

MOSFETs Silicon P-Channel MOS (U-MOSVI)

# SSM3J378R

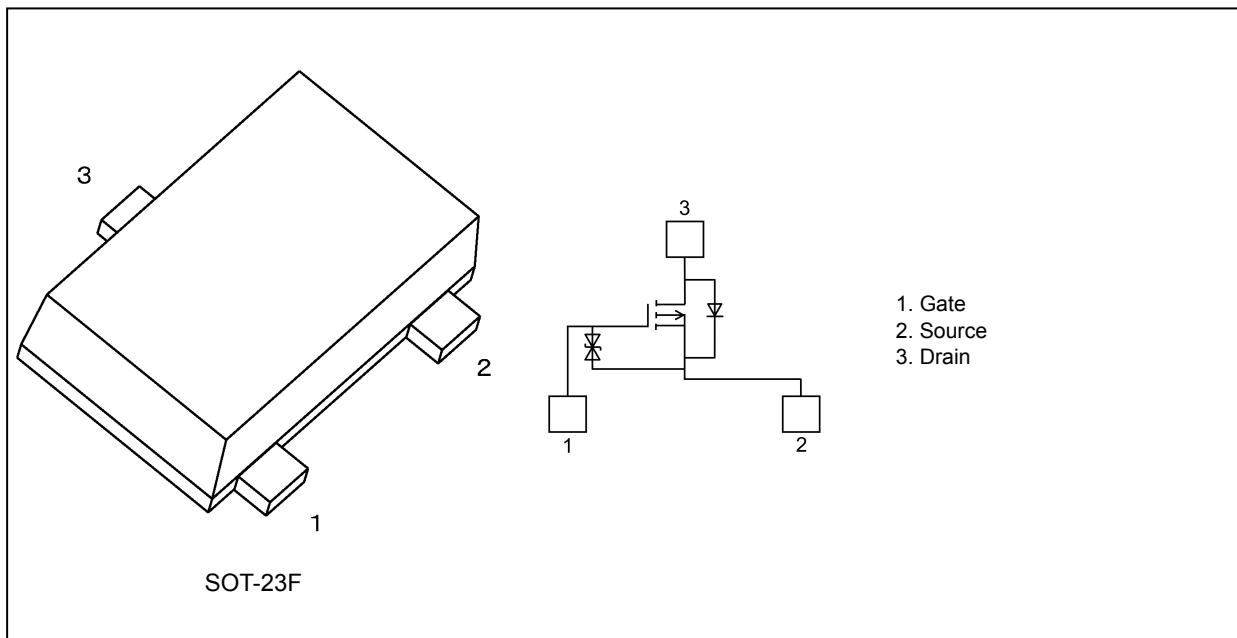
## 1. Applications

- Power Management Switches

## 2. Features

- (1) AEC-Q101 qualified (Please see the orderable part number list)
- (2) 1.5-V gate drive voltage.
- (3) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 88.4 \text{ m}\Omega$  (max) (@ $V_{GS} = -1.5 \text{ V}$ )
  - $R_{DS(ON)} = 56.0 \text{ m}\Omega$  (max) (@ $V_{GS} = -1.8 \text{ V}$ )
  - $R_{DS(ON)} = 39.7 \text{ m}\Omega$  (max) (@ $V_{GS} = -2.5 \text{ V}$ )
  - $R_{DS(ON)} = 29.8 \text{ m}\Omega$  (max) (@ $V_{GS} = -4.5 \text{ V}$ )

## 3. Packaging and Pin Configuration



## 4. Orderable part number

| Orderable part number | AEC-Q101     | Note                    |
|-----------------------|--------------|-------------------------|
| SSM3J378R,LF          | —            | General Use             |
| SSM3J378R,LXGF        | YES (Note 1) | Unintended Use (Note 1) |
| SSM3J378R,LXHF        | YES          | Automotive Use          |

Note 1: For more information, please contact our sales or use the inquiry form on our website.

Start of commercial production  
2017-10

### 5. 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/+6      |                  |
| Drain current (DC) (Note 1)                 | $I_D$     | -6.0       | A                |
| Drain current (pulsed) (Note 1,2)           | $I_{DP}$  | -24.0      |                  |
| 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  $150^\circ\text{C}$ .

