

MOSFETs Silicon N-channel MOS (U-MOSIX-H)

# SSM6K513NU

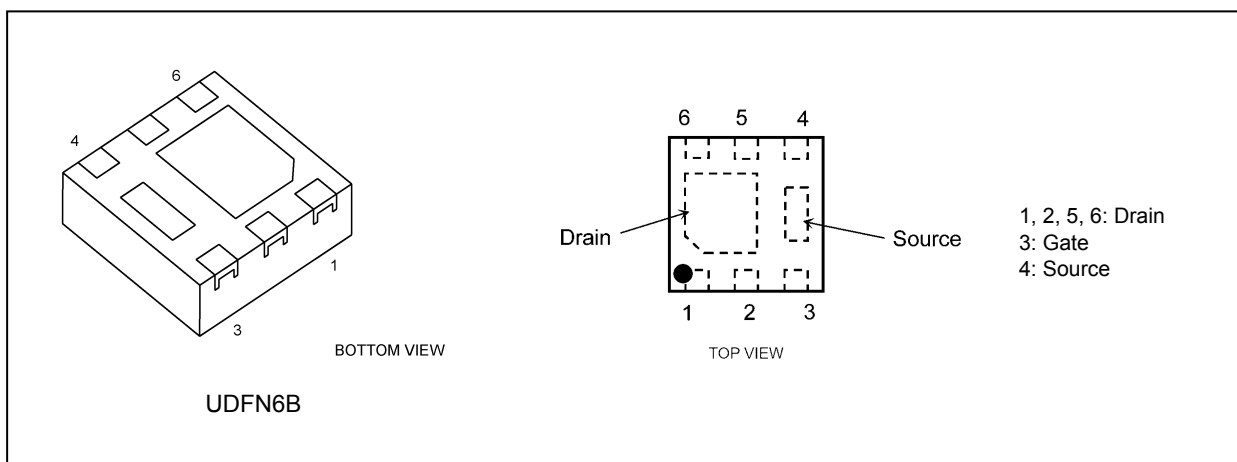
## 1. Applications

- Power Management Switches

## 2. Features

- (1) 4.5 V drive
- (2) Low drain-source on-resistance  
 :  $R_{DS(ON)} = 8.0 \text{ m}\Omega$  (typ.) (@ $V_{GS} = 4.5 \text{ V}$ )  
 $R_{DS(ON)} = 6.5 \text{ m}\Omega$  (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	$V_{DSS}$	30	V
Gate-source voltage (Note 1)	$V_{GSS}$	$\pm 20$	
Drain current (DC)	$I_D$	15	A
Drain current (pulsed) (Note 2)	$I_{DP}$	50	
Power dissipation (Note 3)	$P_D$	1.25	W
Power dissipation ( $t \leq 10$ s) (Note 3)		2.5	
Single-pulse avalanche energy (Note 4)	$E_{AS}$	37.6	mJ
Avalanche current	$I_{AR}$	6.3	A
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
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: +20 V /-16 V ensured at DC condition.

-20 V ensured at pulse condition (duty 5 %).

Note 2: Pulse width (PW)  $\leq 10 \mu\text{s}$ , duty = 1 %

Note 3: Device mounted on a FR4 board.

(25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm, Cu Pad: 645 mm<sup>2</sup>)

Note 4:  $V_{DD} = 24$  V,  $T_{ch} = 25^\circ\text{C}$  (Initial state),  $L = 1$  mH,  $R_G = 25 \Omega$

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. Thermal Characteristics

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

Note 1: Device mounted on an 25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm FR4 glass epoxy board (Cu pad: 645 mm<sup>2</sup>)

