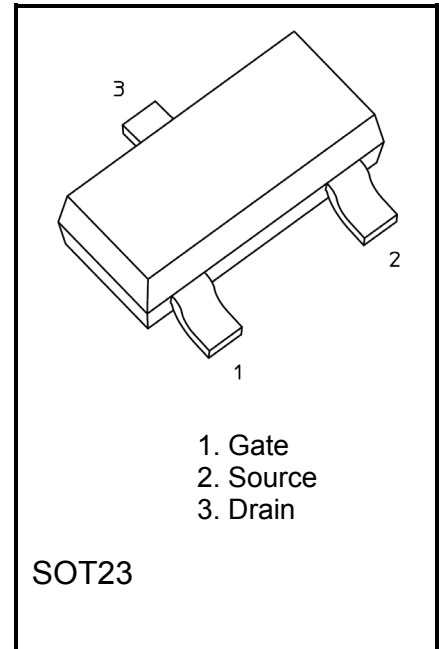


TOSHIBA Field-Effect Transistor Silicon N-Channel MOS Type

# T2N7002AK

○ High Speed Switching Applications

- ESD protected gate
- Low ON-resistance
  - $R_{DS(on)} = 2.8 \Omega$  (typ.) (@ $V_{GS} = 10 V$ )
  - $R_{DS(on)} = 3.1 \Omega$  (typ.) (@ $V_{GS} = 5 V$ )
  - $R_{DS(on)} = 3.2 \Omega$  (typ.) (@ $V_{GS} = 4.5 V$ )



**Absolute Maximum Ratings (Ta = 25°C)**

Characteristic		Symbol	Rating	Unit
Drain–source voltage		$V_{DSS}$	60	V
Gate–source voltage		$V_{GSS}$	$\pm 20$	V
Drain current (Note1)	DC	$I_D$	200	mA
	Pulse	$I_{DP}$ (Note 2)	760	
Power dissipation		$P_D$ (Note 3)	320	mW
		$P_D$ (Note 4)	1000	
Channel temperature		$T_{ch}$	150	°C
Storage temperature		$T_{stg}$	-55 to 150	°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).

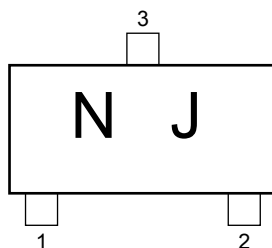
Note 1: The channel temperature should not exceed 150°C during use.

Note 2: Pulse width  $\leq 10 \mu s$ , Duty  $\leq 1\%$

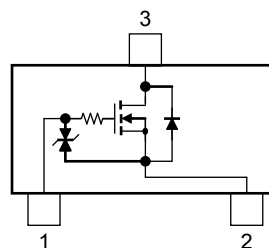
Note 3: Mounted on an FR4 board  
(25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm, Cu Pad: 0.42 mm<sup>2</sup>  $\times$  3)

Note 4: Mounted on an FR4 board  
(25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm, Cu Pad: 645 mm<sup>2</sup>)

