

# Ultra-Broadband Silicon Capacitor UBSC 0402 100nF BV11



Rev. 3.00

## General description

UBSC Capacitor targets Optical communication system 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 system.

The unique technology of integrated passive device in silicon, developed by Murata Integrated Passive Solutions, offers unique performances with low insertion loss, low reflection and phase stability from 16 KHz to 60 GHz+.

These capacitors in ultra-deep trenches in silicon have been developed in a semiconductor process, in order to integrate trench MOS capacitor providing high capacitance value of 100nF (for kHz–MHz range) and high frequency MIM capacitors for low capacitance value for GHz range), combined in a 0402 [1.2x0.7mm] case.

The UBSC capacitor provides very high stability of the capacitance over temperature, voltage variation as well as a very high reliability.

UBSC capacitors have an extended operating temperature ranging from -55 to 150°C, with very low capacitance change over temperature (+70ppm/K).

**Assembly:** Suitable for surface mounted application on rigid PCB, ceramic substrate, FR4 (lamine) or flex platforms.

**Bump finishing:** ENIG

Copper pads optional for embedding version and SAC305 type 6 for pre-bumping version, as an optional finishing.

## Key features

- Ultra-Large band performance up to 67 GHz
- Resonance free
- Phase stability
- Insertion low < 0.3dB Typ. up to 60 GHz
- Ultra-high stability of capacitance value:
  - Temperature 70ppm/K (-55 °C to +150 °C)
  - Voltage < -0.1%/Volt
  - Negligible capacitance loss through ageing
- Low profile: 400µm, 100 µm on request
- Break down voltage : 11V
- Low leakage current < 100pA
- High reliability
- High operating temperature (up to 150 °C)
- Compatible with high temperature cycling during manufacturing operations (exceeding 300 °C)
- Compatible with EIA 0402 footprint

## Key applications

- ROSA/TOSA
- SONET
- High speed digital logic
- Microwave/millimetre system
- High volumetric efficiency (i.e. capacitance per unit volume)
- Broadband test equipment

## Functional diagram

The next figure provides implementation set-up diagram.



Figure 1 Block Diagram

## Electrical performances

| Symbol            | Parameter                            | Conditions                               | Min. | Typ. | Max.                                     | Unit              |
|-------------------|--------------------------------------|--|------|------|--|-------------------|
| C                 | Capacitance value                    | @+25°C                                   | -    | 100  | -  | nF                |
| $\Delta C_P$      | Capacitance tolerance <sup>(1)</sup> | @+25°C                                   | -15  | -    | +15                                      | %                 |
| T <sub>OP</sub>   | Operating temperature                |  | -55  | 20   | 150                                      | °C                |
| T <sub>STG</sub>  | Storage temperature <sup>(2)</sup>   |  | -70  | -    | 165                                      | °C                |
| $\Delta C_T$      | Capacitance temperature variation    | -55 °C to 150 °C                         | -    | 70   | -  | ppm/K             |
| RV <sub>DC</sub>  | Rated voltage <sup>(3)</sup>         |  | -    | -    | 3.8 <sup>(4)</sup><br>3.4 <sup>(5)</sup> | V <sub>DC</sub>   |
| BV                | Break down voltage                   | @+25°C                                   | 11   | -    | -  | V                 |
| $\Delta C_{RVDC}$ | Capacitance voltage variation        | From 0 V to RV <sub>DC</sub> ,<br>@+25°C | -    | -    | -0.1                                     | %/V <sub>DC</sub> |
| IR                | Insulation resistor                  | @RV <sub>DC</sub> , +25°C, 120s          | -    | 10   | -  | GΩ                |
| ESL               | Equivalent Serial Inductance         | @+25°C, SRF shunt mode                   | -    | 180  | -  | pH                |
| ESR               | Equivalent Serial Resistance         | @+25°C, shunt mode                       | -    | 400  | -  | mOhm              |
| Fc-3dB            | Cut-off frequency at 3dB             | @+25°C                                   | -    | 16   | 19                                       | kHz               |
| IL                | Insertion loss                       | @ 20 GHz, +25°C                          | -    | 0.2  | -  | dB                |
|                   |                                      | @ 40 GHz, +25°C                          | -    | 0.4  | -  | dB                |
|                   |                                      | @ 60 GHz, +25°C                          | -    | 0.8  | -  | dB                |
| RL                | Return loss                          | Up to 60 GHz, +25°C                      | 14   | -    | -  | dB                |
| ESD               | HBM stress <sup>(6)</sup>            | JS-001-2017                              | 2    | -    | -  | kV                |

Table 1 - Electrical performances

<sup>(1)</sup>: other tolerance available upon request.

