

# SSM6K514NU

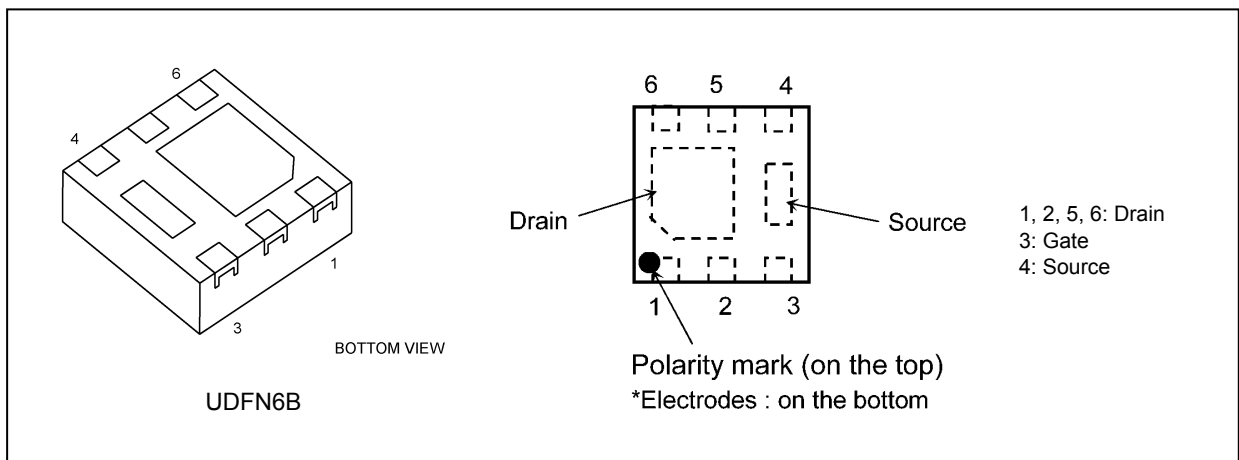
## 1. Applications

- Power Management Switches

## 2. Features

- (1) 4.5 V drive
- (2) Low drain-source on-resistance  
 :  $R_{DS(ON)} = 11.2 \text{ m}\Omega$  (typ.) (@ $V_{GS} = 4.5 \text{ V}$ )  
 $R_{DS(ON)} = 8.9 \text{ m}\Omega$  (typ.) (@ $V_{GS} = 10 \text{ V}$ )

## 3. Packaging and Pin Assignment



Start of commercial production

2016-05

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

| Characteristics                        | Symbol    | Rating     | Unit |
|----------------------------------------|-----------|------------|------|
| Drain-source voltage                   | $V_{DSS}$ | 40         | V    |
| Gate-source voltage                    | $V_{GSS}$ | $\pm 20$   |      |
| Drain current (DC)                     | $I_D$     | 12         | A    |
| Drain current (pulsed) (Note 1)        | $I_{DP}$  | 50         |      |
| Power dissipation (Note 2)             | $P_D$     | 1.25       | W    |
| Power dissipation (t ≤ 10 s) (Note 2)  |           | 2.5        |      |
| Single-pulse avalanche energy (Note 3) | $E_{AS}$  | 49.1       | mJ   |
| Avalanche current                      | $I_{AR}$  | 7          | A    |
| Channel temperature                    | $T_{ch}$  | 150        | °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: Pulse width (PW) ≤ 10 μs, duty = 1 %

Note 2: Device mounted on a FR4 board.

(25.4 mm × 25.4 mm × 1.6 mm, Cu Pad: 645 mm<sup>2</sup>)

Note 3:  $V_{DD} = 32\text{ V}$ ,  $T_{ch} = 25\text{ }^\circ\text{C}$  (Initial state),  $L = 1\text{ mH}$ ,  $R_G = 25\text{ }\Omega$

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.