**Marking**



**Equivalent Circuit (top view)**



Start of commercial production  
2015-01

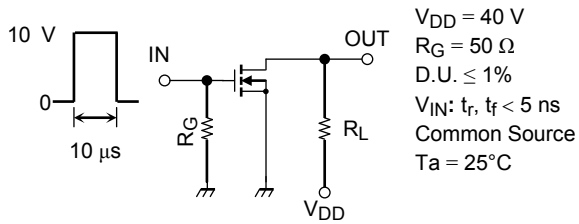
## Electrical Characteristics (Ta = 25°C, Otherwise specified)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 250 \mu A, V_{GS} = 0 V$	60	—	—	V	
Drain cutoff current	$I_{DSS}$	$V_{DS} = 60 V, V_{GS} = 0 V$	—	—	1	$\mu A$	
		$V_{DS} = 60 V, V_{GS} = 0 V, T_J = 150^\circ C$	—	—	200		
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 16 V, V_{DS} = 0 V$	—	—	$\pm 2$	$\mu A$	
		$V_{GS} = \pm 10 V, V_{DS} = 0 V$	—	—	$\pm 0.5$		
		$V_{GS} = \pm 5 V, V_{DS} = 0 V$	—	—	$\pm 0.1$		
Gate threshold voltage	$V_{th}$	$I_D = 250 \mu A, V_{DS} = V_{GS}$	1.1	—	2.1	V	
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 10 V, I_D = 200 mA$ (Note 5)	—	450	—	mS	
Drain-source ON-resistance	$R_{DS(ON)}$ (Note 5)	$I_D = 100 mA, V_{GS} = 10 V$	—	2.8	3.9	$\Omega$	
		$I_D = 100 mA, V_{GS} = 10 V, T_J = 150^\circ C$	—	5.4	8.1		
		$I_D = 100 mA, V_{GS} = 5 V$	—	3.1	4.4		
		$I_D = 100 mA, V_{GS} = 4.5 V$	—	3.2	4.7		
Total Gate Charge	$Q_{G(tot)}$	$V_{DS} = 30 V, I_D = 200 mA$ $V_{GS} = 4.5 V$	—	0.27	0.35	nC	
Gate-Source Charge	$Q_{GS}$		—	0.08	—		
Gate-Drain Charge	$Q_{GD}$		—	0.08	—		
Input capacitance	$C_{iss}$	$V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz$	—	11	17	$\mu F$	
Output capacitance	$C_{oss}$		—	3	—		
Reverse transfer capacitance	$C_{rss}$		—	0.7	—		
Switching time	Turn-on delay time	$t_{d(on)}$	$V_{DD} = 40 V, I_D = 160 mA$ $V_{GS} = 0 V \text{ to } 10 V, R_G = 50 \Omega$	—	2	4	ns
	Rise time	$t_r$		—	3	—	
	Turn-off delay time	$t_{d(off)}$		—	7	14	
	Fall time	$t_f$		—	24	—	
Drain-source forward voltage	$V_{DSF}$	$I_D = -115 mA, V_{GS} = 0 V$ (Note 5)	—	-0.87	-1.2	V	