Note 2: Pulse width (PW)  $\leq 10 \mu\text{s}$ , duty  $\leq 1\%$

Note 3: Device mounted on an FR4 board.(25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm, Cu pad: 645 mm<sup>2</sup>)

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 drain 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.

### 6. 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 mm<sup>2</sup>)

### 7. Electrical Characteristics

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

| Characteristics                         | Symbol        | Test Condition                                 | Min  | Typ. | Max     | Unit             |
|---|---------------|--|------|------|---------|------------------|
| Gate leakage current                    | $I_{GSS}$     | $V_{GS} = -8/+6\text{ V}, V_{DS} = 0\text{ V}$ | —    | —    | $\pm 1$ | $\mu\text{A}$    |
| 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)     | $R_{DS(ON)}$  | $I_D = -3.0\text{ A}, V_{GS} = -4.5\text{ V}$  | —    | 24.9 | 29.8    | $\text{m}\Omega$ |
|   |               | $I_D = -2.5\text{ A}, V_{GS} = -2.5\text{ V}$  | —    | 31.1 | 39.7    |                  |
|   |               | $I_D = -1.5\text{ A}, V_{GS} = -1.8\text{ V}$  | —    | 38.8 | 56.0    |                  |
|   |               | $I_D = -0.5\text{ A}, V_{GS} = -1.5\text{ V}$  | —    | 47.4 | 88.4    |                  |
| Forward transfer admittance (Note 3)    | $ Y_{fs} $    | $V_{DS} = -3\text{ V}, I_D = -1.0\text{ A}$    | 4.5  | 9.1  | —       | 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.

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

| Characteristics                | Symbol    | Test Condition   | Min | Typ. | Max | Unit        |
|--------------------------------|-----------|--|-----|------|-----|-------------|
| Input capacitance              | $C_{iss}$ | $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$  | —   | 840  | —   | $\text{pF}$ |
| Reverse transfer capacitance   | $C_{rss}$ |  | —   | 99   | —   |             |
| Output capacitance             | $C_{oss}$ |  | —   | 118  | —   |             |
| Switching time (turn-on time)  | $t_{on}$  | $V_{DD} = -10\text{ V}, I_D = -2.0\text{ A}$<br>$V_{GS} = 0\text{ to }-2.5\text{ V}, R_{GS} = 4.7\ \Omega,$<br>Duty $\leq 1\%$ , Input: $t_r, t_f < 5\text{ ns}$<br>Common source, See Chapter 7.3 | —   | 32   | —   | ns          |
| Switching time (turn-off time) | $t_{off}$ |  | —   | 107  | —   |             |

#### 7.3. Switching Time Test Circuit

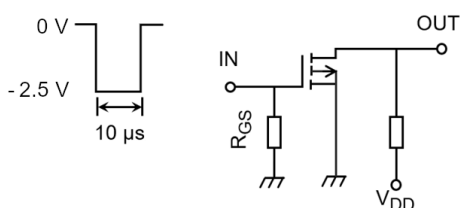


Fig. 7.3.1 Test Circuit of Switching Time

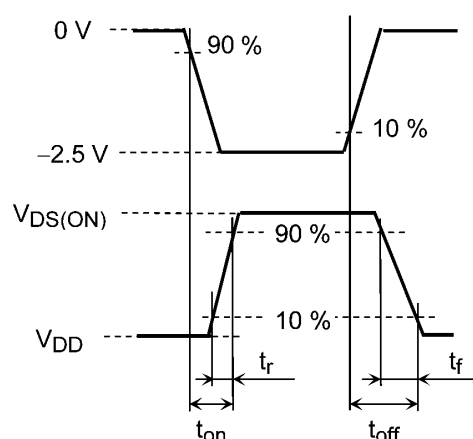


Fig. 7.3.2 Input Waveform/Output Waveform

## 7.4. 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) | $Q_g$     | $V_{DD} = -10\text{ V}, V_{GS} = -4.5\text{ V},$<br>$I_D = -4.0\text{ A}$ | —   | 12.8 | —   | nC   |
| Gate-source charge 1                            | $Q_{gs1}$ |   | —   | 1.4  | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |   | —   | 3.0  | —   |      |

## 7.5. 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) | $V_{DSF}$ | $I_{DR} = 6.0\text{ A}, V_{GS} = 0\text{ V}$ | —   | 0.87 | 1.2 | V    |

Note 1: Pulse measurement.

