

MOSFETs Silicon N-Channel MOS (U-MOS<sup>™</sup> VII-H)

# SSM6K516NU

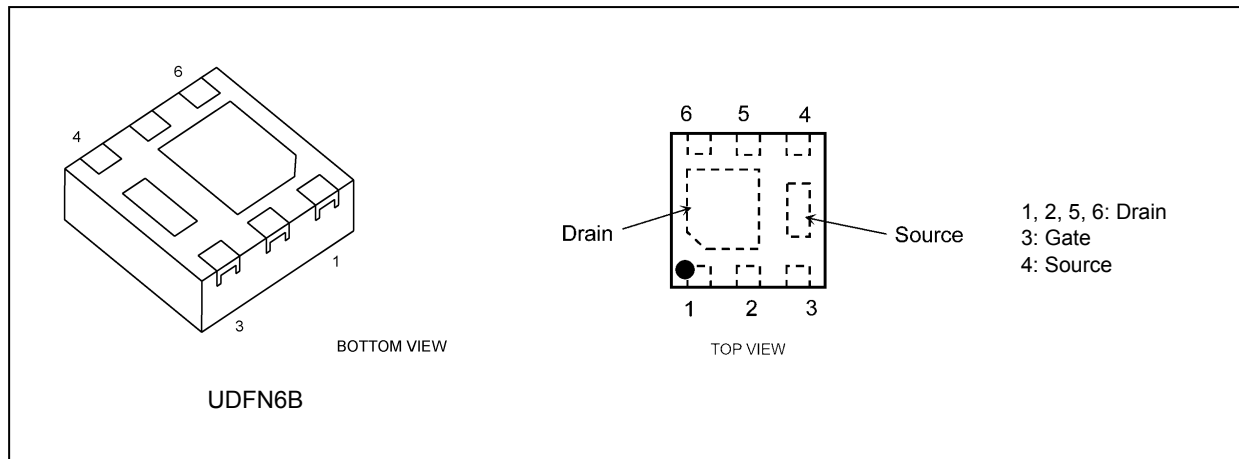
## 1. Applications

- Power Management Switches
- High-Speed Switching

## 2. Features

- (1) 4.5-V drive
- (2) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 46 \text{ m}\Omega$  (max) (@ $V_{GS} = 10 \text{ V}$ )
  - $R_{DS(ON)} = 64 \text{ m}\Omega$  (max) (@ $V_{GS} = 4.5 \text{ V}$ )

## 3. Packaging and Pin Assignment



Start of commercial production  
2020-04

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

| Characteristics                                     | Symbol    | Rating     | Unit               |
|---|-----------|------------|--------------------|
| Drain-source voltage                                | $V_{DS}$  | 30         | V                  |
| Gate-source voltage                                 | $V_{GS}$  | +20/-12    |                    |
| Drain current (DC) (Note 1), (Note 4)               | $I_D$     | 6          | A                  |
| Drain current (pulsed) (Note 1), (Note 2)           | $I_{DP}$  | 24         |                    |
| Power dissipation (Note 3)                          | $P_D$     | 1.25       | W                  |
| Power dissipation ( $t \leq 10\text{ s}$ ) (Note 3) |           | 2.5        |                    |
| Channel temperature                                 | $T_{ch}$  | 150        | $^{\circ}\text{C}$ |
| Storage temperature                                 | $T_{stg}$ | -55 to 150 | $^{\circ}\text{C}$ |

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  $150\text{ }^{\circ}\text{C}$ .

Note 2: Pulse width (PW)  $\leq 1\text{ ms}$ , duty = 1 %

Note 3: Device mounted on a  $25.4\text{ mm} \times 25.4\text{ mm} \times 1.6\text{ mm}$  FR4 glass epoxy board (Cu pad:  $645\text{ mm}^2$ )

Note 4: The maximum current rating is package limited.

