DAISHINKU CORP.

The Value Creation Story

The New Wave Begins Here

Daishinku Value Creation Story

Contents

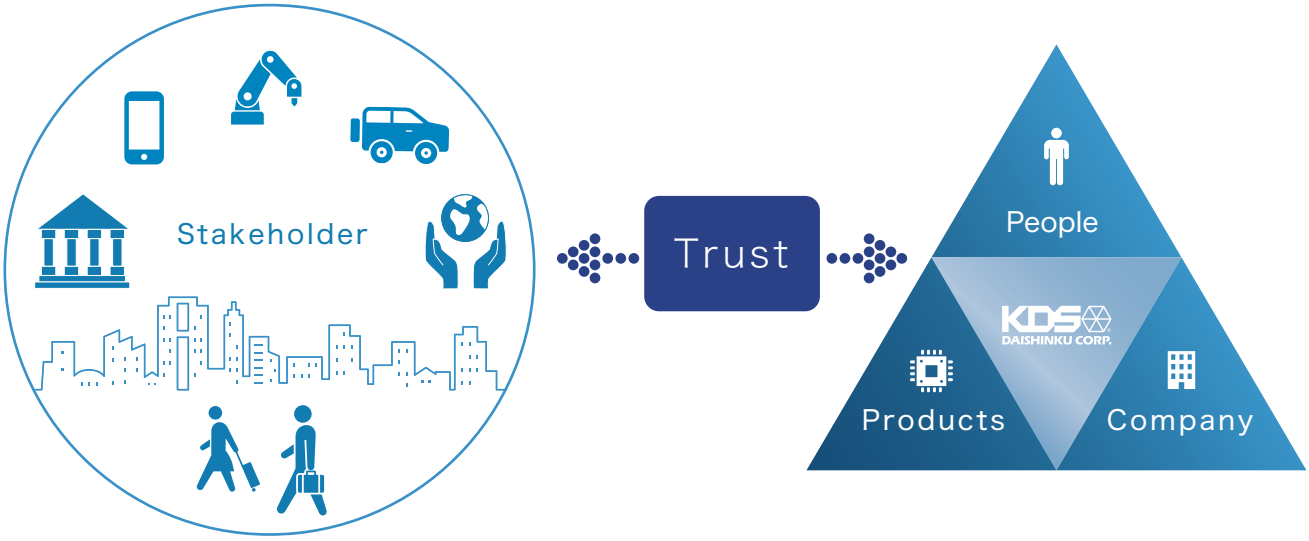
DAISHINKU CORP.

Helping “Connect” through Our Products and Technologies That Are Indispensable to Society

Our Mission

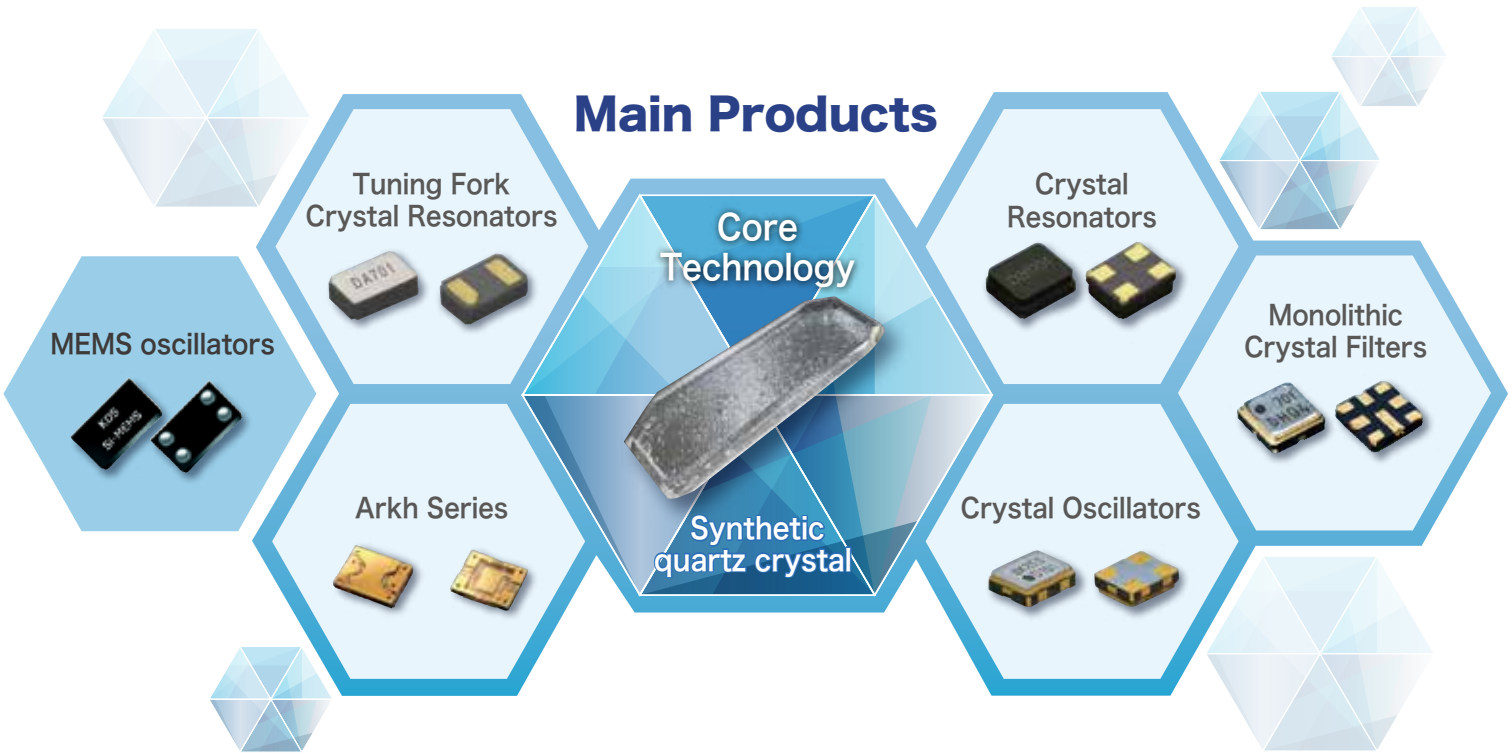
Through the stable supply of our products and technologies
that are indispensable to the digital society, we strive to develop reliance-based relationships with our customers and all other stakeholders and help realize a safer, more affluent, sustainable society where everything

—people, products, and services—is connected.



Our Core Business

Daishinku is a general manufacturer of timing devices, mainly quartz crystal devices. Timing devices, which generate reference signals required by semiconductors (integrated circuits), are widely used, from items familiar to us, including smartphones, vehicles, medical devices, and industrial robots, to industrial equipment. Quartz crystal timing devices, which support our lives, are also called the “salt of industry” in Japan as they are indispensable to the digital society.



