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

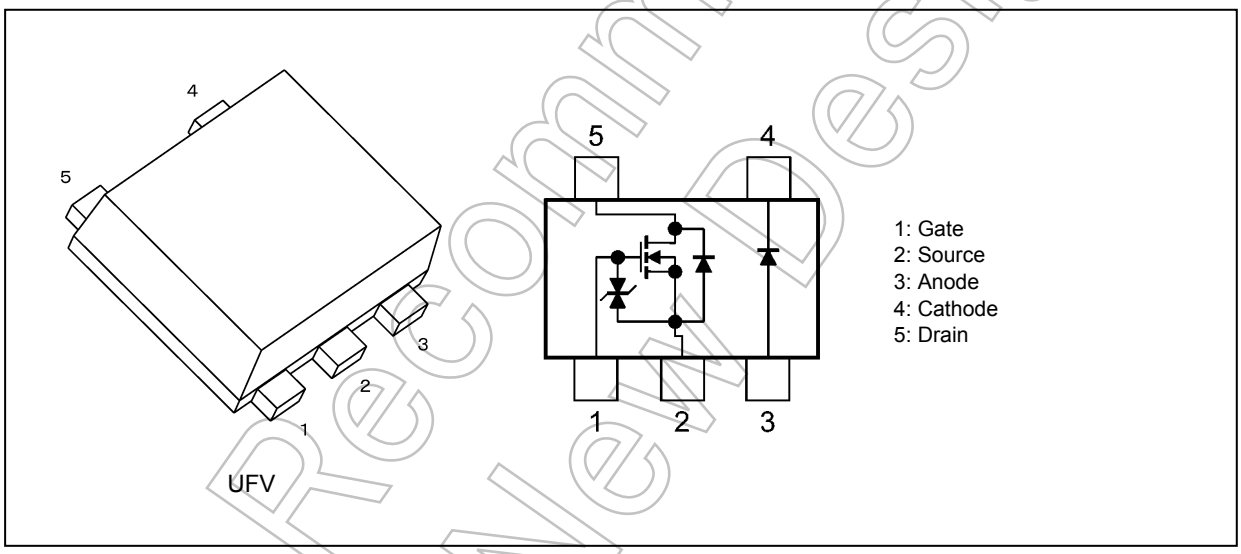
(1) Low drain-source on-resistance
: $R_{DS(ON)}$ = 65 mΩ (max) (@V_{GS} = 4.0 V)
$R_{DS(ON)}$ = 89 mΩ (max) (@V_{GS} = 2.5 V)

(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.

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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.

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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	—	

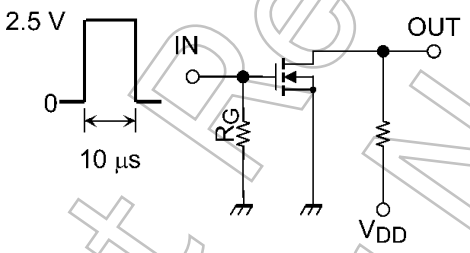

Fig. 5.2.1 Test Circuit of Switching Time

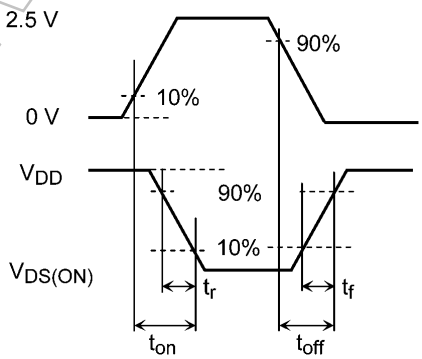

Fig. 5.2.2 Input Waveform/Output Waveform

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	—	

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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

