

# SSM6H19NU

## 1. Applications

- DC-DC Converters

## 2. Features

- (1) N-channel MOSFET and a schottky barrier diode in one package.

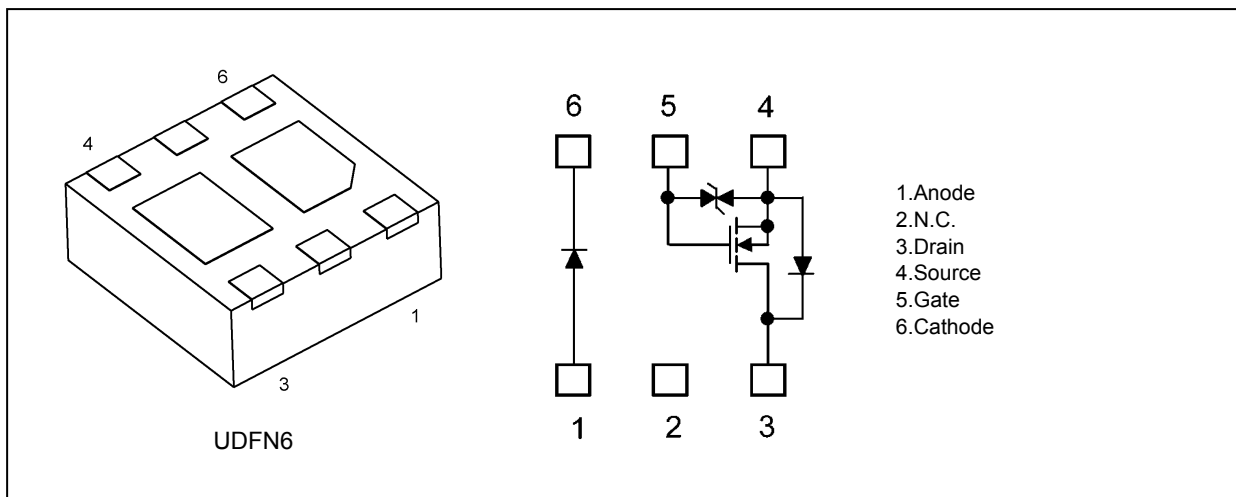
### 2.1. MOSFET Features

- (1) Low drain-source on-resistance  
:  $R_{DS(ON)} = 160 \text{ m}\Omega$  (typ.) (@ $V_{GS} = 3.6 \text{ V}$ )
- (2) 1.8-V gate drive voltage.

### 2.2. Diode Features

- (1) Low forward voltage:  $V_F = 0.51 \text{ V}$  (typ.) (@ $I_F = 500 \text{ mA}$ )

## 3. Packaging and Internal Circuit



## 4. Absolute Maximum Ratings (Note)

### 4.1. Absolute Maximum Ratings of the MOSFET (Unless otherwise specified, $T_a = 25 \text{ }^\circ\text{C}$ )

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	40	V
Gate-source voltage	$V_{GSS}$	$\pm 12$	
Drain current (Note 1)	$I_D$	2.0	A
Drain current (pulsed) (Note 1)	$I_{DP}$	4.0	
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$

Note 1: Ensure that the channel temperature does not exceed  $150 \text{ }^\circ\text{C}$ .

Start of commercial production  
2013-12

### 4.2. Absolute Maximum Ratings of the Diode (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Rating	Unit
Reverse voltage	$V_R$	40	V
Average rectified current	$I_O$	500	mA
Non-repetitive peak forward surge current (t = 10 ms)	$I_{FSM}$	5	A
Junction temperature	$T_j$	125	$^\circ\text{C}$

### 4.3. Absolute Maximum Ratings of the Common Section (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Rating	Unit
Power dissipation (Note 1)	$P_D$	1	W
Power dissipation (t = 10 s) (Note 1)		2	
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:  $P_D$  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<sup>2</sup>)

