

# SSM3K7002CFU

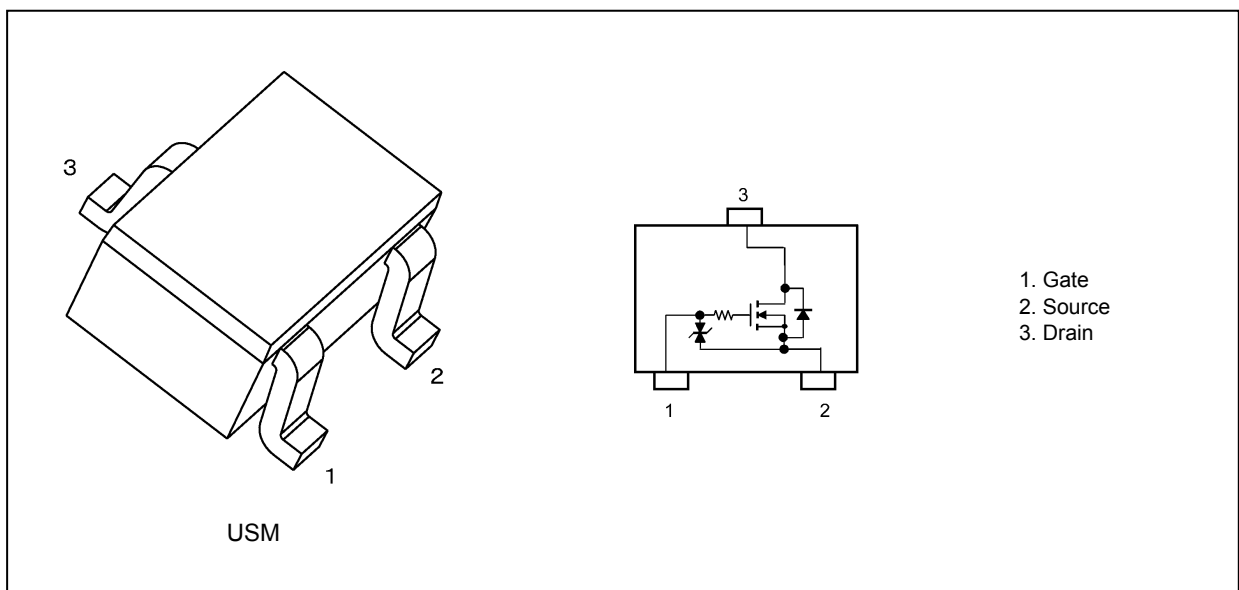
## 1. Applications

- High-Speed Switching

## 2. Features

- (1) Gate-Source diode for protection
- (2) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 2.8 \Omega$  (typ.) (@ $V_{GS} = 10 \text{ V}$ ,  $I_D = 100 \text{ mA}$ )
  - $R_{DS(ON)} = 3.1 \Omega$  (typ.) (@ $V_{GS} = 5 \text{ V}$ ,  $I_D = 100 \text{ mA}$ )
  - $R_{DS(ON)} = 3.2 \Omega$  (typ.) (@ $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 100 \text{ mA}$ )

## 3. Packaging and Pin Assignment



**4. Absolute Maximum Ratings (Note) (Unless otherwise specified, T<sub>a</sub> = 25 °C)**

| Characteristics                           | Symbol           | Rating     | Unit |
|---|------------------|------------|------|
| Drain-source voltage                      | V <sub>DSS</sub> | 60         | V    |
| Gate-source voltage                       | V <sub>GSS</sub> | ±20        |      |
| Drain current (DC) (Note 1)               | I <sub>D</sub>   | 170        | mA   |
| Drain current (pulsed) (Note 1), (Note 2) | I <sub>DP</sub>  | 680        |      |
| Power dissipation (Note 3)                | P <sub>D</sub>   | 150        | mW   |
| Power dissipation (Note 4)                |                  | 700        |      |
| Channel temperature                       | T <sub>ch</sub>  | 150        | °C   |
| Storage temperature                       | T <sub>stg</sub> | -55 to 150 | °C   |

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 μs, duty ≤ 1%

Note 3: Device mounted on an FR-4 board.(total dissipation)  
(25.4 mm × 25.4 mm × 1.6 mm ,Cu pad: 0.6 mm<sup>2</sup> × 3)

