

# Rare Earth Magnet DIANET®



# Creating Time - Optimizing Time - Enriching Time

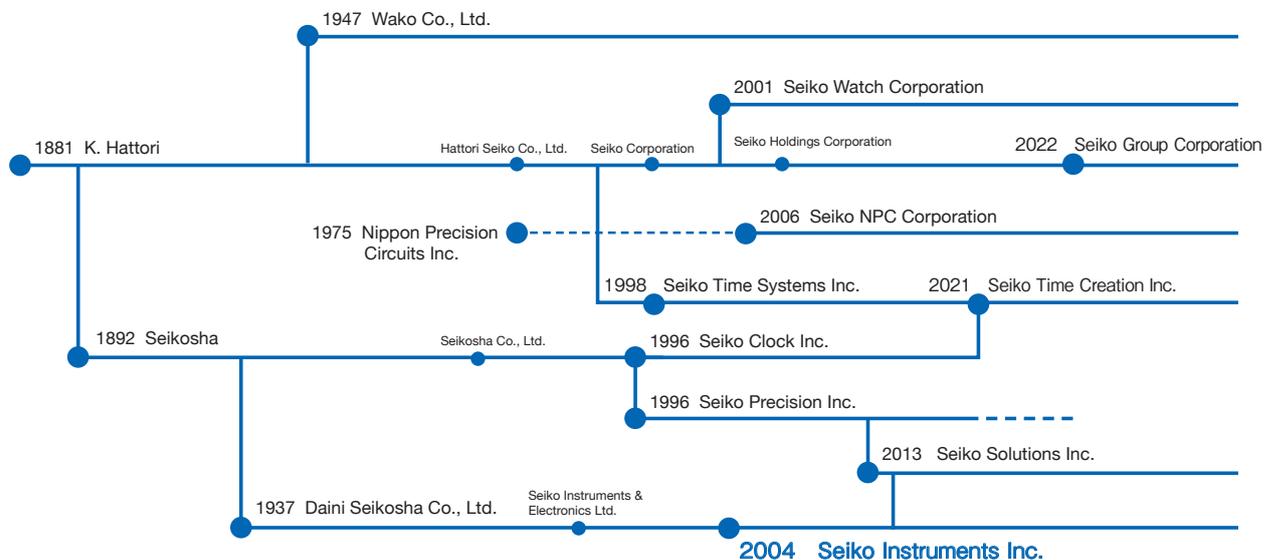
Seiko Instruments Inc. (SII), founded in 1937 as a member of the Seiko Group specializing in the manufacture of watches, has leveraged its core competency in high precision watches to create a wide range of new products and technologies.

Over the years SII has developed high-precision processed parts and machine tools that pride themselves on their sub-micron processing capability, quartz crystals that came about as a result of our quartz watch R&D, and electronic components such as micro batteries.

Optimizing our extensive experience and expertise, we have since diversified into such new fields as compact, lightweight, exceedingly quiet thermal printers, and inkjet printheads, a key component in wide format inkjet printers for corporate use.

SII, in the years to come, will maintain an uncompromised dedication to its time-honored technologies and innovations of craftsmanship, miniaturization, and efficiency that meet the needs of our changing society and enrich the lives of those around us.

## Genealogy of Seiko Group



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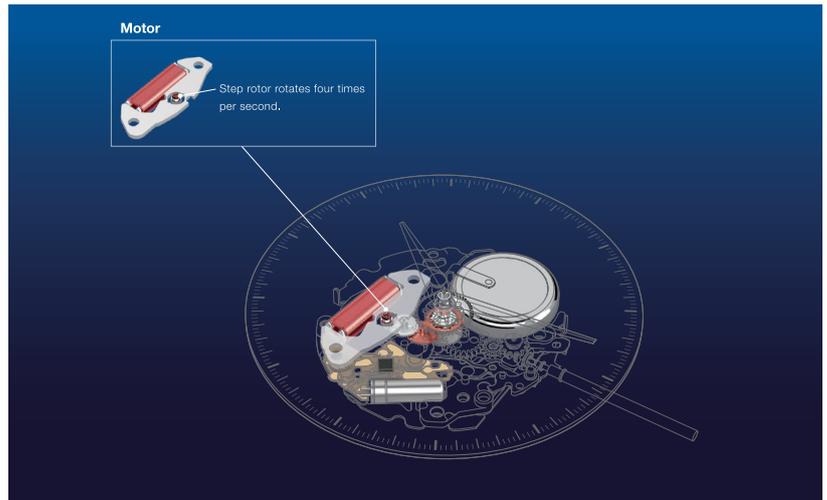
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# DIANET® Samarium Cobalt Magnet