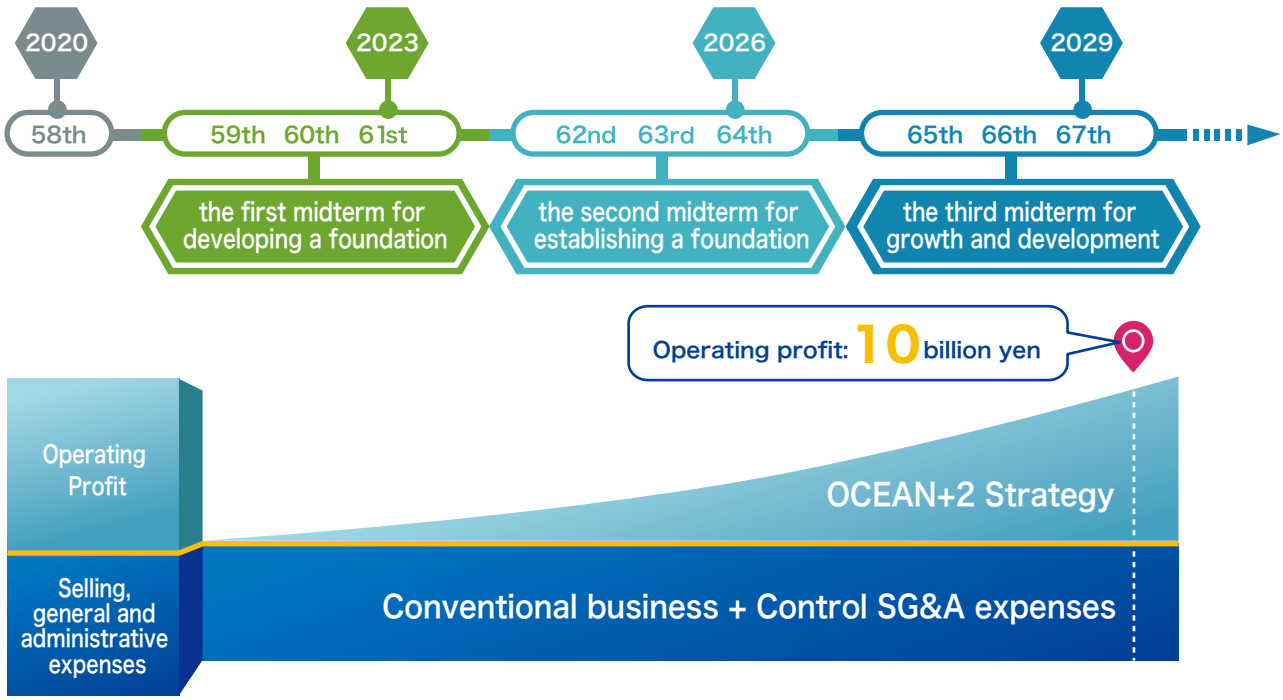
10-year Long-term Management Plan “OCEAN+2 Strategy”

On the occasion of the 60th anniversary of our founding on November 3, 2019, we formulated our first 10-year long-term management plan “OCEAN+2 Strategy” and launched it in April 2020. Breaking away from a red ocean full of excessive competition, we will explore a new market, namely, a blue ocean, based on the development of products with excellent competitive advantages while striving to achieve a stable, highly profitable corporate structure and working to solve social issues.

7 basic strategies of “OCEAN+2 Strategy”

One	Supply of one company
Cost	Challenge of low cost area
Element	Core technology: growth of quartz crystal
Alliance	Co-creation
Niche	Advantage of being a survivor
+1	new crystals
+2	new devices

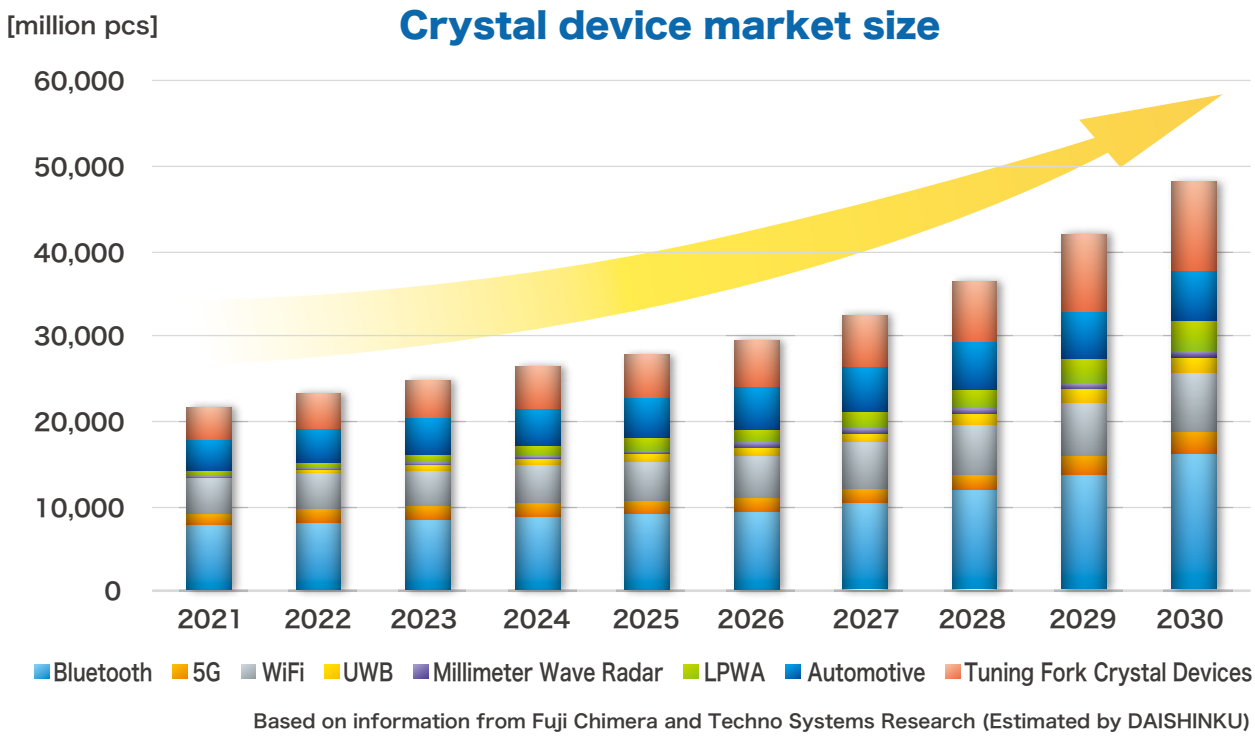
This 10-year long-term management plan is divided into three phases: the first midterm for developing a foundation, the second midterm for establishing a foundation, and the third midterm for growth and development. For each phase, milestones have been set.
We plan to create new value and profits under the OCEAN+2 Strategy while securing stable profits through conventional product development.



