# Ultra-Broadband Silicon Capacitor
# UBSC722.410 (1nF / 0201M / BV30V)

Rev 1.5 TD

## General description

**Market:** UBSC Capacitor targets Optical Communication Systems such as ROSA/TOSA, SONET and all optoelectronics as well as High speed data system or products.
The UBSC is suitable for DC blocking, feedback, coupling and bypassing applications in all broadband optoelectronics and High-Speed data systems.
The unique technology of integrated passive device in silicon, developed by Murata(*), offers unique performances with low insertion loss, low reflection and good phase stability up to 60+ GHz.
These Ultra Broad band MOS Silicon Capacitors (UBSC) in silicon have been developed in a semiconductor process, in order to combine ultra-deep trench MOS capacitors for high capacitance value of 1nF (for kHz–MHz range) and MIM capacitors for low capacitance value (for GHz range), both in a SMT 0201M (0.6 x 0.3mm).
The UBSC capacitor provides very high stability of the capacitance value over temperature, voltage variation as well as a very high reliability.

**Assembly:** suitable for flip-chip applications through existing laminated packages or rigid PCB, ceramic substrate, FR4 or flex.
Please refer to our assembly application note for further recommendations.

**Bump finishing**: SAC305 type 6

## Key features

- **Ultra broadband performance**
- **Resonance free**
- **Phase stability**
- **Low Insertion Loss < 0.3dB Typ**
- **Ultra high stability of capacitance value:**
  - Temperature 60ppm/°C (-55 °C to +150 °C)
  - Voltage < 0.1%/Volts
  - Negligible capacitance loss through ageing
- **Low profile:** 140 µm including bump
- **Break down voltage > 30V**
- **Low leakage current**
- **High reliability**
- **High operating temperature** (up to 150 °C)
- **Compatible with high temperature cycling during manufacturing operations** (exceeding 300 °C)
- **Compatible with EIA 0201 footprint**
- **SAC305 40µm bumps after reflow**

## Key applications

- **ROSA/TOSA**
- **SONET**
- **High speed digital logic**
- **Microwave/millimeter system**
- **Volume limited applications**
- **Broadband test equipment**

(*) Murata Integrated Passive Solutions

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## Functional diagram

The next figure provides implementation set-up of the capacitor (2 connections).

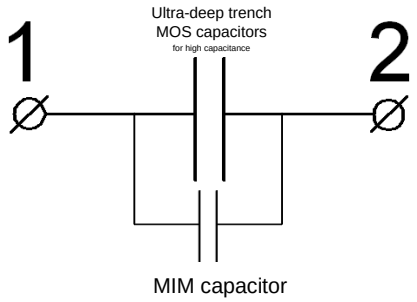



Fig. 1: 1nF/0201M UBSC capacitor block diagram

## Electrical performances

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| C | Capacitance value | @ 25°C | - | 1 | - | nF |
| $\Delta C_P$ | Capacitance tolerance | | -15 | - | +15(*) | % |
| $T_{OP}$ | Operating temperature | | -55 | 20 | 150 | °C |
| $T_{STG}$ | Storage temperature(**) | | -70 | - | 165 | °C |
| $\Delta C_T$ | Capacitance temperature variation | -55 °C to 150 °C | - | 60 | - | ppm/°C |
| BV | Break down voltage | | 30 | - | - | V |
| $RV_{DC}$ | Rated voltage | | - | 10 | 16(***)<br>13.6(****) | $V_{DC}$ |
| $\Delta C_{RVDC}$ | Capacitance voltage variation | From 0 V to $RV_{DC}$ | - | - | 0.1 | $\%/V_{DC}$ |
| IR | Insulation resistor | @ 25°C & $RV_{DC}$ | - | 10 | - | GΩ |
| Fc-3db | Cut-off frequency at 3dB | | - | - | 1600 | KHz |
| IL | Insertion loss | @ 20 GHz | - | 0.2 | - | dB |
| | | @ 40GHz | - | 0.3 | - | dB |
| | | @ 60 GHz | - | 0.3 | - | dB |
| RL | Return loss | Up to 60 GHz | 18 | - | - | dB |

Table 1: 1nF/0201M UBSC capacitor performances

(*) Other capacitance tolerances upon request.

