

MOSFETs Silicon N-Channel MOS (U-MOSIII)

# SSM6N36FE

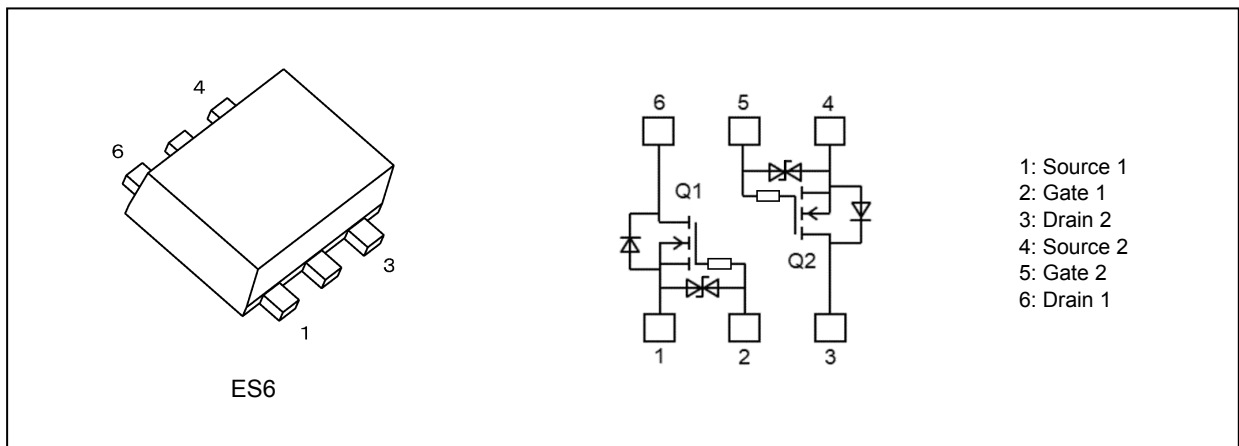
## 1. Applications

- High-Speed Switching

## 2. Features

- (1) 1.5-V drive
- (2) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 1.52 \, \Omega$  (max) (@ $V_{GS} = 1.5 \, V$ )
  - $R_{DS(ON)} = 1.14 \, \Omega$  (max) (@ $V_{GS} = 1.8 \, V$ )
  - $R_{DS(ON)} = 0.85 \, \Omega$  (max) (@ $V_{GS} = 2.5 \, V$ )
  - $R_{DS(ON)} = 0.66 \, \Omega$  (max) (@ $V_{GS} = 4.5 \, V$ )
  - $R_{DS(ON)} = 0.63 \, \Omega$  (max) (@ $V_{GS} = 5.0 \, V$ )

## 3. Packaging and Internal Circuit



Start of commercial production

2008-02

**4. Absolute Maximum Ratings (Note) (Unless otherwise specified,  $T_a = 25\text{ }^{\circ}\text{C}$ ) (Q1, Q2 Common)**

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DS}$	20	V
Gate-source voltage	$V_{GS}$	$\pm 10$	V
Drain current (DC)	$I_D$	500	mA
Drain current (pulsed)	$I_{DP}$	1000	
Power dissipation (Note 1)	$P_D$	150	mW
Channel temperature	$T_{ch}$	150	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$	-55 to 150	$^{\circ}\text{C}$

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: Device mounted on an FR4 board.(total rating)(25.4 mm × 25.4 mm × 1.6 mm, Cu pad: 0.135 mm<sup>2</sup> × 6)

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

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 (Q1, Q2 Common)

### 5.1. Static Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 10\text{ V}$	—	—	$\pm 1$	$\mu\text{A}$
Drain cut-off current	$I_{DSS}$	$V_{DS} = 20\text{ V}$ , $V_{GS} = 0\text{ V}$	—	—	1	$\mu\text{A}$
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)	$V_{(BR)DSX}$	$I_D = 1\text{ mA}$ , $V_{GS} = -10\text{ V}$	12	—	—	
Gate threshold voltage (Note 2)	$V_{th}$	$V_{DS} = 3\text{ V}$ , $I_D = 1\text{ mA}$	0.35	—	1.0	V
Drain-source on-resistance (Note 3)	$R_{DS(ON)}$	$I_D = 200\text{ mA}$ , $V_{GS} = 5.0\text{ V}$	—	0.46	0.63	$\Omega$
		$I_D = 200\text{ mA}$ , $V_{GS} = 4.5\text{ V}$	—	0.51	0.66	
		$I_D = 200\text{ mA}$ , $V_{GS} = 2.5\text{ V}$	—	0.66	0.85	
		$I_D = 100\text{ mA}$ , $V_{GS} = 1.8\text{ V}$	—	0.81	1.14	
		$I_D = 50\text{ mA}$ , $V_{GS} = 1.5\text{ V}$	—	0.95	1.52	
Forward transfer admittance (Note 3)	$ Y_{fs} $	$V_{DS} = 3\text{ V}$ , $I_D = 200\text{ mA}$	420	840	—	mS

