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MOSFETs Silicon N-Channel MOS

# SSM6N357R

## 1. Applications

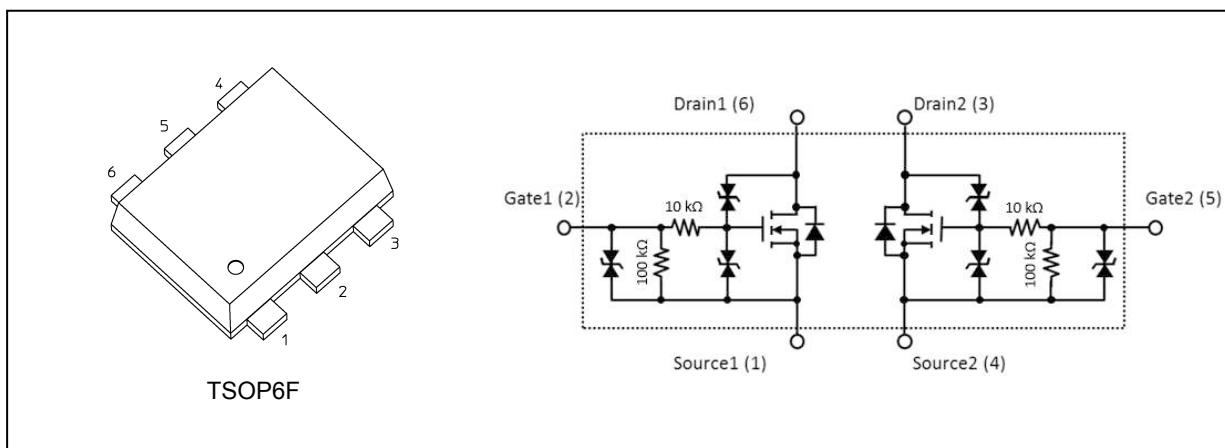
- Relay Drivers

## 2. Features

- (1) AEC-Q101 qualified (Note 1)
- (2) 3.0-V gate drive voltage.
- (3) Built-in Internal Zener diodes and resistors.
- (4) HBM: 2-kV class

Note 1: For detail information, please contact to our sales.

## 3. Packaging and Pin Assignment



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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	60	V
Gate-source voltage	$V_{GSS}$	$\pm 12$	
Drain current (DC) (Note 1)	$I_D$	650	mA
Drain current (pulsed) (Note 1), (Note 2)	$I_{DP}$	1300	
Power dissipation (Note 3)	$P_D$	1	W
Power dissipation ( $t \leq 10s$ ) (Note 3)	$P_D$	1.5	
Channel temperature	$T_{ch}$	150	$^{\circ}\text{C}$
Single-pulse avalanche energy (Note 4)	$E_{AS}$	12.6	mJ
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: Ensure that the channel temperature does not exceed  $150\text{ °C}$ .

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

Note 3: Device mounted on an FR4 board. (25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm, Cu pad: 645 mm<sup>2</sup>)

Note 4:  $V_{DD} = 25\text{ V}$ ,  $T_{ch} = 25\text{ °C}$  (Initial state),  $L = 20\text{ mH}$

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	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 3\text{ V}$	—	—	$\pm 60$	$\mu\text{A}$
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 5\text{ V}$	—	—	$\pm 90$	
Drain cut-off current	$I_{DSS}$	$V_{DS} = 12\text{ V}, V_{GS} = 0\text{ V}$	—	—	0.5	
		$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$	—	—	1	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	60	—	—	V
Gate threshold voltage (Note 1)	$V_{th}$	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1.3	—	2.0	
Drain-source on-resistance (Note 2)	$R_{DS(ON)}$	$I_D = 150\text{ mA}, V_{GS} = 3\text{ V}$	—	1.2	2.4	$\Omega$
		$I_D = 150\text{ mA}, V_{GS} = 5\text{ V}$	—	0.8	1.8	
Forward transfer admittance (Note 2)	$ Y_{fs} $	$V_{DS} = 12\text{ V}, I_D = 150\text{ mA}$	—	500	—	mS

