

MOSFETs Silicon N-Channel MOS

# SSM3K35AMFV

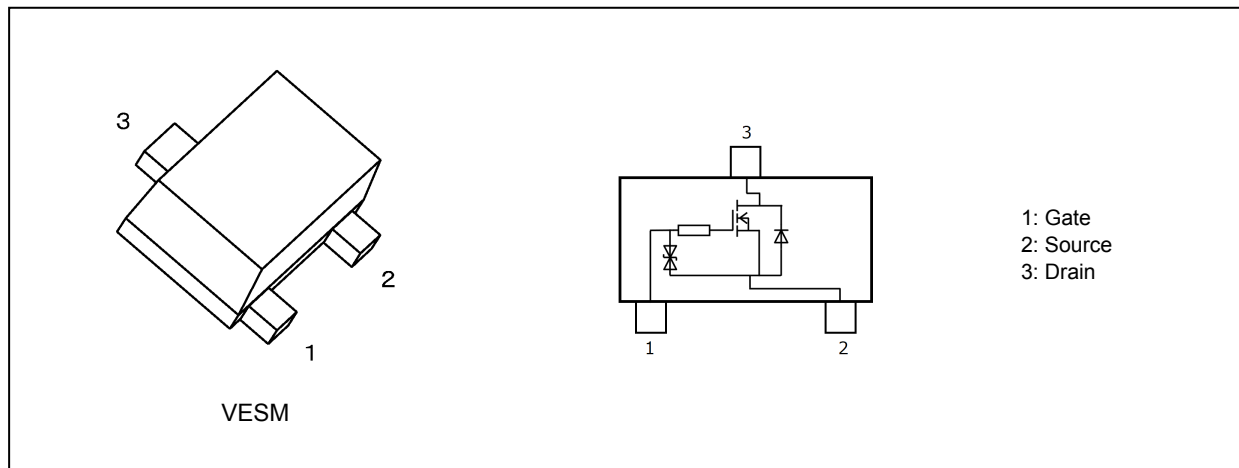
## 1. Applications

- High-Speed Switching
- Analog Switches

## 2. Features

- (1) 1.2 V drive
- (2) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 9.0 \Omega$  (max) (@ $V_{GS} = 1.2 \text{ V}$ ,  $I_D = 10 \text{ mA}$ )
  - $R_{DS(ON)} = 3.1 \Omega$  (max) (@ $V_{GS} = 1.5 \text{ V}$ ,  $I_D = 20 \text{ mA}$ )
  - $R_{DS(ON)} = 2.4 \Omega$  (max) (@ $V_{GS} = 1.8 \text{ V}$ ,  $I_D = 150 \text{ mA}$ )
  - $R_{DS(ON)} = 1.6 \Omega$  (max) (@ $V_{GS} = 2.5 \text{ V}$ ,  $I_D = 150 \text{ mA}$ )
  - $R_{DS(ON)} = 1.1 \Omega$  (max) (@ $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 150 \text{ mA}$ )

## 3. Packaging and Pin Assignment



Start of commercial production  
2016-10

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

| Characteristics                 | Symbol    | Rating     | Unit             |
|---------------------------------|-----------|------------|------------------|
| Drain-source voltage            | $V_{DSS}$ | 20         | V                |
| Gate-source voltage             | $V_{GSS}$ | $\pm 10$   |                  |
| Drain current (Note 1)          | $I_D$     | 250        | mA               |
| Drain current (pulsed) (Note 1) | $I_{DP}$  | 600        |                  |
| Power dissipation (Note 2)      | $P_D$     | 150        | mW               |
| Power dissipation (Note 3)      |           | 500        |                  |
| 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: Ensure that the channel temperature does not exceed  $150\text{ }^\circ\text{C}$ .