## 8. Marking

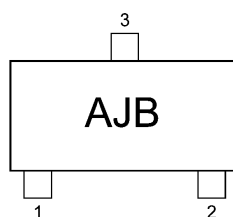
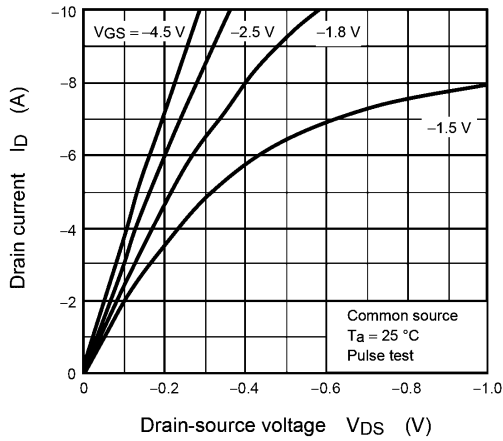
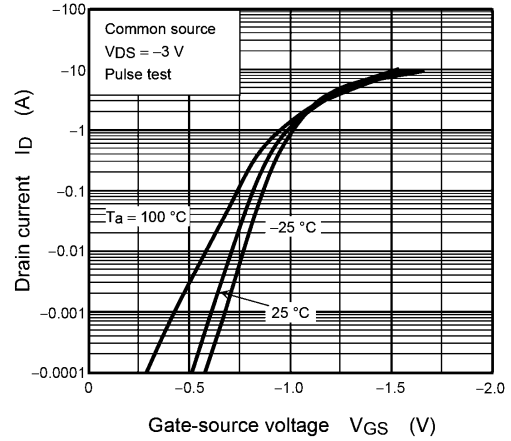


Fig. 8.1 Marking

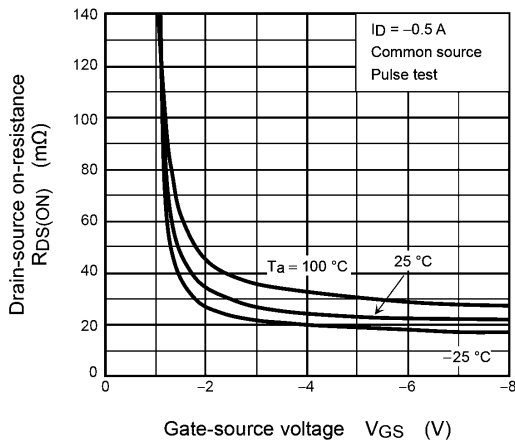
### 9. Characteristics Curves (Note)



