

Strategy by product: Components

Net sales **1,051.7** billion yen YoY change Down **4.8**%

Capacitors

Main products Multilayer ceramic capacitors, Polymer aluminum electrolytic capacitors, Silicon capacitors, High temperature film capacitors for automotive, etc.

Operating results

Sales of multilayer ceramic capacitors increased for cellular phone base stations, driven by moves to introduce 5G systems, and from uses in car electronics, but declined year on year overall due to weakness in demand for wide-ranging uses, affected by moves to adjust production of electronics devices and inventory of electronic components.



Multilayer ceramic capacitors

Business Opportunities

- New demand for communication infrastructures driven by growing use of 5G and demand for small-size, large-capacity products for communication devices
- Increased demand for automotive uses driven by growing use of advanced driver assistance systems (ADAS) and self-driving vehicles, and the introduction of electric vehicles

Risks

- Responses to short-term demand fluctuations amid an uncertain market outlook
- Medium-term slowdown in the overall electronics market in case of a medium- to long-term slump in the global economy

Initiatives in the capacitor business

As demand for chip multilayer ceramic capacitors (MLCC) continued to grow globally over a few years through fiscal 2018, Murata worked to expand production capacity, reviewed product portfolios and increased supply volumes.

Unfortunately, net sales slumped due to uncertainty over the global economic outlook in fiscal 2019. The market recovery has proven to be weaker than we had expected in fiscal 2020 as consumption

and production remain in the slump, affected by the spread of COVID-19. Accordingly, we expect net sales to remain at these levels for a short term. Still, there has been an increase in demand for MLCCs in some markets in the first half of fiscal 2020, against the backdrop of demand related to people working remotely or staying at home. Murata, which operates in diverse markets and has business with a broad range of customers, has been working to support supply to customers and put its production capacity to maximum utilization by adjusting product and customer mixes.

In the meantime, over the medium-term, we are expecting to see new demand for applications in communications infrastructure along with the spread of 5G, in addition to increased demand for compact large-capacity products for use in communications devices and highly reliable products for use in automobiles. We are allocating management resources to products that address such demand and developing new products, while also implementing initiatives to enhance productivity by promoting the use of smart factories. In addition, we will enhance our range of capacitors to address the diverse needs of our customers, add non-ceramic products such as film capacitors, silicon capacitors to our portfolio, and offer new solutions with high reliability suitable for usage environments in the automotive and healthcare/medical markets.

Chip multilayer ceramic capacitors for consumer

The chip multilayer ceramic capacitor (MLCC) is an electronic component with external electrodes electrically and mechanically bonded to a substrate, attached to repeatedly stacked internal electrodes and ceramic dielectrics such as titanium oxide and barium titanate. It is a highly reliable nonpolar capacitor with high withstanding voltage and insulation resistance, superior frequency and heat-resisting characteristics, and long service life.

MLCCs are employed in mobile equipment and home appliances as well as IT devices and network infrastructure equipment, they can temporarily store and discharge electricity, absorb noise in signals, extract signals with certain frequencies, and block direct current and pass alternating current only. MLCCs are also used for applications for which high reliability is required, including automotive, medical, and aerospace equipment. In particular, 600 to 1,000 MLCCs are used in one high-end smart phone. Even low-end or midrange models use 300 to 600 MLCCs per unit.

Regarding MLCCs for consumer devices, to meet market demands particularly for those smaller in size, various products have been developed and have become highly competitive capacitors. Recently, the main product size has shifted from 1005M (1.0×0.5 mm) to 0603M (0.6×0.3 mm) and for wearable devices and small modules, consideration for adoption of 0201M (0.25×0.125 mm), the smallest size commercialized in 2014, has been increasing. Since market needs are expected to grow further for smaller components and high-density mounting, Murata will continue to improve its ceramic material pulverization and multilayer technology and propose new product design and easier-to-use solutions.