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, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 10\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current	$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$	—	—	1	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 1\text{ mA}, V_{GS} = 0\text{ V}$	40	—	—	V
Drain-source breakdown voltage (Note 1)	$V_{(BR)DSX}$	$I_D = 1\text{ mA}, V_{GS} = -12\text{ V}$	25	—	—	
Gate threshold voltage (Note 2)	$V_{th}$	$V_{DS} = 3\text{ V}, I_D = 1\text{ mA}$	0.5	—	1.2	
Drain-source on-resistance (Note 3)	$R_{DS(ON)}$	$I_D = 1.0\text{ A}, V_{GS} = 8.0\text{ V}$	—	145	185	$\text{m}\Omega$
		$I_D = 1.0\text{ A}, V_{GS} = 4.5\text{ V}$	—	155	198	
		$I_D = 1.0\text{ A}, V_{GS} = 4.2\text{ V}$	—	156	201	
		$I_D = 1.0\text{ A}, V_{GS} = 3.6\text{ V}$	—	160	208	
		$I_D = 0.5\text{ A}, V_{GS} = 2.5\text{ V}$	—	180	238	
		$I_D = 0.2\text{ A}, V_{GS} = 1.8\text{ V}$	—	220	390	
Forward transfer admittance (Note 3)	$ Y_{fs} $	$V_{DS} = 3\text{ V}, I_D = 200\text{ mA}$	—	2	—	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, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	130	—	$\text{pF}$
Reverse transfer capacitance	$C_{rss}$		—	7.5	—	
Output capacitance	$C_{oss}$		—	26	—	
Switching time (turn-on time)	$t_{on}$	$V_{DD} = 10\text{ V}, I_D = 0.5\text{ A},$ $V_{GS} = 0\text{ V to } 2.5\text{ V}, R_G = 4.7\ \Omega,$ See Figure 5.2.1, 5.2.2.	—	13	—	ns
Switching time (turn-off time)	$t_{off}$		—	8	—	

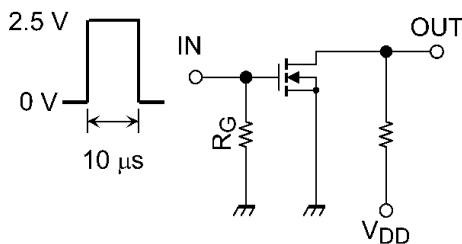


Fig. 5.2.1 Test Circuit of Switching Time

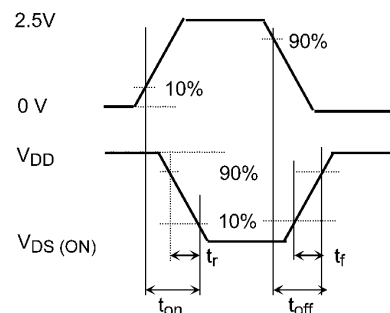


Fig. 5.2.2 Input Waveform/Output Waveform

### 5.3. Gate Charge Characteristics of the MOSFET (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	$Q_g$	$V_{DD} = 10\text{ V}$ , $I_D = 1.8\text{ A}$ $V_{GS} = 4.2\text{ V}$	—	1.1	2.2	nC
		$V_{DD} = 10\text{ V}$ , $I_D = 1.8\text{ A}$ $V_{GS} = 3.6\text{ V}$	—	1.0	2.0	
		$V_{DD} = 10\text{ V}$ , $I_D = 1.8\text{ A}$ $V_{GS} = 2.5\text{ V}$	—	0.75	1.5	

### 5.4. Source-Drain Characteristics of the MOSFET (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage (Note 1)	$V_{DSF}$	$I_D = -2.0\text{ A}$ , $V_{GS} = 0\text{ V}$	—	-0.85	-1.2	V

Note 1: Pulse measurement.

### 5.5. Characteristics of the Diode (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Forward voltage	$V_{F(1)}$	$I_F = 100\text{ mA}$	—	0.31	0.35	V
	$V_{F(2)}$	$I_F = 500\text{ mA}$	—	0.51	0.57	
Reverse current	$I_R$	$V_R = 40\text{ V}$	—	—	50	$\mu\text{A}$
Total capacitance	$C_t$	$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$	—	42	—	pF