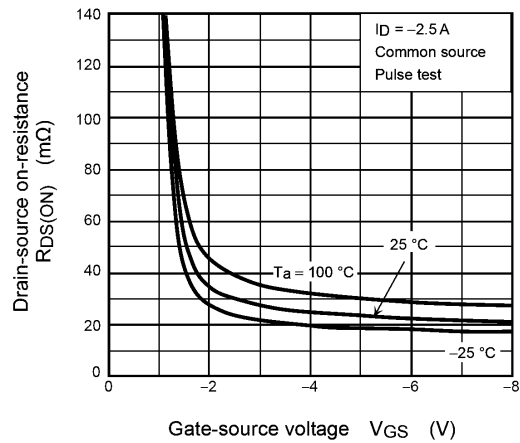
**Fig. 9.1**  $I_D - V_{DS}$



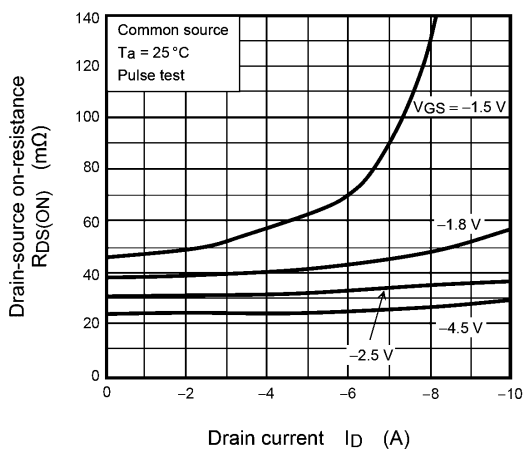
**Fig. 9.2**  $I_D - V_{GS}$



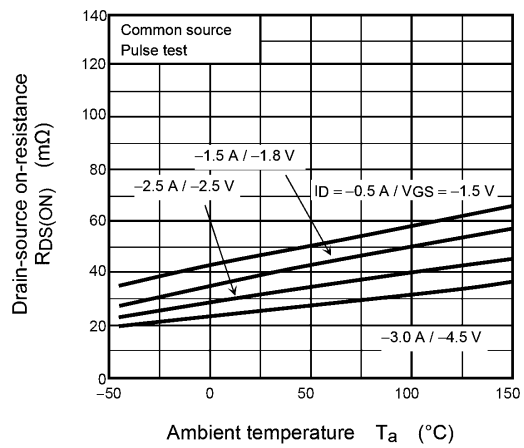
**Fig. 9.3**  $R_{DS(ON)} - V_{GS}$



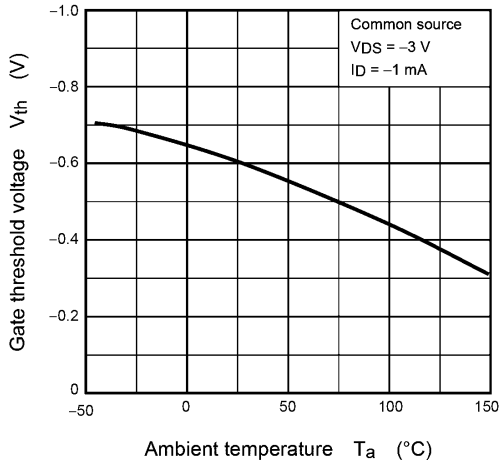
**Fig. 9.4**  $R_{DS(ON)} - V_{GS}$



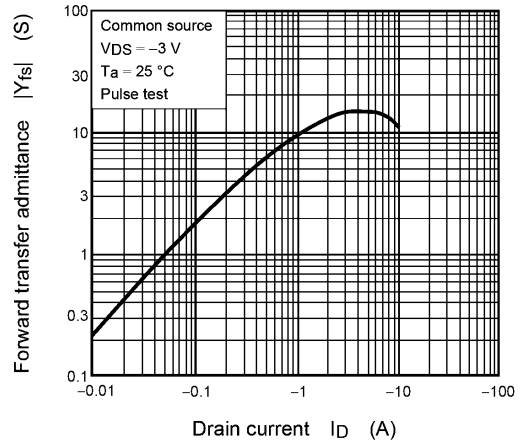
