

MOSFETs Silicon N-Channel MOS (U-MOSIII)

# SSM6N78FU

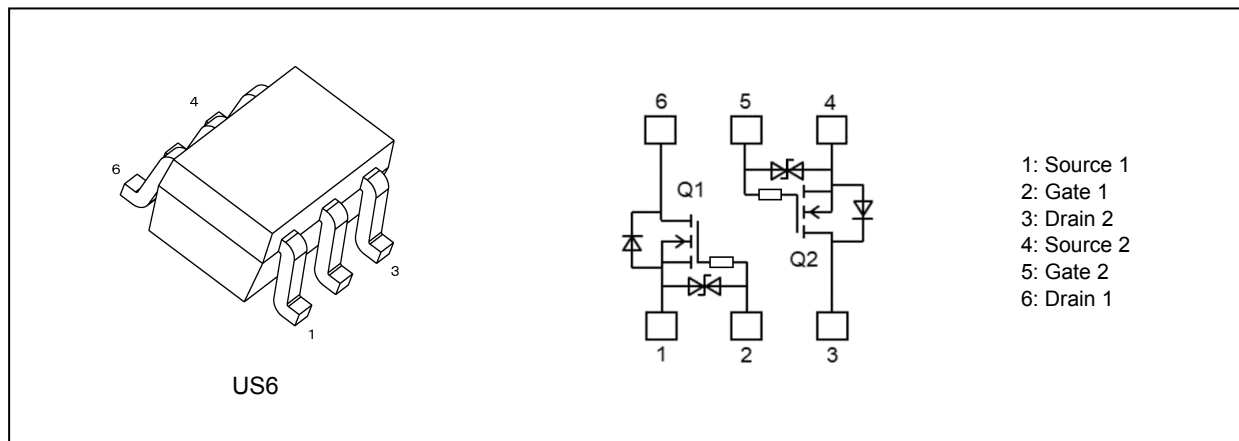
### 1. Applications

- 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) Low leakage current
- (4) N-ch 2-in-1

### 3. Packaging and Internal Circuit



Start of commercial production

2024-04

#### 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	$V_{DSS}$	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)	$P_D$	285	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: 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:  $645\text{ mm}^2$ )

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, $T_a = 25\text{ }^\circ\text{C}$ )(Q1, Q2 Common)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 5\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 0.08$	$\mu\text{A}$
		$V_{GS} = \pm 10\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 1$	
Drain cut-off current	$I_{DSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	—	—	0.08	V
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 1\text{ mA}, V_{GS} = 0\text{ V}$	20	—	—	
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	$\text{mA}$

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, $T_a = 25\text{ }^\circ\text{C}$ )(Q1, Q2 Common)

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	$\text{pF}$
Reverse transfer capacitance	$C_{rss}$		—	5	10	
Output capacitance	$C_{oss}$		—	6	12	
Switching time (turn-on delay time)	$t_{d(on)}$	$V_{DD} = 10\text{ V}, I_D = 75\text{ mA}, V_{GS} = 0\text{ to }4.5\text{ V}, R_{GS} = 10\text{ }\Omega$ Common source, See Chapter 5.3.	—	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

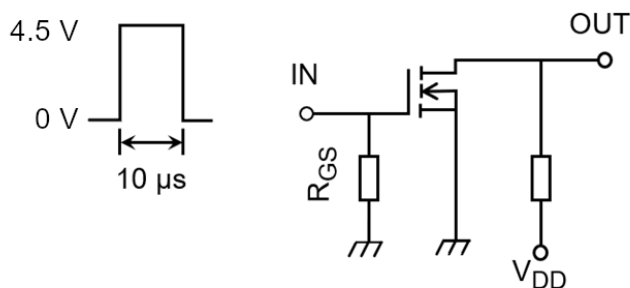


Fig. 5.3.1 Switching Time Test Circuit

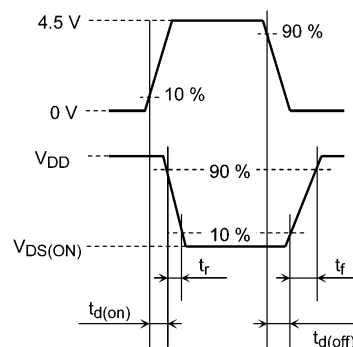


Fig. 5.3.2 Input Waveform/Output Waveform

### 5.4. Gate Charge Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )(Q1, Q2 Common)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	$Q_g$	$V_{DD} = 10\text{ V}$ , $I_D = 200\text{ mA}$ , $V_{GS} = 4.5\text{ V}$	—	0.34	—	nC
Gate-source charge 1	$Q_{gs1}$		—	0.09	—	
Gate-drain charge	$Q_{gd}$		—	0.16	—	