Chip multilayer ceramic capacitor for automotive

For MLCCs used in automotive application, stricter regulations have been set than those of consumer product MLCCs in the areas of product material selection, design standards, product performance, and process management to achieve higher

reliability and longer product life, even though materials and processes are generally the same as those in consumer MLCCs.

MLCCs have been increasingly adopted for safety applications such as airbags and antilock braking systems (ABS), in addition to hybrid and electric vehicles. Moreover, components employed by many customers are becoming smaller and the main size is shifting to 1005M (1.0×0.5 mm) from 1608M (1.6×0.8 mm). Also, these satisfy requirements of temperature cycling tests and high-temperature and high-humidity load tests at 150°C, a step up from the previous guarantee of 125°C. Furthermore, more products meet requirements specific to in-vehicle applications regarding static electricity and surge tests (ISO7637-2). Recently, products that can be used in higher temperature environments are in demand.

To respond to tough market demands as stated above, Murata has developed more reliable materials, ensured product design margins, and established strict inspection standards for the production process to realize highly reliable products suited to use environments. In 2017, Murata succeeded in commercialization of lead-type resin-coated MLCCs resistant to 200°C, and customers are considering adoption. Furthermore, various types of MLCCs according to the use environments have been commercialized, such as water-repellent products and MLCCs with metal terminals jointed.

Also in automotive MLCCs, Murata will continue to create new value for society by developing ceramic materials and improving process and inspection technologies toward creating smaller, more highly reliable, and higher-performance components.

Moreover, there is a strong desire in the in-vehicle system market for the stable supply of Murata's highly reliable components, and to respond to such expectations as the market leader, we are making a maximum equipment investment at domestic and overseas plants. Murata will continue to deliver products with safety and security by identifying customers' product and supply needs as a continuously trusted company.

TOPICS

Measures to prevent COVID-19 in the capacitor business

Since the risk of COVID-19 infections has emerged, Murata has worked to implement infection prevention measures for employees as the top priority. Although there were confirmed cases of infection at some business sites, causing concern for many people including local residents, we prioritized safety of employees and suspended operation for a few days, thoroughly sanitizing the facilities and implementing infection prevention measures.

Because our main plants are located in Japan, China, the Philippines and Singapore, infection risks differ from country to country and the governments of these countries have different policies against infection, we have adopted a policy to allow the management of each local operation to make judgment and take measures they believe are optimum in accordance with changing situations. We have also worked to maintain favorable relations with the local community by donating face masks and hazmat suits via local governments.

On the other hand, as capacitors are components used in wide-ranging electronic devices, Murata takes it as our responsibility to prevent disruption in supply of products as much as possible for society and our customers. We aim to conduct production activities while seeking to strike the right balance and taking the required precautions against the risk of infection while operating our facilities to meet our commitments to our customers and our employees.

We temporarily experienced restrictions on purchase of materials and components and shipment of our products due to an impact on logistic networks but have maintained or restarted production activities with help from partner companies and collaborating with them.

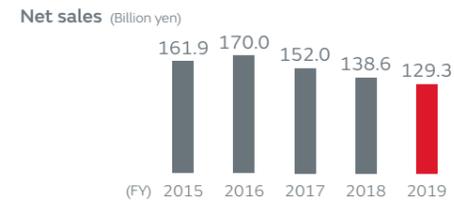
We aim to continue to take measures to reduce infection risk for everyone involved in Murata's capacitor business, prioritize safety, and continue to provide necessary support to customers, while at the same time doing all we can to prevent disruption to production activities (please see p.56).

Piezoelectric components

Main products SAW filters, Ultrasonic sensors, Resonators, Piezoelectric sensors, Ceramic filters, etc.

Operating results

Net sales dropped year on year as sales of SAW filters for smart phones fell due to falling prices.