Challenges Associated with Market Expansion

Stable supply and Environmental Initiatives

There is no doubt that the timing device market will expand, mainly in the automotive market, which is moving toward autonomous driving, and the IoT market, where wireless communication is indispensable.

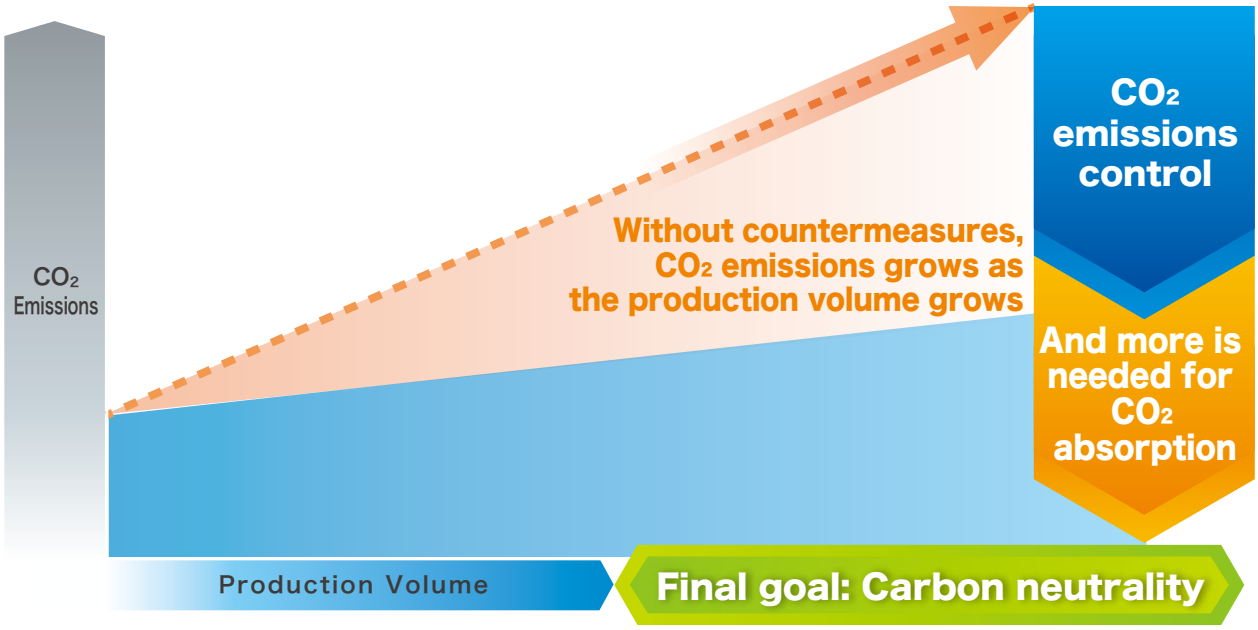


Based on information from Fuji Chimera and Techno Systems Research (Estimated by DAISHINKU)

The market size in 2030 is expected to be more than 2.2 times that of 2021.
To meet this market volume, the timing device industry needs a huge capital investment.
Under these circumstances, there may be a risk of difficulty in ensuring a stable supply due to a shortage of packaging and other materials.
We believe that it is our critical challenge to provide the required quantity of timing devices, which are indispensable for the future connected society, in a timely manner.

Meanwhile, if the ever-increasing demand is met by using equipment that is an extension of the existing production lines, CO_2 emissions will increase along with future increases in production volume. It can be said that this is an issue to be addressed by the timing device industry as a whole. As for us, we aim for further growth as a sustainable company by balancing stable supply and environmental initiatives through reduction in CO_2 emissions from increased production volume and the promotion of extra efforts toward CO_2 capture.

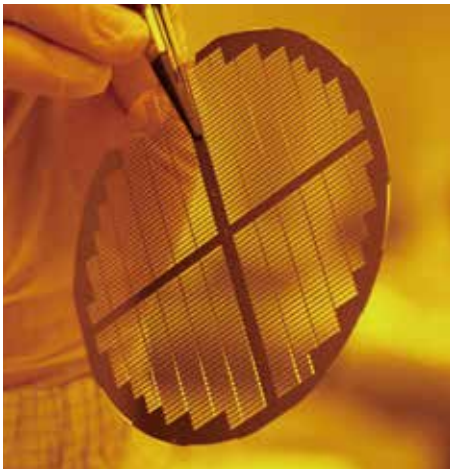
Relationship between Production Volume and CO_2 Emissions



Value Creation with Core Technology

Improvement in cost competitiveness and advancement of environmental initiatives by increasing wafer sizes

With the development of electronics technology, quartz crystal devices are required to have value, such as small size, high frequency, and high accuracy. In the processing of quartz crystal elements, it is difficult to meet these requirements with conventional machining. Therefore, photolithography (technology to which the mechanism of photographic development is applied) is becoming increasingly popular. This technology, which is also used in the manufacture of semiconductors, is suitable for microfabrication. Photolithography requires a crystal to be processed into a wafer shape. Accordingly, the larger the size of the wafer used, the more quartz crystal elements can be obtained per wafer, resulting in increased productivity.



Manufacture of Crystal Wafers

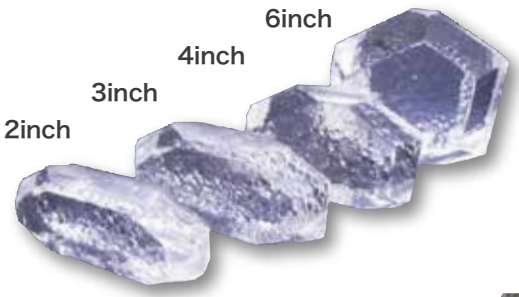
Ggrowth of synthetic quartz crystals

Synthetic quartz crystal is formed under high temperature and high pressure conditions for 2 to 3 months to about 6 months in it called an autoclave, 650 mm across and 14 meters high.

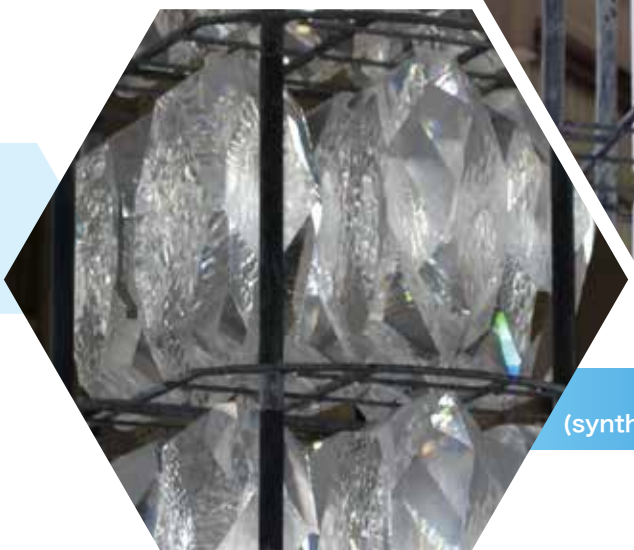
Cut and polish

The synthetic crystal is cut at an angle suited to a specific purpose or application. It is then polished to obtain a desired thickness.