### 6. Electrical Characteristics

#### 6.1. 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	$I_{DSS}$	$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$	—	—	1	$\mu\text{A}$
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	30	—	—	V
Drain-source breakdown voltage (Note 1)	$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	27	—	—	
Gate threshold voltage (Note 2)	$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 0.1\text{ mA}$	1.1	—	2.1	
Drain-source on-resistance (Note 3)	$R_{DS(ON)}$	$I_D = 4.0\text{ A}, V_{GS} = 4.5\text{ V}$	—	8.0	12	m $\Omega$
		$I_D = 4.0\text{ A}, V_{GS} = 10\text{ V}$	—	6.5	8.9	
Forward transfer admittance (Note 3)	$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 2.0\text{ A}$	—	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 ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	—	1130	—	pF
Reverse transfer capacitance	$C_{rss}$		—	52	—	
Output capacitance	$C_{oss}$		—	350	—	
Switching time (turn-on time)	$t_{on}$	$V_{DD} = 15\text{ V}, I_D = 1.0\text{ A}$ $V_{GS} = 0\text{ to }4.5\text{ V}, R_{GS} = 30\ \Omega,$ Duty $\leq 1\%$ , Input: $t_r, t_f < 5\text{ ns}$ Ground source, See Chapter 6.3	—	28	—	ns
Switching time (turn-off time)	$t_{off}$		—	33	—	

#### 6.3. Switching Time Test Circuit

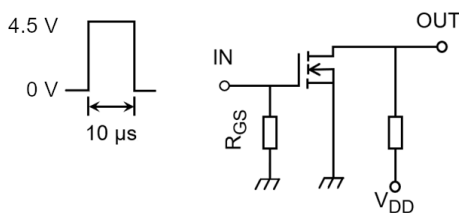


Fig. 6.3.1 Test Circuit of Switching Time

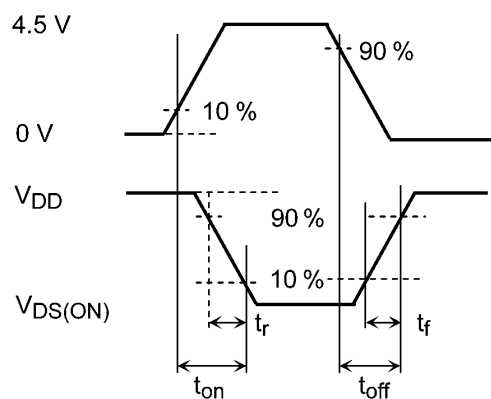


Fig. 6.3.2 Input Waveform/Output Waveform

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

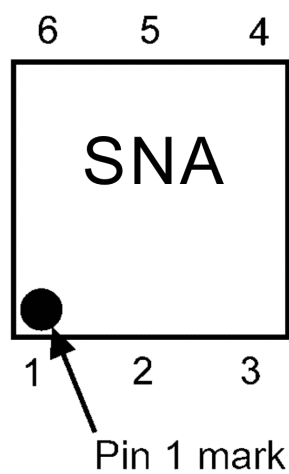
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	$Q_g$	$V_{DD} = 15\text{ V}, V_{GS} = 4.5\text{ V},$ $I_D = 15\text{ A}$	—	7.5	—	nC
Gate-source charge 1	$Q_{gs1}$		—	3.0	—	
Gate-drain charge	$Q_{gd}$		—	2.2	—	

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

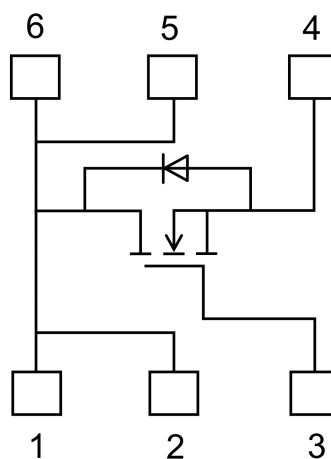
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage (Note 1)	$V_{DSF}$	$I_{DR} = 4.0\text{ A}, V_{GS} = 0\text{ V}$	—	0.76	1.2	V

Note 1: Pulse measurement.

