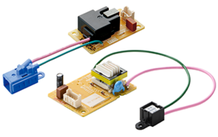
Murata Ionissimo Ionizer Module proven effective to inactivate Novel Coronavirus (SARS-CoV-2)

11/10/2020

Murata Manufacturing Co., Ltd.
President: Norio Nakajima



Murata Manufacturing Co., Ltd. (hereinafter, "Murata") commissioned Nara Medical University to research the effectiveness of ozone gas generated by Murata's Ionissimo ionizer module[*1] and ozonizer module[*2] (hereinafter, "the products") in inactivating the novel coronavirus (SARS-CoV-2[*3]). The ozone gas generated by the products was proven to be effective in inactivating the coronavirus (SARS-CoV-2). This confirmation of the Ionizer Module's effectiveness was conducted using an airtight testing chamber; its effectiveness in an actual usage environment, outside the testing chamber, has not yet been tested.

Tested products

Ionizer modules: MHM306 series and MHM402 series
Ozonizer modules: MHM500 series

Testing contractor

Nara Medical University, Department of Microbiology and Infectious Diseases, School of Medicine (Professor Hisakazu Yano and Professor Ryuichi Nakano)

Confirmation of effectiveness of the Ionissimo Ionizer Module in inactivating the novel coronavirus

Data

- Testing period: August to September 2020
- Subject: Novel coronavirus (SARS-CoV-2)

Methodology

- 20 µl of fluid containing the virus was applied to a petri dish and left to stand until dry.
- The test piece containing the virus was left to stand in a 6.7-liter airtight chamber and exposed for a fixed period of time to ozone generated by the ozonizer and propelled by a fan.
- Only a single test piece was placed in the chamber and removed when the reaction time had elapsed.
- After the test piece was removed, the procedure was reset and a new test piece placed in the chamber, with the reaction time starting again from 0 minutes.
- After the reaction time had elapsed, 2 ml of SCDLP culture medium[*4] was dripped onto the test piece, and a cell scraper was used to collect the virus.
- The collected fluid was used to infect Vero E6/TMPRSS2[*5] cells, and the virus infectivity[*6] (PFU/mL) was measured using a plaque assay[*7].
- Test pieces not exposed to ozone were used as a control.
- The test was carried out three times in the following environment: humidity 50.0% to 59.7%; and temperature 19.6°C to 21.8°C.
- The ozone concentration value was measured beforehand with no test piece present.

Results

It was confirmed that at least 99.9% of the virus became inactive following exposure for 120 minutes to a concentration of 0.1 ppm, which is the acceptable ozone concentration designated by the Japan Society for Occupational Health.
Note: The present confirmation of effectiveness was conducted using the products in a testing chamber environment and does not indicate effectiveness in an actual installation/usage environment.

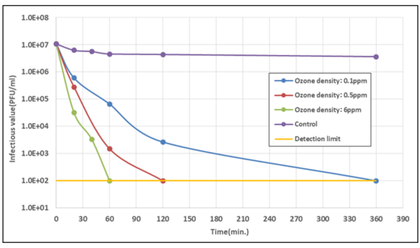


Figure 1. Change in virus infectivity due to ozone
Actual measured virus infectivity value (average where n = 3)
Note: Control (violet line in Fig. 1): air environment without ozone exposure

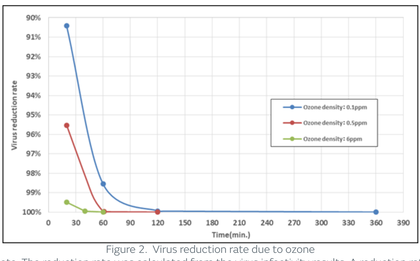


Figure 2. Virus reduction rate due to ozone
Note: The reduction rate was calculated from the virus infectivity results. A reduction rate beyond the detectable limit is indicated as > 99.997%.

Table 1. Virus reduction rate due to ozone

Ozone concentration	0 min.	20 min.	40 min.	60 min.	120 min.	360 min.	720 min.
0.1 ppm	–	90.425%	–	98.550%	99.939%	> 99.997%	> 99.997%
0.5 ppm	–	95.531%	–	–	> 99.997%	–	–
6.0 ppm	–	99.492%	99.941%	> 99.997%	–	–	–

Notes

1. Ions are generated by applying a high-voltage direct current to needle-shaped electrodes (metal wires about 70 µm thick). The ions are electrically charged, and the charge catches tiny floating particles by Coulomb force. At the same time, Murata's ionizers have electrodes formed on a ceramic board surrounding the needle-shaped electrodes, and these generate ozone. The oxidizing power of the ozone effectively disinfects and eliminates odors.
2. Ozone is efficiently generated by applying a high-voltage alternating current to electrodes formed on a ceramic board. The oxidizing power of the ozone effectively disinfects and eliminates odors.
3. Severe acute respiratory syndrome coronavirus 2, abbreviated as SARS-CoV-2. It causes coronavirus disease 2019 (COVID-19) and is related to the SARS coronavirus (SARS-CoV).
4. A fluid culture medium used to collect the virus.
5. A type of cell susceptible to infection by novel coronavirus.
6. The number of virus particles that are infectious to cells.
7. A method used to isolate or quantify a virus.

For more information visit below:

Ionizer modules
MHM306
MHM402

Ozonizer modules
MHM500

Murata in Brief
Murata Manufacturing Co., Ltd. is a worldwide leader in the design, manufacture and sale of ceramic-based passive electronic components & solutions, communication modules and power supply modules. Murata is committed to the development of advanced electronic materials and leading edge, multi-functional, high-density modules. The company has employees and manufacturing facilities throughout the world. For more information, visit Murata's website at www.murata.com

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Ionizer / Ozonizer (active oxygen)

Compact, powerful ion generators

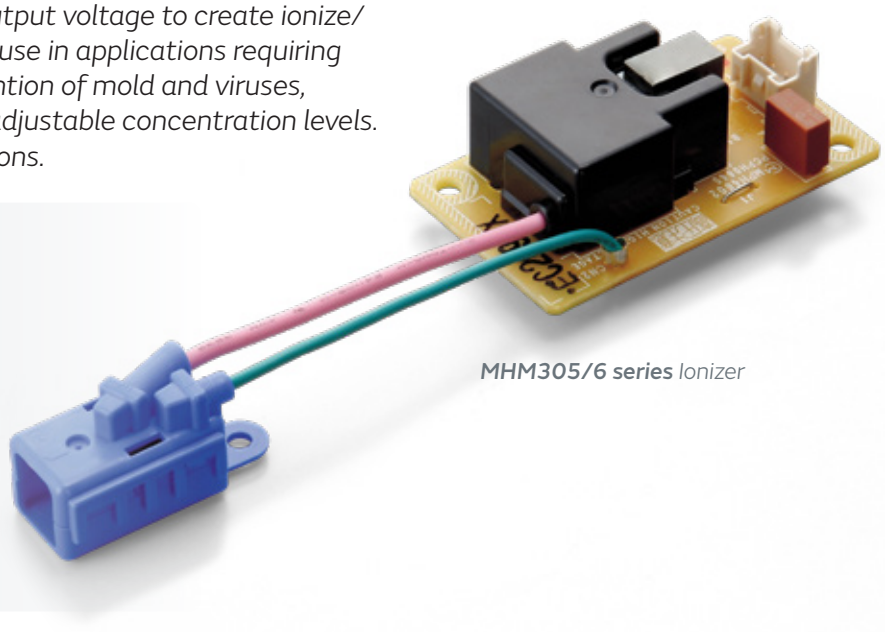
Ionizer and Ozonizer modules utilize a high output voltage to create ionize/ ozonize air molecules. These modules are for use in applications requiring sterilization, odor removal, air purifiers, prevention of mold and viruses, elimination of static energy and more. User adjustable concentration levels. Compact designs with AC and DC input versions.

