

MOSFETs Silicon P-Channel MOS (U-MOSVI)

SSM3J331R

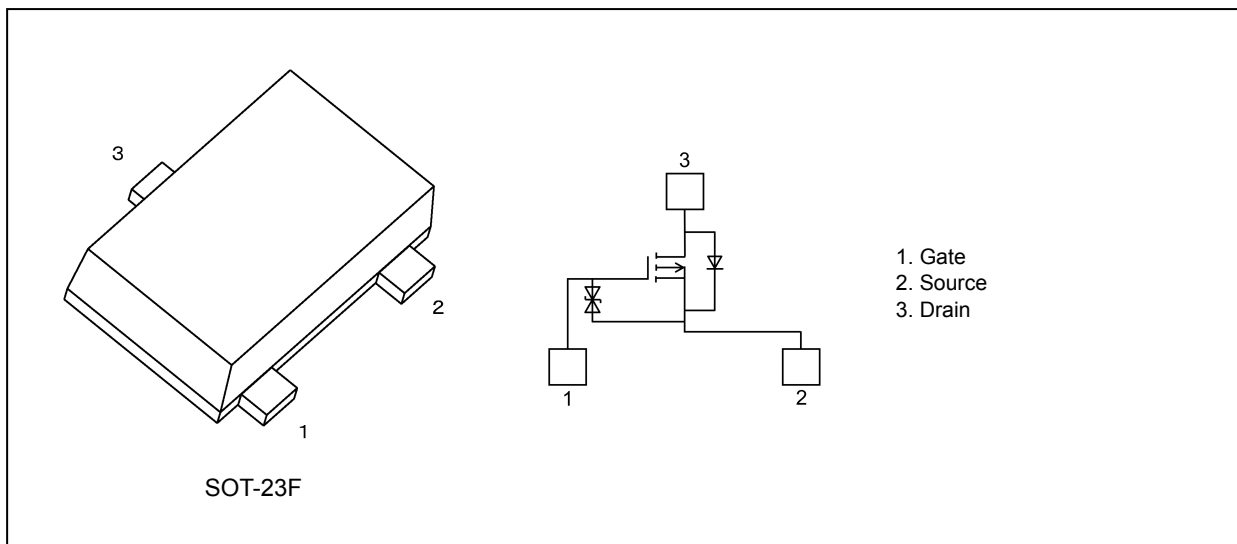
1. Applications

- Power Management Switches

2. Features

- (1) 1.5-V gate drive voltage.
- (2) Low drain-source on-resistance
 - : $R_{DS(ON)} = 150 \text{ m}\Omega$ (max) (@ $V_{GS} = -1.5 \text{ V}$)
 - $R_{DS(ON)} = 100 \text{ m}\Omega$ (max) (@ $V_{GS} = -1.8 \text{ V}$)
 - $R_{DS(ON)} = 75 \text{ m}\Omega$ (max) (@ $V_{GS} = -2.5 \text{ V}$)
 - $R_{DS(ON)} = 55 \text{ m}\Omega$ (max) (@ $V_{GS} = -4.5 \text{ V}$)

3. Packaging and Internal Circuit



Start of commercial production
2011-07

4. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25^\circ\text{C}$)

| Characteristics | Symbol | Rating | Unit |
|---|-----------|------------|------------------|
| Drain-source voltage | V_{DSS} | -20 | V |
| Gate-source voltage | V_{GSS} | ± 8 | |
| Drain current (DC) (Note 1) | I_D | -4 | A |
| Drain current (pulsed) (Note 1,2) | I_{DP} | -10 | |
| Power dissipation (Note 3) | P_D | 1 | W |
| Power dissipation ($t \leq 10$ s) (Note 3) | P_D | 2 | W |
| Channel temperature | T_{ch} | 150 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | -55 to 150 | |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note 1: Ensure that the channel temperature does not exceed 150°C .