(**) component without packing.

(***) 10 years of intrinsic life time predictions at 100°C

(****) 10 years of intrinsic life time predictions at 150°C

## Module S-parameters of 1nF UBSC in transmission mode

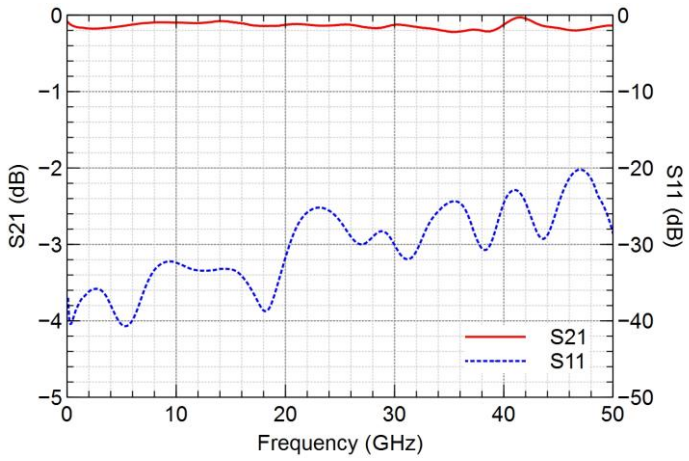
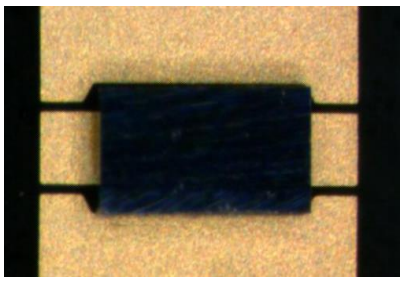
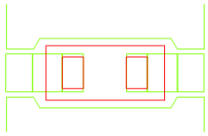



Fig. 2 1nF UBSC measurement results (module of S-parameters)

## Test bench board





Red: Part outline
Green: Fixture outline

10-mil thick Quartz substrate using coplanar waveguide (CPW) environment. The CPW test fixture was designed with a 200um gap between the mounting pads and a 180um wide center trace matched to the capacitor's termination width with access line of 50 Ohm characteristic impedance

Fig. 3 test bench picture used for 1nF UBSC characterization

## Capacitance variation versus DC biasing

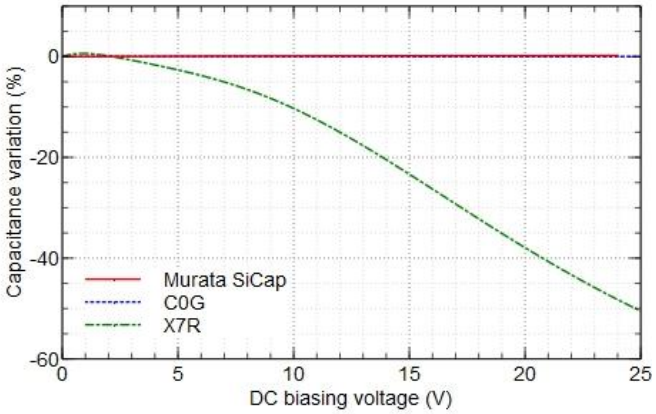



Fig. 4 Capacitance variation versus DC biasing (in function of UBSC and MLCC technology)

