

# Ultra-Large band Silicon Capacitor ULSC 0201 47nF BV11



Rev. 3.07

## General description

ULSC Capacitor targets Optical communication system such as ROSA/TOSA, SONET and all optoelectronics as well as High speed data system or products.

The ULSC 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 34 KHz to 28 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 47 nF (for kHz–MHz range) and high frequency MIM capacitors for low capacitance value for GHz range), combined in a 0201 [0.8x0.6mm] case.

ULSC capacitors have an extended operating temperature ranging from -55 to 150°C, with very low capacitance change over temperature, well as a very high reliability.

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

**Bump finishing:** SAC305 type 6.

Copper pads optional for embedding version and ENIG for un-bumped version, as an optional finishing.

## Key features

- Ultra-Large band performance up to 28 GHz
- Resonance free
- Phase stability
- Insertion low < 0.2dB Typ. up to 28 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
- 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

## 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	-	47	-	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> 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> , @+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	-	20	-	pH
ESR	Equivalent Serial Resistance	@+25°C, shunt mode	-	220	-	mOhm
F <sub>C-3dB</sub>	Cut-off frequency at 3dB	@+25°C	-	34	40	kHz
IL	Insertion loss	@ 28 GHz, +25°C	-	0.2	-	dB
RL	Return loss	Up to 28 GHz, +25°C	26	-	-	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 lifetime prediction at 100°C continuous operation.

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

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

## Module of S-parameters of 47nF ULSC in transmission mode

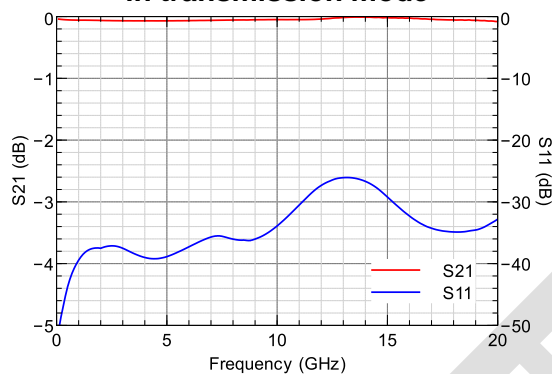
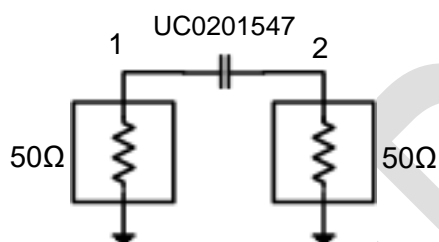


Figure 2 - 47nF ULSC Measured results (module of S-parameters)

## Schematic of 47nF ULSC in transmission mode



### 6.6-mil Rogers 4350B.

Microstrip mode – line width = 0.400mm and gap = 0.300 mm. (nominal 50-ohm characteristic impedance).

Figure 3 - 47nF ULSC measurement schematic

## Example of 0201 surface mounted

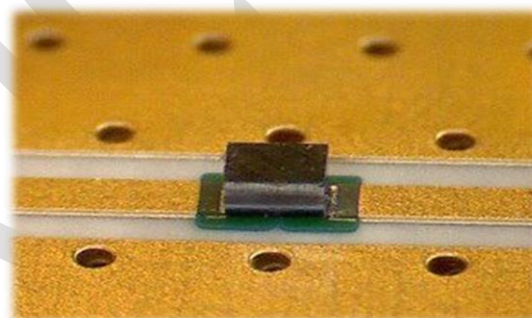


Figure 4 – micro picture of ULSC mounted on board in coplanar mode

## Pinning definition

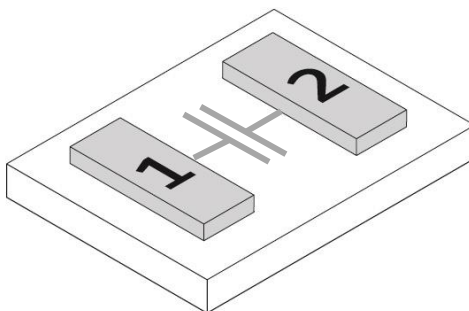


Figure 5 Pin configuration

pin #	Symbol	Coordinates X / Y
1	Signal	-225.0 / 0.0
2	Signal	225.0 / 0.0

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

## Ordering Information for ULSC493.547

Regardless of packaging, Murata Integrated Passive Devices delivers products with AQL level II (0.65).