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, $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 10\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$	—	46	—	pF
Reverse transfer capacitance	$C_{rss}$		—	7.3	—	
Output capacitance	$C_{oss}$		—	10.8	—	
Switching time (turn-on time)	$t_{on}$	$V_{DD} = 10\text{ V}$ , $I_D = 200\text{ mA}$ , $V_{GS} = 0\text{ to } 2.5\text{ V}$ , $R_{GS} = 50\text{ }\Omega$ Duty $\leq 1\%$ , $V_{IN}$ : $t_r, t_f < 5\text{ ns}$ , Common source, See Chapter 5.3.	—	30	—	ns
Switching time (turn-off time)	$t_{off}$		—	75	—	

### 5.3. Switching Time Test Circuit

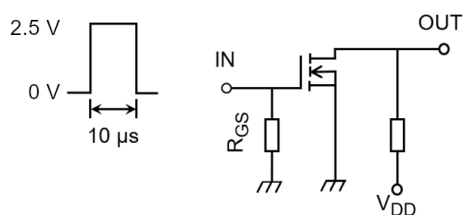


Fig. 5.3.1 Switching Time Test Circuit

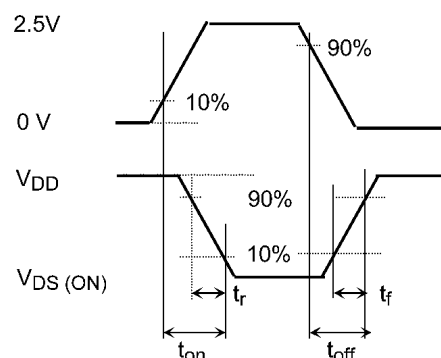


Fig. 5.3.2 Input Waveform/Output Waveform

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)	$Q_g$	$V_{DS} = 10\text{ V}$ , $I_D = 0.5\text{ A}$ , $V_{GS} = 4.0\text{ V}$	—	1.23	—	nC
Gate-source charge	$Q_{gs}$		—	0.60	—	
Gate-drain charge	$Q_{gd}$		—	0.63	—	

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)	$V_{DSF}$	$I_{DR} = 0.5\text{ A}$ , $V_{GS} = 0\text{ V}$	—	0.88	1.2	V

Note 1: Pulse measurement.