**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                    | $I_{GSS}$     | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$ | —   | —    | $\pm 100$ | nA            |
| Drain cut-off current                   | $I_{DSS}$     | $V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$     | —   | —    | 1         | $\mu\text{A}$ |
| Drain-source breakdown voltage          | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$       | 40  | —    | —         | V             |
| Drain-source breakdown voltage (Note 1) | $V_{(BR)DSX}$ | $I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$     | 37  | —    | —         |               |
| Gate threshold voltage (Note 2)         | $V_{th}$      | $V_{DS} = 10\text{ V}, I_D = 0.1\text{ mA}$     | 1.4 | —    | 2.4       |               |
| Drain-source on-resistance (Note 3)     | $R_{DS(ON)}$  | $I_D = 4\text{ A}, V_{GS} = 4.5\text{ V}$       | —   | 11.2 | 17.3      | m $\Omega$    |
|                                         |               | $I_D = 4\text{ A}, V_{GS} = 10\text{ V}$        | —   | 8.9  | 11.6      |               |
| Forward transfer admittance (Note 3)    | $ Y_{fs} $    | $V_{DS} = 10\text{ V}, I_D = 2\text{ A}$        | —   | 6.8  | —         | 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 be below (0.1 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              | $C_{iss}$ | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$                                                                                                                          | —   | 1110 | —   | pF   |
| Reverse transfer capacitance   | $C_{rss}$ |                                                                                                                                                                                             | —   | 26   | —   |      |
| Output capacitance             | $C_{oss}$ |                                                                                                                                                                                             | —   | 245  | —   |      |
| Switching time (turn-on time)  | $t_{on}$  | $V_{DD} = 20\text{ V}, I_D = 1.0\text{ A}$<br>$V_{GS} = 0\text{ to }4.5\text{ V}, R_G = 30\ \Omega,$<br>Duty $\leq 1\%$ , Input: $t_r, t_f < 5\text{ ns}$<br>Ground source, See Chapter 5.3 | —   | 24   | —   | ns   |
| Switching time (turn-off time) | $t_{off}$ |                                                                                                                                                                                             | —   | 35   | —   |      |

**5.3. Switching Time Test Circuit**

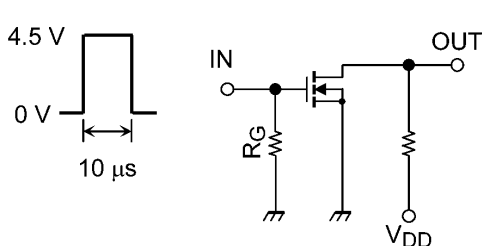


Fig. 5.3.1 Test Circuit of Switching Time

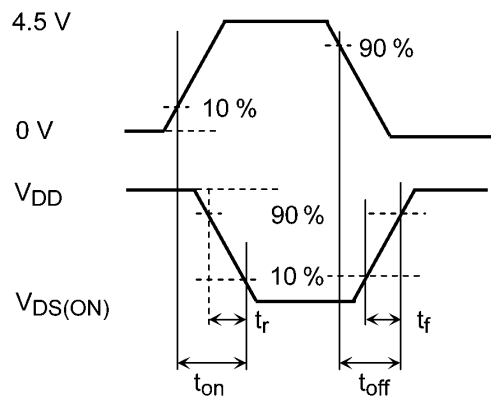


Fig. 5.3.2 Input Waveform/Output Waveform

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

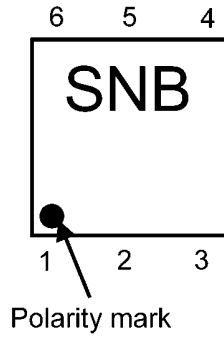
| Characteristics                                 | Symbol    | Test Condition                                                        | Min | Typ. | Max | Unit |
|-------------------------------------------------|-----------|-----------------------------------------------------------------------|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$     | $V_{DD} = 20\text{ V}, V_{GS} = 4.5\text{ V},$<br>$I_D = 12\text{ A}$ | —   | 7.5  | —   | nC   |
| Gate-source charge 1                            | $Q_{gs1}$ |                                                                       | —   | 2.9  | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |                                                                       | —   | 2.8  | —   |      |

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

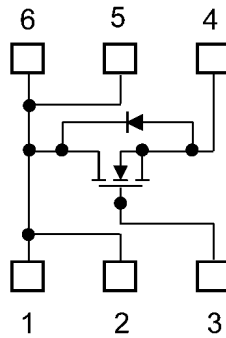
| Characteristics                | Symbol    | Test Condition                             | Min | Typ.  | Max  | Unit |
|--------------------------------|-----------|--------------------------------------------|-----|-------|------|------|
| Diode forward voltage (Note 1) | $V_{DSF}$ | $I_D = -4.0\text{ A}, V_{GS} = 0\text{ V}$ | —   | -0.74 | -1.2 | V    |

Note 1: Pulse measurement.