Type number	Package		
	Packaging <sup>(1)</sup>	Finishing	Description
935155493547-T3N	7" T&R (1 000 pieces/reel) <sup>(3) (5)</sup>	ENIG <sup>(2)</sup>	ULSC 0201 - 47nF – 2 pads – 0.8 x 0.6 mm x 0.40mm <sup>(4)</sup>
935156493547-T3N	7" T&R (1 000 pieces/reel) <sup>(3) (5)</sup>	ENIG <sup>(2)</sup>	ULSC 0201 - 47nF – 2 pads – 0.8 x 0.6 mm x 0.10mm <sup>(4)</sup>
935156493547-T5N	7" T&R (5 000 pieces/reel) <sup>(3) (6)</sup>	ENIG <sup>(2)</sup>	ULSC 0201 - 47nF – 2 pads – 0.8 x 0.6 mm x 0.10mm <sup>(4)</sup>
935155493547-T3S	7" T&R (1 000 pieces/reel) <sup>(3) (5)</sup>	SAC <sup>(2)</sup>	ULSC 0201 - 47nF – 2 pads – 0.8 x 0.6 mm x 0.40mm <sup>(4)</sup>
935156493547-T3S	7" T&R (1 000 pieces/reel) <sup>(3) (5)</sup>	SAC <sup>(2)</sup>	ULSC 0201 - 47nF – 2 pads – 0.8 x 0.6 mm x 0.10mm <sup>(4)</sup>
935156493547-T5S	7" T&R (5 000 pieces/reel) <sup>(3) (6)</sup>	SAC <sup>(2)</sup>	ULSC 0201 - 47nF – 2 pads – 0.8 x 0.6 mm x 0.10mm <sup>(4)</sup>

(1) Other Film Frame Carrier are possible on request

(2) SAC = ENIG (0.1µm Au / 5µm Ni) + SAC305 type 6

or ENIG 0.1µm Au / 5µm Ni

(3) Missing capacitors can reach 0.5%

(4) Refer to **Erreur ! Source du renvoi introuvable.**

(5) Dedicated for Pre-Production

(6) For all demands including Mass Production

Table 3 - Packaging and ordering information

Product Name	Die Name	Description
ULSC493.547	UC0201547	ULSC 47nF/0201/BV11 – 2 pads – 0.8 x 0.6 mm x 0.40mm
ULSC493.547	UC0201547	ULSC 47nF/0201/BV11 – 2 pads – 0.8 x 0.6 mm x 0.10mm

Table 4 - Die information

## Pad Metallization

This surface mounted Silicon Capacitor is delivered as standard with SAC305 type 6 bumping (Refer to Figure 6). Other Metallization, such as ENIG (0.1µm Au / 5µm Ni) (Refer to Figure 7), Copper, Thick Gold or Aluminium pads are possible on request.

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

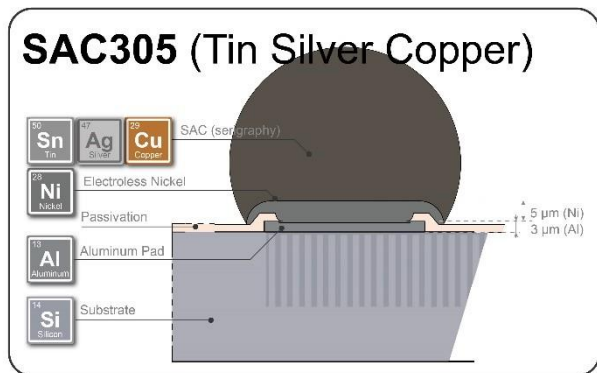


Figure 6 – Top electrode description of SAC305 pre-bumped version

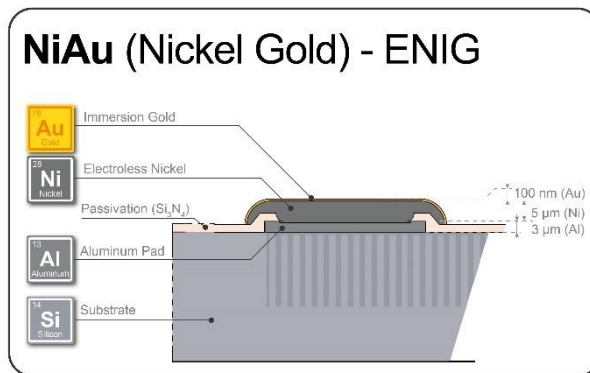


Figure 7 – Top electrode description of ENIG finishing version

## 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.

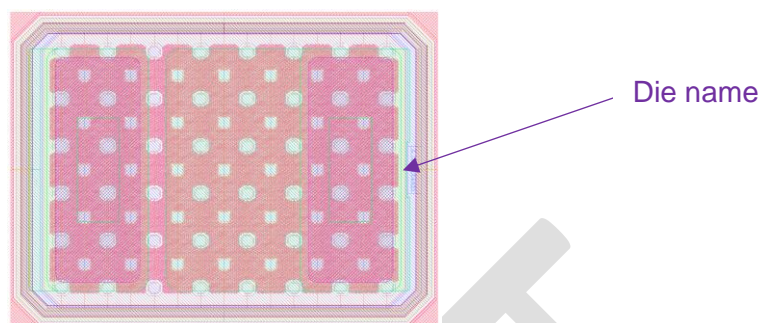


Figure 8 – Layout view

	L (mm)	W (mm)	T (mm)	c (mm)	p (mm)	e (mm)	t (mm)
Component dimension	0.80 $\pm 0.02$	0.60 $\pm 0.02$	0.41 max or 0.11 max	0.15	0.30	0.40	0.005 <sup>(1)</sup> or 0.04 <sup>(2)</sup> 0.065 <sup>(3)</sup>
Landing pad recommendation	/	/	/	0.164 min	0.286 max	0.414 min	/

(1) Standard with ENIG

(2) Solder joint height after reflow on board in case of SAC305 pre-bumping.