6. Marking

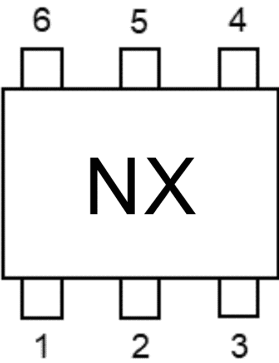


Fig. 6.1 Marking

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

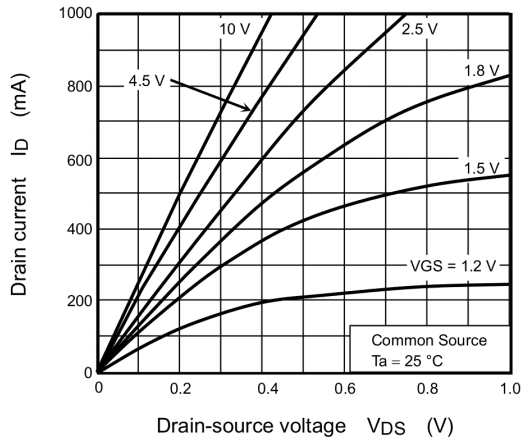


Fig. 7.1  $I_D - V_{DS}$

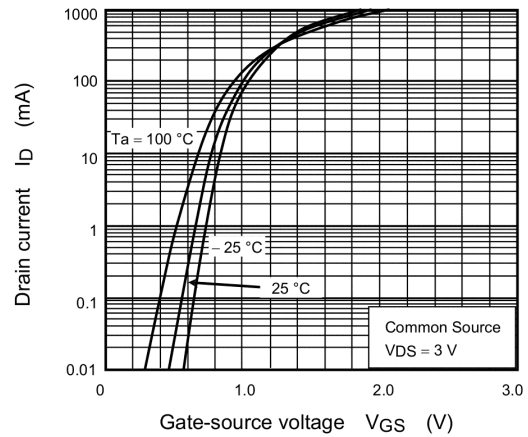


Fig. 7.2  $I_D - V_{GS}$

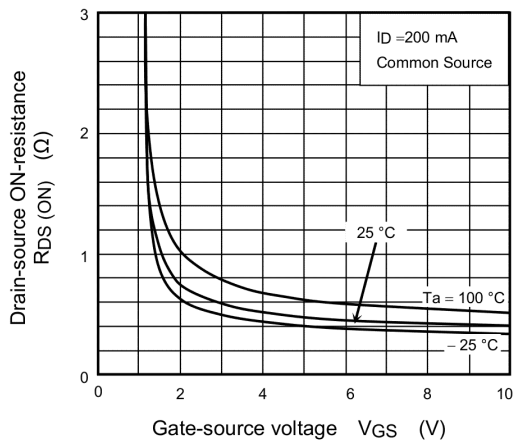


Fig. 7.3  $R_{DS(ON)} - V_{GS}$

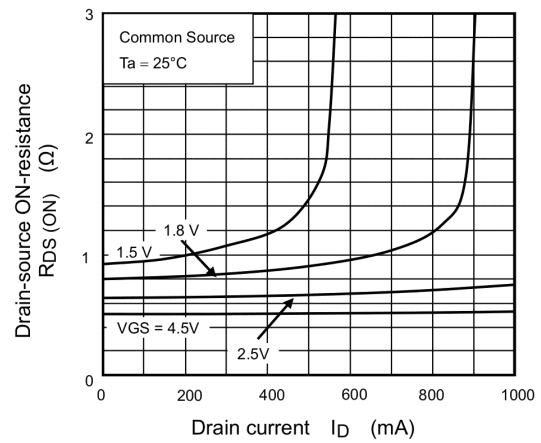


Fig. 7.4  $R_{DS(ON)} - I_D$