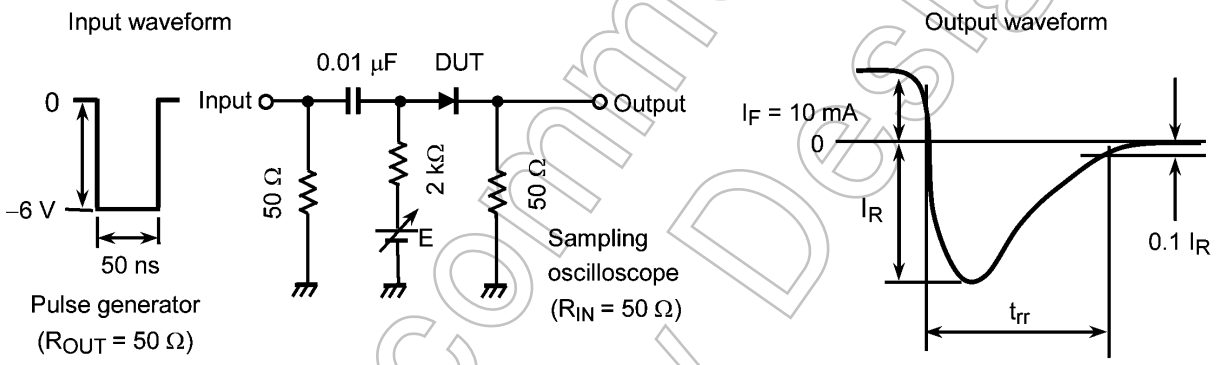

Fig. 5.5.1 Input Waveform/Output Waveform

6. Marking

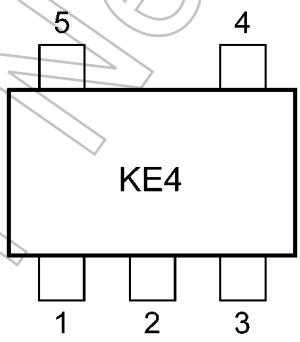

Fig. 6.1 Marking

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7. Characteristics Curves (Note)