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

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. Thermal Characteristics

| Characteristics                                | Symbol         | Max | Unit                 |
|--|----------------|-----|----------------------|
| Channel-to-ambient thermal resistance (Note 1) | $R_{th(ch-a)}$ | 100 | $^{\circ}\text{C/W}$ |

Note 1: Device mounted on an  $25.4\text{ mm} \times 25.4\text{ mm} \times 1.6\text{ mm}$  FR4 glass epoxy board (Cu pad:  $645\text{ mm}^2$ )

### 6. Electrical Characteristics

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

| Characteristics                         | Symbol        | Test Condition                                      | Min | Typ. | Max      | Unit             |
|---|---------------|---|-----|------|----------|------------------|
| Gate leakage current                    | $I_{GSS}$     | $V_{DS} = 0\text{ V}$ , $V_{GS} = +20/-12\text{ V}$ | —   | —    | $\pm 10$ | $\mu\text{A}$    |
| Drain cut-off current                   | $I_{DSS}$     | $V_{DS} = 30\text{ V}$ , $V_{GS} = 0\text{ V}$      | —   | —    | 1        |                  |
| Drain-source breakdown voltage          | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}$ , $V_{GS} = 0\text{ V}$        | 30  | —    | —        | V                |
| Drain-source breakdown voltage (Note 1) | $V_{(BR)DSX}$ | $I_D = 10\text{ mA}$ , $V_{GS} = -12\text{ V}$      | 18  | —    | —        |                  |
| Gate threshold voltage (Note 2)         | $V_{th}$      | $V_{DS} = 10\text{ V}$ , $I_D = 0.1\text{ mA}$      | 1.3 | —    | 2.5      |                  |
| Drain-source on-resistance (Note 3)     | $R_{DS(ON)}$  | $I_D = 4.0\text{ A}$ , $V_{GS} = 10\text{ V}$       | —   | 33   | 46       | $\text{m}\Omega$ |
|   |               | $I_D = 2.0\text{ A}$ , $V_{GS} = 4.5\text{ V}$      | —   | 48   | 64       |                  |
| Forward transfer admittance (Note 3)    | $ Y_{fs} $    | $V_{DS} = 10\text{ V}$ , $I_D = 1.0\text{ A}$       | —   | 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 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.

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

| Characteristics                | Symbol    | Test Condition   | Min | Typ. | Max | Unit |
|--------------------------------|-----------|--|-----|------|-----|------|
| Input capacitance              | $C_{iss}$ | $V_{DS} = 15\text{ V}$ , $V_{GS} = 0\text{ V}$ ,<br>$f = 1\text{ MHz}$   | —   | 280  | —   | pF   |
| Reverse transfer capacitance   | $C_{rss}$ |  | —   | 20   | —   |      |
| Output capacitance             | $C_{oss}$ |  | —   | 53   | —   |      |
| Switching time (turn-on time)  | $t_{on}$  | $V_{DD} = 15\text{ V}$ , $I_D = 0.5\text{ A}$ ,<br>$V_{GS} = 0\text{ to }4.5\text{ V}$ , $R_{GS} = 10\text{ }\Omega$<br>Duty $\leq 1\%$ , Input: $t_r$ , $t_f < 5\text{ ns}$ ,<br>Common source,<br>See Chapter 6.3. | —   | 15   | —   | ns   |
| Switching time (turn-off time) | $t_{off}$ |  | —   | 12   | —   |      |