Thus, to secure a competitive advantage in photolithography-type products, we have been working on increasing the sizes of rough crystals and wafers, which serve as core technology, for a decade.
A synthetic quartz crystal is grown by recrystallizing natural quartz melted under high temperature and high pressure conditions on a plate-shaped seed crystal. The growth speed of a crystal varies depending on the direction. Therefore, taking a longer time does not mean growing a larger rough crystal.
The first thing to do is to develop a seed crystal of the desired size.
Formerly, 3-inch wafers were in the mainstream. Now, however, we have already shifted to mass production of 4-inch wafers. In the fiscal year ended March 2022, we expanded the floor space of the Tokushima Production Division to add a clean room for the photolithography process designed for the production of 4-inch wafers. The newly introduced equipment has specifications applicable also to the production of 6-inch wafers in the future.



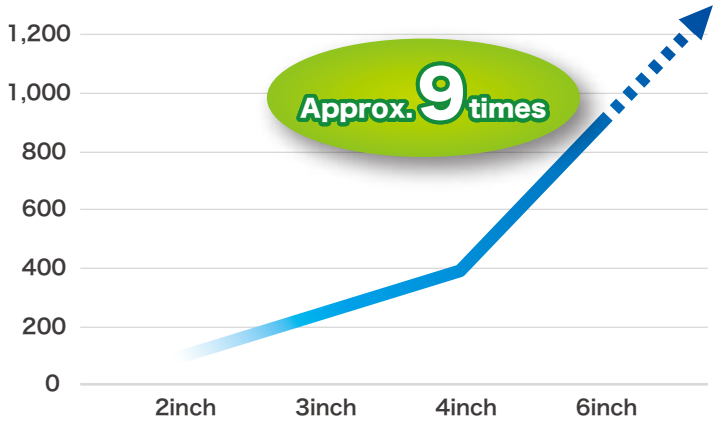
Before growth
(seed crystals)



After growth
(synthetic quartz crystals)

We have already completed the development of rough crystals for 6-inch wafers, and in June 2022 we increased the initial mass production lots. We also started developing seed crystals for 8-inch wafers several years ago and are steadily making progress. Although technical and time barriers make it difficult to increase the sizes of rough crystals and wafers, advancing this initiative is very important as it is core technology to secure a competitive advantage in the future.

Correlation between wafer size and the number of crystal blanks



* When the number of producible chips from 2-inch wafer is regarded as 100.

For example, the number of crystal blanks that can be obtained from a 6-inch wafer is about nine times that of a 2-inch wafer.

We will improve its cost competitiveness by increasing the size of crystal wafers and will secure a competitive advantage in terms of technology and costs, especially to counter the rise of competing manufacturers in Asia.

Value Creation with Key Products

Optimum devices for stable supply and environmental initiatives

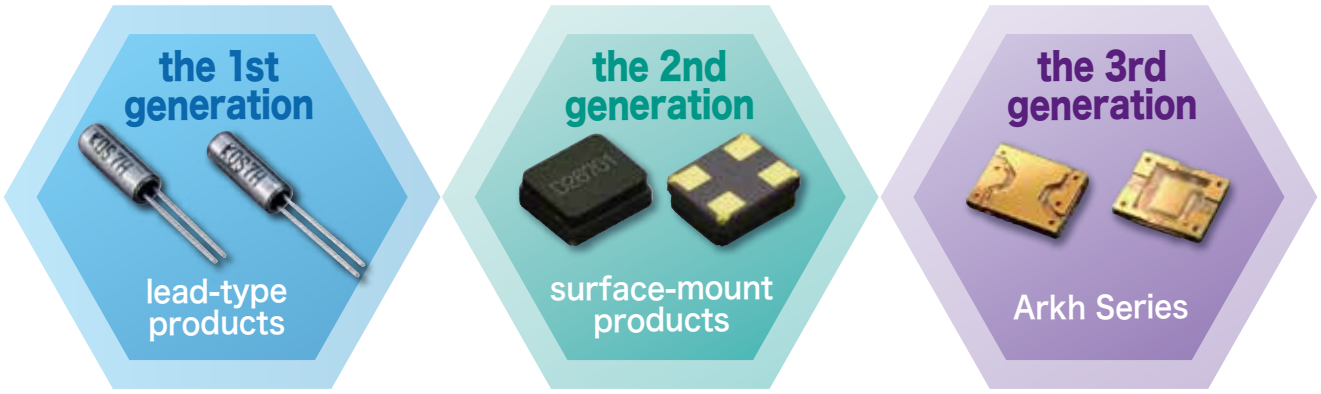
For electronic components of a device, which consist of a small number of parts, the product design and production method play an important role in reducing CO_2 emissions and advancing other environmental initiatives. To realize our ideal, the following requirements need to be met.

- To reduce the external procurement ratio
- To increase the output per unit area
- To enable fully automatic production
- To make products smaller/lighter
- To embed products in other parts used by customers

It is our original ArkhSeries products that meet these requirements, serving as key products that can both ensure a stable supply and advance environmental initiatives.

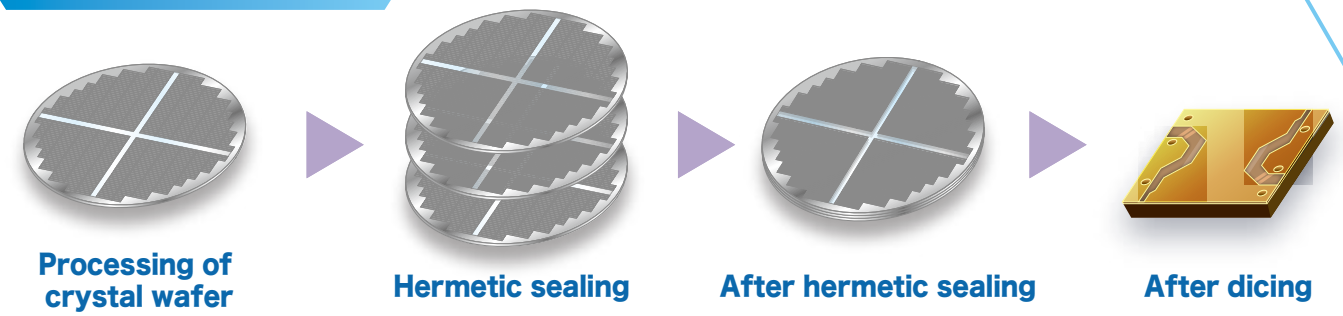
About Arkh Series

We define the first generation of crystal devices as lead-type products and the second generation as surface-mount products using ceramic packaging, which are currently in the mainstream.
The products newly developed as the third generation are those of the Arkh Series, based on the Arkh.3G, which has a completely novel structure.



