

# SSM6N61NU

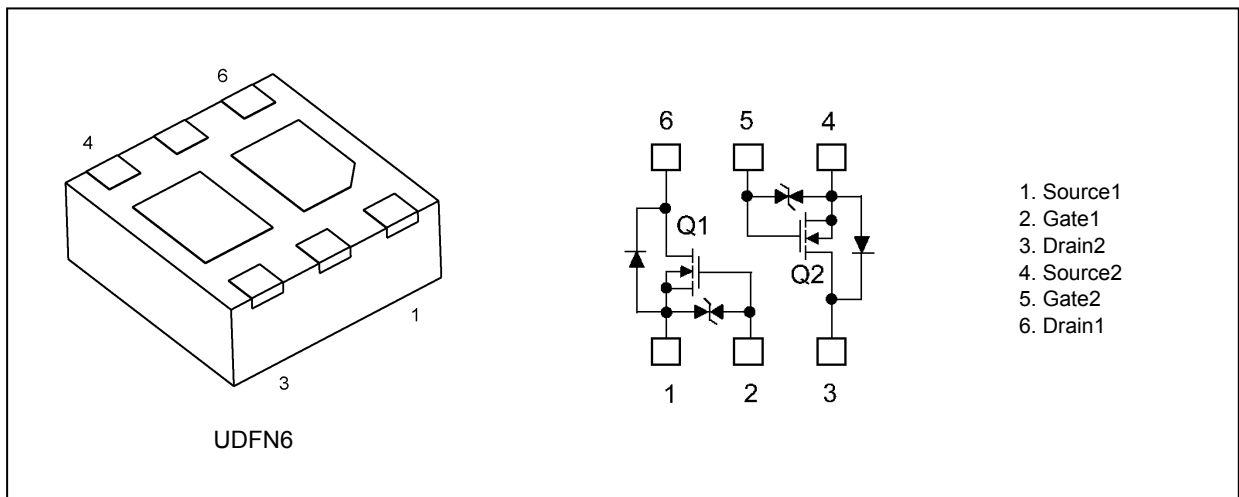
## 1. Applications

- Power Management Switches
- DC-DC Converters

## 2. Features

- (1) 1.5-V gate drive voltage.
- (2) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 33\text{ m}\Omega$  (max) (@ $V_{GS} = 4.5\text{ V}$ )
  - $R_{DS(ON)} = 45\text{ m}\Omega$  (max) (@ $V_{GS} = 2.5\text{ V}$ )
  - $R_{DS(ON)} = 74\text{ m}\Omega$  (max) (@ $V_{GS} = 1.8\text{ V}$ )
  - $R_{DS(ON)} = 108\text{ m}\Omega$  (max) (@ $V_{GS} = 1.5\text{ V}$ )

## 3. Packaging and Pin Assignment



Start of commercial production

2015-12

**4. Absolute Maximum Ratings (Note) (Unless otherwise specified, T<sub>a</sub> = 25 °C)  
(Q1,Q2 Common)**

Characteristics	Symbol	Rating	Unit	
Drain-source voltage	V <sub>DSS</sub>	20	V	
Gate-source voltage	V <sub>GSS</sub>	±8		
Drain current (DC) (Note 1)	I <sub>D</sub>	4	A	
Drain current (pulsed) (Note 1), (Note 2)	I <sub>DP</sub>	16		
Power dissipation	(Note 3)	P <sub>D</sub>	1	W
			t ≤ 10 s (Note 3)	
Channel temperature	T <sub>ch</sub>	150	°C	
Storage temperature	T <sub>stg</sub>	-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 °C.

Note 2: Pulse width (PW) ≤ 10 s, duty ≤ 1%

Note 3: 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,  $T_a = 25\text{ }^\circ\text{C}$ )(Q1,Q2 Common)**

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 6\text{ V}$	—	—	$\pm 1$	$\mu\text{A}$
Drain cut-off current	$I_{DSS}$	$V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}$	—	—	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)	$V_{th}$	$V_{DS} = 3\text{ V}, I_D = 1\text{ mA}$	0.40	—	1.00	
Drain-source on-resistance (Note 3)	$R_{DS(ON)}$	$I_D = 0.5\text{ A}, V_{GS} = 1.5\text{ V}$	—	54	108	$\text{m}\Omega$
		$I_D = 0.5\text{ A}, V_{GS} = 1.8\text{ V}$	—	40	74	
		$I_D = 1.0\text{ A}, V_{GS} = 2.5\text{ V}$	—	31	45	
		$I_D = 4.0\text{ A}, V_{GS} = 4.5\text{ V}$	—	25	33	
Forward transfer admittance (Note 3)	$ Y_{fs} $	$V_{DS} = 3\text{ V}, I_D = 2\text{ A}$	—	12	—	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 (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )(Q1,Q2 Common)**

