

| | |
|---------------------|-------|
| V_{DSS} | 60V |
| $R_{DS(on)}$ (Max.) | 170mΩ |
| I_D | 2A |
| P_D | 1.0W |

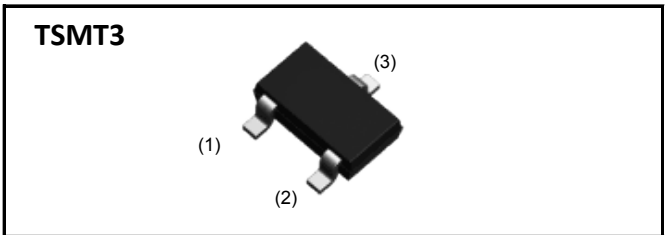
●Features

- 1) Low on - resistance.
- 2) Built-in G-S Protection Diode.
- 3) Small Surface Mount Package (TSMT3).
- 4) Pb-free lead plating ; RoHS compliant

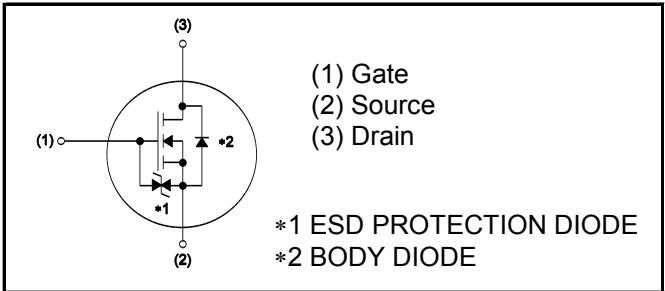
●Application

DC/DC converters

●Outline



●Inner circuit



●Packaging specifications

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

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

| Parameter | Symbol | Value | Unit |
|------------------------------|--------------------|-------------|------|
| Drain - Source voltage | V_{DSS} | 60 | V |
| Continuous drain current | I_D^{*1} | ±2 | A |
| Pulsed drain current | $I_{D,pulse}^{*2}$ | ±8 | A |
| Gate - Source voltage | V_{GSS} | ±20 | V |
| Power dissipation | P_D^{*3} | 1.0 | W |
| | P_D^{*4} | 0.54 | W |
| 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 | R_{thJA}^{*3} | - | - | 125 | °C/W |
| Thermal resistance, junction - ambient | R_{thJA}^{*4} | - | - | 231 | °C/W |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|--|---|---|--------|------|----------|---------------|
| | | | Min. | Typ. | Max. | |
| Drain - Source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS} = 0V, I_D = 1mA$ | 60 | - | - | V |
| Breakdown voltage temperature coefficient | $\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$ | $I_D = 1mA$ referenced to 25°C | - | 67 | - | mV/°C |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 60V, V_{GS} = 0V$ | - | - | 1 | μA |
| Gate - Source leakage current | I_{GSS} | $V_{GS} = \pm 20V, V_{DS} = 0V$ | - | - | ± 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 | - | -4.4 | - | mV/°C |
| Static drain - source on - state resistance | $R_{DS(on)}^{*5}$ | $V_{GS}=10V, I_D=2A$ | - | 120 | 170 | m Ω |
| | | $V_{GS}=4.5V, I_D=2A$ | - | 140 | 195 | |
| | | $V_{GS}=4.0V, I_D=2A$ | - | 150 | 210 | |
| | | $V_{GS}=10V, I_D=2A, T_j=125^\circ\text{C}$ | - | 220 | 310 | |
| Gate input resistance | R_G | $f = 1\text{MHz}, \text{open drain}$ | - | 3.0 | - | Ω |
| Transconductance | g_{fs}^{*5} | $V_{DS} = 10V, I_D = 2A$ | 1.3 | 3.0 | - | S |

*1 Limited only by maximum temperature allowed.

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

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

*4 Mounted on a FR4 (12×20×0.8mm)

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|------------------------------|-------------------|--|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{V}$ | - | 180 | - | pF |
| Output capacitance | C_{oss} | $V_{DS} = 10\text{V}$ | - | 50 | - | |
| Reverse transfer capacitance | C_{rss} | $f = 1\text{MHz}$ | - | 22 | - | |
| Turn - on delay time | $t_{d(on)}^{*5}$ | $V_{DD} \approx 30\text{V}, V_{GS} = 10\text{V}$ | - | 6 | - | ns |
| Rise time | t_r^{*5} | $I_D = 1.0\text{A}$ | - | 10 | - | |
| Turn - off delay time | $t_{d(off)}^{*5}$ | $R_L = 30\Omega$ | - | 20 | - | |
| Fall time | t_f^{*5} | $R_G = 10\Omega$ | - | 6 | - | |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|----------------------|---------------|---|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Total gate charge | Q_g^{*5} | $V_{DD} \approx 30\text{V}, I_D = 2\text{A}$ $V_{GS} = 5\text{V}$ | - | 2.7 | - | nC |
| | | $V_{DD} \approx 30\text{V}, I_D = 2\text{A}$ $V_{GS} = 10\text{V}$ | - | 4.9 | - | |
| Gate - Source charge | Q_{gs}^{*5} | $V_{DD} \approx 30\text{V}, I_D = 2\text{A}$ | - | 1.0 | - | |
| Gate - Drain charge | Q_{gd}^{*5} | $V_{GS} = 5\text{V}$ | - | 0.6 | - | |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---------------|---------------------------------------|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Inverse diode continuous, forward current | I_S^{*1} | $T_a = 25^\circ\text{C}$ | - | - | 0.8 | A |
| Forward voltage | V_{SD}^{*5} | $V_{GS} = 0\text{V}, I_S = 2\text{A}$ | - | - | 1.2 | V |

