

# DF6F6.8MTU

## 1. Applications

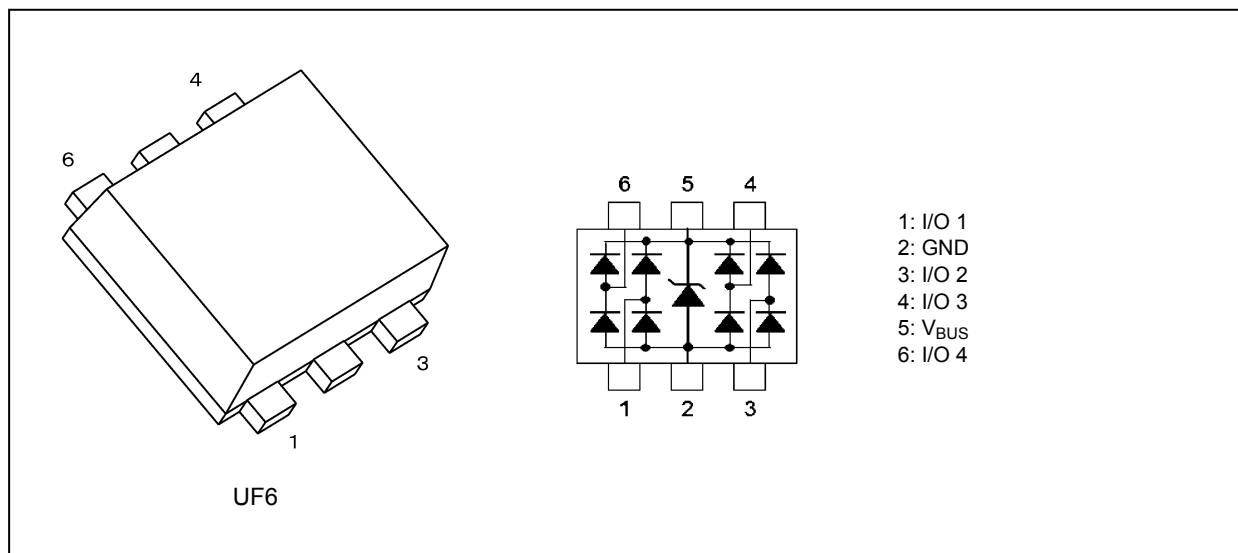
- ESD Protection

Note: This product is designed for protection against electrostatic discharge (ESD) and is not intended for any other purpose, including, but not limited to, voltage regulation.

## 2. Features

- (1) ESD protection for up to 4 high-speed data lines and 1 V<sub>BUS</sub> line.
- (2) Ultra compact packaging for easy configuration in any ESD protection circuits.
- (3) Low Input/output-to-ground capacitance: C<sub>t(1)</sub> = 0.6 pF (typ.).

## 3. Packaging and Internal Circuit



## 4. Absolute Maximum Ratings (Note) (Unless otherwise specified, T<sub>a</sub> = 25 °C)

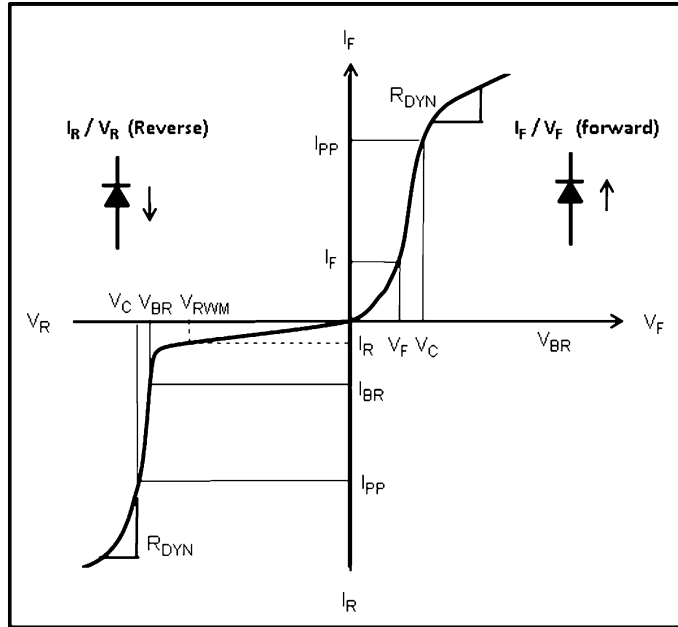
Characteristics	Symbol	Rating	Unit
Electrostatic discharge voltage (IEC61000-4-2)(Contact)	V <sub>ESD</sub>	±8	kV
Junction temperature	T <sub>j</sub>	150	°C
Storage temperature	T <sub>stg</sub>	-55 to 150	°C

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).

