

Semiconductor Devices



Microwave Application Products

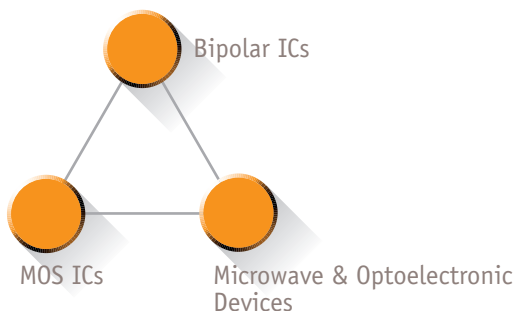


Microwave Tubes and Radar Components

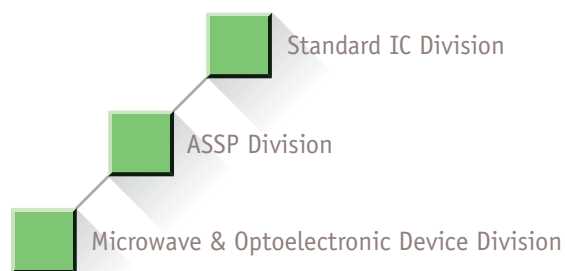


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Products in our semiconductor devices are mostly analog semiconductors, classified broadly into bipolar ICs, MOS ICs, and microwave & optoelectronic devices.



These semiconductor products are handled by the Standard IC, ASSP, and Microwave & Optoelectronic Device divisions, covering product planning to design.



Main products

- **Standard IC Division:** Operational amplifiers, comparators, power supply ICs, audio/video ICs, motor ICs, and communication ICs

We are committed to development of high-value-added operational amplifiers and comparators. Demands for the power supply ICs for digital AV equipment hold steady. The audio/video ICs are in great demand, from TV and audio equipment and to cellular phones. The motor ICs are mainly used for the PC fan motors.

- **ASSP Division:** LCD driver ICs, audio-related ICs, and other ASSPs
We are committed to development of LCD driver ICs for OA equipment and cellular phones and various audio ICs and crystal oscillator ICs. DSP is most watched.

- **Microwave & Optoelectronic Device Division:** Mainly GaAs ICs, high-frequency (quasimicrowave)

ICs, and optoelectronic devices

As for high-frequency (quasimicrowave) ICs, ICs for cellular phones were the main products, and as for the optoelectronic devices, the optical-noise-proof remote control receivers and the photo reflectors are the main products.

In high-frequency ICs, diversification of manufacturing process resulted in increased product alternatives for customers.

Also, we established the technology embedding a logic circuit in the HEMT chip to obtain the both of RF and digital function.

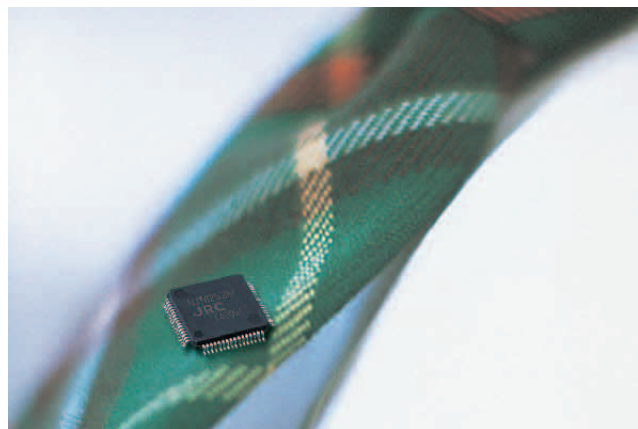
[Business Results in fiscal 2003]

The total amount of the sales in three sections was ¥59,420 million (up 21% from the previous year).

