Components for:

Wearable Devices

Sensors, wireless modules & unique technologies shaping the future of wearable electronics
More and more, we are seeing wearable electronics in our everyday lives.

At Murata we are rapidly utilizing our science and technology expertise, and focusing our R&D efforts to respond to designers of wearable devices requiring components that feature miniaturization and low power consumption.

This application guide features a series of components designed to address these requirements. Our sensors, wireless communication products and other unique solutions offer miniaturization of design, with high reliability, while addressing the requirements for low power consumption.

If this application guide does not provide the specific solution you require for your design, please contact the Murata sales office nearest you, or visit murata.com.

Let us work with you to bring your next wearable design to a reality
Sensors
High-precision, low energy sensors that perceive and react to environmental and physiological information.

Wireless
Wi-Fi®, Bluetooth®, NFC and other components for reliable wireless connections.

Unique technologies
Ultra-small size converters, crystal units and other high-performance products to provide more added-value for wearable devices.

Activity monitoring
MEMS barometer for pressure sensing
See page 4

Connectivity
Bluetooth Low Energy with built-in antenna
See page 7

Timing accuracy
Superior quality miniature crystal units
See page 12

Wearable devices
MEMS air pressure sensor

Low noise, low energy barometer can be used to measure height differential for activity monitoring

Murata’s pressure-sensing MEMS technology, with its built-in temperature drift system, can be used to accurately measure changes in height.

Features
- High precision
- Low energy
- Temperature drift system
- Small size: 2.3 x 2.6 x 0.95mm

Applications
- Navigation systems
- Activity monitoring systems
- Health care equipment
- Meteorological data collection, etc.

Temperature drift system

Reducing 0.5Pa(rms) noise level helps the sensor to achieve high-precision data monitoring.

Low noise

Conversion time | RMS noise (spec.) | Current consumption
--- | --- | ---
1/12 sec | 2.1Pa(rms) | 4.1µA
1 sec | 0.5PA(rms) | 42µA

Murata’s temperature drift system ensures that the sensor will not be affected by temperature, and will ensure correct data.

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--- | --- | ---
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Low energy

Capacity type helps sensor to achieve low current consumption, contributing to energy conservation.

Conversion time | RMS noise (spec.) | Current consumption
--- | --- | ---
1/12 sec | 2.1Pa(rms) | 4.1µA
1 sec | 0.5PA(rms) | 42µA

Murata’s temperature drift system ensures that the sensor will not be affected by temperature, and will ensure correct data.
Low profile, flexible thermistor

Highly responsive skin temperature sensing

Easily routed in complex designs the flexible film temperature sensor is ideal for sensing body skin temperature and burning of calories.

This range of surface-mounted NTC temperature sensors is packaged on a flexible printed circuit (FPC) film and measures 50.00x3.17x0.55 mm in size. With an FPC thickness of approximately 100µm, they can be easily routed inside complex designs and tight spaces. Owing to its low heat capacity, the sensor's thermal responsiveness is excellent. The film temperature sensor has been granted four patents, including one basic patent and three peripheral patents.

Features

- Low profile
- Easy to adhere to the product design
- Excellent response
- Customizable length

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPC type</td>
<td>WxL = 3 x 25~50</td>
<td>FTNT5XH103FA1A050 10kΩ/3380K</td>
</tr>
<tr>
<td></td>
<td>T = 0.55mm (max.) (includes FPC T=0.075mm)</td>
<td>FTNT55WF104FA1A050 100kΩ/4250K</td>
</tr>
<tr>
<td>Chip type</td>
<td>(head only) 1.6x0.8mm T=0.44mm</td>
<td>FTN18XH103F01RT 10kΩ/3380K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FTN18WF104F01RT 100kΩ/4250K</td>
</tr>
</tbody>
</table>

After a few minutes the measured error is less than 0.1°C

See more online

FTNT55 Press release
Optical sensor for heart rate monitoring

Vital signs & proximity sensing

This miniature proximity and illuminance sensor measures just 3.05mm x 2.1mm x 1.1mm and integrates both an optical proximity sensor and an illuminance sensor.