**5. Electrical Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

$V_{RWM}$ : Working peak reverse voltage  
 $V_{BR}$ : Reverse breakdown voltage  
 $I_{BR}$ : Reverse breakdown current  
 $I_R$ : Reverse current  
 $V_C$ : Clamp voltage  
 $I_{PP}$ : Peak pulse current  
 $R_{DYN}$ : Dynamic resistance  
 $I_F$ : Forward current  
 $V_F$ : Forward voltage



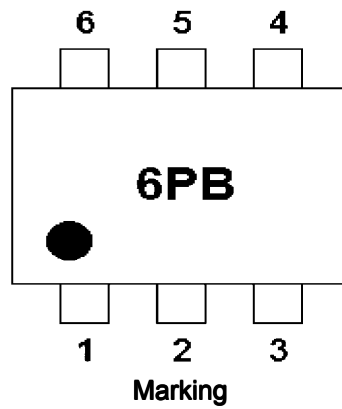
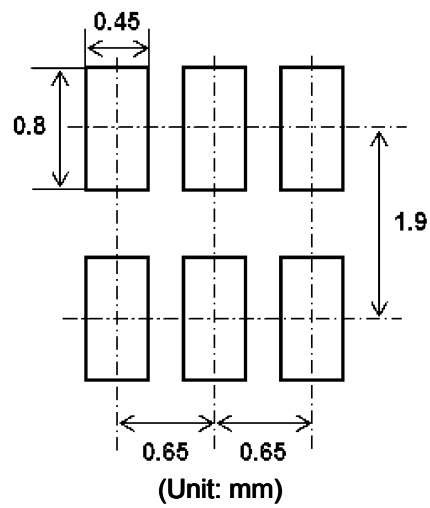
**Fig. 5.1 Definitions of Electrical Characteristics**

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Working peak reverse voltage	$V_{RWM}$		—	—	—	5.0	V
Reverse breakdown voltage	$V_{BR(1)}$		$I_{BR} = 5\text{ mA}$ (between I/O and GND)	6.0	—	—	V
	$V_{BR(2)}$		$I_{BR} = 5\text{ mA}$ (between $V_{BUS}$ and GND)	6.8	—	—	V
Reverse current	$I_{R(1)}$		$V_{RWM} = 5\text{ V}$ (between I/O and GND)	—	—	0.5	$\mu\text{A}$
	$I_{R(2)}$		$V_{RWM} = 5\text{ V}$ (between $V_{BUS}$ and GND)	—	—	0.5	$\mu\text{A}$
Clamp voltage	$V_{C(1)}$	(Note 1)	$I_{PP} = 1\text{ A}$ (between I/O and GND)	—	15	20	V
	$V_{C(2)}$	(Note 1)	$I_{PP} = 2.5\text{ A}$ (between I/O and GND)	—	18	24	V
	$V_{C(3)}$	(Note 1)	$I_{PP} = 1\text{ A}$ (between $V_{BUS}$ and GND)	—	14	19	V
	$V_{C(4)}$	(Note 1)	$I_{PP} = 9\text{ A}$ (between $V_{BUS}$ and GND)	—	25	30	V
Dynamic resistance	$R_{DYN(1)}$	(Note 2)	(between I/O and GND)	—	0.9	—	$\Omega$
	$R_{DYN(2)}$	(Note 2)	(between $V_{BUS}$ and GND)	—	0.6	—	$\Omega$
Total capacitance	$C_{t(1)}$	(Note 3)	$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$ (between I/O and GND)	—	0.6	1.0	pF
	$C_{t(2)}$		$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$ (between $V_{BUS}$ and GND)	—	67	—	pF
	$C_{t(3)}$		$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$ (between I/O and I/O)	—	0.3	—	pF
Input/output-to-ground capacitance difference	$\Delta C_{I-GND}$		$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$ (between I/O and GND)	—	0.01	—	pF

Note 1: Based on IEC61000-4-5 8/20  $\mu\text{s}$  pulse.