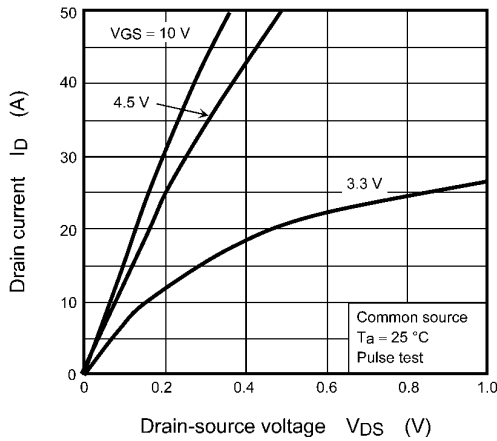
## 7. Marking



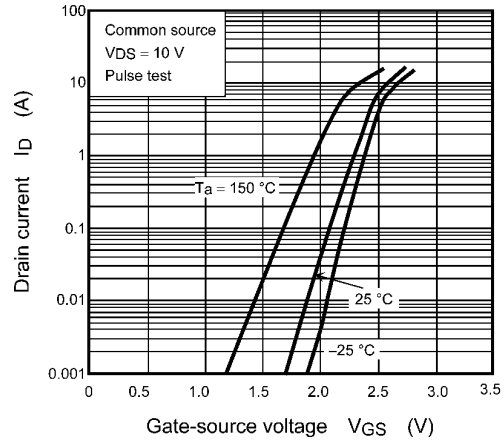
## 8. Internal Circuit



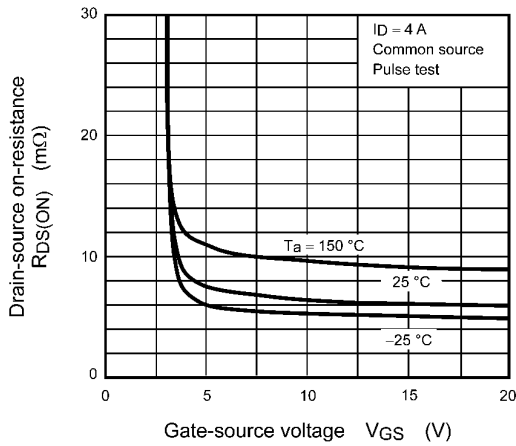
### 9. Characteristics Curves (Note)