Note 2: Pulse width (PW) ≤ 10 ms, duty $\leq 1\%$

Note 3: Device mounted on a FR4 board.(25.4 mm \times 25.4 mm \times 1.6 mm, Cu Pad: 645 mm²)

Note: The MOSFETs in this device are sensitive to electrostatic discharge. When handling this device, the worktables, operators, soldering irons and other objects should be protected against anti-static discharge.

Note: The channel-to-ambient thermal resistance, $R_{th(ch-a)}$, and the power dissipation, P_D , vary according to the board material, board area, board thickness and pad area. When using this device, be sure to take heat dissipation fully into account.

5. Thermal Characteristics

| Characteristics | Symbol | Max | Unit |
|--|----------------|-----|--------------------|
| Channel-to-ambient thermal resistance (Note 1) | $R_{th(ch-a)}$ | 125 | $^\circ\text{C/W}$ |

Note 1: Device mounted on an 25.4 mm \times 25.4 mm \times 1.6 mm FR4 glass epoxy board (Cu pad: 645 mm²)

6. Electrical Characteristics

6.1. Static Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---------------|--|------|------|---------|------------------|
| Gate leakage current | I_{GSS} | $V_{GS} = \pm 8\text{ V}, V_{DS} = 0\text{ V}$ | — | — | ± 1 | μA |
| Drain cut-off current | I_{DSS} | $V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$ | — | — | -1 | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D = -1\text{ mA}, V_{GS} = 0\text{ V}$ | -20 | — | — | V |
| Drain-source breakdown voltage (Note 1) | $V_{(BR)DSX}$ | $I_D = -1\text{ mA}, V_{GS} = 5\text{ V}$ | -15 | — | — | |
| Gate threshold voltage (Note 2) | V_{th} | $V_{DS} = -3\text{ V}, I_D = -1\text{ mA}$ | -0.3 | — | -1.0 | |
| Drain-source on-resistance (Note 3) | $R_{DS(ON)}$ | $I_D = -3.0\text{ A}, V_{GS} = -4.5\text{ V}$ | — | 46 | 55 | $\text{m}\Omega$ |
| | | $I_D = -3.0\text{ A}, V_{GS} = -2.5\text{ V}$ | — | 58 | 75 | |
| | | $I_D = -1.0\text{ A}, V_{GS} = -1.8\text{ V}$ | — | 70 | 100 | |
| | | $I_D = -0.5\text{ A}, V_{GS} = -1.5\text{ V}$ | — | 85 | 150 | |
| Forward transfer admittance (Note 3) | $ Y_{fs} $ | $V_{DS} = -3\text{ V}, I_D = -1.0\text{ A}$ | 3.6 | 7.2 | — | S |

Note 1: If a reverse bias is applied between gate and source, this device enters $V_{(BR)DSX}$ mode. Note that the drain-source breakdown voltage is lowered in this mode.

Note 2: Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (-1 mA for this device). Then, for normal switching operation, $V_{GS(ON)}$ must be higher than V_{th} , and $V_{GS(OFF)}$ must be lower than V_{th} . This relationship can be expressed as: $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$.

Take this into consideration when using the device.

Note 3: Pulse measurement.

6.2. Dynamic Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|--------------------------------|-----------|--|-----|------|-----|-------------|
| Input capacitance | C_{iss} | $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$ | — | 630 | — | pF |
| Reverse transfer capacitance | C_{rss} | | — | 60 | — | |
| Output capacitance | C_{oss} | | — | 75 | — | |
| Switching time (turn-on time) | t_{on} | $V_{DD} = -10\text{ V}, I_D = -0.5\text{ A}$ $V_{GS} = 0\text{ to }-2.5\text{ V}, R_{GS} = 4.7\ \Omega,$ Duty $\leq 1\%$, Input: $t_r, t_f < 5\text{ ns}$ Common source, See Chapter 6.3 | — | 14 | — | ns |
| Switching time (turn-off time) | t_{off} | | — | 68 | — | |