## 6. Marking

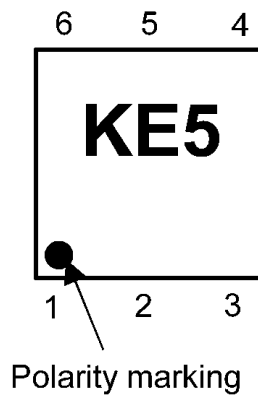


Fig. 6.1 Marking

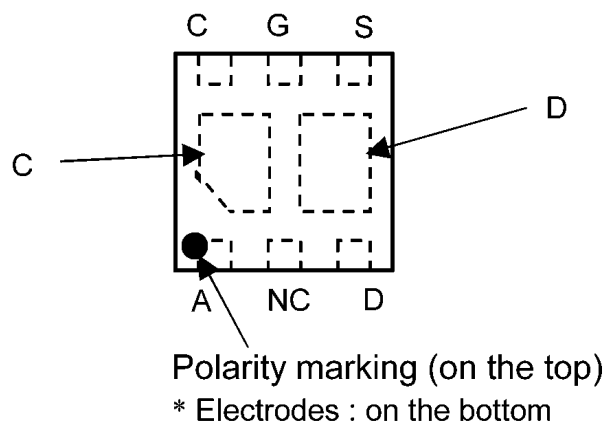
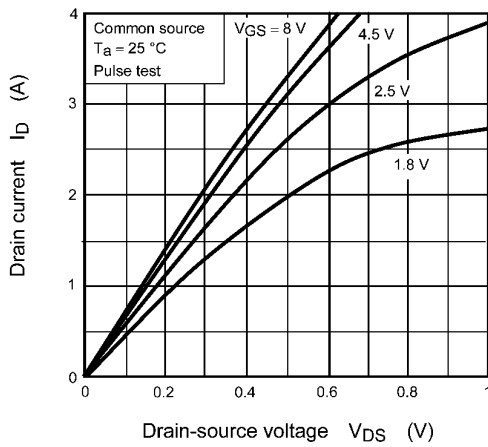


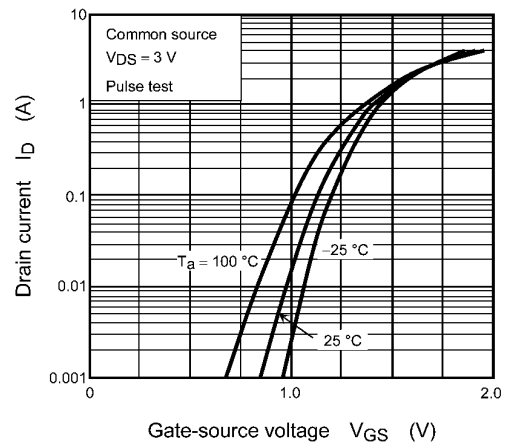
Fig. 6.2 Pin Condition (Top View)

### 7. Characteristics Curves (Note)

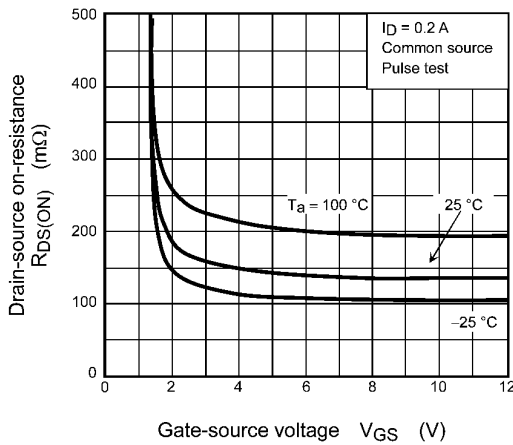
#### 7.1. Characteristics Curves of the MOSFET