Note 2: Mounted on an FR4 board ( $25.4\text{ mm} \times 25.4\text{ mm} \times 1.6\text{ mm}$ , Cu pad:  $0.585\text{ mm}^2$ )

Note 3: Mounted on an FR4 board ( $25.4\text{ mm} \times 25.4\text{ mm} \times 1.6\text{ mm}$ , Cu pad:  $645\text{ mm}^2$ )

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          |
|---|---------------|---|------|------|---------|---------------|
| Gate leakage current                    | $I_{GSS}$     | $V_{GS} = \pm 10\text{ V}, V_{DS} = 0\text{ V}$                               | —    | —    | $\pm 1$ | $\mu\text{A}$ |
| Drain cut-off current                   | $I_{DSS}$     | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$                                   | —    | —    | 1       |               |
| Drain-source breakdown voltage          | $V_{(BR)DSS}$ | $I_D = 1\text{ mA}, V_{GS} = 0\text{ V}$                                      | 20   | —    | —       | V             |
| Gate threshold voltage (Note 1)         | $V_{th}$      | $V_{DS} = 10\text{ V}, I_D = 100\text{ }\mu\text{A}$                          | 0.35 | —    | 1.0     |               |
| Drain-source on-resistance (Note 2)     | $R_{DS(ON)}$  | $I_D = 150\text{ mA}, V_{GS} = 4.5\text{ V}$                                  | —    | 0.75 | 1.1     | $\Omega$      |
|   |               | $I_D = 150\text{ mA}, V_{GS} = 2.5\text{ V}$                                  | —    | 1.1  | 1.6     |               |
|   |               | $I_D = 150\text{ mA}, V_{GS} = 1.8\text{ V}$                                  | —    | 1.4  | 2.4     |               |
|   |               | $I_D = 20\text{ mA}, V_{GS} = 1.5\text{ V}$                                   | —    | 1.7  | 3.1     |               |
|   |               | $I_D = 10\text{ mA}, V_{GS} = 1.2\text{ V}$                                   | —    | 2.4  | 9.0     |               |
|   |               | $I_D = 150\text{ mA}, V_{GS} = 4.5\text{ V}, T_j = 125\text{ }^\circ\text{C}$ | —    | 1.25 | 2.5     |               |
| Forward transfer admittance (Note 2)    | $ Y_{fs} $    | $V_{DS} = 10\text{ V}, I_D = 150\text{ mA}$                                   | —    | 0.5  | —       | S             |
| Reverse drain current (pulsed) (Note 2) | $I_{DRP}$     | —   | —    | —    | 600     | mA            |

Note 1: Let  $V_{th}$  be the voltage applied between gate and source that causes the drain current ( $I_D$ ) to be below ( $100\text{ }\mu\text{A}$  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                    | $C_{iss}$    | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$  | —   | 18   | 36  | pF   |
| Reverse transfer capacitance         | $C_{rss}$    |  | —   | 5    | 10  |      |
| Output capacitance                   | $C_{oss}$    |  | —   | 6    | 12  |      |
| Switching time (turn-on delay time)  | $t_{d(on)}$  | $V_{DD} = 10\text{ V}, I_D = 75\text{ mA}, V_{GS} = 0\text{ to }4.5\text{ V}, R_{GS} = 10\text{ }\Omega$ | —   | 2    | —   | ns   |
| Switching time (rise time)           | $t_r$        |  | —   | 2    | —   |      |
| Switching time (turn-off delay time) | $t_{d(off)}$ |  | —   | 6.5  | —   |      |
| Switching time (fall time)           | $t_f$        |  | —   | 5.5  | —   |      |

#### 5.3. Switching Time Test Circuit

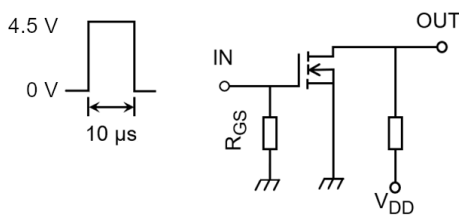


Fig. 5.3.1 Switching Time Test Circuit

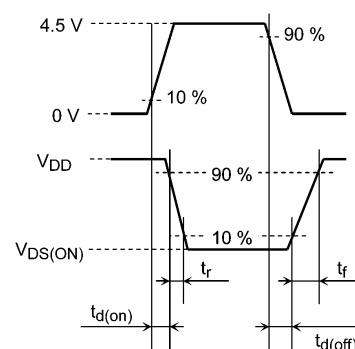


Fig. 5.3.2 Input Waveform/Output Waveform

### 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) | $Q_g$     | $V_{DD} = 10\text{ V}$ , $I_D = 200\text{ mA}$ ,<br>$V_{GS} = 4.5\text{ V}$ | —   | 0.62 | —   | nC   |
| Gate-source charge 1                            | $Q_{gs1}$ |   | —   | 0.09 | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |   | —   | 0.16 | —   |      |

### 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) | $V_{DSF}$ | $I_{DR} = 150\text{ mA}$ , $V_{GS} = 0\text{ V}$ | —   | 0.8  | 1.2 | V    |

Note 1: Pulse measurement.

