Composite Devices Silicon N-Channel MOS/Diode Epitaxial Planar

SSM5H90ATU

1. Applications

- High-Speed Switching

2. Features

(1) Combined an N-channel MOSFET and a diode in one package.

2.1. MOSFET Features

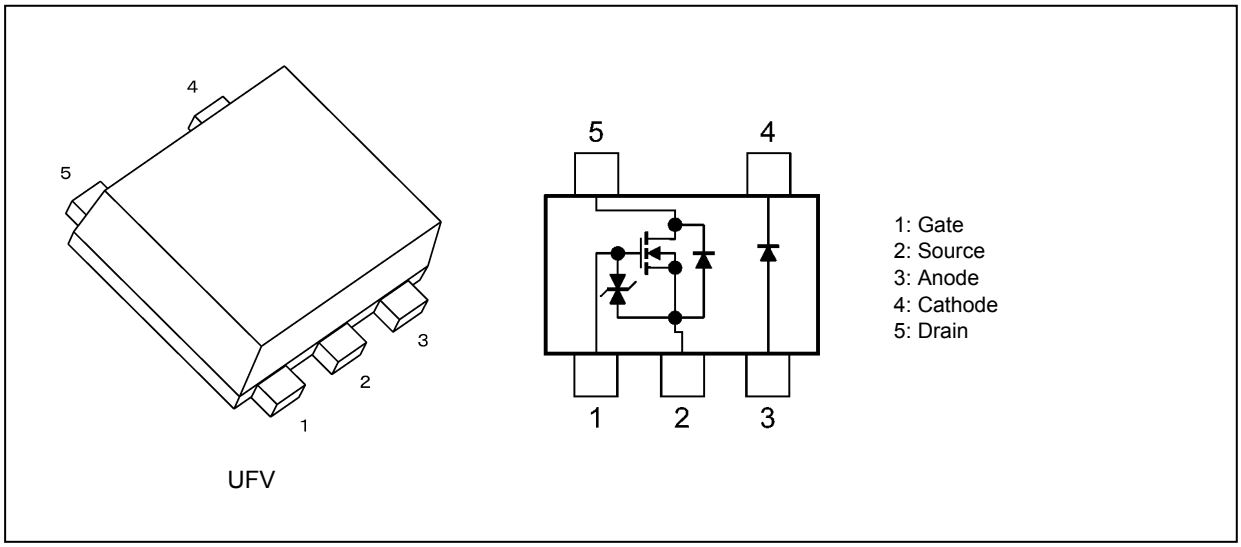
(1) Low drain-source on-resistance
: $R_{DS(ON)}$ = 65 mΩ (max) (@V_{GS} = 4.0 V)
$R_{DS(ON)}$ = 89 mΩ (max) (@V_{GS} = 2.5 V)

(2) 2.5-V gate drive voltage.

2.2. Diode Features

(1) Low reverse current: I_R = 0.1 μA (typ.) (@V_R = 30 V)

3. Packaging and Internal Circuit



4. Absolute Maximum Ratings (Note)

4.1. Absolute Maximum Ratings of the MOSFET (Unless otherwise specified, T_a = 25 °C)

Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	20	V
Gate-source voltage		V_{GSS}	±10	
Drain current	(Note 1)	I_D	2.4	A
Drain current (pulsed)	(Note 1)	I_{DP}	4.8	
Channel temperature		T_{ch}	150	°C

Note 1: Ensure that the channel temperature does not exceed 150 °C.