Note 4: Device mounted on an FR-4 board.(total dissipation)  
(25.4 mm × 25.4 mm × 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<sub>th(ch-a)</sub>, and the drain power dissipation, P<sub>D</sub>, 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 (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

| Characteristics                      | Symbol        | Test Condition   | Min | Typ. | Max       | Unit          |
|--------------------------------------|---------------|--|-----|------|-----------|---------------|
| Gate leakage current                 | $I_{GSS}$     | $V_{DS} = 0\text{ V}, V_{GS} = \pm 16\text{ V}$                              | —   | —    | $\pm 2$   | $\mu\text{A}$ |
|                                      |               | $V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$                              | —   | —    | $\pm 0.5$ |               |
|                                      |               | $V_{DS} = 0\text{ V}, V_{GS} = \pm 5\text{ V}$                               | —   | —    | $\pm 0.1$ |               |
| Drain cut-off current                | $I_{DSS}$     | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$                                  | —   | —    | 1         | $\mu\text{A}$ |
|                                      |               | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}, T_j = 150\text{ }^\circ\text{C}$ | —   | —    | 200       |               |
| Drain-source breakdown voltage       | $V_{(BR)DSS}$ | $I_D = 250\text{ }\mu\text{A}, V_{GS} = 0\text{ V}$                          | 60  | —    | —         | V             |
| Gate threshold voltage (Note 1)      | $V_{th}$      | $I_D = 250\text{ }\mu\text{A}, V_{DS} = V_{GS}$                              | 1.1 | —    | 2.1       | V             |
| Drain-source on-resistance (Note 2)  | $R_{DS(ON)}$  | $I_D = 100\text{ mA}, V_{GS} = 10\text{ V}$                                  | —   | 2.8  | 3.9       | $\Omega$      |
|                                      |               | $I_D = 100\text{ mA}, V_{GS} = 10\text{ V}, T_j = 150\text{ }^\circ\text{C}$ | —   | 5.4  | 8.1       |               |
|                                      |               | $I_D = 100\text{ mA}, V_{GS} = 5\text{ V}$                                   | —   | 3.1  | 4.4       |               |
|                                      |               | $I_D = 100\text{ mA}, V_{GS} = 4.5\text{ V}$                                 | —   | 3.2  | 4.7       |               |
| Forward transfer admittance (Note 2) | $ Y_{fs} $    | $V_{DS} = 10\text{ V}, I_D = 200\text{ mA}$                                  | —   | 450  | —         | mS            |

Note 1: Let  $V_{th}$  be the voltage applied between gate and source that causes the drain current ( $I_D$ ) to be below ( $250\text{ }\mu\text{A}$  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 2: Pulse measurement.

**5.2. Dynamic Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

| Characteristics                      | Symbol       | Test Condition  | Min | Typ. | Max | Unit        |
|--------------------------------------|--------------|---|-----|------|-----|-------------|
| Input capacitance                    | $C_{iss}$    | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$   | —   | 11   | 17  | $\text{pF}$ |
| Reverse transfer capacitance         | $C_{rss}$    |   | —   | 0.7  | —   |             |
| Output capacitance                   | $C_{oss}$    |   | —   | 3    | —   |             |
| Switching time (turn-on delay time)  | $t_{d(on)}$  | $V_{DD} = 40\text{ V}, I_D = 160\text{ mA}, V_{GS} = 0\text{ to }10\text{ V}, R_G = 50\text{ }\Omega$ | —   | 2    | 4   | ns          |
| Switching time (rise time)           | $t_r$        |   | —   | 3    | —   |             |
| Switching time (turn-off delay time) | $t_{d(off)}$ |   | —   | 7    | 14  |             |
| Switching time (fall time)           | $t_f$        |   | —   | 24   | —   |             |