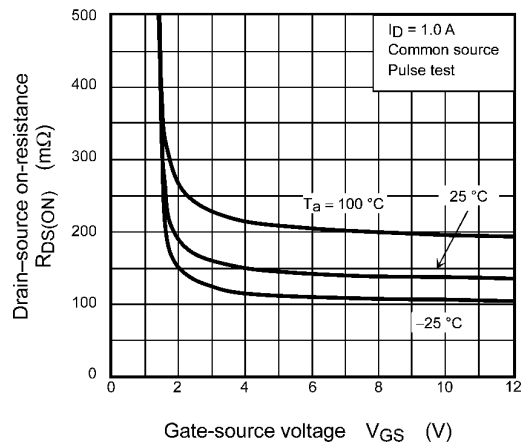
**Fig. 7.1.1**  $I_D - V_{DS}$



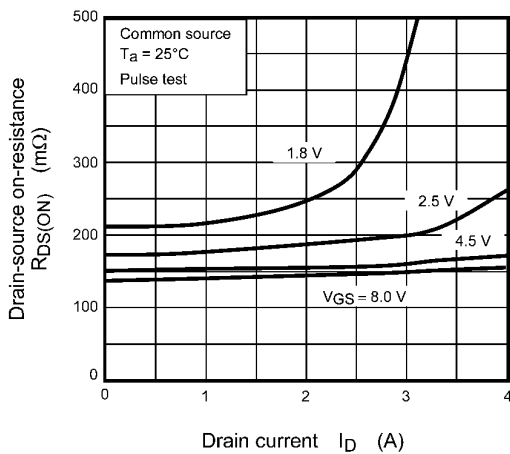
**Fig. 7.1.2**  $I_D - V_{GS}$



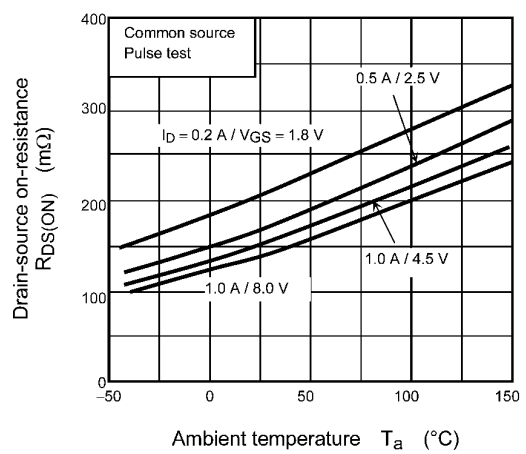
**Fig. 7.1.3**  $R_{DS(ON)} - V_{GS}$



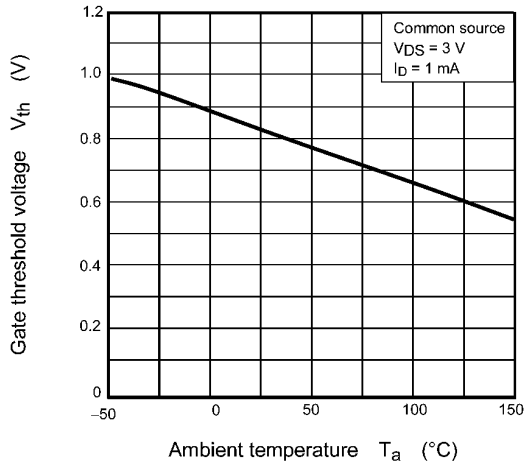
**Fig. 7.1.4**  $R_{DS(ON)} - V_{GS}$



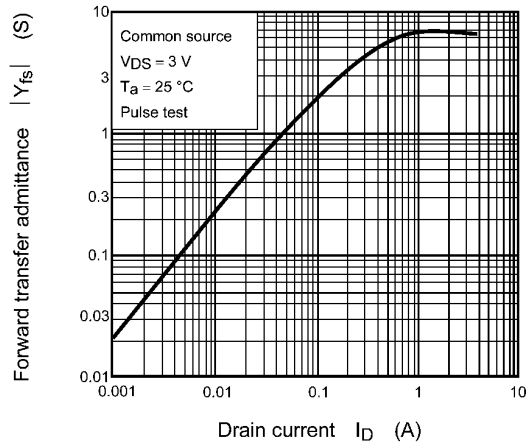
**Fig. 7.1.5**  $R_{DS(ON)} - I_D$



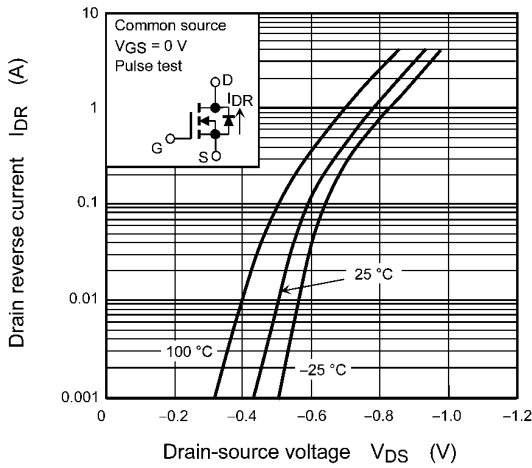