6.3. Switching Time Test Circuit

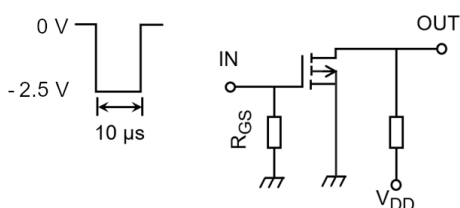


Fig. 6.3.1 Test Circuit of Switching Time

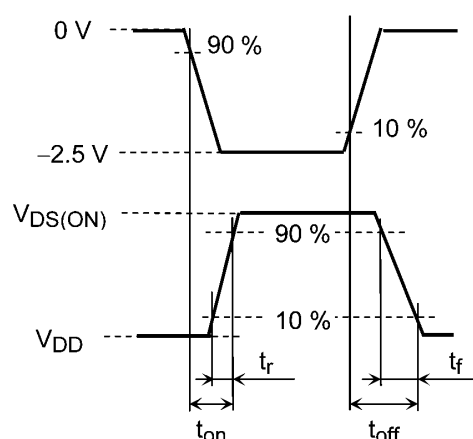


Fig. 6.3.2 Input Waveform/Output Waveform

6.4. Gate Charge Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|-----------|---|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | Q_g | $V_{DD} = -10\text{ V}, V_{GS} = -4.5\text{ V},$ $I_D = -3.4\text{ A}$ | — | 10.4 | — | nC |
| Gate-source charge 1 | Q_{gs1} | | — | 0.7 | — | |
| Gate-drain charge | Q_{gd} | | — | 3 | — | |

6.5. Source-Drain Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|--------------------------------|-----------|--|-----|------|-----|------|
| Diode forward voltage (Note 1) | V_{DSF} | $I_{DR} = 4.0\text{ A}, V_{GS} = 0\text{ V}$ | — | 0.86 | 1.2 | V |

Note 1: Pulse measurement.