## 6. Marking

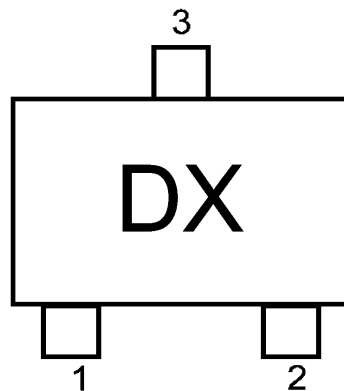


Fig. 6.1 Marking

### 7. Characteristics Curves (Note)

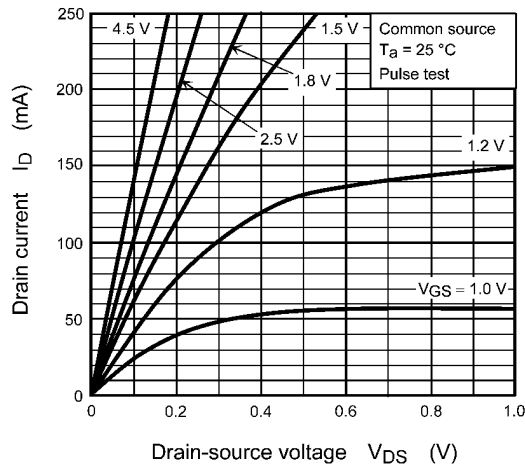


Fig. 7.1  $I_D - V_{DS}$

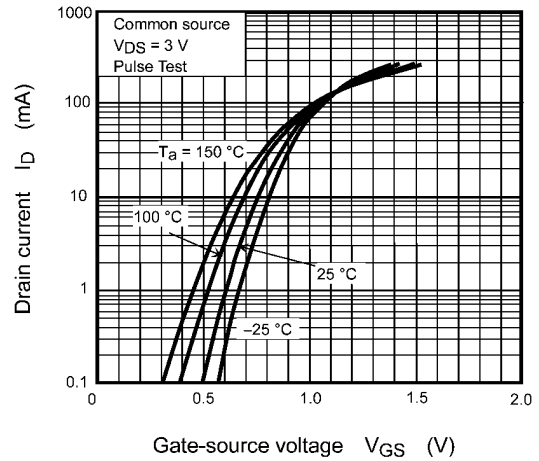


Fig. 7.2  $I_D - V_{GS}$

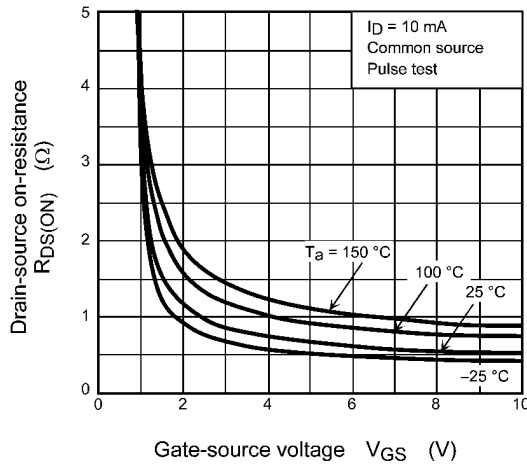