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	—	410	—	$\text{pF}$
Reverse transfer capacitance	$C_{rss}$		—	40	—	
Output capacitance	$C_{oss}$		—	85	—	
Switching time (turn-on time)	$t_{on}$	$V_{DS} = 10\text{ V}, I_D = 0.5\text{ A},$ $V_{GS} = 0\text{ to }4.5\text{ V}, R_G = 10\text{ }\Omega$	—	25	—	ns
Switching time (turn-off time)	$t_{off}$		—	45	—	

**5.3. Switching Time Test Circuit**

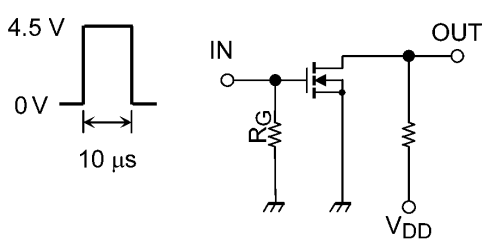


Fig. 5.3.1 Switching Time Test Circuit

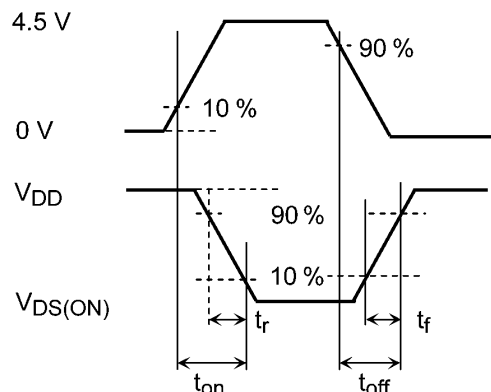


Fig. 5.3.2 Input Waveform/Output Waveform

**5.4. Gate Charge Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )(Q1,Q2 Common)**

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	$Q_g$	$V_{DD} = 8\text{ V}, I_D = 4\text{ A},$ $V_{GS} = 4.5\text{ V}$	—	3.6	—	nC
Gate-source charge 1	$Q_{gs1}$		—	0.62	—	
Gate-drain charge	$Q_{gd}$		—	0.79	—	

**5.5. Source-Drain Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )  
(Q1,Q2 Common)**

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage (Note 1)	$V_{DSF}$	$I_D = -4\text{ A}, V_{GS} = 0\text{ V}$	—	-0.8	-1.2	V

Note 1: Pulse measurement.

**6. Marking**

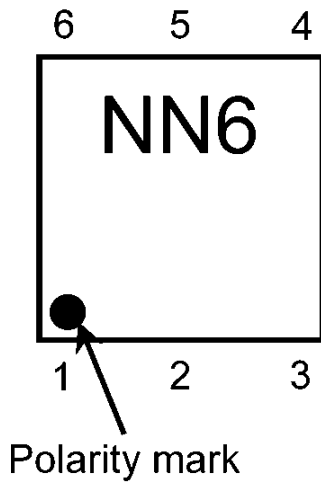


Fig. 6.1 Marking

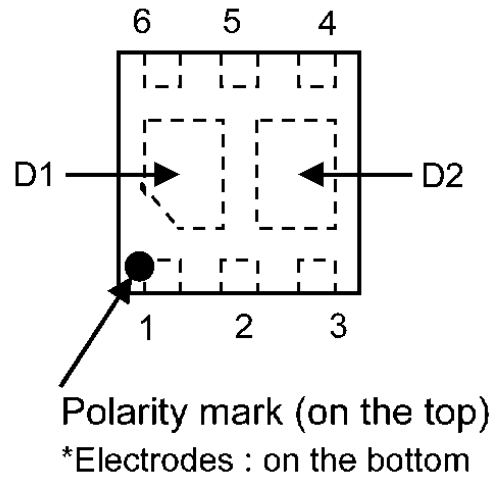
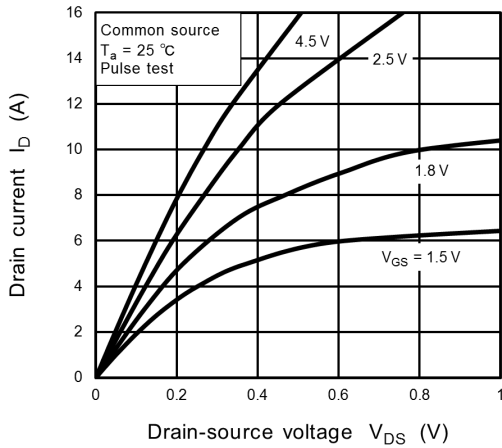
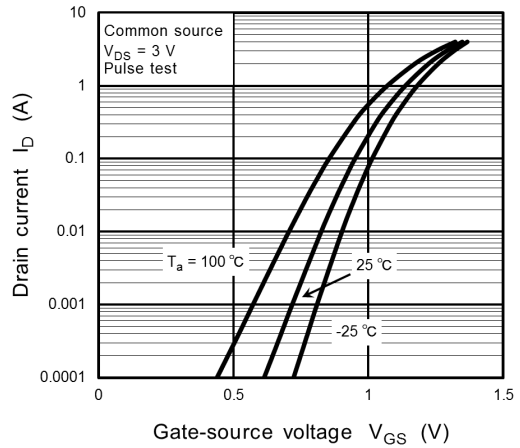