*5 Pulsed

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

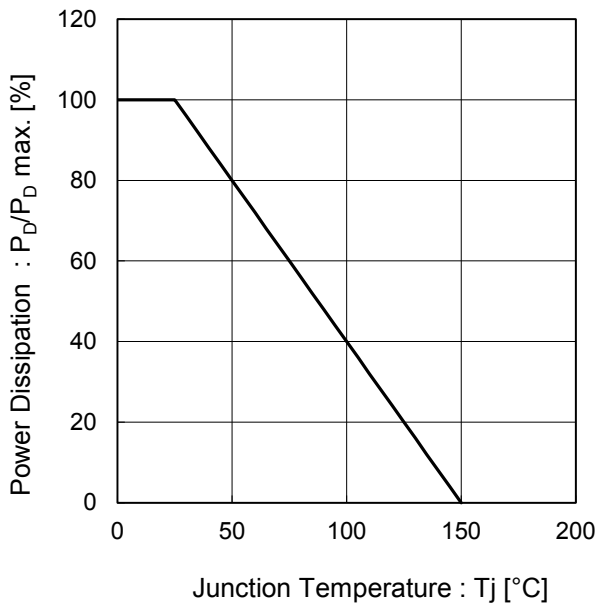


Fig.2 Maximum Safe Operating Area

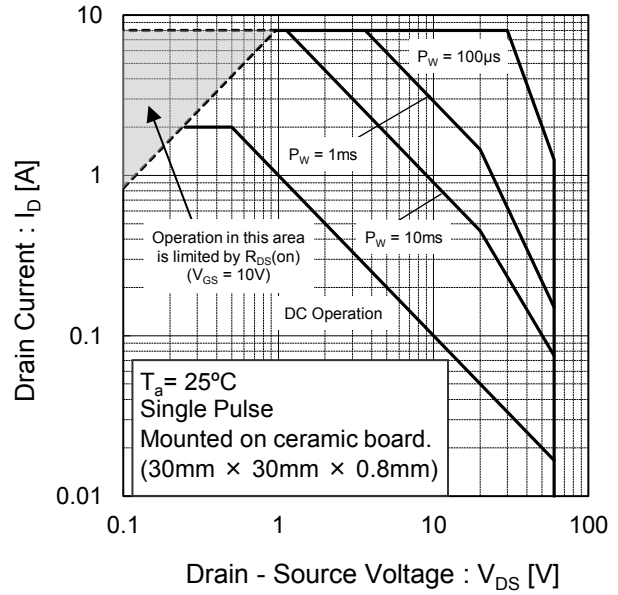


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

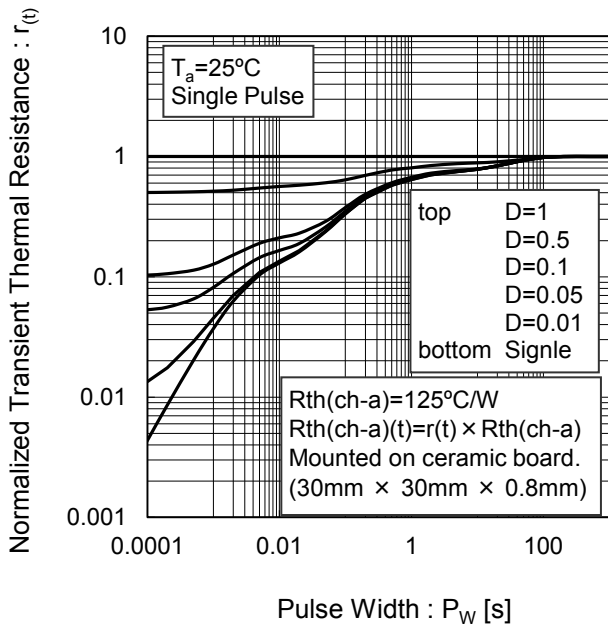
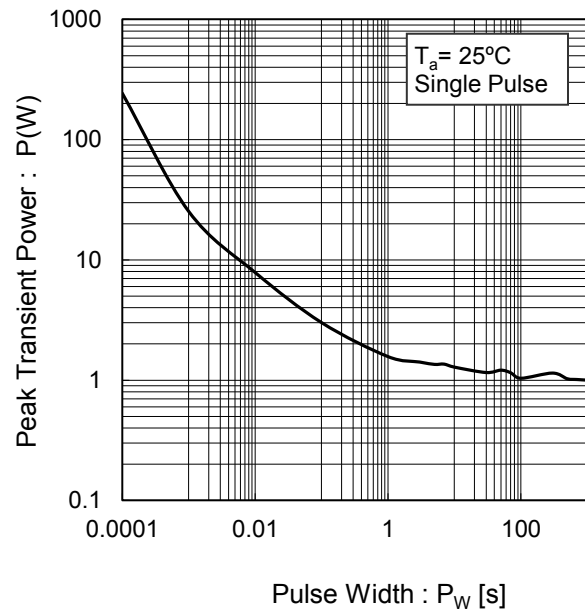


