ESD Protection Diodes Silicon Epitaxial Planar

# DF6F6.8MTU

#### 1. Applications

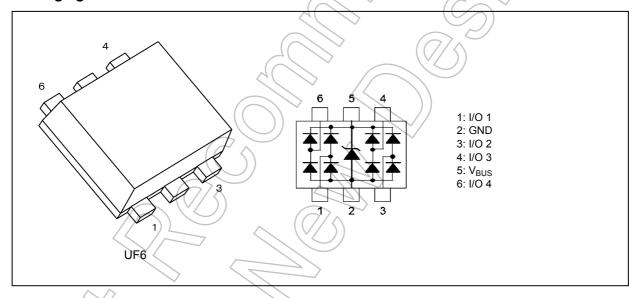
· ESD Protection

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  $V_{BUS}$  line.
- (2) Ultra compact packaging for easy configuration in any ESD protection circuits.
- (3) Low Input/output-to-ground capacitance:  $C_{t(1)} = 0.6 \text{ pF (typ.)}$ .

#### 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	Tj	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, Ta = 25 °C)

 $V_{\text{RWM}}$ : Working peak reverse voltage

V<sub>BR</sub>: Reverse breakdown voltage I<sub>BR</sub>: Reverse breakdown current

I<sub>R</sub>: Reverse current V<sub>C</sub>: Clamp voltage I<sub>PP</sub>: Peak pulse current R<sub>DYN</sub>: Dynamic resistance I<sub>F</sub>: Forward current V<sub>F</sub>: Forward voltage

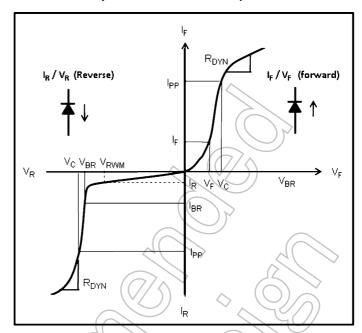


Fig. 5.1 Definitions of Electrical Characteristics

Characteristics	Symbol	Note	Test Condition	Min	Тур.	Max	Unit
Working peak reverse voltage	$V_{RWM}$			))—	_	5.0	V
Reverse breakdown voltage	V <sub>BR(1)</sub>	7	I <sub>BR</sub> = 5 mA (between I/O and GND)	6.0	ı	-	V
	V <sub>BR(2)</sub>		I <sub>BR</sub> = 5 mA (between V <sub>BUS</sub> and GND)	6.8	l	_	V
Reverse current	I <sub>R(1)</sub>		V <sub>RWM</sub> = 5 V (between I/O and GND)		ı	0.5	μА
	I <sub>R(2)</sub>		V <sub>RWM</sub> = 5 V (between V <sub>BUS</sub> and GND)			0.5	μА
Clamp voltage	V <sub>C(1)</sub>	(Note 1)	I <sub>PP</sub> = 1 A (between I/O and GND)		15	20	V
	V <sub>C(2)</sub>	(Note 1)	I <sub>PP</sub> = 2.5 A (between I/O and GND)		18	24	٧
	V <sub>C(3)</sub>	(Note 1)	I <sub>PP</sub> = 1 A (between V <sub>BUS</sub> and GND)		14	19	٧
	V <sub>C(4)</sub>	(Note 1)	I <sub>PP</sub> = 9 A (between V <sub>BUS</sub> and GND)	_	25	30	٧
Dynamic resistance	R <sub>DYN(1)</sub>	(Note 2)	(between I/O and GND)	_	0.9	_	Ω
$\wedge$ (( ))	R <sub>DYN(2)</sub>	(Note 2)	(between V <sub>BUS</sub> and GND)		0.6	_	Ω
Total capacitance	C <sub>t(1)</sub>	(Note 3)	V <sub>R</sub> = 0 V, f = 1 MHz (between I/O and GND)		0.6	1.0	pF
	C <sub>t(2)</sub>		$V_R = 0 \text{ V, f} = 1 \text{ MHz}$ (between $V_{BUS}$ and GND)		67		pF
$\rightarrow$	C <sub>t(3)</sub>		V <sub>R</sub> = 0 V, f = 1 MHz (between I/O and I/O)		0.3	_	pF
Input/output-to-ground capacitance difference	$\Delta C_{t ext{-GND}}$		V <sub>R</sub> = 0 V, f = 1 MHz (between I/O and GND)	_	0.01	_	pF