#### 6.3. Switching Time Test Circuit

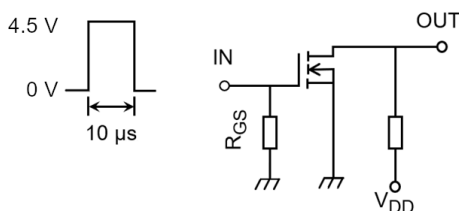


Fig. 6.3.1 Switching Time Test Circuit

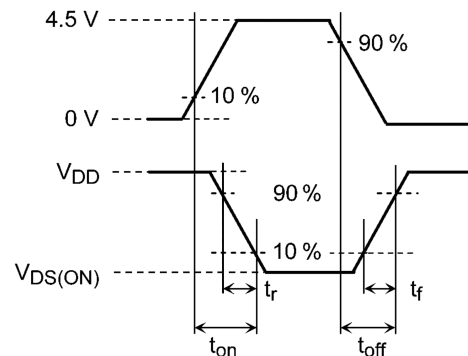


Fig. 6.3.2 Input Waveform/Output Waveform

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

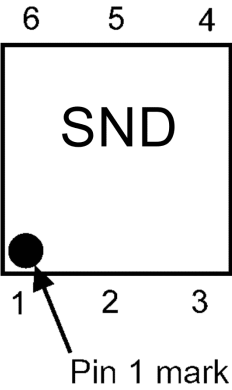
| Characteristics                                 | Symbol    | Test Condition   | Min | Typ. | Max | Unit |
|---|-----------|--|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$     | $V_{DD} = 15\text{ V}$ , $I_D = 4\text{ A}$ ,<br>$V_{GS} = 4.5\text{ V}$ | —   | 2.5  | —   | nC   |
| Gate-source charge 1                            | $Q_{gs1}$ |  | —   | 1.6  | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |  | —   | 0.5  | —   |      |

6.5. Source-Drain Characteristics (Unless otherwise specified, T<sub>a</sub> = 25 °C)

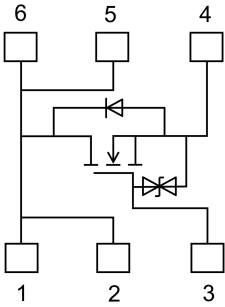
| Characteristics                | Symbol           | Test Condition                                 | Min | Typ. | Max | Unit |
|--------------------------------|------------------|--|-----|------|-----|------|
| Diode forward voltage (Note 1) | V <sub>DSF</sub> | I <sub>DR</sub> = 4.0 A, V <sub>GS</sub> = 0 V | —   | 0.85 | 1.2 | V    |

Note 1: Pulse measurement.