Note 1: Let  $V_{th}$  be the voltage applied between gate and source that causes the drain current ( $I_D$ ) to below (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 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	$C_{iss}$	$V_{DS} = 12\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	—	43	60	$\mu\text{F}$
Reverse transfer capacitance	$C_{rss}$		—	2.5	—	
Output capacitance	$C_{oss}$		—	20	—	
Switching time (turn-on time) (Note 1)	$t_{on}$	$V_{DD} = 12\text{ V}, V_{GS} = 0\text{ to }3.0\text{ V},$ $R_G = 50\ \Omega$	—	990	—	ns
Switching time (turn-off time) (Note 1)	$t_{off}$		—	3000	—	

Note 1: See Chapter 5.3

#### 5.3. Switching Time Test Circuit

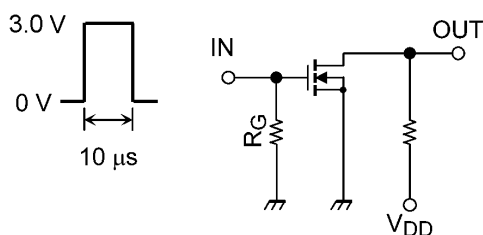


Fig. 5.3.1 Switching Time Test Circuit

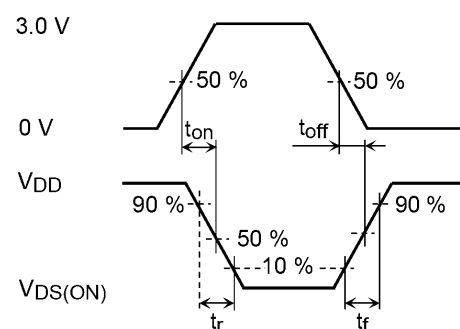


Fig. 5.3.2 Input Waveform/Output Waveform

#### 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)	$Q_g$	$V_{DD} = 12\text{ V}, I_D = 650\text{ mA},$ $V_{GS} = 5.0\text{ V}$	—	1.5	—	nC
Gate-source charge 1	$Q_{gs1}$		—	0.2	—	
Gate-drain charge	$Q_{gd}$		—	1.2	—	



## 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)	$V_{DSF}$	$I_D = -650\text{ mA}$ , $V_{GS} = 0\text{ V}$	—	-0.87	-1.2	V

Note 1: Pulse measurement.

## 6. Marking

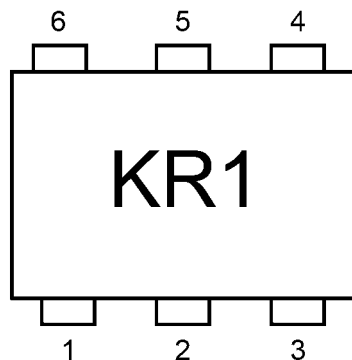
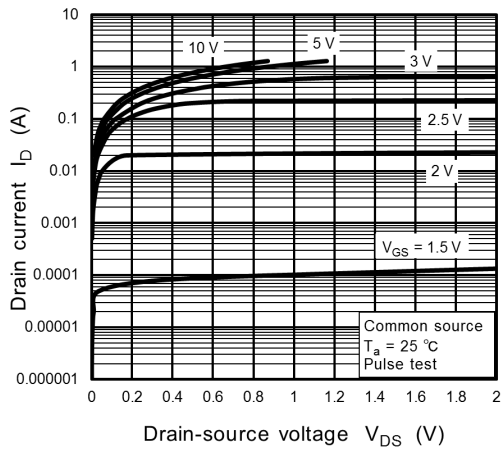
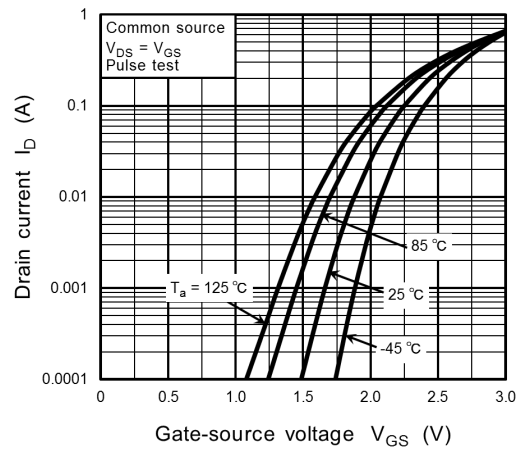


