

# DF2S23P2FU

## 1. General

The DF2S23P2FU is a TVS diode (ESD protection diode) protects semiconductor devices used in mobile device interfaces and other applications to protect against static electricity and noise.

The DF2S23P2FU has realized high  $I_{pp}$ , in order to protect a semiconductor devices from the indirect lightning stroke and the transition voltage (at the time of power activation).

Furthermore, the DF2S23P2FU is housed in an standard package (2.5 mm × 1.25 mm), it can be used for various applications.

## 2. Applications

Mobile Equipment

- Smartphones
- Tablets
- Notebook PCs

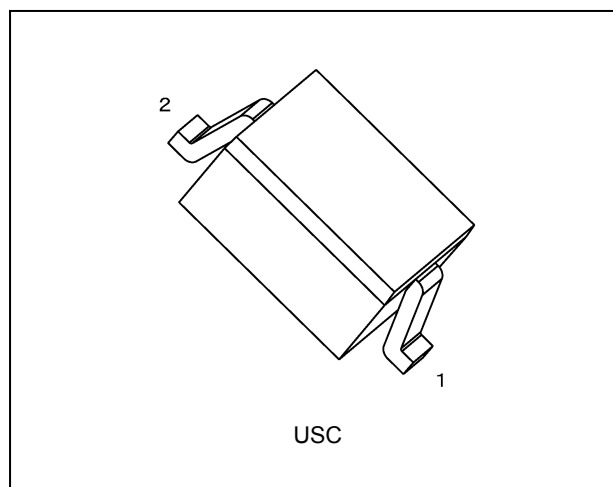
Desktop PCs

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.

## 3. Features

- (1) Suitable for use with a 20 V signal line. ( $V_{RWM} \leq 21$  V)
- (2) Protects devices with its high ESD performance.  
( $V_{ESD} = \pm 30$  kV (Contact / Air) @IEC61000-4-2)
- (3) Low dynamic resistance protects semiconductor devices from static electricity and noise.  
( $R_{DYN} = 0.13 \Omega$  (typ.))
- (4) Low clamping voltage characteristic protects semiconductor devices from static electricity and noise.  
( $V_C = 30$  V@ $I_{PP} = 14$  A (typ.))
- (5) Compact package is suitable for use in high density board layouts such as in mobile devices.  
(2.5 mm × 1.25 mm size (Nickname: USC))

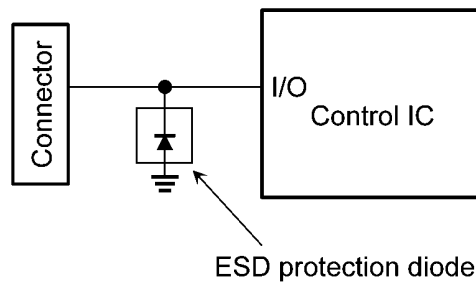
## 4. Packaging



Start of commercial production

2018-08

## 5. Example of Circuit Diagram



## 6. Quick Reference Data

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Working peak reverse voltage	$V_{RWM}$	(Note 1)	—	—	—	21	V
Dynamic resistance	$R_{DYN}$	(Note 2)	—	—	0.13	—	$\Omega$
Electrostatic discharge voltage (IEC61000-4-2) (Contact)	$V_{ESD}$	(Note 3)	—	—	—	30	kV

Note 1: Recommended operating condition.

Note 2: TLP parameters:  $Z_0 = 50 \Omega$ ,  $t_p = 100 \text{ ns}$ ,  $t_r = 300 \text{ ps}$ , averaging window:  $t_1 = 30 \text{ ns}$  to  $t_2 = 60 \text{ ns}$ , extraction of dynamic resistance using least squares fit of TLP characteristics between  $I_{PP1} = 16 \text{ A}$  and  $I_{PP2} = 30 \text{ A}$ .

Note 3: Criterion: No damage to devices.

