

MOSFETs Silicon P-Channel MOS (U-MOSVI)

# SSM6J424TU

## 1. Applications

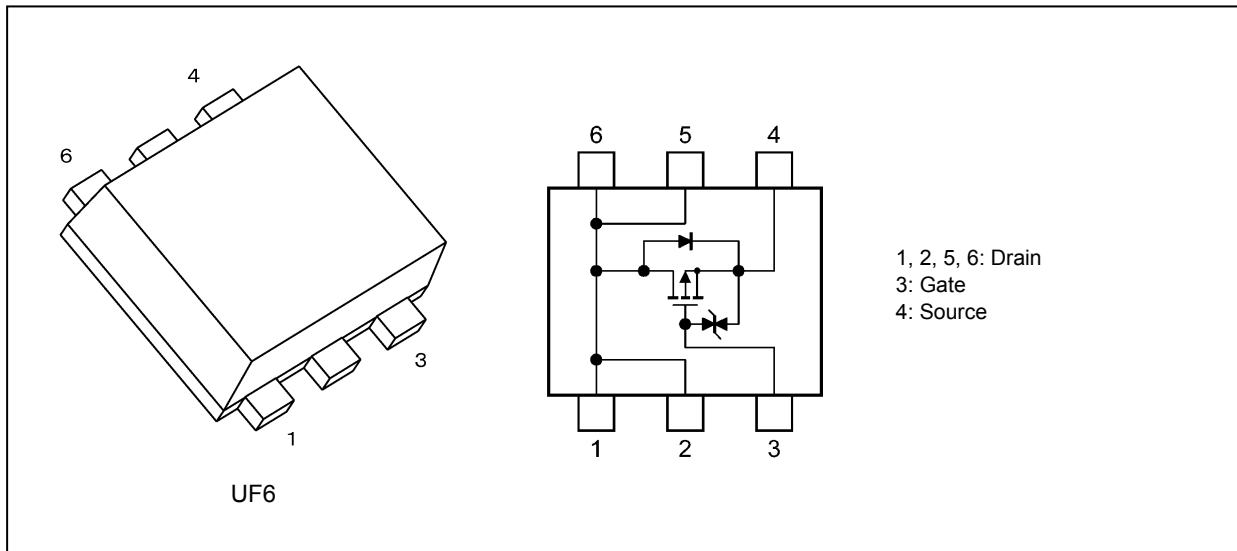
- Power Management Switches

## 2. Features

- (1) AEC-Q101 qualified (Note 1)
- (2) 1.5-V gate drive voltage.
- (3) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 54 \text{ m}\Omega$  (max) (@ $V_{GS} = -1.5 \text{ V}$ )
  - $R_{DS(ON)} = 36 \text{ m}\Omega$  (max) (@ $V_{GS} = -1.8 \text{ V}$ )
  - $R_{DS(ON)} = 26 \text{ m}\Omega$  (max) (@ $V_{GS} = -2.5 \text{ V}$ )
  - $R_{DS(ON)} = 22.5 \text{ m}\Omega$  (max) (@ $V_{GS} = -4.5 \text{ V}$ )

Note 1: For detail information, please contact to our sales.

## 3. Packaging and Pin Configuration



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

| Characteristics                 | Symbol           | Rating     | Unit               |
|---------------------------------|------------------|------------|--------------------|
| Drain-source voltage            | $V_{\text{DSS}}$ | -20        | V                  |
| Gate-source voltage             | $V_{\text{GSS}}$ | -8/+6      |                    |
| Drain current (DC)              | $I_{\text{D}}$   | -6         | A                  |
| Drain current (pulsed) (Note 1) | $I_{\text{DP}}$  | -14        |                    |
| Power dissipation (Note 2)      | $P_{\text{D}}$   | 1          | W                  |
| Channel temperature             | $T_{\text{ch}}$  | 150        | $^{\circ}\text{C}$ |
| Storage temperature             | $T_{\text{stg}}$ | -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: Pulse width (PW)  $\leq 10$  ms, duty  $\leq 1\%$

Note 2: 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,  $R_{\text{th(ch-a)}}$ , and the power dissipation,  $P_{\text{D}}$ , 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. Electrical Characteristics