Fig. 6.1 Marking

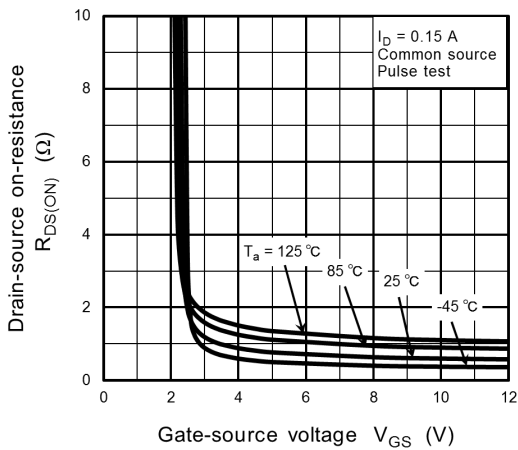
### 7. Characteristics Curves (Note)



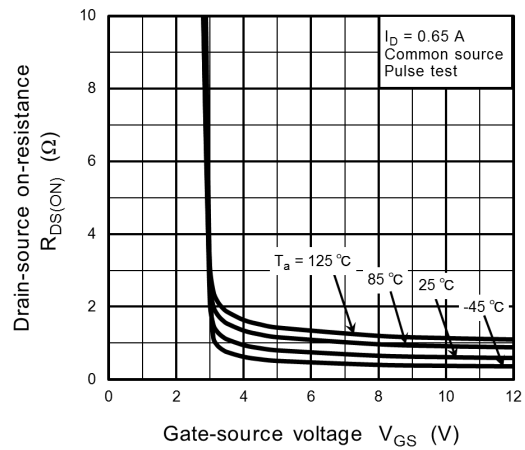
**Fig. 7.1  $I_D - V_{DS}$**



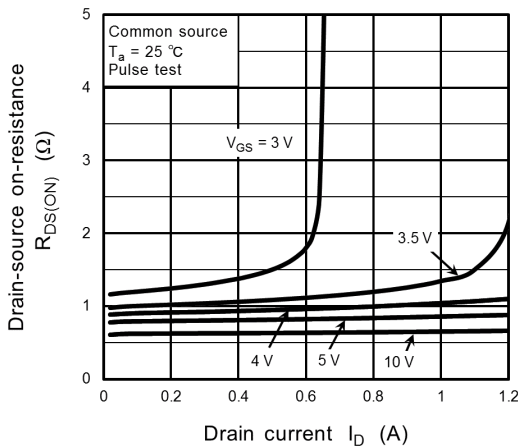
**Fig. 7.2  $I_D - V_{GS}$**



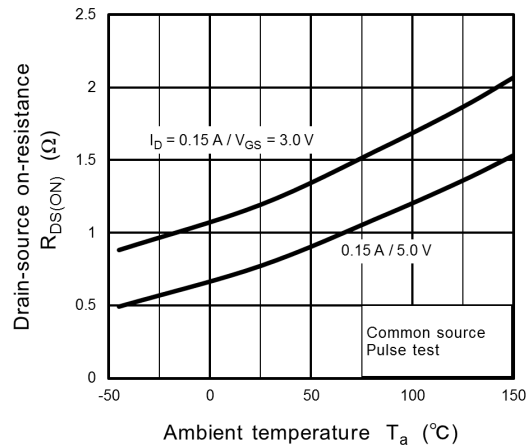