Fig. 6.2 Pin Condition(Top View)

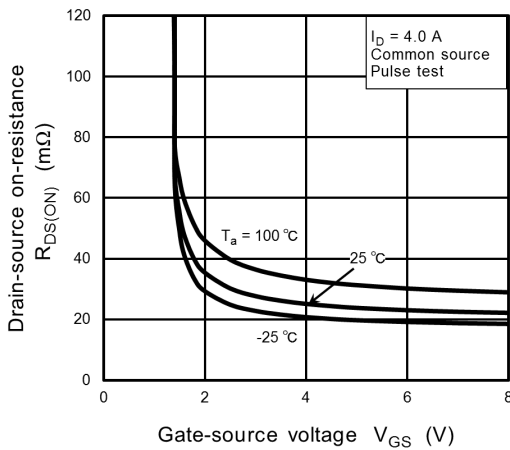
**7. Characteristics Curves (Q1,Q2 Common) (Note)**



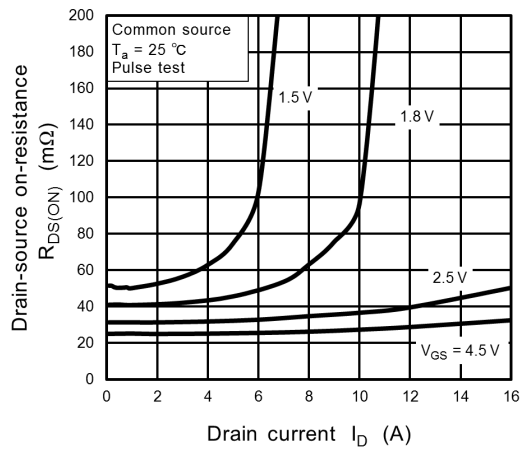
**Fig. 7.1  $I_D - V_{DS}$**



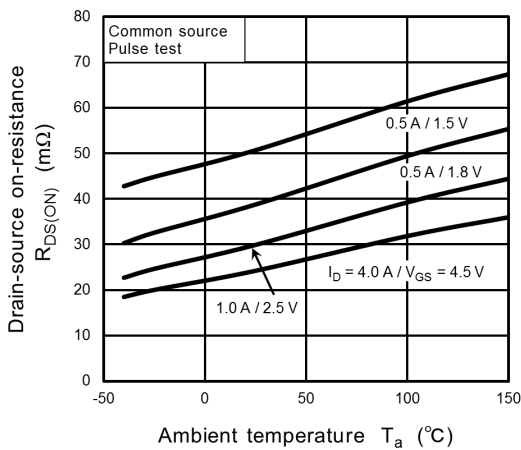
**Fig. 7.2  $I_D - V_{GS}$**



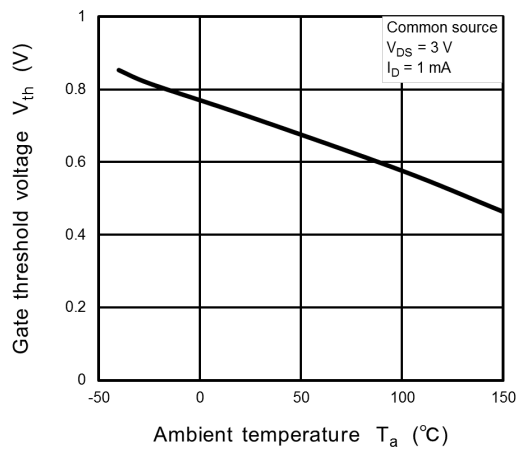
**Fig. 7.3  $R_{DS(ON)} - V_{GS}$**



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