Start of commercial production
2012-03

4.2. Absolute Maximum Ratings of the Diode (Unless otherwise specified, T_a = 25 °C)

Characteristics		Symbol	Rating	Unit
Peak reverse voltage		V_{RM}	85	V
Reverse voltage		V_R	80	
Peak forward current		I_{FM}	200	mA
Average rectified current		I_O	100	
Non-repetitive peak forward surge current	(t = 10 ms)	I_{FSM}	1	A
Junction temperature		T_j	125	°C

4.3. Absolute Maximum Ratings of the Common Section (Unless otherwise specified, T_a = 25 °C)

Characteristics			Symbol	Rating	Unit
Power dissipation		(Note 1)	P_D	0.5	W
Power dissipation	(t = 10 s)	(Note 1)		0.8	
Storage temperature			T_{stg}	-55 to 125	°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: P_D for the entire IC
Device mounted on a 25.4 mm × 25.4 mm × 1.6 mm FR-4 glass epoxy board (Cu pad: 645 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 of the MOSFET (Unless otherwise specified, T_a = 25 °C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±10 V, V_{DS} = 0 V	—	—	±10	μA
Drain cut-off current		I_{DSS}	V_{DS} = 20 V, V_{GS} = 0 V	—	—	10	
Drain-source breakdown voltage		$V_{(BR)DSS}$	I_D = 1 mA, V_{GS} = 0 V	20	—	—	V
Drain-source breakdown voltage	(Note 1)	$V_{(BR)DSX}$	I_D = 1 mA, V_{GS} = -10 V	12	—	—	
Gate threshold voltage	(Note 2)	V_{th}	V_{DS} = 3 V, I_D = 1 mA	0.5	—	1.2	
Drain-source on-resistance	(Note 3)	$R_{DS(ON)}$	I_D = 1.5 A, V_{GS} = 4.0 V	—	53	65	mΩ
			I_D = 1.5 A, V_{GS} = 2.5 V	—	64	89	
Forward transfer admittance	(Note 3)	$\|Y_{fs}\|$	V_{DS} = 3 V, I_D = 1.0 A	3	6	—	S

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 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 3: Pulse measurement.

5.2. Dynamic Characteristics of the MOSFET (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	200	—	pF
Reverse transfer capacitance	C_{rss}		—	13	—	
Output capacitance	C_{oss}		—	40	—	
Switching time (turn-on time)	t_{on}	V_{DD} = 10 V, I_D = 2 A, V_{GS} = 0 V to 2.5 V, R_G = 4.7 Ω, See Figure 5.2.1, 5.2.2.	—	9	—	ns
Switching time (turn-off time)	t_{off}		—	9.5	—	

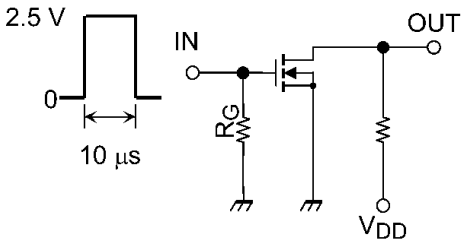


Fig. 5.2.1 Test Circuit of Switching Time

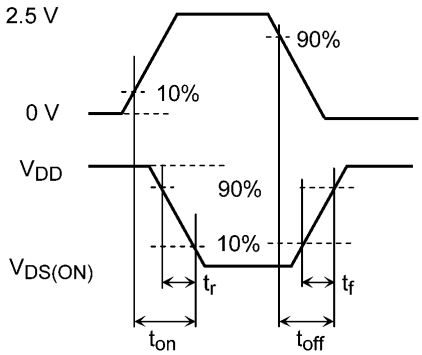


Fig. 5.2.2 Input Waveform/Output Waveform

5.3. Gate Charge Characteristics of the MOSFET (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	V_{DD} = 10 V, I_D = 2.4 A, V_{GS} = 4 V	—	2.2	—	nC
Gate-source charge	Q_{gs}		—	1.3	—	
Gate-drain charge	Q_{gd}		—	0.9	—	

5.4. Source-Drain Characteristics of the MOSFET (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage (Note 1)	V_{DSF}	I_D = -2.4 A, V_{GS} = 0 V	—	-0.81	-1.2	V

Note 1: Pulse measurement.