Fig.4 Single Pulse Maximum Power dissipation



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

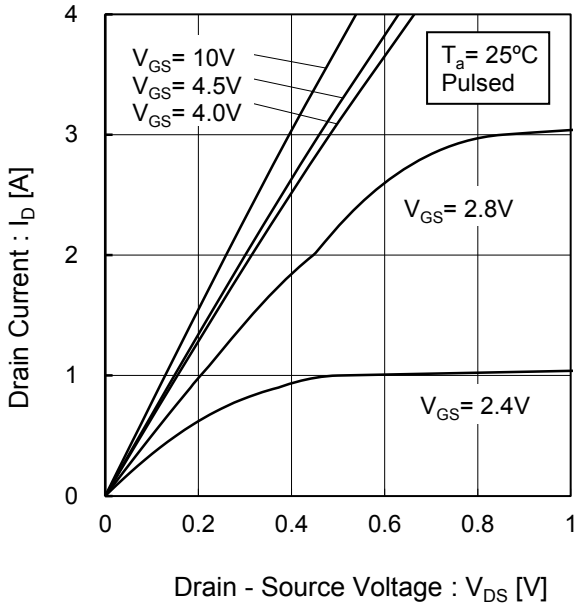
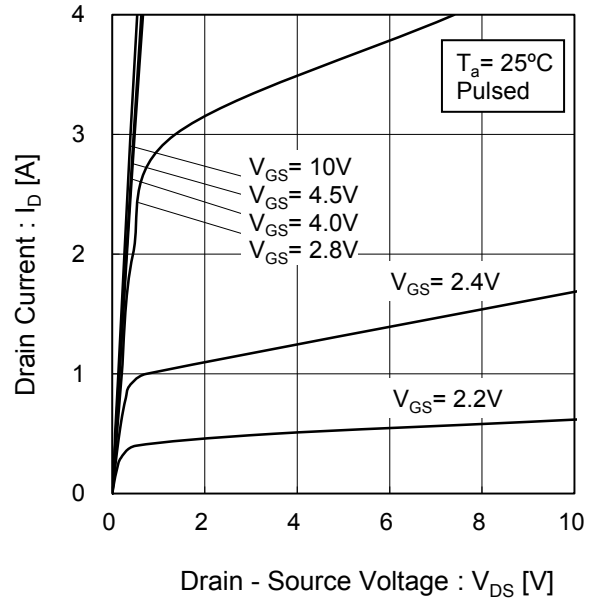


Fig.6 Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.7 Breakdown Voltage vs. Junction Temperature