“DIANET”, Which has its origin in rotor magnets of quartz watches, has superior heat resistance and strong magnetic force even though its outside diameter is only 1 mm or less.

“DIANET” is used for a wide range of automotive products, and its advanced quality and performance are highly recognized.

Leveraging SII’s strength in technologies for small-sized products, DIANET® is used in other applications in addition to quartz watches, including actuators for smartphone cameras and medical devices.



Internal quartz watch movement

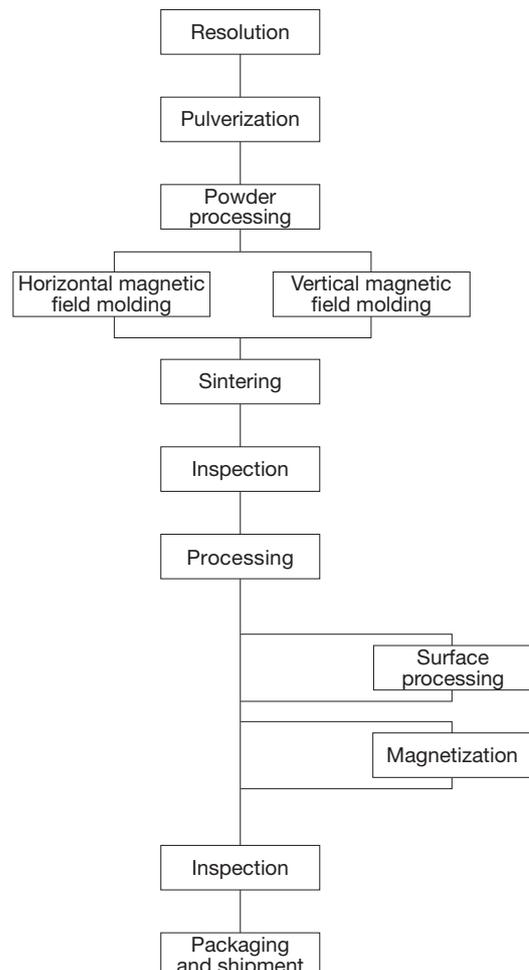


Quartz watch movement

## ■ Features of DIANET

- Superior heat resistance and reflow mountable.
- Superior corrosion resistance. No corrosion-related deterioration of magnetic properties.
- No processing-related deterioration of magnetic properties, thus contributing to equipment downsizing and reducing energy consumption.
- Superior precision processing that meets dimensional tolerance requirements in microns.
- Minimum dispersion of magnetic characteristics achieved with SII’s unique processing technology.
- Our near net shape processing technology makes it possible to provide magnets at low cost.

