

# SSM6K403TU

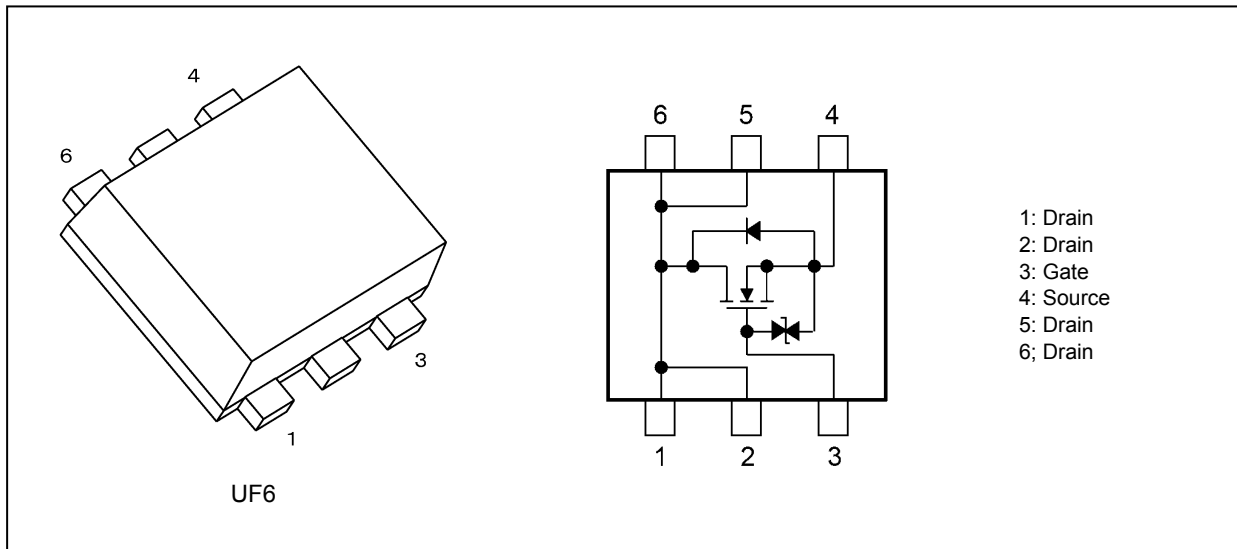
## 1. Applications

- Power Management Switches
- High-Speed Switching

## 2. Features

- (1) 1.5-V drive
- (2) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 66 \text{ m}\Omega$  (max) (@ $V_{GS} = 1.5 \text{ V}$ )
  - $R_{DS(ON)} = 43 \text{ m}\Omega$  (max) (@ $V_{GS} = 1.8 \text{ V}$ )
  - $R_{DS(ON)} = 32 \text{ m}\Omega$  (max) (@ $V_{GS} = 2.5 \text{ V}$ )
  - $R_{DS(ON)} = 28 \text{ m}\Omega$  (max) (@ $V_{GS} = 4.0 \text{ V}$ )

## 3. Packaging and Internal Circuit



Start of commercial production  
2008-01

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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	20	V
Gate-source voltage	$V_{GSS}$	$\pm 10$	
Drain current (DC) (Note 1)	$I_D$	4.2	A
Drain current (pulsed) (Note 1), (Note 2)	$I_{DP}$	8.4	
Power dissipation (Note 3)	$P_D$	500	mW
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: Ensure that the channel temperature does not exceed 150 °C.