Note 2: TLP parameter:  $Z_0 = 50\text{ }\Omega$ ,  $t_p = 100\text{ ns}$ ,  $t_r = 300\text{ ps}$ , averaging window:  $t_1 = 30\text{ ns}$  to  $t_2 = 60\text{ ns}$ , extraction of dynamic resistance using a least-squares fit of TLP characteristics at  $I_{PP}$  between 3 A to 8 A.

Note 3: Guaranteed by design.

**6. Marking****7. Land Pattern Dimensions (for reference only)**

8. Characteristics Curves (Note)

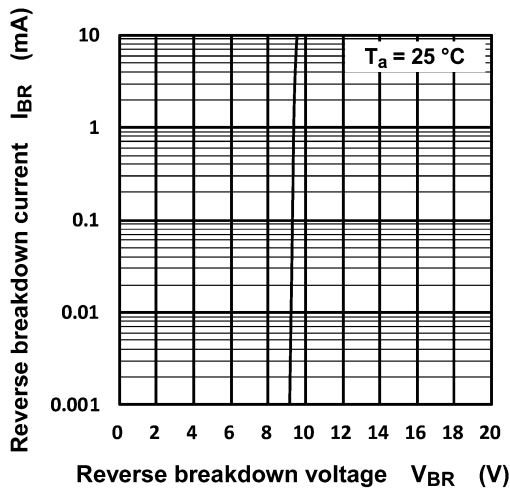


Fig. 8.1  $I_{BR} - V_{BR}$   
(I/O to GND)

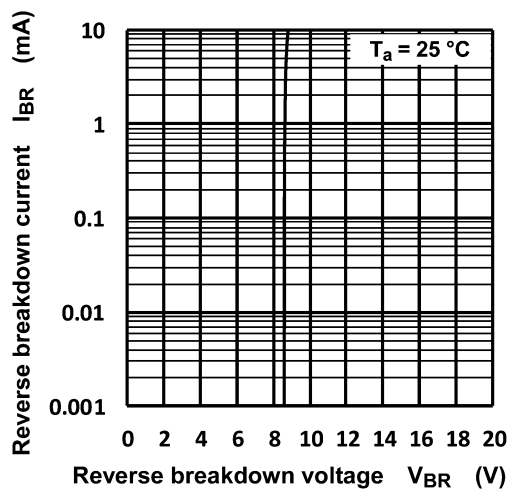


Fig. 8.2  $I_{BR} - V_{BR}$   
(V<sub>BUS</sub> to GND)

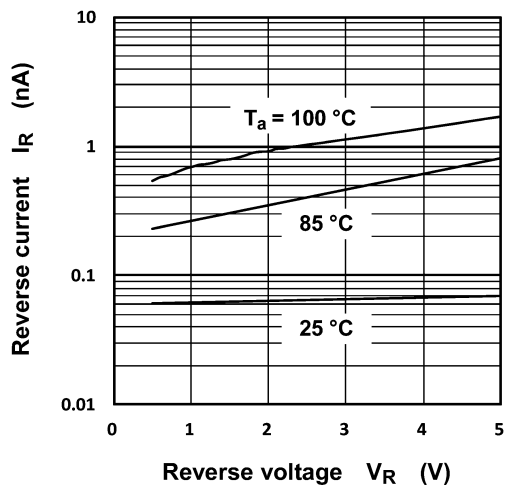


Fig. 8.3  $I_R - V_R$   
(I/O to GND)

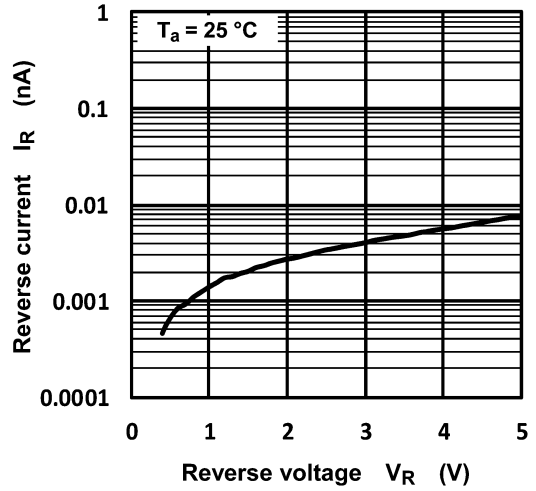


Fig. 8.4  $I_R - V_R$   
(V<sub>BUS</sub> to GND)