**5.3. Switching Time Test Circuit**

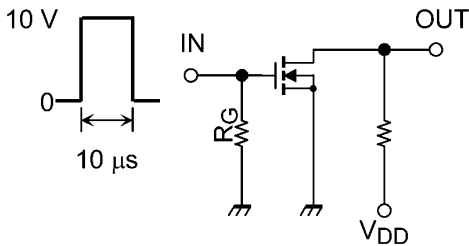


Fig. 5.3.1 Switching Time Test Circuit

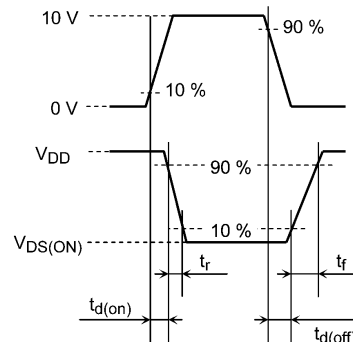


Fig. 5.3.2 Input Waveform/Output Waveform

**5.4. Gate Charge Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

| Characteristics                                 | Symbol   | Test Condition  | Min | Typ. | Max  | Unit |
|---|----------|---|-----|------|------|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$    | $V_{DS} = 30\text{ V}$ , $I_D = 200\text{ mA}$ ,<br>$V_{GS} = 4.5\text{ V}$ | —   | 0.27 | 0.35 | nC   |
| Gate-source charge                              | $Q_{gs}$ |   | —   | 0.08 | —    |      |
| Gate-drain charge                               | $Q_{gd}$ |   | —   | 0.08 | —    |      |

**5.5. Source-Drain Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

| Characteristics                | Symbol    | Test Condition                                 | Min | Typ.  | Max  | Unit |
|--------------------------------|-----------|--|-----|-------|------|------|
| Diode forward voltage (Note 1) | $V_{DSF}$ | $I_D = -115\text{ mA}$ , $V_{GS} = 0\text{ V}$ | —   | -0.87 | -1.2 | V    |

Note 1: Pulse measurement.

**6. Marking**

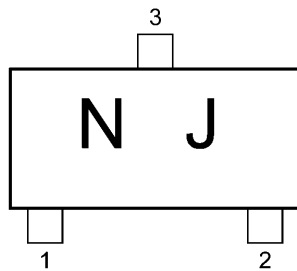
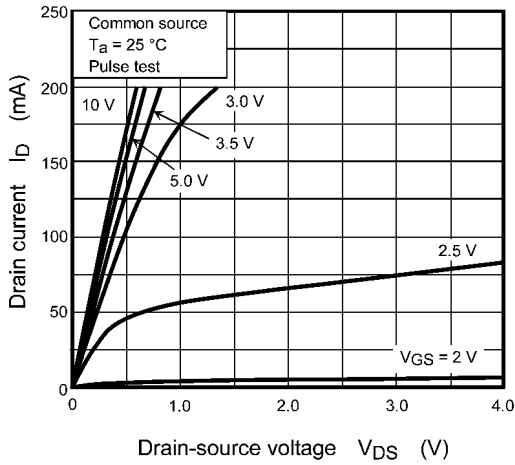
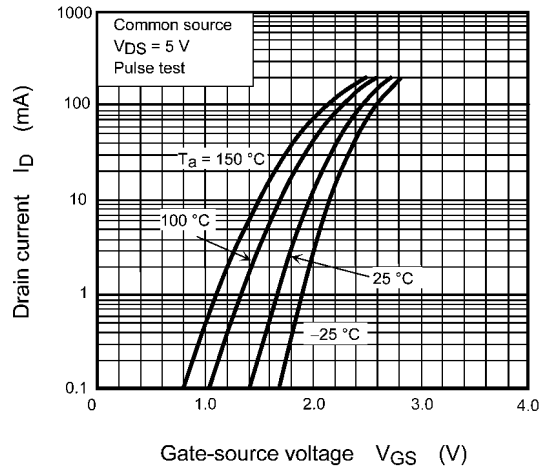