Unlike a conventional structure in which a quartz crystal element is held in a ceramic package using a conductive adhesive, the Arkh.3G adopts wafer-level packaging (WLP) technology that allows three crystal wafers to be bonded together. In WLP, the process from wafer cleaning to bonding is carried out in a vacuum without exposure to the air, enabling the prevention of contamination by foreign substances and reduction of quality risks to the greatest extent possible. Another feature of the Arkh.3G is that it is half the thickness of conventional products, serving as our overwhelmingly superior original product, especially in terms of demand for thin products. Using these technologies developed for the production of the Arkh Series, we will work to create new value.

WLP technology



Processing of crystal wafer

Photolithography is applied to crystal wafer to form outlines and electrodes.

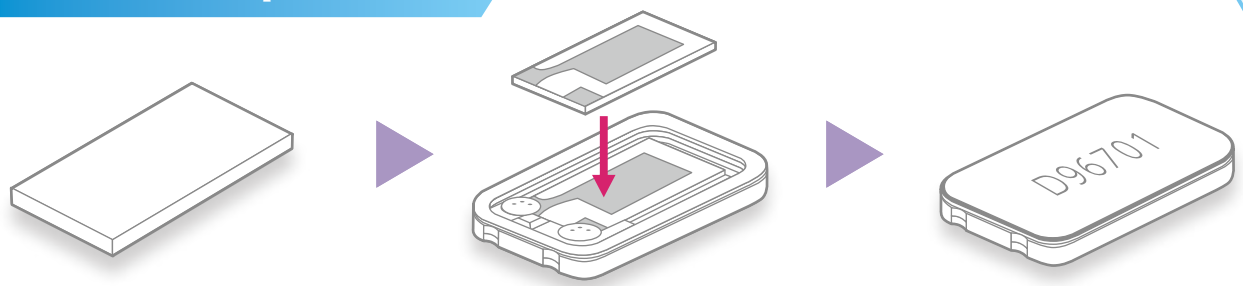
Hermetic sealing

After hermetic sealing

After adjusting for periodicity in a vacuum atmosphere, three crystal wafers are bonded, sealed and diced.

After dicing

Conventional products



Processing of crystal blanks

The synthetic crystal is cut at an angle suited to a specific purpose or application. It is then polished to obtain a desired thickness.

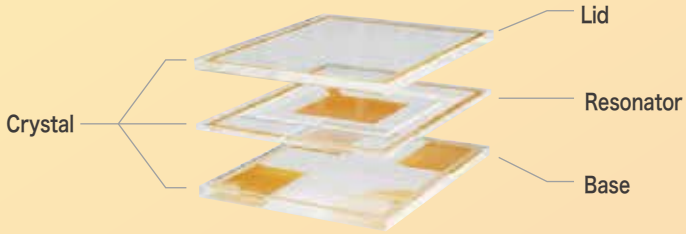
Bonding a crystal blank After

A crystal blank with electrodes is fixed in a package of ceramic or other similar material with a conductive adhesive, whose humidity and time of application are strictly controlled.

Hermetic sealing

Arkh.3G

Structure of Arkh.3G



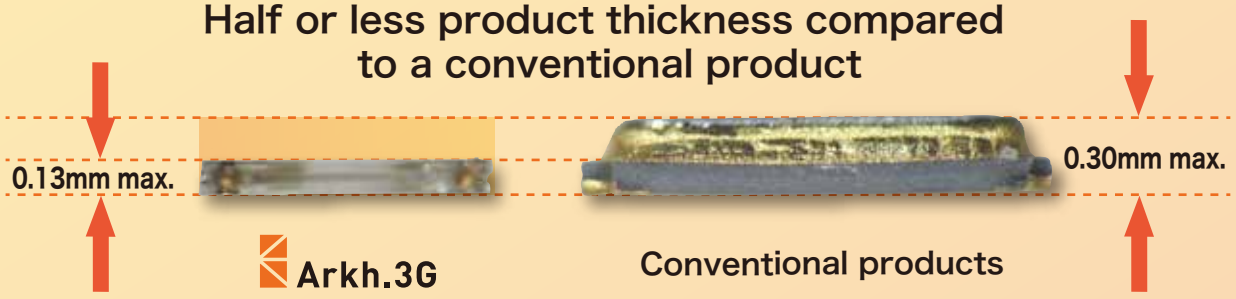
Origin of the brand name “Arkh”

The name is from the Greek word **“arkhitekton,”** namely, the etymology (origin) of the English word “architecture,” which connotes the meaning of “structure.” The brand name represents our desire to emphasize that the brand is the “origin” of crystal devices with a completely new “structure.”

*** Arkh.3G have received the 2019 Good Design Award.**

Cross-sectional comparison between the Arkh Series and conventional products

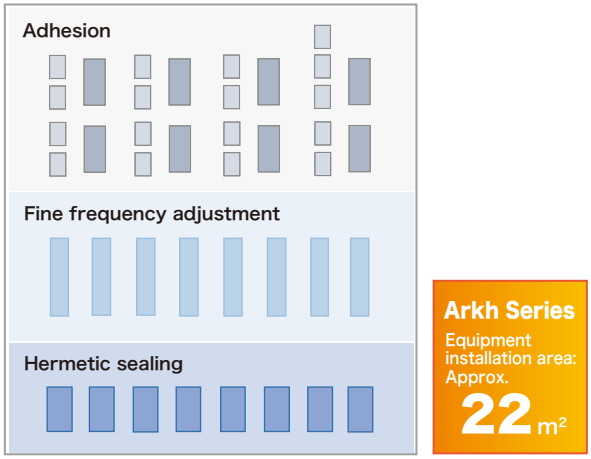
Half or less product thickness compared to a conventional product



① Challenge of achieving seven-times output per unit area

We believe that the adoption of WLP technology in the production of the Arkh Series will allow us to take full advantage of the size increase of crystal wafers, which we are currently working on. As the assembly of conventional products requires quartz crystal elements to be mounted one by one on ceramic packaging, the production capacity depends on the assembly equipment. WLP technology, on the other hand, enables assembly in wafer form. Therefore, the number of crystal devices that can be produced in one assembly is proportional to the wafer size. In other words, using larger crystal wafers can increase the output per unit area.
Meanwhile, unlike conventional products, the Arkh.Series products do not need to be transferred one by one for each process, whereby the equipment installation area can be significantly reduced.
By reducing the equipment installation area and using WLP technology, we will increase the production capacity per unit area to seven times the current level. While ensuring a stable supply without adding more plants or equipment, we are taking on the challenge of reducing CO_2 emissions."