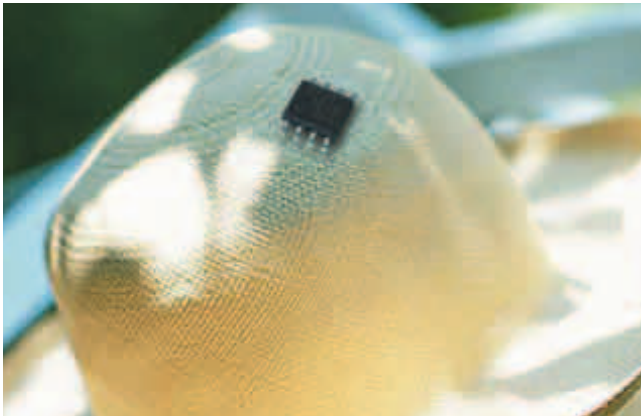
- **Bipolar ICs:** ¥43,411 million (consolidated). In addition to sales of the flagship products, operational amplifiers and comparators, sales of power supply ICs and audio- and video-related ICs were favorable; we are also committed to development of products for in-cars and industrial use. Sales of motor ICs far exceeded our expectations due to favorable sales in overseas markets including China (and Taiwan) and Korea.

- **MOS ICs:** ¥10,835 million (consolidated). Sales of LCD driver ICs slowed down due to delayed development of new products and insufficient marketing push. On the other hand, sales of audio ICs increased steadily. Sales of DSPs increased substantially.

- **Microwave & Optoelectronic Devices:** ¥5,174 million (consolidated). Sales of ICs for cellular phones were robust, and sales of ICs for PHS phones in the Chinese market were increased. Sales of ICs for wireless LAN products and optoelectronic devices also increased steadily.



The NJM2529 is a signal processor for TFT display containing all functions required by color TFT signal processing.



The NJM2722 is a single and ultra-high speed, wide band operational amplifiers. It is suitable for pulse amplifiers, D/A current to voltage conversion, measuring instrument, digital communication, video signal processing, line buffer, and cable drivers.

[2004 Product Development by division and fiscal 2004 target]

■ Standard IC Division

• Operational amplifiers and comparators

The tendency is toward a stable increase in sales based on our experience in having developed large number of new products in these three years. However, due to demand for discount, ensuring profits is difficult. To overcome this situation, we are, in cooperation with foreign companies, committed to developing high-value-added products with high precision and high speed. The volume of the production ranks is number one in Japan. In the overseas markets, sales of products for TVs in the Chinese market and for small DVD players in the American market are increasing. In fiscal 2004, we expected that the high-value-added operational amplifiers (ultra high-speed products) using the dielectric isolation process and in-car products will bring about the gains in sales. In addition, we are making a prompt selling system with an eye to expansion from consumer equipment to industrial equipment. In development of new products, we set up the Saga Electronics Design Center (a group company) in January 2004, to expand our derivatives designed based on the established design core. In the future, we expect sales to increase by developing a long-term strategy and human resources in the Design Center.

• Power supply ICs

Sales, mainly for digital AV equipment, increased because we had developed many new products, with sophisticated features, which widened the range of choices available to customers. From which we will obtain the benefit in the future.

In fiscal 2004, we will commercialize power supply ICs in new fields to gain new customers for digital applications. In addition, we will bring CMOS DC/DC converter ICs, an

almost-finished high-value-added product, to the system power supply market. Moreover, we are making a foray into new fields such as battery charger IC and cellular-phone chargers as planned.

• Audio/video ICs

Sales of audio/video ICs are quite good because some of the major TV manufacturers employed our ICs. In particular, most audio manufacturers have employed our audio ICs. This is due largely to our customers-tailored product development. From fiscal 2004, we will continue to sell audio processors as the leading products, in the audio equipment field. Furthermore, sales of electronic volume device developed as a product following the audio processors can be expected to increase because some TV manufacturers in Japan and Korea adopted it. We offer the electronic volume device and general-purpose ICs as a chip set, increasing opportunities for entering markets. In the video equipment field, we are strengthening marketing of low-voltage video amplifier ICs targeting the digital camera market. We are also strengthening the line-up of signal processors for TFT liquid crystal display by adding functions to increase market competitiveness.

