

# Strategy by product (Components) Net sales 924.1 billion yen YoY Up 21.3%

## Capacitors



### Main products

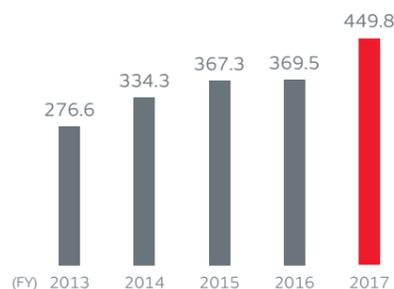
Multilayer ceramic capacitors,  
Polymer aluminum electrolytic capacitors,  
Trimmer capacitors, Supercapacitors,  
Single layer microchip capacitors,  
Variable capacitors, Silicon capacitors,  
High temperature film capacitors for automotive,  
etc.



### Operating results

For fiscal 2017, sales of multilayer ceramic capacitors (MLCCs) for communications equipment, the main product in this category, grew significantly as demand increased in a broad range of applications. New products for new smartphone models achieved much higher sales, as did MLCCs for car electronics as a result of progress in vehicle electrification. As a result, overall net sales increased to 449.8 billion yen (up 21.7% year-on-year).

Net sales (Billion yen)



### Initiatives in the capacitor business

Murata is reviewing fair prices of MLCCs in addition to its product portfolio to respond to rapidly growing demand for capacitors. Also, Murata has been developing new products ahead of competitors and expanding a global production system while maintaining high quality.

To expand the boundaries of the capacitor business, we will add film capacitors, silicon capacitors, and other non-ceramic products to our portfolio and offer new proposals with high reliability suitable to use environments in the automobile 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 devices and home appliances as well as IT devices and network infrastructure equipment as 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 smartphone. Even low-end or midrange models use 300 to 600 MLCCs per unit.

Regarding consumer MLCCs, 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 (1.0X0.5 mm) to 0603M (0.6X0.3 mm) and for wearable devices and small modules, consideration for adoption of 0201M (0.25X0.125 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.

Demands for MLCCs are rapidly expanding in every market. Murata will expand its business, centering on small products with large capacities for which production is difficult for competitors due to material and technical issues.

### Chip multilayer ceramic capacitor for automotive

For automotive MLCCs, stricter regulations have been set out than those of consumer 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 ABS in addition to hybrid and electric vehicles that have become increasingly widespread, and production of these packages is rapidly increasing. Moreover, components employed by many customers are becoming smaller and the main size is shifting to 1005M (1.0X0.5 mm) from 1608M (1.6X0.8 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 which can be used in higher temperature environments are in demand.

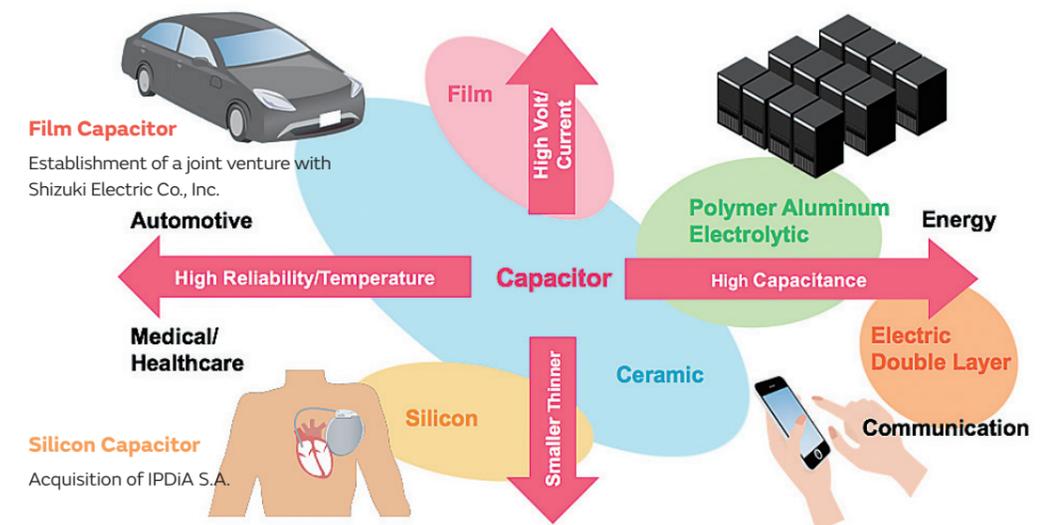
To respond to tough market demands as stated above, Murata has developed more reliable materials, ensured

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 products resistant to 200°C despite the use of lead type resin-coated MLCCs, and customer companies 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 joined.

