

DF2B6M4BSL

1. General

The DF2B6M4BSL is a TVS diode (ESD protection diode) that protects semiconductor components from static electricity and noise in electronic device antennas and high-speed interface ports.

This product has ultra-low capacitance characteristics, it is possible to suppress the deterioration of signal quality that is a concern in antennas and high-speed signal lines. And the DF2B6M4BSL provides low V_{peak} voltage when ESD is applied and superior protective performance.

DF2B6M4BSL is housed in an ultra-compact package (0.62 mm × 0.32 mm) to meet applications that require a small footprint.

2. Applications

Mobile Equipment

IoT Equipment

Wearable Equipment

- Wi-Fi
- Antenna
- DisplayPort Interface
- USB/HDMI
- PCI Express

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.

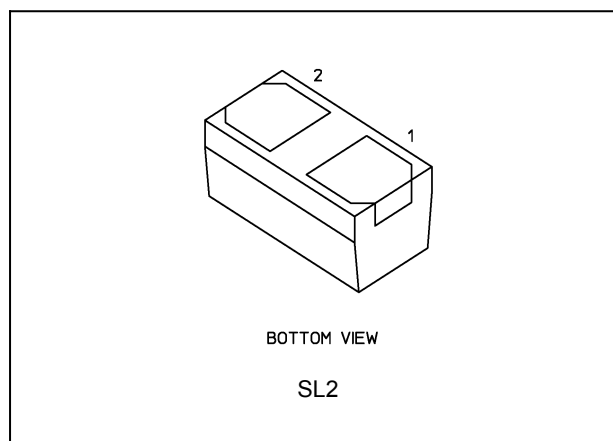
3. Features

- (1) Suitable for use with a 5.0 V signal line. ($V_{RWM} \leq 5.5$ V)
- (2) Low harmonic distortion
 - f = 2.4 GHz, 20 dBm input
 - 2nd Harmonics: -65.5 dBm (Reference)
 - 3rd Harmonics: -54.4 dBm (Reference)
 - f = 5.0 GHz, 20 dBm input
 - 2nd Harmonics: -64.7 dBm (Reference)
 - 3rd Harmonics: -55.5 dBm (Reference)
- (3) Low V_{peak} : $V_{CL-max-peak} = 215$ V (Reference) (@IEC61000-4-2(Contact), +8 kV)
- (4) Compact package is suitable for use in high density board layouts such as in mobile devices. (0.62 mm × 0.32 mm size (Nickname: SL2))

Start of commercial production

2021-12

4. Packaging



5. Example of Circuit Diagram

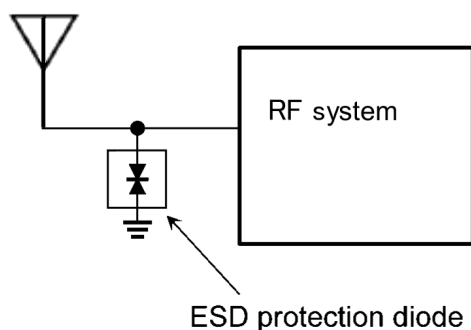


Fig. 5.1 High frequency antenna circuit

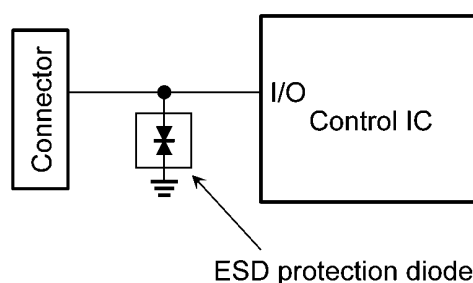


Fig. 5.2 High-speed signal circuit

6. Quick Reference Data

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Working peak reverse voltage	V_{RWM}	(Note 1)	—	—	—	5.5	V
Total capacitance	C_t		$V_R = 0\text{ V}$, $f = 1\text{ MHz}$	—	0.12	0.15	pF
Dynamic resistance	R_{DYN}	(Note 2)	—	—	1.05	—	Ω
Electrostatic discharge voltage (IEC61000-4-2) (Contact)	V_{ESD}	(Note 3)	—	8	—	—	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 $I_{PP1} = 8\text{ A}$ and $I_{PP2} = 16\text{ A}$.