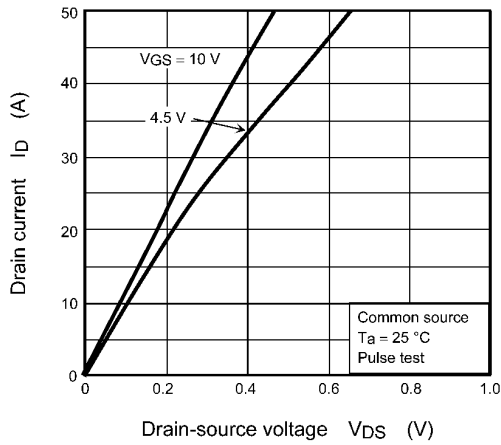
**6. Marking**



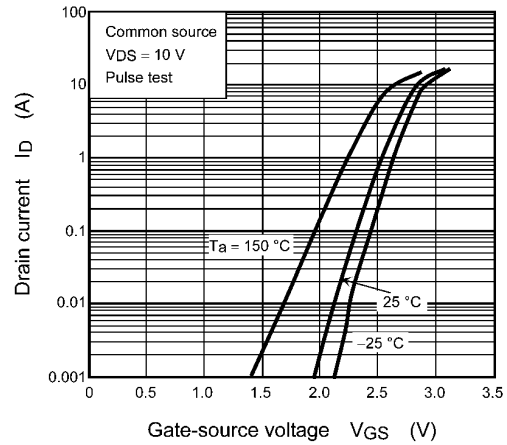
**7. Internal Circuit**



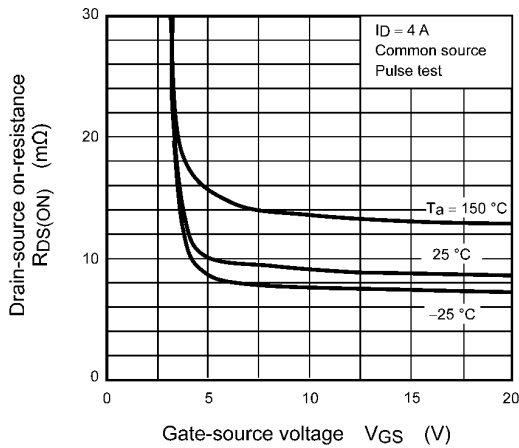
**8. Characteristics Curves (Note)**



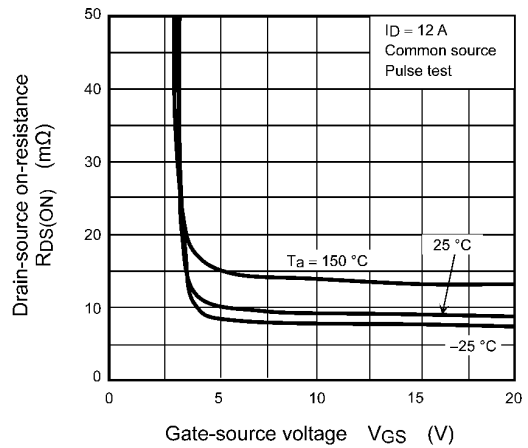
**Fig. 8.1  $I_D - V_{DS}$**



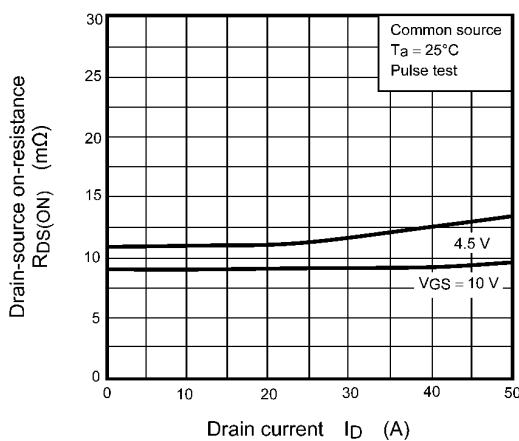
**Fig. 8.2  $I_D - V_{GS}$**



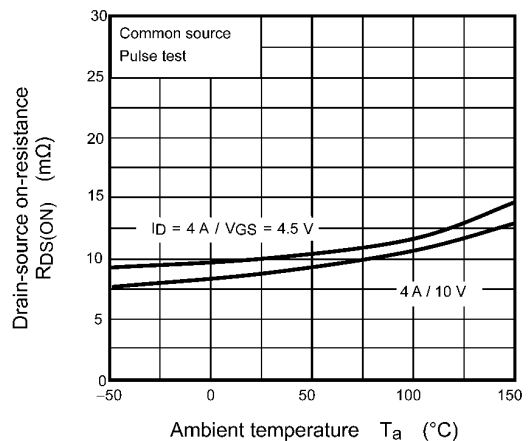