7.1. Characteristics Curves of the MOSFET

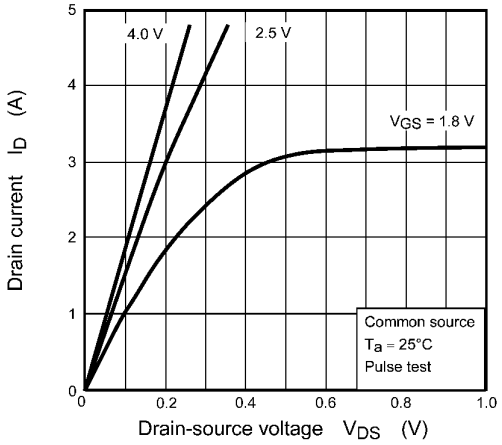

Fig. 7.1.1 I_D - V_{DS}

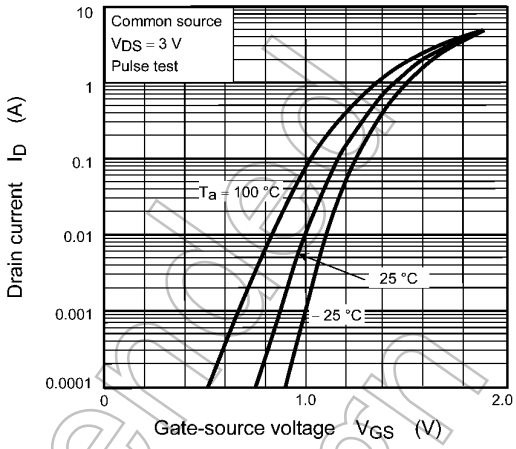

Fig. 7.1.2 I_D - V_{GS}

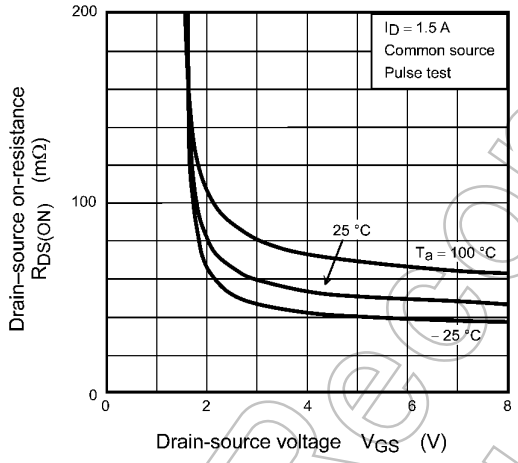

Fig. 7.1.3 $R_{DS(ON)}$ - V_{GS}

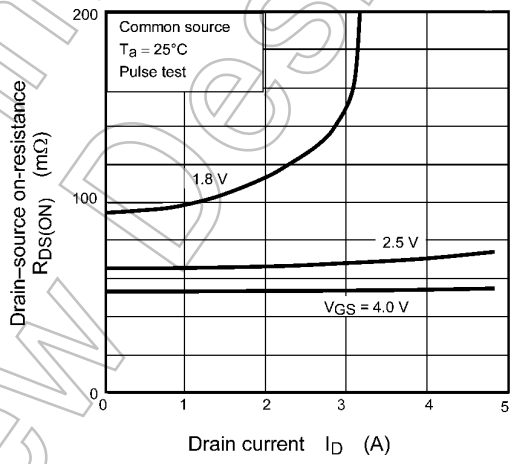

Fig. 7.1.4 $R_{DS(ON)}$ - I_D

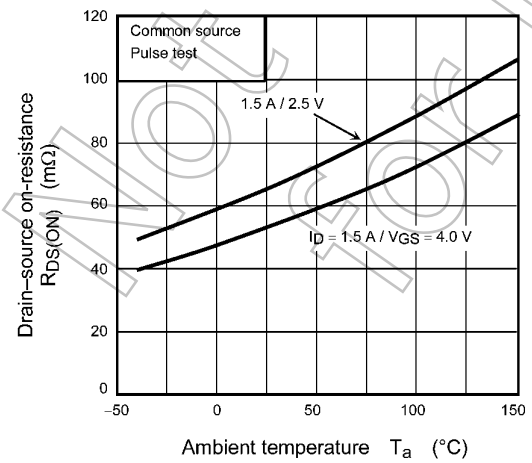

Fig. 7.1.5 $R_{DS(ON)}$ - T_a

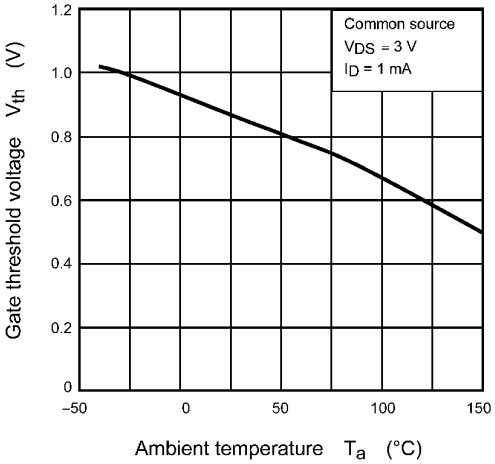

Fig. 7.1.6 V_{th} - T_a

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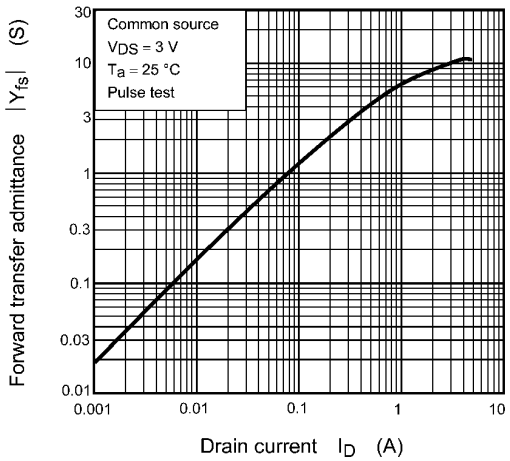