Note 2: Pulse width (PW)  $\leq 10$  ms, duty  $\leq 1\%$

Note 3: 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,  $R_{th(ch-a)}$ , 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 (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 1\text{ mA}, V_{GS} = 0\text{ V}$	20	—	—	V
Drain-source breakdown voltage	$V_{(BR)DSX}$	$I_D = 1\text{ mA}, V_{GS} = -10\text{ V}$	12	—	—	V
Drain cut-off current	$I_{DSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	—	—	1	$\mu\text{A}$
Gate leakage current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$	—	—	$\pm 1$	$\mu\text{A}$
Gate threshold voltage (Note 1)	$V_{th}$	$V_{DS} = 3\text{ V}, I_D = 1\text{ mA}$	0.35	—	1.0	V
Forward transfer admittance (Note 2)	$ Y_{fs} $	$V_{DS} = 3\text{ V}, I_D = 3.0\text{ A}$	10	20	—	S
Drain-source on-resistance (Note 2)	$R_{DS(ON)}$	$I_D = 3.0\text{ A}, V_{GS} = 4.0\text{ V}$	—	19	28	$\text{m}\Omega$
		$I_D = 3.0\text{ A}, V_{GS} = 2.5\text{ V}$	—	23	32	
		$I_D = 1.0\text{ A}, V_{GS} = 1.8\text{ V}$	—	28	43	
		$I_D = 0.5\text{ A}, V_{GS} = 1.5\text{ V}$	—	35	66	

Note 1: 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 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	$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	—	1050	—	pF
Output capacitance	$C_{oss}$		—	175	—	
Reverse transfer capacitance	$C_{rss}$		—	160	—	
Switching time (turn-on time)	$t_{on}$	$V_{DD} = 10\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 0\text{ to } 2.5\text{ V}, R_G = 4.7\ \Omega,$ Duty $\leq 1\%$ , Input: $t_r, t_f < 5\text{ ns},$ Common source, $T_a = 25\text{ }^\circ\text{C}$	—	18	—	ns
Switching time (turn-off time)	$t_{off}$		—	32	—	

#### 5.3. Switching Time Test Circuit

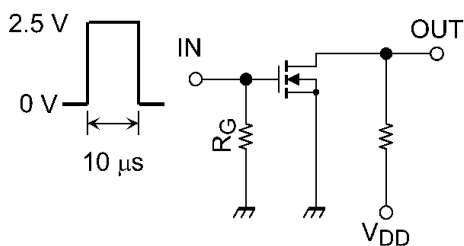


Fig. 5.3.1 Switching Time Test Circuit

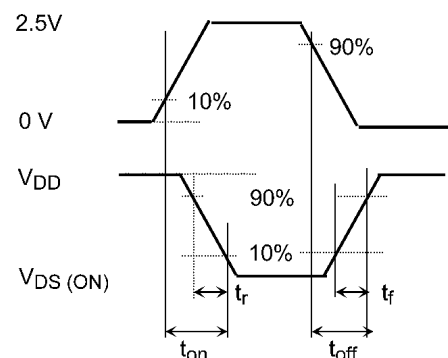


Fig. 5.3.2 Input Waveform/Output Waveform

### 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)	$Q_g$	$V_{DD} = 10\text{ V}$ , $I_D = 4.2\text{ A}$ , $V_{GS} = 4\text{ V}$	—	16.8	—	nC
Gate-source charge	$Q_{gs}$		—	12.1	—	
Gate-drain charge	$Q_{gd}$		—	4.7	—	

### 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)	$V_{DSF}$	$I_D = -4.2\text{ A}$ , $V_{GS} = 0\text{ V}$	—	-0.8	-1.2	V

Note 1: Pulse measurement.