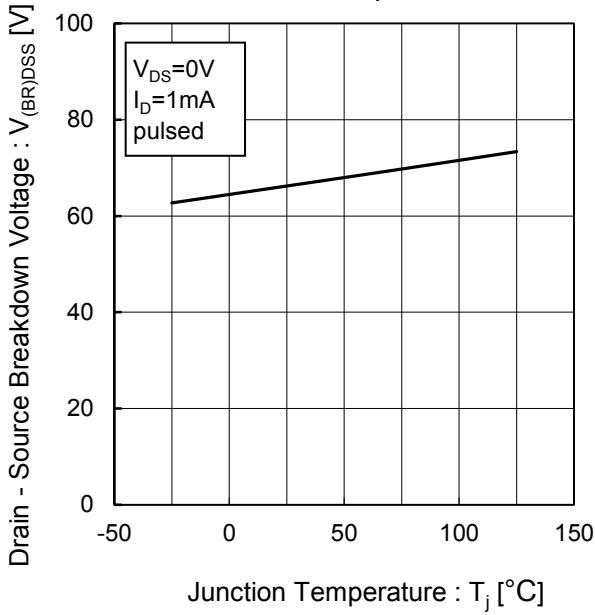


Fig.8 Typical Transfer Characteristics

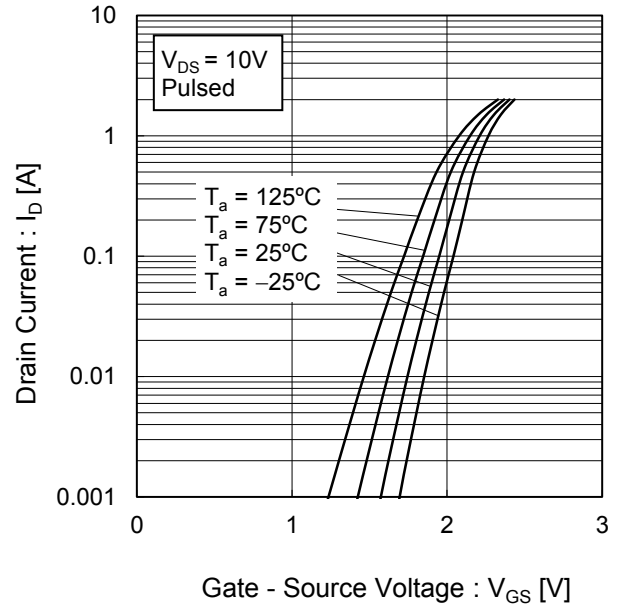


Fig.9 Gate Threshold Voltage vs. Junction Temperature

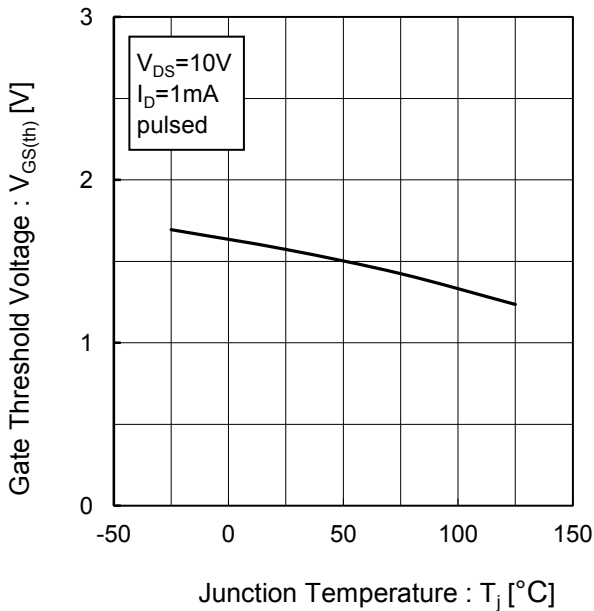
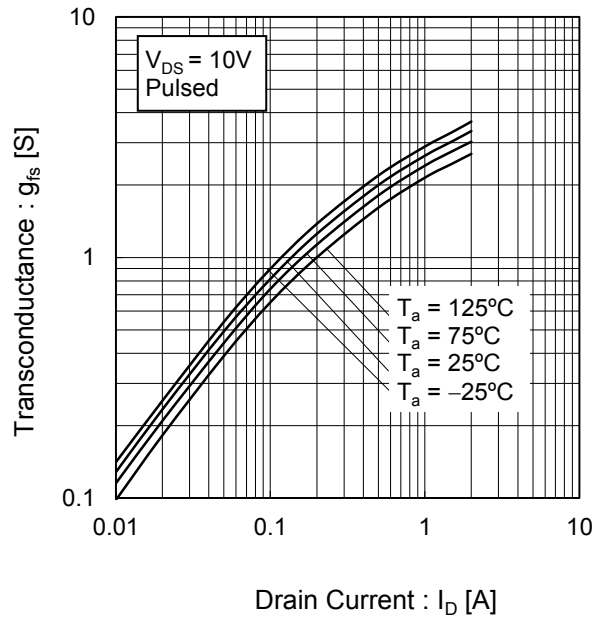


Fig.10 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.11 Drain Current Derating Curve

