



# Ultra-Broadband Silicon Capacitor UBSC492.510 (10nF / 0201M / BV=11V)

Rev 2.5

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<sup>(\*)</sup>, 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 10nF (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.

UBSC capacitors have an extended operating temperature ranging from -55 to 150°C, with very low capacitance change over temperature (+/-0.5%).

**Assembly:** flip chip applications through existing laminated packages or rigid PCB, ceramic substrate, FR4 or flex platforms suitable.

Please refer to our assembly application note for further recommendations.

**Bump finishing:** SAC305 type 6

## Key features

- Ultra broadband performance to 67GHz
- Resonance free
- Phase stability
- Insertion loss < 0.4dB 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 height
- 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
- SAC305 40µm bumps after reflow

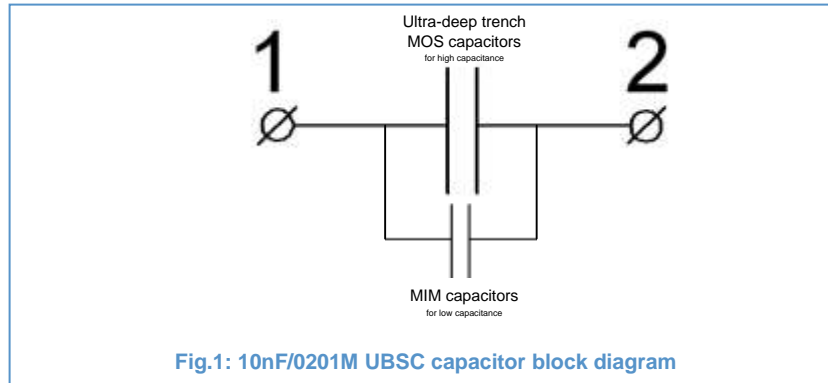
## Key applications

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

(\*) Murata Integrated Passive Solutions

## Functional diagram

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



## Electrical performances

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
C	Capacitance value	@ 25°C	-	10	-	nF
$\Delta C_P$	Capacitance tolerance		-15	-	+15 <sup>(*)</sup>	%
T <sub>OP</sub>	Operating temperature		-55	20	150	°C
T <sub>STG</sub>	Storage temperature <sup>(**)</sup>		-70	-	165	°C
$\Delta C_T$	Capacitance temperature variation	-55 °C to 150 °C	-	60	-	ppm/°C
BV	Break down voltage	@ 25°C	11	-	-	V
RV <sub>DC</sub>	Rated voltage		-	-	4.7 <sup>(3*)</sup> 3.8 <sup>(4*)</sup> 3.4 <sup>(5*)</sup>	V <sub>DC</sub>
$\Delta C_{RVDC}$	Capacitance voltage variation	From 0 V to RV <sub>DC</sub>	-	-	0.1	%/V <sub>DC</sub>
IR	Insulation resistor	@ 25°C & RV <sub>DC</sub>	-	10	-	GΩ
ESL	Equivalent Serial Inductance	@ 1GHz	-	50	100	pH
ESR	Equivalent Serial Resistance		-	100	300	mOhm
F <sub>c-3db</sub>	Cut-off frequency at 3dB		-	-	160	kHz
IL	Insertion loss	@ 20 GHz	-	-	0.2	dB
		@ 40GHz	-	-	0.3	dB
		@ 60 GHz	-	-	0.4	dB
RL	Return loss	Up to 60 GHz	24	-	-	dB

**Table 1: 10nF/0201M UBSC capacitor performances**

(\*) Other capacitance tolerances upon request.