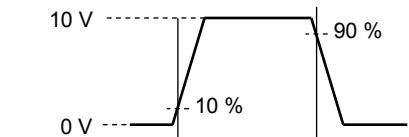
Note 5: Pulse test

**Switching Time Test Circuit**

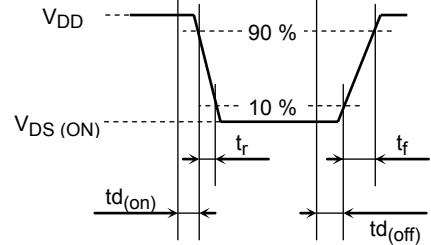
**(a) Test Circuit**



**(b) VIN**



**(c) VOUT**

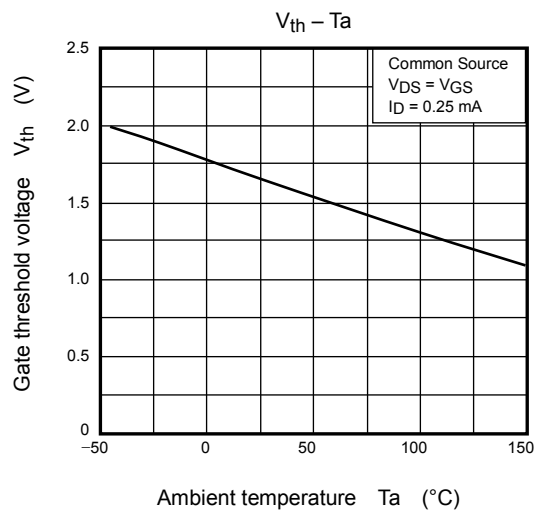
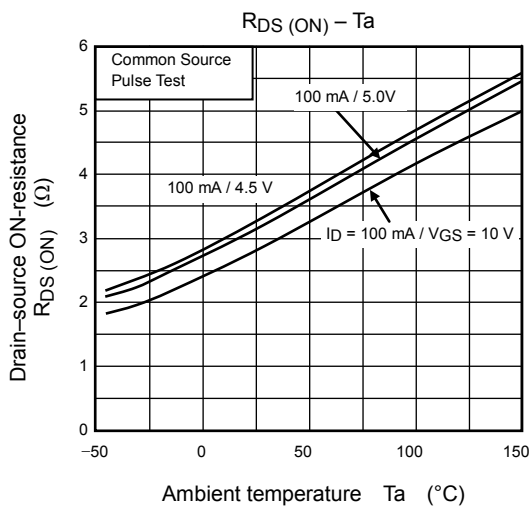
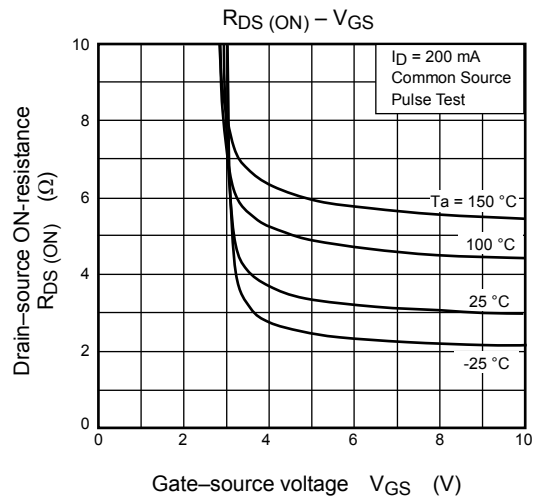
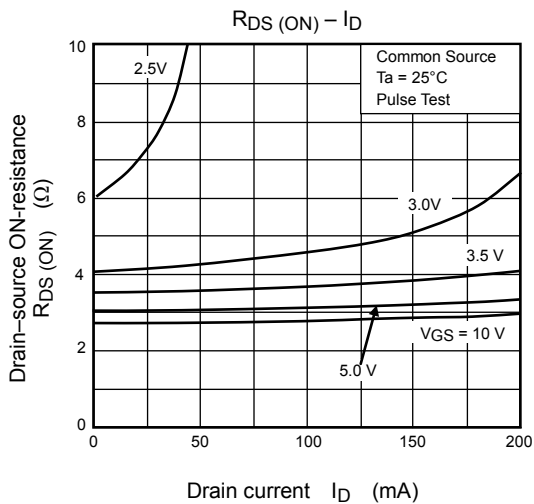
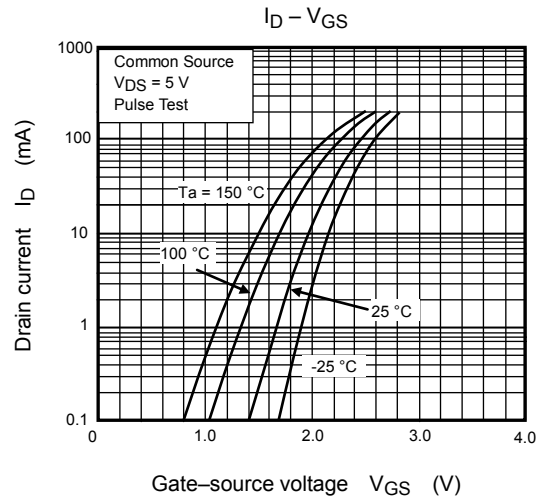
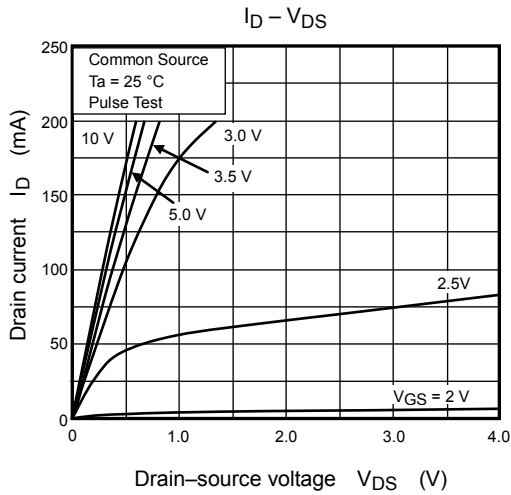