Heart rate monitoring
When used as a pulse oximeter, the sensor produces data to create a PPG*. This is done by illuminating the skin and measuring the changes in light absorption caused by the fluctuation in blood saturation in the tissue of the skin. It is then possible to accurately measure the wearer’s pulse.

*Photoplethysmogram (an optically obtained plethysmogram or volumetric measurement of an organ)

Features
- Low power consumption
- Small package: 3.05 x 2.1 x 1.1mm
- Contains both light receiving element and light emitting device

Specification
- **Size**: 3.05x2.1x1.1mm
- **Supply voltage**: 2.9~3.6VDD
- **Operating temperature**: -30°C ~ +85°C
- **Proximity detection**: 30mm max.
- **Illumination detection**: 0.5~128klx
- **Pulse detection**: 40~200bpm

Proximity sensing
The proximity sensor uses a photoreceptor to measure the distance to an object based on the amount of returned light. Another photoreceptor is used to detect the amount of ambient brightness. Such sensors are widely used in smartphones to darken the screen when the phone is near the user's face during a call or to increase the brightness of the screen's backlight when used outdoors.

Pulse detection

Light source

Reflective object
Bluetooth® Smart module

BLE Smart module with built-in antenna for an easy connection

As the Bluetooth® system continues to expand, Murata ensures that the latest advancements in Bluetooth® technology are available to you. This BLE Smart module provides an easy connection, saving time for design engineers.

Specification

<table>
<thead>
<tr>
<th>Part number</th>
<th>LBCA2HNZYZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>BT4.1 (BLE) module with antenna</td>
</tr>
<tr>
<td>IC</td>
<td>DA14580 (Dialog)</td>
</tr>
<tr>
<td>Size</td>
<td>7.4 x 7.0 x 1.0mm</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>2.2~2.3V</td>
</tr>
<tr>
<td>Operating temp.</td>
<td>-40°C~+85°C</td>
</tr>
<tr>
<td>Current</td>
<td>4.8/5.1mA, Tx/Rx mode @ 3.0V supply</td>
</tr>
<tr>
<td></td>
<td>0.6µA in deep sleep mode</td>
</tr>
<tr>
<td>Interface</td>
<td>UART / SPI / I2C / GPIO / ADC / Quadrature Decoder</td>
</tr>
<tr>
<td>Certification</td>
<td>FCC/IC, CE, TELEC (Japan), and Bluetooth®4.1LE (QDID)</td>
</tr>
</tbody>
</table>

External X’tal / TCXO (32.768KHz) if needed

Antenna

X’tal (16MHz)

LC Network for DCDC

Power source

UART / SPI / I2C / GPIO / ADC

Quadrature Decoder

www.murata.com

Wearable devices
Wireless Bluetooth®/Wi-Fi™

Bluetooth®/Wi-Fi™ Module

Ultra-small, resin mold package

As the Bluetooth® system continues to expand, Murata ensures that the latest advancements in Bluetooth® technology are available to you. This BLE Smart module provides an easy connection, saving time for design engineers.

Specification

<table>
<thead>
<tr>
<th>Part number</th>
<th>LBEE5KJ1CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Wi-Fi™ + Bluetooth® Ultra small package model</td>
</tr>
<tr>
<td>IC</td>
<td>Broadcom BCM4334W</td>
</tr>
<tr>
<td>Size</td>
<td>6.2 x 5.5mm x 1.2mm</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>3.2 ~ 4.5V for VBAT</td>
</tr>
<tr>
<td></td>
<td>1.8V for VIO</td>
</tr>
<tr>
<td>Operating temp.</td>
<td>-20°C~+70°C Wi-Fi™</td>
</tr>
<tr>
<td>Wi-Fi™ interface</td>
<td>IEEE802.11b/g/n compliant Bluetooth®</td>
</tr>
<tr>
<td>Wi-Fi™ interface</td>
<td>SDIO</td>
</tr>
<tr>
<td>Bluetooth® interface</td>
<td>UART, PCM</td>
</tr>
<tr>
<td>Bluetooth® interface</td>
<td>FCC/IC, CE, TELEC (Japan), and Bluetooth®4.1LE (QDID)</td>
</tr>
</tbody>
</table>