Features

- Compact design
- High voltage power supply
- Easy integration

Applications

- Air purifiers
- Hand washing systems
- Sterilization apparatus for surgical instruments
- Sterilizing CPAP tubes



***MHM305/6 series** Ionizer*

Microblower



MZB1001T02 series

The microblower blows air and generates high discharge pressure of air driven by the ultrasonic vibrations of ceramics from a thin and extremely compact body. It also features lower power consumption due to its ceramic based drive system.

Features

- Small and thin design
- No vibration sound
- Small air pulsation
- Quick response

Applications

- Breath analyzers
- Diffusers

Air pump



MZB3004T04 series

The air pump enables high discharge pressure of air driven by the ultrasonic vibration of ceramics from a thin and extremely compact body. It includes a passive valve function; when the pump stops driving air, air is quickly exhausted.

Features

- Small and thin design
- No vibration sound
- Small air pulsation
- Quick response

Applications

- Gas analyzer
- Blood pressure monitors
- Sleep apnea device

Enabling the future of

Healthcare & Medical

Latest technologies for healthcare and medical applications



Murata's products and technologies are improving tomorrow's healthcare devices and equipment - for life

Murata is setting the pace for advancements in electronics for use in healthcare applications and is a key provider of the technologies which are shaping the future of healthcare around the world.

Electronic components, sensors, wireless connectivity, RFID, batteries, and power modules have rapidly become so essential towards enhancing the functionality and reliability of the healthcare equipment required by our growing and changing population.

Apart from our standard products, which are present in almost any electronic equipment you use, Murata has developed new, innovative products specifically for healthcare applications in testing and diagnostics; patient monitoring and assistance; wearable, portable and stretchable electronics; digital care and in-home care.

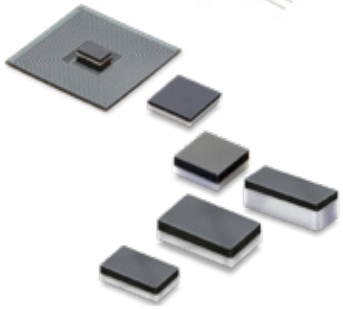
In this brochure we provide you an overview of some of our innovations. We look forward to working with you to continue the advancements in healthcare and medical equipment and solutions, for life.

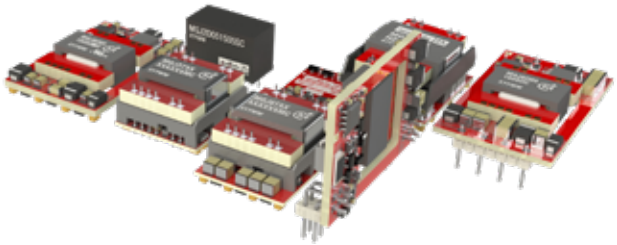


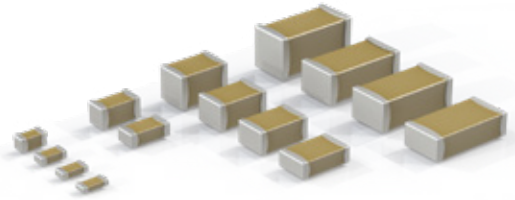
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Medical Application Disclaimer Notice

Murata's products are not specifically designed or authorized for use in safety-critical applications, being applications in which a failure of Murata's product may cause severe personal injury or death, unless Murata and respective customer executed a written agreement that specifically governs such use of Murata's products. Customers shall indemnify Murata and its representatives against any damages, claims, suits and expenses arising out of the unauthorized use of Murata's products in such safety-critical applications.

Customer shall ensure that it has adequate expertise in connection with safety, regulations and regulatory requirements for its applications, and customer is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its devices or products, including any use of Murata's products in customer's applications, regardless of any information or support that may be (or has been) provided by Murata in relation thereto.

Sensors

Murata's sensor lineup responds to sensing needs of various applications within healthcare and medical.

Utilizing sensing functions that make full use of MEMS processing technology, magneto resistive elements including ceramic material technology, enabling highly efficient and highly reliable sensing devices, modules and systems.





Product line-up

- **Temperature sensors**
- **Ultrasonic sensors**
- **Infrared sensors**
- **Shock sensors**
- **MEMS sensors**
- **AMR sensors (magnetic sensors)**

Applications

- Wearables
- Thermometers
- Diagnostic imaging
- Blood pressure monitors



Thermistors

A wide range of options

Murata thermistors employ high precision, excellent thermal response, reliability and performance. Our diverse product range not only includes different shapes (SMD chip and lead types), but also covers diverse applications such as inrush current suppression and temperature compensation (NTC thermistors), and overcurrent protection, overheat sensing, and inrush current suppression (PTC thermistors).



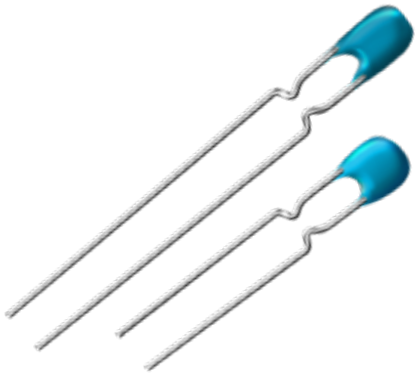
Product lineup

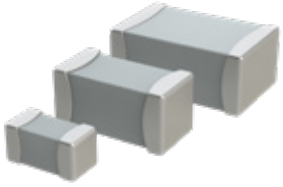
- **NTC thermistors**
- **PTC thermistors (POSISTOR®)**

NTC Thermistors

High accuracy temperature sensing and mapping

Murata's SMD and lead type thermistors enable accurate and reliable temperature sensing and real-time mapping with high precision and excellent thermal response.





Features

- Detect temperature with high accuracy
- Omit temperature calibration in assembly process
- Space saving

Applications

- Home care patient monitoring
- Smart glucose monitoring
- Smart insulin pumps
- Smart wound care
- Smart pills
- Controlling skin infections

MEMS sensors

High accuracy, low-power consumption



Murata is a leading manufacturer of acceleration, inclination and angular motion sensor solutions for healthcare applications.

Medical sensors increase the intelligence of life supporting devices, and they can be used in new types of patient monitoring applications that allow patients to lead more independent lives. Detecting signals triggered by symptoms helps optimize medication and prevent serious onsets of illness.