**Fig. 9.5**  $R_{DS(ON)} - I_D$



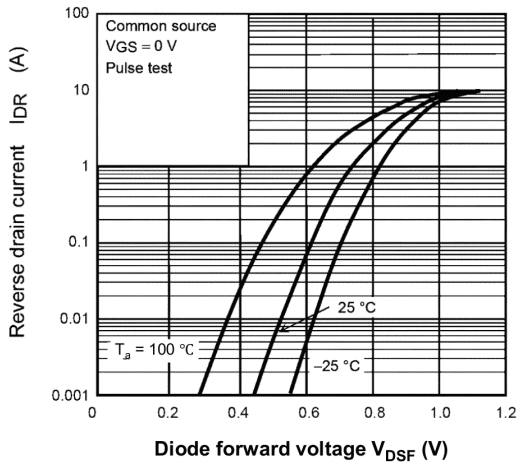
**Fig. 9.6**  $R_{DS(ON)} - T_a$



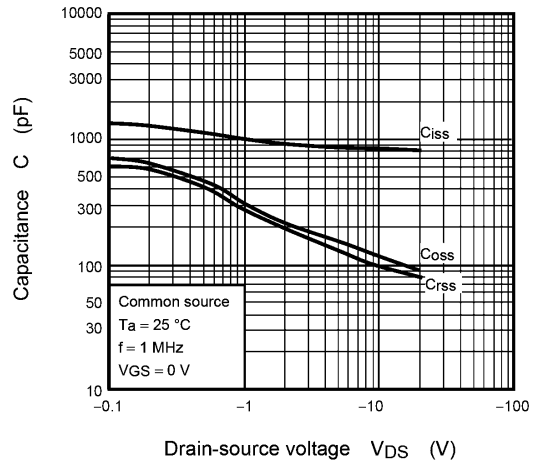
**Fig. 9.7  $V_{th} - T_a$**



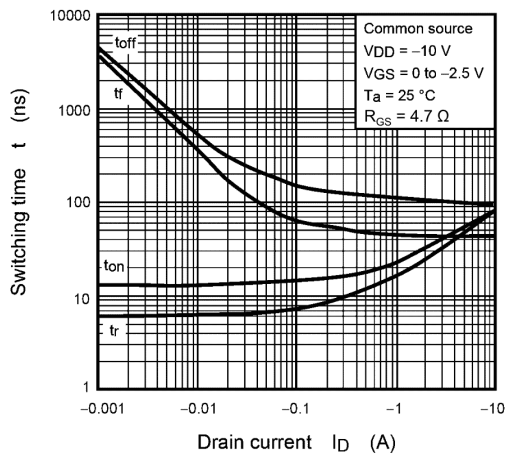
**Fig. 9.8  $|Y_{fs}| - I_D$**



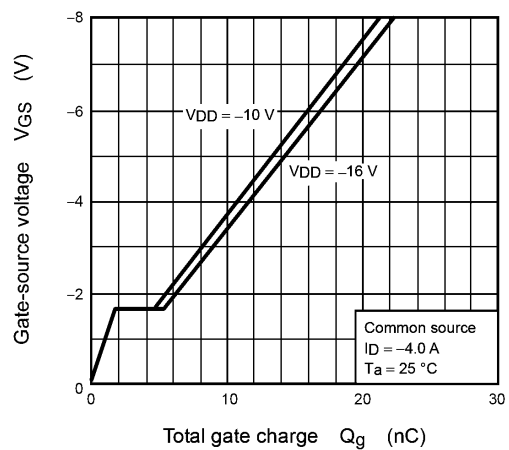
**Fig. 9.9  $I_{DR} - V_{DSF}$**



**Fig. 9.10  $C - V_{DS}$**