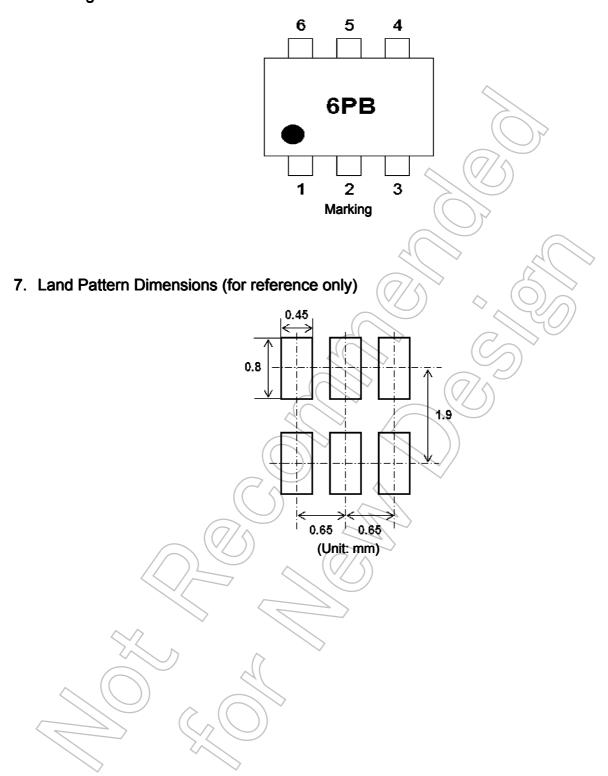
Note 1: Based on IEC61000-4-5 8/20  $\mu s$  pulse.

Note 3: Guaranteed by design.

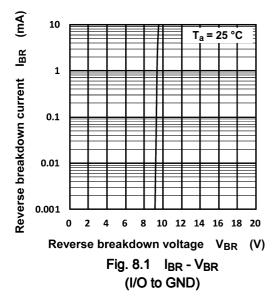
Note 2: TLP parameter: Z0 = 50  $\Omega$ , tp = 100 ns, tr = 300 ps, averaging window: t1 = 30 ns to t2 = 60 ns, extraction of dynamic resistance using a least-squares fit of TLP characteristics at I<sub>PP</sub> between 3 A to 8 A.



### 6. Marking



### 8. Characteristics Curves (Note)



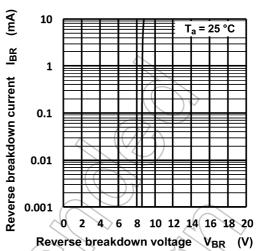


Fig. 8.2 IBR - VBR (V<sub>BUS</sub> to GND)

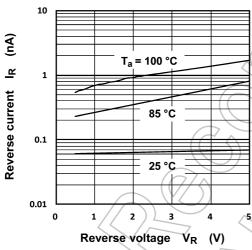
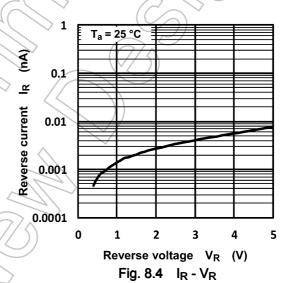
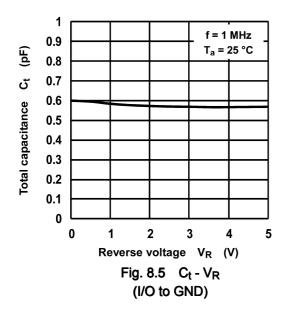
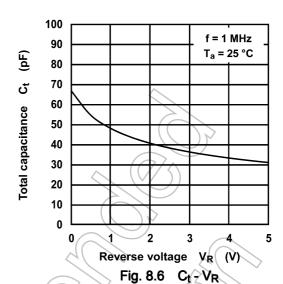


Fig. 8.3 I<sub>R</sub> - V<sub>R</sub> (I/O to GND)

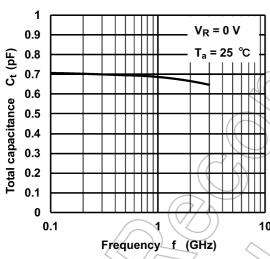


(V<sub>BUS</sub> to GND)





(V<sub>BUS</sub> to GND)



g 0.3 g 0.2 0.1 0 0.1 1 1 10 Frequency f (GHz) Fig. 8.7 Ct-f (I/O to GND)