7. Marking

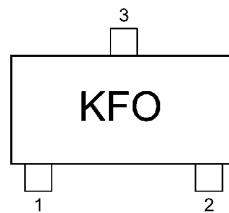


Fig. 7.1 Marking

8. Characteristics Curves (Note)

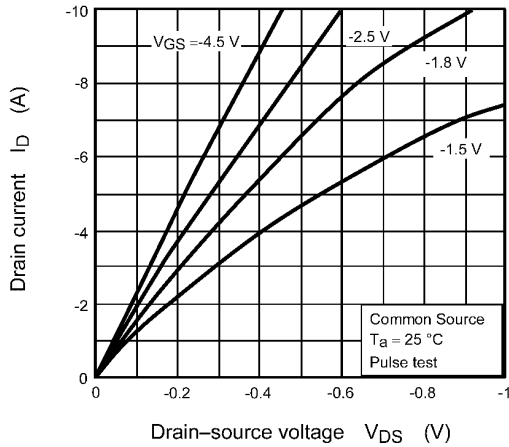


Fig. 8.1 $I_D - V_{DS}$

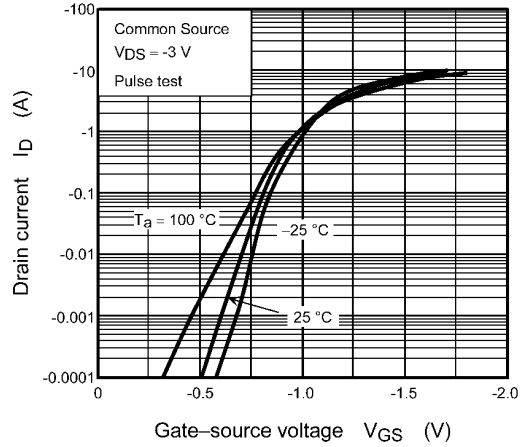


Fig. 8.2 $I_D - V_{GS}$

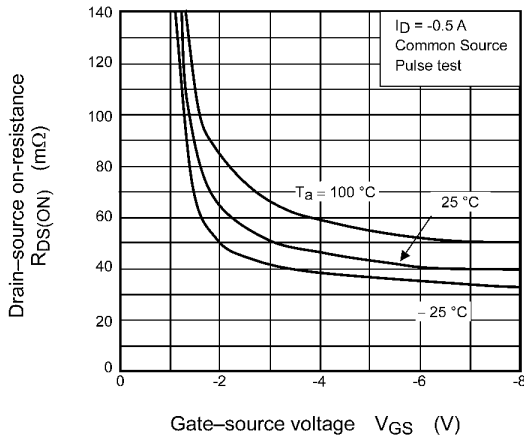


Fig. 8.3 $R_{DS(ON)} - V_{GS}$

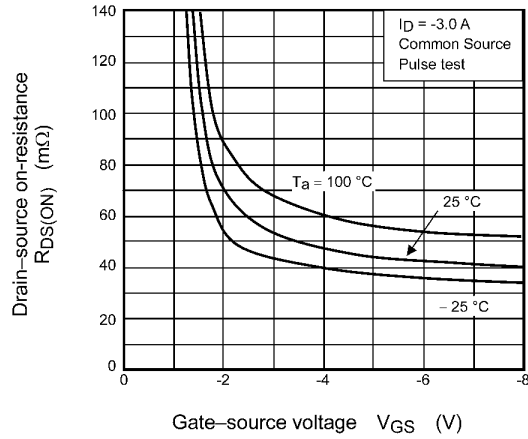