Murata's unique MEMS design, which combines single crystal silicon and glass, ensures exceptional reliability, unprecedented accuracy and excellent stability over time. The power requirements of these medical sensors are extremely low, which gives them a significant advantage in small battery-operated devices.

As the leading supplier of activity sensors for pacemakers, Murata also offers a wide range of pressure sensors, accelerometers, inclinometers and gyroscopes for various demanding medical and healthcare applications. Device developers and manufacturers of many existing and emerging healthcare applications have been able to reach their power and size requirements thanks to Murata's MEMS technology.

Sensor elements (Dies)

Vertical Accelerometer Elements

SCG12S and SCG14S



- Size 3mm x 2.12mm x 1.95 or 1.25mm
- Various measuring ranges possible (1 - 12g)
- Proven capacitive 3D-MEMS Technology

Horizontal Accelerometer Elements

SCG10X and SCG10Z



- Size SCG10X: 2.55mm x 2.95mm x 1.91mm
- Size SCG10Z: 1.50mm x 1.70mm x 1.83mm
- Various measuring ranges possible (1 - 12g)
- Proven capacitive 3D-MEMS Technology

Pressure Sensor Elements

SCB10H



- Size 1.4mm x 1.4mm x 0.85mm
- High pressure shock survival (> 200 bar)
- Various pressure ranges possible (1.2 - 25 bar)
- Proven capacitive 3D-MEMS technology
- Operates at near vacuum applications

Sensor components

Accelerometer

Digital 1-, 2- or 3-axis Accelerometers



- Excellent accuracy
- Excellent stability over temperature
- Ranges: ± 1g, ± 6g

Inclinometer

Digital 3-axis Inclinometers



- Excellent accuracy
- Excellent stability over temperature
- Ranges: ± 10 °, ± 90 °

Gyroscope

Digital 1-axis Angular Rate Sensors



- Excellent accuracy
- Excellent stability over temperature
- Ranges: ± 100 °/s , ± 300 °/s

Combo sensor

Digital 4-, 5-, 6-axis Angular Rate Sensors

- Excellent accuracy
- Excellent stability over temperature
- Ranges: ± 125 °/s , ± 300 °/s, ± 6 g , ± 15 g

BCGMCU

Non-contact heart rate and other cardiac measurement parameters

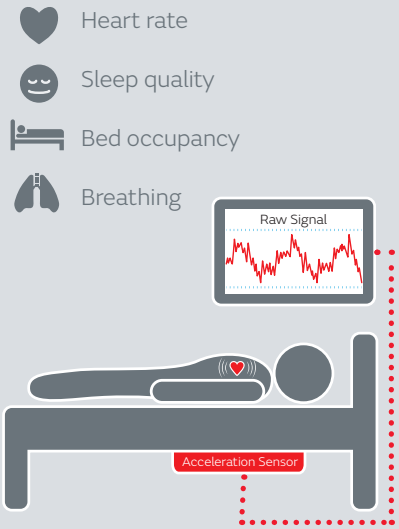
Electronic BCG (Ballistocardiography) reference design with accelerometer signal processing and algorithm in the preprogrammed micro controller

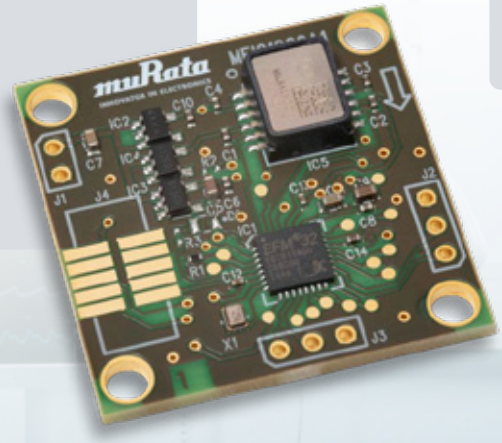
Features

- A continuous contactless monitoring concept when in the bed
- Enhanced performance with the 2nd generation BCG-solution
- Heart rate (HR), heart rate variability (HRV), respiration rate (RR) and bed occupancy detection can be utilized to analyze for example stress and relaxation index and sleep quality
- Opens new possibilities for patient monitoring and elderly care in hospitals, assisted living and even at homes

Benefits

- Safety
- Efficiency
- Responsiveness





Connectivity modules

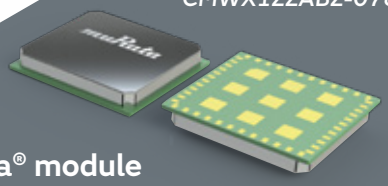
Low-power reliable connectivity for healthcare devices

Healthcare devices are increasingly connected to each other and the web. Use a Murata module for proven RF excellence.

Murata RF modules make it easy for you to build connectivity into most devices, even those where space is limited and power consumption needs to stay low.

With wireless modules as small as 6.95 x 5.15 x 1.1mm, wireless communication has never been easier to design in.

CMWX1ZZABZ-078



LoRa® module

Dual mode, ultra compact, low cost standalone module.

New ultra-compact, low-cost, low-power-wide- area-network (LPWAN) wireless module that supports the LoRaWAN® & Sigfox long range wireless protocol.

Vulnerable patient location detection* enabled by LoRa®-equipped wearables

**subject to LoRa® network availability*

Features

- Support BLE, Bluetooth®, Wi-Fi™, Sigfox, LoRa®, LTE CAT M1 / NB IoT, UWB and other wireless standards
- Combo-modules available (Bluetooth®/WiFi™)
- Easy to design in
- Reference regulatory certification on select modules
- Antenna matching supported on select modules

Applications

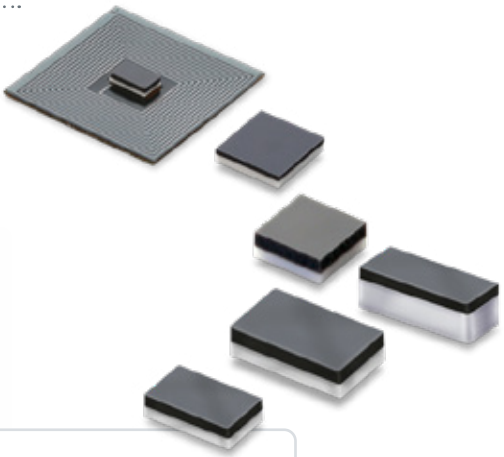
- E-health / Home monitoring
- Spirometers
- Drug delivery devices
- Hearing aids
- Therapeutic massagers
- Muscle stimulators
- Cardiac monitors
- Thermometers, etc.

Bluetooth® Wi Fi™ sigfox LoRa Alliance LTE-M NB-IoT

RFID & NFC solutions

Safeguarding your assests

RFID & NFC technology is providing the next generation of medical products and devices with the embedded intelligence required for item tracking, system automation and enhanced security features.



