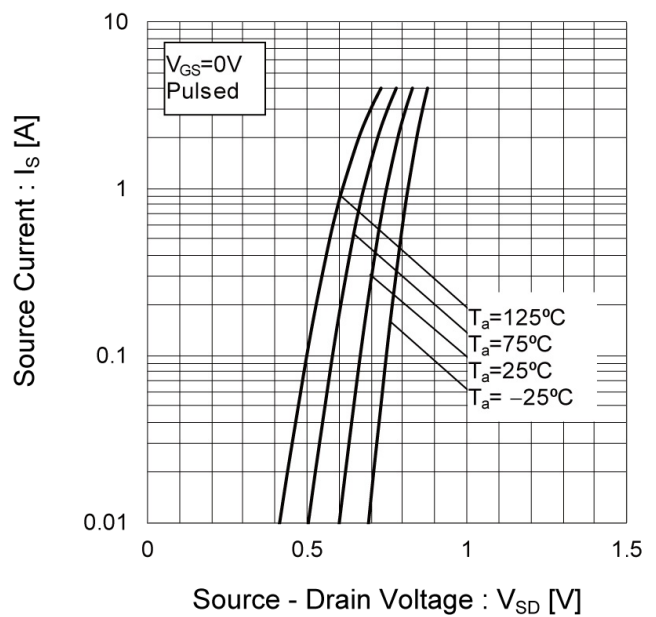


Fig.21 Source Current vs. Source Drain Voltage



● Measurement circuits <It is the same for the Tr1 and Tr2>

Fig. 1-1 SWITCHING TIME MEASUREMENT CIRCUIT

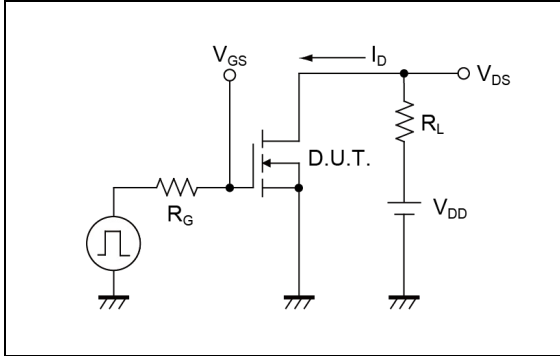


Fig. 1-2 SWITCHING WAVEFORMS

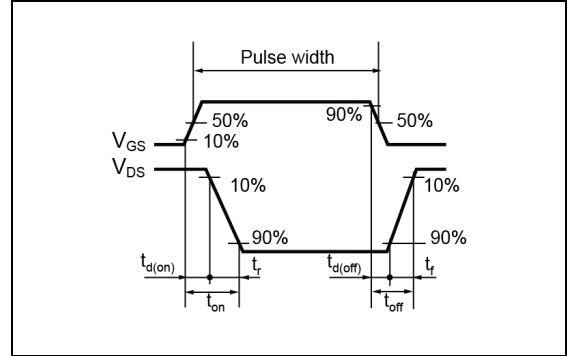