Note 3: Criterion: No damage to devices.

6.1. ESD Clamp Waveform (Note)

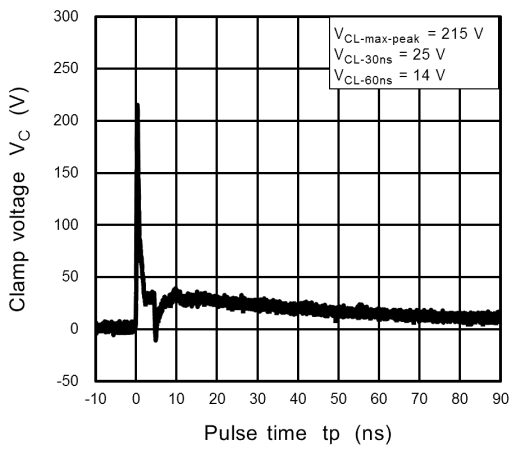


Fig. 6.1.1 +8 kV

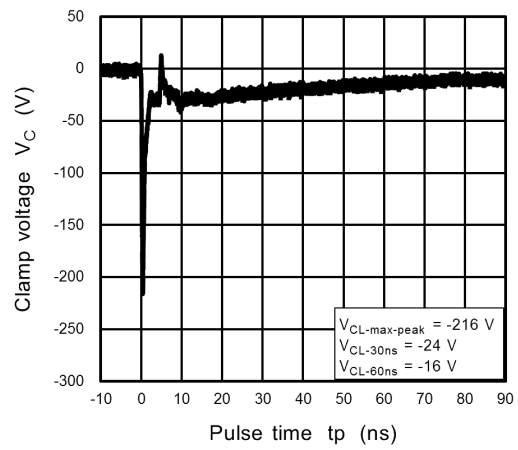


Fig. 6.1.2 -8 kV

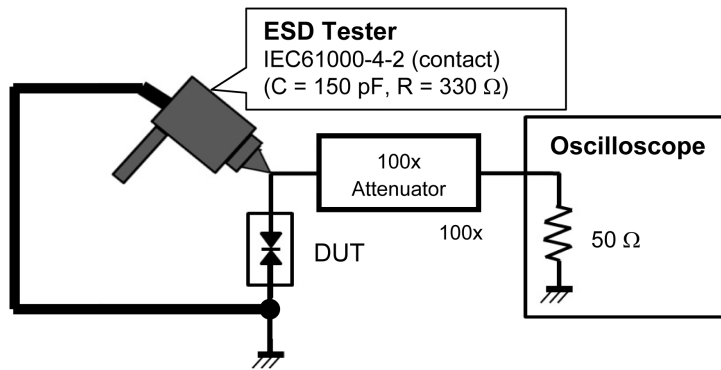


Fig. 6.1.3 IEC61000-4-2 (Contact)