**Fig. 7.3  $R_{DS(ON)} - V_{GS}$**



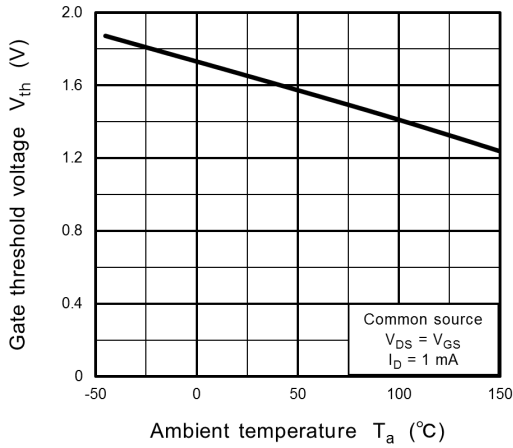
**Fig. 7.4  $R_{DS(ON)} - V_{GS}$**



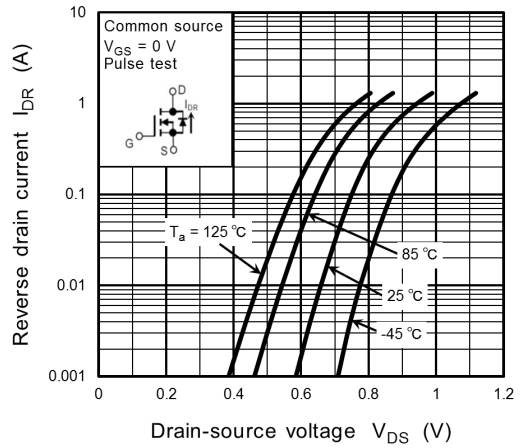
**Fig. 7.5  $R_{DS(ON)} - I_D$**



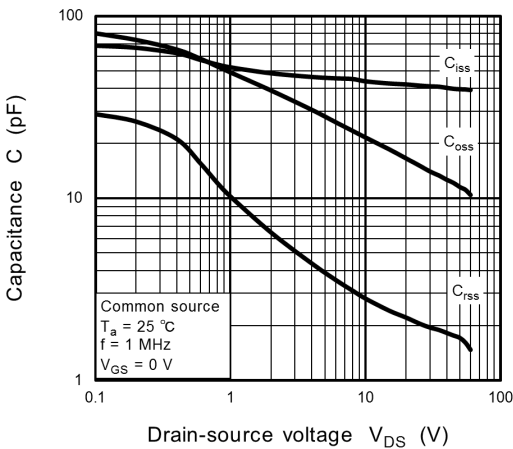
**Fig. 7.6  $R_{DS(ON)} - T_a$**



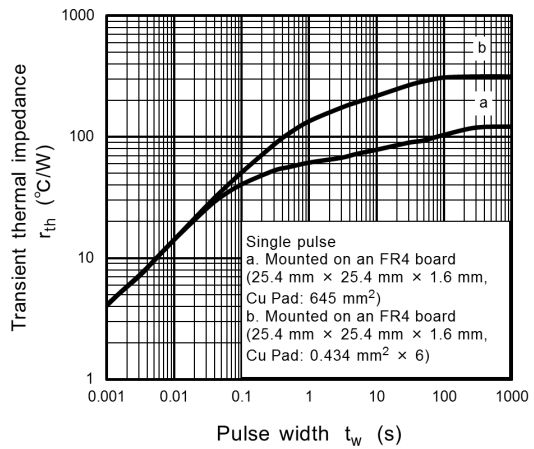