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



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

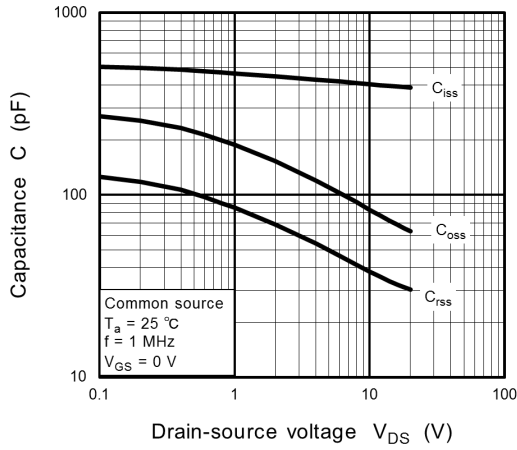


Fig. 7.7 C -  $V_{DS}$

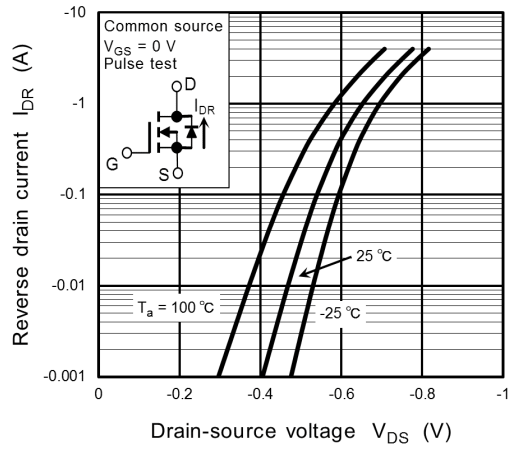


Fig. 7.8  $I_{DR} - V_{DS}$

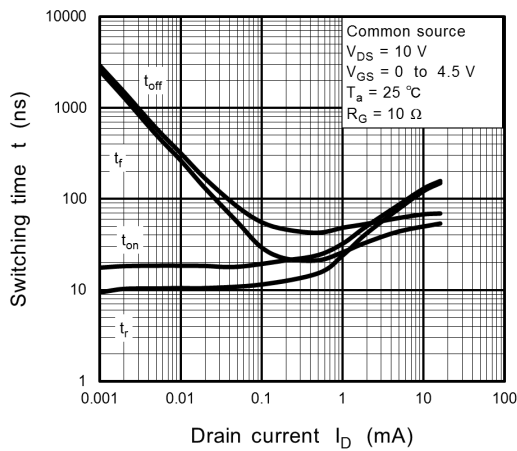


Fig. 7.9  $t - I_D$