Conventional products
Equipment installation area: Approx. 150 m²



② Fully automatic production

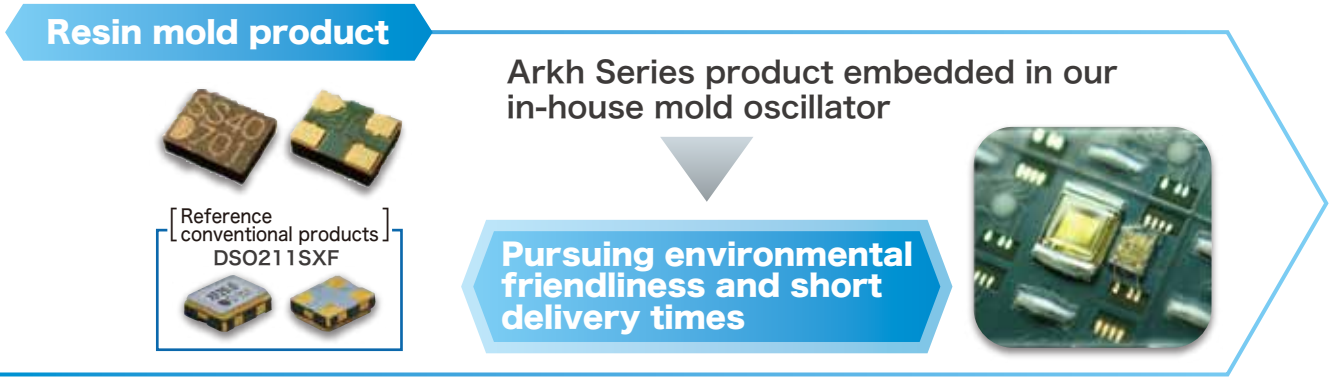
WLP and other special production technologies used for the Arkh Series have enabled us to construct a new production line.
Once crystal wafers are loaded, all the assembly work of the Arkh.3G can be completed in a vacuum without being touched by human hands. By further evolving this production line, we are taking on the challenge of achieving fully automatic production.

③ Reduction of external procurement ratio

Using crystals, which can be procured in-house, for the packaging, the Arkh Series does not require packaging materials to be procured externally. Therefore, stable procurement can be ensured without being affected by supply chain disruptions due to, for example, the COVID-19 pandemic.
We are taking on the challenge of ensuring a stable supply also in terms of the business continuity plan (BCP).

④ Trend toward resin molding

Looking back on the history of packaging, the mainstream for ICs have changed from ceramic packaging to resin mold packaging. For crystal devices, on the other hand, the conversion to resin molding in terms of small products had yet to be achieved until recently because crystal devices require physical space for their mechanical oscillations. However, embedding an Arkh Series product instead of a crystal blank has enabled resin molding, solving the packaging issue. Ceramic packaging is also used as a packaging material for various sensors. Therefore, there are concerns about supply shortages due to increasing demand. Large ceramic packages, in particular, hinder stable supply because they decrease the number of packages obtained from one sheet.
With our proprietary technology that allows us to use mold packaging instead of ceramic packaging, we are taking on the challenge of ensuring a stable supply of products of various sizes requested by our customers.



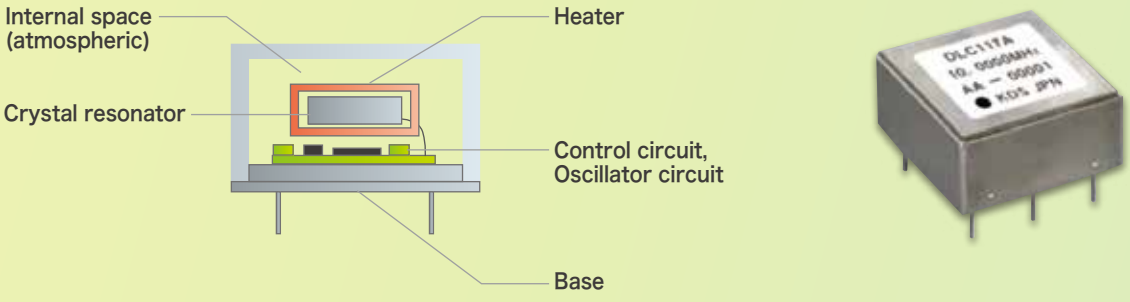
⑤ Development of products with low environmental impact

The Arkh Series technologies help develop products with low environmental impact. In mobile phone base stations, an ultra-precision crystal oscillator called OCXO is used as a reference signal source. An OCXO is equipped with an oven function that stabilizes the internal environment in order to make the oscillator less susceptible to external temperature changes. Accordingly, OCXOs consume large amounts of power, and their complicated structure consisting of a large number of parts requires manual assembly. Therefore, conventional OCXOs had the disadvantage of being costly and not suitable for mass production.

Given these circumstances, we have developed the Arkh.5G OCXO with the Arkh.3G embedded in its core, reducing the volume of the core. In addition, placed in a vacuum, this new core structure can reduce the need for corrections to be made to respond to temperature changes. Consequently, we succeeded in making the Arkh.5G an ultra-compact product that consumes less power."

Arkh.5G

Conventional products



Assuming that all OCXOs for 5G base stations that are considered necessary in the future will be replaced with the Arkh.5G, the volume of CO_2 reduced compared to our conventional products will be equivalent to the volume absorbed by a forest that is about the same size as 4,000 Tokyo Domes per year. Furthermore, the simple structure of the Arkh.5G is designed to facilitate assembly on a fully automated production line, drawing a clear line between the Arkh.5G and conventional OCXOs even in terms of stable supply.We are taking on the challenge of developing products with low environmental impact as shown above.