### 5.5. Source-Drain Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )(Q1, Q2 Common)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage (Note 1)	$V_{DSF}$	$I_D = -150\text{ mA}$ , $V_{GS} = 0\text{ V}$	—	-0.8	-1.2	V

Note 1: Pulse measurement.

## 6. Marking

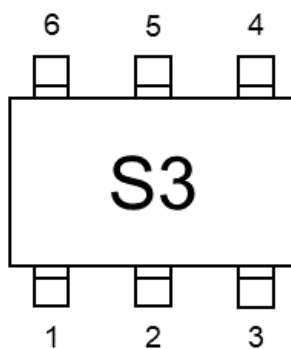


Fig. 6.1 Marking

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

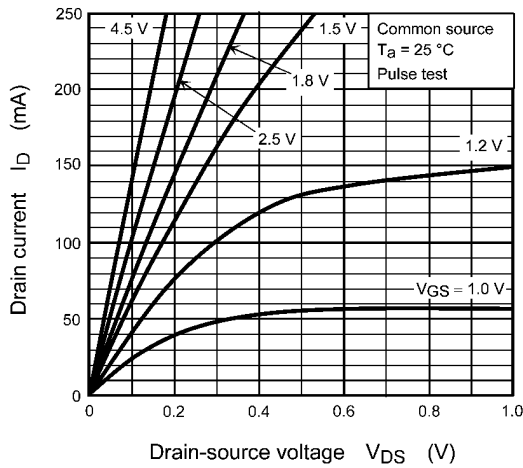