## ■ Manufacturing process

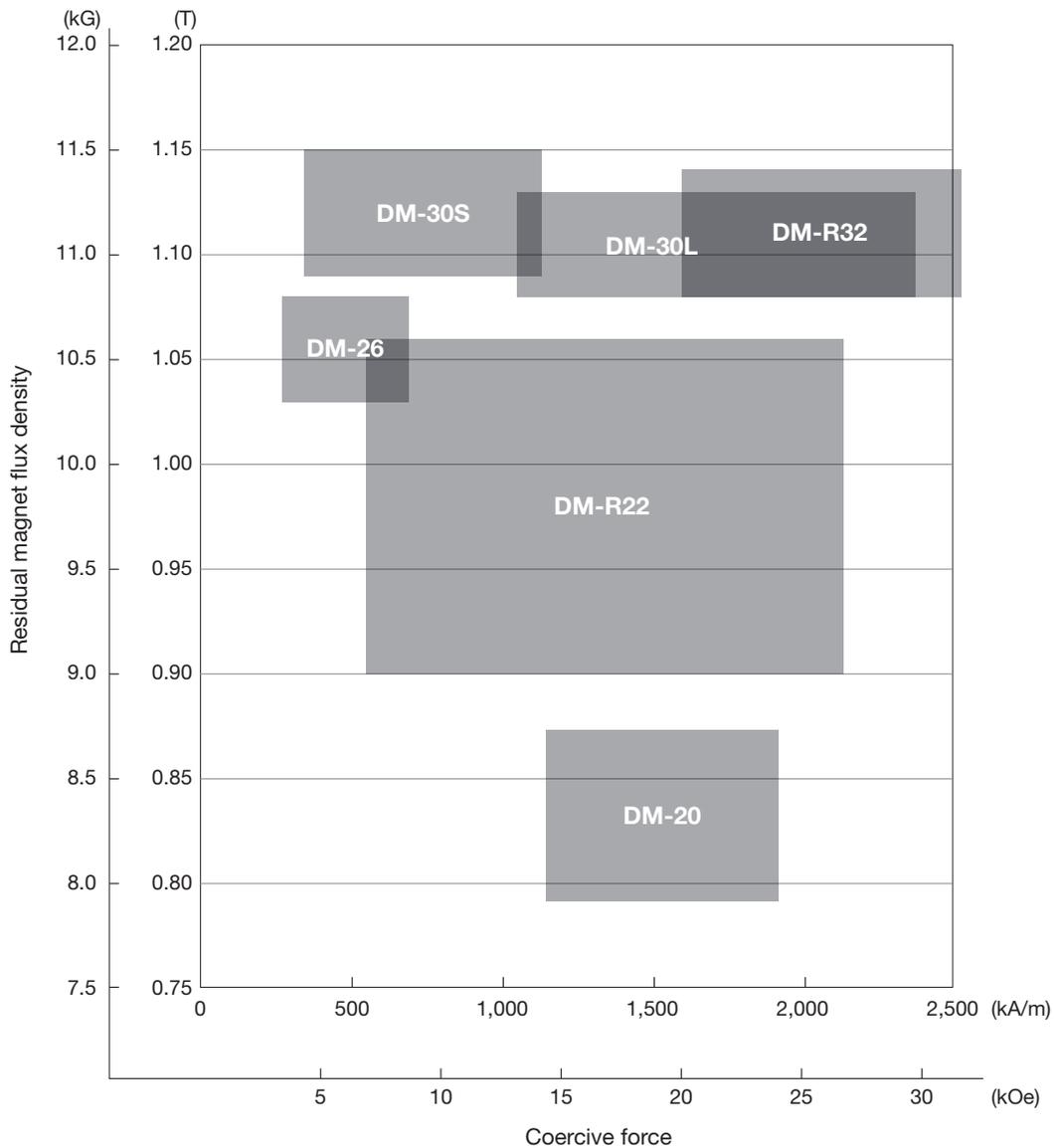


# Basic Characteristics

## Basic Characteristics

System	Material	Residual magnet flux density		Coercive force				Maximum energy product	
		Br		bHc		iHc		BHmax	
		(T)	(G)	(kA/m)	(Oe)	(kA/m)	(Oe)	(kJ/m <sup>3</sup> )	(MGOe)
1-5 based (SmCo <sub>5</sub> )	DM-20	0.79 to 0.87	7,900 to 8,700	613 <	7,700 <	1,114 to 1,910	14,000 to 24,000	123 <	15.5 <
2-17 based (Sm <sub>2</sub> Co <sub>17</sub> )	DM-R22	0.90 to 1.06	9,000 to 10,600	588 to 796	7,400 to 10,000	580 to 2,109	7,300 to 26,500	155 to 215	19.5 to 27.0
	DM-26	1.03 to 1.08	10,300 to 10,800	302 to 637	3,800 to 8,000	302 to 668	3,800 to 8,400	155 to 215	19.5 to 27.0
	DM-30S	1.09 to 1.15	10,900 to 11,500	405 to 756	5,100 to 9,500	374 to 1,115	4,700 to 14,000	200 to 239	25.0 to 30.0
	DM-30L	1.08 to 1.13	10,800 to 11,300	684 <	8,600 <	1,074 to 2,348	13,500 to 29,500	200 to 243	25.0 to 30.5
	DM-R32	1.08 to 1.14	10,800 to 11,400	748 to 859	9,400 to 10,800	1,592 ≤	20,000 ≤	214 to 247	27.0 to 31.0