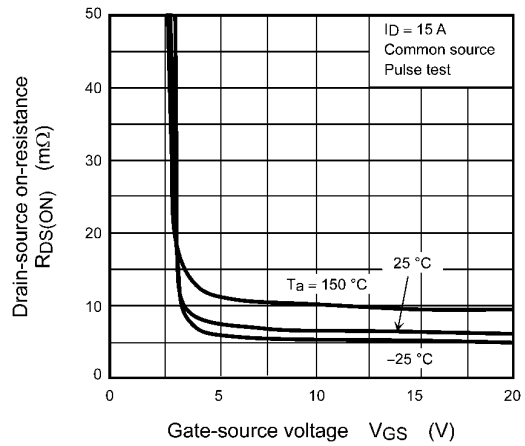
**Fig. 9.1**  $I_D - V_{DS}$



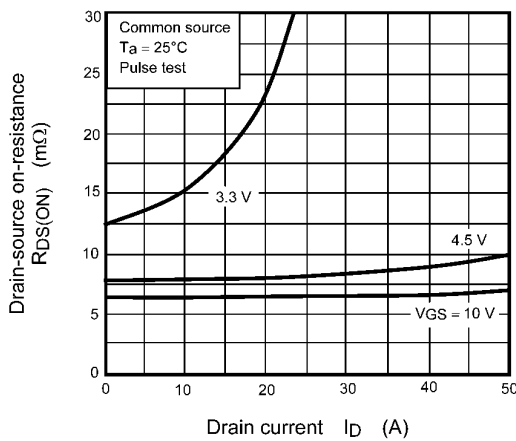
**Fig. 9.2**  $I_D - V_{GS}$



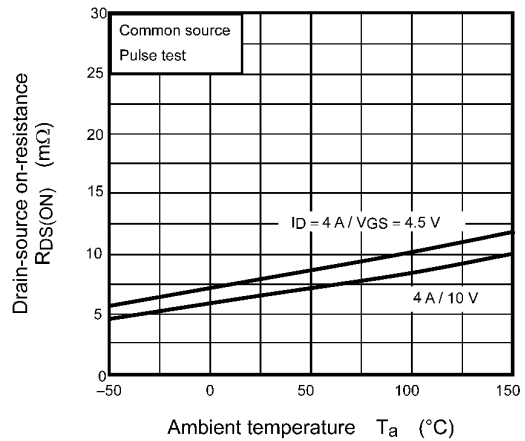
**Fig. 9.3**  $R_{DS(ON)} - V_{GS}$



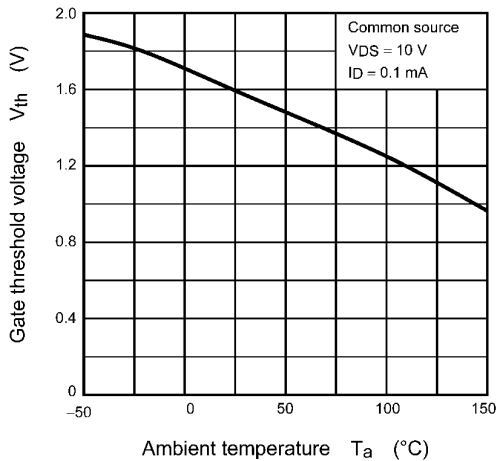
**Fig. 9.4**  $R_{DS(ON)} - V_{GS}$



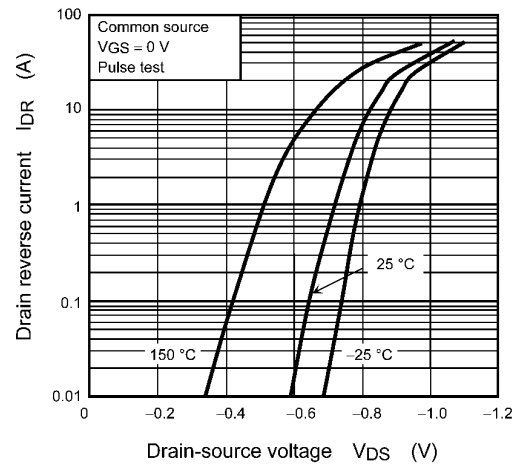
**Fig. 9.5**  $R_{DS(ON)} - I_D$



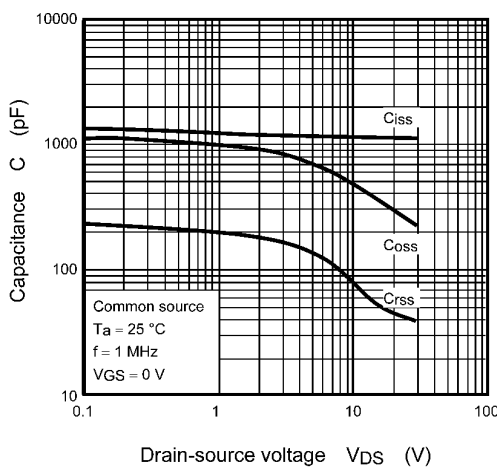