Fig. 7.1  $I_D - V_{DS}$

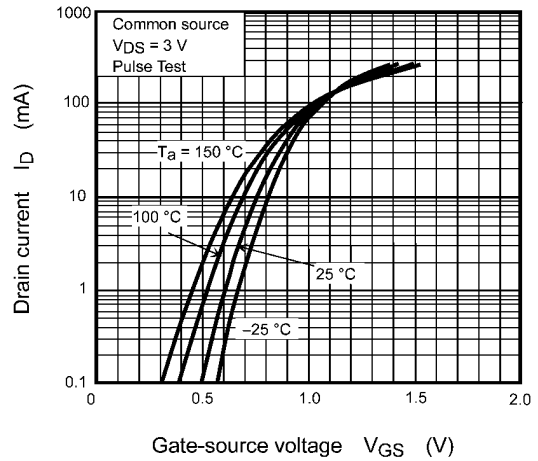


Fig. 7.2  $I_D - V_{GS}$

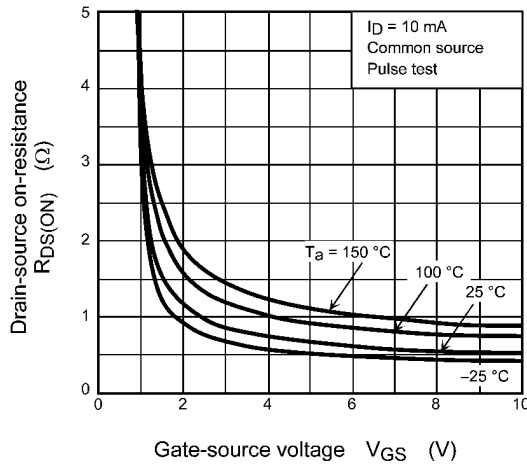


Fig. 7.3  $R_{DS(ON)} - V_{GS}$

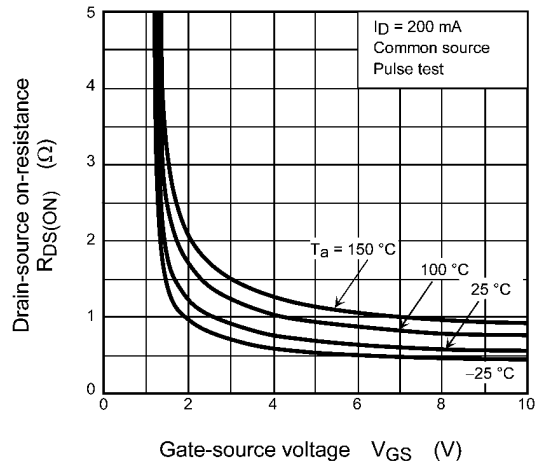


Fig. 7.4  $R_{DS(ON)} - V_{GS}$

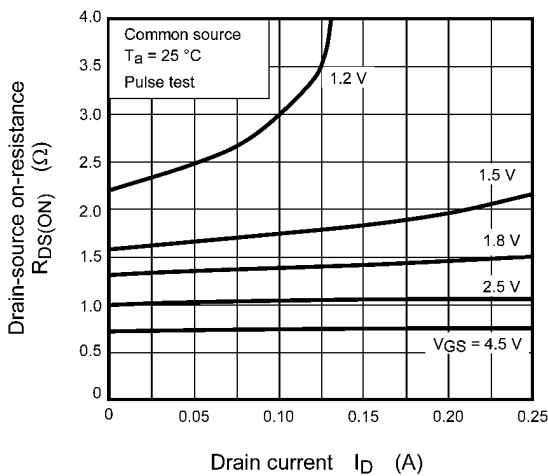


Fig. 7.5  $R_{DS(ON)} - I_D$

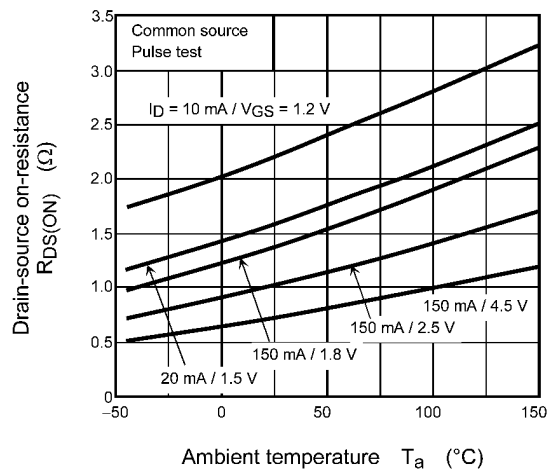


Fig. 7.6  $R_{DS(ON)} - T_a$