Fig. 6.1 Marking

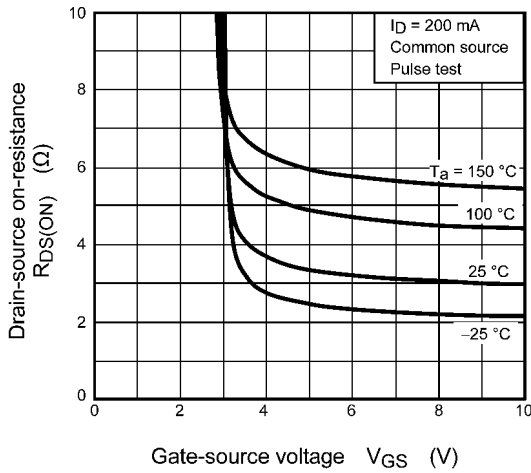
**7. Characteristics Curves (Note)**



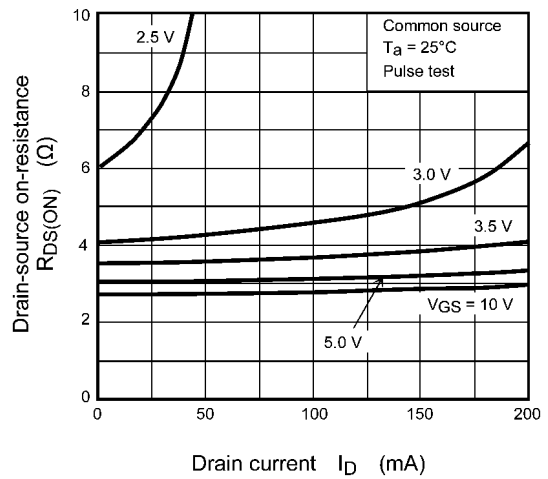
**Fig. 7.1  $I_D - V_{DS}$**



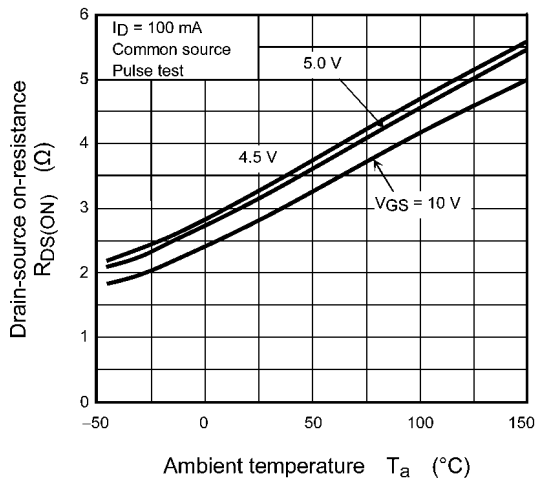
**Fig. 7.2  $I_D - V_{GS}$**



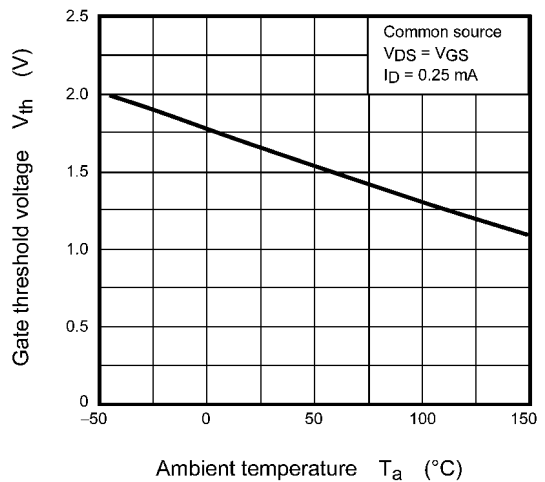
**Fig. 7.3  $R_{DS(ON)} - V_{GS}$**



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