(\*\*) only valid for components without packing

(3\*) : 2 years of intrinsic life time predictions at 85°C

(4\*) : 10 years of intrinsic life time predictions at 100°C

(5\*) : 10 years of intrinsic life time predictions at 150°C

## Module S-parameters of 10nF UBSC in transmission mode

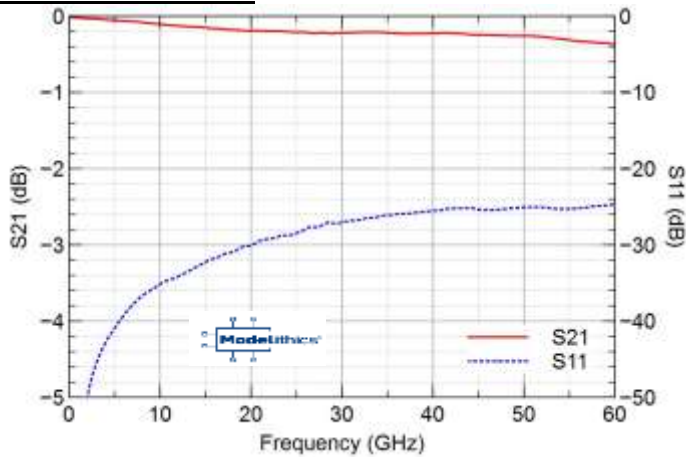
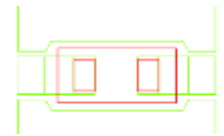
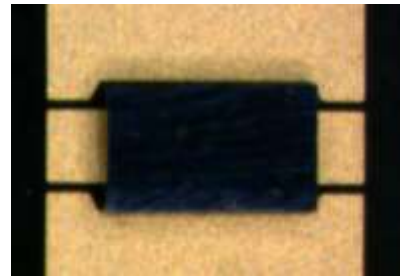


Fig. 2 10nF UBSC measurement results (module of S-parameters)

## 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 10nF UBSC characterization

## Capacitance variation versus DC biasing

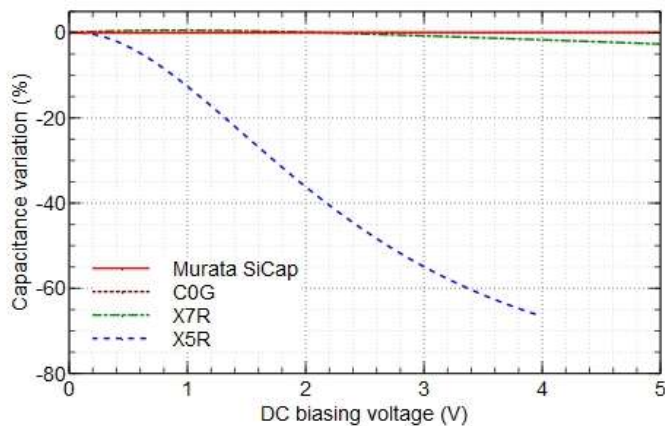


Fig. 4 Capacitance variation versus DC biasing (in function of UBSC and MLCC technology)

## Capacitance variation versus operating temperature

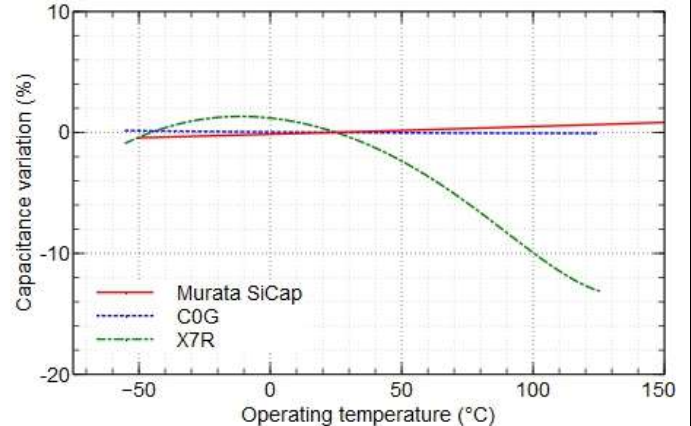


Fig.5 Capacitance variation versus operating temperature (in function of UBSC and MLCC technology)