(3) Solder bump height before assembly

Table 5 - Dimensions and tolerances

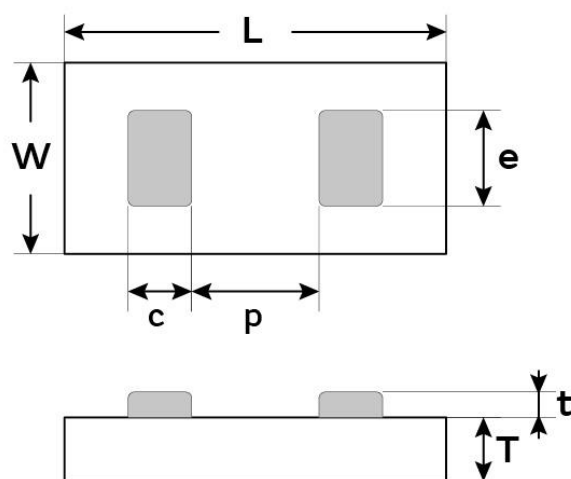


Figure 9 - Package outline drawing

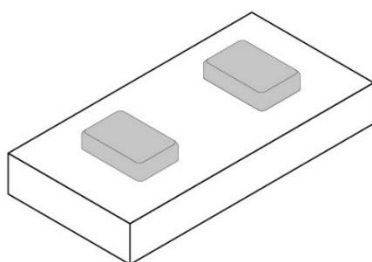


Figure 10 - Package isometric view

PRODUCT



## Assembly

ULSC series 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.

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 11 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.

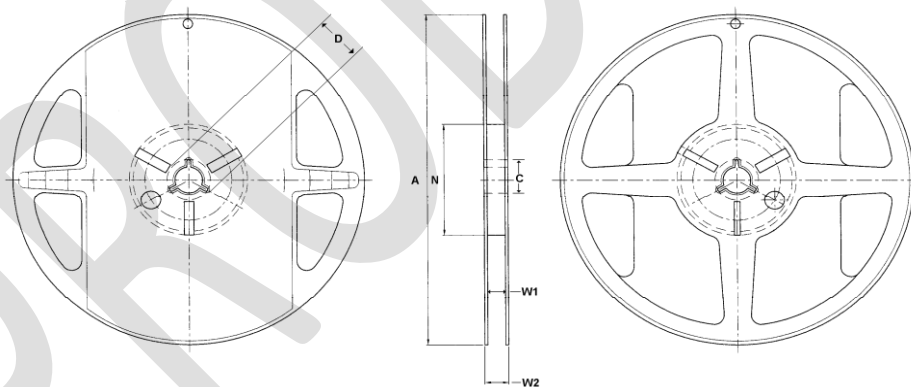


Figure 12 - Reel drawing

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

Table 6 - Reel dimensions (mm)



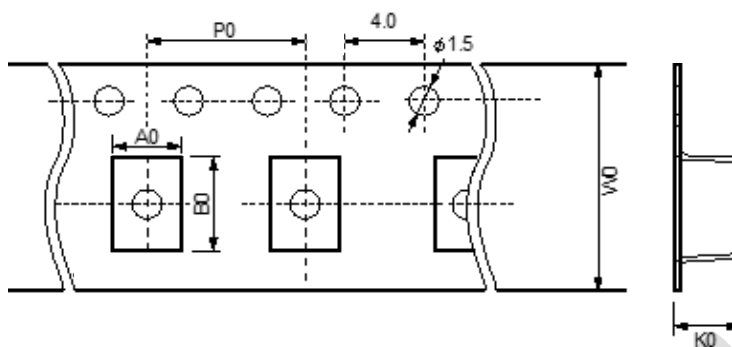


Figure 13 – Tape drawing (not to scale)

Cavity dimensions			Carrier tape width W0	Carrier tape pitch P0	Quantity per reel	Die thickness
A0	B0	K0				T(mm)
0.76	0.96	0.22	8	2	1 000	100μm
tbd	tbd	tbd	8	2	5 000	100μm
0.74	0.94	0.57	8	4	1 000	400μm

Table 7 - Tape dimensions (mm)

## 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	2016 November 07th	Objective specification	OGA
Release 1.05	2021 March 16th	Minor update	OGA
Release 2.00	2021 April 21th	Minor update	OGA
Release 3.00	2021 June 25th	Product release	OGA, LLR, CGU, SCA, DDE,DYO,SYO
Release 3.01	2022 Jan 25th	Typo on the reference	OGA
Release 3.02	2022 Feb 16th	Typo on the thickness tolerance + PN with 5Kpcs / reel	OGA
Release 3.03	2023 May 10th	Bump cross section adding	OGA
Release 3.04	2023 July 06th	Typo update	OGA
Release 3.06	2023 Sept 20th	Extension of max. frequency guaranteed	OGA
Release 3.07	2025 March 15th	Complementary land pattern information	DYE / MOK / OGA

## Disclaimer / Life support applications

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