### 6.1. ESD Clamp Waveform (Note)

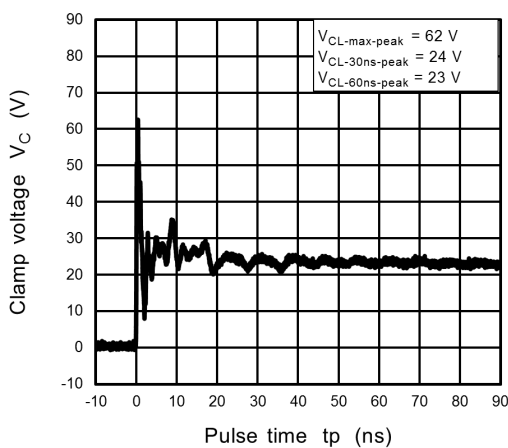


Fig. 6.1.1 +8 kV

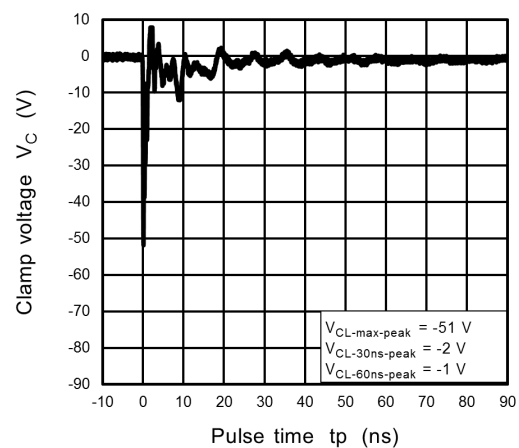


Fig. 6.1.2 -8 kV

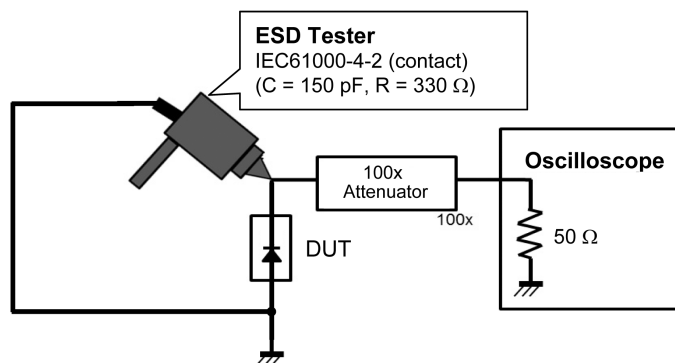
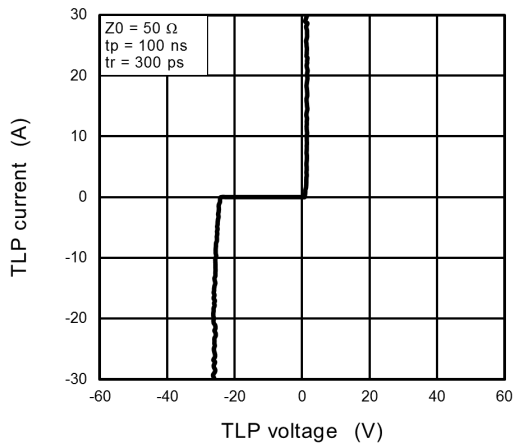


Fig. 6.1.3 IEC61000-4-2 (Contact)

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

## 6.2. TLP Characteristics (Note)



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

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

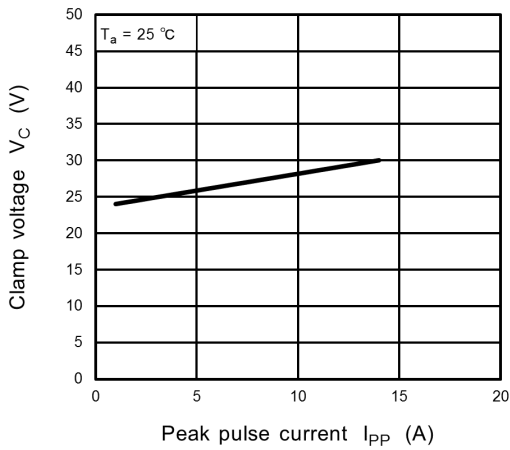


Fig. 6.3.1  $V_C - I_{PP}$

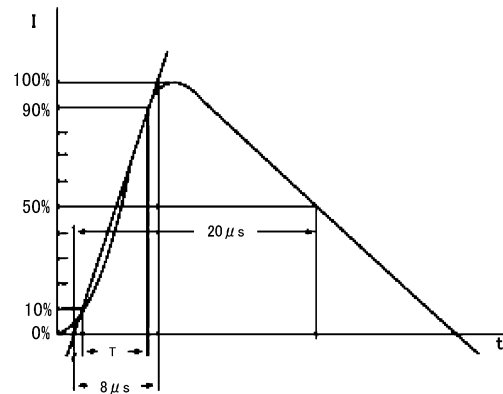


Fig. 6.3.2 Based on IEC61000-4-5 8/20  $\mu\text{s}$  pulse.

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

### 7. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Note	Rating	Unit
Electrostatic discharge voltage (IEC61000-4-2) (Contact)	$V_{ESD}$	(Note 1)	$\pm 30$	kV
Electrostatic discharge voltage (IEC61000-4-2) (Air)			$\pm 30$	
Peak pulse power ( $t_p = 8/20\ \mu\text{s}$ )	$P_{PK}$		500	W
Peak pulse current ( $t_p = 8/20\ \mu\text{s}$ )	$I_{PP}$	(Note 2)	14	A
Junction temperature	$T_j$		150	$^\circ\text{C}$
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: According to IEC61000-4-2.

Note 2: According to IEC61000-4-5.

