

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

# XSM6K336NW

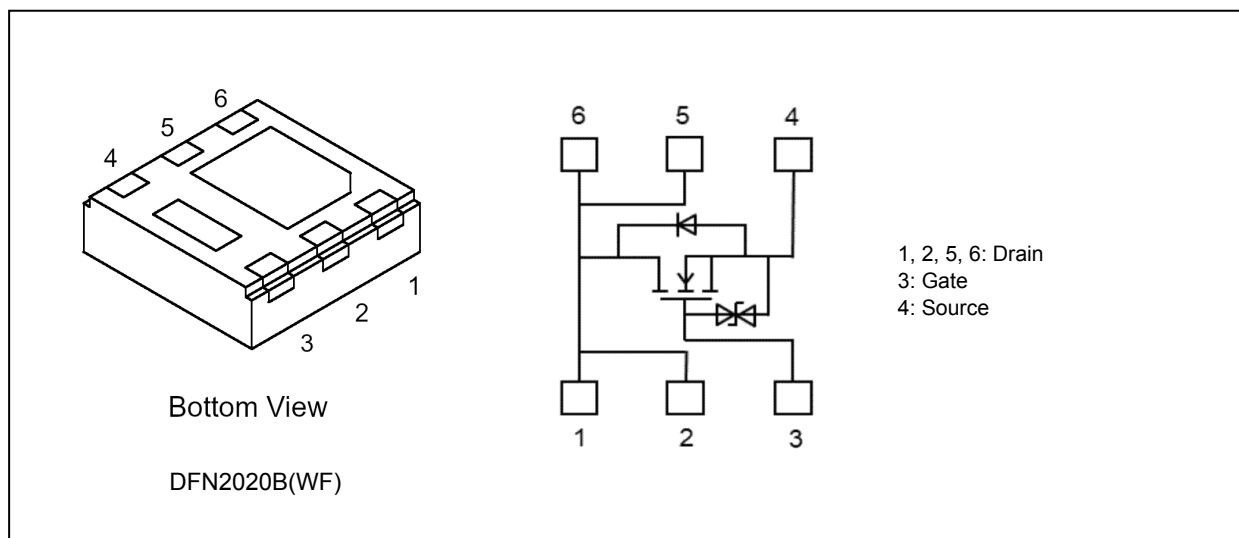
## 1. Applications

- Power Management Switches
- DC-DC Converters

## 2. Features

- (1) 4.5 V gate drive voltage.
- (2) Low drain-source on-resistance  
 $R_{DS(ON)} = 95 \text{ m}\Omega \text{ (max) (@} V_{GS} = 10 \text{ V)}$   
 $R_{DS(ON)} = 140 \text{ m}\Omega \text{ (max) (@} V_{GS} = 4.5 \text{ V)}$

## 3. Packaging and Internal Circuit



Start of commercial production

2025-04

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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{\text{DSS}}$	30	V
Gate-source voltage	$V_{\text{GSS}}$	$\pm 20$	
Drain current (DC) (Note 1)	$I_{\text{D}}$	3	A
Drain current (pulsed) ( $t \leq 10 \text{ ms}$ ) (Note 1,2)	$I_{\text{DP}}$	8	
Power dissipation (Note 3)	$P_{\text{D}}$	1.51	W
Power dissipation ( $t \leq 10 \text{ s}$ ) (Note 3)	$P_{\text{D}}$	3.3	W
Single-pulse avalanche energy (Note 4)	$E_{\text{AS}}$	2.3	mJ
Single-pulse avalanche current	$I_{\text{AS}}$	3.0	A
Channel temperature	$T_{\text{ch}}$	150	$^{\circ}\text{C}$
Storage temperature	$T_{\text{stg}}$	-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  $150^{\circ}\text{C}$ .