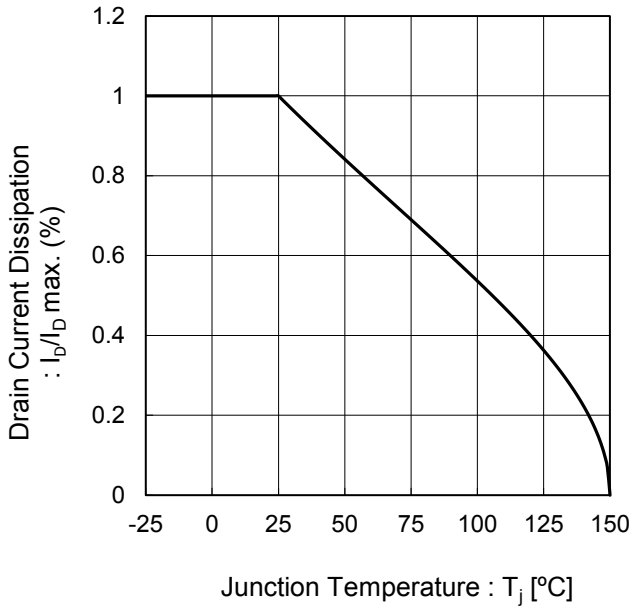


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

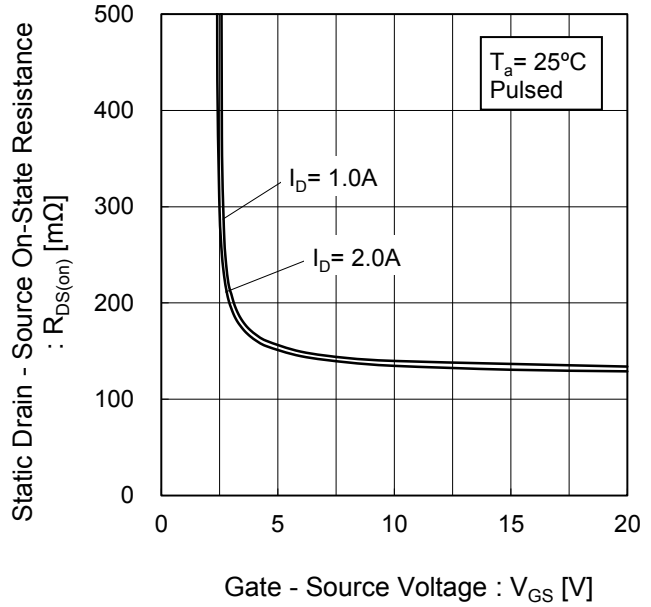


Fig.13 Static Drain - Source On - State Resistance vs. Drain Current (I_D)

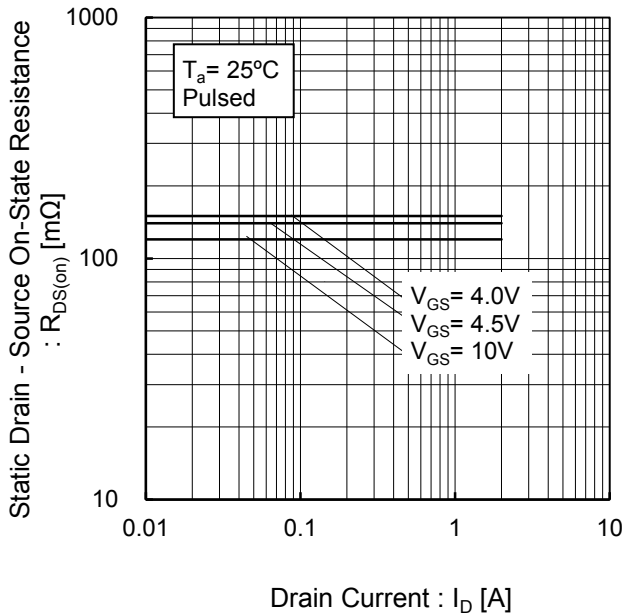
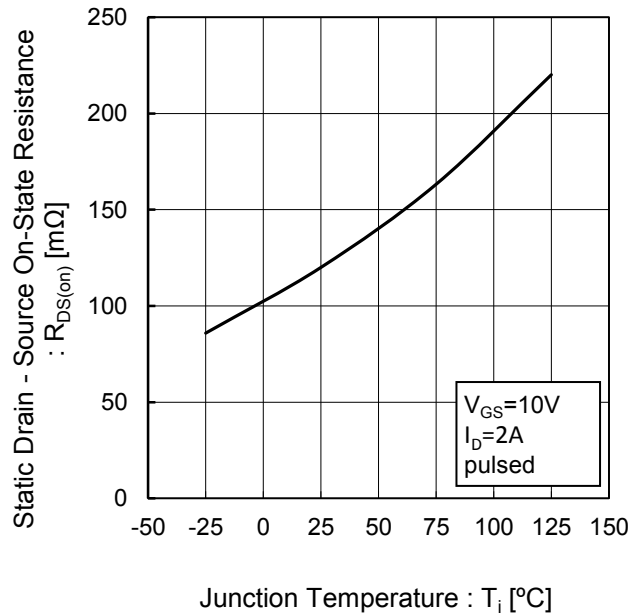


Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature



●Electrical characteristic curves

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

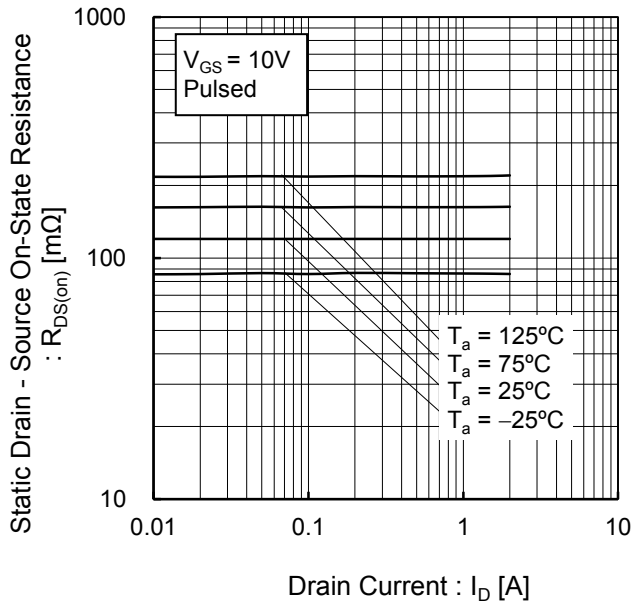


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current(III)

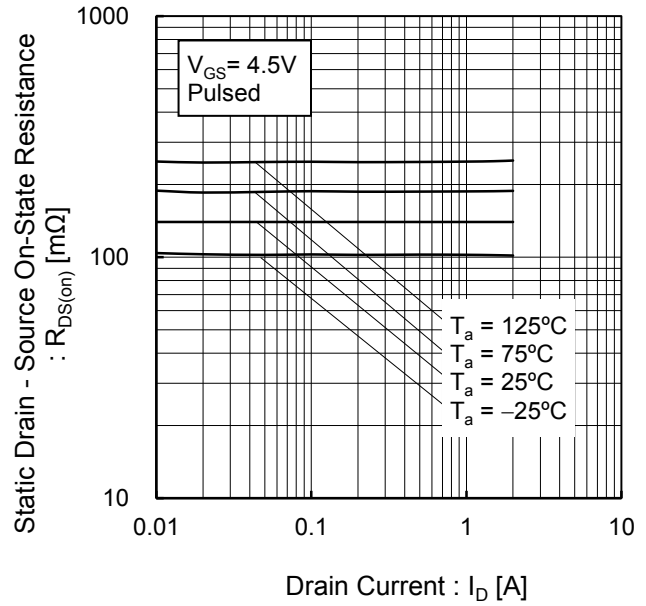
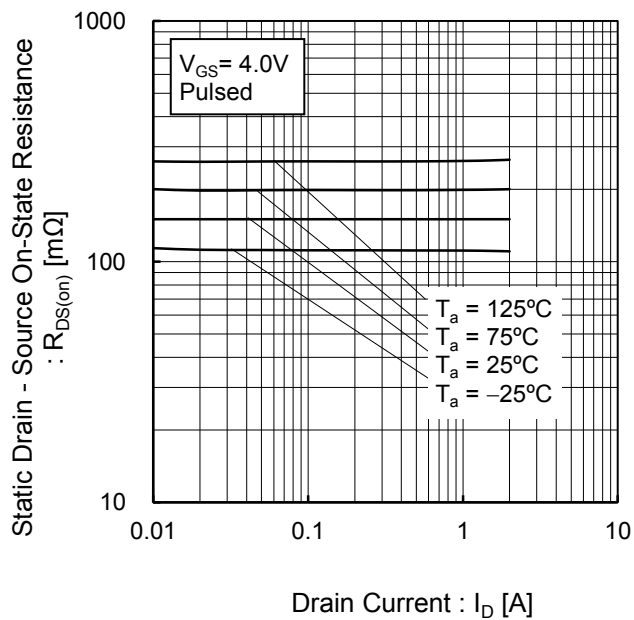


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current(IV)