Fig. 8.4 $R_{DS(ON)} - V_{GS}$

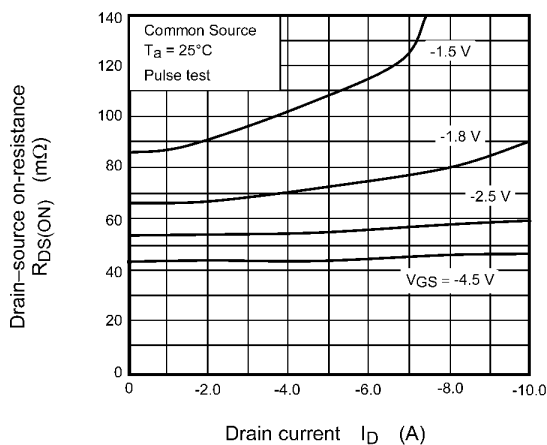


Fig. 8.5 $R_{DS(ON)} - I_D$

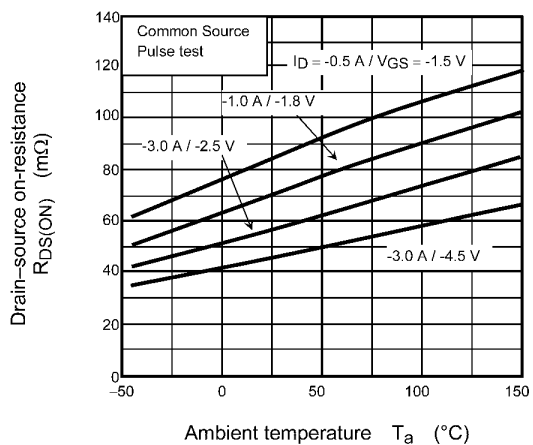


Fig. 8.6 $R_{DS(ON)} - T_a$

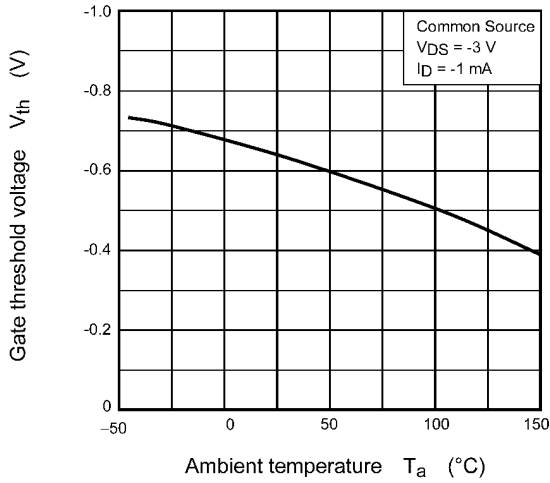


Fig. 8.7 $V_{th} - T_a$

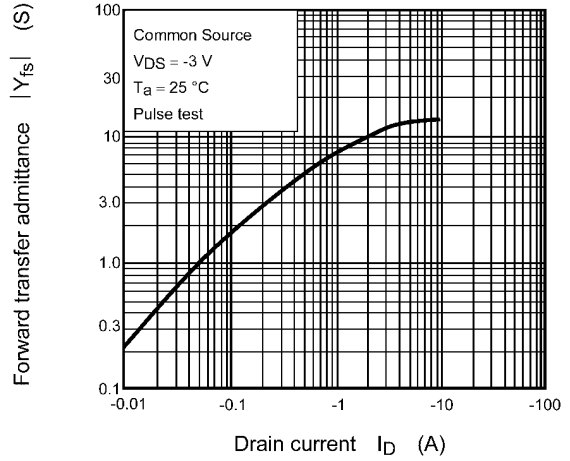


Fig. 8.8 $|Y_{fs}| - I_D$

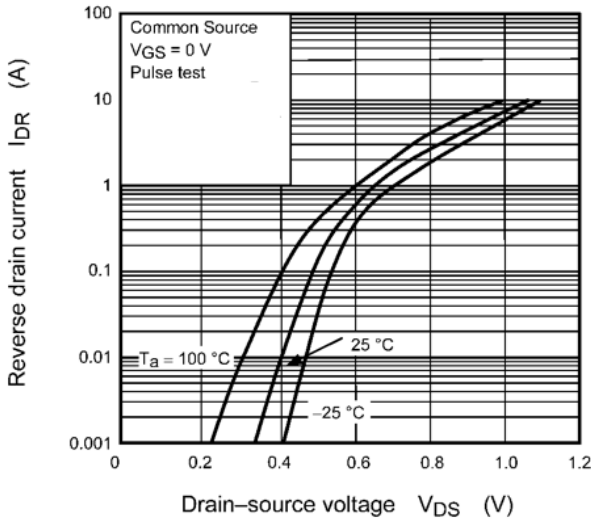