## Capacitance variation versus operating temperature

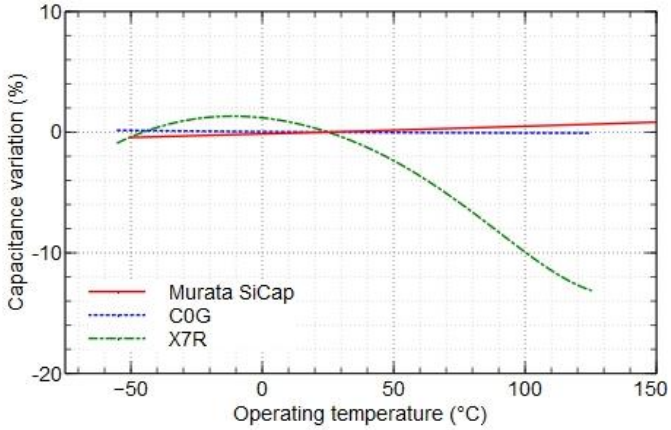



Fig.5 Capacitance variation versus operating temperature (in function of UBSC and MLCC technology)

## Failure Predictions

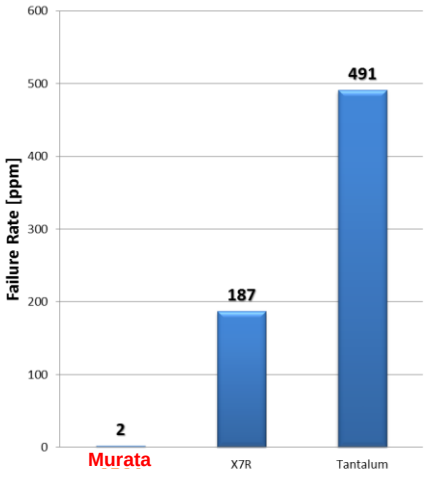



Fig. 6 Projected capacitor Failure Rate in 10 Years at 85°C and 50% of the Rating voltage (in function of UBSC, tantalum and MLCC technology)

## Schematic of 1nF UBSC in transmission mode

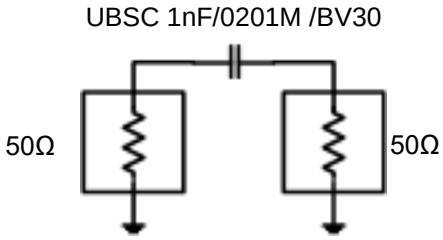



Fig.7 1nF UBSC measurement schematic

## Pinning definition

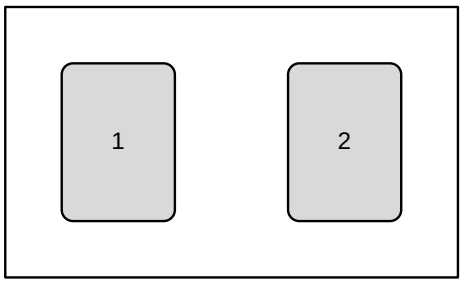



Fig. 8: 1nF Capacitor pin configurations

| pin # | Symbol | Description |
|---|---|---|
| 1 | Signal1 | Signal |
| 2 | Signal2 | Signal |

Table 2: Pin description

## Ordering information

| Type number | Package | | |
|---|---|---|---|
| | P/N | Die name | Description |
| 935 152 722 4510 | UBSC722.410 | - | 1nF / 0201M / BV>30V – 2 pads – 0.6 x 0.3 x 0.14 mm(*) |

Table 3: Die information

(*): Capacitor die dimension: 0.56 x 0.26 mm (without scribe line)

Capacitor die size after sawing: 0.6 x 0.3 mm

Scribe line = 80µm (saw lane currently used = 40µm)

| Type number | Package | | |
|---|---|---|---|
| | Packing | Finishing | Description |
| 935 152 722 410-F1S | 6” film frame carrier | SAC(**) | 0201M - 1nF – 2 pads – 0.6 x 0.3 mm x 0.14mm |

Table 4: Packing ordering information

(**) ENIG+ SAC305 type 6

## Test and Quality inspection

The Murata manufacturing center is certified:

- ISO-9001
- ISO-14001
- ISO-13485
- ISO-TS16949
- OHSAS-18001

Murata is RoHS compliant.

## Mounting conditions

The UBSC Capacitor is compatible with standard reflow technology.
It is recommended to design mirror pads on the PCB.
For further information, please see our mounting application note.