●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

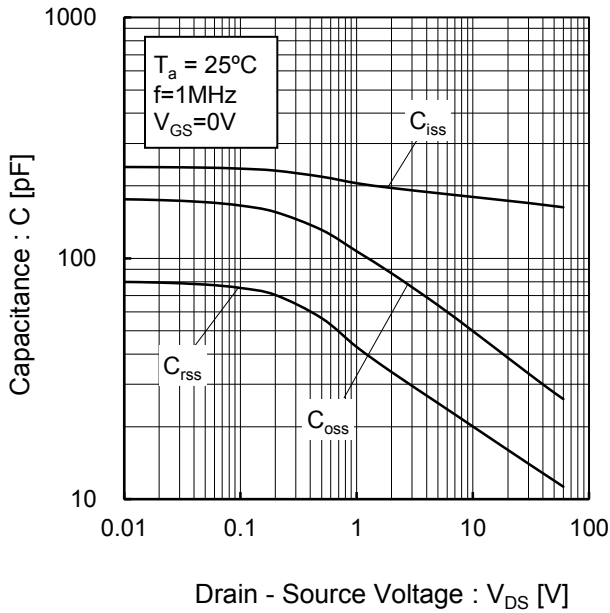


Fig.19 Switching Characteristics

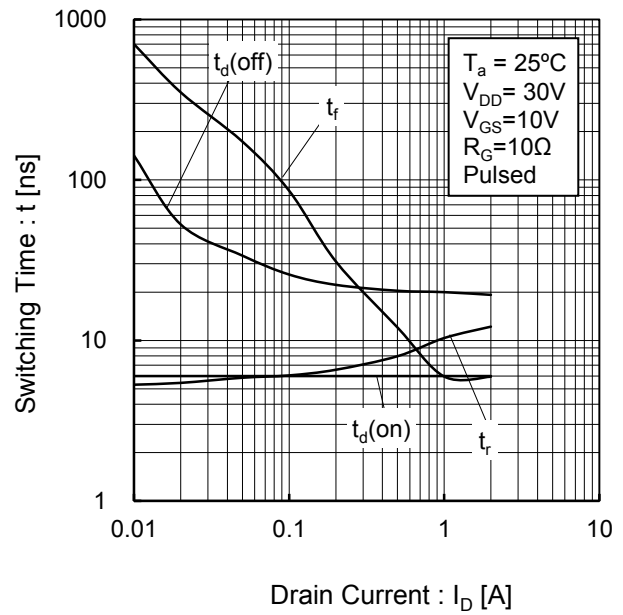


Fig.20 Dynamic Input Characteristics

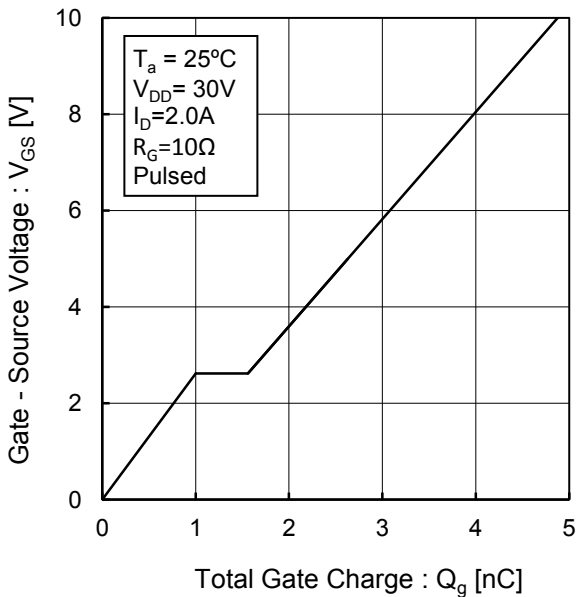
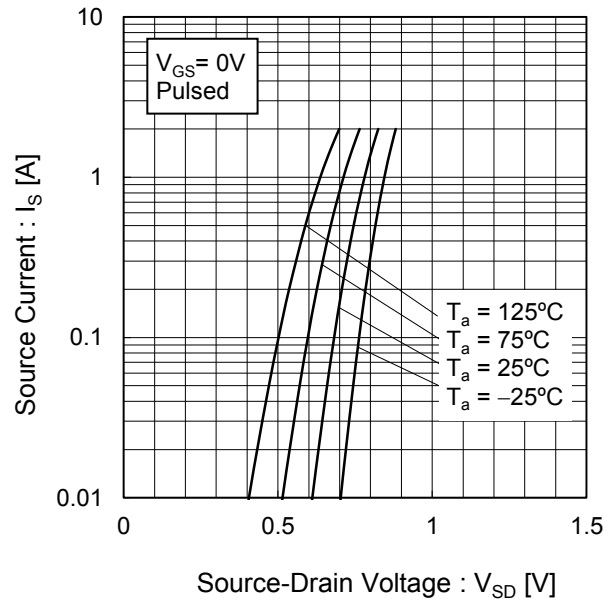