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 automotive market for the stable supply of Murata's highly reliable components, and to respond to such expectations as the market leader, we are making maximum equipment investment at domestic and overseas plants. Murata delivers products with safety and security by identifying customers' product and supply needs as a continuously trusted company.

Murata capacitor field



# Strategy by product (components) Net sales 924.1 billion yen YoY Up 21.3%

## Piezoelectric components



### Main products

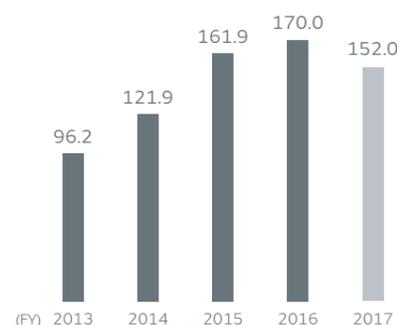
SAW filters, Ultrasonic sensors, Resonators, Trimmer capacitors, Piezoelectric sensors, Ceramic filters, etc.



### Operating results

For fiscal 2017, substantial reductions in the production and prices of Chinese smartphones caused a sharp sales decline for SAW filters. As a result, overall net sales were 152.0 billion yen (down 10.6% year-on-year).

Net sales (Billion yen)



## SAW filters

Murata's SAW devices are actively working inside smartphones and other devices by using the state-of-the-art technologies to reduce noise during communication and create an environment where users can enjoy SNS and other services without stress.

Applying the surface acoustic wave (SAW) discovered by an English seismologist, Murata has continued to offer the very best products from the early 1980s by making use of original materials, the latest production facilities, the most advanced R&D structures, and distribution channels seamlessly supporting the entire world. Currently, Murata holds the majority of the market share of SAW devices for smartphones.

With the 2020 Tokyo Olympics, 5G service with transmission speeds 100 times faster than current technologies will be fully commercialized. With this trend, increasingly smaller and higher frequency SAW devices with superior composite performance will be a requirement. Murata has been leading the world in responding to these market needs by making use of the most advanced circuit simulation technology and multi-layer technology. We will enhance our presence as a pioneer of SAW devices in the future by improving the lineup of I.H.P. SAW devices in addition to existing SAW devices.

## Ultrasonic sensors

For half a century, Murata's ultrasonic sensors have supported external environment recognition with ultrasonic sensors using its device technology. Murata has accumulated original technologies such as piezoelectric ceramics and sound designs of sensors for various applications, including consumer and industrial uses. Using Murata's unique knowledge as stated above, Murata will continue to respond to advanced market needs through technology development and proposals for new devices.

Regarding automotive uses, demand for ultrasonic sensors is rapidly increasing as sensors indispensable to the evolution of vehicles in areas including automatic parking and starter inhibitors, have advanced from proximity warning applications for parking support. We intend to develop new products which cover both short and long distances with one sensor and contribute to the development of safe and comfortable cars.

In the IoT sector that includes products such as smartphones, AI speakers and HEMS/BEMS, which are expected to grow, ultrasonic sensors are one of the important options as sensors that detect user movement while securing privacy. Murata is carrying out new development for realizing much smaller products and enhancing resolution, including SMD ultrasonic sensors which we were the first in the world to commercialize.