**Fig. 7.1.6**  $R_{DS(ON)} - T_a$



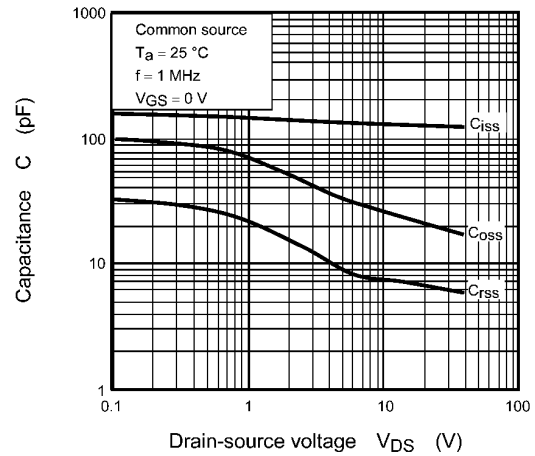
**Fig. 7.1.7  $V_{th} - T_a$**



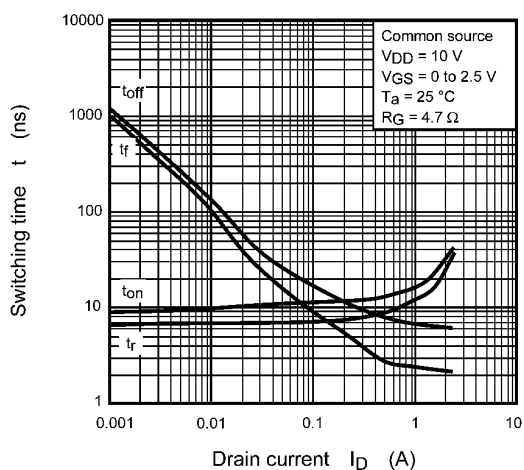
**Fig. 7.1.8  $|Y_{fs}| - I_D$**



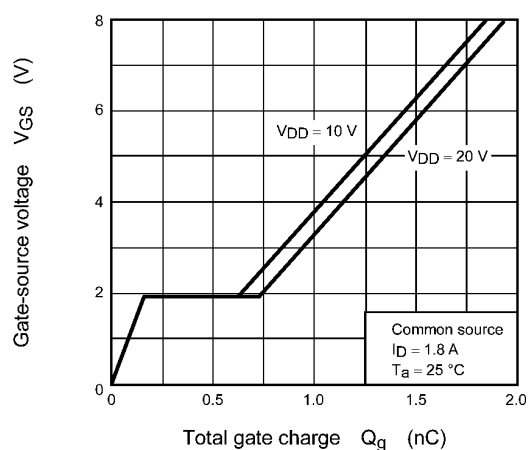
**Fig. 7.1.9  $I_{DR} - V_{DS}$**



**Fig. 7.1.10  $C - V_{DS}$**



**Fig. 7.1.11  $t - I_D$**



**Fig. 7.1.12 Dynamic Input Characteristics**

## 7.2. Characteristics