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

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

Note 4:  $V_{\text{DD}} = 24 \text{ V}$ ,  $T_{\text{ch}} = 25^{\circ}\text{C}$  (initial),  $L = 0.2 \text{ mH}$ ,  $R_{\text{G}} = 25 \Omega$ ,  $I_{\text{AS}} = 3.0 \text{ A}$

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,  $R_{\text{th(ch-a)}}$ , and the power dissipation,  $P_{\text{D}}$ , 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, $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current (Note 3)	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current (Note 3)	$I_{DSS}$	$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$	—	—	1	
Drain-source breakdown voltage (Note 3)	$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	30	—	—	V
Drain-source breakdown voltage (Note 1),(Note 3)	$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	15	—	—	
Gate threshold voltage (Note 2),(Note 3)	$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 0.1\text{ mA}$	1.3	—	2.5	
Drain-source on-resistance (Note 3)	$R_{DS(ON)}$	$I_D = 2.0\text{ A}, V_{GS} = 10\text{ V}$	—	67	95	$\text{m}\Omega$
		$I_D = 1.0\text{ A}, V_{GS} = 4.5\text{ V}$	—	100	140	

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 (Unless otherwise specified, $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	—	126	—	$\text{pF}$
Reverse transfer capacitance	$C_{rss}$		—	8	—	
Output capacitance	$C_{oss}$		—	26	—	
Switching time (turn-on time)	$t_{on}$	See Fig. 5.2.1	—	7	—	$\text{ns}$
Switching time (turn-off time)	$t_{off}$		—	8	—	

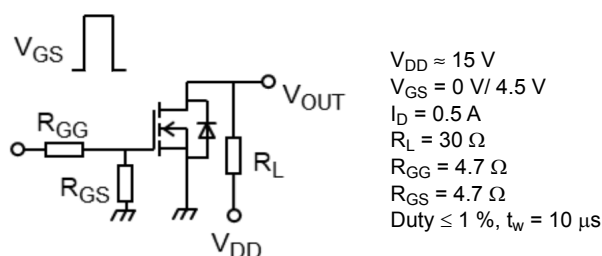


Fig. 5.2.1 Switching Time Test Circuit

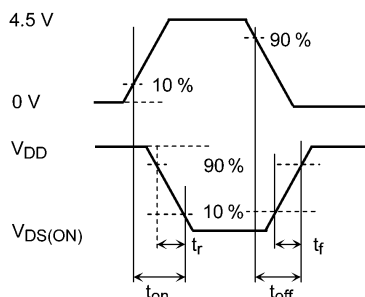


Fig. 5.2.2 Input Waveform/Output Waveform

5.3. Gate Charge Characteristics (Unless otherwise specified, T<sub>a</sub> = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q <sub>g</sub>	V <sub>DD</sub> = 15 V, V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 3.0 A	—	1.7	—	nC
Gate-source charge 1	Q <sub>gs1</sub>		—	0.8	—	
Gate-drain charge	Q <sub>gd</sub>		—	0.7	—	

5.4. 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> = 3.0 A, V <sub>GS</sub> = 0 V	—	-0.89	-1.2	V

Note 1: Pulse measurement.