### 8. 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

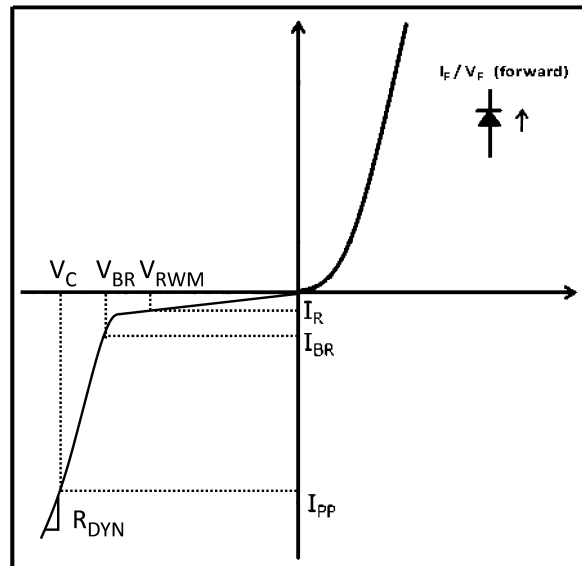


Fig. 8.1 Definitions of Electrical Characteristics

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Working peak reverse voltage	$V_{RWM}$	(Note 1)	—	—	—	21	V
Total capacitance	$C_t$		$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$	—	160	—	pF
Dynamic resistance	$R_{DYN}$	(Note 2)	—	—	0.13	—	$\Omega$
Reverse breakdown voltage	$V_{BR}$		$I_{BR} = 1\text{ mA}$	21.5	24.1	25.5	V
Reverse current	$I_R$		$V_{RWM} = 21\text{ V}$	—	—	0.1	$\mu\text{A}$
Clamp voltage	$V_C$	(Note 3)	$I_{PP} = 1\text{ A}$	—	24.2	—	V
			$I_{PP} = 14\text{ A}$	—	30	35.7	
		(Note 2)	$I_{TLP} = 16\text{ A}$	—	25.5	—	V
			$I_{TLP} = 30\text{ A}$	—	27.3	—	

Note 1: Recommended operating condition.

Note 2: TLP parameters:  $Z_0 = 50\ \Omega$ ,  $t_p = 100\text{ ns}$ ,  $t_r = 300\text{ ps}$ , averaging window:  $t_1 = 30\text{ ns}$  to  $t_2 = 60\text{ ns}$ , extraction of dynamic resistance using least squares fit of TLP characteristics between  $I_{PP1} = 16\text{ A}$  and  $I_{PP2} = 30\text{ A}$ .

Note 3: Based on IEC61000-4-5 8/20  $\mu\text{s}$  pulse.

## 9. Characteristics Curves (Note)

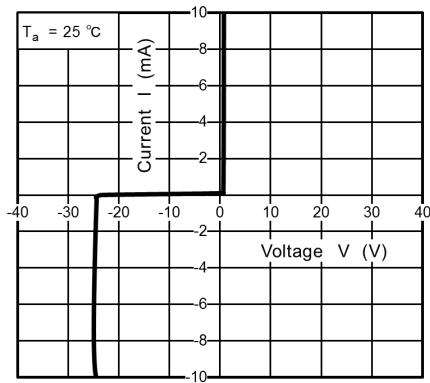


Fig. 9.1 I - V

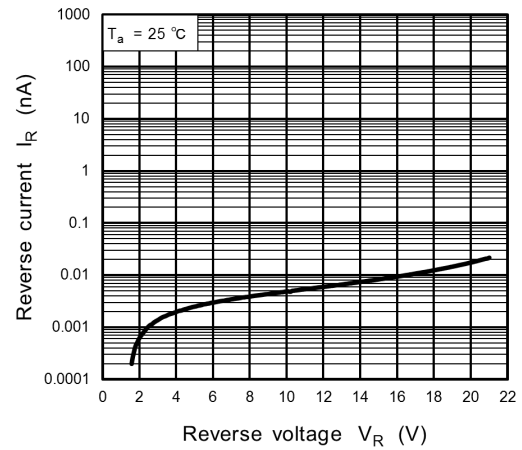


Fig. 9.2  $I_R - V_R$

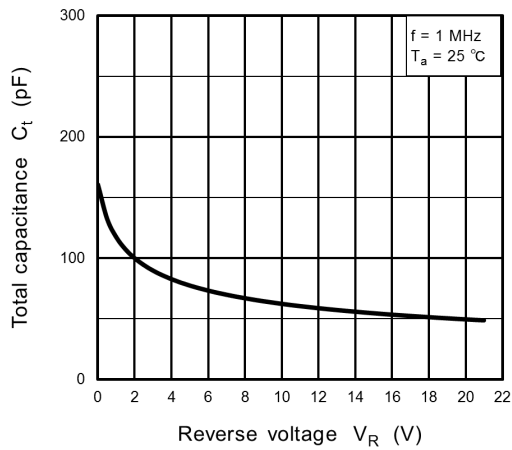
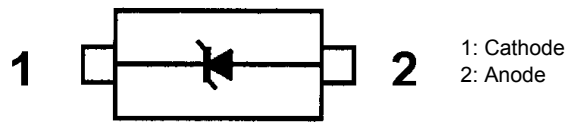