Fig. 7.3  $R_{DS(ON)} - V_{GS}$

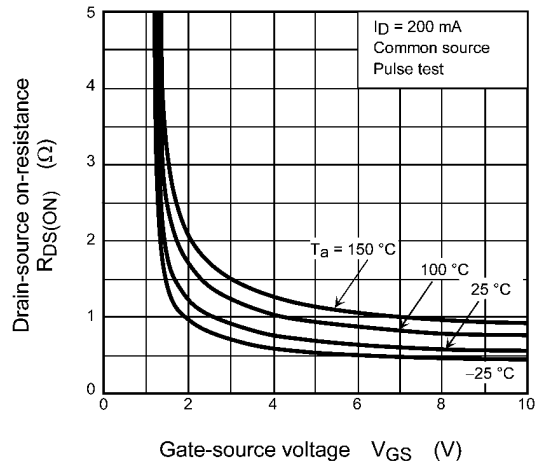


Fig. 7.4  $R_{DS(ON)} - V_{GS}$

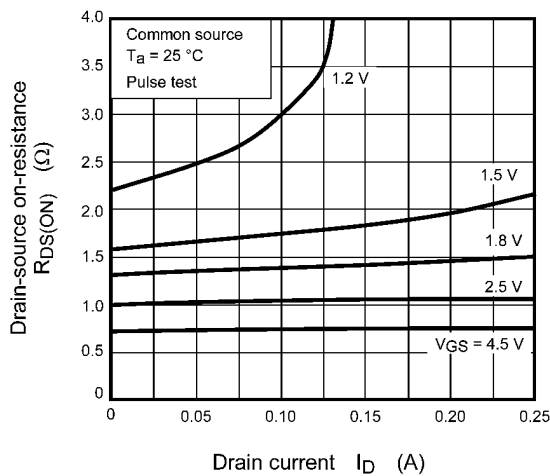


Fig. 7.5  $R_{DS(ON)} - I_D$

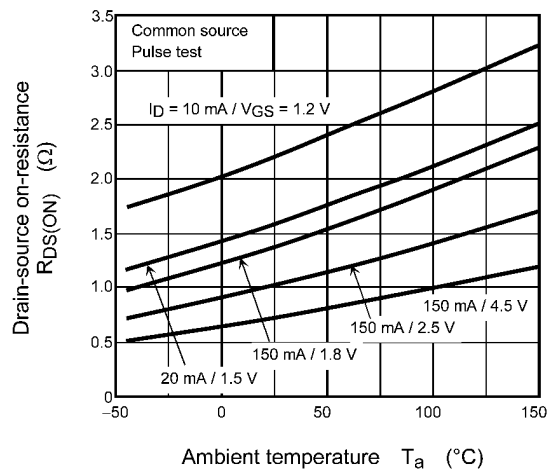
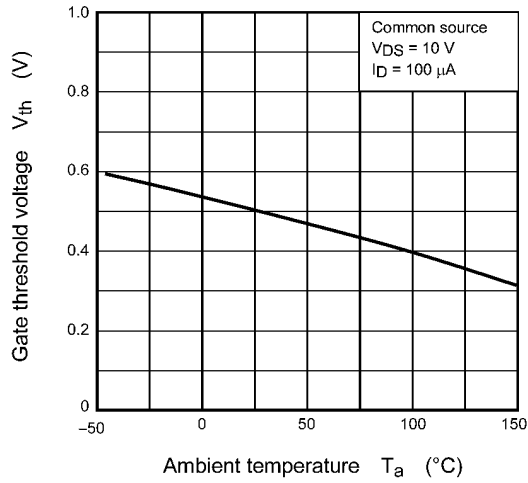
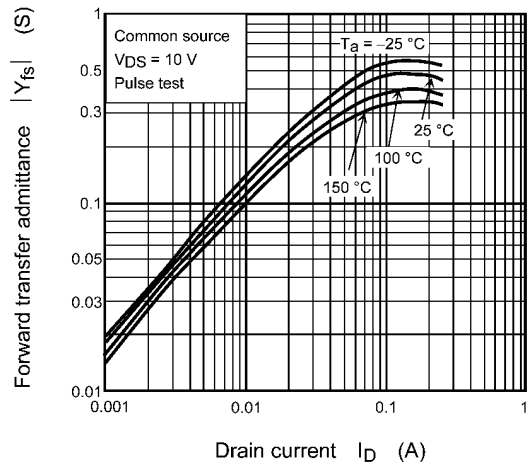