Evolution of Production Lines for Conventional Products

Building flexible production lines

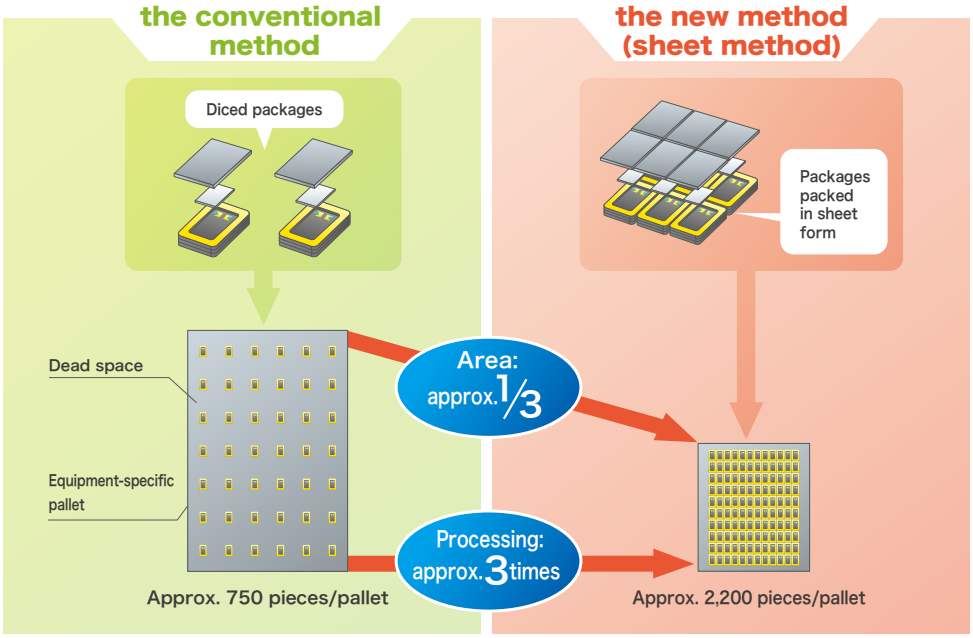
Currently, our production lines have different equipment for each model, making it difficult to change models and production bases. On our existing production lines, products are loaded onto different equipment one by one for each process, requiring complicated product transfer. Therefore, the production lines tend to be enlarged. In addition, the sizes of containers (pallets) used to transport products vary by model, which increases the number of dedicated equipment. Also, an increase in the number of product models leads to an increase in the number of production equipment.

To resolve this issue, we are working on developing equipment that can carry out assembly without requiring process-by-process product loading by using packages in sheet form through the application of the technologies cultivated in the production of the Arkh Series.

The development of such equipment will reduce dead space and the number of pieces of transport equipment required. In addition, we are working on building a production line that can process a large number of pieces at the same time. By advancing these initiatives, we are taking on the challenge of increasing the output per unit area by five times while aiming to halve the equipment installation area and to increase the equipment capacity by 2.5 times. We believe that building a flexible production line that can produce products regardless of product model is effective also in terms of the business continuity plan (BCP) because such a production line can help avoid geopolitical risks.

	Means	Merit
Equipment installation area: 1/2	New method without using pallets (sheet method)	More products can be transported in a smaller area.
		No wasted space enables the equipment to be downsized.
		No pallet-to-pallet transfer enables the system to be simplified.
Equipment capacity: 2.5 times	Simultaneous processing of multiple pieces	The installation of multiple heads in one piece of equipment enables more pieces to be processed at the same time, thereby increasing the production capacity.

Comparison image of the conventional method and the new method (sheet method)



Reduction in the Number of Days Required to Grow Synthetic Quartz Crystals and Improvement in the Energy Efficiency of the Growing Furnace

Synthetic quartz crystals are grown in a growing furnace called an “autoclave” under high temperature and high pressure conditions over a long period of time. In growing synthetic crystals, electricity charges account for more than 70% of the cost. Therefore, reducing power consumption will lead to the reduction of CO_2 emissions. As an initiative to reduce power consumption, we have improved the energy efficiency of the growing furnace itself. By reinforcing and repairing thermal insulation materials, we succeeded in reducing daily power consumption by about 20% when compared to the consumption before taking measures. In addition, through our efforts to shorten the number of days required for growing crystals by reviewing the growing conditions, we have reduced power consumption by 30% or more per growing. As a result, the energy consumed to grow synthetic quartz crystals has been approximately halved and the production capacity of the same equipment has increased by 1.5 times.

Electricity charges account for about 70%
of the cost of growing synthetic quartz crystals

Saving energy by about 20%
by improving the crystal-growth furnace
(reinforcing heat insulating material, etc.)

Moreover

Saving energy by about 30%
by reducing the growing period
from 150 days to 100 days

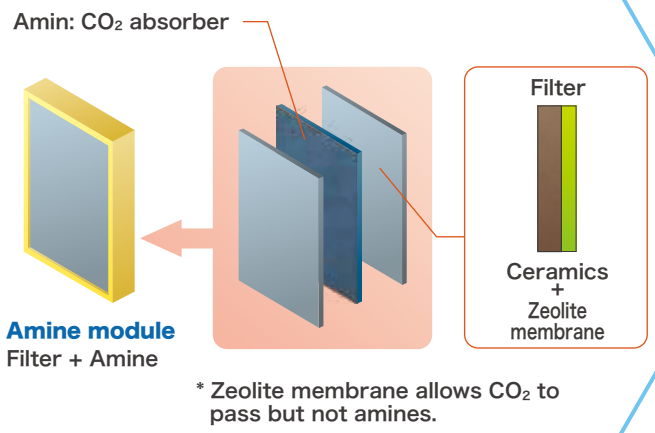
Total energy consumption reduced by about 50%

Production capacity (growth furnace): 1.5 times

Efforts toward Carbon Neutrality

Challenge to capture CO_2

Amine module



We are not only controlling the generation of CO_2 but also taking on the challenge of capturing CO_2.
We have launched the development of a CO_2 capture module using zeolite, which is generated in the process of developing "+1 new crystals" under the OCEAN+2 Strategy, and amine, namely, a CO_2 absorber. In the future, we aim to capture CO_2 generated in Scopes 1* and 2* (about 80,000 tons per year).

* Scope 1: Direct emissions from our own fuel use and industrial processes

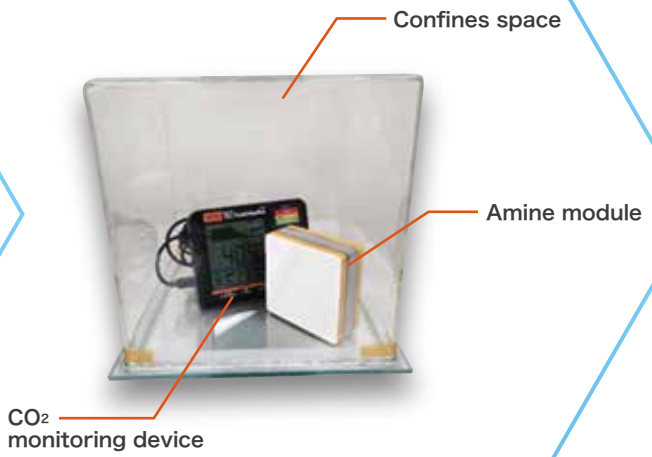
* Scope 2: Indirect emissions from the use of purchased heat and electricity

The zeolite used for the filter of the CO_2 capture module is a sustainable material as it is purified using the waste fluid generated in the process of growing synthetic quartz crystals. At present, CO_2 capture using amine is popular at large plants. Yet, by developing a system using a small portable module, we are taking on the challenge of realizing a world in which anyone can casually participate in carbon neutrality efforts.