**Fig. 8.3  $R_{DS(ON)} - V_{GS}$**



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



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



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

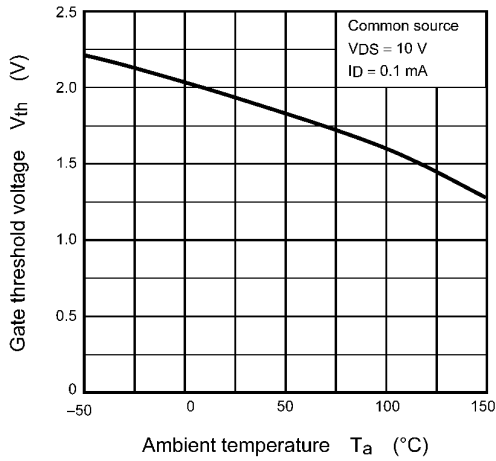


Fig. 8.7  $V_{th} - T_a$

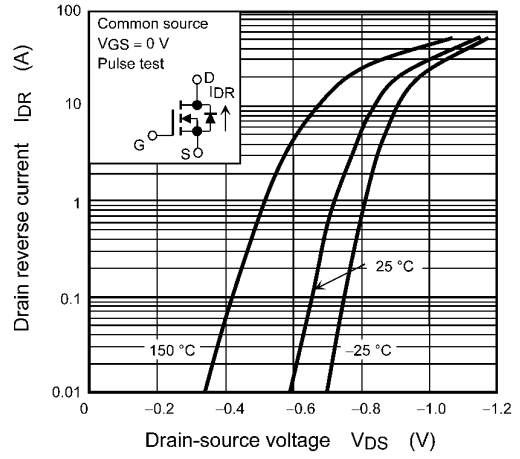