6. Marking

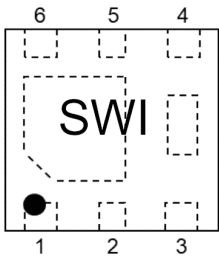
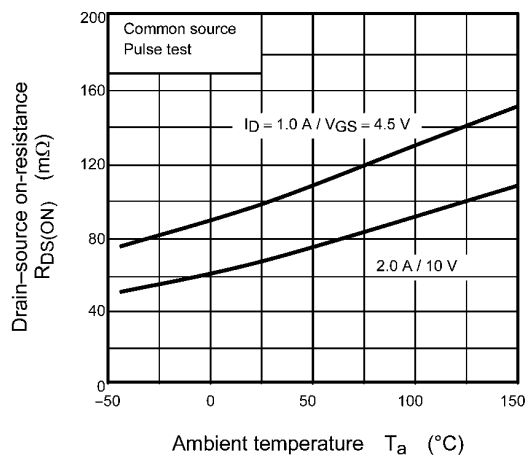
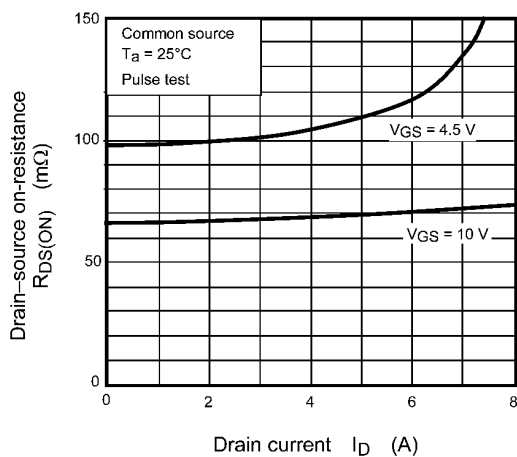
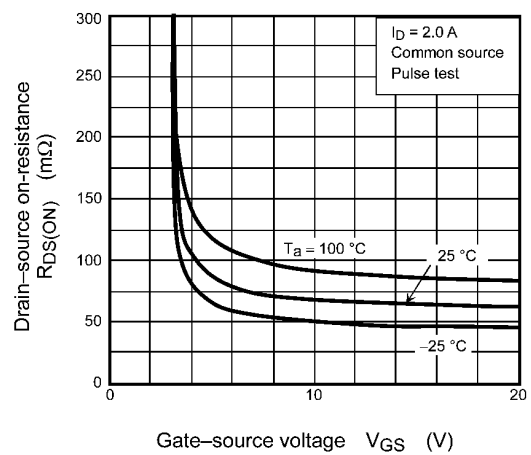
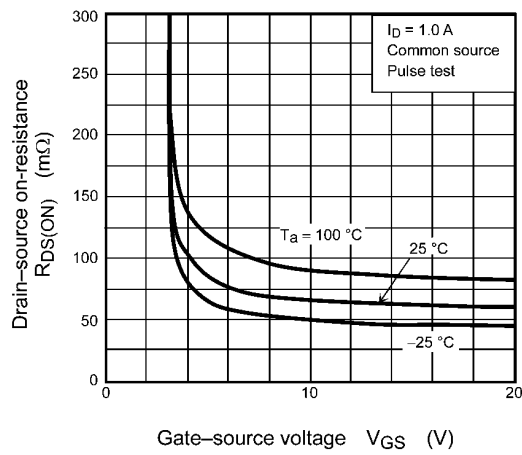
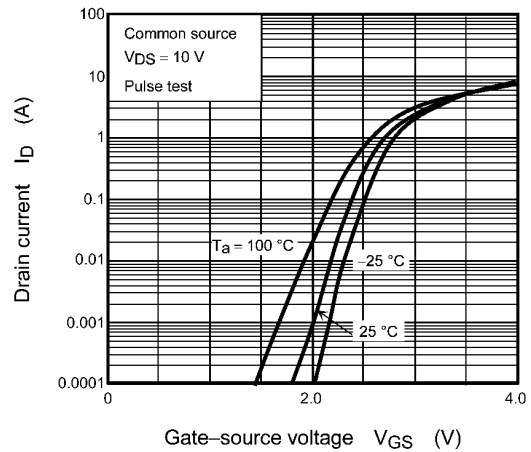
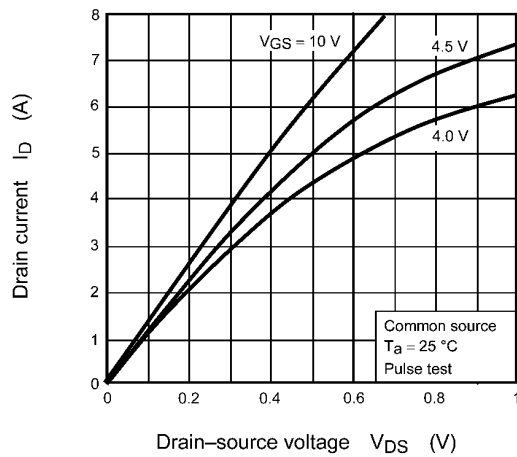