## Other components



### Main products

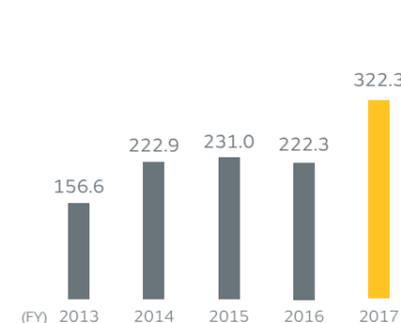
Inductors (coils), EMI suppression filters, Connectors, Sensors, Thermistors, Lithium-ion batteries, etc.



### Operating results

For fiscal 2017, this segment achieved substantial sales growth due to growth in demand for coils, EMI suppression filters, and MEMS sensors for automotive electronics. The lithium-ion battery business also contributed to success, with the acquisition process from Sony Corporation being completed in September 2017. As a result, overall net sales were 322.3 billion yen (up 45.0% year-on-year).

Net sales (Billion yen)



## Inductors (coils)

Chip inductors are passive components that are a part of electronic circuits, alongside capacitors and resistors. Typical products include power inductors used for power supply circuits and RF inductors used for high frequency circuits.

Power inductors are deeply related to power conversion efficiency that is important in the performance of DC-DC converters, and performance required for products is different depending on circuit systems in DC-DC converters and operating conditions. Therefore, Murata applied a multilayer process and ferrite winding process to commercialize power inductors suitable for target applications and use conditions and has delivered these to the markets.

Through business integration with TOKO, Inc. in 2016, Murata introduced the Metal Alloy winding process and realized smaller and higher performance products. Also, Murata differentiates itself from other companies through advantages including well-balanced performance compatible with large currents that is a feature of Metal Alloy technology, and excellent performance stability during operation. As for RF inductors, we have obtained a large market share by delivering various kinds of products which enable downsizing, as smartphones have replaced conventional mobile phones. Recently, the number of electronic parts used for vehicles has been increasing further due to the shift to EV, ADAS, and automated driving. In response, Murata will expand the lineup of compact inductors with high performance and high reliability and meet market needs.

## Lithium-ion batteries

Murata's lithium-ion batteries are classified into laminated or cylindrical type batteries. Laminated type batteries are mainly employed for mobile devices as sizes can be freely changed owing to the laminate film exterior material. Murata uses leakage-free gel electrolytes with high safety characteristics, which do not easily swell compared to liquid electrolytes used by other companies. Murata's cylindrical type batteries have advantages particularly in high output applications widely used for gardening tools, power tools, electric bicycles, cleaners, and other fields.

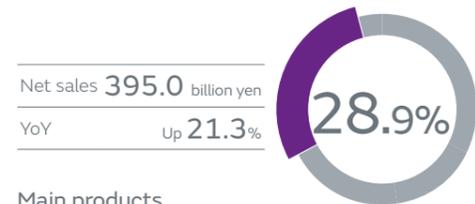
Murata intends to grow by appealing to customers with higher safety for the laminated type and by continuing differentiation with higher output for the cylindrical type in gardening tool and other markets where electrification is accelerating. In addition, by integrating battery modules with cylindrical cells, and the efficient power converter technology and sensor network technology owned by Murata, we will provide an energy management system centered on the housing and industrial markets.

Murata will carry out these initiatives by integrating Murata's production technology and processes and Sony's knowledge on batteries and battery materials.

## Strategy by product (modules)

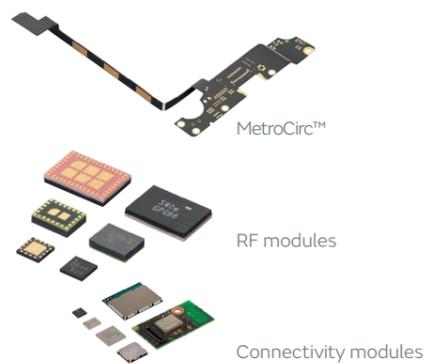
Net sales **443.9** billion yen YoY Up **19.7%**

### Communication modules



#### Main products

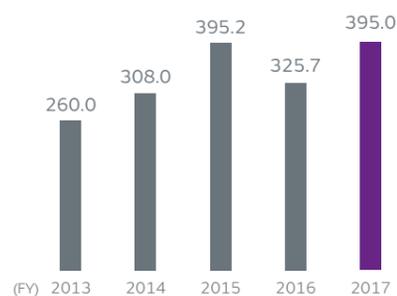
Connectivity modules, RF modules, MetroCirc™, etc.