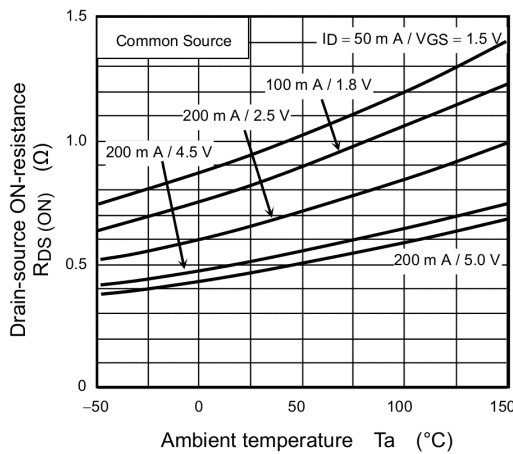


Fig. 7.5  $R_{DS(ON)} - T_a$

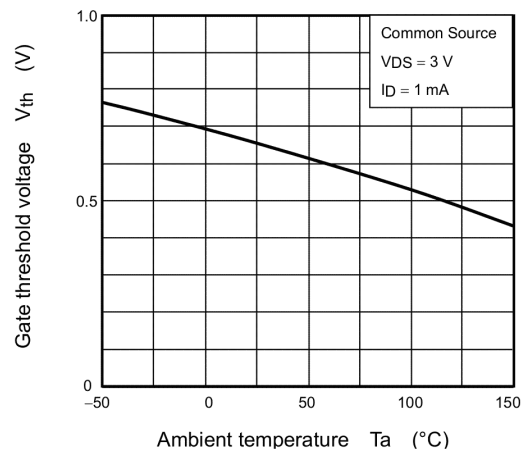


Fig. 7.6  $V_{th} - T_a$

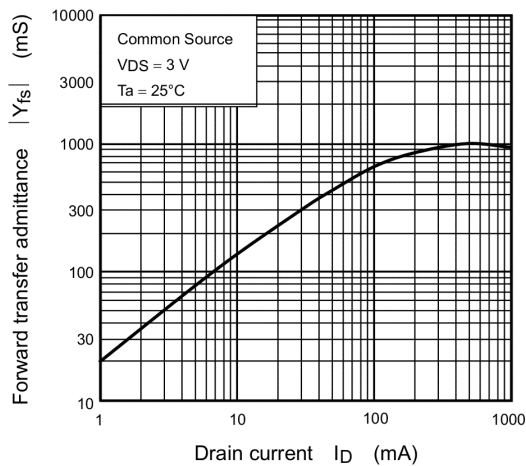


Fig. 7.7  $|Y_{fs}| - I_D$

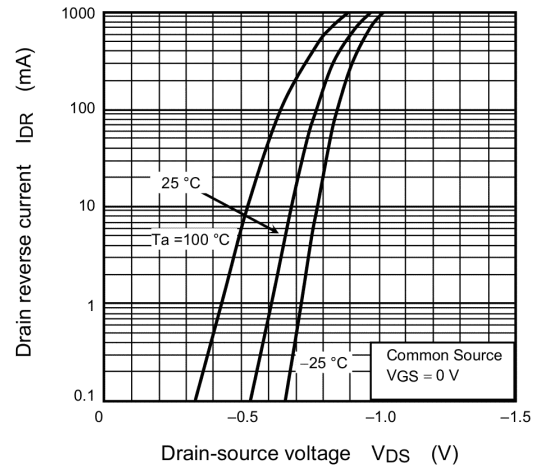


Fig. 7.8  $I_{DR} - V_{DS}$

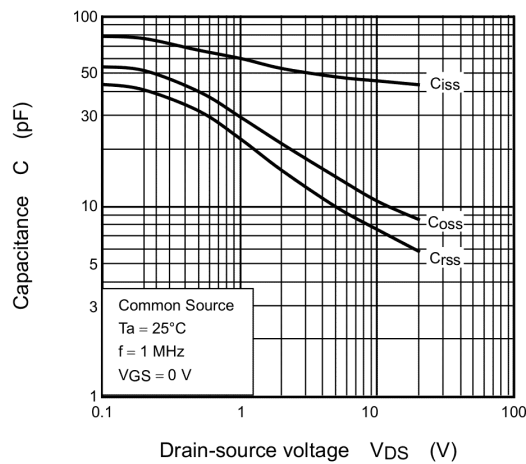


Fig. 7.9  $C - V_{DS}$

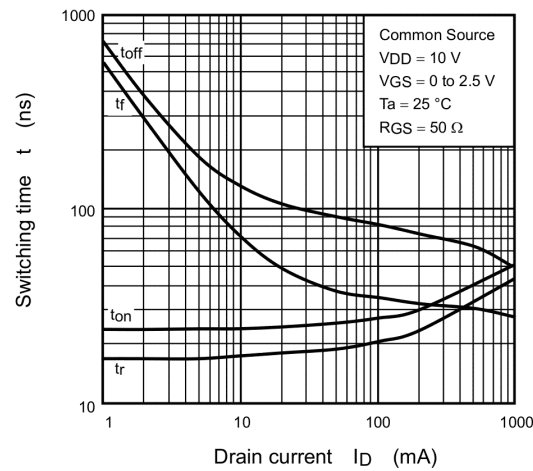


Fig. 7.10  $t - I_D$