## 6. Marking

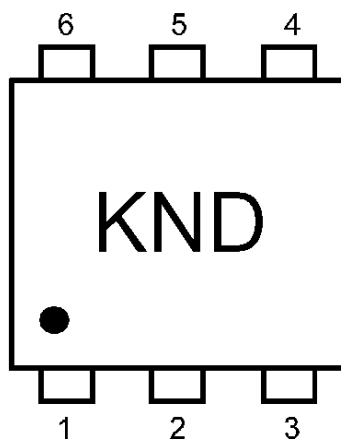


Fig. 6.1 Marking

### 7. Characteristics Curves (Note)

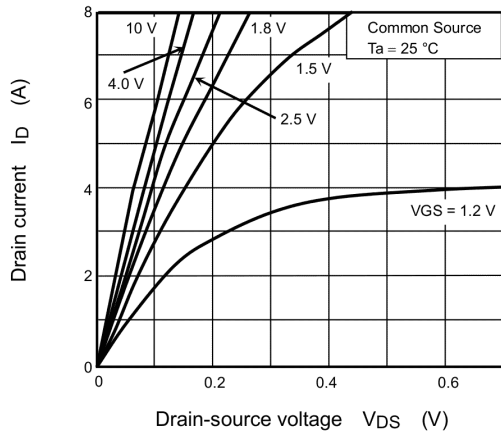


Fig. 7.1  $I_D - V_{DS}$

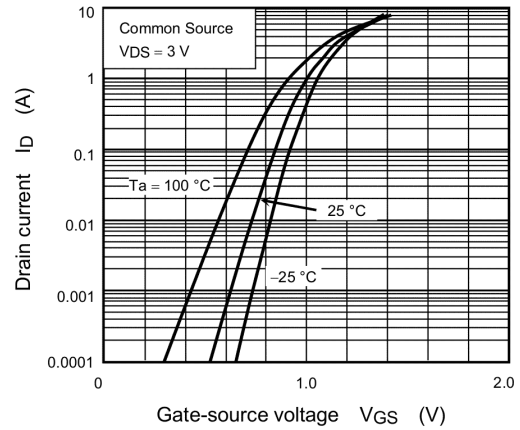


Fig. 7.2  $I_D - V_{GS}$

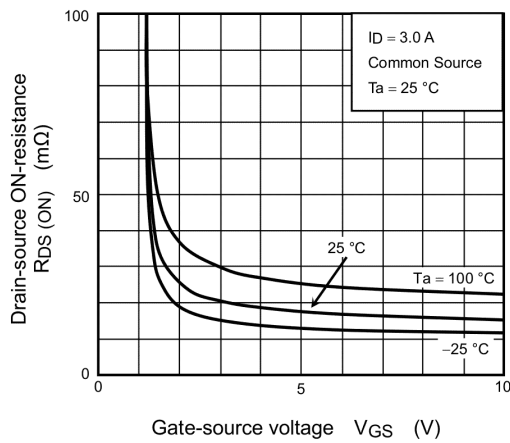


Fig. 7.3  $R_{DS(ON)} - V_{GS}$