• Motor ICs

Sales substantially exceeded our expectation because those in China and Taiwan increased. We positioned motor ICs for the PC fan motors as the leading products and commercialized motor ICs for two-phase motors. In addition, we have strengthened the line-ups of motor ICs for three-phase DC motors and stepper motors to enhance a selling system by applications. Cooling fan motor driver ICs (5 V fan motor driver ICs) account for a 10% share of the world market. The reason is that the cooling fan motor driver ICs employ CMOS technology to ensure the features of low rotation noise and low current dissipation, which are not incorporated in competitors' products.



The NJU7600 is a high speed low voltage operation switching regulator control IC. It is suitable for battery powered application and analog supply generation from 3.3 V logic supply voltage.

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■ ASSP Division

• LCD driver and Display-related ICs

Main products in this division are LCD driver ICs for cellular phones, cars and OA equipment. Sales of the organic EL driver ICs were unfavorable because the market had not matured although it had been expected to expand.

Development of the white LED backlight driver ICs for color LCDs is almost completed and we will sell the devices actively in the future. For the LCD driver ICs, we finished developing 4096-color STN LCD driver ICs and launched mass-production of them.

From fiscal 2004, we will strengthen marketing of the white LED backlight driver ICs for color LCDs and will also develop 65,000-color STN LCD driver ICs. For the display-related ICs, we expect these ICs to sell favorably in the overseas markets including China and Korea.

• Audio-related ICs

We have completed development of the Class D amplifier. We have developed the ICs specialized for portable audio products. It is anticipated that these ICs for MD will enjoy the No. 1 share for several years.

From fiscal 2004, we will strengthen marketing of the Class D amplifier and focus on commercialization of high-power ICs for car audio.

• Quartz crystal oscillator ICs

Sales grew substantially in fiscal 2003 and we could make up for the decrease in sales of 2002. This is largely because we were committed to the development of lower-voltage and higher-frequency ICs and offered competitive ICs over other competitors' products.

In fiscal 2004, we will continue to strengthen the line-up of products to increase sales.

• DSPs (Digital Signal Processors)

Our DSPs have been watched for the last several years. We positioned this fiscal 2003 as the first year to launch DSP. Sales of DSPs substantially exceeded our initial expectation. We could enter the markets mainly of plasma TVs, audio equipment and car navigation system. In addition to DSP core technology, we are improving and strengthening the line-ups of IP macros as resources.

We expect that the sales in fiscal 2004 will be more than four times the sales in fiscal 2003. We will position DSPs as higher-value-added products by shifting to the 0.18 μm process technology and adding various types of functions. Our DSPs have been targeted for the domestic market only so far, but we will enter overseas markets from fiscal 2005.

■ Microwave & Optoelectronic Device Division

• GaAs MMIC (GaAs: gallium arsenide)

We have developed devices specialized for high-frequency (quasimicrowave) ICs, so sales of GaAs MMICs for cellular phones increased. In Japan cellular phones market, front-

end ICs and antenna switch ICs are the main products. We developed new ICs for all carrier systems including W-CDMA, and the products of this field have boosted our sales. In overseas markets, sales of low-noise amplifiers for GPS and for wideband were good. In addition to cellular phone ICs, the devices for wireless LAN are also widely prevalent and increased our sales abruptly. On the other hand, we advanced the development of new devices including transceiver ICs in accordance with the increase of PHS phones in China. As for the optical semiconductor devices, we further improved and completed the development of optical-noise-proof remote control receivers, which is resistant to inverter noise generated by fluorescent lamps, etc., and COB-type microminiature photo reflectors that incorporate new packages. In fiscal 2003, it is particularly worth noting that we developed a "process recipe" to increase alternatives for customers (see below). We also established technology embedding a logic circuit in the HEMT chip to obtain the both of RF and digital function.