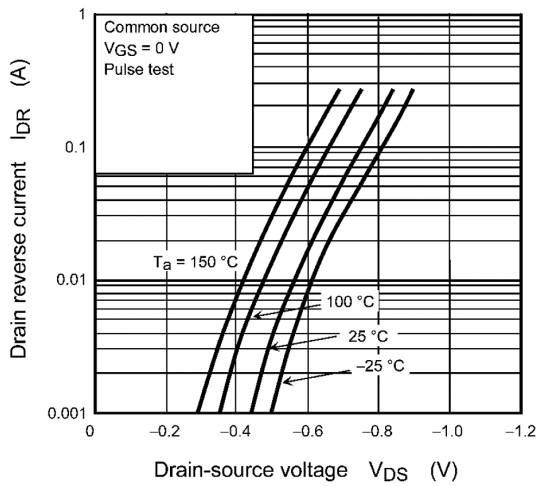
Fig. 7.6  $R_{DS(ON)} - T_a$



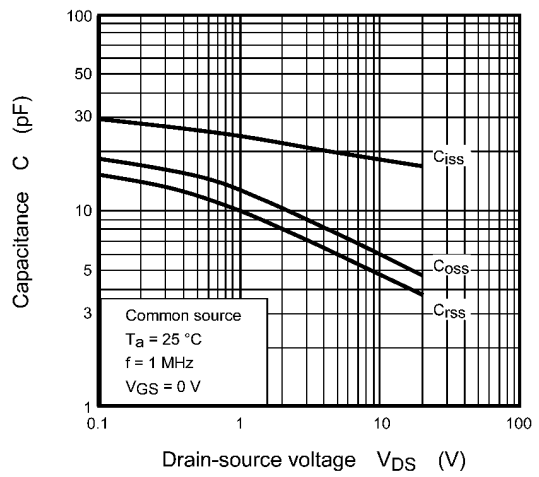
**Fig. 7.7  $V_{th} - T_a$**



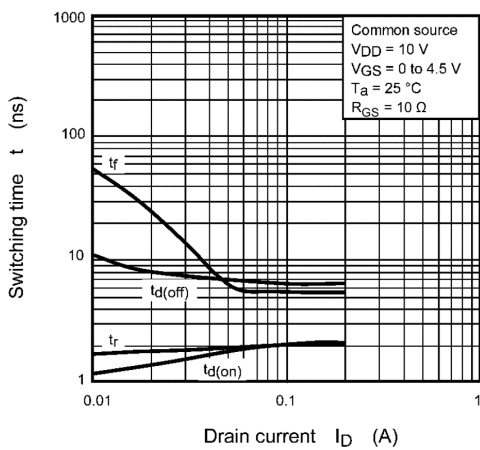
**Fig. 7.8  $|Y_{fs}| - I_D$**



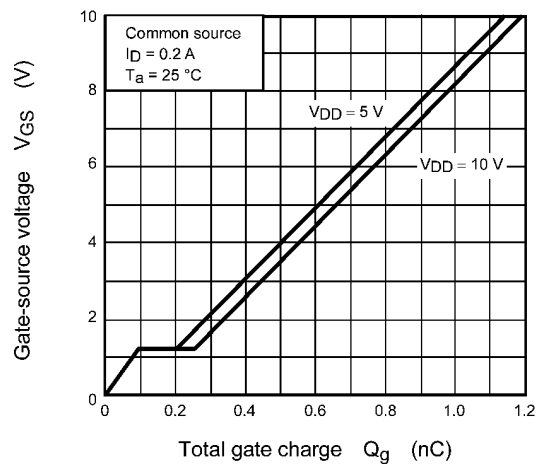
**Fig. 7.9  $I_{DR} - V_{DS}$**



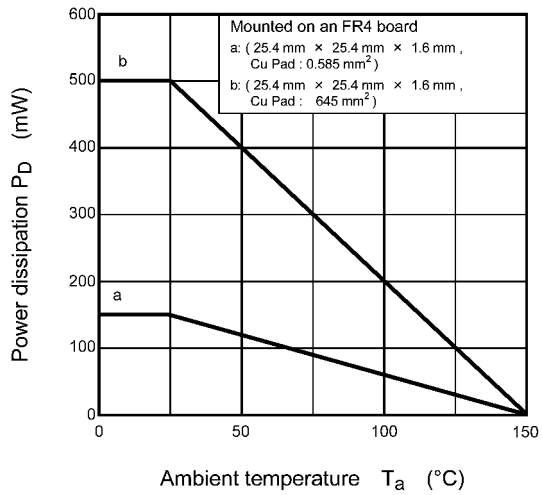