Fig. 8.8  $I_{DR} - V_{DS}$

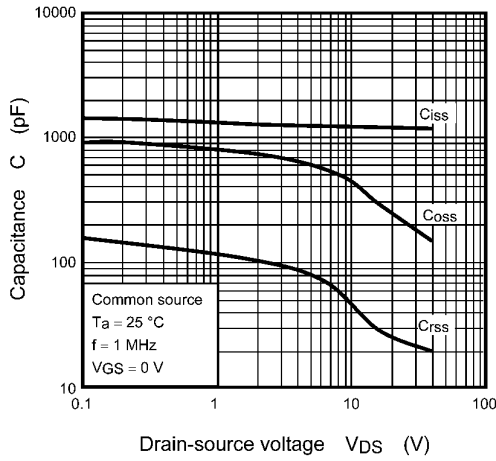


Fig. 8.9  $C - V_{DS}$

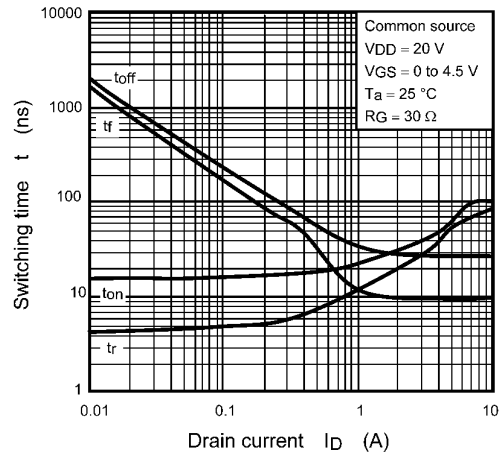


Fig. 8.10  $t - I_D$

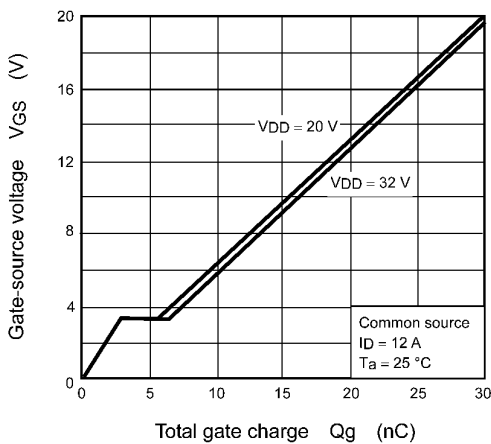


Fig. 8.11 Dynamic Input Characteristics

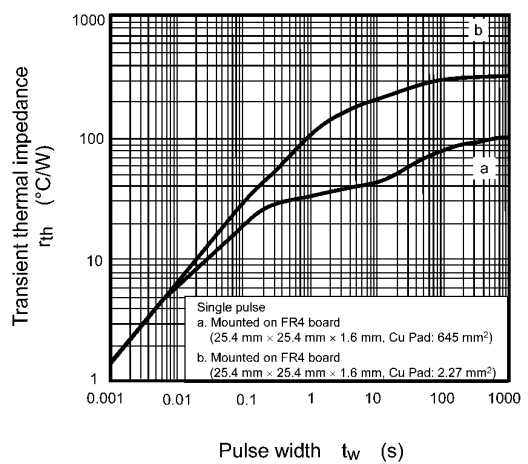
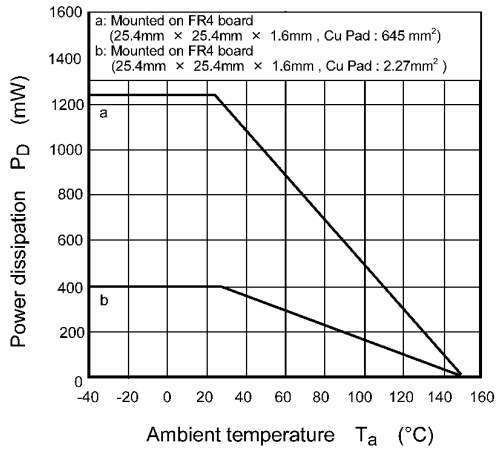
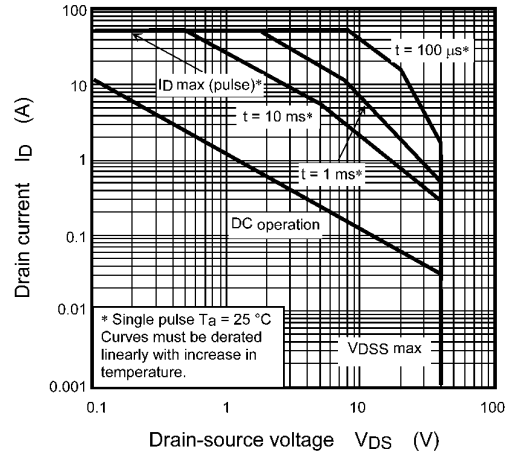