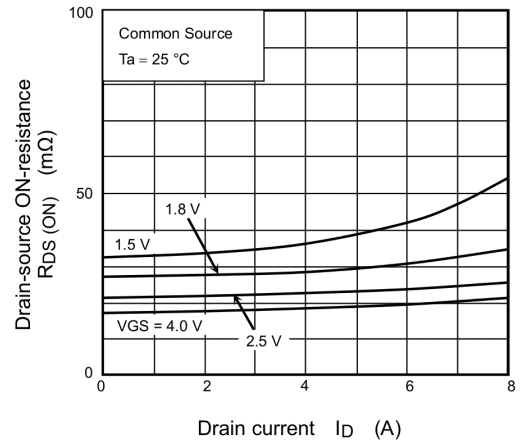


Fig. 7.4  $R_{DS(ON)} - I_D$

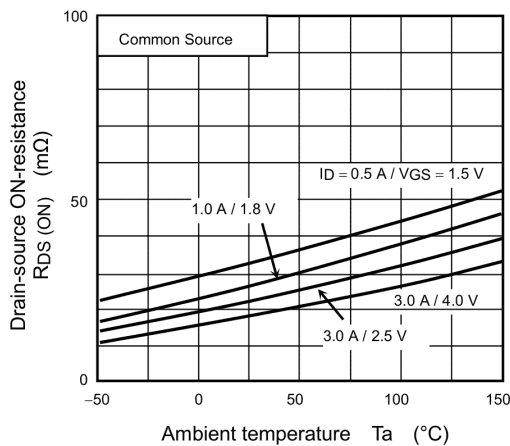


Fig. 7.5  $R_{DS(ON)} - T_a$

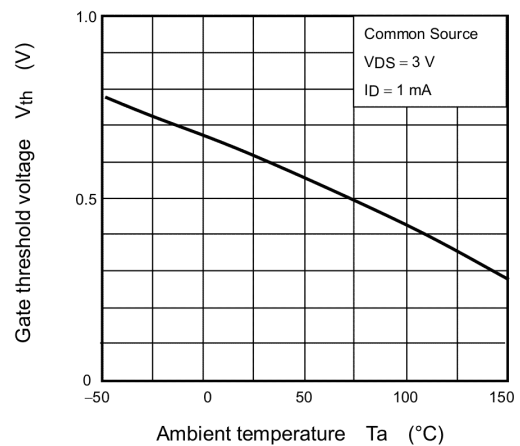


Fig. 7.6  $V_{th} - T_a$

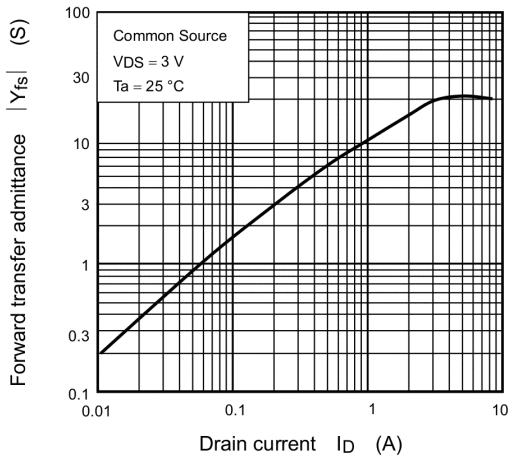


Fig. 7.7  $|Y_{fs}| - I_D$

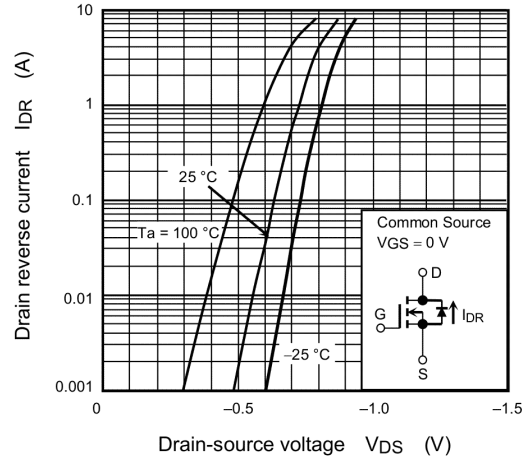


Fig. 7.8  $I_{DR} - V_{DS}$