SAW filters



Business Opportunities

- Emergence and expansion of new applications and communication devices for 5G
- Increasing demand for higher frequency and smaller filters with superior composite performance

Risks

- Intensified competition with other manufactures and entry by Chinese manufacturers into the SAW filter market
- Potential moves by customers and component suppliers due to U.S.-China trade friction

SAW filters are an essential component for eliminating communications noise to provide a smooth experience for enjoying online content on a smart phone. Murata's SAW filters, with state-of-the-art technologies, are actively working inside various communication terminals including smart phones.

Murata has led the industry for a long time by making use of the R&D structures that can create unique technologies, and distribution channels

seamlessly supporting the entire world. At present, Murata holds the largest production capacity in the industry, and has secured a global share of 50% of the SAW filter market for communications applications.

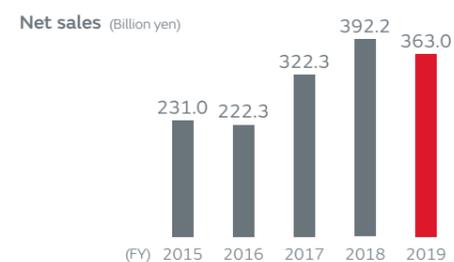
5G services with transmission speed more than 100 times faster than current 4G technologies are expected to be commercialized in earnest in 2020, raising expectations for the birth and expansion of new applications and communications devices. Increasingly smaller and higher-frequency SAW filters with superior composite performance will be a requirement. In response to these market needs, Murata will accelerate efforts to create compact products with superior features by utilizing proprietary I.H.P. technologies, TC-SAW technologies, while working to strengthen alliances in new technologies. Murata aims to contribute to the development of society and industry by working to differentiate our future product line-up from those of competitors, striving to maintain or build optimum supply structures corresponding to supply-demand balances amid a wildly fluctuating economy.

Other components

Main products Inductors (coils), EMI suppression filters, Connectors, MEMS sensors, Thermistors, Lithium-ion batteries, etc.

Operating results

Although sales of inductors (coils) for smart phones and PCs increased, sales of lithium-ion batteries for smart phones and power tools were sluggish, resulting in a year-on-year decline in sales.



Inductor (coil)



Business Opportunities

- Increased demand and higher performance due to the introduction of 5G-compatible smart phones
- Electrification of automobiles and electrification through ADAS and automated driving

Risks

- Stable supply to meet increasing demand due to the introduction of 5G

A chip inductor is one of the passive components that make up an electronic circuit, along with a capacitor and a resistor. Major products include power inductors used for the power supply circuit and RF inductors used for the high-frequency circuit.

Power inductors are largely related to power conversion efficiency, which is an important performance of dc-dc converters, and the required performance differs depending on the property of the relevant converter to be used. In addition to traditional processes such as ferrite windings and ferrite multilayer, Murata has added the Metal Alloy process owned by Saitama Murata Manufacturing Co., Ltd. (formerly: TOKO, INC.), which became our wholly owned subsidiary in 2016, to its product lineup to achieve further miniaturization and increased performance as well as well-balanced performance at high currents, which is a characteristic of metal alloy technology, and stable performance during operation. By taking advantage

of such higher performance of power inductors and Murata's monozukuri (manufacturing) capabilities as our strength, we are growing our business areas while expanding our sales channels not only into the communications market but also into the in-vehicle system market.

RF inductors are expected to be used as an inductor for high-frequency circuits for 5G communications. The product series that uses the film manufacturing method, which is Murata's unique process, has been highly regarded due to their unparalleled characteristics, which are compact and have a high Q (quality factor) value, and adopted in many high-frequency circuits. As for 5G communications, the market is expected to expand for RF inductors through their use not only in conventional smartphones but also in new applications such as IoT, and it is considered that the quantity of RF inductors used will increase. Meanwhile, the market for RF inductors is also expanding in the automotive field due to the shift toward electrification such as the introduction of electric vehicles and ADAS and the addition of advanced communication functions of automobiles such as telematics and V2X. As for RF inductors, which are characterized by compactness and high performance, Murata is expanding its lineup of highly reliable designs for automotive applications. With the demand for inductors significantly increasing, we will strive to grasp the market trends and promote the expansion of our production capacity in order to provide a stable supply to meet the demand of our customers.