Fig. 8.9 $I_{DR} - V_{DS}$

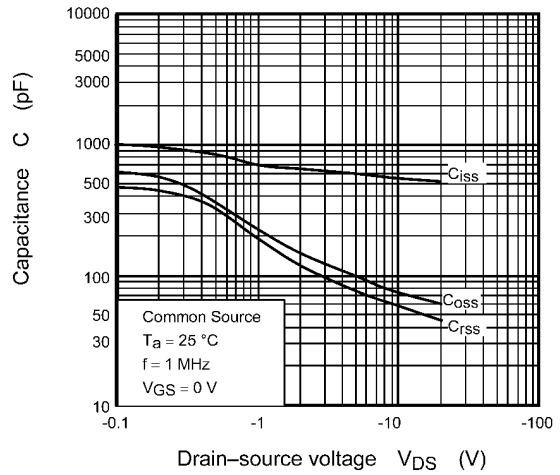


Fig. 8.10 $C - V_{DS}$

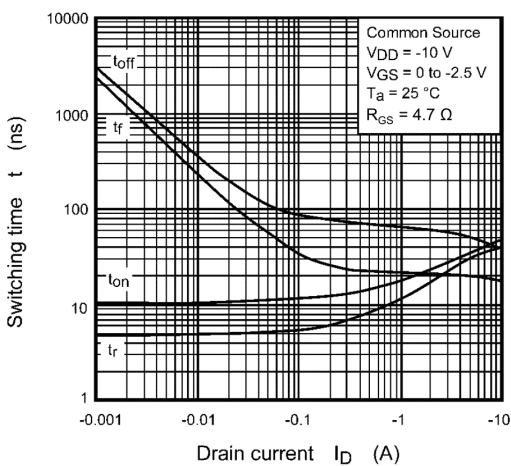


Fig. 8.11 $t - I_D$

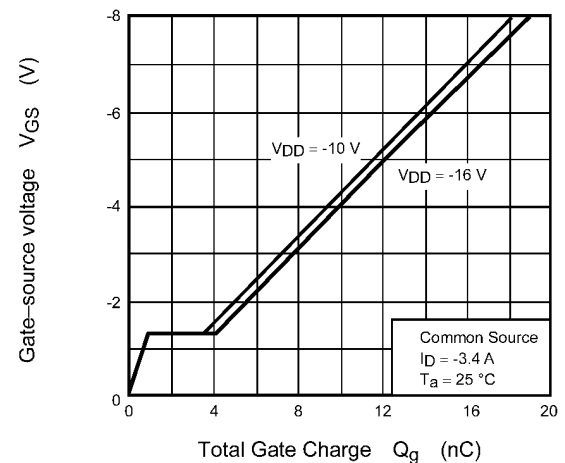


Fig. 8.12 Dynamic Input/Output Characteristics

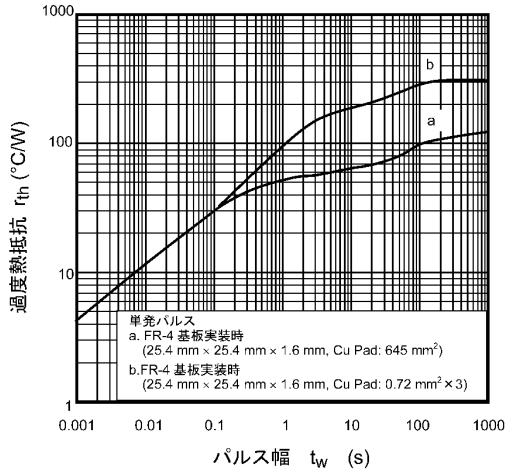


Fig. 8.13 $r_{th} - t_w$

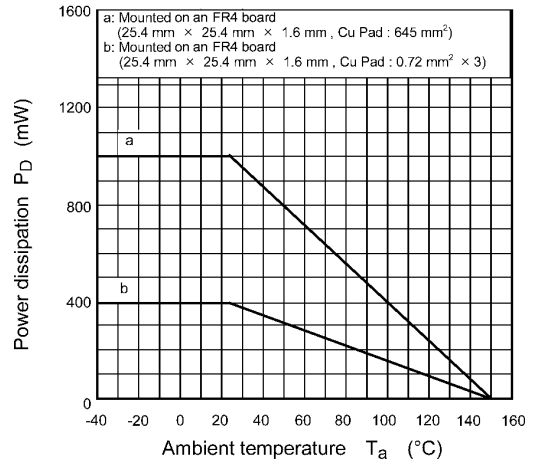