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



**Fig. 7.6  $V_{th} - T_a$**

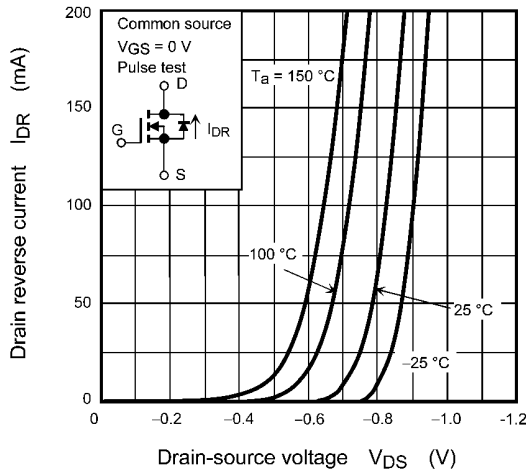


Fig. 7.7  $I_{DR} - V_{DS}$

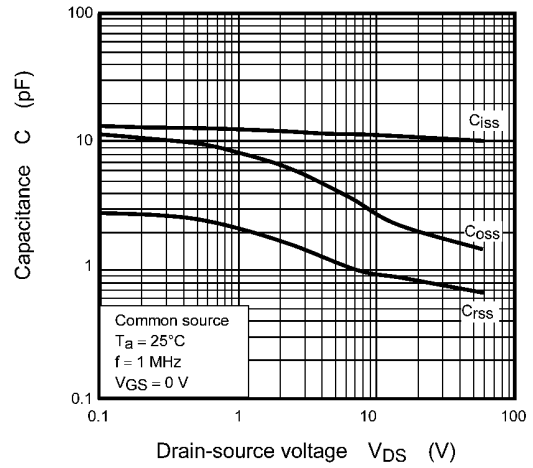


Fig. 7.8  $C - V_{DS}$

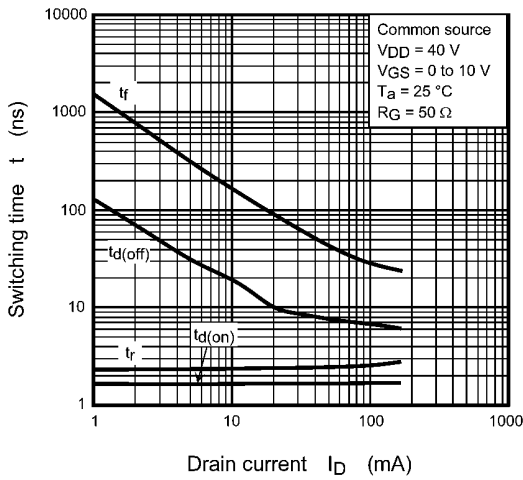


Fig. 7.9  $t - I_D$

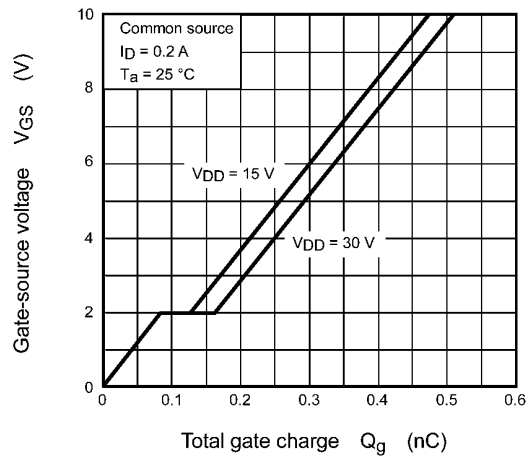


Fig. 7.10 Dynamic Input Characteristics

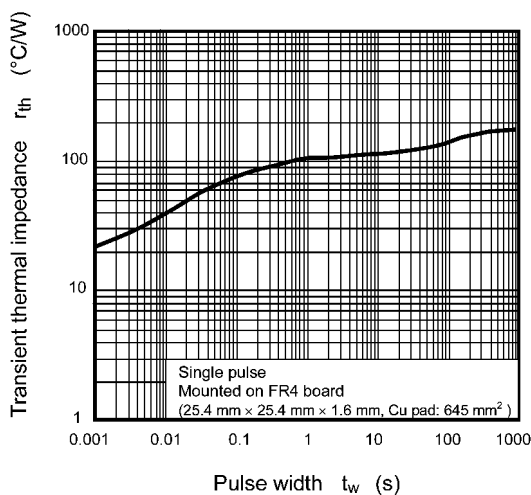