## Failure Predictions

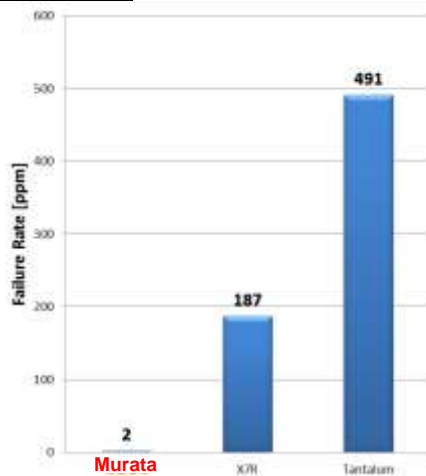


Fig. 6 Projected capacitor Failure Rate in 10 Years at 85°C and 50% of the Rating voltage (in function of UBSC, tantalum and MLCC technology)

## Schematic of 10nF UBSC in transmission mode

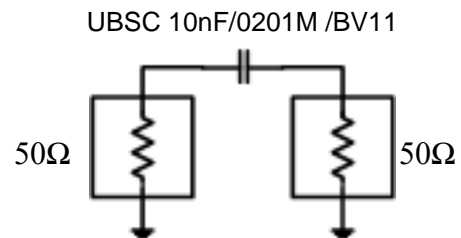
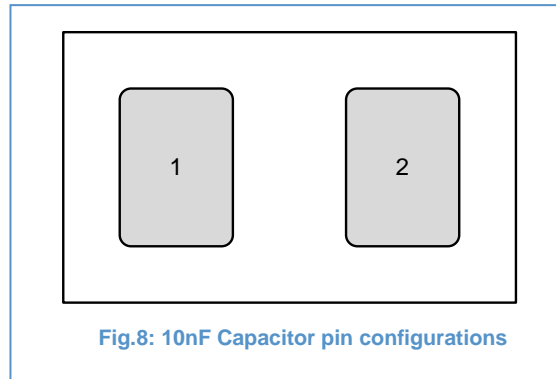


Fig.7 10nF UBSC measurement schematic

FREE S-Parameters-Based Linear Simulation Models for ADS  
<http://www.modelithics.com/mvplpdia.asp>

## Pinning definition



pin #	Symbol	Description
1	Signal1	Signal
2	Signal2	Signal

Table 2: Pin description

## Ordering information

Type number	Package		
	P/N	Die name	Description
935 152 492 510	UBSC492.510	-	10nF / 0201M / BV>11V – 2 pads – 0.6 x 0.3 x 0.14mm <sup>(*)</sup>

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
935 152 492 510-F1S	6" film frame carrier	SAC(**)	0201M - 10nF – 2 pads – 0.6 x 0.3 mm x 0.14mm
935 152 492 510-T3S	7" T&R (1 000 pieces/reel)	SAC(**)	0201M - 10nF – 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

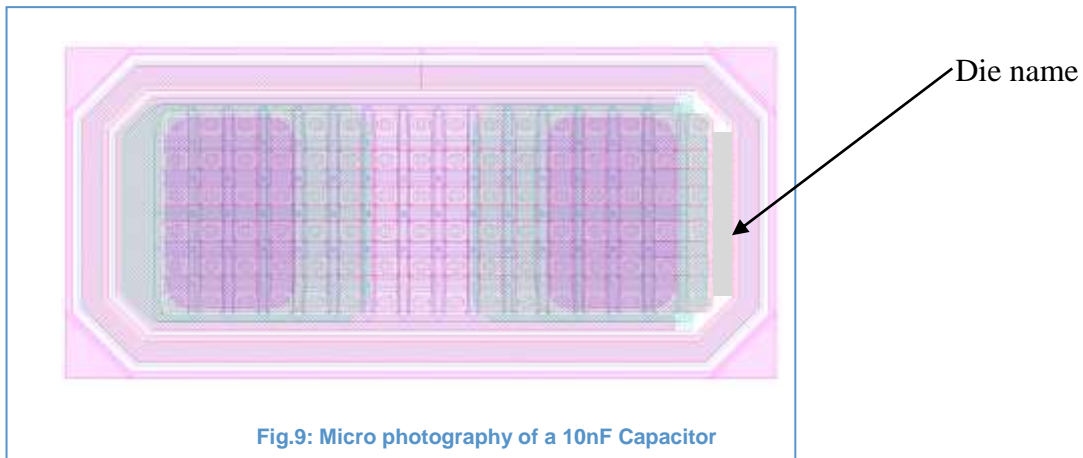
The UBSC Capacitor is compatible with standard reflow technology.  
It is recommended to design mirror pads on the PCB.  
For further information, please see our mounting application note.