5.5. Characteristics of the Diode (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Forward voltage	$V_{F(1)}$	I_F = 1 mA	—	0.62	—	V
	$V_{F(2)}$	I_F = 10 mA	—	0.75	—	
	$V_{F(3)}$	I_F = 100 mA	—	0.98	1.20	
Reverse current	I_R	V_R = 30 V	—	—	0.1	μA
		V_R = 80 V	—	—	0.5	
Total capacitance	C_t	V_R = 0 V, f = 1 MHz	—	0.5	3.0	pF
Reverse recovery time	t_{rr}	I_F = 10 mA, See Figure 5.5.1.	—	1.6	4.0	ns

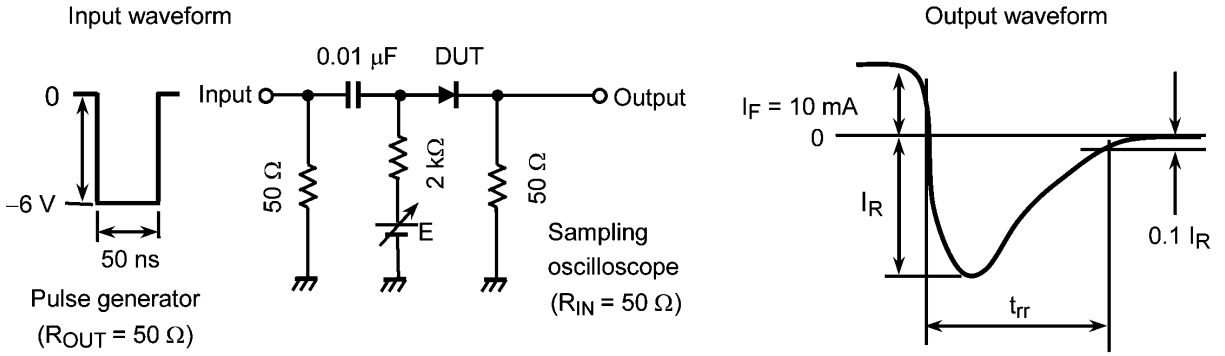


Fig. 5.5.1 Input Waveform/Output Waveform

6. Marking

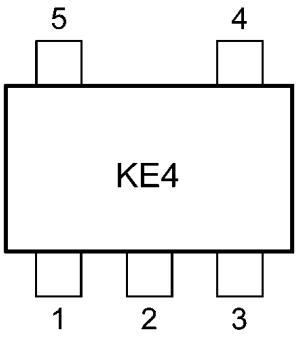


Fig. 6.1 Marking

7. Characteristics Curves (Note)

7.1. Characteristics Curves of the MOSFET

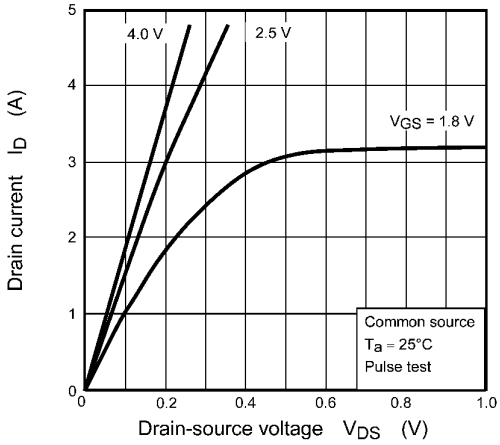


Fig. 7.1.1 I_D - V_{DS}

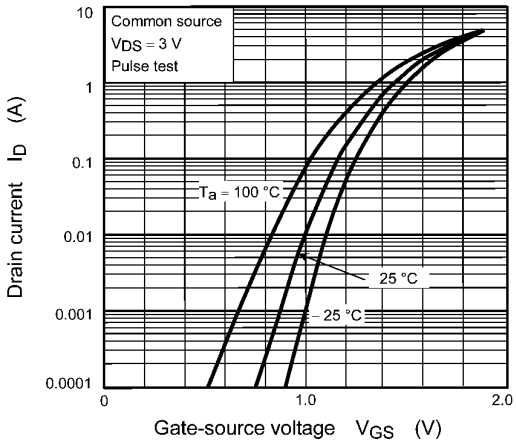


Fig. 7.1.2 I_D - V_{GS}