### 5.1. 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)     | $R_{DS(ON)}$  | $I_D = -6.0\text{ A}$ , $V_{GS} = -4.5\text{ V}$  | —    | 18   | 22.5    | $\text{m}\Omega$ |
|                                         |               | $I_D = -5.5\text{ A}$ , $V_{GS} = -2.5\text{ V}$  | —    | 21   | 26      |                  |
|                                         |               | $I_D = -3.0\text{ A}$ , $V_{GS} = -1.8\text{ V}$  | —    | 25   | 36      |                  |
|                                         |               | $I_D = -1.5\text{ A}$ , $V_{GS} = -1.5\text{ V}$  | —    | 29   | 54      |                  |
| Forward transfer admittance (Note 3)    | $ Y_{fs} $    | $V_{DS} = -3\text{ V}$ , $I_D = -2.0\text{ A}$    | 9.1  | 18.2 | —       | 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.

### 5.2. 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>$f = 1\text{ MHz}$                                                                                                                                         | —   | 1650 | —   | $\text{pF}$ |
| Reverse transfer capacitance   | $C_{rss}$ |                                                                                                                                                                                                                 | —   | 90   | —   |             |
| Output capacitance             | $C_{oss}$ |                                                                                                                                                                                                                 | —   | 220  | —   |             |
| Switching time (turn-on time)  | $t_{on}$  | $V_{DD} = -10\text{ V}$ , $I_D = -2.0\text{ A}$<br>$V_{GS} = 0\text{ to }-2.5\text{ V}$ , $R_G = 4.7\text{ }\Omega$ ,<br>Duty $\leq 1\%$ , Input: $t_r$ , $t_f < 5\text{ ns}$<br>Common source, See Chapter 5.3 | —   | 77   | —   | ns          |
| Switching time (turn-off time) | $t_{off}$ |                                                                                                                                                                                                                 | —   | 206  | —   |             |

### 5.3. Switching Time Test Circuit

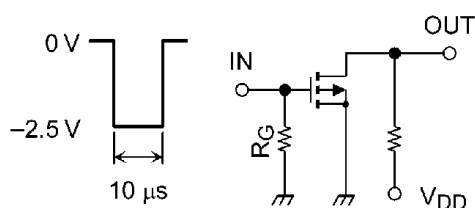


Fig. 5.3.1 Test Circuit of Switching Time

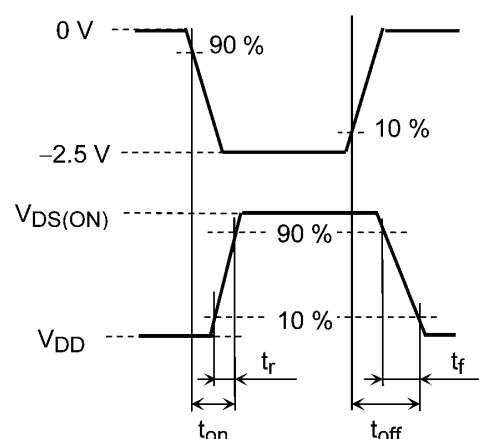


Fig. 5.3.2 Input Waveform/Output Waveform

5.4. Gate Charge Characteristics (T<sub>a</sub> = 25°C unless otherwise specified)

| Characteristics                                 | Symbol           | Test Condition                                                                | Min | Typ. | Max | Unit |
|-------------------------------------------------|------------------|-------------------------------------------------------------------------------|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | Q <sub>g</sub>   | V <sub>DD</sub> = -10 V, V <sub>GS</sub> = -4.5 V,<br>I <sub>D</sub> = -6.0 A | —   | 23.1 | —   | nC   |
| Gate-source charge 1                            | Q <sub>gs1</sub> |                                                                               | —   | 3.8  | —   |      |
| Gate-drain charge                               | Q <sub>gd</sub>  |                                                                               | —   | 4.1  | —   |      |

5.5. Source-Drain Characteristics (T<sub>a</sub> = 25°C unless otherwise specified)

| Characteristics                | Symbol           | Test Condition                                | Min | Typ. | Max | Unit |
|--------------------------------|------------------|-----------------------------------------------|-----|------|-----|------|
| Diode forward voltage (Note 1) | V <sub>DSF</sub> | I <sub>D</sub> = 6.0 A, V <sub>GS</sub> = 0 V | —   | 0.74 | 1.2 | V    |

Note 1: Pulse measurement.