Curves of the Diode

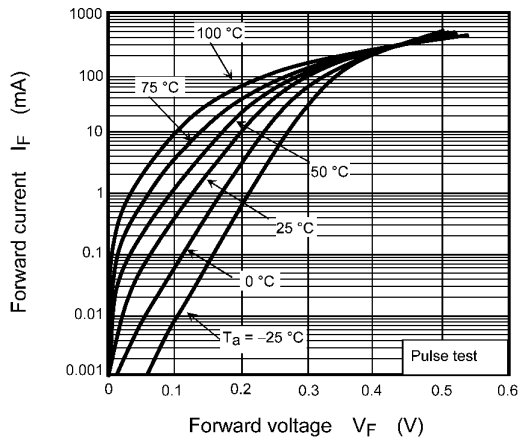


Fig. 7.2.1  $I_F - V_F$

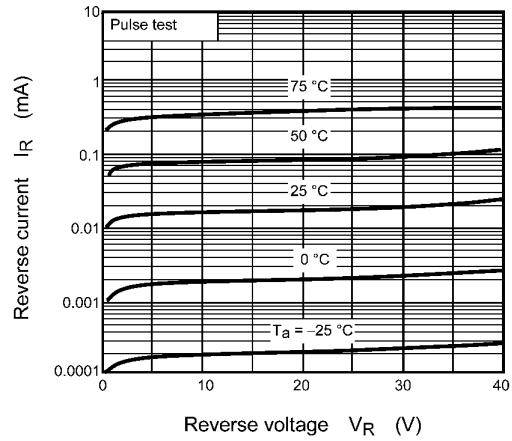


Fig. 7.2.2  $I_R - V_R$

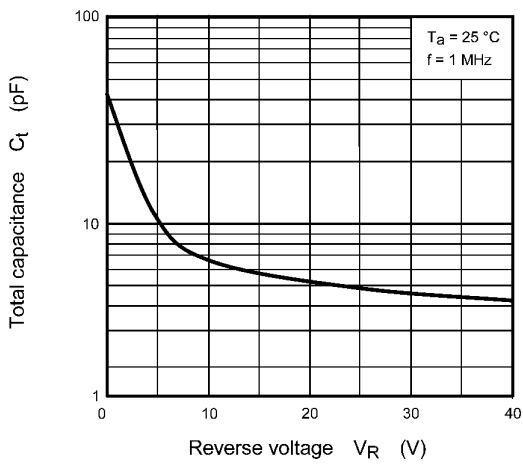
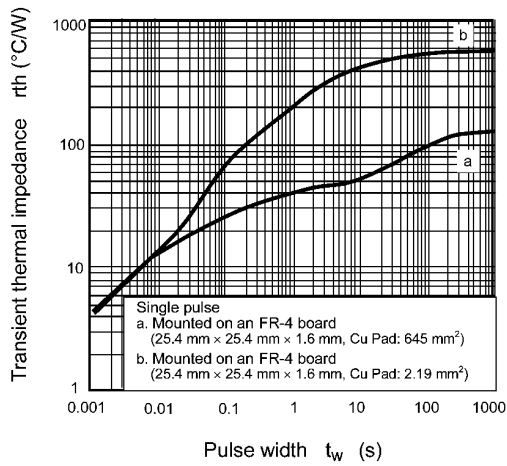
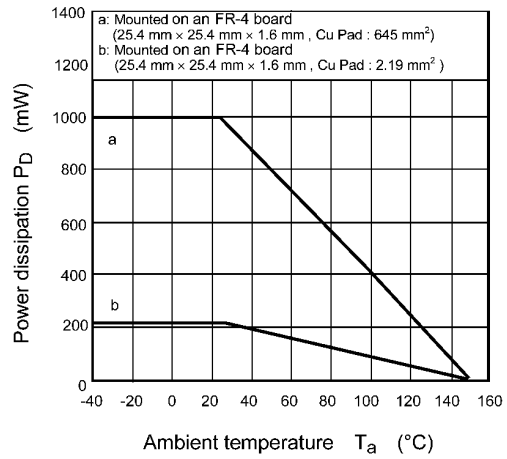


Fig. 7.2.3  $C_t - V_R$

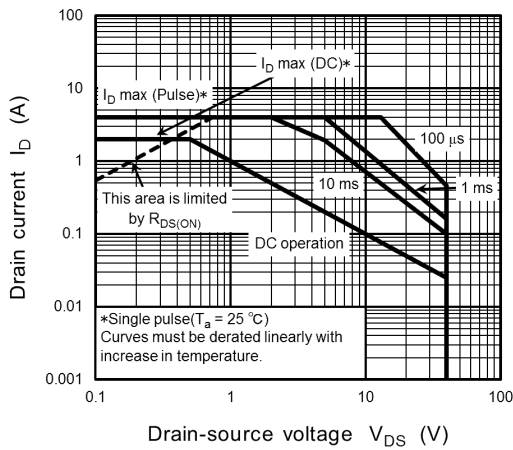
### 7.3. Characteristics Curves of the MOSFET · Diodes Common