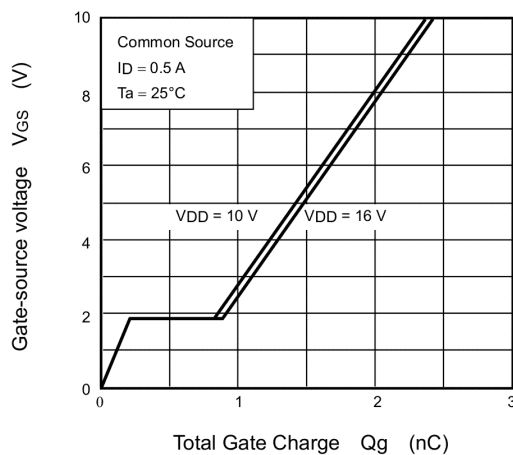


Fig. 7.11 Dynamic Input Characteristic

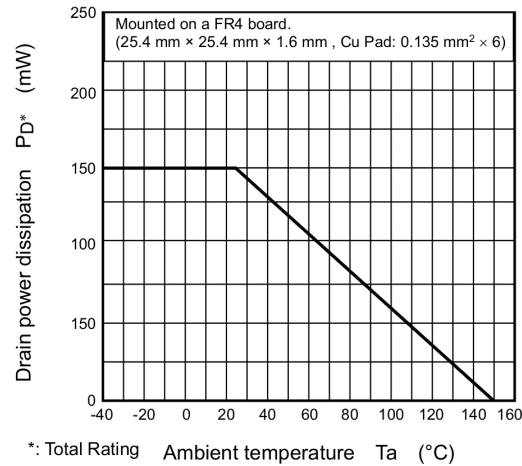
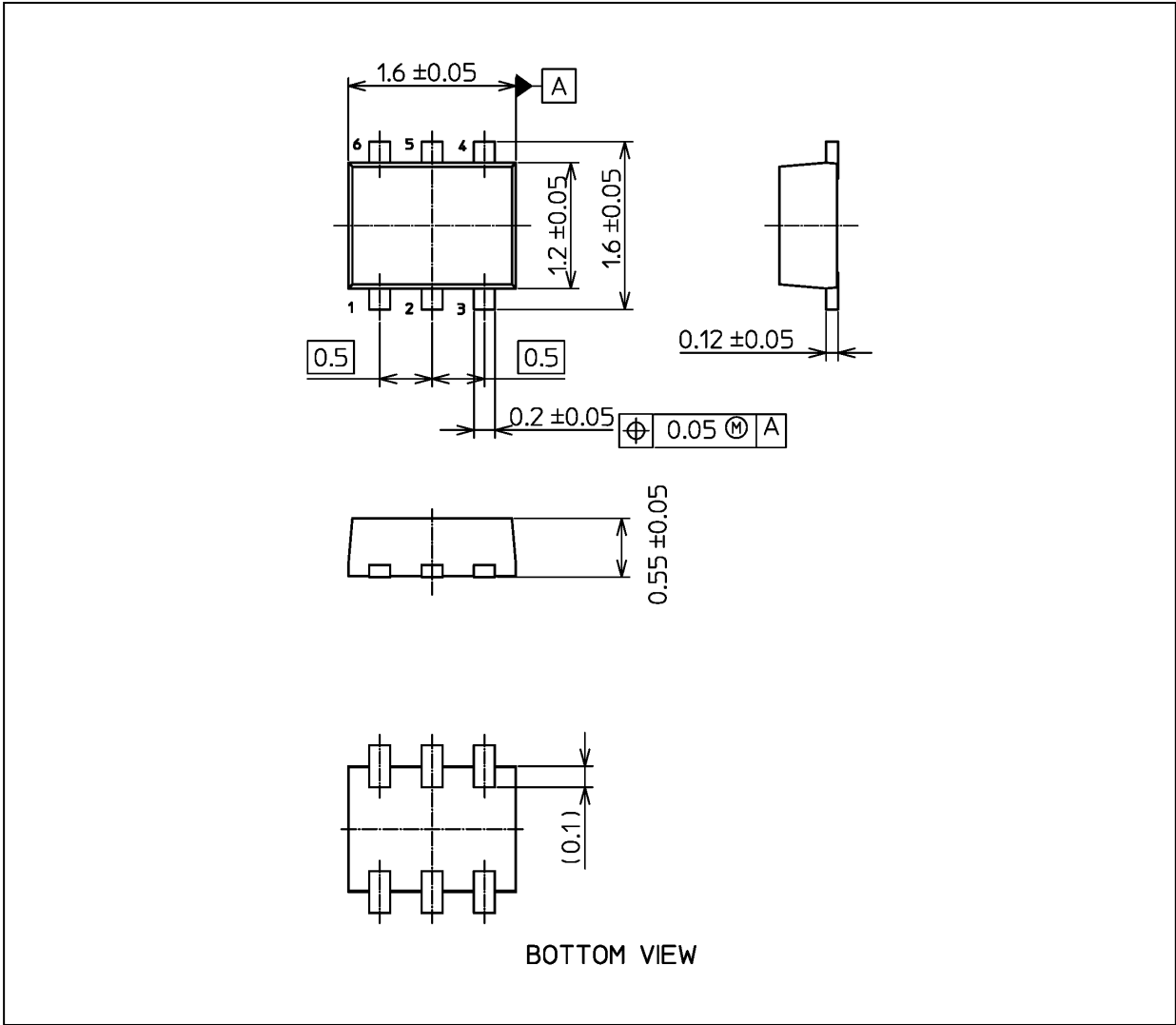


Fig. 7.12  $P_{D^*} - T_a$

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

Package Dimensions

Unit: mm



Weight: 3.0 mg (typ.)

Package Name(s)
JEDEC: SOT-563
Nickname: ES6

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