Fig. 2-1 GATE CHARGE MEASUREMENT CIRCUIT

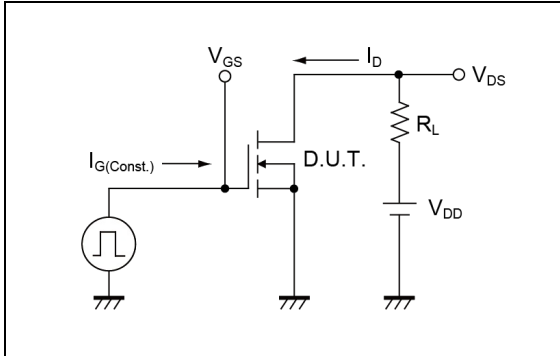
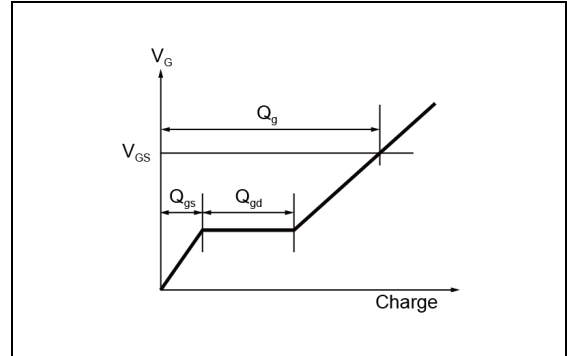
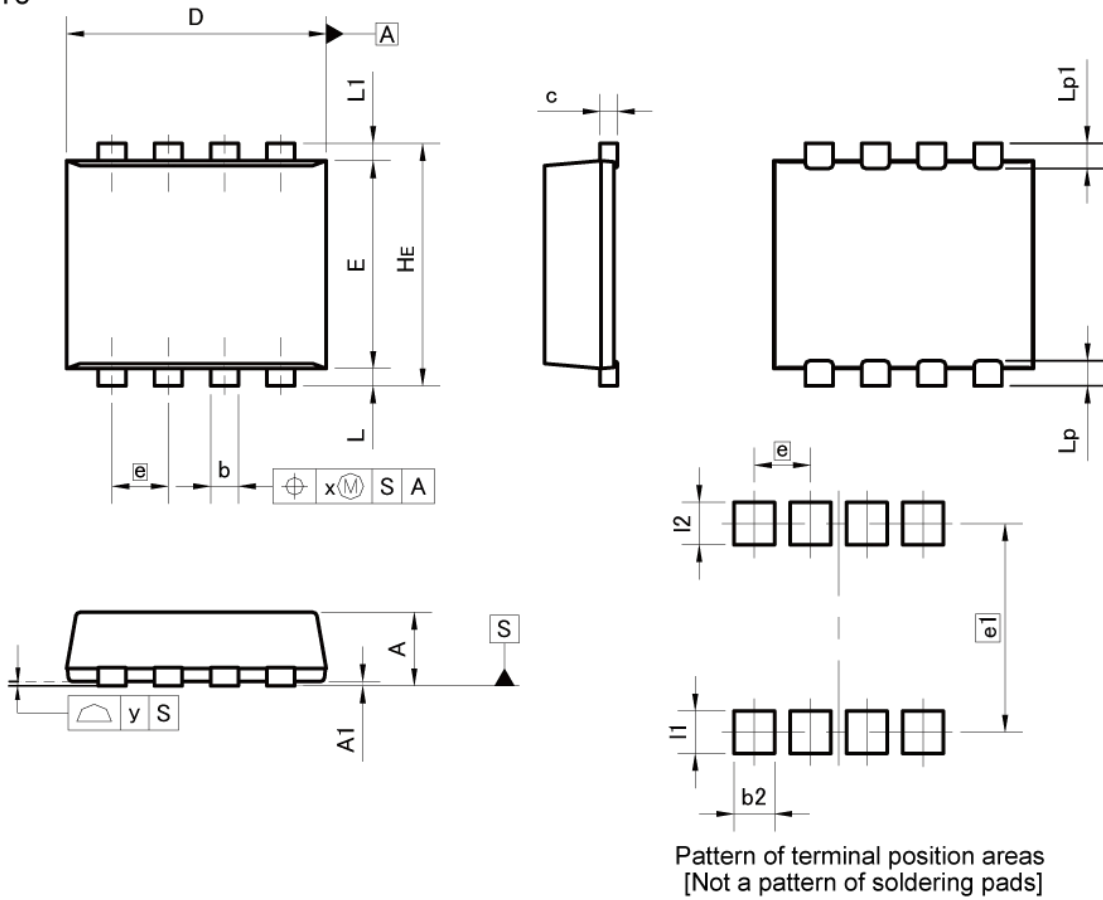


Fig. 2-2 GATE CHARGE WAVEFORM



●Dimensions

TSMT8



| 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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