Dual side mounted, Resin mold package
NFC antenna

Designed for optimum performance ...and to save you design time

<table>
<thead>
<tr>
<th>Type</th>
<th>Part number</th>
<th>Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZB</td>
<td>FLANBPA-0023</td>
<td>20 x 15</td>
</tr>
<tr>
<td>ZB</td>
<td>FLANBPA-0060</td>
<td>32 x 12</td>
</tr>
<tr>
<td>ZB</td>
<td>FLANBPA-0060</td>
<td>40 x 10</td>
</tr>
</tbody>
</table>

Customized

<table>
<thead>
<tr>
<th>Type</th>
<th>Part number</th>
<th>Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL</td>
<td>Classical flat antenna</td>
<td>TBA</td>
</tr>
<tr>
<td>PB</td>
<td>Metal housing solution</td>
<td>TBA</td>
</tr>
<tr>
<td>FCA</td>
<td>Ferrite chip antenna</td>
<td>5.7 x 2.8 x 0.9</td>
</tr>
</tbody>
</table>

High frequency tag

Ultra-small RFID tag with LTCC technology and integrated antenna

Features
- Small size
- Save design time (embedded antenna in the substrate)
- User memory

Application
- Wi-Fi/Bluetooth pairing by NFC
Unique device Micro DC-DC

μDC-DC converter
Ultra-small power module

Murata’s micro DC-DC converters are small power modules that utilize a unique ferrite substrate with an embedded power inductor, and incorporate the I/O capacitors onto the same package. Ultra-compact size and superior noise suppression make these devices ideal for cellular and smart phones and tablets, wearable devices, communication applications, and portable products.

Features
- Small footprint buck/boost converter
- Low EMI noise by using an inductor-embedded ferrite substrate
- PFM/PWM automatic mode switching function
- Load current up to 800mA
- Wide input voltage range
- Output voltage: 0.8V – 3.3V

Integrated power inductor

One chip solution

<table>
<thead>
<tr>
<th>Series</th>
<th>Type</th>
<th>Size(mm)</th>
<th>Load current (A)</th>
<th>Input voltage (V)</th>
<th>Output voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LXDC2HL</td>
<td>Buck</td>
<td>2.5 x 2.0 x 1.1</td>
<td>&lt; 0.6</td>
<td>2.3 - 5.5</td>
<td>1.0, 1.2, 1.3, 1.35, 1.5, 1.8, 2.5, 2.8, 3.0, 3.3</td>
</tr>
<tr>
<td>LXDC2HN</td>
<td>Buck</td>
<td>2.5 x 2.0 x 1.2</td>
<td>&lt; 0.6</td>
<td>2.3 - 5.5</td>
<td>1.0, 1.2, 1.3, 1.35, 1.5, 1.8, 2.5, 2.8, 3.0, 3.3</td>
</tr>
<tr>
<td>LXDC2UR</td>
<td>Buck</td>
<td>2.5 x 2.3 x 1.2</td>
<td>&lt; 0.6</td>
<td>2.3 - 5.5</td>
<td>1.2, 1.5, 1.8, 3.0, 3.3</td>
</tr>
<tr>
<td>LXDC2XQ</td>
<td>Buck</td>
<td>2.8 x 2.6 x 1.2</td>
<td>&lt; 1.5</td>
<td>2.7 - 5.5</td>
<td>1.2, 1.5, 1.8, 2.5, 3.3</td>
</tr>
<tr>
<td>LXDC55K</td>
<td>Buck</td>
<td>5.7 x 5.0 x 2.1</td>
<td>&lt; 3</td>
<td>2.7 - 5.5</td>
<td>0.8 - 3.6 set by additional resistor</td>
</tr>
<tr>
<td>LXDC55F</td>
<td>Buck</td>
<td>5.7 x 5.0 x 2.1</td>
<td>&lt; 1.5</td>
<td>4.0 - 14.0</td>
<td>0.8 - 5.3 set by additional resistor</td>
</tr>
<tr>
<td>LXDC44A</td>
<td>Boost</td>
<td>4.0 x 4.0 x 2.0</td>
<td>&lt; 0.7</td>
<td>2.7 - 5.5</td>
<td>5.0</td>
</tr>
<tr>
<td>LXDC2HL-G</td>
<td>Buck</td>
<td>2.5 x 2.0 x 1.0</td>
<td>&lt; 3</td>
<td>5.5</td>
<td>1.0, 1.1, 1.2, 1.5, 1.8, 2.5</td>
</tr>
</tbody>
</table>
ESD protection device