Fig. 8.14 $P_D - T_a$

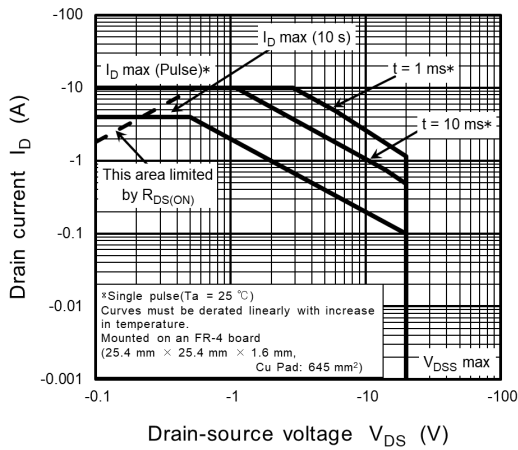
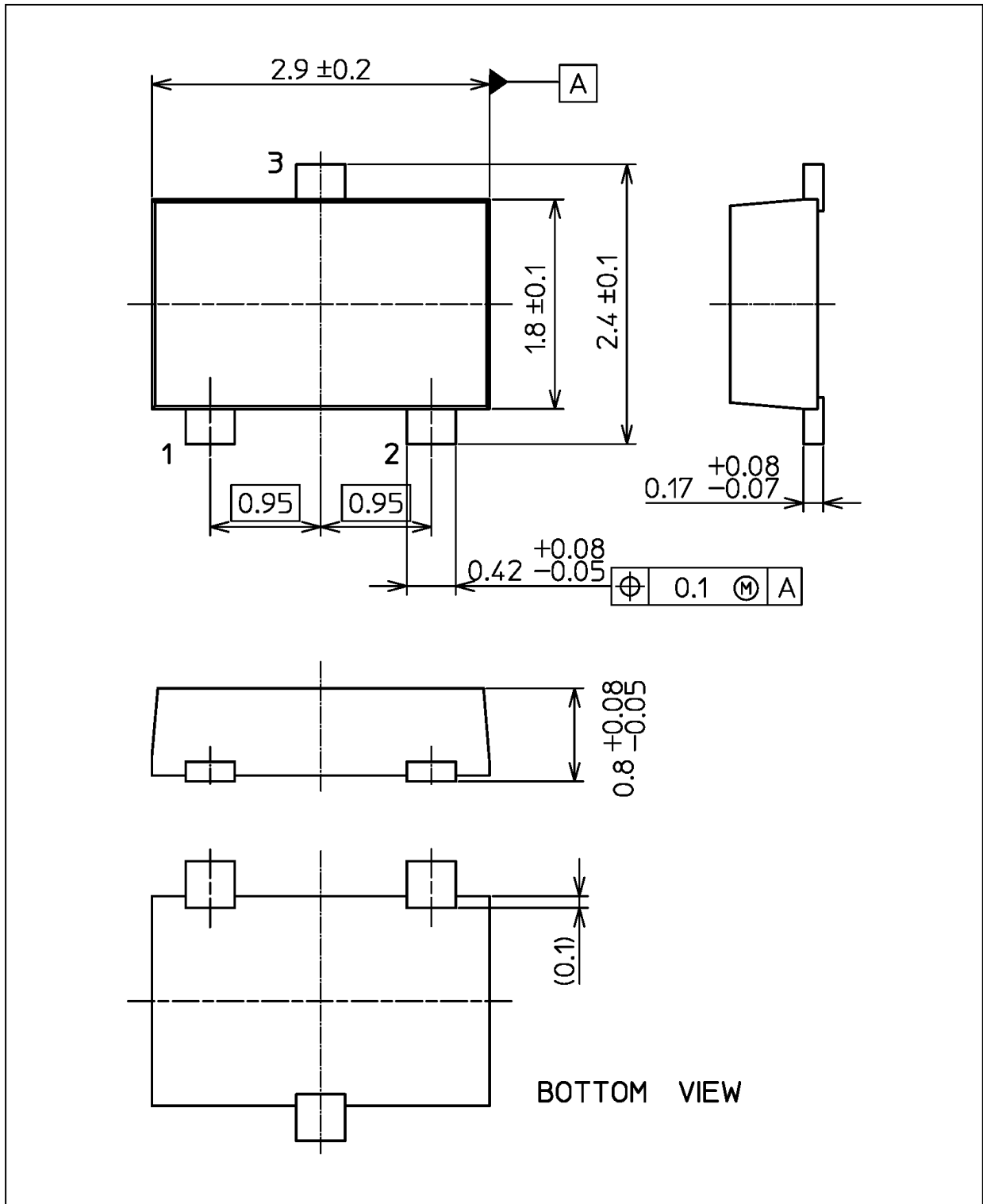


Fig. 8.15 Safe Operating Area

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Package Dimensions

Unit: mm



Weight: 0.011 g (typ.)

| |
|-------------------|
| Package Name(s) |
| Nickname: SOT-23F |

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