**Fig. 9.11  $t - I_D$**



**Fig. 9.12 Dynamic Input Characteristics**

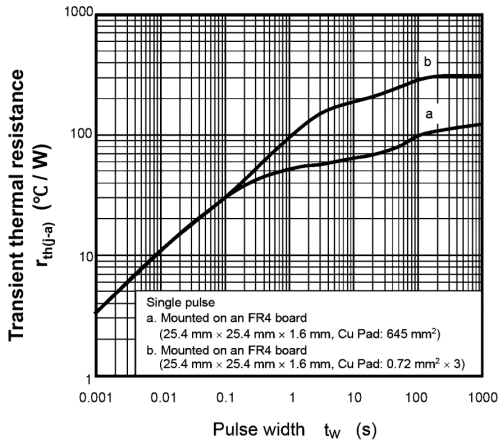


Fig. 9.13  $r_{th(j-a)} - t_w$

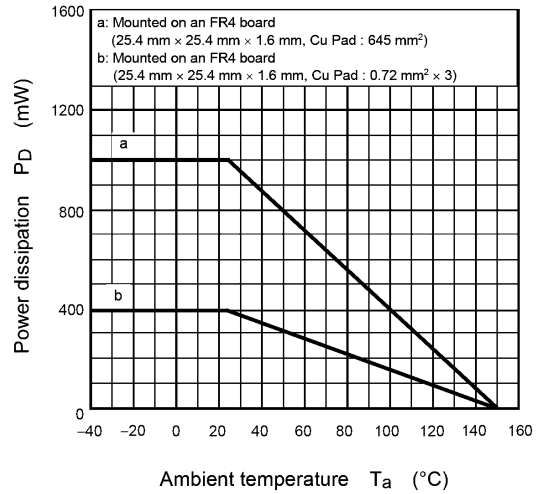
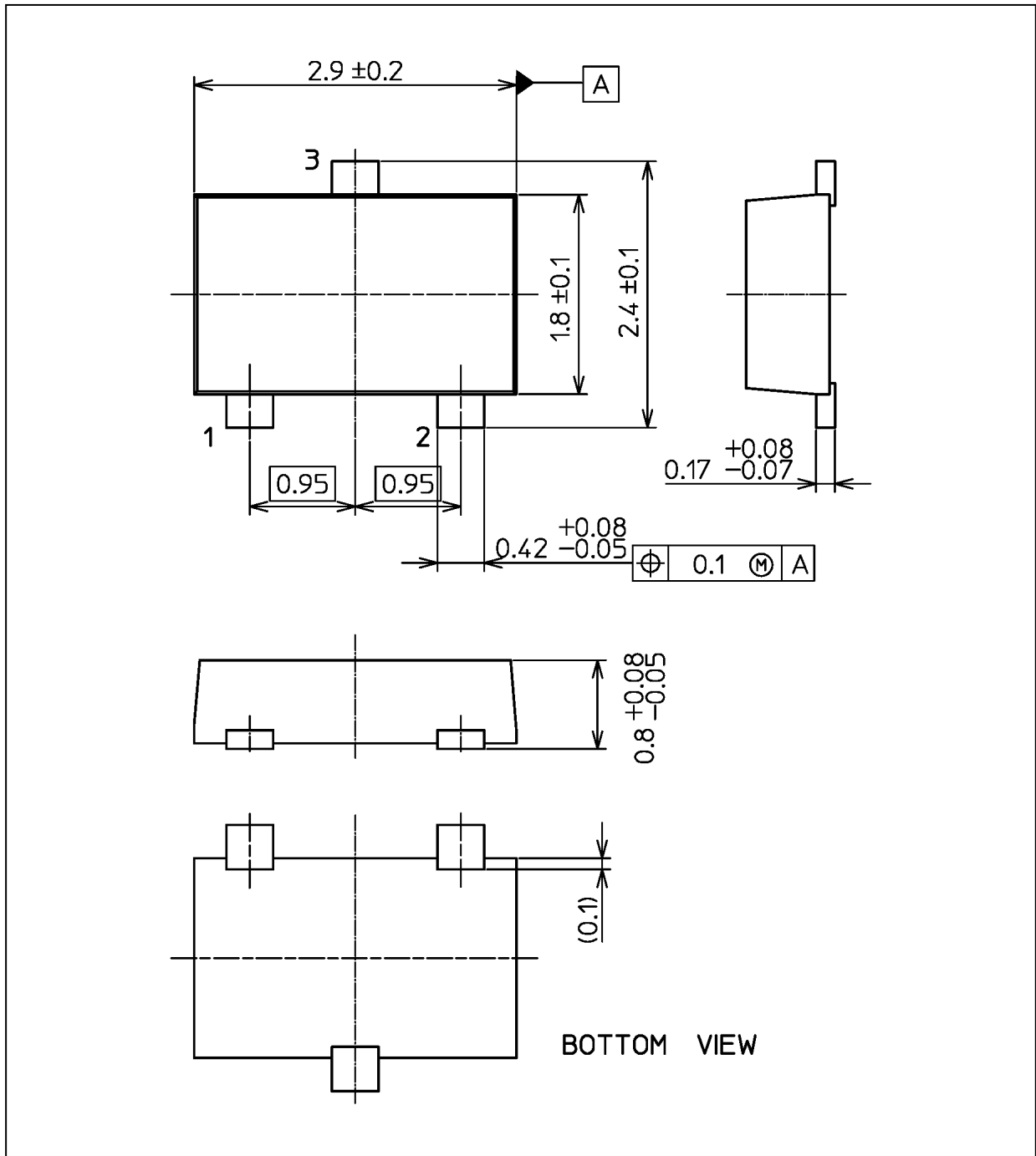


Fig. 9.14  $P_D - T_a$

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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