#### Operating results

For fiscal 2017, circuit ceramic modules and RF sub modules for high-end smartphones faced sluggish sales due to a reduction in the Murata share of orders won from a specific customer. However, short-range wireless communication modules for products such as smartphones and personal computers were successful. Sales in multilayer resin substrates also achieved substantial growth as an increasing number were used in high-end smartphones. As a result, overall net sales were 395.0 billion yen (up 21.3% year-on-year).

Net sales (Billion yen)



### Connectivity modules

Connectivity modules are compound components for wirelessly accessing the Internet or other devices from various devices.

These are used in various types of familiar devices such as smartphones, tablets, digital cameras, home appliances, and car navigation systems, and enable users to download and upload photos and music from the Internet, call hands-free while driving, and confirm air conditioner operation and turn switches on and off remotely.

An IoT society where all types of objects around us are connected to the Internet is just around the corner. In this IoT society, various types of devices will have wireless communication functions. Requirements vary depending on use such as low power consumption, high-speed data communication, high reliability, and low profile.

Murata provides products compatible with new communication technologies such as WiFi, 5G, and V2X through design technologies for smaller and higher performance products alongside software technologies to enhance connectivity, while contributing to the development of an IoT society as our mission in creating the future of electronics.

#### MetroCirc™

MetroCirc™ is a multilayer resin substrate comprising resin sheets using LCP film and copper foil sheets stacked in many layers employing Murata's multilayer technology. It has exceptional RF characteristics and does not require any adhesion layer, making it thinner. Furthermore, it facilitates a flexible bending process and is thus said to be an origami-like substrate. Through various circuit designs, it can function not only as a substrate but also as a transmission wire component, or have integrated coil functionality. Thanks to these characteristics, it contributes to smaller, thinner, and higher performance smartphones and wearable devices.

Because of its RF characteristics and low transmission loss properties, MetroCirc™ will prove its worth and is expected to expand its uses for various applications including substrates for millimeter wave modules, millimeter wave transmission lines, and wired high speed differential transmission lines. Murata will continue to offer high value added products for resolution of customer issues by making the most of Murata's advanced film and multilayer technologies.

### RF modules

Murata's 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 which 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 smartphones and other mobile phones and tablet PCs.

With the arrival in the future of the high speed and large capacity 5G service, which will enhance people's

quality of life, RF modules for realizing dual connectivity in addition to multiple frequency bands and carrier aggregation will become necessary.

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.

Murata will leverage these competitive advantages to propose RF modules most suitable to new markets and customer needs and aim to be a leading company to be selected by customers.

### Power supplies and other modules



#### Main products

Power supplies, etc.

#### Operating results

For fiscal 2017, power supplies mainly for office automation equipment recorded sales growth. As a result, overall net sales were 48.9 billion yen (up 8.3% year-on-year).

Net sales (Billion yen)



### Power supply modules

Changes in the business portfolio of power supply module business are currently underway. Murata continues in its process to divest the conventional custom power supply business and aims to develop high value added products by utilizing Murata's strengths as differentiating factors.

Murata's power supply modules featuring high reliability, high efficiency, and high power density are used for markets including servers, datacom, communications devices, in-vehicle systems, and industrial electrical equipment.

In the future, 5G service will be common in the communications device market where data traffic will increase from the expansion of big data. Also, in the in-vehicle system market, as the range of electronic components grows with higher functionality, highly efficient, compact power supplies with higher power density will increasingly become requirements.

To meet these market demands, Murata will provide compact power supply modules developed by integrating power circuit technologies, RF technologies, self-manufacturing of key devices, and highly reliable packaging technologies accumulated over many years, as well as highly efficient, high power density power supply systems as power supply solutions combined with batteries to contribute to both increased functionality and energy saving of electronic devices.



DC-DC converters