**Fig. 9.6**  $R_{DS(ON)} - T_a$



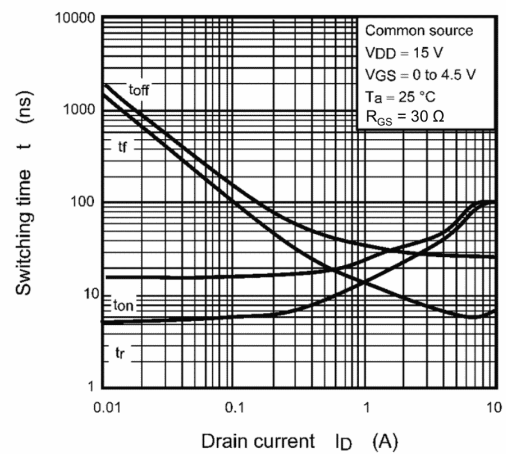
**Fig. 9.7**  $V_{th} - T_a$



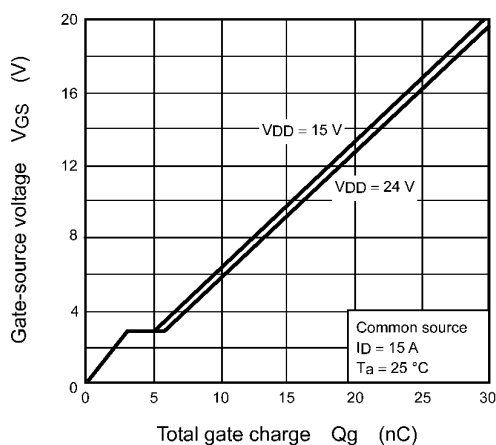
**Fig. 9.8**  $I_{DR} - V_{DS}$



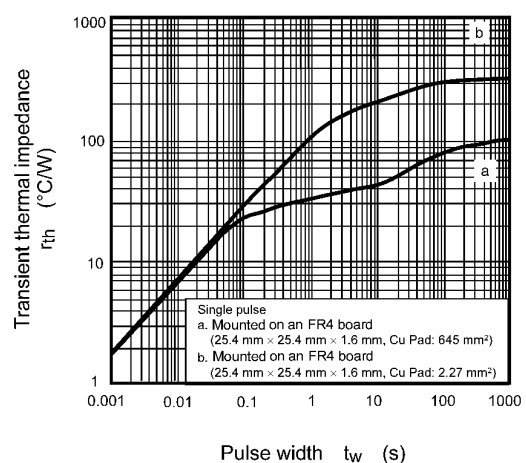
**Fig. 9.9**  $C - V_{DS}$



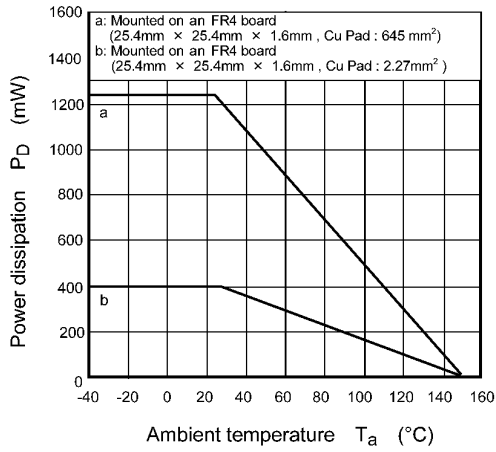
**Fig. 9.10**  $t - I_D$



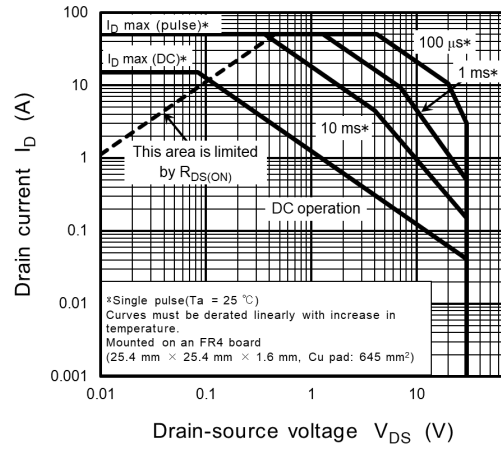
**Fig. 9.11** Dynamic Input Characteristics