Features

Wide range of RFID tags, including:

- **RFID Tags**
  - Integrated antenna
  - Ultra small size (1.25 x 1.25mm)
  - Suitable for injection molding process
  - Adheres to global standards
- **On-metal RFID tags**
  - Durable design
  - Design to be attached to metal objects
  - Autoclavable
- **NFC tags**
  - Integrated antenna
  - Embeddable in plastic
  - Small size (3.2 x 3.2mm)

Applications

- Inventory Management
- Surgery tool management
- Drug authentication
- Medication control system
- Asset Management
- Consumable product validation
- Brand protection



Smart disposables

Embedded directly into the product during molding process



Surgical tool tracking

Patented technology to use metal surface as an antenna for RFID tag



Product authentication

Item identification to validate contents



Low-power DC-DC converters

Low power standard models to custom designs with medical approvals

Murata's range of DC-DC converters for healthcare applications offer various levels of medical safety agency recognition - in consideration of both the safety of the patient and the operator. They also feature low barrier capacitance to serve the medical application requirement of low leakage current.

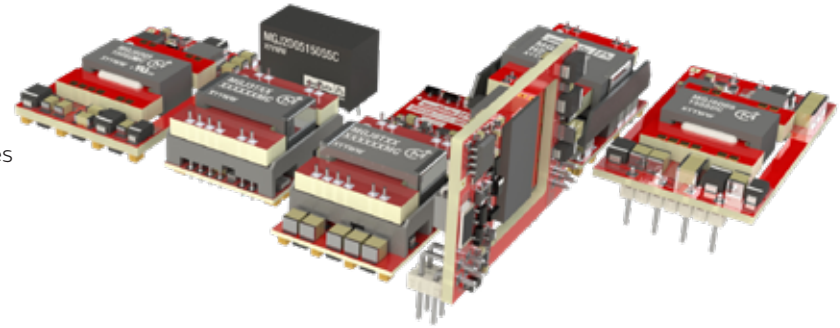
Applications

- MRI
- X-Ray
- Ultrasound
- Blood pressure monitors
- Telehealth and remote health monitoring systems
- Infusion pumps
- CPAP machines
- Equipment cable isolation
- Robotics

Gate Drive DC-DC converters

Features

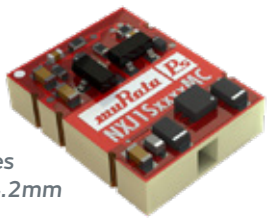
- Characterised dV/dt immunity 80kV/µs
- Characterised partial discharge performance
- Solutions for single switch up to 3-phase bridge
- Suitable for DC link voltages up to 3kVDC
- Surface mount and through-hole options
- Wide input voltage range options
- Low coupling capacitance 3-15pF typical
- 1 to 6 watt output power
- Output voltages for the most common devices
- Operation to 105°C



1W Single output SMD

Features

- 3.3V, 5V & 12V inputs
- 3.3V, 5V, 12V & 15V outputs
- UL60950 recognized
  - Reinforced insulation to a working voltage of 200Vrms
  - Basic insulation to a working voltage of 250Vrms
- ANSI/AAMI ES60601-1 recognized
  - 1 MOPP to a working voltage of 250Vrms
- Isolation test voltage 4.2kVDC
- Up to 110°C operating temperature
- Industry standard footprint

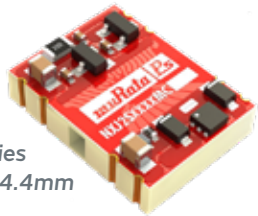


NXJ1 series
10.5 x 13.7 x 4.2mm

2W Single output SMD

Features

- 5V, 12V & 24V inputs
- 5V, 12V & 15V outputs
- UL60950 recognized
  - Reinforced insulation to a working voltage of 250Vrms
- ANSI/AAMI ES60601-1 recognized
  - 1 MOPP & 2 MOOP to a working voltage of 250Vrms
- Isolation test voltage 5.2kVDC
- 85°C operating temperature
- Industry standard footprint



NXJ2 series
14.5 x 16.0 x 4.4mm

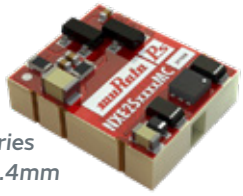
1 & 2W Single output SMD

Features



NXE1 series
10.4 x 12.7 x 4.4mm

- 3.3V, 5V & 12V inputs
- 3.3V, 5V, 12V & 15V outputs
- UL60950 recognized
  - Reinforced insulation to a working voltage of 125Vrms
  - Basic insulation to a working voltage of 250Vrms
- ANSI/AAMI ES60601-1 recognized
  - 1 MOPP to a working voltage of 250Vrms
- Isolation test voltage 3kVDC
- 85°C operating temperature
- Industry standard footprint



NXE2 series
10.4 x 12.7 x 4.4mm

1W Dual output SMD

Features

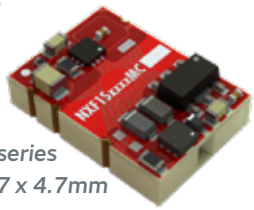


MGJ1 series
15 x 20 x 4.4mm

- 5V, 12V, 15V & 24V inputs
- +15V/-5V, +15V/-9V & +19V/-5V outputs
- UL60950 recognized
  - Reinforced insulation to a working voltage of 250Vrms
- ANSI/AAMI ES60601-1 recognized
  - 2 MOPP to a working voltage of 250Vrms
- DC link voltage 3kVDC
- Isolation test voltage 5.7kVDC
- 105°C operating temperature
- Optimized bipolar output voltages for IGBT/SiC & MOSFET gate drives

1W Regulated SMT

Features



NXF1 series
15.2 x 10.7 x 4.7mm

- 3.3V & 5V inputs
- 3.3V & 5V outputs
- UL60950 recognized
  - Reinforced insulation to a working voltage of 125Vrms
  - Basic insulation to a working voltage of 250Vrms
- ANSI/AAMI ES60601-1 recognized
  - 1 MOPP/2 MOOP to a working voltage of 125Vrms
  - 1 MOOP to a working voltage of 250Vrms
- Isolation test voltage 3kVDC
- Up to 105°C operating temperature

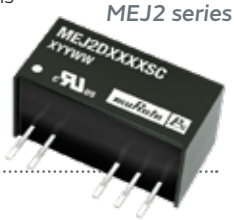
1 & 2W Single & dual output

Features



MEJ1 series

MEJ2 series

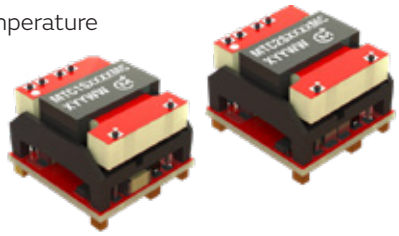


- 3.3V, 5V, 12V, 15V & 24V inputs
- 3.3V, 5V, 9V, 12V & 15V outputs
- ±3.3V, ±5V, ±9V, ±12V & ±15V dual outputs
- UL60950 recognized
  - basic/supplementary insulation to a working voltage of 250Vrms
- ANSI/AAMI ES60601-1 recognized
  - 1 MOOP to a working voltage of 200Vrms
- Isolation test voltage 5.2kVDC
- 85°C operating temperature
- Internal SMD construction
- Industry standard SIP package style

1 & 2W Single output SMD

Features

- 2:1 input range with nominals of 12V & 24V
- 3.3V, 5V & 12V outputs
- UL60950 recognized
  - Reinforced insulation to a working voltage of 250Vrms
- ANSI/AAMI ES60601-1 recognized
  - 1 MOPP & 2 MOOP to a working voltage of 250Vrms
- Isolation test voltage 3kVAC
- 100°C operating temperature



MTC1 & MTC2 series
14.2 x 15.0 x 11.2mm

6W Dual output DIP

Features



NCM6 series

- Wide 4:1 input range with nominals of 5V, 12V & 48V
- 3.3V, 5V, 12V & 15V outputs
- ±5V, ±12V & ±15V dual outputs
- UL60950 recognized
  - Reinforced insulation to a working voltage of 250Vrms
- ANSI/AAMI ES60601-1 recognized
  - 1 MOPP & 2 MOOP to a working voltage of 250Vrms
- Isolation test voltage 5.2kVDC
- 85°C operating temperature
- Typical efficiency to 88%

High power AC-DC converters

High power standard models to custom designs with medical approvals*

Murata's range of AC-DC converters for healthcare applications offer the most current levels of medical safety agency recognition, in consideration of both the safety of the patient and the operator. They also feature low barrier capacitance to serve the medical application requirement of low leakage current.