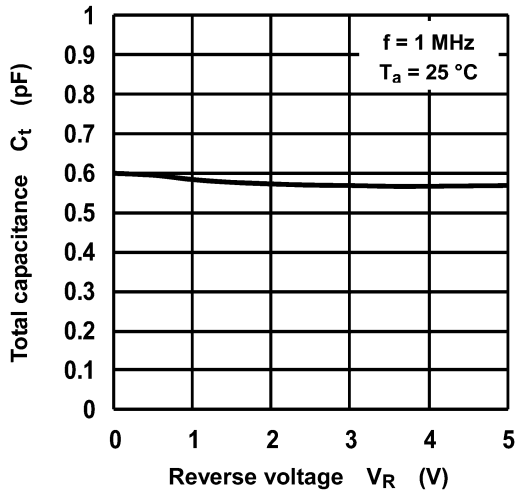


Fig. 8.5  $C_t - V_R$   
(I/O to GND)

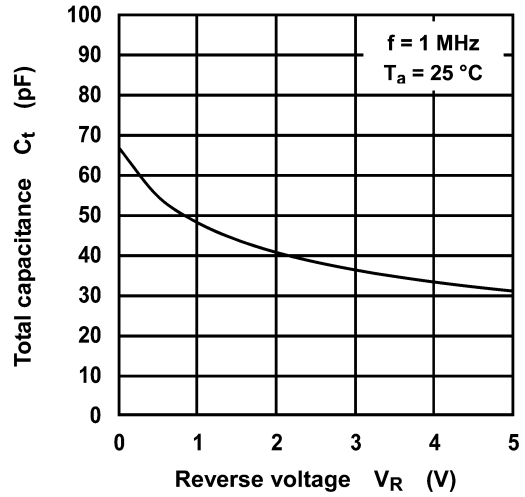


Fig. 8.6  $C_t - V_R$   
(VBUS to GND)

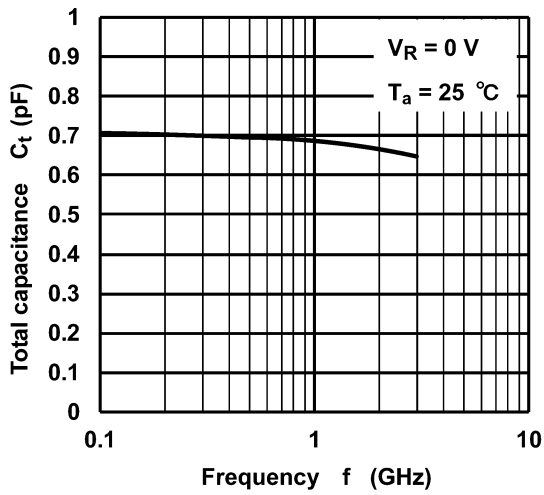
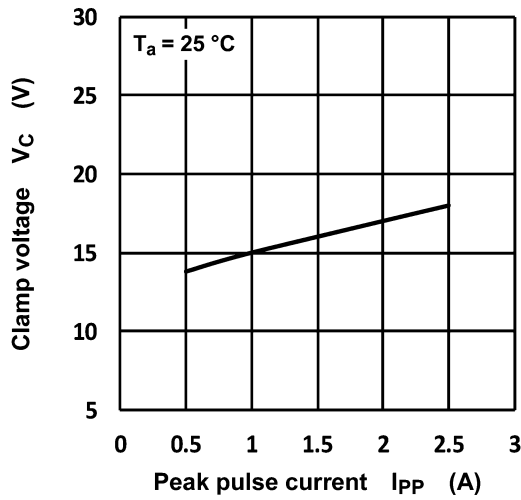