### 9. Clamp Voltage V<sub>C</sub> - Peak Pulse Current (I<sub>PP</sub>) (Note)

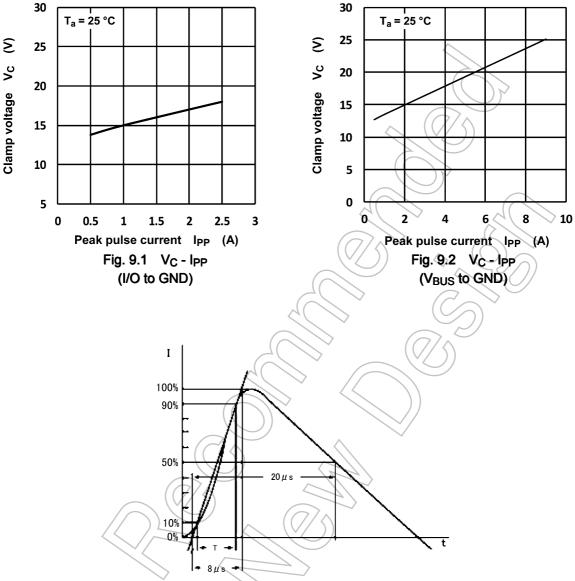
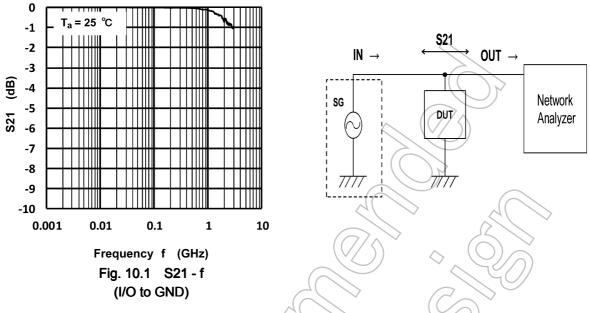


Fig. 9.3 Based on IEC61000-4-5 8/20 μs pulse

### 10. Insertion Loss (S21) (Note)



### 11. ESD Clamp Waveform (Note)

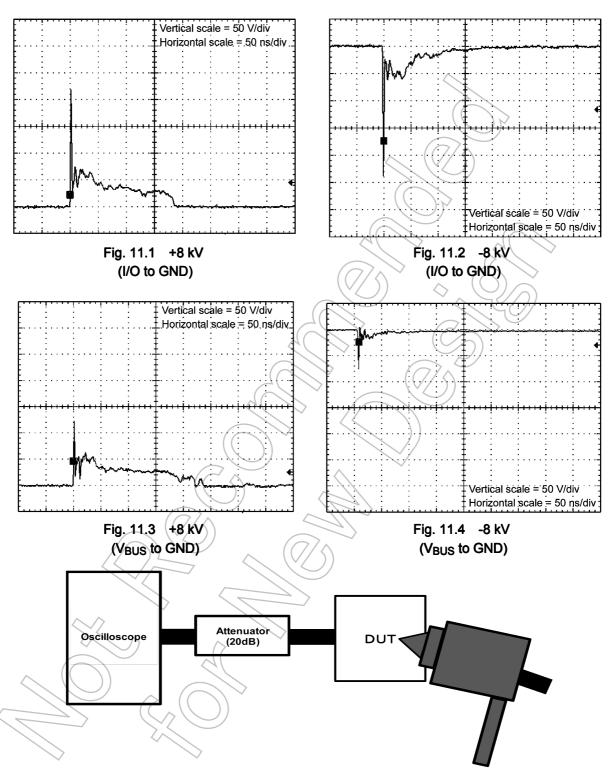
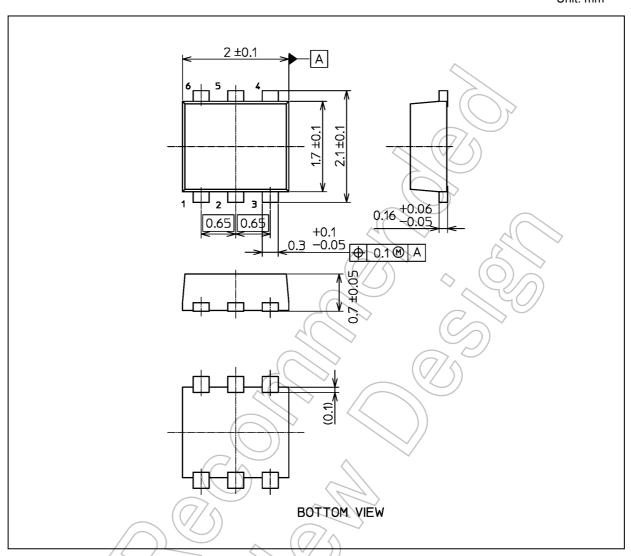


Fig. 11.5 IEC61000-4-2 (Contact)

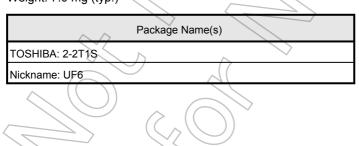


### **Package Dimensions**

Unit: mm



Weight: 7.0 mg (typ.)





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