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

6.2. Harmonic distortion characteristics (Note)

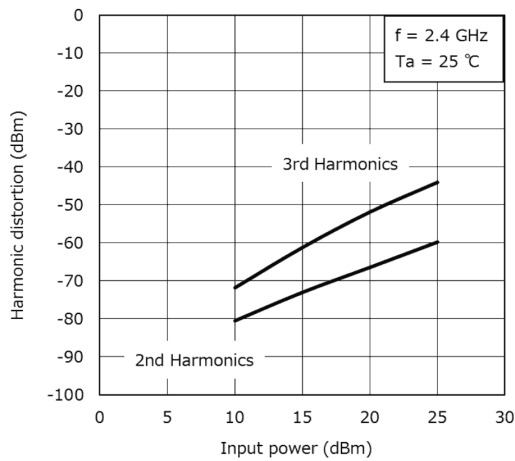


Fig. 6.2.1 f = 2.4 GHz

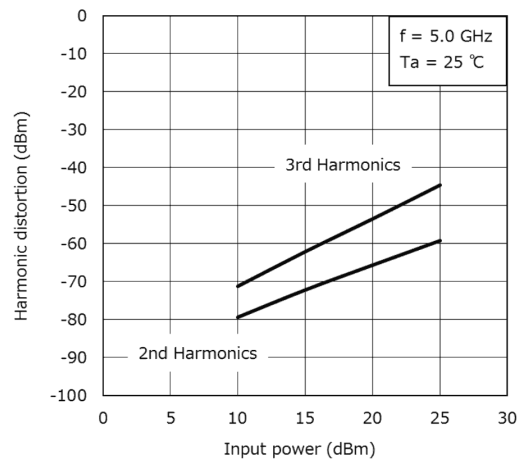


Fig. 6.2.2 f = 5.0 GHz

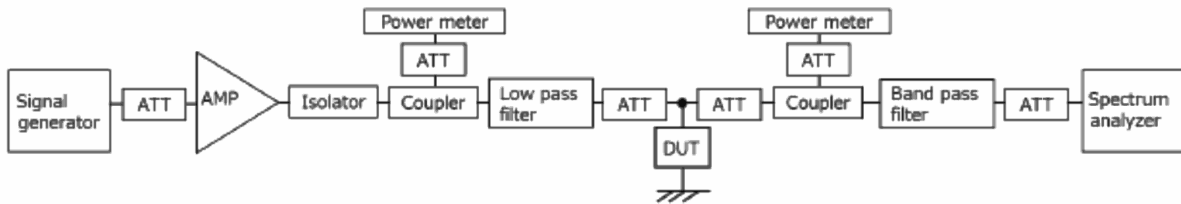
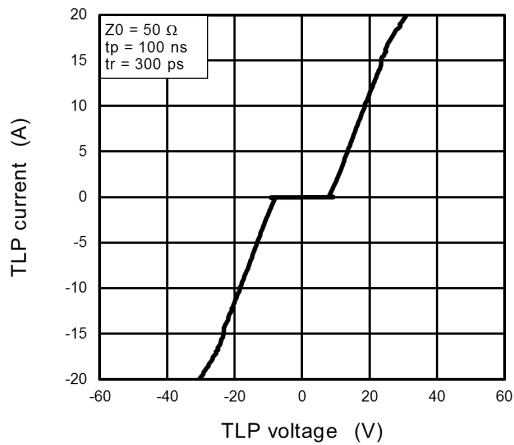


Fig. 6.2.3 Schematic diagram of harmonic distortion evaluation system

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

6.3. TLP Characteristics (Note)



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

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

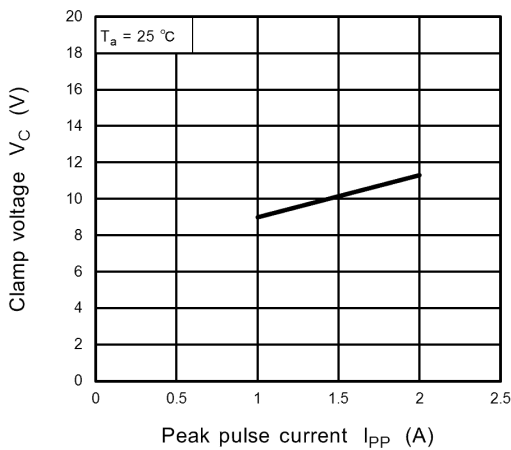


Fig. 6.4.1 $V_C - I_{PP}$

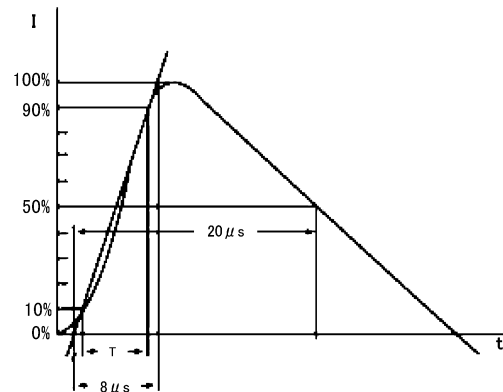


Fig. 6.4.2 Based on IEC61000-4-5 8/20 μ s pulse.