Fig. 8.12  $r_{th} - t_w$



**Fig. 8.13  $P_D - T_a$**

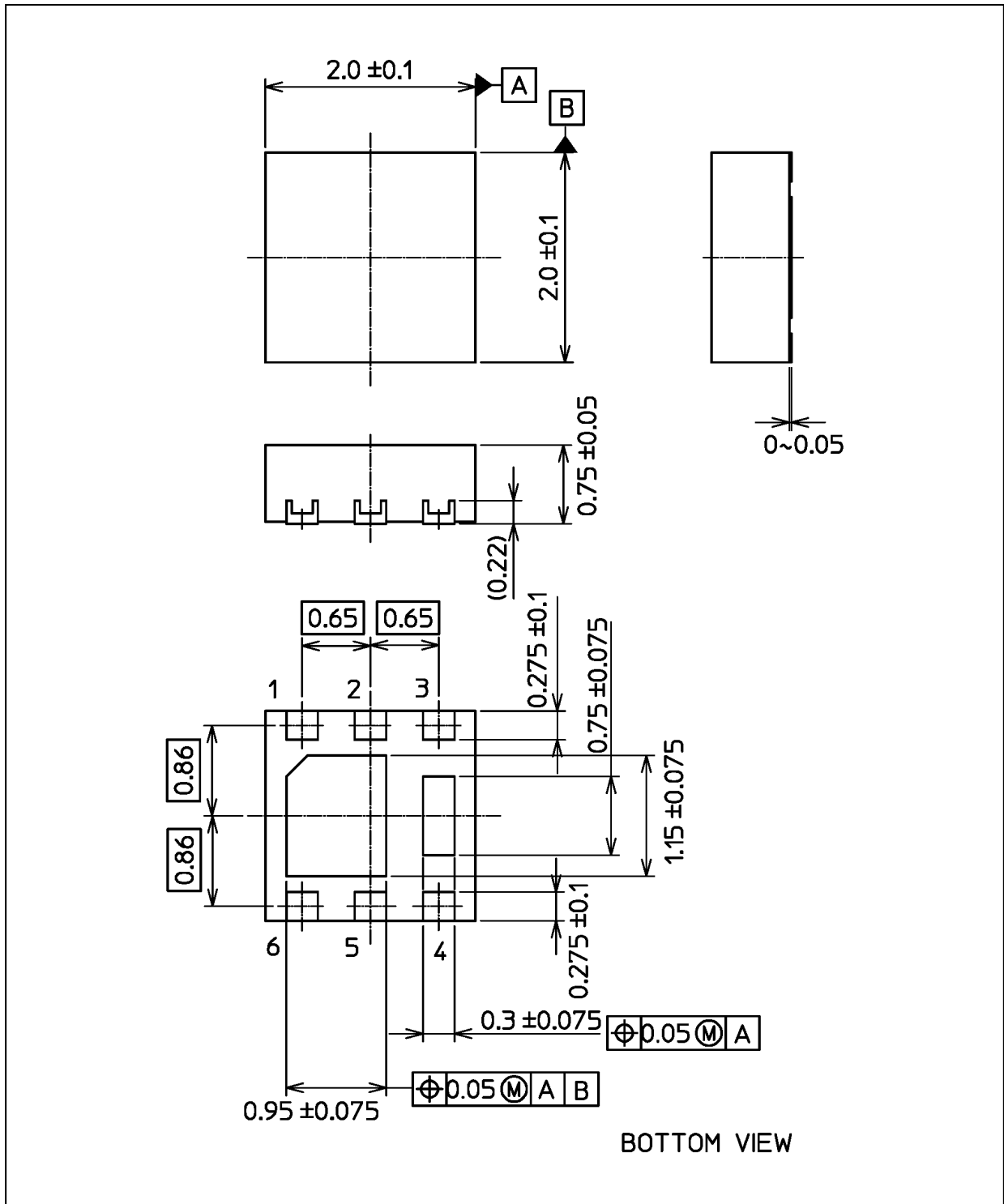


**Fig. 8.14 Safe Operating Area**

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

Package Dimensions

Unit: mm



Weight: 8.5 mg (typ.)

|                  |
|------------------|
| Package Name(s)  |
| JEDEC: SOT-1220  |
| Nickname: UDFN6B |



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