6. Marking

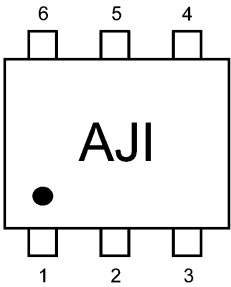


Fig. 6.1 Marking

## 7. Characteristics Curves (Note)

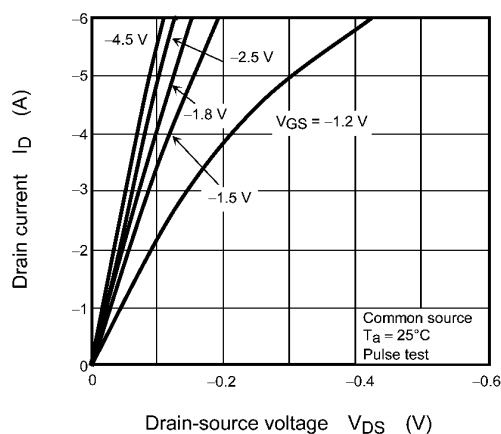


Fig. 7.1  $I_D - V_{DS}$

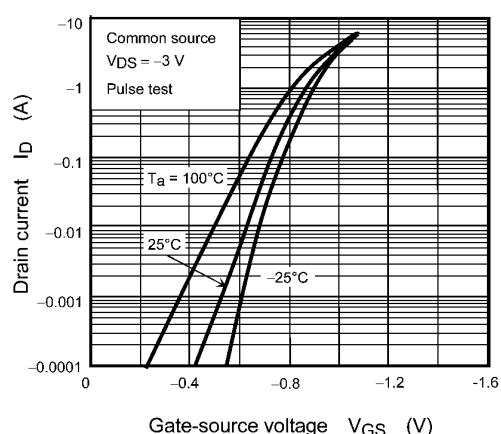


Fig. 7.2  $I_D - V_{GS}$

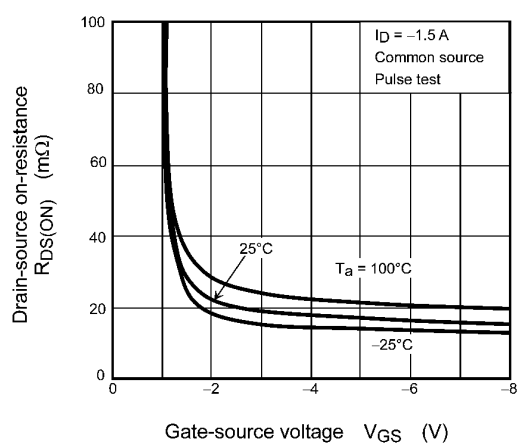


Fig. 7.3  $R_{DS(ON)} - V_{GS}$

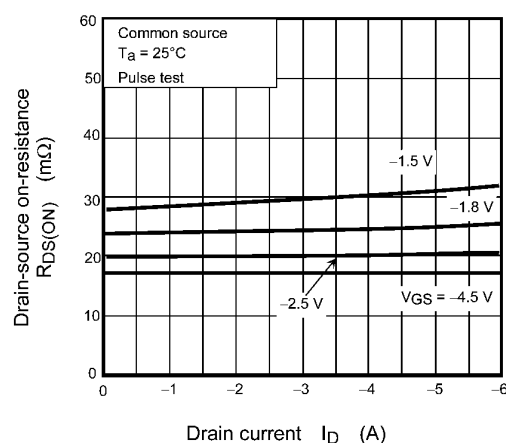