## Range of Magnetic Characteristics



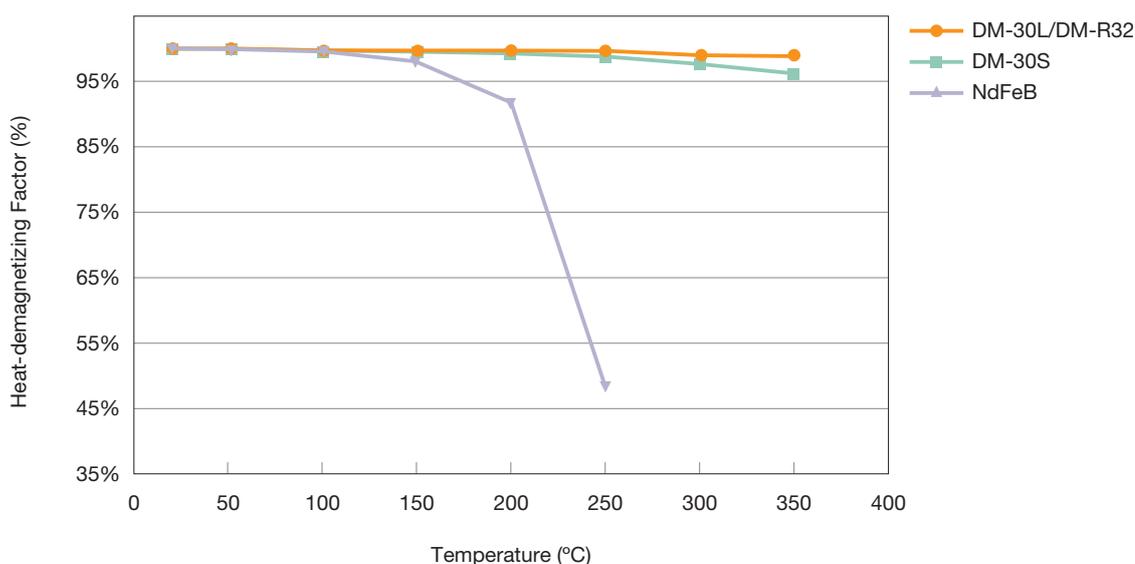
Note: Magnetic characteristics will vary depending upon the customer's specified dimensions and shape. Please contact us for details.

## ■ Heat-demagnetizing Factor

Samarium cobalt magnets (SmCo magnets) have a Curie temperature\* of over 800°C, which is higher than that of Neodymium magnets (NdFeB magnets). This superior heat resistance enables reflow soldering for the mounting process.

\* Curie temperature (T<sub>c</sub>): the temperature at which a ferromagnetic substance becomes paramagnetic on heating.

### Comparison of Heat-demagnetizing Factor (FLUX value)



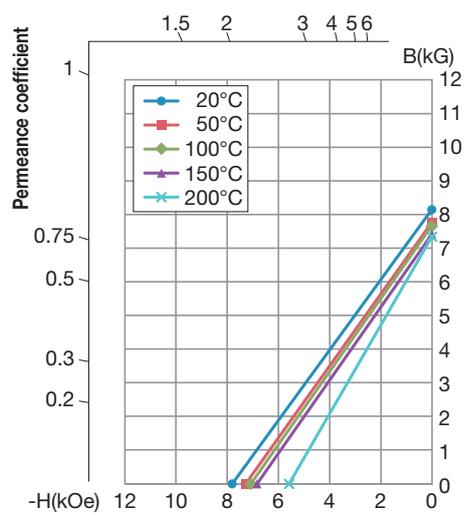
The heat-demagnetizing factor varies depending on the usage environment and conditions. This does not guarantee the heat-resistant temperature.