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)	± 8	kV
Electrostatic discharge voltage (IEC61000-4-2) (Air)			± 8	
Peak pulse power ($t_p = 8/20\text{ }\mu\text{s}$)	P_{PK}		30	W
Peak pulse current ($t_p = 8/20\text{ }\mu\text{s}$)	I_{PP}	(Note 2)	2.0	A
Junction temperature	T_j		150	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to 150	

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_T : Trigger voltage
 V_H : Holding voltage
 (Reverse breakdown voltage)
 I_{t1} : Test current (Reverse breakdown current)
 I_R : Reverse current
 V_C : Clamp voltage
 I_{PP} : Peak pulse current
 R_{DYN} : Dynamic resistance

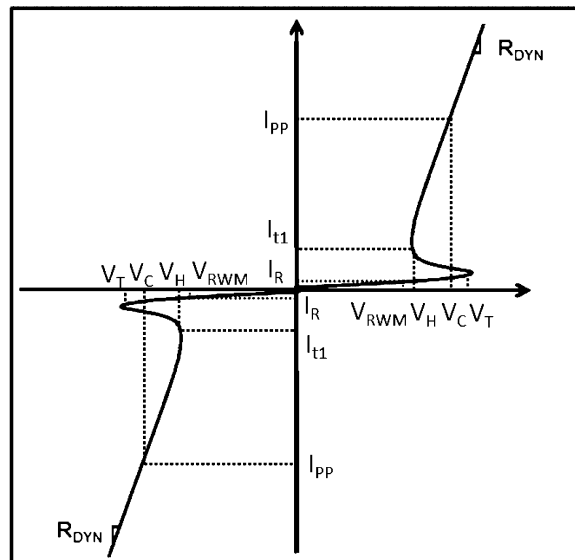


Fig. 8.1 Definitions of Electrical Characteristics

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Working peak reverse voltage	V_{RWM}	(Note 1)	—	—	—	5.5	V
Total capacitance	C_t		$V_R = 0\text{ V}$, $f = 1\text{ MHz}$	—	0.12	0.15	pF
Dynamic resistance	R_{DYN}	(Note 2)	—	—	1.05	—	Ω
Trigger voltage	V_T		—	5.6	—	—	V
Holding voltage	V_H		$I_{t1} = 1\text{ mA}$	5.6	6.2	8.0	V
Reverse current	I_R		$V_{RWM} = 5.5\text{ V}$	—	—	0.1	μA
Clamp voltage	V_C	(Note 3)	$I_{PP} = 1\text{ A}$	—	9	—	V
			$I_{PP} = 2\text{ A}$	—	11.3	15	
		(Note 2)	$I_{TLP} = 8\text{ A}$	—	16.5	—	V
			$I_{TLP} = 16\text{ A}$	—	25	—	

Note 1: Recommended operating condition.

Note 2: TLP parameters: $Z_0 = 50\text{ }\Omega$, $t_p = 100\text{ ns}$, $t_r = 300\text{ ps}$, averaging window: $t_1 = 30\text{ ns}$ to $t_2 = 60\text{ ns}$, extraction of dynamic resistance using least squares fit of TLP characteristics between $I_{PP1} = 8\text{ A}$ and $I_{PP2} = 16\text{ A}$.

Note 3: Based on IEC61000-4-5 8/20 μs pulse.