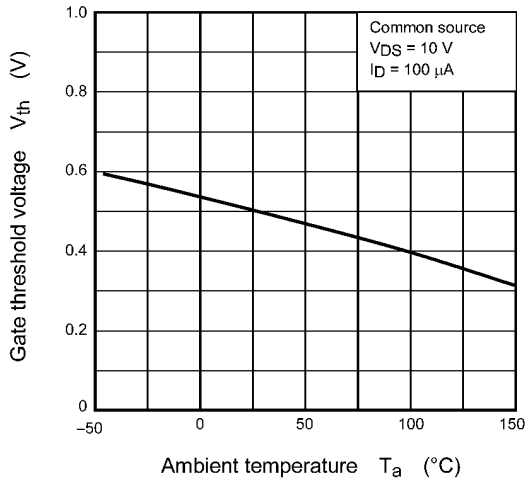


Fig. 7.7  $V_{th} - T_a$

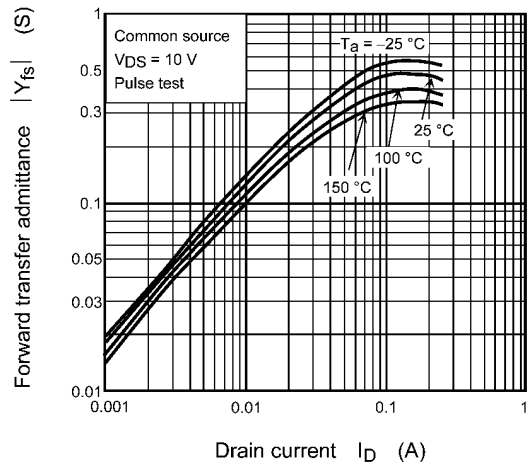


Fig. 7.8  $|Y_{fs}| - I_D$

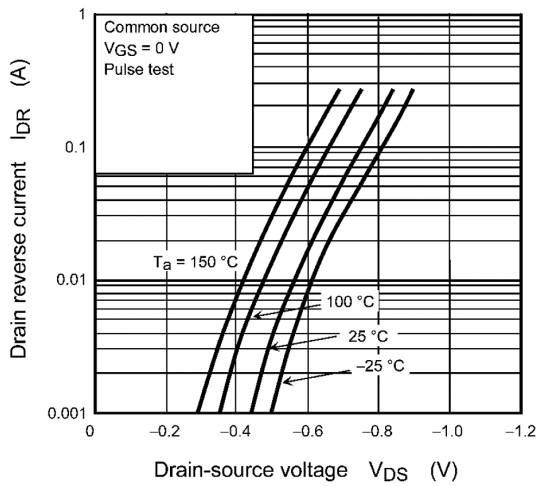


Fig. 7.9  $I_{DR} - V_{DS}$

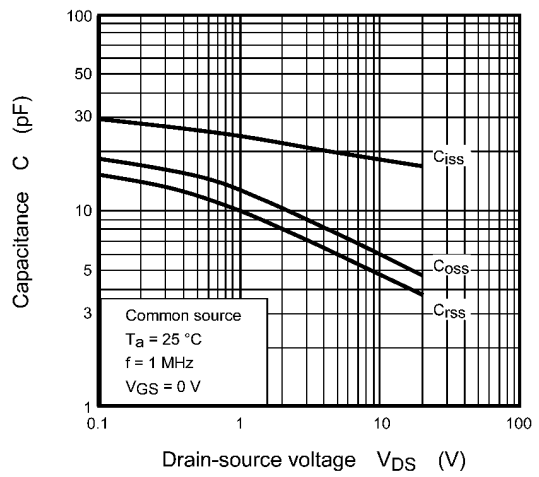


Fig. 7.10  $C - V_{DS}$

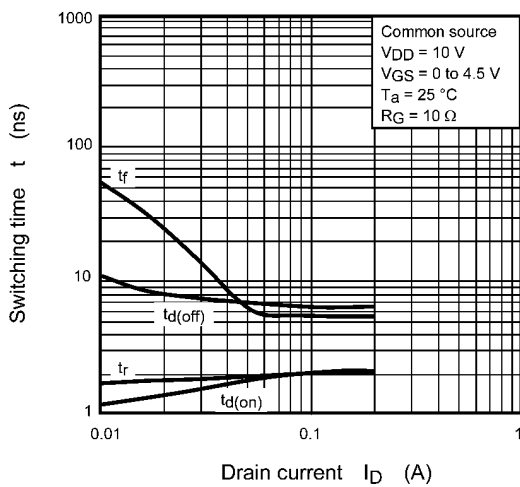


Fig. 7.11  $t - I_D$

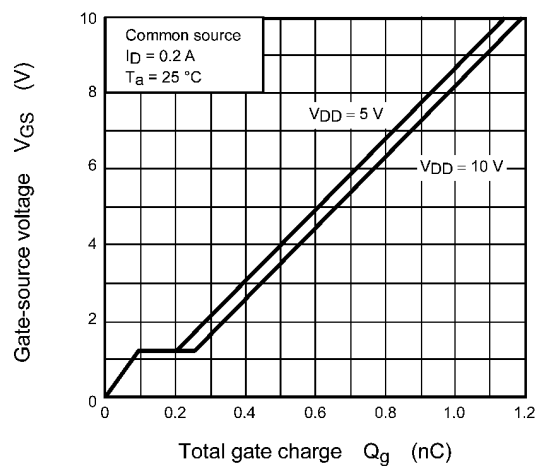