- HBT (Hetero-junction Bipolar Transistor) Process ((1) Power amplifiers for PHS phone transceiver (2) Power amplifiers for wireless LAN (3) Power amplifiers for W-CDMA; (2) and (3) are under development.)
- FET Process (Ion implantation)
- HEMT Process (Various types of switches and amplifiers for cellular phones: small switches, low-noise amplifiers)

In fiscal 2004, we will focus on the development of GaAs MMICs for GSM cellular phones, most widely used in the world. We will also develop devices compatible with faster wireless LAN system (2.4 GHz and 5 GHz) as well as cellular phones. As for PHS phones in the Chinese market, we finished the development of high-frequency analog switches and all-in-one ICs equipped with a receiver and transmitter, so we will start mass-production. In the field of optoelectronic devices, we are developing ICs for DVD pickup laser diode power monitor photodiodes (supporting 100 MHz), and promising blue laser pickup photodiodes (supporting 100 MHz or higher) for the next generation.



The NJU26501 is a multi-function digital audio decoder. It is suitable for multi-channel products such as DVD Player, AV AMP, Home Theater and Car Audio, or any kinds of multi-channel audio products.



The NJU6855 is a 160COMMON × 128RGB LCD driver for 65,536-color STN display. It is suitable for battery-powered handheld applications.

[General overview]

- Standard IC Division:

For these four years, we have emphasized human resources, and increased the number of employees, including new graduates hired, to try to ensure future profits. We continue the development of our core products, operational amplifiers and comparators emphasizing high precision and high speed. In addition, we are also working on development of new products energetically to get to market with power supply ICs and new products for audio and video equipment based on our concept for new products, "to develop products with high profitability". We are making efforts to ensure profits by developing high-value-added products with technical collaboration with foreign companies.

The NJR FUKUOKA, which started operations in April 2003, achieved sales far exceeding our expectation. Also, the Design Center set up in January 2004 will be used effectively to develop and design new products.

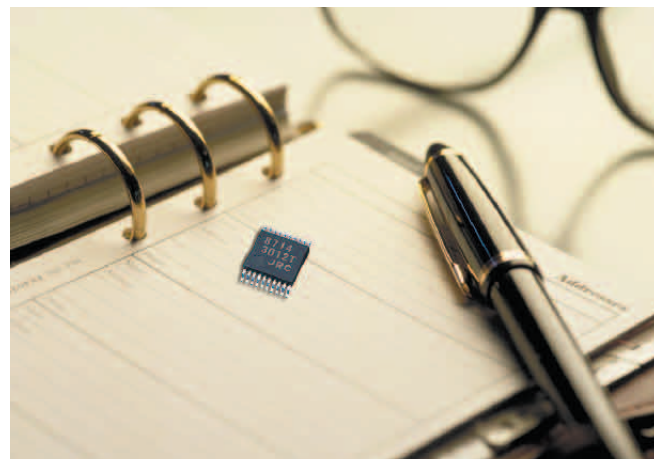
- ASSP Division:

We will market unique ICs using our own technology, such as LCD driver ICs in fiscal 2004. While meeting the specifications for sub displays for cellular phones, we will introduce LCD driver ICs actively on the small size color display market especially in China and Korea. We will flexibly support the price of color STN to increase the sales of LCD ICs, whereas we will

market actively backlight driver ICs for those other than cellular phones. As for the audio-related ICs, we plan to expand sales of Class D high power amplifier to the TV and home audio markets. In addition, we are preparing to expand sales to the in-car audio market from fiscal 2004. We will further strengthen the line-up of quartz crystal oscillator ICs whose sales grew substantially in fiscal 2003 and build up a customer-oriented system. Sales of DSPs are expected to increase dramatically and we plan to sell them actively enhancing their functions.

- Microwave & Optoelectronic Devices Division:

Although sales were good in fiscal 2002, they increased only slightly in fiscal 2003. This is largely because sales of PHS phones in the Chinese market grew less than expected. In the future, we will actively market devices for high-frequency (quasimicrowave) ICs for GSM cellular phones. In addition, we are putting our hopes in our COB (chip on board) type microminiature photo reflector, and optical-noise-proof remote control receivers. We expect sales of GPS low-noise amplifiers and wideband low-noise amplifiers to increase steadily. In the high-speed wireless LAN market, we have made products for this market (2.4 GHz and 5 GHz), and now plan to enter the market actively in the future.



The NJU8714 is a stereo BTL switching driver for Class D amplifier. It is suitable for portable audio set and others.

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