## Pad Metallization

The UBSC Capacitor is delivered as standard with SAC305 bumping.
Other Metallization, such as ENIG, Copper, Thick Gold or Aluminum pads are possible on request.
UBSC series is compatible with standard reflow technology.

## Package outline

The UBSC Capacitor is delivered as a naked die, with bumps.

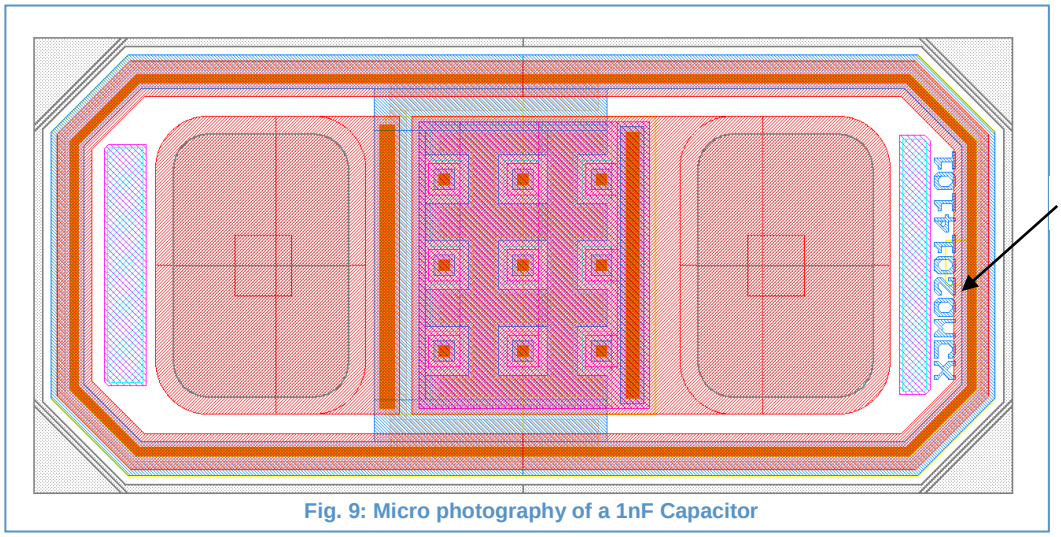
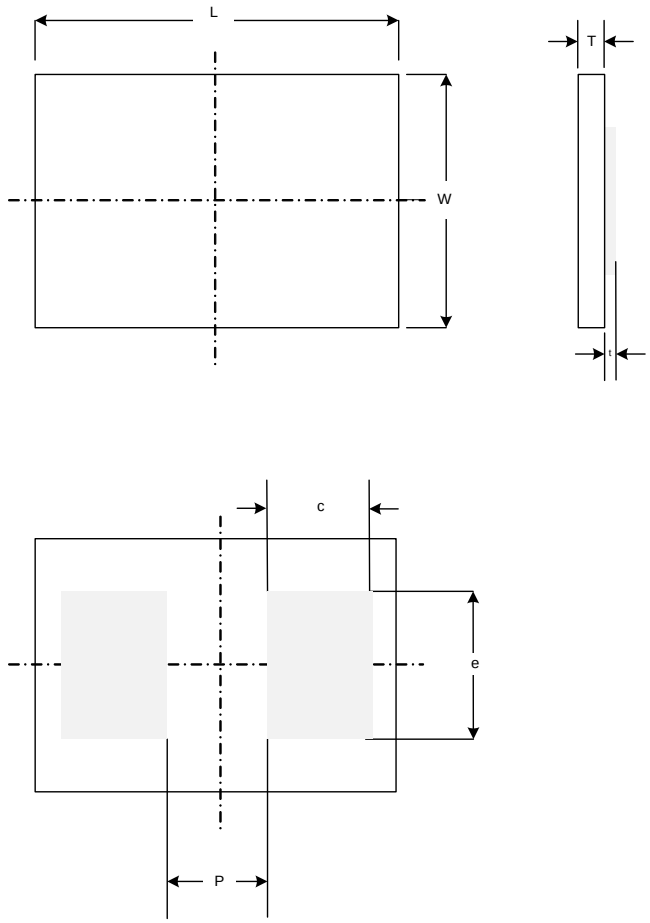