7. Marking



8. Internal Circuit



### 9. Characteristics Curves (Note)

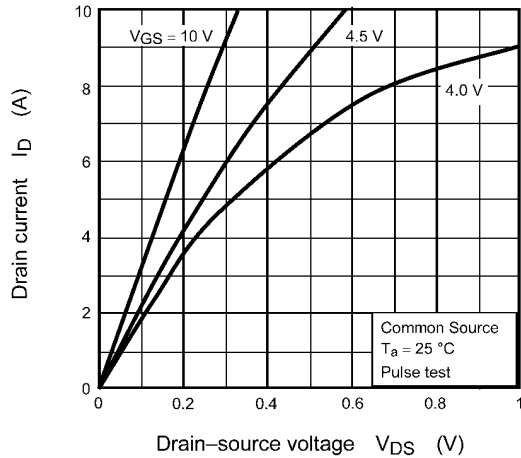


Fig. 9.1  $I_D - V_{DS}$

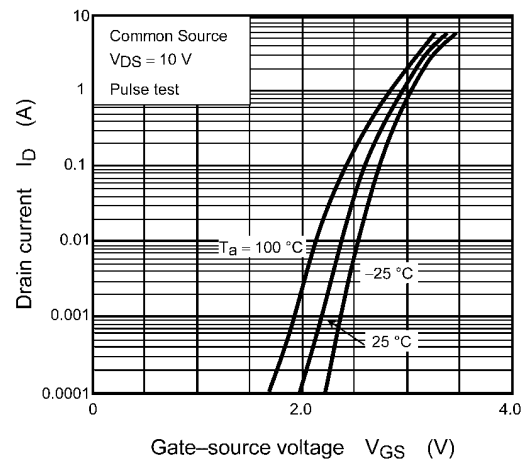


Fig. 9.2  $I_D - V_{GS}$

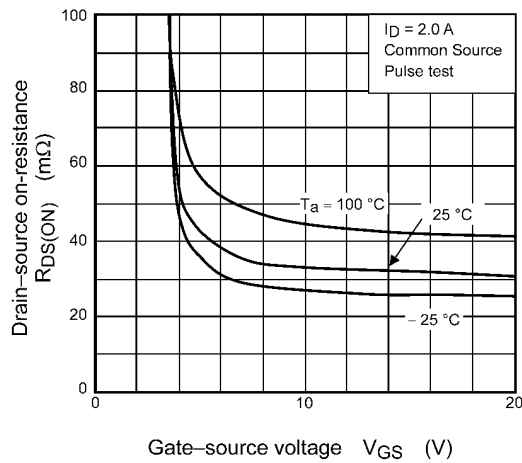


Fig. 9.3  $R_{DS(ON)} - V_{GS}$

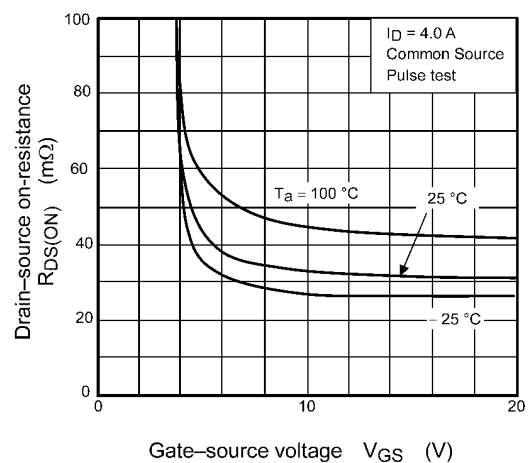


Fig. 9.4  $R_{DS(ON)} - V_{GS}$