**Fig. 7.10  $C - V_{DS}$**



**Fig. 7.11  $t - I_D$**



**Fig. 7.12 Dynamic Input Characteristics**

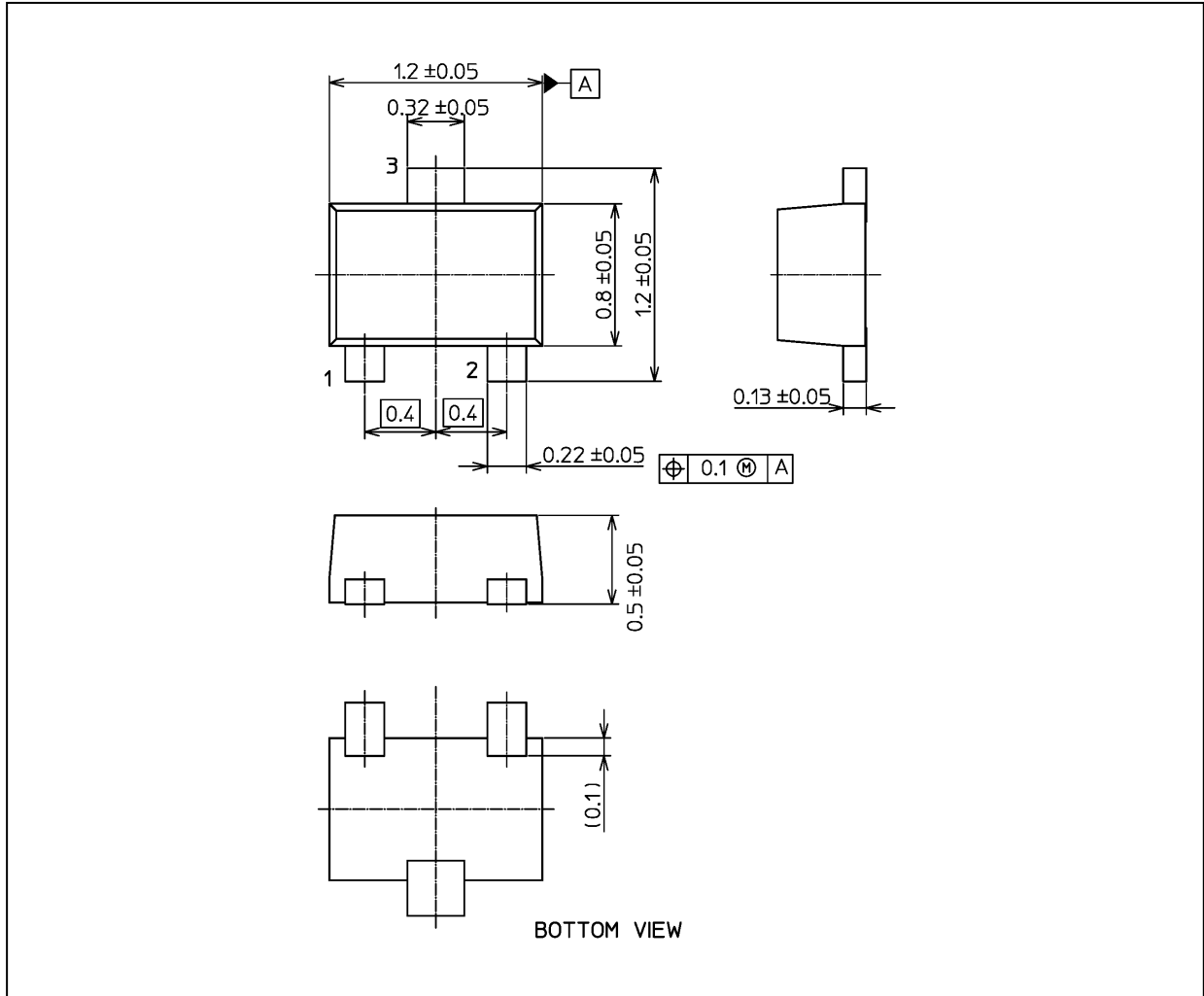


**Fig. 7.13 P<sub>D</sub> - T<sub>a</sub>**

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

### Package Dimensions

Unit: mm



Weight: 1.5 mg (typ.)

| Package Name(s) |
|-----------------|
| JEDEC: SOT-723  |
| Nickname: VESM  |



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