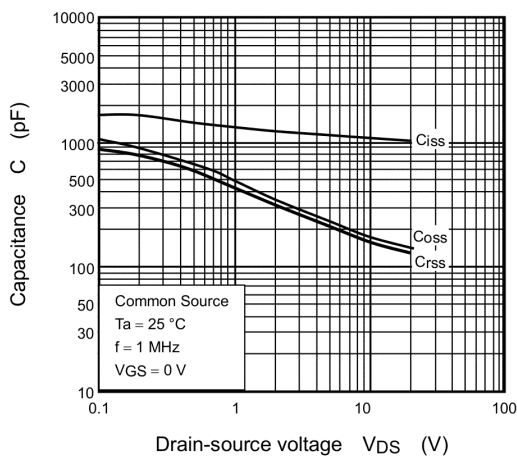


Fig. 7.9  $C - V_{DS}$

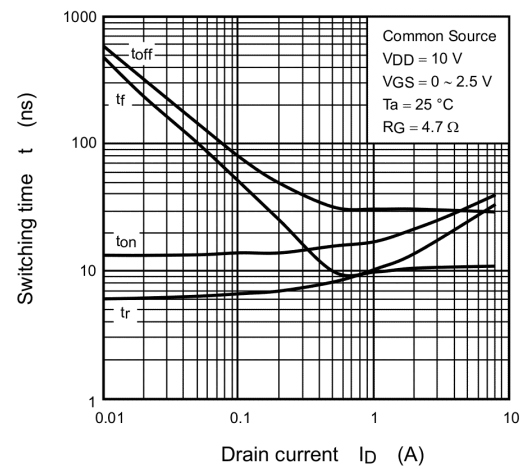


Fig. 7.10  $t - I_D$

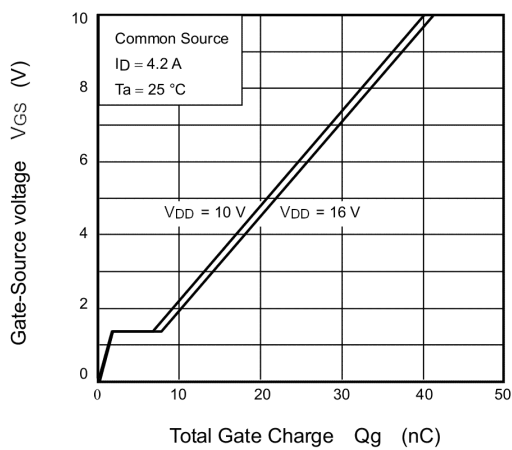


Fig. 7.11 Dynamic Input Characteristic

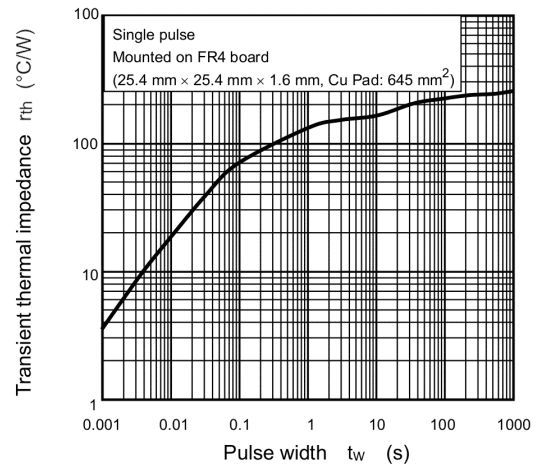
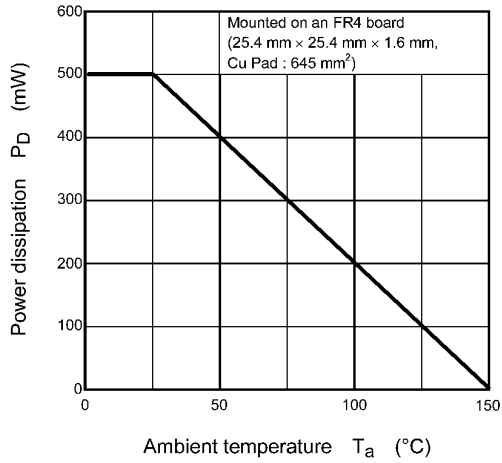
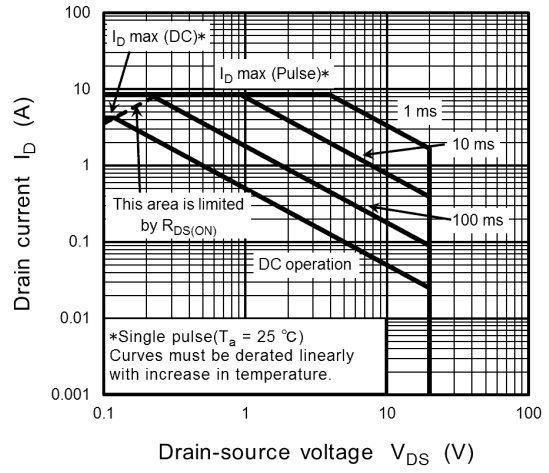