250W AC-DC, PQC250 series

Features

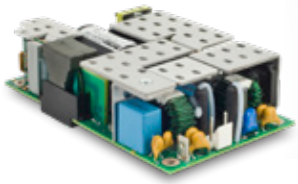
- 250W convection rated up to +50°C ambient, 200W at +70°C
- Small and compact design (3" x 5" x 1.4")
- High reliability, MTBF > 2 million hours
- Less than 0.5W standby power
- Efficiency of 94% at 50% load.
- Certified to IEC60601-1-2 4th edition EMC requirement
- Main output options from 12V up to 54V
- Standard aux. output of 5V @ 500mA
- 2 x MOPP pri-sec.



400W AC-DC, MVAC400 series

Features

- 250W convection, 400W with moving air
- Small 3" x 5" package
- IEC60601-1 Ed 3 Medical Safety
- Efficiency up to 94%
- 2 x MOPP pri-sec



650W AC-DC, PQU650 series

Features

- 450W Convection, 650W with forced air
- Package size: 6" x 4" x 1.57"
- 800W power boost at start for motors
- Efficiency of 95% typical at 50% load
- IEC60601 Ed 3 medical (2 x MOPP Pri-Sec)
- Certified to IEC60601-1-2 4th edition EMC requirements
- Certified to IEC62368-1
- Main output options from 12 through 54Vdc
- Standard aux. output of 5V @ 500mA



Applications

- Ventilators
- Ultrasound monitors
- ECG equipment
- Hospital beds
- Surgical lights
- Sphygmomanometers
- Incubators

** Some medical approvals pending*

Micro batteries

Murata offers a wide range of micro batteries with high performance and reliability, taking advantage of the state-of-the-art design and production technologies.





Capsule endoscopy

Alkaline manganese batteries (LR)

1.5V primary batteries with high drain characteristics.

Features

- Excellent high-drain pulse discharge characteristics
- Excellent cost performance
- Excellent leakage resistance

Silver oxide batteries (SR)

1.55V primary batteries with high capacity and stable discharge.

Features

- High energy density
- Excellent stable discharge characteristics
- Excellent leakage resistance

Coin manganese dioxide lithium batteries (CR)

3V primary batteries with high energy density.

Features

- Lightweight, high voltage and high energy density
- Outstanding temperature characteristics
- Excellent long-term reliability

Applications

- **Drug delivery devices**
- **Capsule endoscopy**
- **Medical testing instruments**
- **Health monitoring devices:**
  - Continuous glucose monitoring
  - Thermometers, etc.

Model	Nominal Voltage (V)	Nominal Capacity (mAh)	Operating Temperature Range	Diameter (mm)	Height (mm)	Weight (g)
LR41	1.5	45	-10ºC to +60ºC	7.9	3.6	0.6
LR44	1.5	150	--10ºC to +60ºC	11.6	5.4	2
SR626	1.55	28	-10ºC to +60ºC	6.8	2.6	0.4
SR927	1.55	60	-10ºC to +60ºC	9.5	2.7	0.8
CR1220	3	40	-30ºC to +70ºC	12.5	2	0.8
CR2032	3	220	-30ºC to +70ºC	20	3.2	3.2

Data is not guaranteed, and is provided for reference purposes only. Characteristic changes depending on environment, load condition and cut-off voltage.

For other sizes or specifications not included in above list, please consult a sales representative.

Drug delivery device; Continuous glucose monitoring

Silicon capacitors

Medical-grade SiCAPs for implantable devices

Murata SiCAPs (silicon capacitors) offer new advantages in terms of reliability, lifetime, miniaturization and assembly processes and technologies for the medical electronic devices. Thanks to the excellent intrinsic characteristics of this silicon based technology, these products offer new technical opportunities to design even smarter and smaller medical electronics, particularly implantable ones.



MGSC series

Enabling smarter and smaller medical electronics particularly for implantable devices.

Features

- High reliability
- Low ageing (<0.001%/1000 hours)
- Extreme integration (several passives in just one die)
- Versatile technology to cope with user requirements
- Low profile down to 80µm

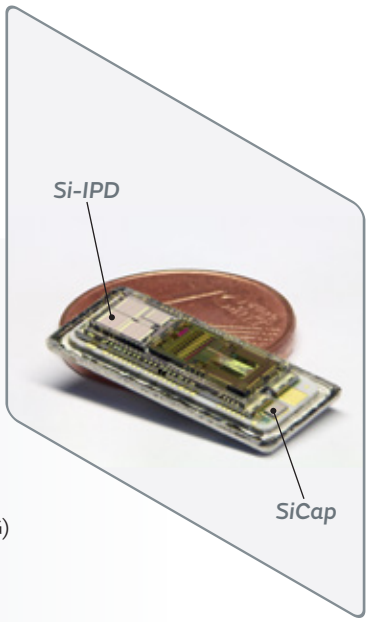
Applications

- Cardiac Rhythm Management (Pacemakers, Defibrillators, Monitors)
- Neurostimulation / Neuromodulation (e.g Vagus Nerve, Spinal Cord, Sacral Nerve, Peripheral Nerve)
- Ocular & Artificial Retina Implants
- Cochlear & Hearing Aid
- Sensors & Monitors (e.g Blood Pressure, Glucose, ECG/EEG)
- Drug Infusion Pumps
- Life support equipment

Heterogeneous micro systems

Integrated passive device(Si-IPD) technology

Si-IPDs (Integration Passive Devices) target all critical implantable devices and life support solutions. Due to the criticality of the applications, a specific 100% screening is done on all manufactured devices to avoid any "early life" defects. Each IPD is a custom companion chip and is designed according to your own requirements.



Features

- Miniaturization and compactness due to 100µm thick components
- "Early life" high reliability to avoid initial failures of the devices
- Low derating in operational conditions
- Low ageing of the components to maintain better performance levels

Applications

- Cardiac Rhythm Management (Pacemakers, Defibrillators, Monitors)
- Neurostimulation / Neuromodulation (e.g Vagus Nerve, Spinal Cord, Sacral Nerve, Peripheral Nerve)
- Ocular & Artificial Retina Implants
- Cochlear & Hearing Aid
- Sensors & Monitors (e.g Blood Pressure, Glucose, ECG/EEG)
- Drug Infusion Pumps
- Life support equipment

Ceramic capacitors

Medical-grade monolithic ceramic capacitors for implantables



GCH / GCR series

Murata's medical-grade monolithic ceramic capacitors were developed based on high-reliability capacitor design technology, quality control and process management expertise gained by Murata in the development of products for applications requiring high-reliability, such as the automotive market.