<sup>(2)</sup>: without packaging.

<sup>(3)</sup>: Lifetime is voltage and temperature dependent, please refer to application note 'Lifetime of 3D capacitors'.

<sup>(4)</sup>: 10 years of intrinsic life time prediction at 100°C continuous operation.

<sup>(5)</sup>: 10 years of intrinsic life time prediction at 150°C continuous operation.

<sup>(6)</sup>: please refer to application note 'ESD Challenge in 3D Murata Integrated Passive technology'.

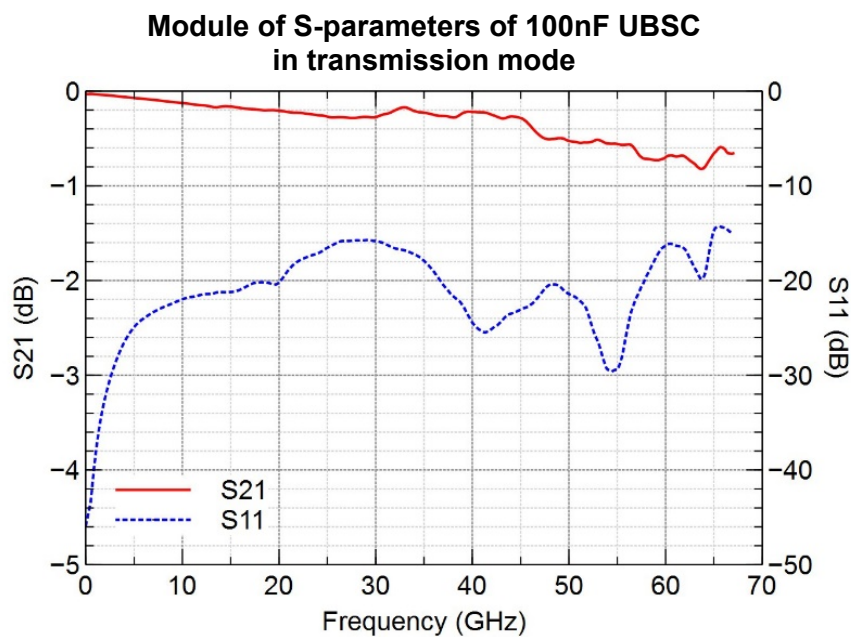
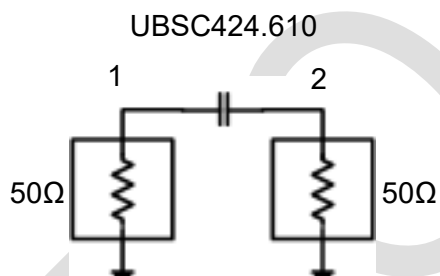


Figure 2 - 100nF UBSC Measured results  
(module of S-parameters)

#### Schematic of 100nF UBSC in transmission mode



#### 10-mil Rogers 4350B.

Microstrip mode – line width = 0.551mm and gap = 0.246 mm.  
(nominal 50 ohm characteristic impedance).