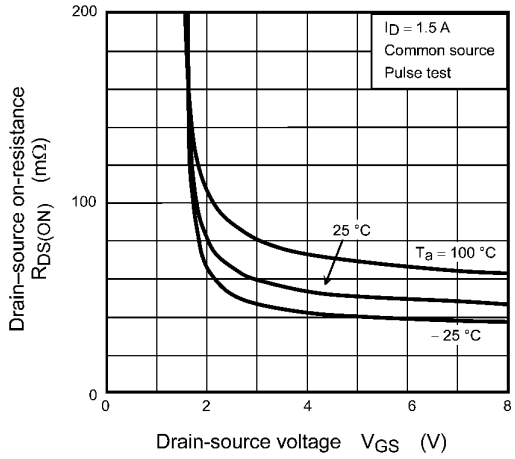


Fig. 7.1.3 $R_{DS(ON)}$ - V_{GS}

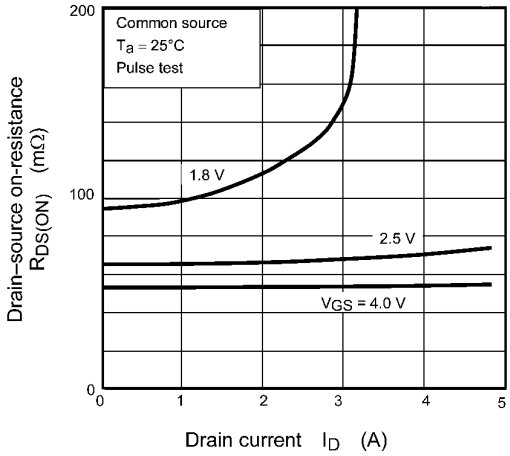


Fig. 7.1.4 $R_{DS(ON)}$ - I_D

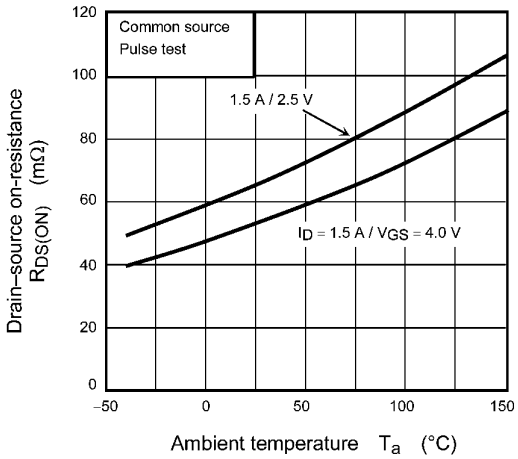


Fig. 7.1.5 $R_{DS(ON)}$ - T_a

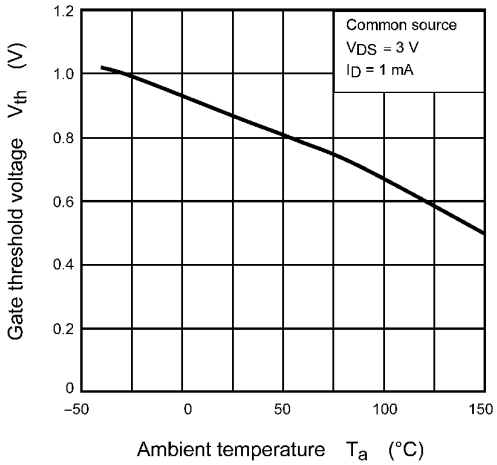


Fig. 7.1.6 V_{th} - T_a

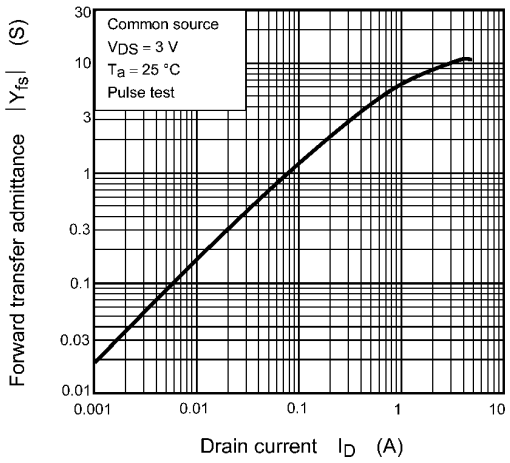


Fig. 7.1.7 $|Y_{fs}|$ - I_D

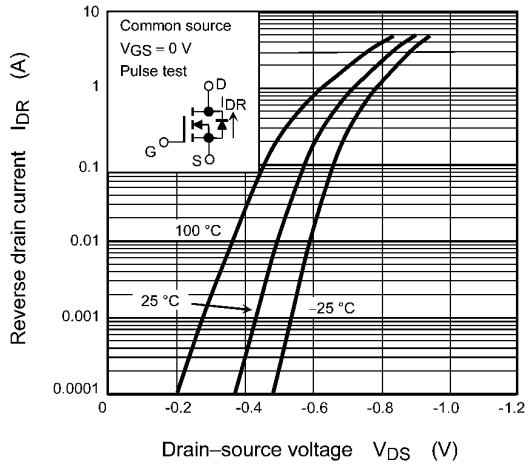