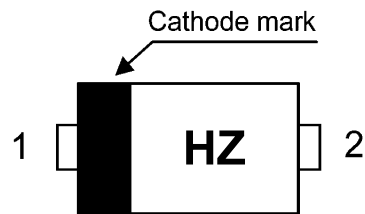
Fig. 9.3  $C_t - V_R$

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

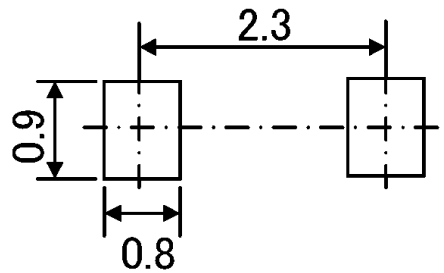
## 10. Internal Circuit



## 11. Marking (Top view)



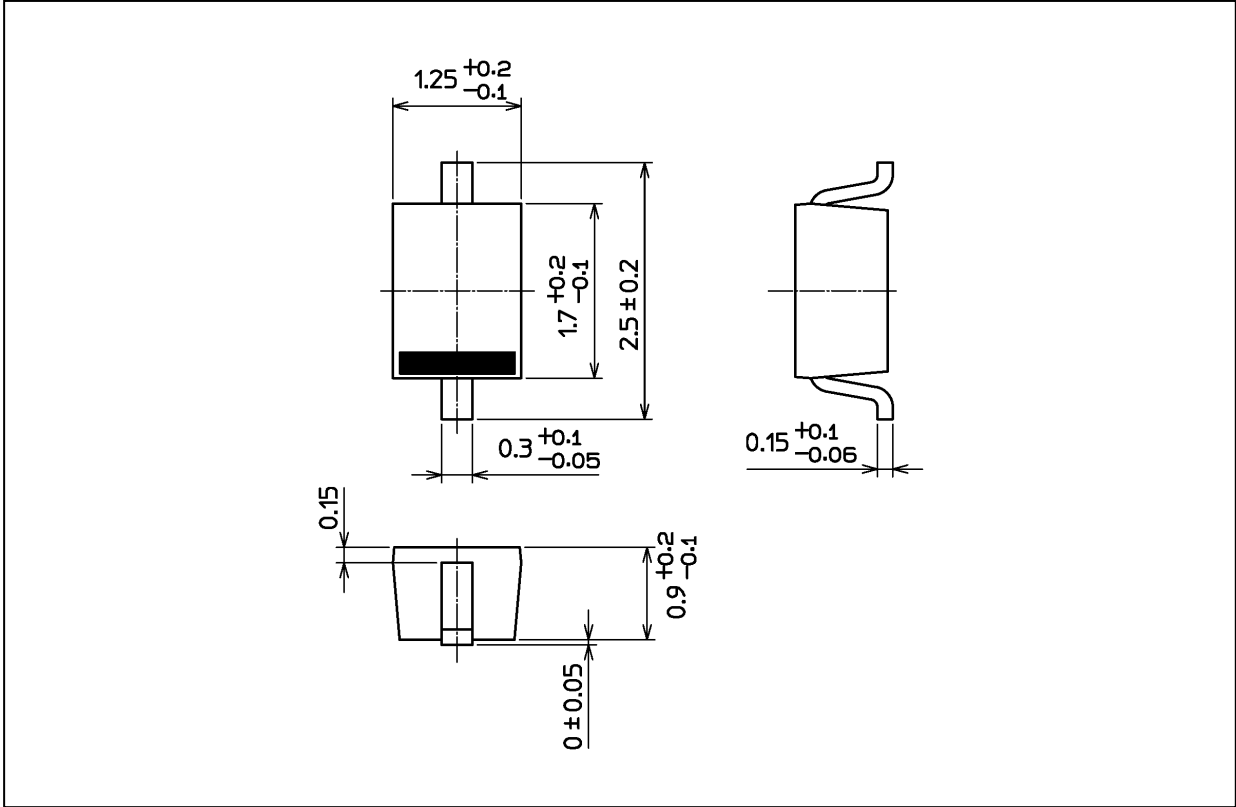
## 12. Land Pattern Dimensions (for reference only)



Unit: mm

Package Dimensions

Unit: mm



Weight: 4.5 mg (typ.)

Package Name(s)
Nickname: USC

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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А