Figure 3 - 100nF UBSC measurement schematic

#### Example of 0402 surface mounted

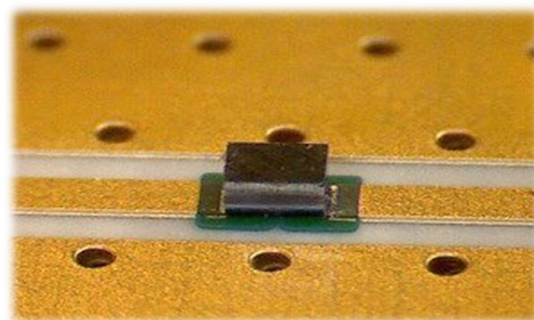


Figure 4 – micro picture of UBSC mounted on board  
in coplanar mode



## Pinning definition

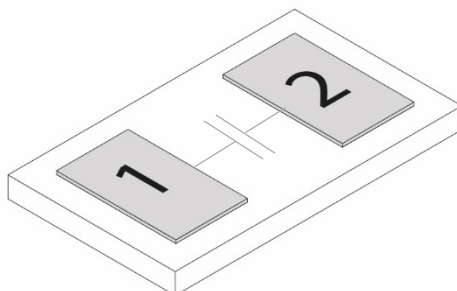


Figure 5 Pinning definition

| pin # | Symbol | Coordinates X / Y |
|-------|--------|-------------------|
| 1     | Signal | -350.0 / 0.0      |
| 2     | Signal | 350.0 / 0.0       |

Table 2 - Pinning description. Reference (0,0) located at the centre of the die.

## Ordering Information

Murata Integrated Passive Devices delivers products with AQL level II (0.65). Tighter quality levels are available upon request.

| Part number      | Package                              |                     |  |
|------------------|--------------------------------------|---------------------|--|
|                  | Packaging                            | Finishing           | Description  |
| 935151424610-F1N | 6" film frame carrier <sup>(1)</sup> | ENIG <sup>(2)</sup> | UBSC 0402 - 100nF – 2 pads – 1.2 x 0.7mm x 0.40mm <sup>(4)</sup> |
| 935151424610-T3N | T&R 1 000units <sup>(3)</sup>        | ENIG <sup>(2)</sup> | UBSC 0402 - 100nF – 2 pads – 1.2 x 0.7mm x 0.40mm <sup>(4)</sup> |
| 935152424610-F1N | 6" film frame carrier <sup>(1)</sup> | ENIG <sup>(2)</sup> | UBSC 0402 - 100nF – 2 pads – 1.2 x 0.7mm x 0.10mm <sup>(4)</sup> |
| 935152424610-T3N | T&R 1 000units <sup>(3)</sup>        | ENIG <sup>(2)</sup> | UBSC 0402 – 100nF – 2 pads – 1.2 x 0.7mm x 0.1mm <sup>(4)</sup>  |

Table 3 - Packaging and ordering information

- (1) Other film frame carriers are possible on request  
 (2) ENIG : 0.1µm Au / 5µm Ni  
 (3) missing capacitors can reach 0.5%  
 (4) refer to figure 7

| Product Name | Die Name  | Description  |
|--------------|-----------|--|
| UBSC424.610  | XC0402610 | UBSC 100nF / 0402 / BV11 – 2 pads – 1.2 x 0.7 x 0.40mm |
| UBSC424.610  | XC0402610 | UBSC 100nF / 0402 / BV11 – 2 pads – 1.2 x 0.7 x 0.10mm |

Table 4 - Die information

### Pad Metallization

This surface mounted Silicon Capacitor is delivered as standard with NiAu (ENIG (0.1 $\mu$ m Au / 5 $\mu$ m Ni)).

Other Metallization, such as Copper, Thick Gold or Aluminum pads are possible on request.

Silicon dies are not sensitive to humidity, please refer to applications notes 'Assembly Notes' section 'Handling precautions and storage'.

### Material regulation

This product is RoHS compliant at the time of publication. For further information about regulation compliancy, please ask your sales representative.

### Package outline

The product is delivered as a bare silicon die.