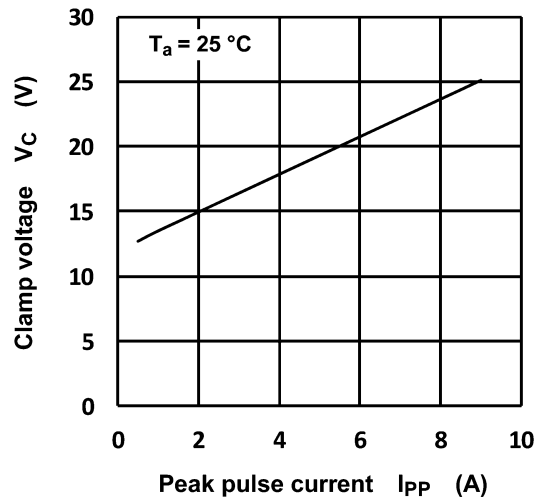
Fig. 8.7  $C_t - f$   
(I/O to GND)

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

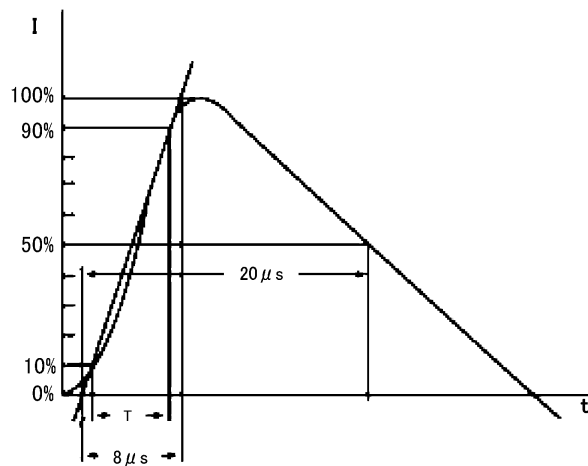
**9. Clamp Voltage  $V_C$  - Peak Pulse Current ( $I_{PP}$ ) (Note)**



**Fig. 9.1  $V_C$  -  $I_{PP}$   
(I/O to GND)**



**Fig. 9.2  $V_C$  -  $I_{PP}$   
(VBUS to GND)**



**Fig. 9.3 Based on IEC61000-4-5 8/20  $\mu$ s pulse**

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

10. Insertion Loss (S21) (Note)

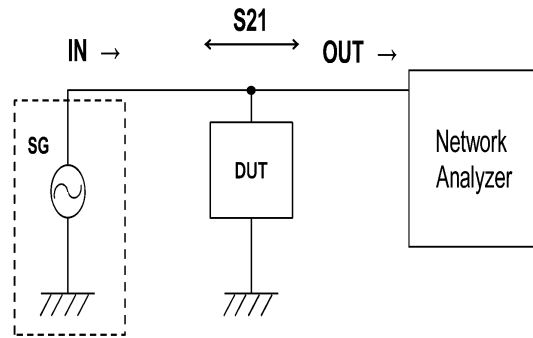
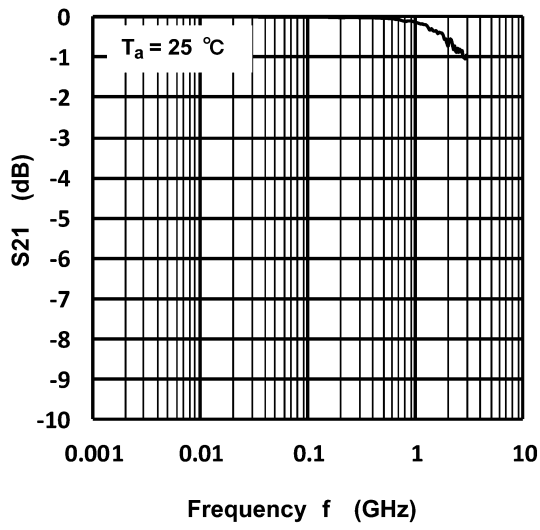
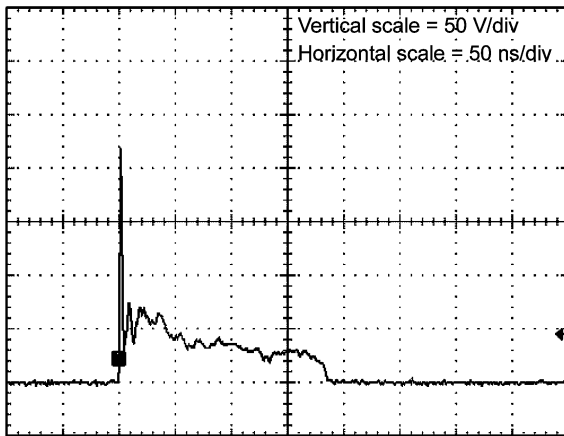