Fig. 7.4  $R_{DS(ON)} - I_D$

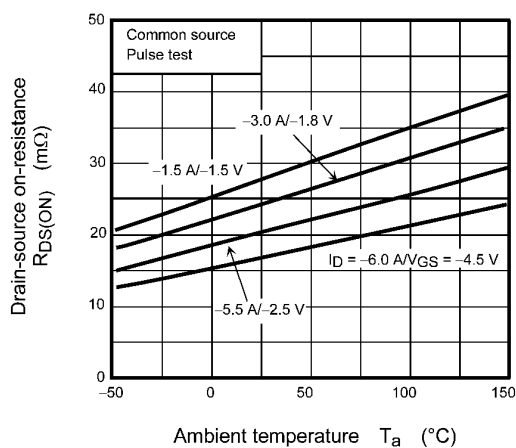


Fig. 7.5  $R_{DS(ON)} - T_A$

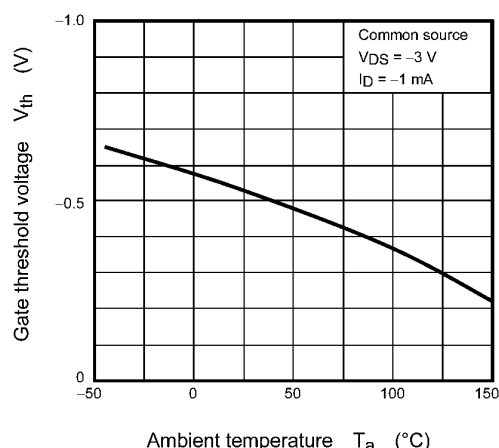


Fig. 7.6  $V_{th} - T_A$

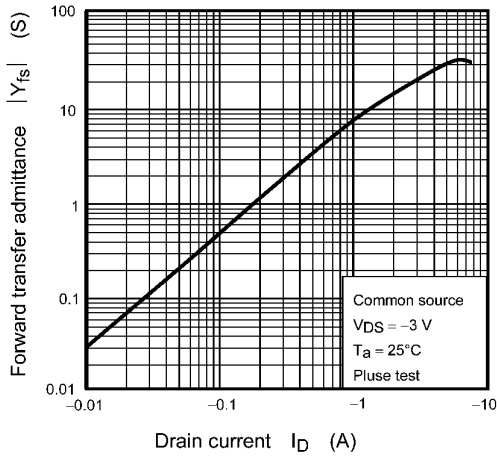


Fig. 7.7  $|Y_{fs}| - I_D$

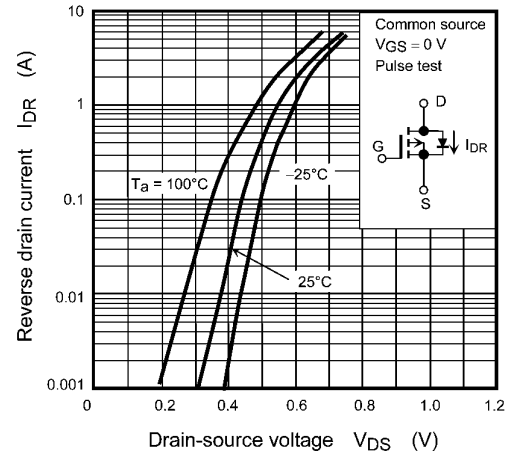


Fig. 7.8  $I_{DR} - V_{DS}$

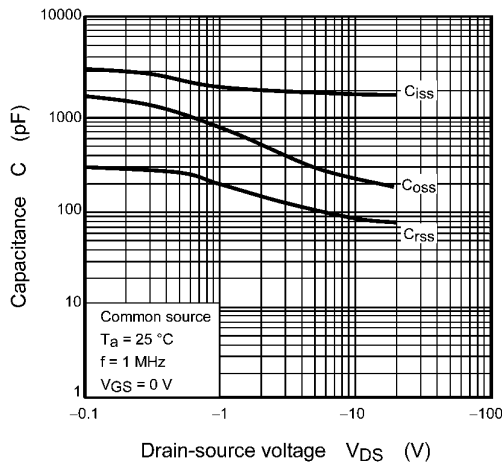


Fig. 7.9  $C - V_{DS}$