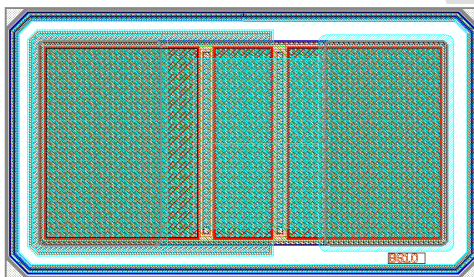


Figure 6 – Layout view

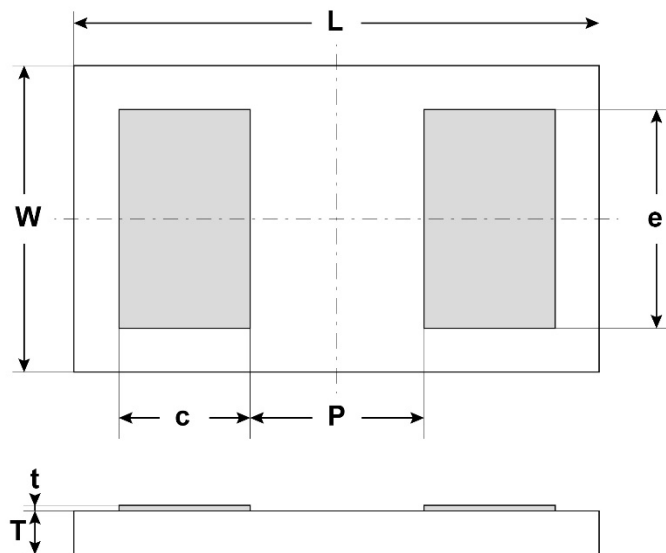


Figure 7 - Package isometric view

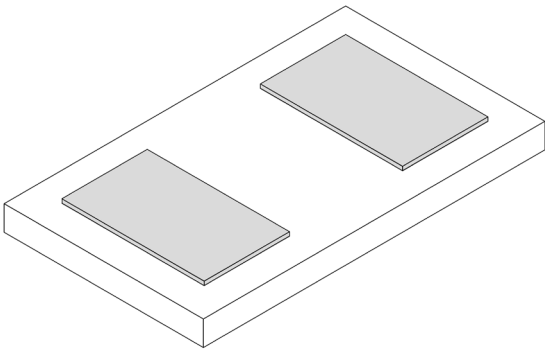


Figure 8 - Package isometric view

| L (mm)     | W (mm)     | T (mm)             | c (mm) | p (mm) | e (mm) | t (mm)               |
|------------|------------|--------------------|--------|--------|--------|----------------------|
| 1.20 ±0.04 | 0.70 ±0.04 | 0.40 or 0.10 ±0.01 | 0.30   | 0.40   | 0.50   | 0.005 <sup>(1)</sup> |

Table 5 - Dimensions and tolerances

(1) Standard with ENIG

Assembly

The attachment techniques recommended by Murata on the customer’s 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 <https://www.murata.com/en-us/products/capacitor/siliconcapacitors> and read them carefully.**



Figure 9 Scan this QR Code to access the Murata Silicon Capacitor web page



## Packaging format

Please refer to application note 'Products Storage Conditions and Shelf Life'.

## Tape and Reel:

Dies are flipped in the tape cavity (bump down) with die ID located near the driving holes of the tape.

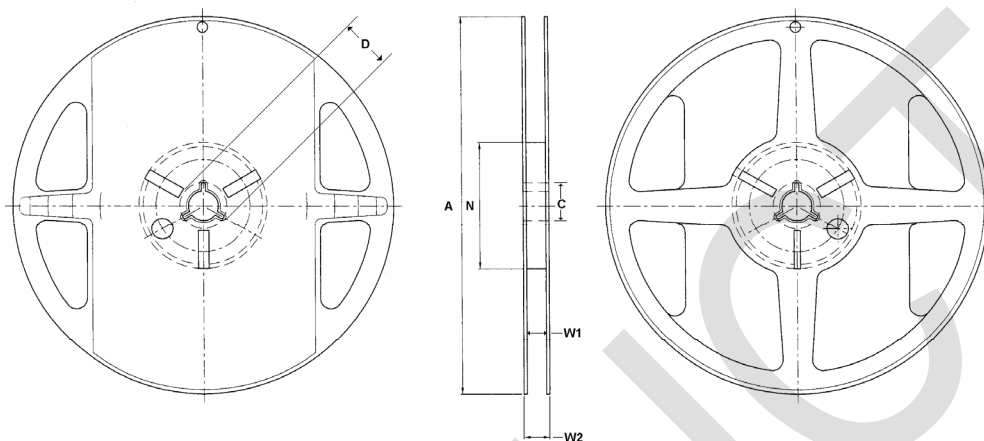


Figure 10 - Reel drawing

| Tape Width | Diameter A        | C    | D    | Hub N | W1  | W2   |
|------------|-------------------|------|------|-------|-----|------|
| 8          | 178<br>(7 inches) | 13.5 | 20.2 | 60    | 9.3 | 11.5 |