**Fig. 7.7  $V_{th} - T_a$**



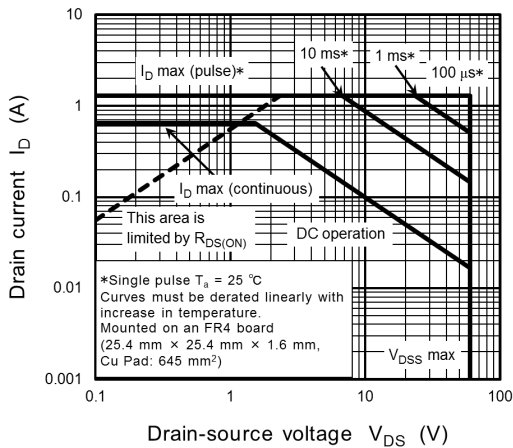
**Fig. 7.8  $I_{DR} - V_{DS}$**



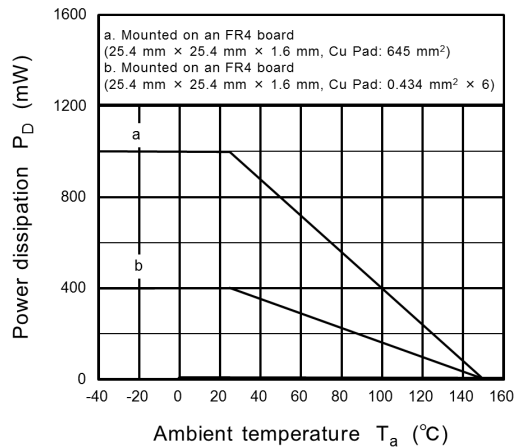
**Fig. 7.9  $C - V_{DS}$**



**Fig. 7.10  $r_{th} - t_w$**



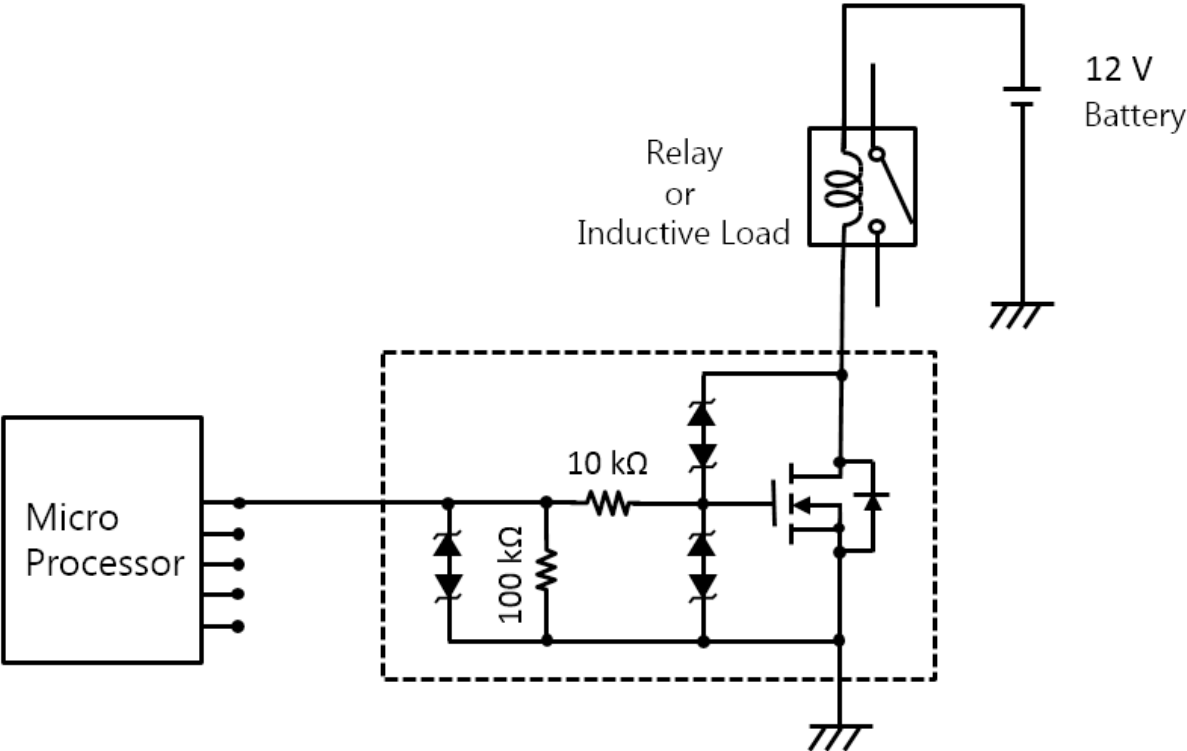