Fig. 7.1.8 I_{DR} - V_{DS}

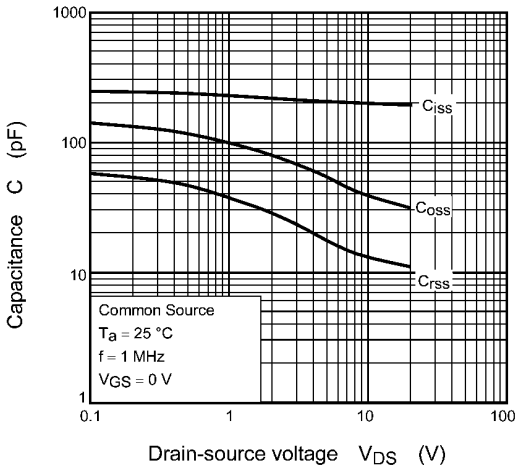


Fig. 7.1.9 C - V_{DS}

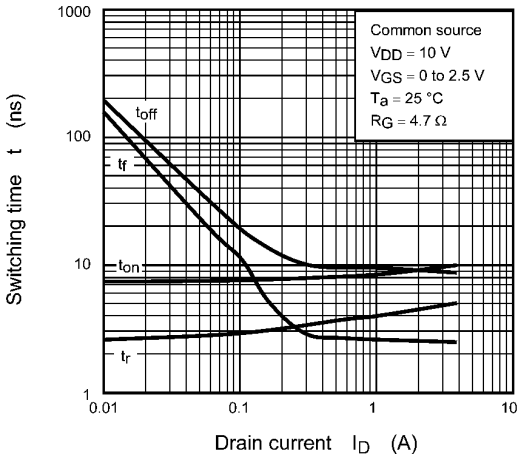


Fig. 7.1.10 t - I_D

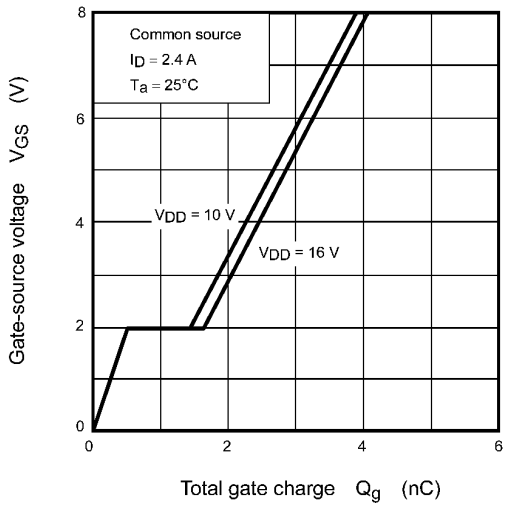


Fig. 7.1.11 Dynamic Input Characteristics

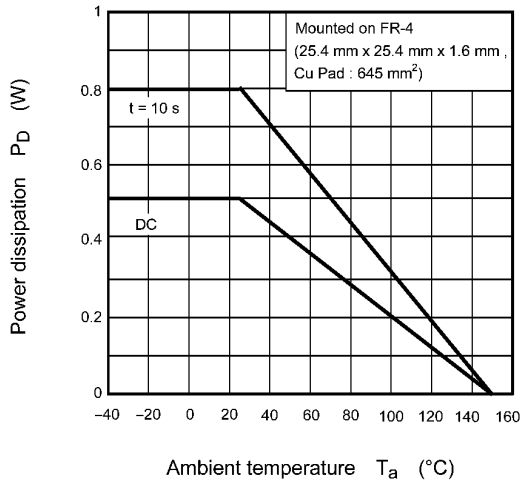


Fig. 7.1.12 P_D - T_a

7.2. Characteristics Curves of the Diode

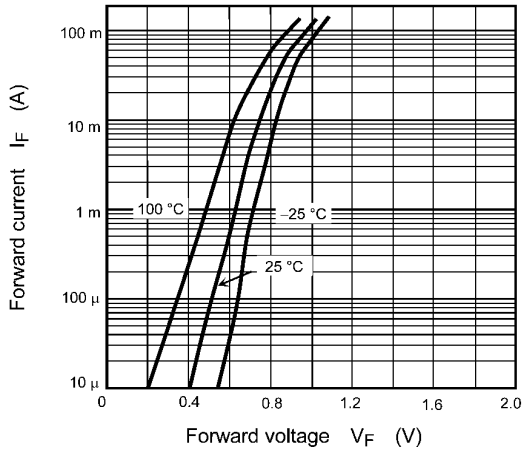