Features

- GCH series suitable for use in non-critical circuits
- GCR series suitable for use in critical circuits
- GCR / GCH series : Appearance inspections or verification of various characteristics available on request

Applications

- Cardiac Rhythm Management (Pacemakers, Defibrillators, Monitors)
- Neurostimulation / Neuromodulation (e.g Vagus Nerve, Spinal Cord, Sacral Nerve, Peripheral Nerve)
- Ocular & Artificial Retina Implants
- Cochlear & Hearing Aid
- Sensors & Monitors (e.g Blood Pressure, Glucose, ECG/EEG)
- Drug Infusion Pumps
- Life support equipment

General purpose MLCCs for non-implantable wearable and portable medical devices

Murata's ultra-compact MLCC has been developed and mass-produced ahead of competitors in response to the trend of downsized medical devices, Murata's ultra-compact MLCC was developed and mass-produced ahead of competitors. Amid this trend, the required mode for medical devices is changing from a benchtop to a portable mode, and from a portable to a wearable mode, which has increased the demand for even smaller products for use in wearable devices.



GRM series

Features

- GRM series achieves large-capacity and small size in a multilayer structure
- Sn plating is applied to the external electrodes; excellent solderability
- High reliability with no polarity

Applications

- Patient monitoring
- Wearable sensor patches
- Smart drug delivery
- Smart insulin pens
- Blood glucose meters
- Continuous glucose monitoring

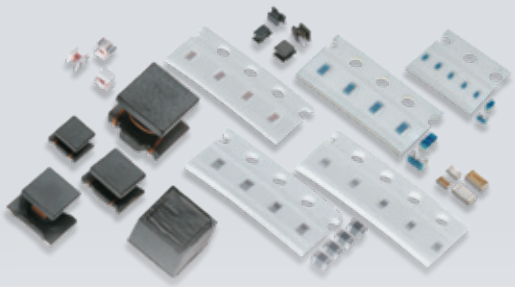
Inductors

Murata's broad line of inductors feature compact size and high-performance. The unique coil and case structures give them low DC resistance and outstanding high-frequency characteristics.

Murata offers a broad variety of products for different applications. The diverse lineup offers the customer a choice of the types of inductors and characteristics optimal for the circuit in question.

Product line-up

- **RF inductors**
- **General circuit inductors**
- **Power inductors**
- **Variable inductors**
- **SMT/Through-hole**
- **Shielded / Unshielded**
- **Standard / Custom**



Applications

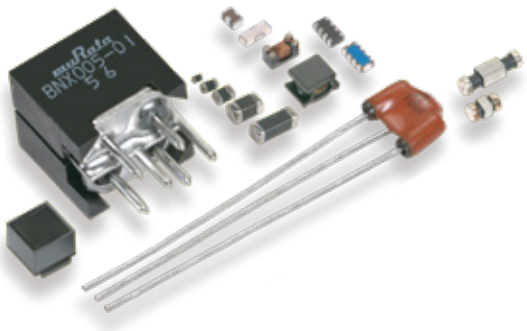
- Endoscopes
- Ultrsound diagnostic equipment
- Dialysis
- X-ray panels
- Biomonitors
- MRIs and CTs



Power inductors

EMI noise suppression

Using Murata's ceramic processing technology and unique materials, we offer a complete line of EMI suppression filters. Murata also provides wide range of technical support tools based on many years of experience operating in the field of noise suppression.



Product line-up

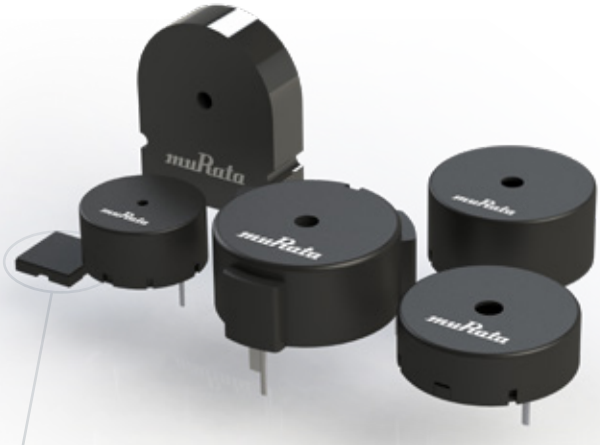
- **SMD ferrite beads**
- **Common mode choke coils**
- **Leaded and SMD EMI filters**
- **AC line filter**
- **ESD protection devices**

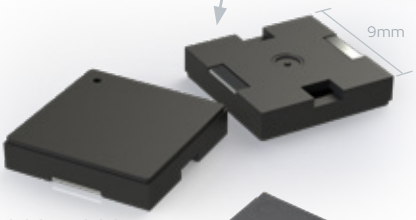
Sound components

Piezoelectric sound components utilize natural oscillation of piezoelectric ceramics. They are widely used in the applications from healthcare to consumer products.

SMD piezoelectric sounder are ultra-compact, light and it's low power consumption extends battery life of both portable and stationary healthcare devices

The smallest and lightest surface mount piezoelectric sounder available. Occupying significantly less surface area, with a combined weight and area reduction of 44% compared to other similar products.





PKMCS0909E4000-R1



PKLCS1212E2000-R1



PKMCS1818E20A0-R1

Applications

- Drug delivery
- Health monitoring
- Ventilators
- Equipment tracking

LF antenna

3D Rx and 1D Tx low frequency

Low frequency antenna coils are semi-custom antennas for operating in the 125kHz frequency range The receiving antenna has three coils wound on orthogonal axis providing 360 degree reception. Together with the transmit coil, a high sensitivity magnetic communication system is established.

FDA Class 1 and 2 / GHTF A and B devices



Applications

- Asset tracking systems
- Patient location
- Medical equipment location
- Secure entry and exit

RF connectors

Coaxial, multipin and test points

Microwave coaxial connectors, RF test points and multipin connectors allow for the design and development of connected devices where there is a need for precise measurement or routing high frequencies signals and/or mixed analog signals within the device.