Fig. 6.1 Marking

### 7. Characteristics Curves (Note)



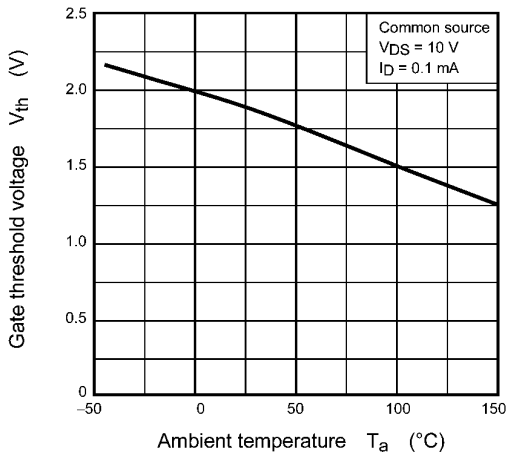


Fig. 7.7  $V_{th} - T_a$

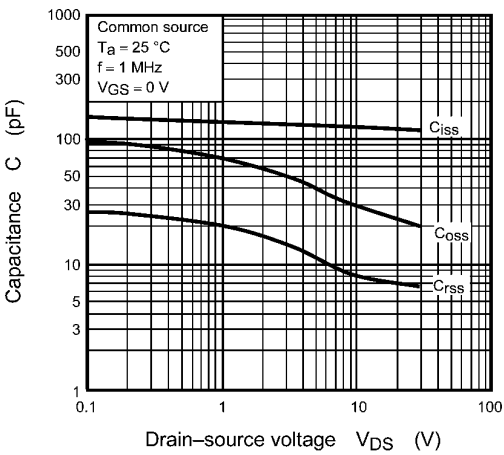


Fig. 7.8  $C - V_{DS}$

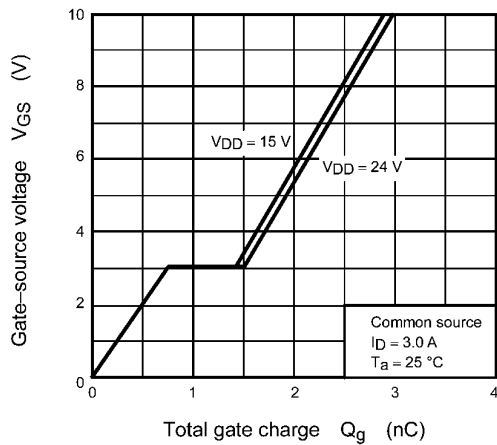


Fig. 7.9 Dynamic Input/Output Characteristics

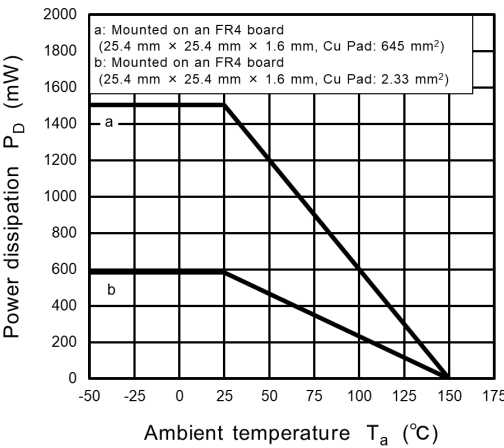


Fig. 7.10  $P_D - T_a$

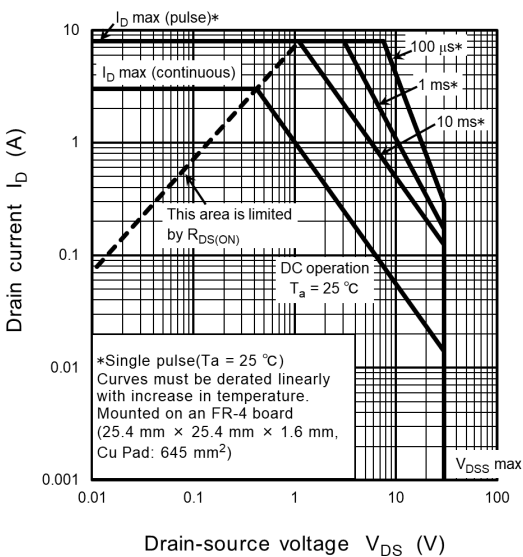