**Features**
- Small size
- Ultra low capacitance
- Robustness, good repetitive performance

**Applications**
- Antenna port
- Data line

<table>
<thead>
<tr>
<th>Type</th>
<th>Part number</th>
<th>Capacitance (pF)</th>
<th>Reverse Working Voltage (V)</th>
<th>W x L (mm)</th>
<th>T (mm max)</th>
<th>Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic</td>
<td>LXES15AAA1-133</td>
<td>0.05</td>
<td>15.0</td>
<td>1.0 x 0.5</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LXES15AAA1-153</td>
<td>0.05</td>
<td>4.0</td>
<td>1.0 x 0.5</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LXES03AAA1-134</td>
<td>0.035</td>
<td>6</td>
<td>0.6 x 0.3</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LXES03AAA1-154</td>
<td>0.05</td>
<td>4.0</td>
<td>1.0 x 0.5</td>
<td>0.33</td>
<td>Under development</td>
</tr>
<tr>
<td>Silicon</td>
<td>LXES1UTAA1-157</td>
<td>0.5</td>
<td>6.0</td>
<td>1.0 x 0.6</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LXES03TBB1-141</td>
<td>0.45</td>
<td>5.5</td>
<td>0.6 x 0.3</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LXES03TAA1-142</td>
<td>5</td>
<td>5.5</td>
<td>0.6 x 0.3</td>
<td>0.23</td>
<td></td>
</tr>
</tbody>
</table>

ESD + common-mode choke

**Features**
- Common mode choke filter (60ohm@100MHz)
- ESD protection per IEC61000-4-2

**Applications**
- Antenna port
- Data line

<table>
<thead>
<tr>
<th>Part number</th>
<th>Capacitance (pF-typical)</th>
<th>Common mode impedance (Ω)**</th>
<th>L x W (mm)</th>
<th>Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>LXES11DAA2-135</td>
<td>0.4</td>
<td>60</td>
<td>1.25 x 1.00</td>
<td></td>
</tr>
<tr>
<td>LXES11DAA2-137</td>
<td>0.4</td>
<td>35</td>
<td>1.25 x 1.00</td>
<td></td>
</tr>
<tr>
<td>LXES21DAA4-136</td>
<td>0.4</td>
<td>60</td>
<td>2.0 x 1.25</td>
<td></td>
</tr>
<tr>
<td>LXES21DAA4-138</td>
<td>0.4</td>
<td>35</td>
<td>2.0 x 1.25</td>
<td></td>
</tr>
<tr>
<td>LXES21DAA4-140</td>
<td>0.4</td>
<td>90</td>
<td>2.0 x 1.25</td>
<td></td>
</tr>
</tbody>
</table>
Crystal units
Ultra-small timing devices

Crystal units are made of high stability piezoelectric quartz crystal that function as a mechanical resonator. With the advance of the IC technology, various equipment may be controlled by a single LSI integrated circuit, such as the one-chip microprocessor. Crystal units can generate clock signals which are essential for ICs and LSIs to operate, achieving high stability, adjustment-free performance and miniaturization.