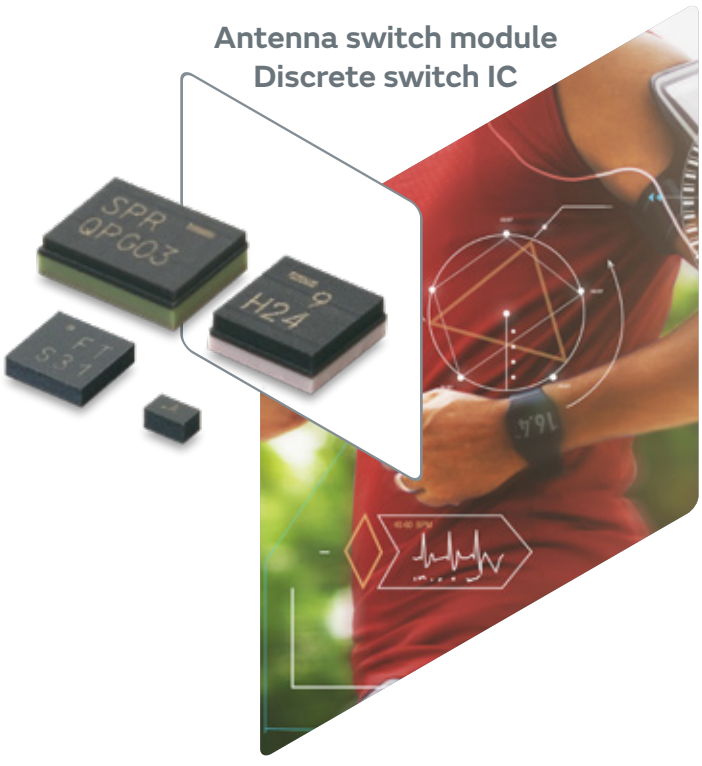
FDA Class 1 and 2 / GHTF A and B devices

Applications

- Digital stethoscope
- Patient monitoring devices
- Smart beds

RF switches

Murata offers the industry best SOS technology providing high linearity, low loss, and high isolation switches in many combinations to simplify designs.



FDA Class 1 and 2 / GHTF A and B devices

Applications

- Mother and neonatal care monitors
- Wearable fitness and activity monitors
- Telehealth systems

LTCC products

Filters, diplexers, couplers and baluns

Murata's High performance Low Temperature Cofired Ceramic technology is used to make Filters, diplexers, couplers and baluns for many of your RF design needs. Murata works with industry leading chip manufactures to make custom matched products to go with specific chipsets integrating discrete circuits into one passive devise saving board space, design time and reducing bill of materials.



FDA Class 1 and 2 / GHTF A and B devices

Applications

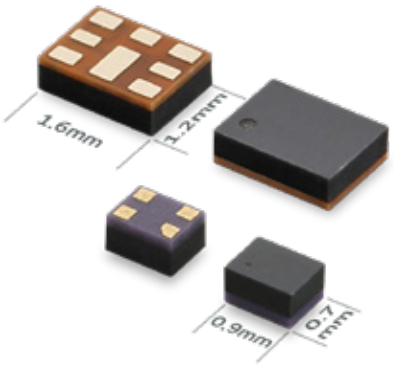
- Connected healthcare devices
- Mother and neonatal care monitors
- Wearable fitness and activity monitors
- Digital stethoscope
- Hearing aids

SAW components

Murata delivers high performance surface acoustic wave (SAW) radio frequency (RF) components that include filters, duplexers, giving RF engineers a broad range of SAW based RF component selections from one global manufacturer.

Murata SAW technology is industry-leading in size, performance, cost and time-to-market. We have one of the broadest SAW portfolios with frequencies from 600 MHz to 3 GHz, for cellular bands, ISM bands, GPS and GNSS bands, and other frequency bands.

Our state of the art production facilities allow us to offer SAW components for high-volume and high-performance markets.



FDA Class 1 and 2 / GHTF A and B devices

Applications

- Connected healthcare devices
- Mother and neonatal care monitors
- Wearable fitness and activity monitors
- Digital stethoscope
- Hearing aids
- Asset tracking systems
- Medical sensor patches / smart bandaids

Ionizer / Ozonizer (active oxygen)

Compact, powerful ion generators

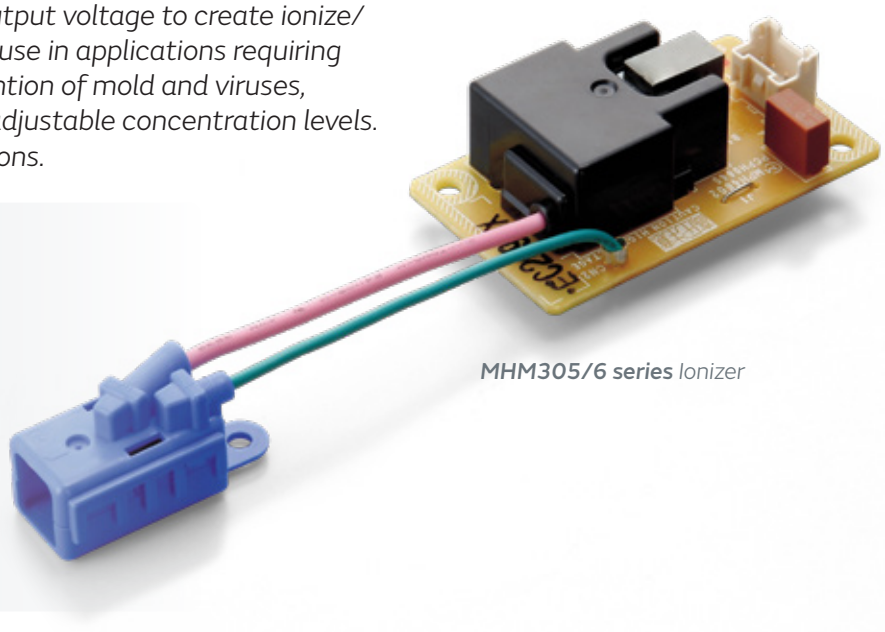
Ionizer and Ozonizer modules utilize a high output voltage to create ionize/ ozonize air molecules. These modules are for use in applications requiring sterilization, odor removal, air purifiers, prevention of mold and viruses, elimination of static energy and more. User adjustable concentration levels. Compact designs with AC and DC input versions.

Features

- Compact design
- High voltage power supply
- Easy integration

Applications

- Air purifiers
- Hand washing systems
- Sterilization apparatus for surgical instruments
- Sterilizing CPAP tubes



***MHM305/6 series** Ionizer*

Microblower



MZB1001T02 series

The microblower blows air and generates high discharge pressure of air driven by the ultrasonic vibrations of ceramics from a thin and extremely compact body. It also features lower power consumption due to its ceramic based drive system.

Features

- Small and thin design
- No vibration sound
- Small air pulsation
- Quick response

Applications

- Breath analyzers
- Diffusers

Air pump



MZB3004T04 series

The air pump enables high discharge pressure of air driven by the ultrasonic vibration of ceramics from a thin and extremely compact body. It includes a passive valve function; when the pump stops driving air, air is quickly exhausted.

Features

- Small and thin design
- No vibration sound
- Small air pulsation
- Quick response

Applications

- Gas analyzer
- Blood pressure monitors
- Sleep apnea device

Timing devices

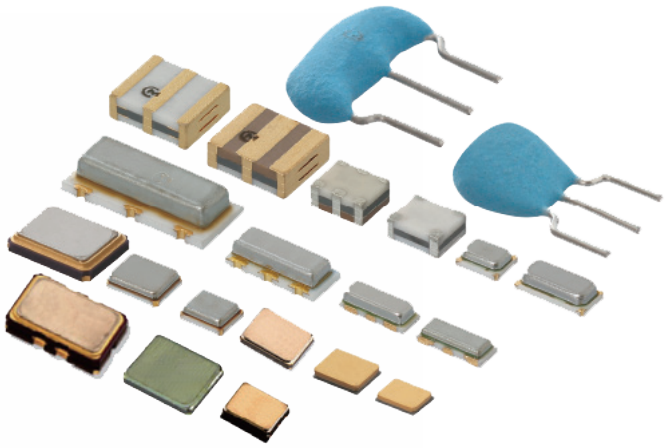
Timing devices are passive components which create clock signals by the piezoelectric effect. These devices are used for various applications, including wearables.