9. Characteristics Curves (Note)

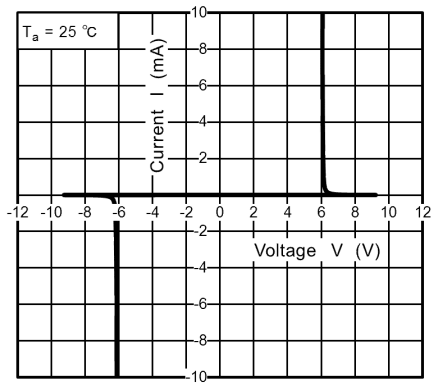


Fig. 9.1 I - V

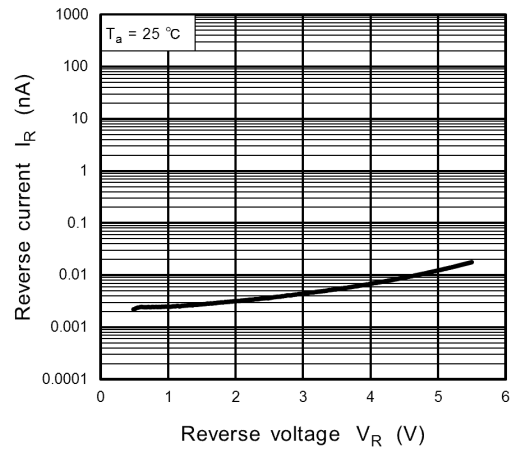


Fig. 9.2 $I_R - V_R$

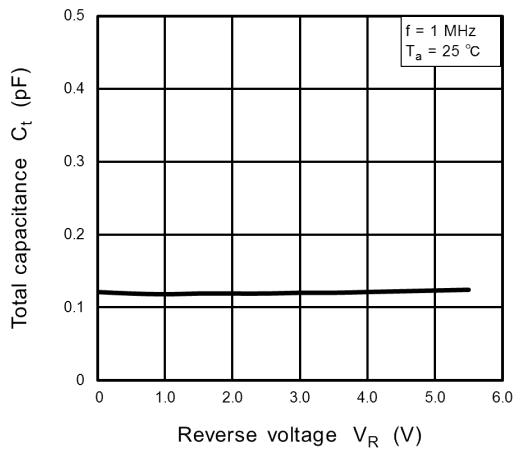


Fig. 9.3 $C_t - V_R$

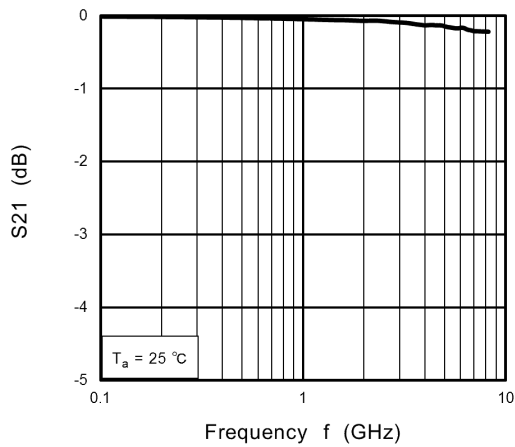
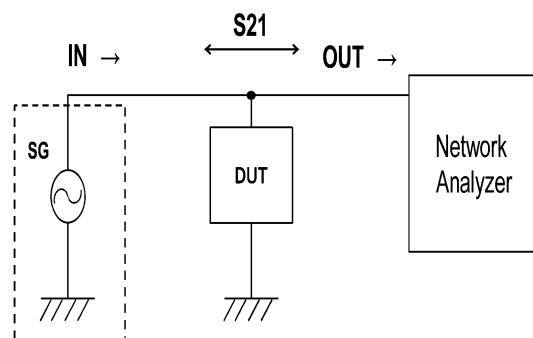
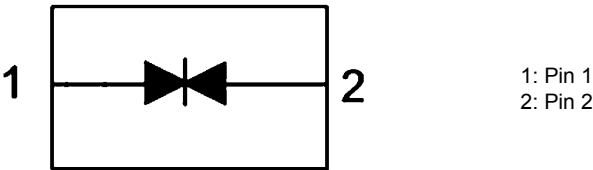


Fig. 9.4 $S_{21} - f$



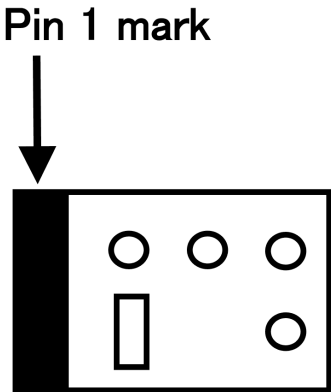
Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

10. Internal Circuit (Note)

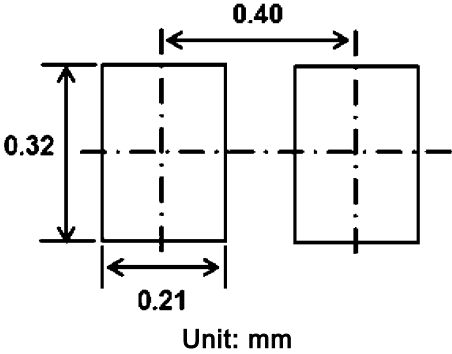


Note: Connect Pin 2 to GND when using Pin 1 for I/O.
Connect Pin 1 to GND when using Pin 2 for I/O.