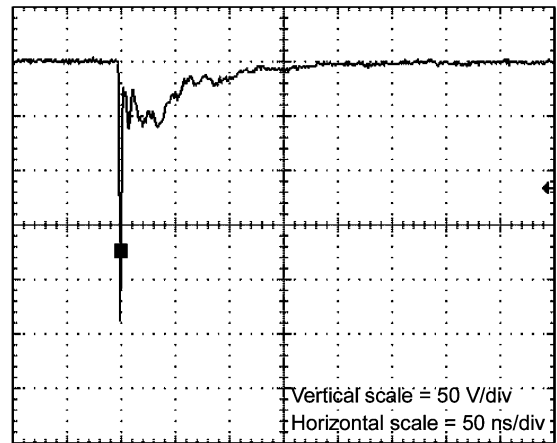
Fig. 10.1 S21 - f  
(I/O to GND)

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

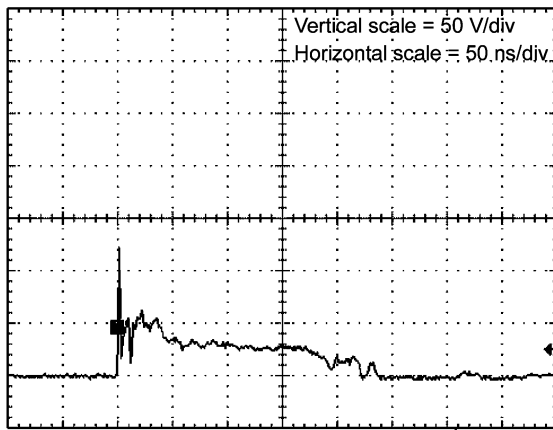
11. ESD Clamp Waveform (Note)