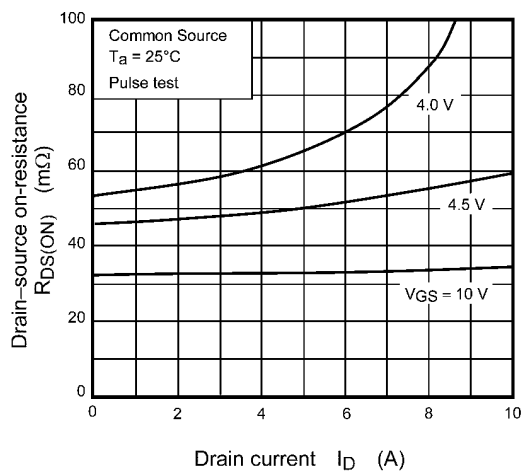


Fig. 9.5  $R_{DS(ON)} - I_D$

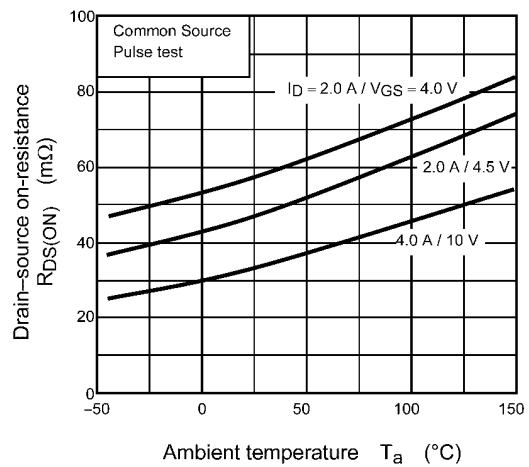


Fig. 9.6  $R_{DS(ON)} - T_a$

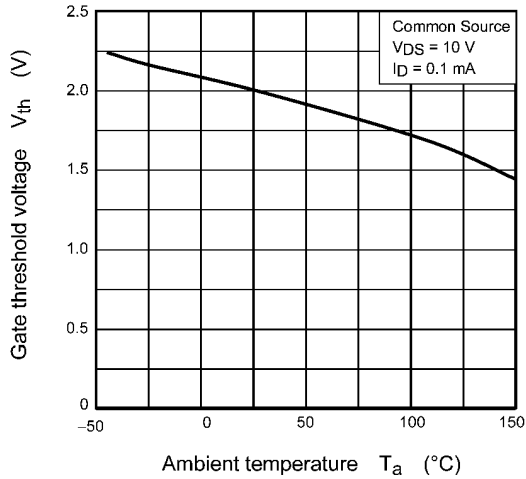


Fig. 9.7  $V_{th} - T_a$

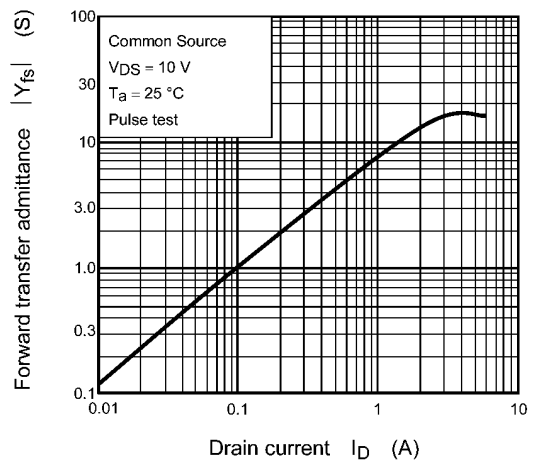


Fig. 9.8  $|Y_{fs}| - I_D$

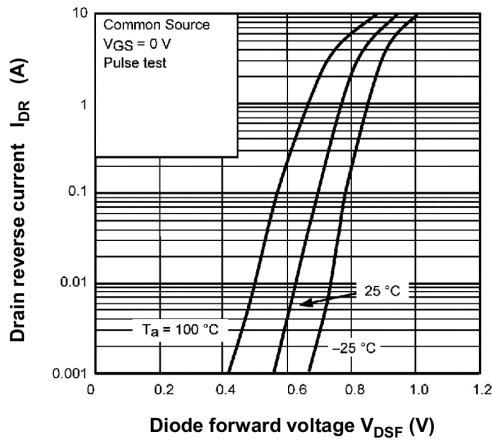