**Fig. 9.12**  $r_{th} - t_w$



**Fig. 9.13  $P_D - T_a$**

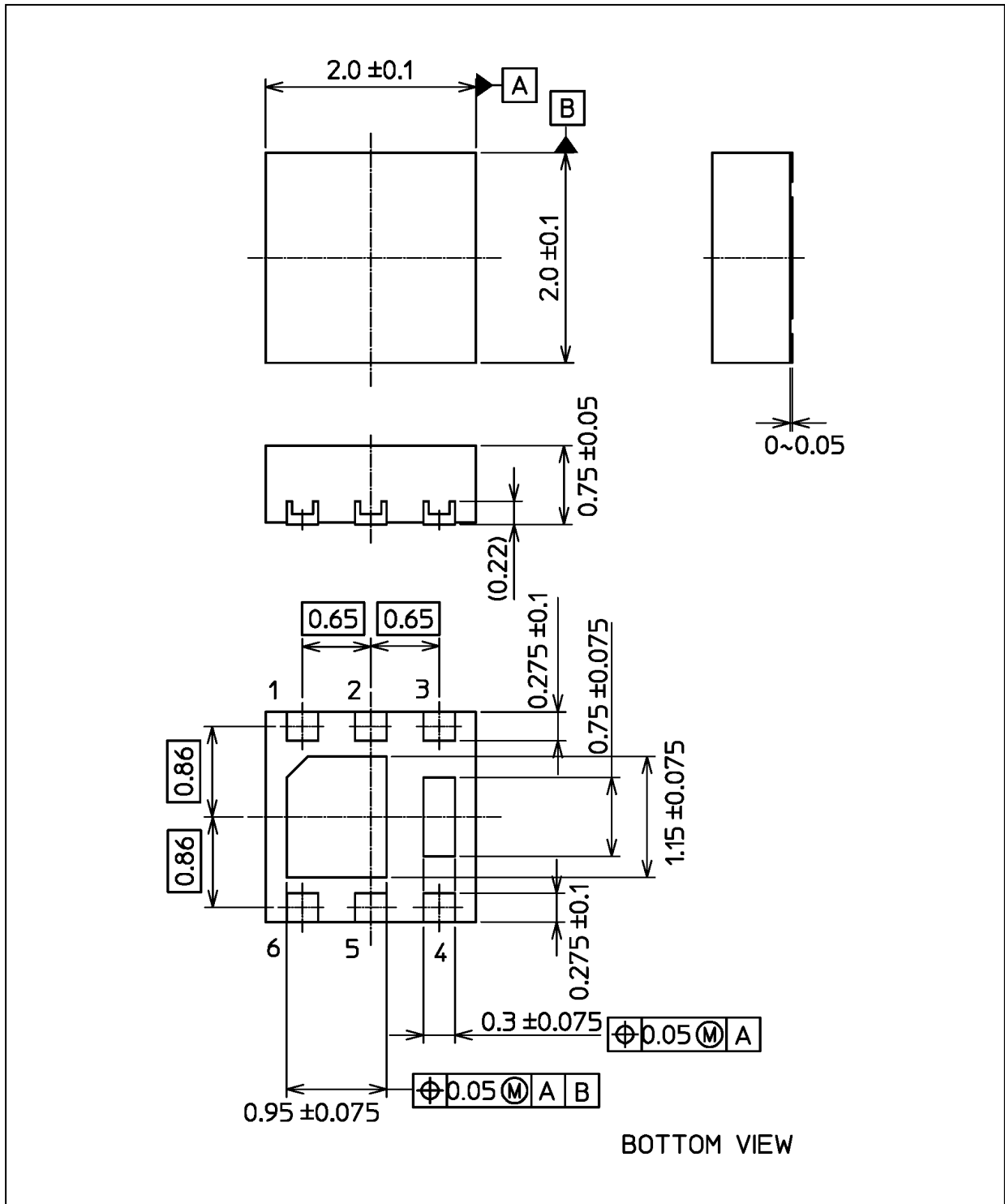


**Fig. 9.14 Safe Operating Area**

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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