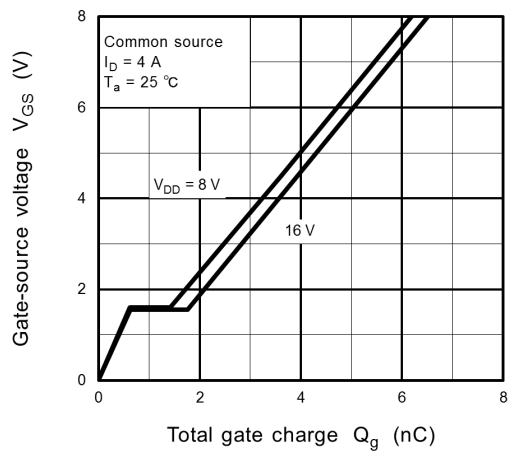


Fig. 7.10 Dynamic Input Characteristics

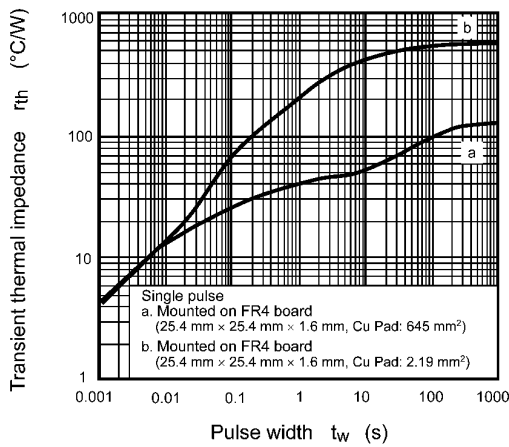


Fig. 7.11  $r_{th} - t_w$

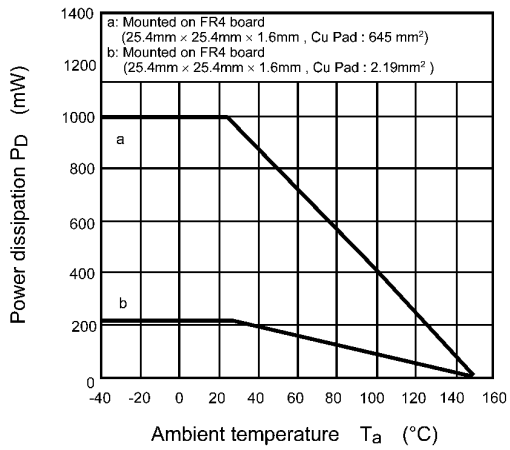
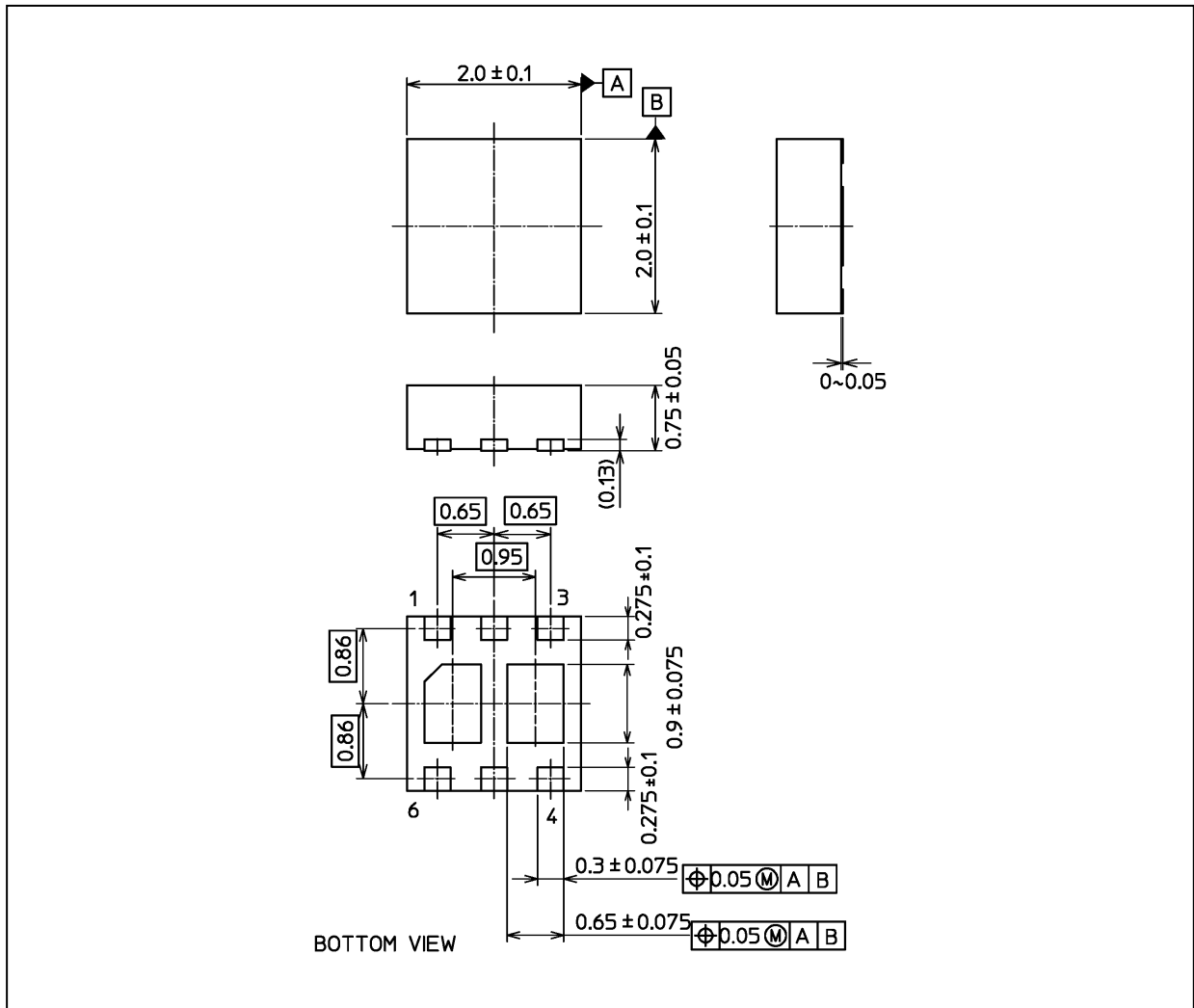


Fig. 7.12  $P_D - T_a$

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)
Nickname: UDFN6

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