Fig. 7.11 Safe Operating Area

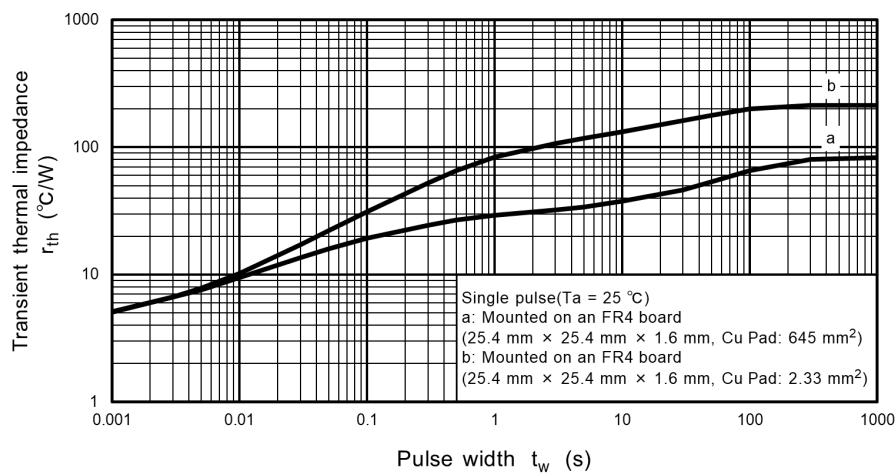
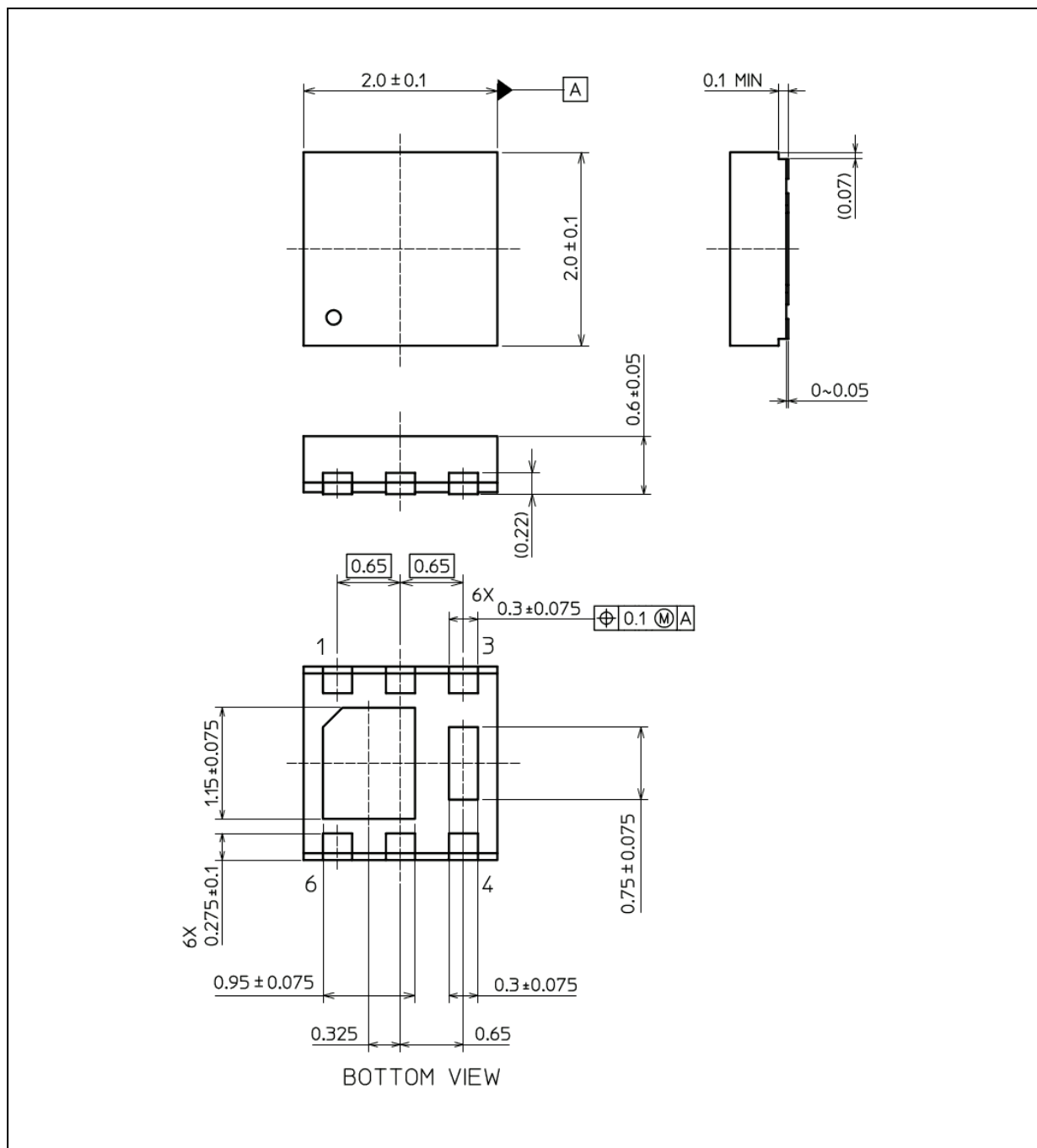


Fig. 7.12  $r_{th} - t_w$

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

## Package Dimensions

Unit: mm



Weight: 8.0 mg (typ.)

Package Name(s)
JEDEC: SOT-1220
Nickname: DFN2020B(WF)



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