Lithium-ion batteries



Business Opportunities

- Trends toward cordless power tools and gardening tools, and shift from gasoline engines to batteries and motors
- Small batteries for automotive, medical and wearable applications
- Utilization of natural energy, in-house consumption of electricity, and backup power supplies such as data centers

Risks

- Entry of South Korean and Chinese competitors into Murata's target markets

electric bicycles, and cleaners. Moreover, the use of coin type batteries for wristwatch and automotive applications and in fields such as the medical field is increasing due to their compactness and high reliability.

The fiercely competitive environment is expected to continue in the lithium-ion battery market but Murata will address market and customers' needs by supplying Murata's products that combine safety and high output. In addition, by integrating storage battery modules equipped with cylindrical cells with power converter technology, etc. to provide an energy management system centered on the housing and industrial markets, we will promote utilization of natural energy.

In the future, we are planning mass production of fully solid-state batteries, which are expected to act as next-generation batteries. We shall develop our business primarily around applications in areas such as wireless earphones and wearables, by applying the manufacturing technologies that we developed for multilayer ceramic capacitors.

In the lithium-ion battery market, the demand is expected to grow continuously. We will provide batteries that can satisfy our customers and society by leveraging the competitive advantages of our batteries, such as high safety and high input/output characteristics.

Strategies by product: Modules

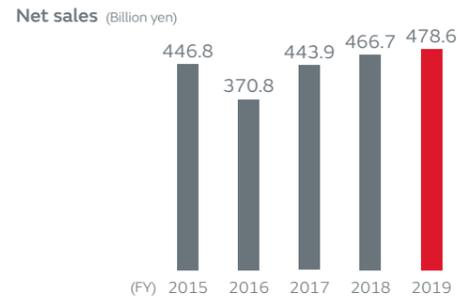
Net sales **478.6** billion yen YoY change Up **2.6%**

Modules

Main products Connectivity modules, MetroCirc™, RF modules, Power supply modules, etc.

Operating results

Sales increased year on year as RF modules for smart phones significantly grew despite a decrease in MetroCirc™ and connectivity modules for high-end smart phones.



Connectivity modules



Business Opportunities

- Spread of 5G
- Full-fledged consideration of Beyond 5G
- In an IoT society, automobiles and various types of devices will have wireless communication functions.

Risks

- Intensified competition among competitors
- Saturation of the demand for smart phones

Connectivity modules are essential compound components that wirelessly connect various devices. These are mounted on familiar home appliances used in our daily lives, such as smart phones, tablet PCs, digital cameras and air conditioners, in-vehicle devices such as car navigation systems and in various settings, including enabling users to download and upload photos and music from the Internet, and hands-free calling while driving.

With the rapid progress of the IoT society where all types of objects around us are connected to the Internet, new wireless communication standards such as WiFi® 11ax, Cellular LPWA (Low Power Wide Area) and UWB (Ultra Wide Band) are also expected to spread. In the automotive market, the installation of wireless communication functions and the evolution of communication functions are advancing

every year under the keyword CASE (Connected Autonomous Shared & Services Electric).

5G services launched this year. 5G includes communications using millimeter wave bands, namely 28GHz and 39GHz, and Murata can offer high-property communication modules that use proprietary multilayer resin substrates to keep transmission loss low. Discussions regarding Beyond 5G (6G) standards have already started and we can expect that a world in which everything can be connected through higher-speed communications will be further expanding.

The growth of smart phones, which has been significantly rapid so far, is expected to slow down in the future, at the same time, competition among competitors is intensifying. Under such circumstance, Murata's connectivity modules continue to provide value in response to various changes, such as 5G and new communication standards, by taking advantage of our strengths including proprietary multilayer resin substrates technology, and design technologies to realize compactness, higher-performance, high-reliability, and software technologies to enhance connectivity, we will build a partnership that makes us the customers' number one choice by promptly supplying products that comply with all wireless communication standards. We will contribute to the development of an IoT society as our mission in creating the future of electronics.