Fig. 7.11  $r_{th} - t_w$

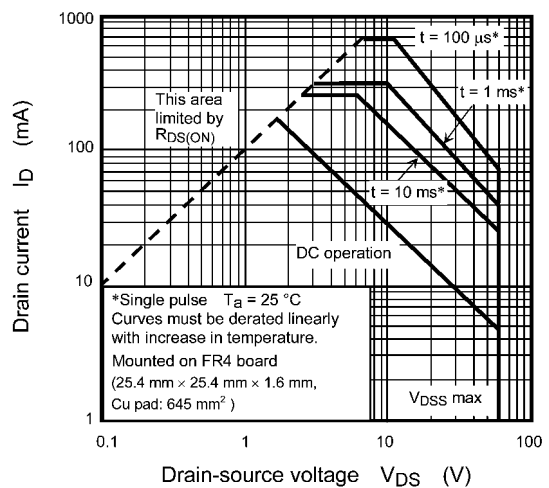
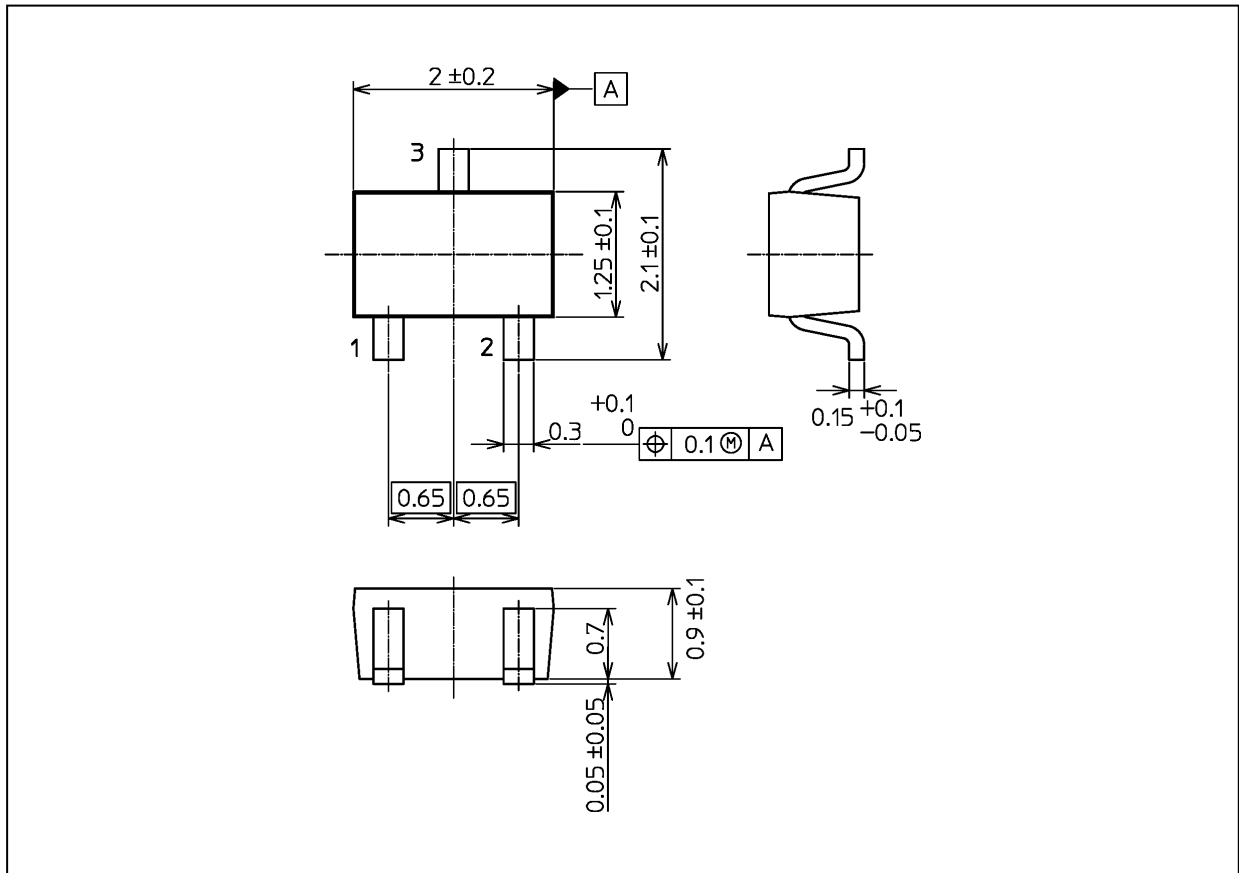


Fig. 7.12 Safe Operating Area

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

Package Dimensions

Unit: mm



Weight: 6.0 mg (typ.)

|                 |
|-----------------|
| Package Name(s) |
| Nickname: USM   |

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