Fig. 9.9  $I_{DR} - V_{DSF}$

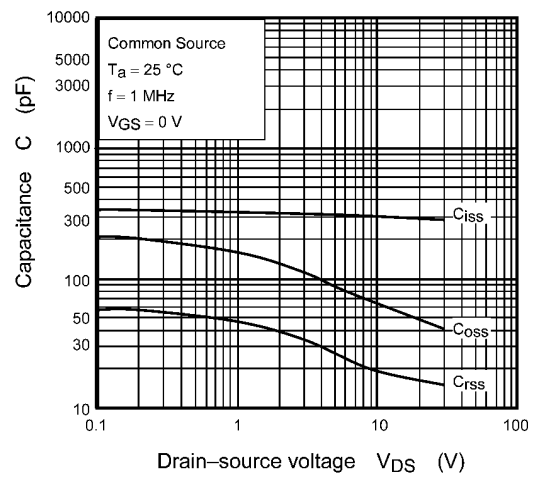


Fig. 9.10  $C - V_{DS}$

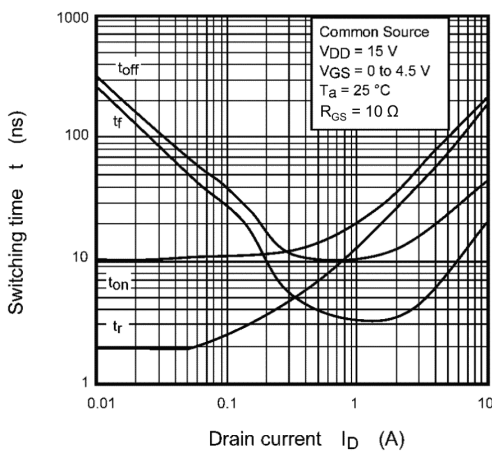


Fig. 9.11  $t - I_D$

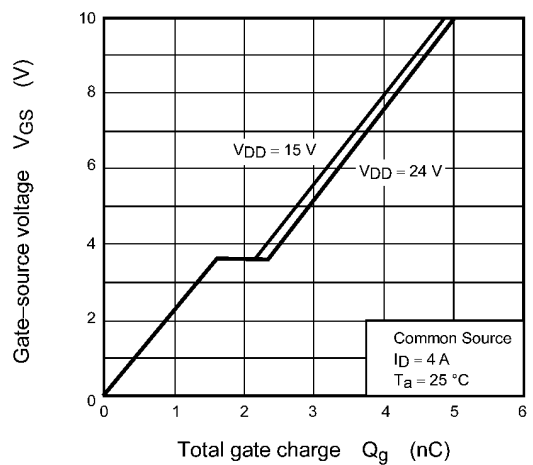


Fig. 9.12 Dynamic Input Characteristics

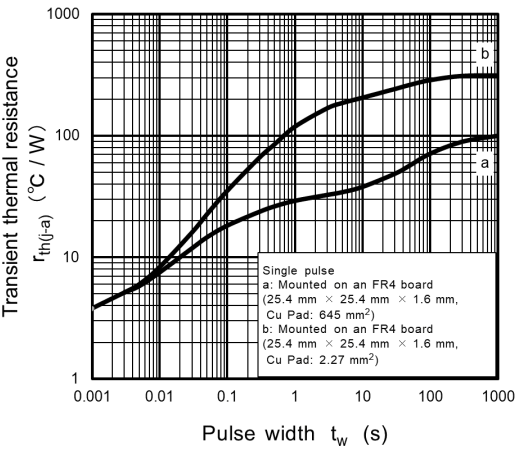


Fig. 9.13  $r_{th(j-a)} - t_w$

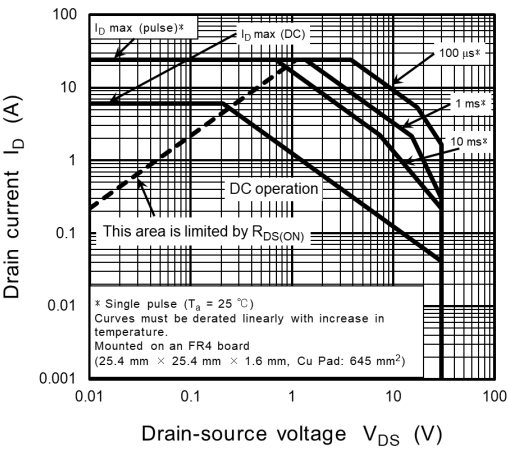