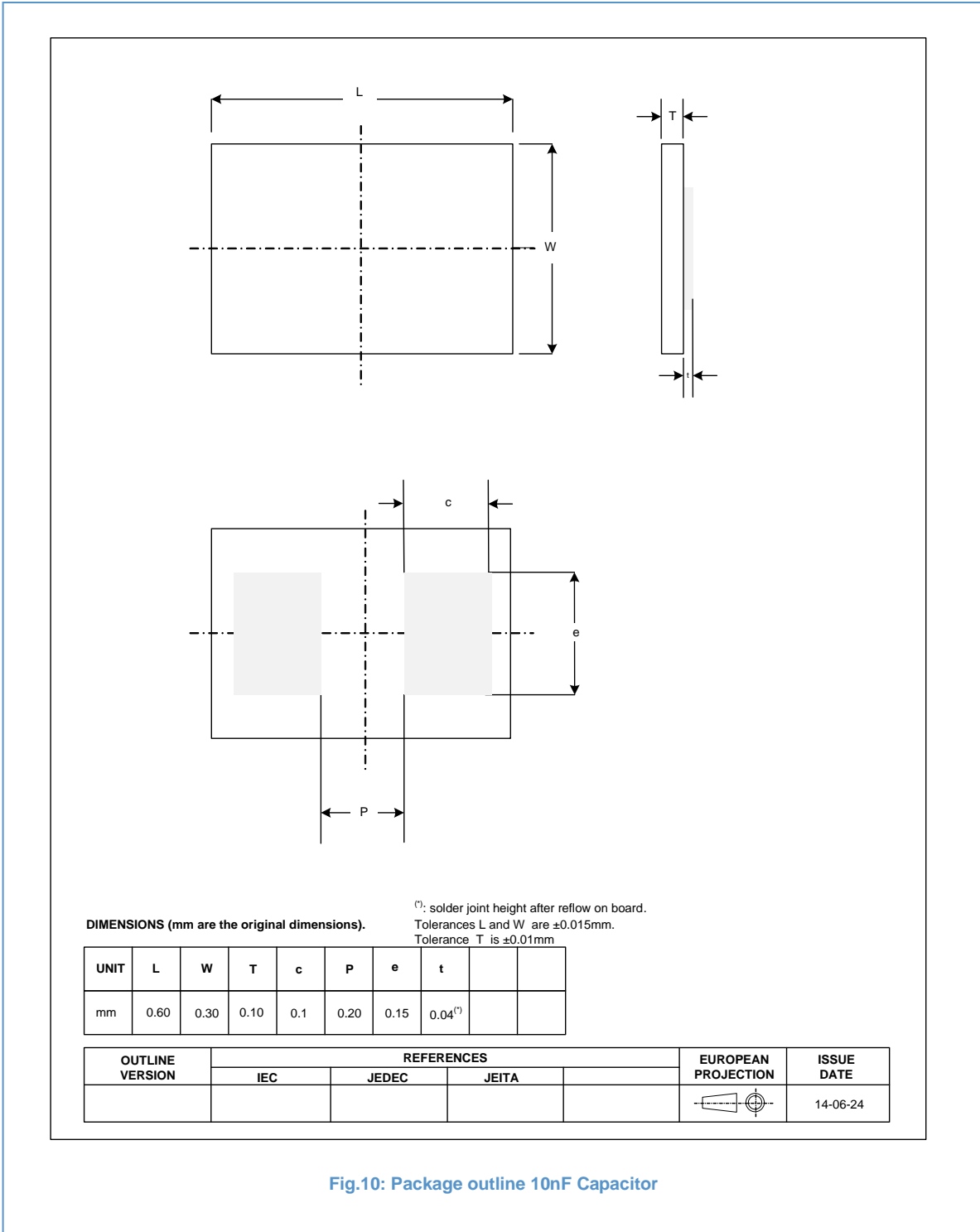
## Pad Metallization

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.  
It is recommended to design mirror pads on the PCB.  
For further information, please see our mounting application note.

## Package outline

The UBSC Capacitor is delivered as a naked die, with opening for contacts.





**Fig.10: Package outline 10nF Capacitor**

## Assembly consideration

The attachment techniques recommended by Murata for the UBSC/BBSC/ULSC 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](http://www.ipdia.com/assembly) and read them carefully.**



For UBSC/BBSC/ULSC assembly instructions @ 100  $\mu\text{m}$ , please go to [www.ipdia.com/assembly](http://www.ipdia.com/assembly) and download the pdf file called 'Murata UBSC, BBSC, ULSC-100&400 $\mu\text{m}$  - NiAu finishing - Assembly by Soldering'.

## Packing format

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

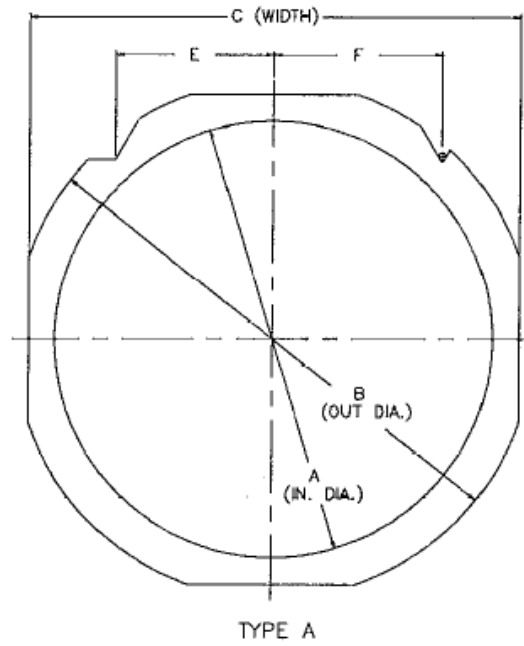


Fig.8: Dimension of film frame carrier

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 7: Details of film frame carrier



## Definitions

<b>Data sheet status</b>	
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.
<b>Limiting values</b>	
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.	
<b>Application information</b>	
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	2015 February 27 <sup>th</sup>	Objective specification	OGA
Release 1.1 to 1.3	2015 Oct 28 <sup>th</sup>	General update	OGA
Release 1.4	2016 January 5 <sup>th</sup>	12NC creation	OGA
Release 1.5	2016 March 9 <sup>th</sup>	Test result & WP packing	OGA
Release 1.6 to 1.8	2016 April	Update	OGA
Release 1.9	2016 Sept 29 <sup>th</sup>	Update of packing section	OGA
Release 2.0	2016 Oct 10 <sup>th</sup>	Cut-off frequency at 3dB	OGA
Release 2.1	2016 Oct 11 <sup>th</sup>	Typo error on Fc-3dB	OGA
Release 2.2	2016 Nov 22 <sup>nd</sup>	General curves updates	OGA
Release 2.3	2017 April 5 <sup>th</sup>	Murata version	OGA
Release 2.4	2017 June 14 <sup>th</sup>	Update	OGA
Release 2.5	2017 July 05 <sup>th</sup>	Update	OGA

## 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.

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