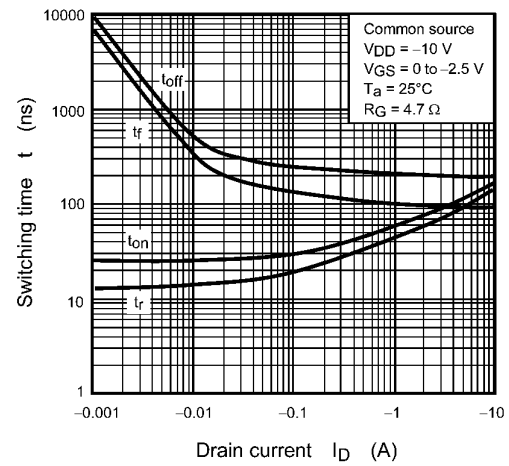


Fig. 7.10  $t - I_D$

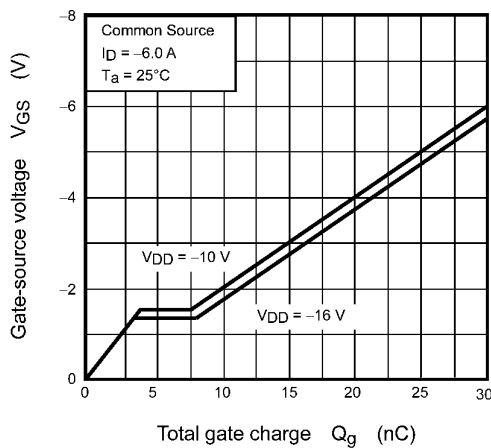


Fig. 7.11 Dynamic Input/Output Characteristics

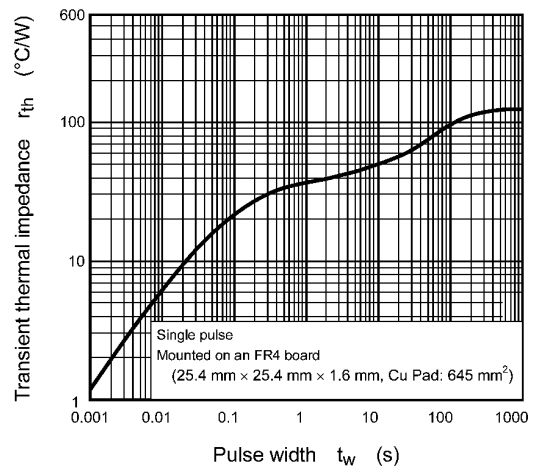


Fig. 7.12  $r_{th} - t_w$

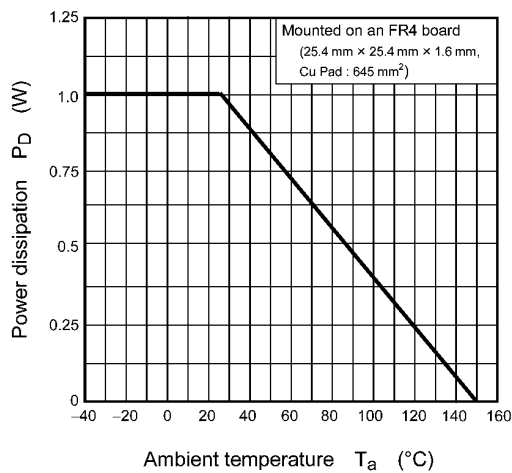


Fig. 7.13  $P_D - T_a$

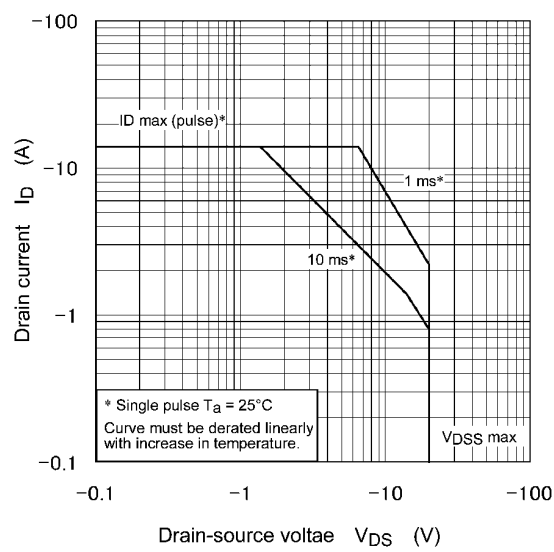
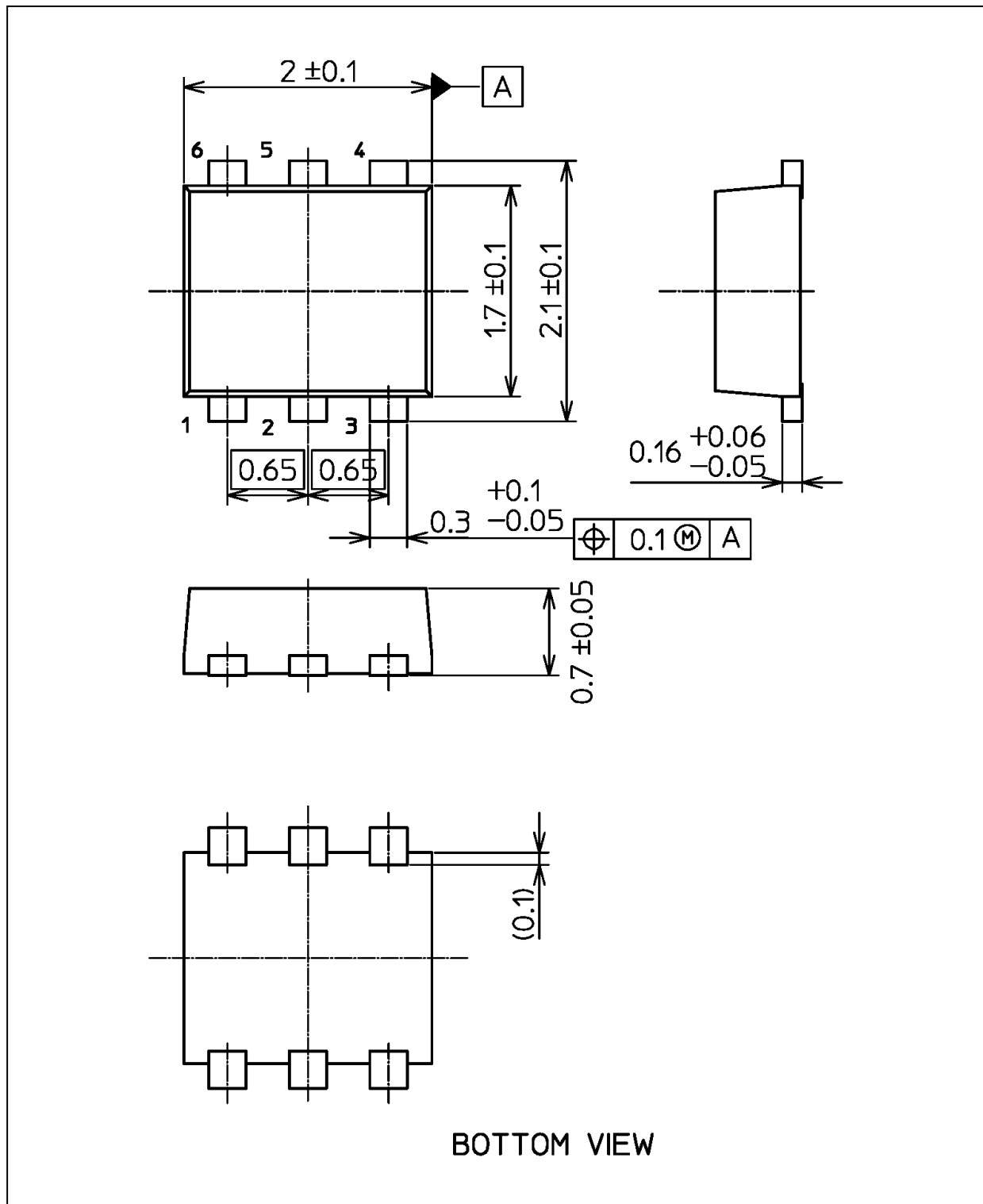


Fig. 7.14 Safe Operating Area

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

## Package Dimensions

Unit: mm



Weight: 7.0 mg (typ.)

| Package Name(s) |
|-----------------|
| TOSHIBA: 2-2T1S |
| Nickname: UF6   |



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**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

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