Fig. 7.1.7 $|Y_{fs}|$ - I_D

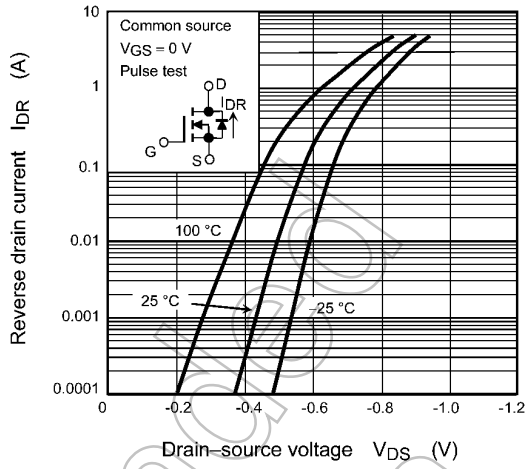

Fig. 7.1.8 I_{DR} - V_{DS}

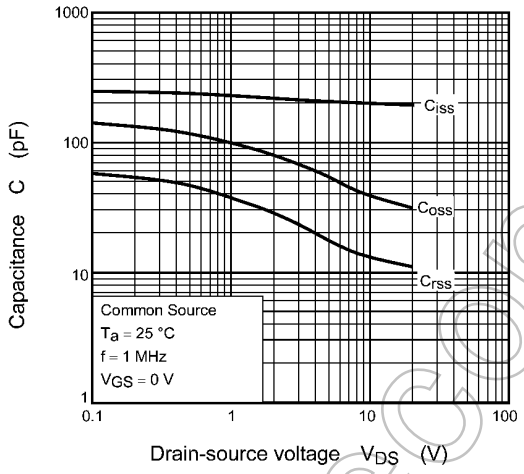

Fig. 7.1.9 C - V_{DS}

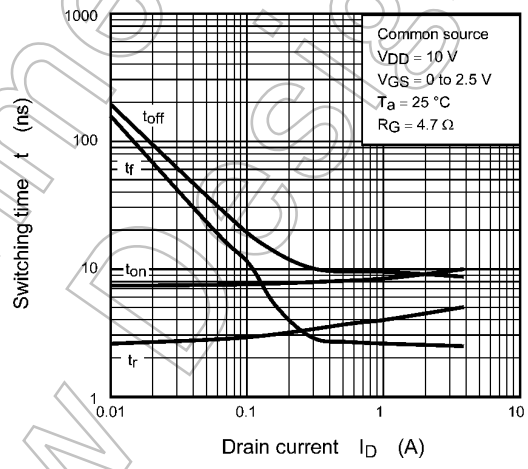

Fig. 7.1.10 t - I_D

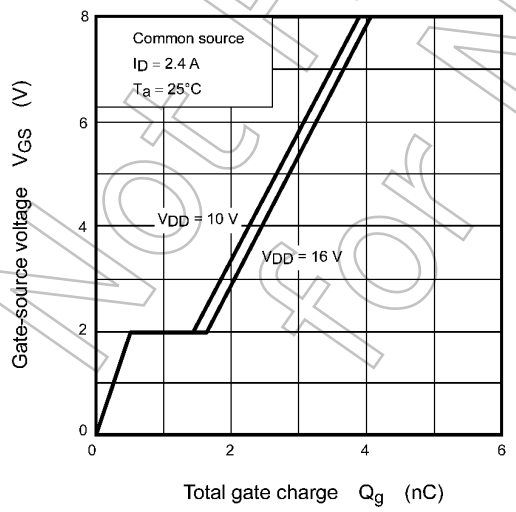

Fig. 7.1.11 Dynamic Input Characteristics

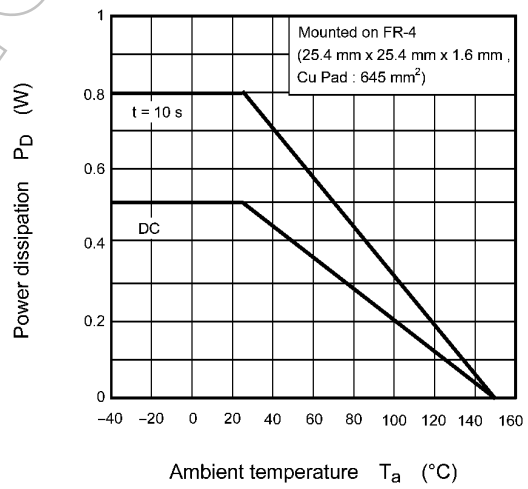

Fig. 7.1.12 P_D - T_a

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7.2. Characteristics Curves of the Diode