Table 6 – Reel dimensions (mm)

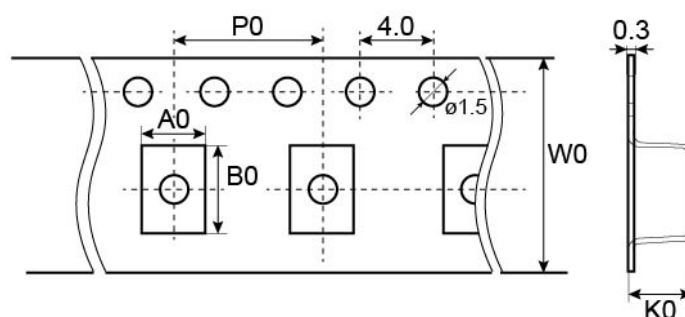


Figure 11 - Tape drawing

| Cavity dimensions |      |      | Carrier tape width W0 | Carrier tape pitch P0 | Reel Capacity |
|-------------------|------|------|-----------------------|-----------------------|---------------|
| Ao                | Bo   | Ko   |                       |                       |               |
| 0.92              | 1.31 | 0.56 | 8                     | 4                     | 1 000         |

Table 7 - Tape dimensions (mm)



**Film Frame Carrier:**

With UV curable dicing tape (UV performed).

Good dies are identified using the SINF electronic mapping format. No ink is added on wafer to label other dies.

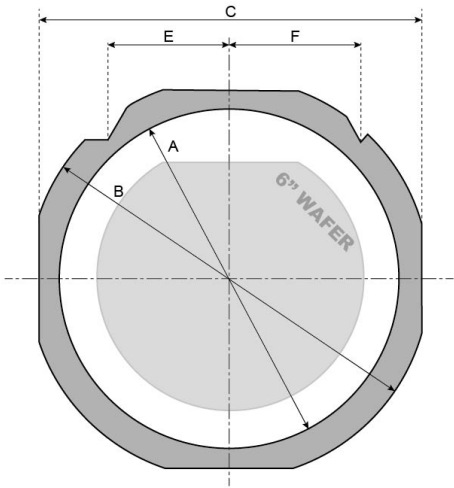


Figure 12 FF070 Frame with a 6 inch wafer

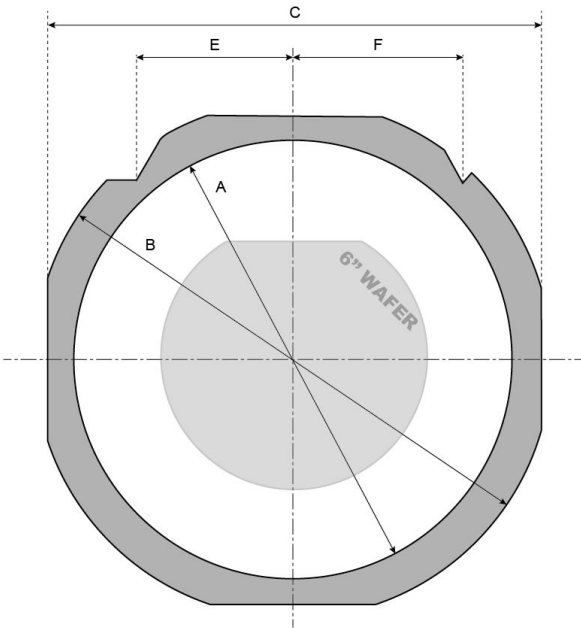


Figure 13 FF108 Frame with a 6 inch wafer

| Frame Reference | Frame Style | Inside diameter A | Outside diameter B | Width C | Thickness | Pin location E | Pin location F |
|-----------------|-------------|-------------------|--------------------|---------|-----------|----------------|----------------|
| FF070 (1)       | DTF-2-6-1   | 7.638"            | 8.976"             | 8.346"  | 0.048"    | 2.370"         | 2.5"           |
| FF108 (1)       | DTF-2-8-1   | 9.842"            | 11.653"            | 10.866" | 0.048"    | 2.381"         | 2.5"           |