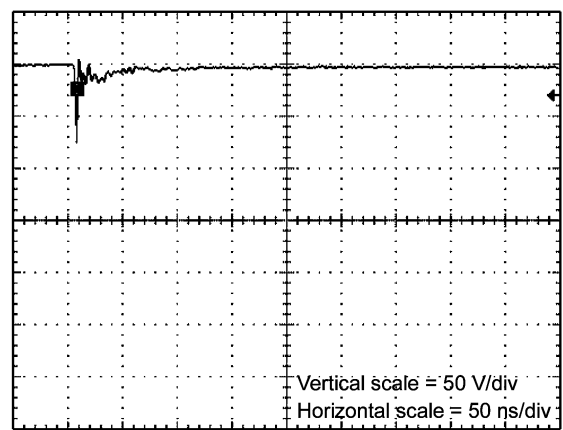
**Fig. 11.1 +8 kV  
(I/O to GND)**



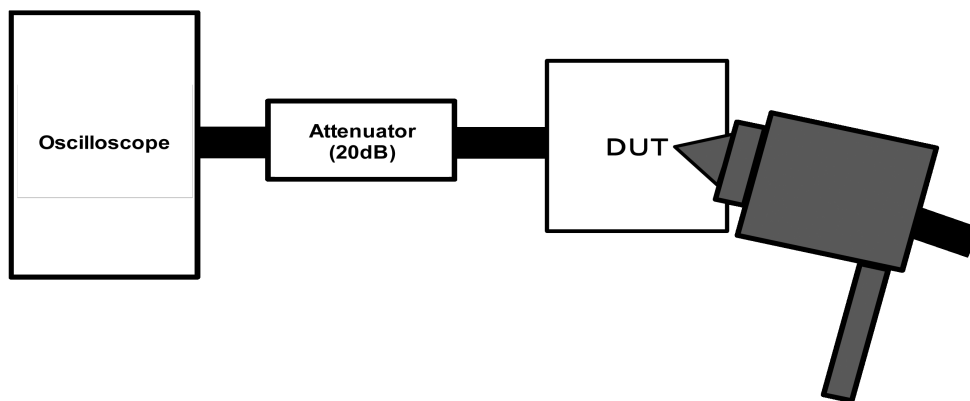
**Fig. 11.2 -8 kV  
(I/O to GND)**



**Fig. 11.3 +8 kV  
(VBUS to GND)**



**Fig. 11.4 -8 kV  
(VBUS to GND)**



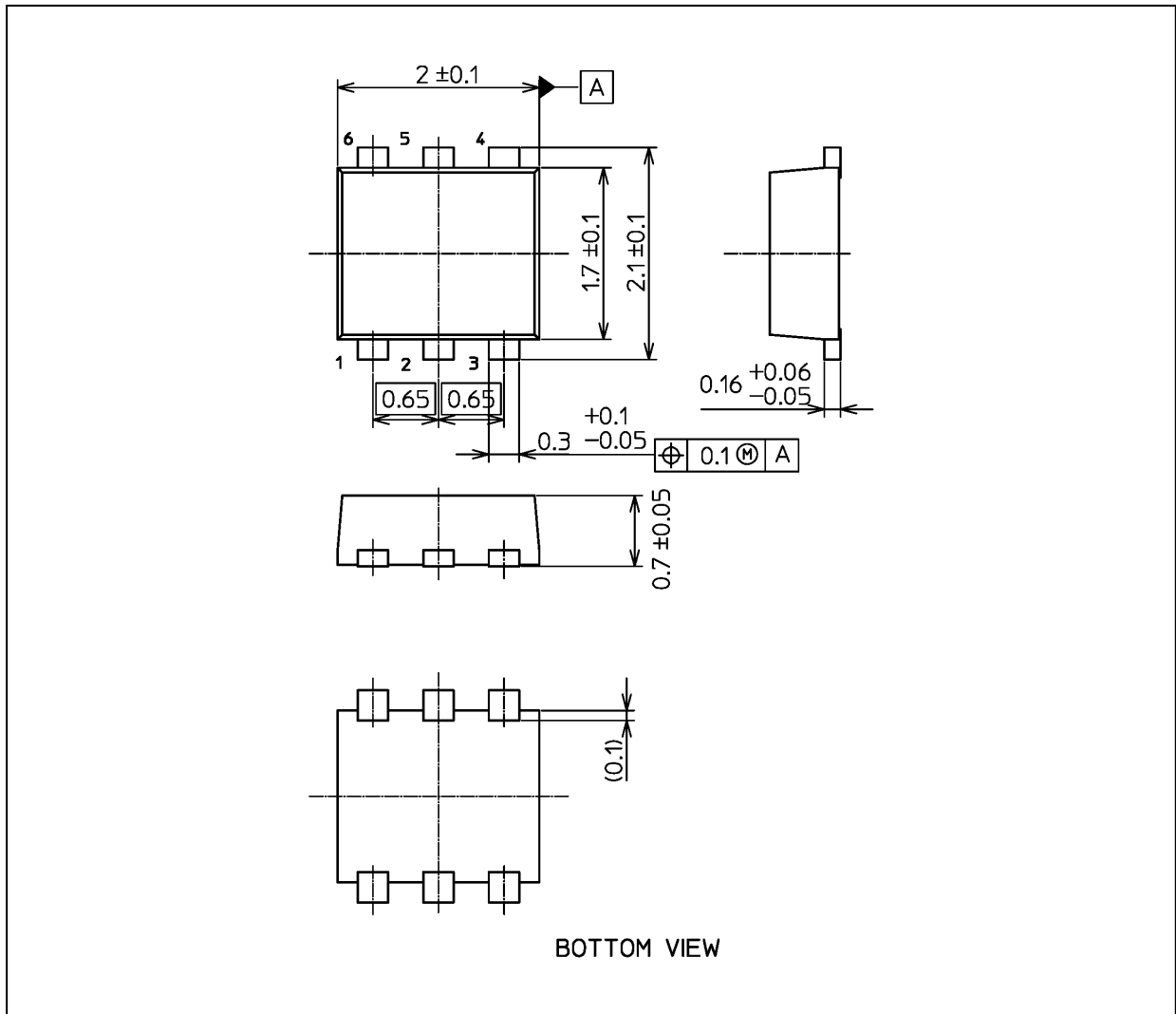
**Fig. 11.5 IEC61000-4-2 (Contact)**

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)
TOSHIBA: 2-2T1S
Nickname: UF6

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