Fig. 9: Micro photography of a 1nF Capacitor




**DIMENSIONS (mm are the original dimensions).**

(*): solder joint height after reflow on board.
Tolerances L and W are ±0.015mm.
Tolerance T is ±0.01mm

| UNIT | L | W | T | c | P | e | t | | |
|---|---|---|---|---|---|---|---|---|---|
| mm | 0.60 | 0.30 | 0.10 | 0.1 | 0.20 | 0.15 | 0.04(*) | | |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | 14-06-24 |

Fig. 10: Package outline 1nF Capacitor

## Assembly consideration

The attachment techniques recommended by Murata for the UBSC/BBSC/ULSC capacitors silicon capacitors on the customers substrates are fully detailed in specific documents available on our website. **To assure the correct use and proper functioning of Murata capacitors please download the assembly instructions on www.ipdia.com/assembly and read them carefully.**


For UBSC/BBSC/ULSC assembly instructions @ 100 & 400 µm, please go to www.ipdia.com/assembly and download the pdf file called **‘‘Murata UBSC, BBSC, ULSC- 100&400µm - NiAu finishing - Assembly by Soldering’.**

## Packing format

**Film frame carrier format definition**: Ref: FF070 (Perfection products)

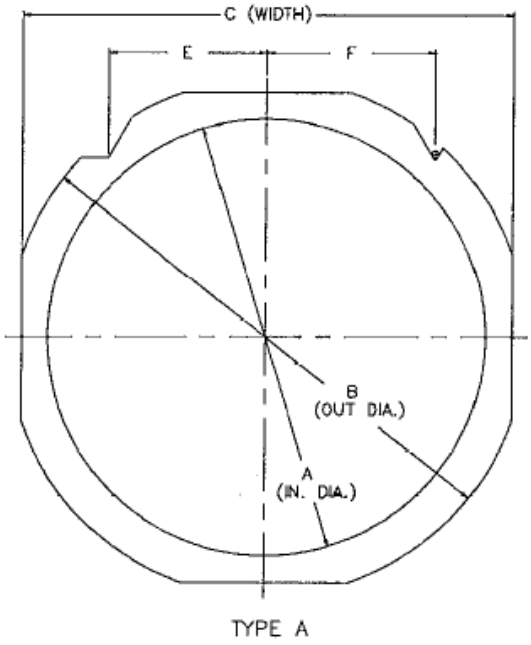



Fig. 11: Dimension of film frame carrier

| Wafer diameter (***) | Frame type | Inside diameter (A) | Outside diameter (B) | Width (C) | Thickness (D) | Pin location (E) | Pin location (F) | Frame style | Weight(lbs) (stainless) |
|---|---|---|---|---|---|---|---|---|---|
| 6.0” (150mm) | Type A | 7.639” | 8.976” | 8.346” | 0.048 | 2.370” | 2.500” | DTF-2-6-1 | 0.21 |

(***) other size and type on request.

Table 5: Details of film frame carrier

## *Definitions*

| **Data sheet status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

## Revision history

| Revision | Date | Description | Author |
|---|---|---|---|
| **Release 1.0** | **2016 June 28th** | **Objective specification** | **OGA** |
| **Release 1.1** | **2016 Sept 22nd** | **Preliminary specification** | **LLR/NNO** |
| **Release 1.2** | **2016 Sept 29th** | **Packing update** | **OGA** |
| **Release 1.3** | **2017 March 27th** | **Packing update** | **OGA** |
| **Release 1.4** | **2017 April 4th** | **Murata version** | **OGA** |
| **Release 1.5** | **2017 June 9th** | **Rated voltage update** | **OGA** |
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## *Life Support Applications*

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Murata customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Murata for any damages resulting from such improper use or sale.