Fig. 7.2.1 I_F - V_F

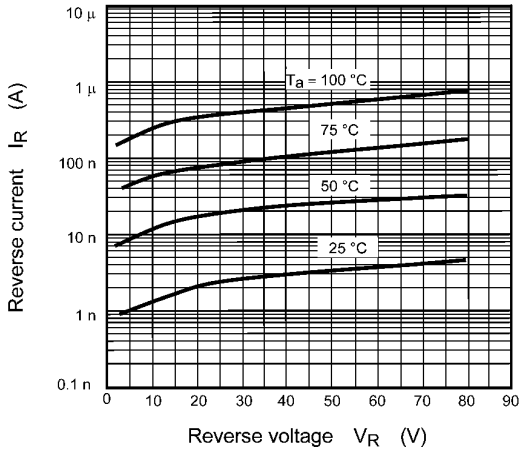


Fig. 7.2.2 I_R - V_R

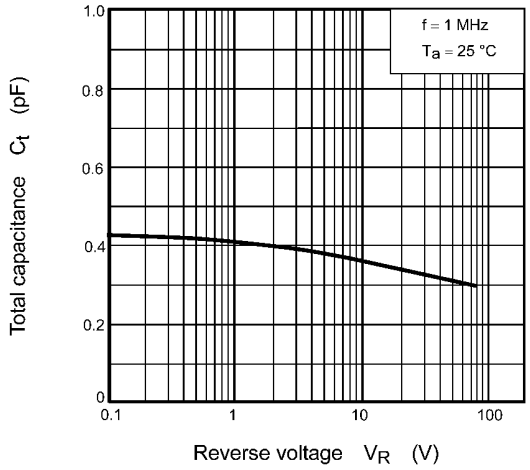
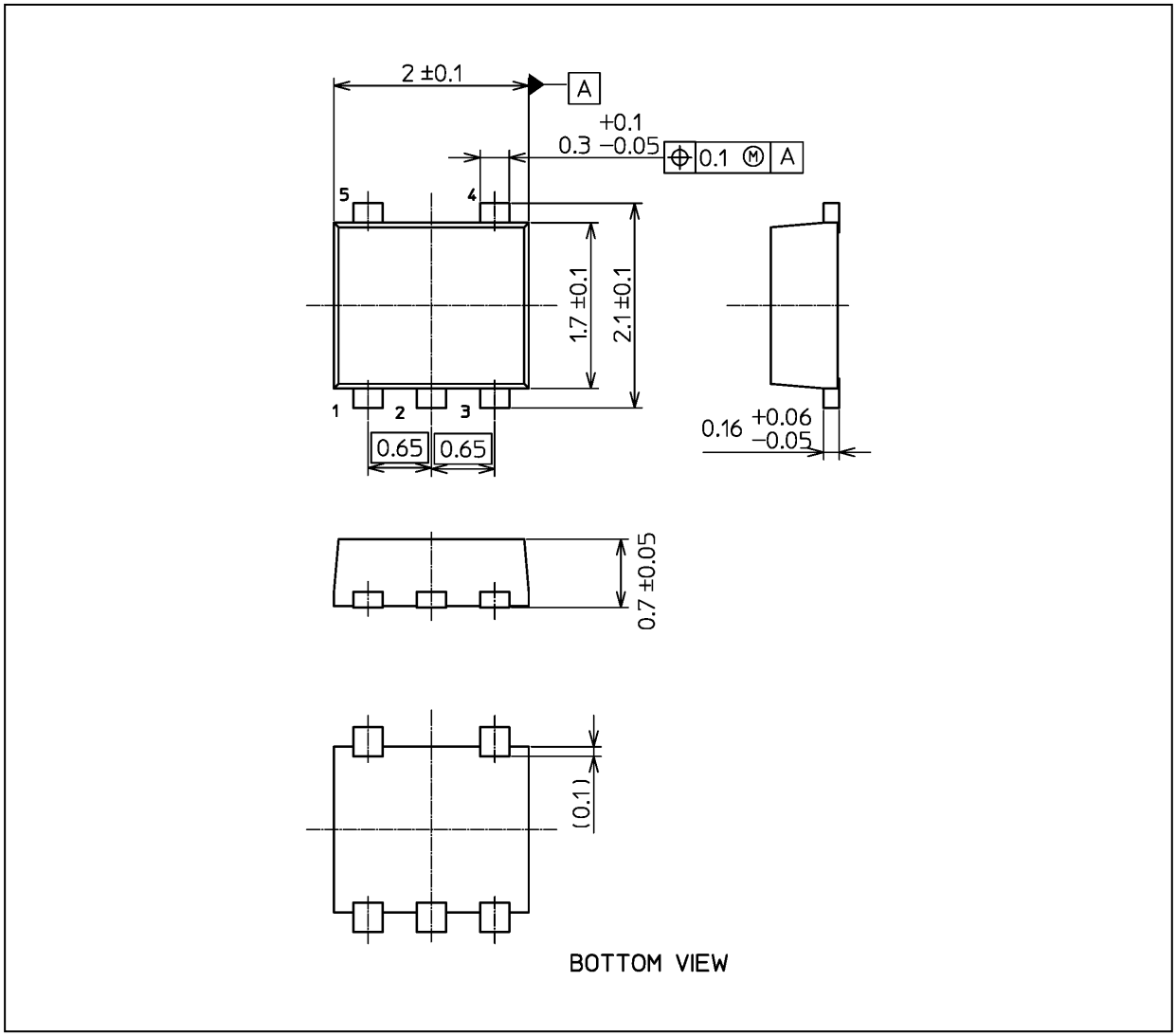


Fig. 7.2.3 C_t - V_R

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

Package Dimensions

Unit: mm



Weight: 7.0 mg (typ.)

Package Name(s)
Nickname: UFV

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