**Fig. 7.3.1**  $r_{th} - t_w$



**Fig. 7.3.2**  $P_D - T_a$

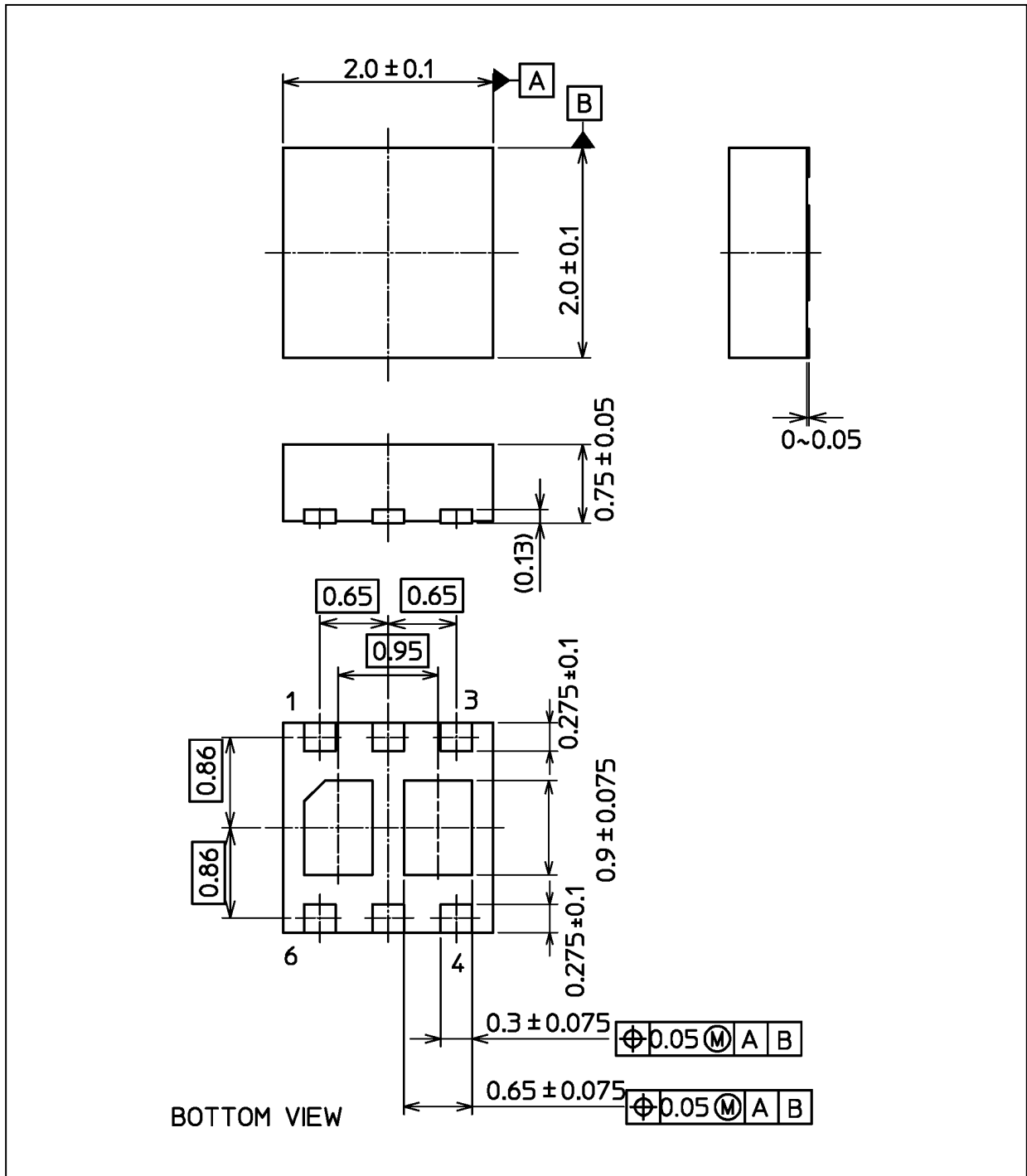


**Fig. 7.3.3** Safe Operating Area

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

## Package Dimensions

Unit: mm



Weight: 8.5 mg (typ.)

Package Name(s)
Nickname: UDFN6

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