<table>
<thead>
<tr>
<th>Product type</th>
<th>Package size</th>
<th>Frequency (representative)</th>
<th>Tolerance</th>
<th>Suitable for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal unit Tight tolerance type</td>
<td>1.6x1.2mm 2.0x1.6mm</td>
<td>24/26/32/37.4/40/48Mhz others</td>
<td>[Initial] +/-10ppm [Freq. shift by temp] +/-10~15ppm</td>
<td>Wifi Bluetooth ACPU Low power Micon Sensor hub</td>
</tr>
<tr>
<td>Crystal unit Low cost type</td>
<td>2.0x1.6mm</td>
<td>24/26/27/27.12/32/48Mhz others</td>
<td>[Initial] +/-20ppm, +/-30ppm [Freq. shift by temp] +/-20ppm, +/-40ppm</td>
<td>BT Low energy NFC ACPU Low power Micon Sensor hub</td>
</tr>
</tbody>
</table>

Ceramic resonators
Compact high-density timing devices

Ceramic resonators (CERALOCK®) are made of high stability piezoelectric ceramics that function as a mechanical resonator.

<table>
<thead>
<tr>
<th>Product type</th>
<th>Package size &amp; Frequency</th>
<th>TTL tolerance (initial + T.C + Aging)</th>
<th>Suitable for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic resonator Built-in cap type</td>
<td>4.5x2.0mm for 4/6Mhz, others 3.2x1.3mm for 8/12/16Mhz, others</td>
<td>+/-0.8%</td>
<td>Low power Micon Sensor hub</td>
</tr>
<tr>
<td>Ceramic resonator No built-in cap type</td>
<td>3.3x1.6mm for 4/6Mhz 2.0x1.6mm for 8/10/12Mhz</td>
<td>+/-0.8%</td>
<td>Low power Micon Sensor hub</td>
</tr>
</tbody>
</table>

Features
- Advanced small packaging technology
- High quality quartz crystal material
- Tight tolerance type high precision

Features
- Low power consumption by low frequency oscillation
- Advanced ceramic material technology
- Diversified products
Ultra-small passive components (008004)

Using expertise in raw materials and production techniques, the 008004 (0.25*0.125mm) capacitor, inductors and ferrite beads were successfully developed. These ultra-small size parts support wearable devices for compact design areas.

Multi layer ceramic capacitor
The ultra-small design was made possible by improving the materials and the printing, pressing and cutting operations.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Cap</th>
<th>Rated voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>X5R</td>
<td>~10nF</td>
<td>6.3V</td>
</tr>
<tr>
<td>CH/C0G</td>
<td>~1pF</td>
<td>25V</td>
</tr>
</tbody>
</table>

Inductors

Specification
- L: 1.0 – 5.6nH
- Q: above 5 (at 500MHz)

Features
- High Q value
- Design with small capacitor used in RF circuit, enables miniaturization of your design and add more functionality.

Ferrite beads

Features
- Unique of High precision and high range
- Electrode formed technology and high precision laminated technology realized small size products.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Resistor</th>
<th>Rated current</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLM01AX100SN1</td>
<td>100Ω(Typ)</td>
<td>400mA</td>
</tr>
<tr>
<td>BLM01AX330SN1</td>
<td>33Ω±25%</td>
<td>200mA</td>
</tr>
<tr>
<td>BLM01AX121SN1</td>
<td>1200Ω±25%</td>
<td>100mA</td>
</tr>
</tbody>
</table>

www.murata.com
Product line-up

- Filters
- Baluns
- Diplexers
- Dividers
- SAW filters
- Receptacle
- RF cable plug
- WiFi™ module
- Bluetooth® module
- Bluetooth®/Wi-Fi™ combo module
- NFC antenna
- Cellular
- Connectivity
  - Bluetooth®/Bluetooth® Smart
  - WiFi™
  - GPS
- NFC
- Power converter
- μDC-DC converter

Wearable devices

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Product line-up

- Air pressure sensor
- Optical sensor
- Thermistor
- Ultra small size capacitor
- Inductor ferrite beads
- Speaker
- Display
- Sensor
- Peripheral interface
- Battery
- CPU
- Crystal
- Thermistor
- ESD protection device
- Ultra small size capacitor
- Inductor ferrite beads

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Wearable devices
Note

Export Control

For customers outside Japan:

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

Product specifications in this catalog are as of March 2014. 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.

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

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

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