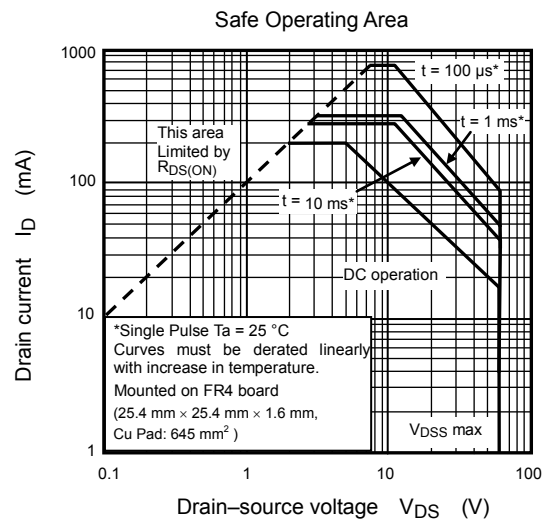
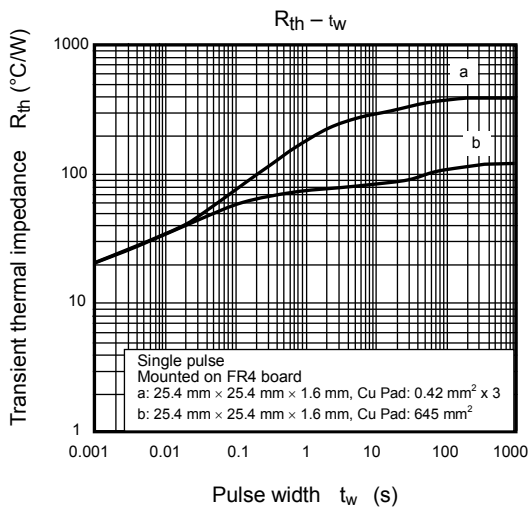
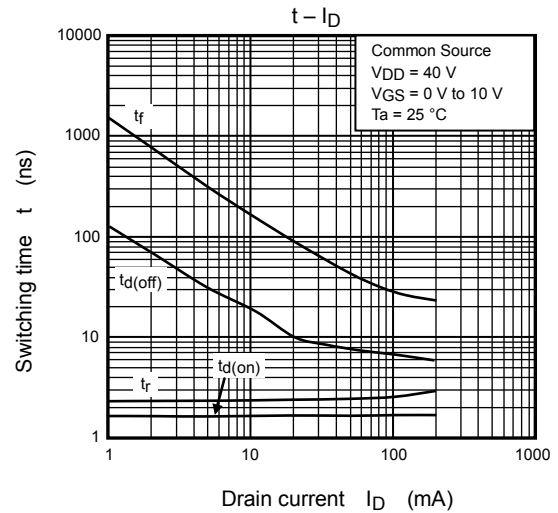
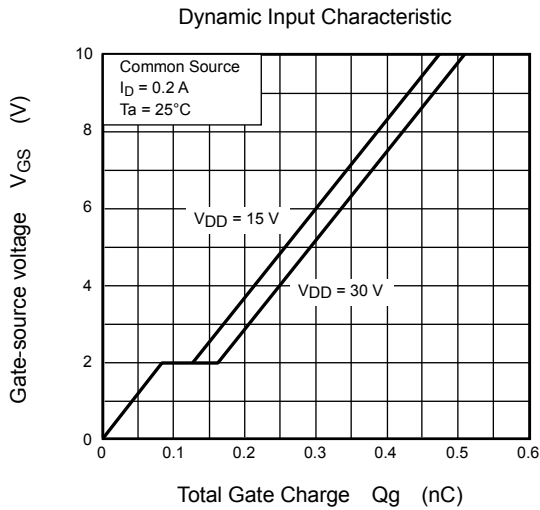
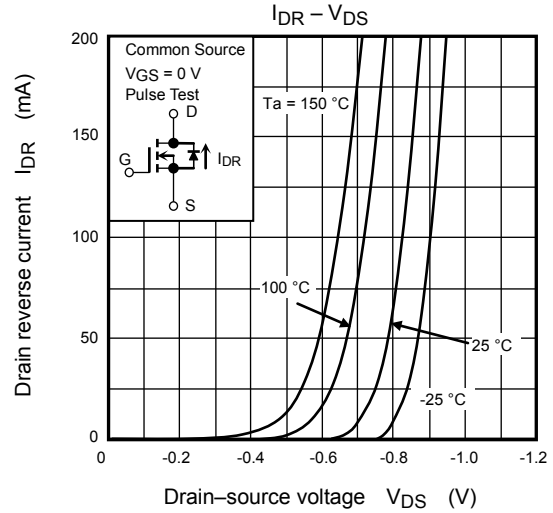
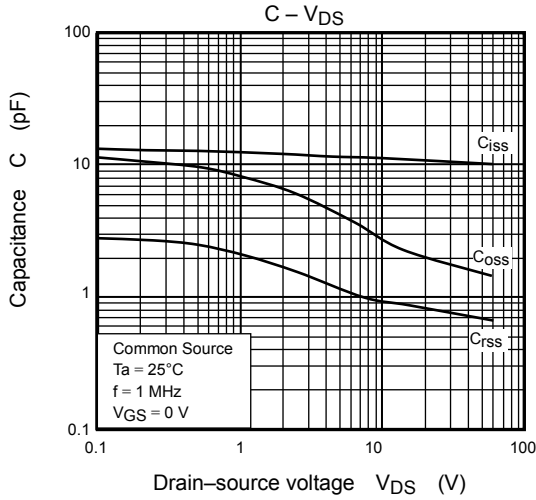
**Notice of Usage**

Let  $V_{th}$  be the voltage applied between gate and source that causes the drain current ( $I_D$ ) to below (0.25 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.