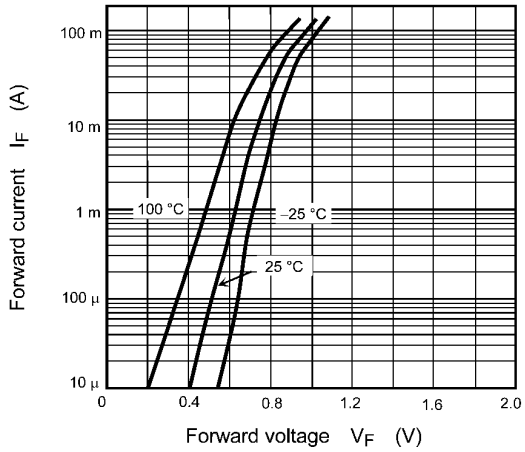

Fig. 7.2.1 I_F - V_F

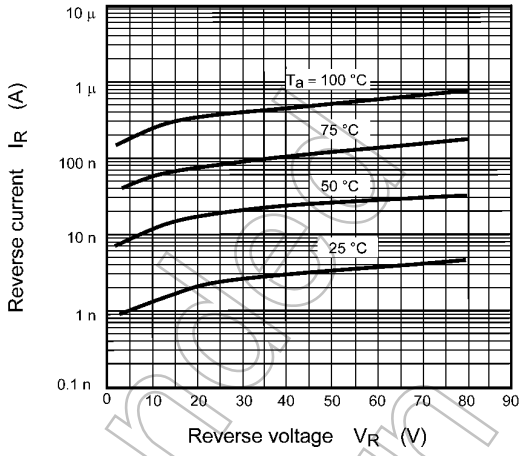

Fig. 7.2.2 I_R - V_R

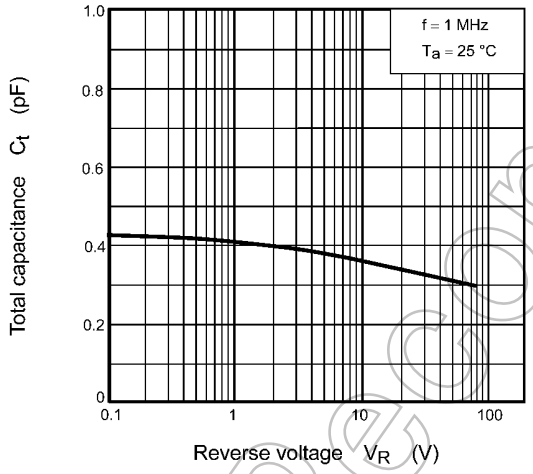

Fig. 7.2.3 C_t - V_R

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

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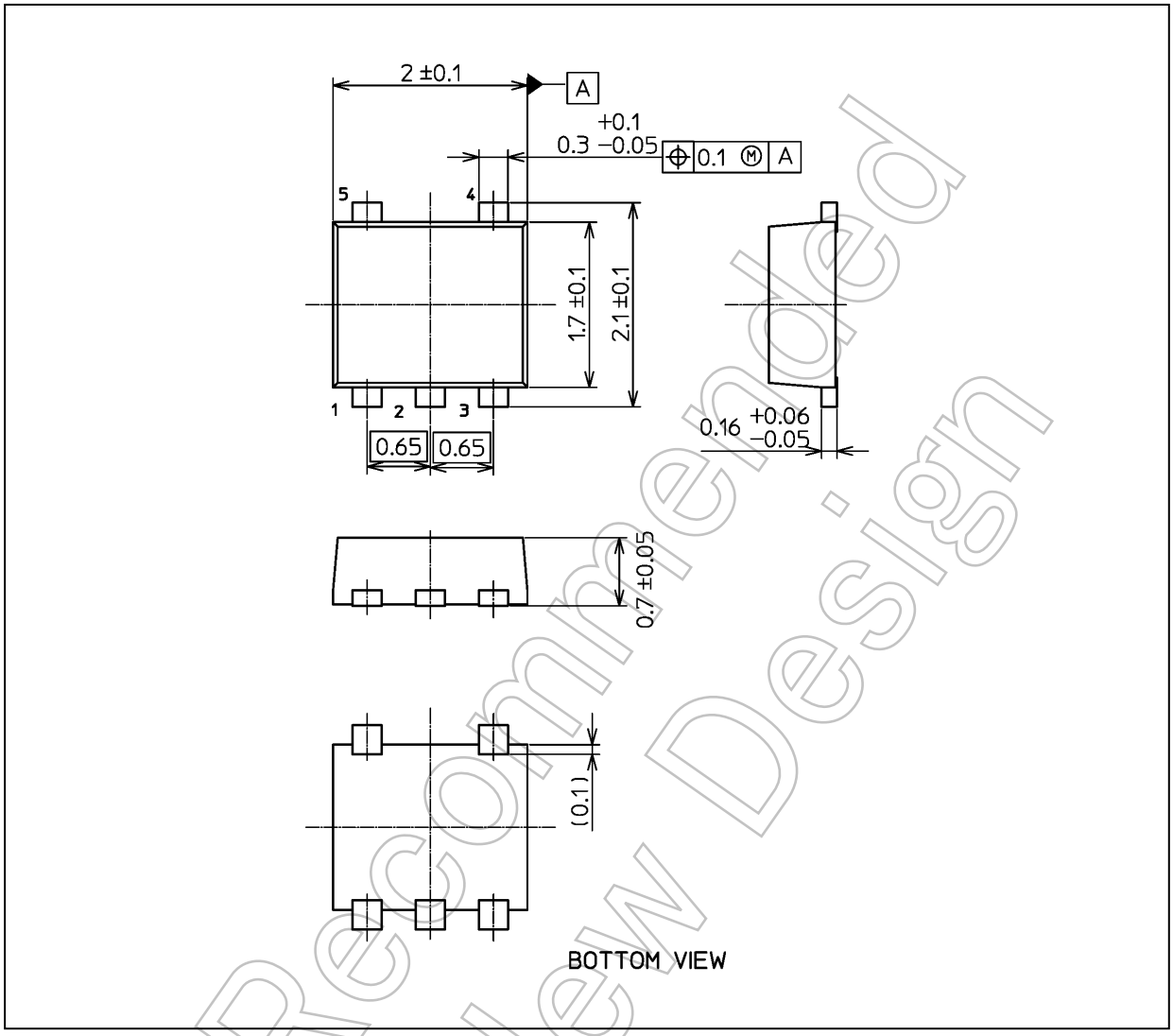
Package Dimensions

Unit: mm



Weight: 7.0 mg (typ.)

Package Name(s)
Nickname: UFV

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