Amine module

Prototype

Experiment



The Value Creation Story

Initiatives

Core Technology

The size increase of rough crystal

The size increase of crystal wafers

Arkh.Series

Fully automatic production

Arkh.3G

Arkh.5G

Trend toward resin molding

Built-in IC

Output 7 times

Collaboration products

Conventional products

New production line

Output 5 times

Challenge of ensuring stable supply and advancing environmental initiatives

Increase in productivity

Reduction of environmental impact

Carbon neutrality

CO_2 emissions control
Strengthening of cost competitiveness

Reduction of external procurement ratio
Saving energy

CO_2 capture efforts which anyone can be involved in

Afterword
—Road to Value Creation

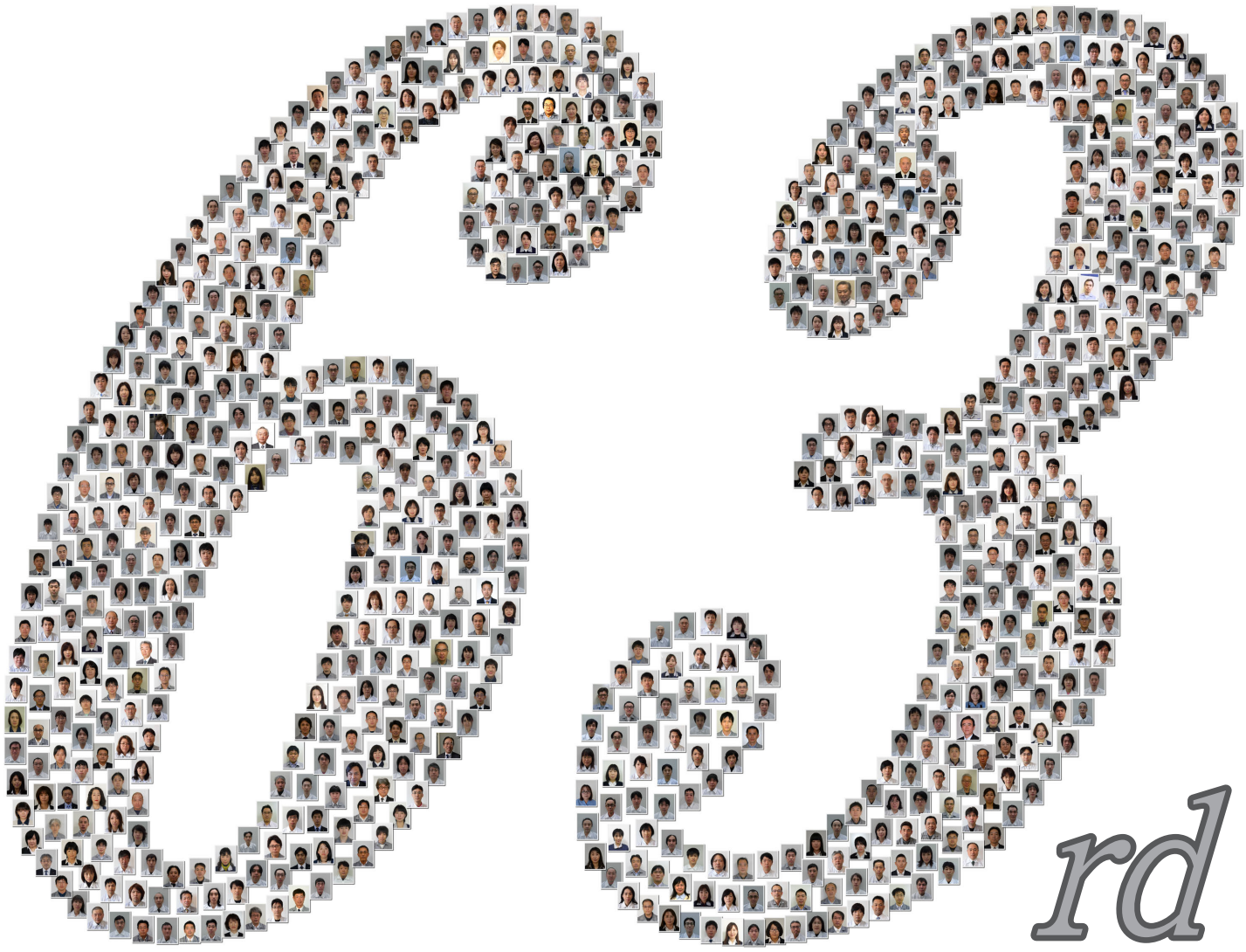
We, Japanese quartz crystal manufacturers, made a big mistake in the past. After the transition to surface-mount devices, we pursued only downsizing and did not think about the true evolution of devices, so we could only devise pricing strategies. As a result, we were overtaken by overseas manufacturers and lost our corporate competitiveness.
The long-term management plan “OCEAN+2 Strategy” announced by Daishinku in 2019 is based on what should be done to break away from the red ocean. This value creation story is an abstract of a story required to devise our long-term management plan.

From the beginning and still today, I believe that what is indispensable when creating a long-term management plan is a story that can evoke a favorable response from all employees. Clear future directions make it easier to take proactive measures and make preparations. It is the storyline of the long-term management plan that enabled us to formulate our midterm plan, which consists of three phases from the first to the third, with specific numerical targets. The midterm plan has prepared us to fully achieve the targets set in our short-term plan. Thorough preparations enable the short-term plan targets to be fully achieved, as long as no uncontrollable impediments arise. However, in reality, there are many risks that cannot be assumed in the planning stage. To deal with these risks, it is necessary to make allowance. Therefore, we make sure to allow a margin for risks by having midterm and long-term perspectives.

In the past crystal industry, many manufacturers adopted a closed strategy in principle, and Daishinku was no exception. However, given the speed of change in the market environment these days, I think it would be better to apply an open strategy in order not to make the same mistake again. Our value creation story has many parts in which we can collaborate with other parties. I believe that collaboration and alliance will result in the stable supply of products to people all over the world, helping make the world more convenient. Furthermore, although environmental initiatives must be advanced to realize a sustainable society, there is a limit to what Daishinku can do alone.
Considering what challenge we can take on by getting more companies and local governments involved, we came up with the CO_2 capture module initiative. I am still not sure if this is really a good initiative, but Daishinku will be committed to achieving carbon neutrality.

In closing, please be informed that this Daishinku value creation story is Chapter 1.
In the future, changes in the world may force us to change this original story a little. However, we will strive to connect Chapter 1 to Chapter 2 without fail while sincerely working for the quartz crystal industry, Japan, and the whole world.

President
Minoru Iizuka



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