Fig. 9.14 Safe Operating Area

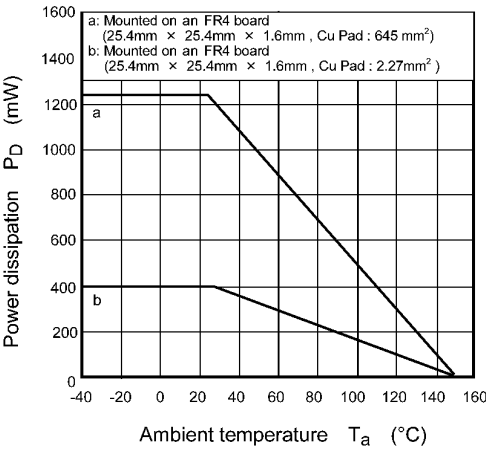
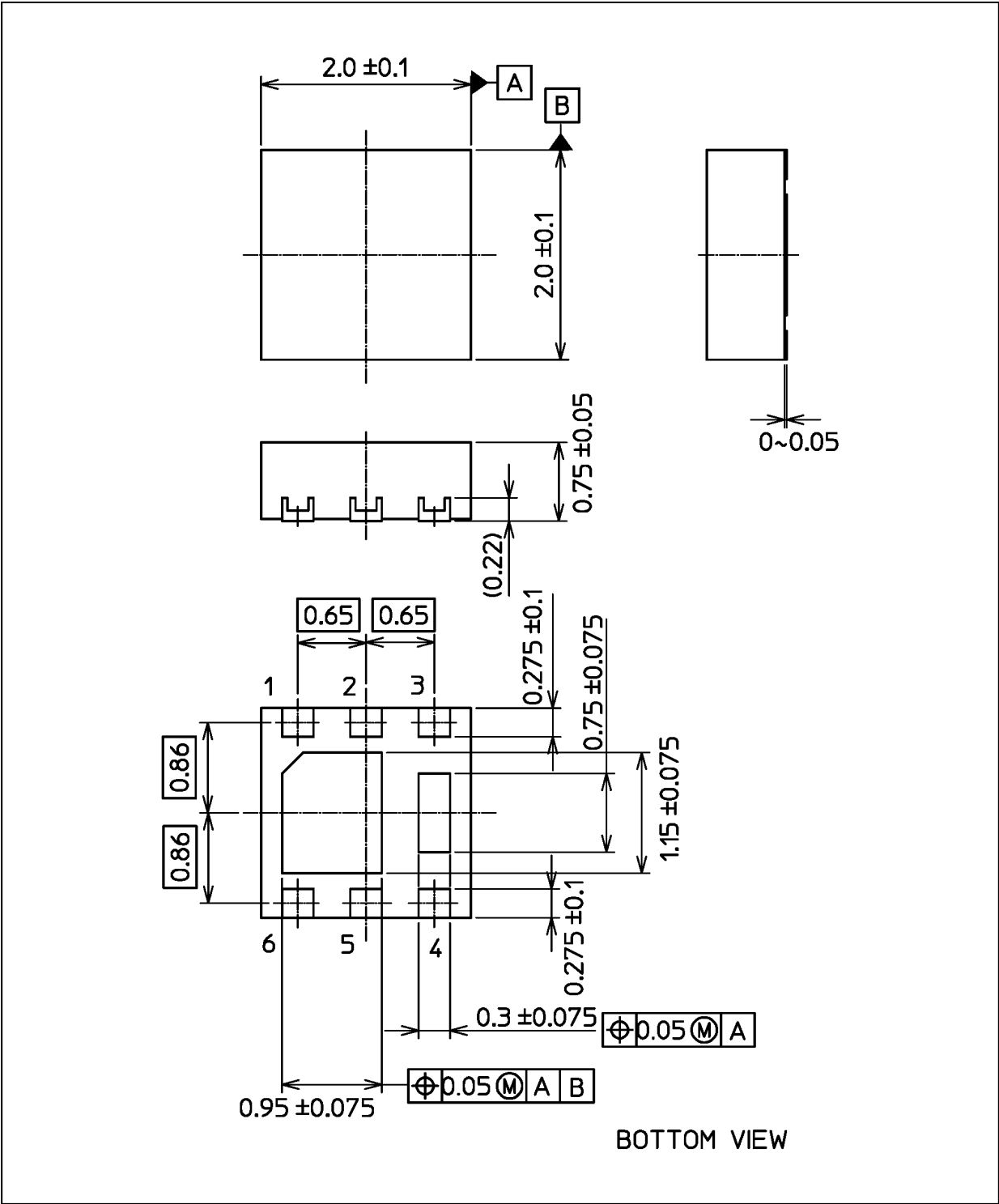


Fig. 9.15  $P_D - T_a$

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

Package Dimensions

Unit: mm



Weight: 8.5 mg (typ.)

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

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