**Fig. 7.11 Safe Operating Area**



**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.

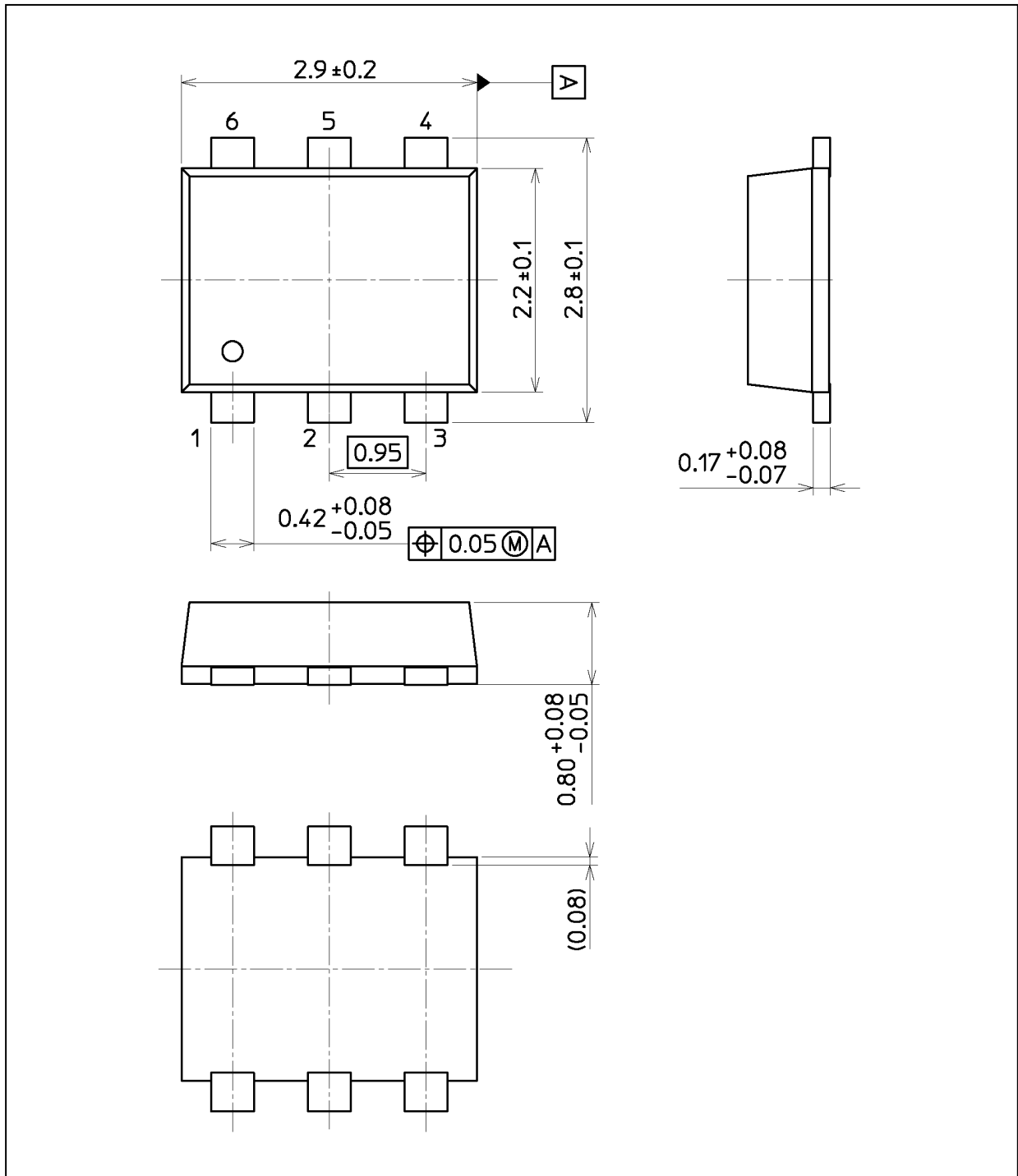
8. Application Information





## Package Dimensions

Unit: mm



Weight: 0.016 g (typ.)

Package Name(s)
Nickname: TSOP6F

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