Product line-up

- **Ceramic resonators**
- **Crystal units**
- **Crystal oscillators**
- **32.768kHz MEMS Resonator**

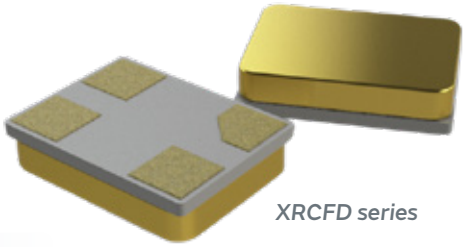
Applications

- Medical patch devices
- Wearables



Crystal units

Murata's crystal units offer a compelling balance of value and accuracy, in an innovative package. Such features are ideal for size and cost sensitive designs and a variety of applications.



XRCFD series

Features

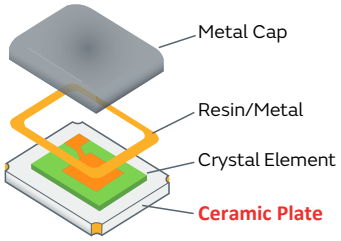
Small size
1210 size for 32MHz to 52MHz
1612 size for 24MHz to 48MHz
2016 size for 24MHz to 50MHz

Frequency Tolerance
Available +/-10ppm

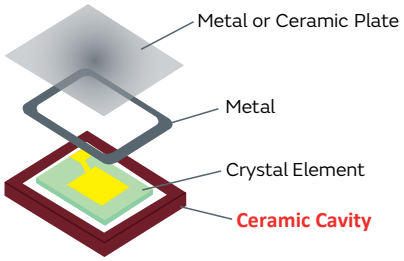
Economical & robust design
- Simple structure using Murata's proven package technology
- Particle screening process for enhanced reliability

RoHS Compliant & Pb Free

Murata Crystal Unit



Conventional Crystal Unit



Improving tomorrow's healthcare devices and equipment - for life

Murata has a proven track record for establishing and earning trustworthy relationships with our customers and partners, from startups and scaleups to globally established companies, universities, and institutes. When we team with others, we bring our collaborative spirit, entrepreneurial mindset and a commitment to earn their trust, proudly knowing they will rely on us to help activate and commercialize their ideas and solutions of tomorrow.

This philosophy, combined with our investment and commitment in advanced R&D and world-class engineering and manufacturing, have enabled us to move from being a market-leading component supplier to a solutions collaborator and developer.

Given the rapidly changing factors impacting medical care, there is a seismic shift emerging in healthcare delivery and management. The amount of innovation the industry is experiencing now is extraordinary.

Our continuously aggressive investment in R&D towards anticipating the needs of the future have positioned us to be a key provider of technologies which are helping to shape the future of healthcare solutions.

We are looking for strategic partnerships and investment opportunities that align with our core strengths and philosophy. Let's talk about how we can work together to contribute to a healthcare ecosystem of ongoing innovations in the areas of equipment, systems, and infrastructure, working together towards continuous improvement in the quality of life.

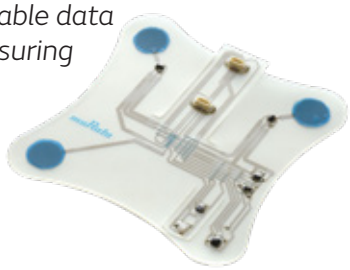
Learn more about us at murata.com, or contact us via: murata.com/contact-for-collaboration



Flexible & stretchable electronics

Multi-sensor stretchable subsystems

Flexible & stretchable electronics enable data driven medical applications while ensuring improved patient experience.



Applications

- Medical IoT solutions

Features

- Sensing on body surfaces
- Measure multiple parameter
- Stretches with body movement
- Soft comfortable material
- Semi-disposable

PICOLEAF™ flexible force sensor

Layered anisotropic piezoelectric film

Force detection with piezoelectric material in a transparent film that can be integrated within a touch panel/display.



Applications

- Wearable devices
- Touch panel

Features

- Multi-level force sensing using piezoelectric thin film technology
- Applied to a curved or flexible surface of a display or housing (ex: film OLED/metal frame)
- Seamless button operation using only pressure touch
- High transparency

Wireless power transfer

Direct-current-resonance technology

Practical advanced technology to convert DC electrical energy into electromagnetic field energy.

Applications

- Medical devices
- Wearable devices

Features

- Optimal technology for power transfer to implantable devices
- High power efficiency by novel power conversion circuit
- Simple structure
- No need for precise alignment between transmitting unit and receiving unit
- Safety & protection function

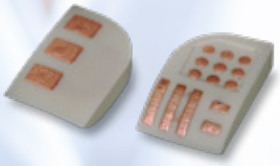
NeuroStone™

Freeform inter-connection ceramic device

NeuroStone™ enables directional free circuit module designing and contributes to miniaturization of the module.

Applications

- Medical devices
- Wearable devices
- AR/VR devices



Features

- Free shape ceramic body
- Copper electrode in any direction inside and on the ceramic
- Easy to assemble and contribute to reduce components number
- Applied to multi-directional interconnection of miniature assembly
- High reliability

Global locations

For details please visit www.murata.com



⚠Note

1 Export Control

Restriction of weapons of mass destruction and conventional weapons

Murata has established and implemented a fundamental policy regarding Security Export Control to comply with all applicable export control laws and regulations of each country where Murata operates. We are committed to follow this policy. We respectfully request our valued customers' understanding and cooperation for the following.

For customers outside Japan:

Murata requests customers to ensure that no Murata products are used or sold, through any channels, for use in the design, development, production, utilization, maintenance or operation of, or otherwise contribution to Weapons of Mass Destruction (nuclear, chemical or biological weapons or missiles), conventional weapons, or items specially designed for them.

For customers in Japan:

For products which are controlled items subject to the "Foreign Exchange and Foreign Trade Law" of Japan, the export license specified by the law is required for export.

2 Please contact our sales representatives or product engineers before using the products in this brochure for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.

1. *Aircraft equipment*
2. *Undersea equipment*
3. *Medical equipment*
4. *Traffic signal equipment*
5. *Data-processing equipment*
6. *Aerospace equipment*
7. *Power plant equipment*
8. *Transportation equipment (vehicles, trains, ships, etc.)*
9. *Disaster prevention / crime prevention equipment*
10. *Application of similar complexity and/or reliability requirements to the applications listed above*

3 Product specifications in this catalog are as of November 2020. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.

4 Please read rating and & CAUTION (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.

5 This catalog has only typical specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.

6 Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.

7 No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.

Download healthcare brochure

Read Ionizer press release

www.murata.com

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