Table 8 - Frame dimensions (inches)

(1) or equivalent





**Expander grip ring 6" diameter:**

With UV curable dicing tape (UV performed)

Good dies are identified using the SINF electronic mapping format. No ink is added on wafer to label other dies.

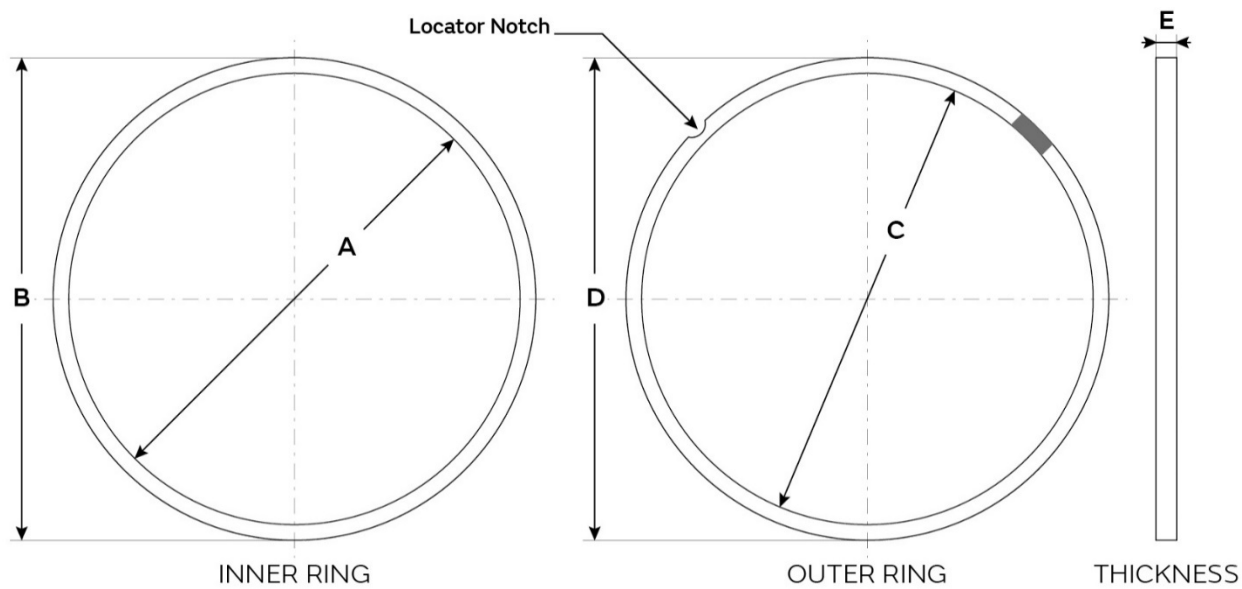


Figure 14 – Grip Ring drawing

| Grip Ring Style           | A      | B      | C      | D      | E      | Locator Notch |
|---------------------------|--------|--------|--------|--------|--------|---------------|
| GRP-2620-6 <sup>(1)</sup> | 7.670" | 7.973" | 7.975" | 8.280" | 0.236" | None          |

Table 9 - Frame dimensions (inches)

(1) or equivalent

PRO

## 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

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 Electrical performances 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 1.00 | 2014 February 18 <sup>th</sup> | Objective specification           | LDU                             |
| Release 2.02 | 2020 June 17 <sup>th</sup>     | Template Change – content changes | OGA                             |
| Release 3.00 | 2021 May 06 <sup>th</sup>      | Product revision                  | CGU, LLR, DDE,<br>SCA, DYO, OGA |

## Disclaimer / Life support applications

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