Fig.21 Source Current vs. Source Drain Voltage



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

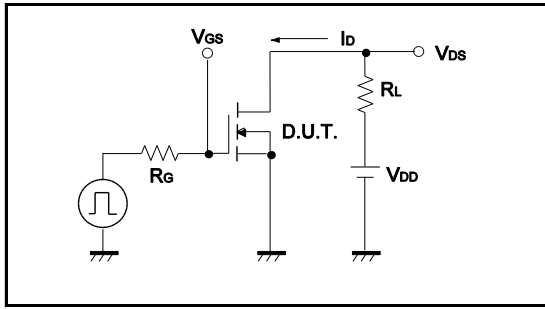


Fig.1-2 Switching Waveforms

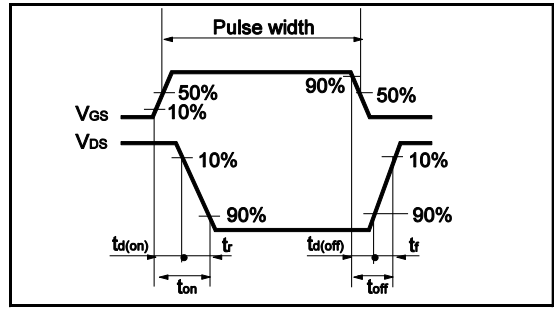


Fig.2-1 Gate Charge Measurement Circuit

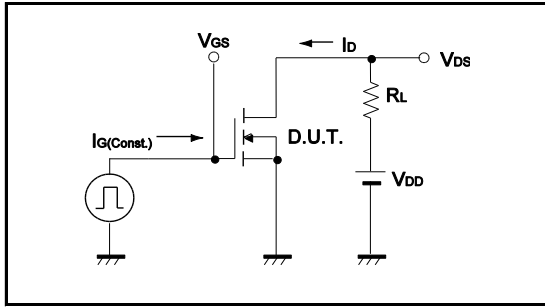
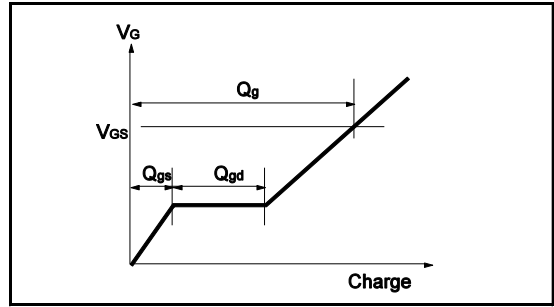
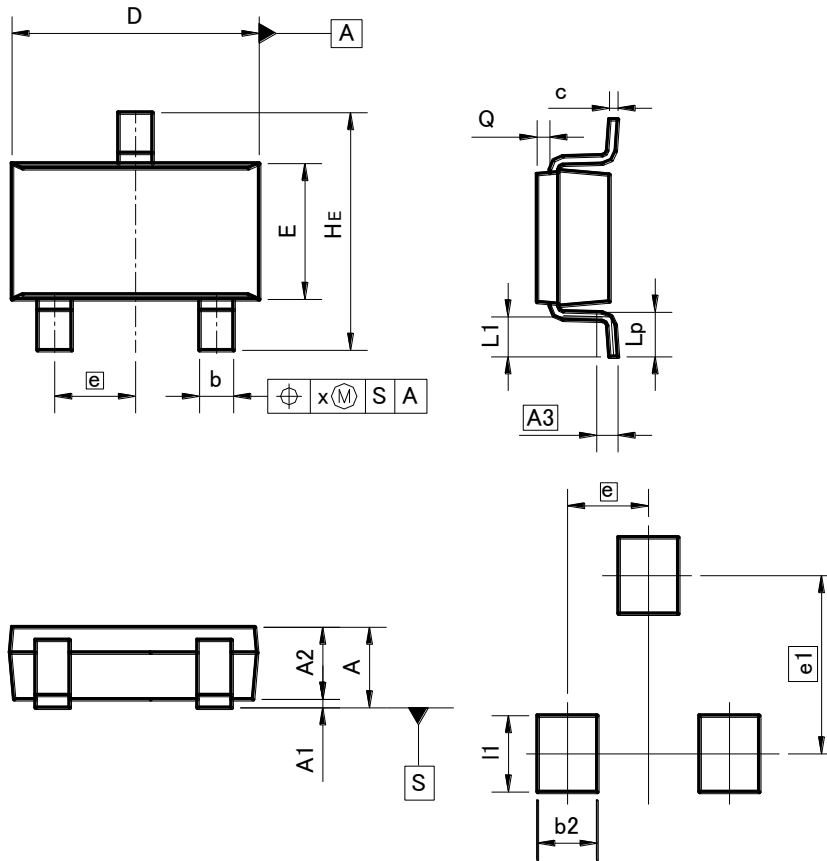


Fig.2-2 Gate Charge Waveform



●Dimensions (Unit : mm)

TSMT3



Pattern of terminal position areas

| DIM | MILIMETERS | | INCHES | |
|-----|------------|------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | - | 1.00 | - | 0.039 |
| A1 | 0.00 | 0.10 | 0 | 0.004 |
| A2 | 0.75 | 0.95 | 0.03 | 0.037 |
| A3 | 0.25 | | 0.01 | |
| b | 0.35 | 0.50 | 0.014 | 0.02 |
| c | 0.10 | 0.26 | 0.004 | 0.01 |
| D | 2.80 | 3.00 | 0.11 | 0.118 |
| E | 1.50 | 1.80 | 0.059 | 0.071 |
| e | 0.95 | | 0.04 | |
| 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 | 0.01 |
| x | - | 0.20 | - | 0.008 |

| DIM | MILIMETERS | | INCHES | |
|-----|------------|------|--------|-------|
| | MIN | MAX | MIN | MAX |
| e1 | 2.10 | | 0.08 | |
| b2 | - | 0.70 | - | 0.028 |
| l1 | - | 0.90 | - | 0.035 |

Dimension in mm/inches

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