**Handling Precaution**

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.

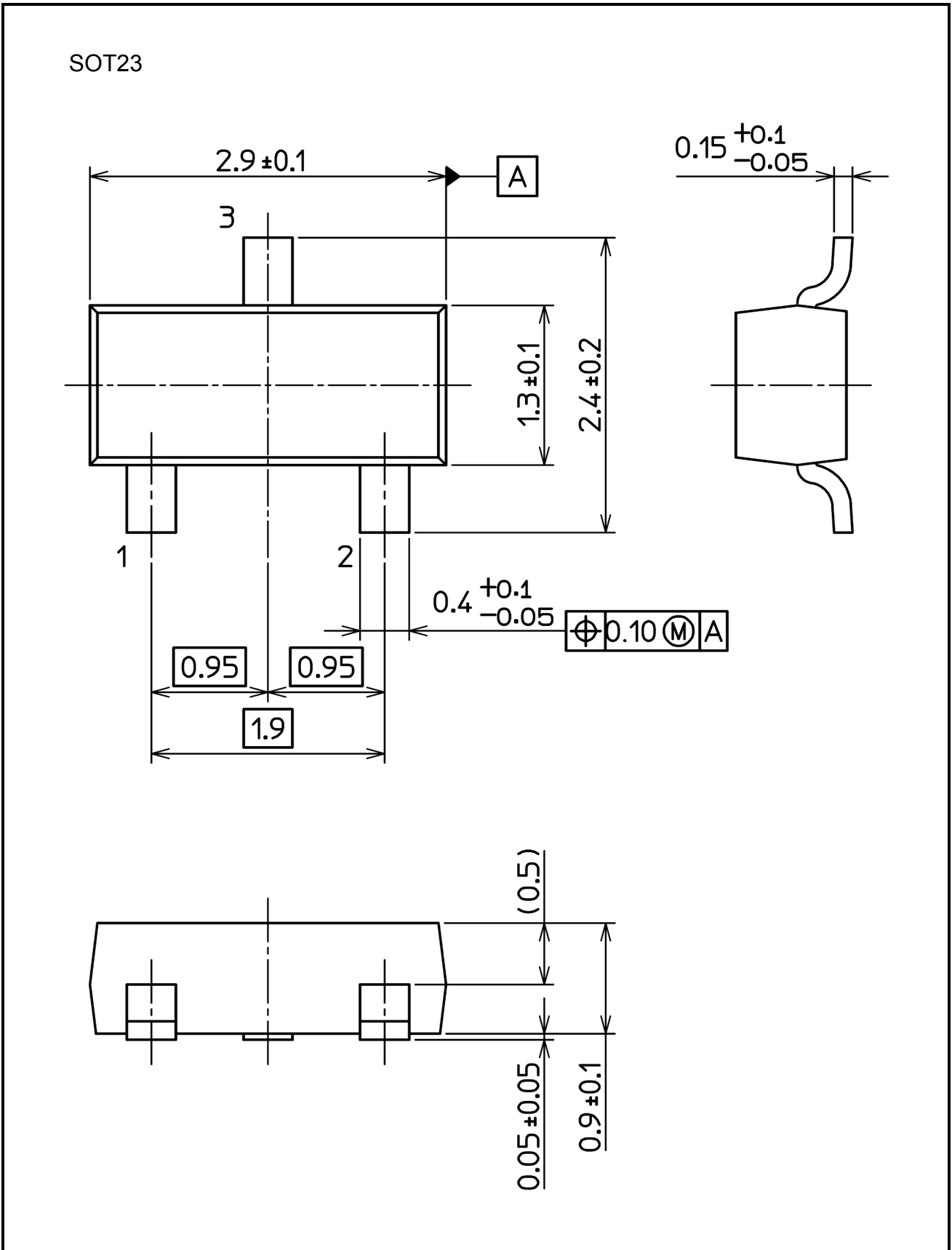




Note: The above characteristics curves are presented for reference only and not guaranteed by production test.

## Package Dimensions

Unit: mm



Weight: 0.009g (typ.)

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