MetroCirc™



Business Opportunities

- Expansion of the high-frequency communications market as represented by 5G
- Resolution of customers' issues by utilizing the characteristics of MetroCirc™, such as low water absorption and shape retention property

Risks

- Intensified competition
- Changes in the demand due to changes in customers' design

MetroCirc™ is a thinner multilayer resin substrate comprising LCP (liquid crystal polymer) sheets.

It is characterized by exceptional RF characteristics, low water absorption, and the ability to handle a flexible bending process because it does not require an adhesive layer, and high multiple layers are possible by using Murata's multilayer technology.

It is possible to design circuits by inserting copper foil sheets between LCP sheets, and these circuits are used as transmission wires, coils, and other functional components in smart phones, wearable devices, and other applications, contributing to smaller, thinner, and higher performance devices.

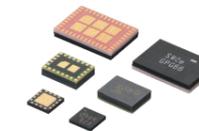
Millimeter waves and other high-frequency waves are used in 5G, which has widely spread, so it may be expected that MetroCirc™ will be further used in substrates for millimeter wave modules, millimeter wave transmission lines, and other applications that utilize the low transmission loss properties at high frequencies that is a feature of MetroCirc™.

In addition, we believe that there will be more opportunities for a wide range of customers to favor MetroCirc™ in the future as the frequencies used become higher, because this will further highlight MetroCirc™'s competitive superiority in terms of transmission loss compared with competing technologies, and we believe that we can take the lead even in an increasingly competitive environment.

Looking ahead, it is likely that customers will face more issues related to high-frequency communications as the number of devices using 5G increases; however, by using MetroCirc™, which has the strengths mentioned above, we can make a variety of proposals depending on customers' designs and issues.

We will further contribute to resolving customers' issues, through the combination of high-performance materials and Murata's unique ideas, developed based on our multilayer technology.

RF modules



Business Opportunities

- Spread of 5G
- Modularization of electric components

Risks

- Potential moves by customers and component suppliers due to U.S.-China trade friction
- Entry of low-price module manufacturers into the market

RF modules are multifunctional and high-performance electronic component units that realize an analogue high-frequency circuit that controls communications among wireless devices by integrating various key devices.

This module is comprised of passive devices such as SAW filters that demultiplex high frequencies and LC filters, high power amplifiers in transmission, low distortion amplifiers in reception, antenna changeover switches, and other semiconductor devices, and is actively used for various types of wireless devices including smart phones and tablet PCs.

Murata, which internally develops various key devices that form the basis for module configuration and package technologies for modularization, is able to carry out integrated production. As a result, Murata has a strong competitive advantage in terms of business speed, production capability, and quality, in addition to performance.

With the arrival of 5G, which enables "high-speed large-capacity communication," "multiple

concurrent connection communication" and "low latency real-time communication," RF modules for realizing further high frequency, expansion of frequency bands and dual connectivity, in addition to multiple frequency bands and carrier aggregation for communication systems up to 4G, will become necessary. In addition, the modularization of electronic components is expected to advance in line with the miniaturization and increased functionalities of wireless devices.

It is expected that the unique benefits of 5G are to promote the diversification of IoT devices and bring many conveniences to life and work. We consider that the expansion of IoT devices brought about by 5G will expand business opportunities not only with customers specializing in the communications market, such as smart phones and tablet PCs, but also with customers in new markets that we have not been involved with before.

In the 6G era, which is also called Beyond 5G, "ultra-low power consumption" and "ultra-reliable communication" are required. In order to survive in the global competition, we will continue to strengthen our "high technological capabilities" and "high-quality monozukuri (manufacturing)" that are the pride as a Japanese company that Murata has cultivated over the years.

Murata will promptly identify future market and customer needs, while also leveraging our competitive advantages to propose RF modules most suitable to customers, as we aim to be a company selected by customers.