Fig. 7.12  $r_{th} - t_w$



**Fig. 7.13  $P_D - T_a$**

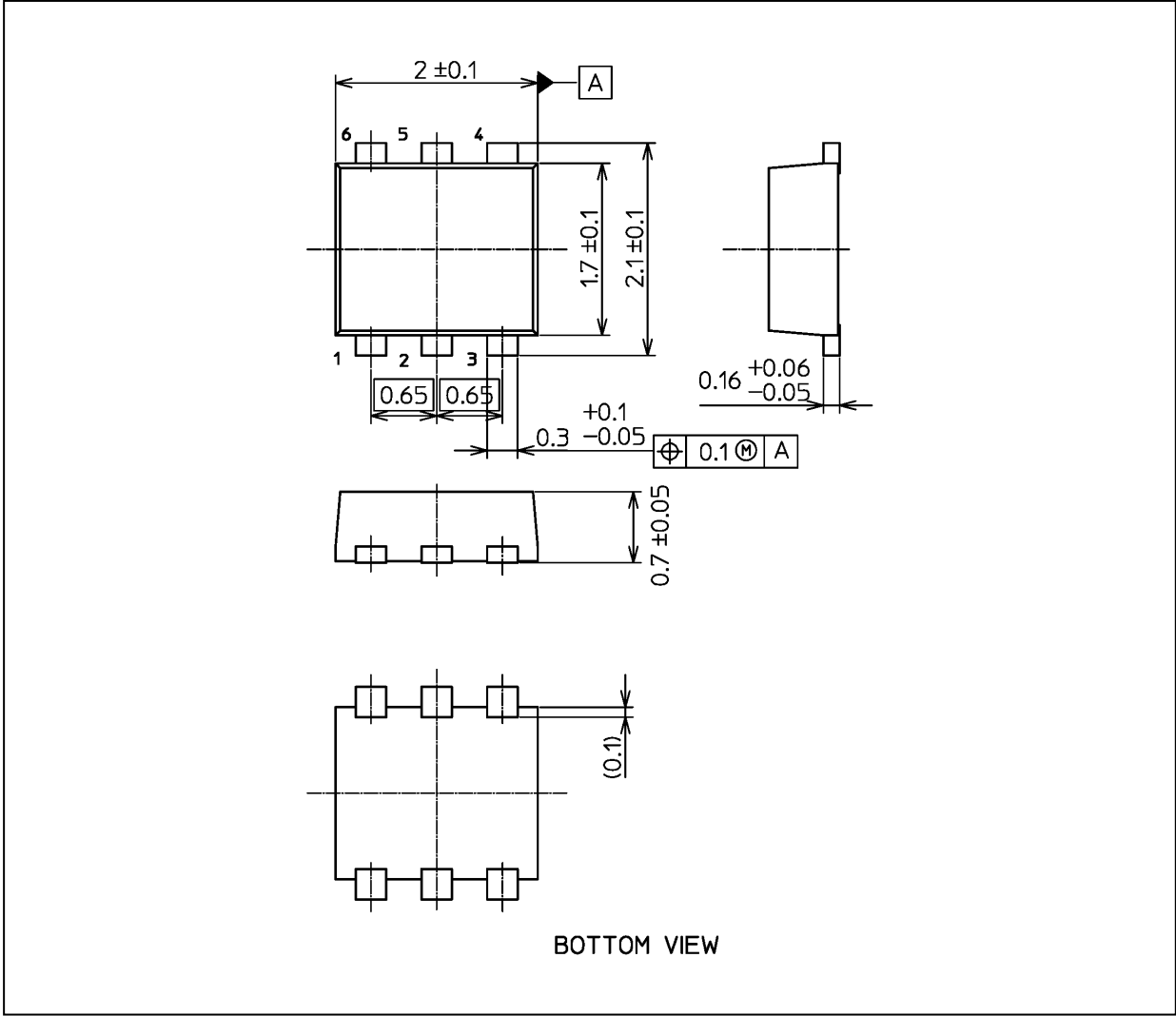


**Fig. 7.14 Safe Operating Area**

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)
Nickname: UF6

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