11. Marking (Top view)

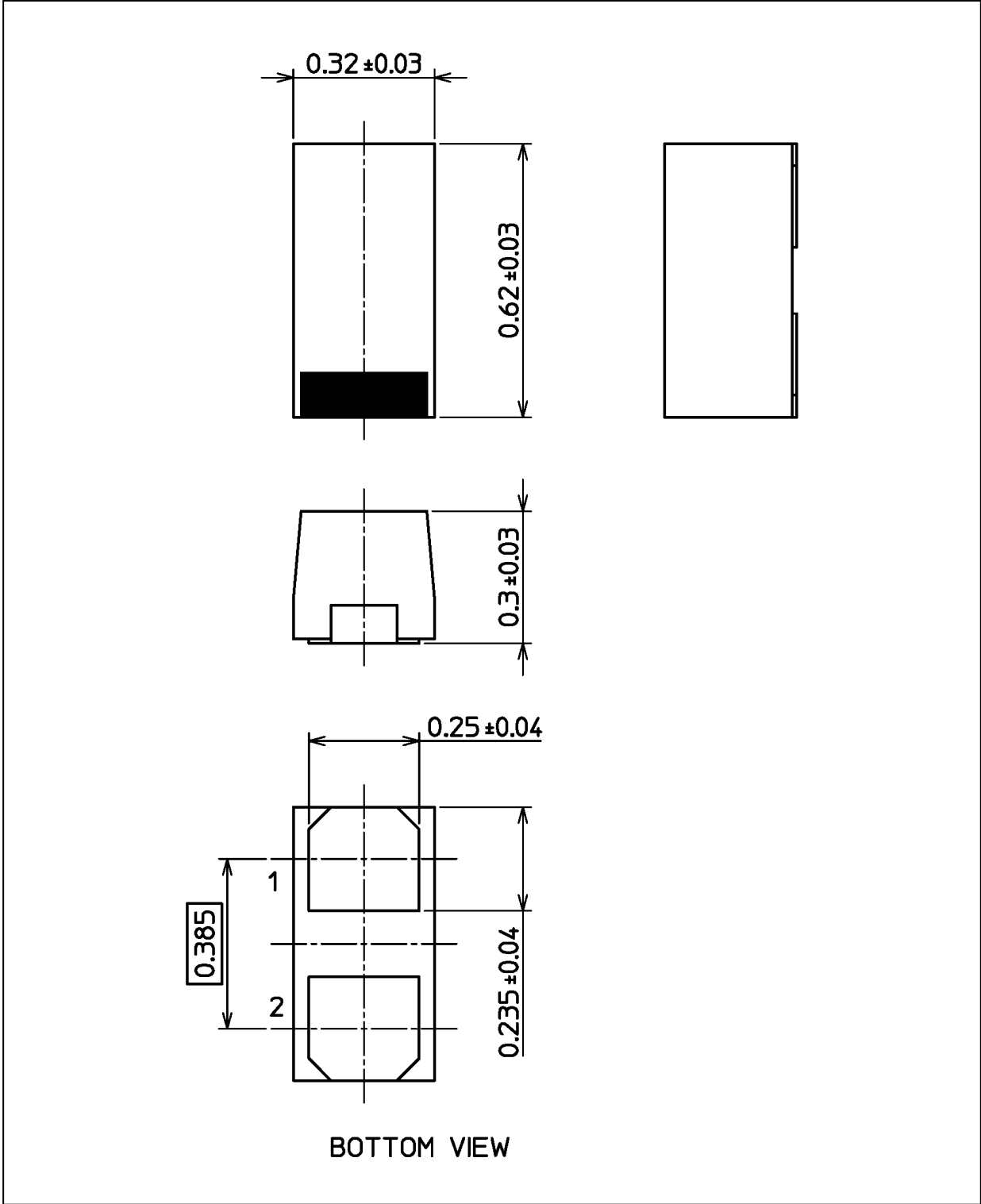


12. Land Pattern Dimensions (for reference only)



Package Dimensions

Unit: mm



Weight: 0.2 mg (typ.)

Package Name(s)
Nickname: SL2

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