Fig. 7.12 Dynamic Input Characteristics

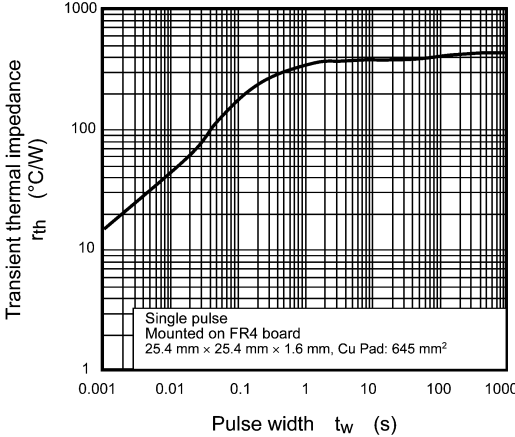


Fig. 7.13  $r_{th} - t_w$

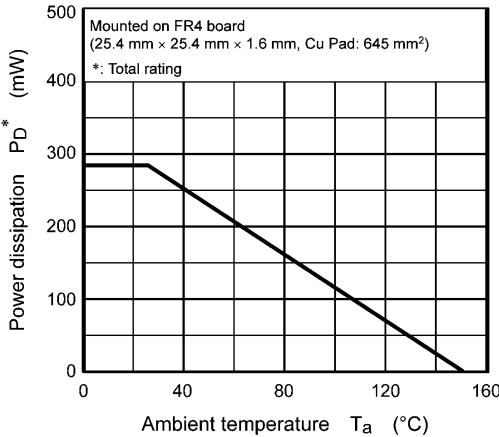
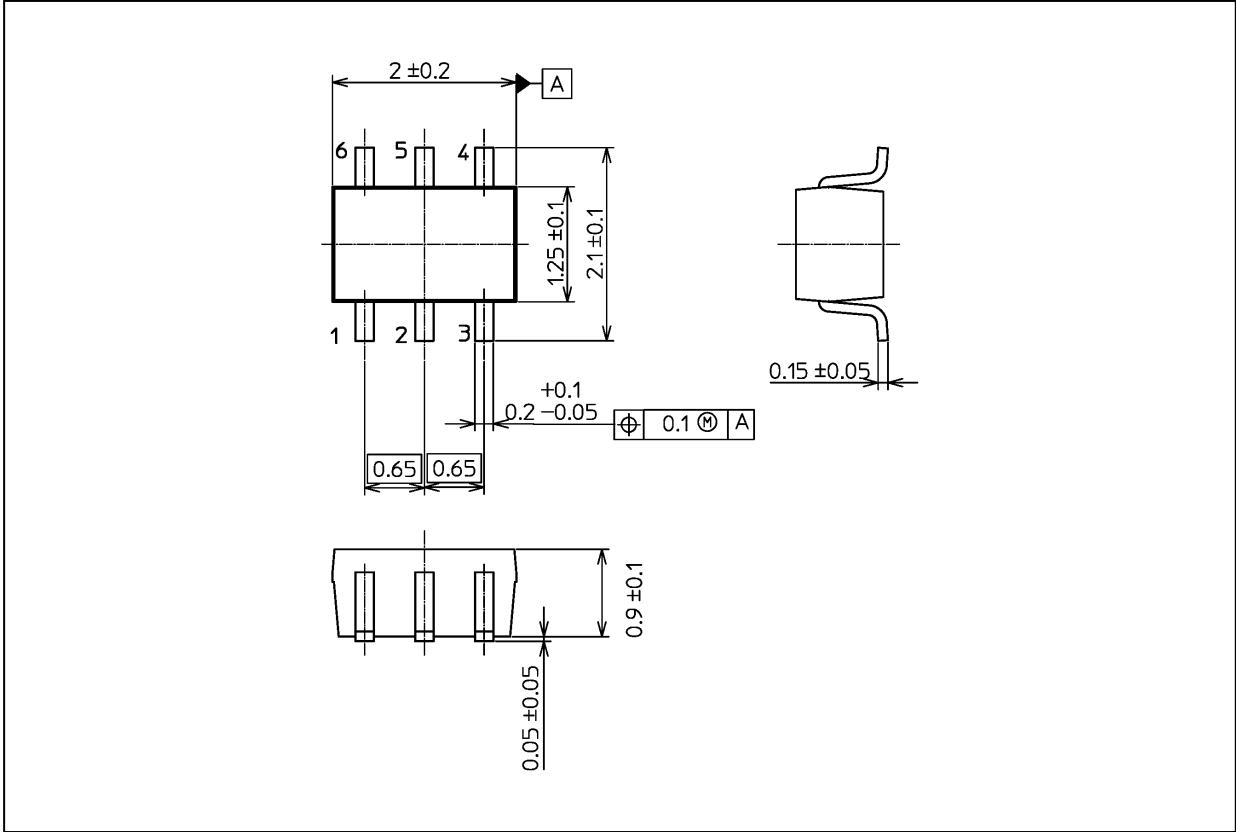


Fig. 7.14  $P_D - T_a$

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

Package Dimensions

Unit: mm



Weight: 6.8 mg (typ.)

Package Name(s)
JEDEC: SOT-363
Nickname: US6



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