## ■ Processing-related Deterioration

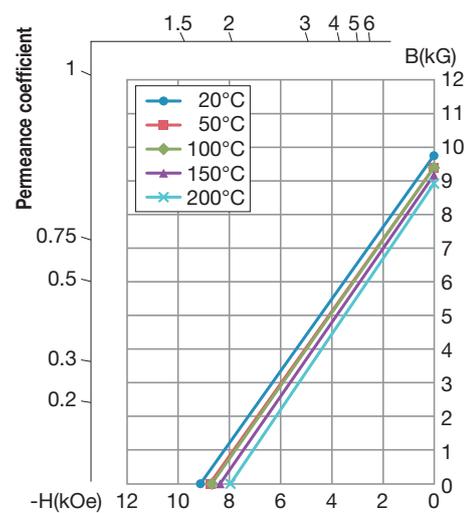
Compared to Neodymium magnets (NdFeB magnets), samarium cobalt magnets (SmCo magnets) do not easily deteriorate during processing. Accordingly, the magnetic property of samarium cobalt does not deteriorate when processed into micro magnets.

# Temperature Characteristics

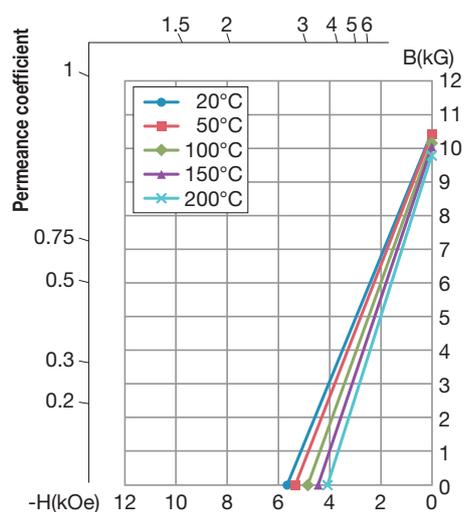
■ DM-20 B-H



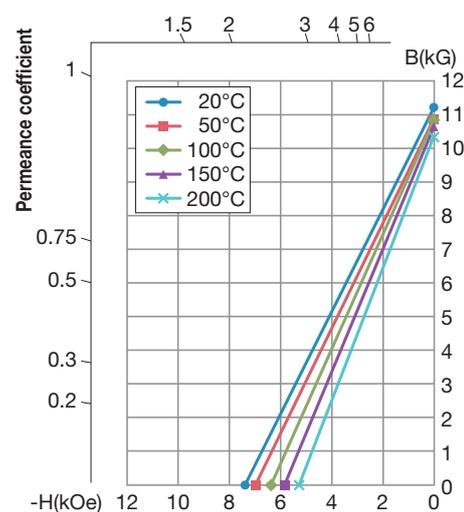
■ DM-R22 B-H



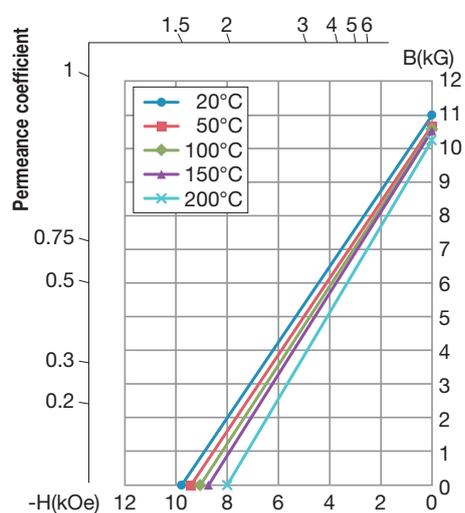
■ DM-26 B-H



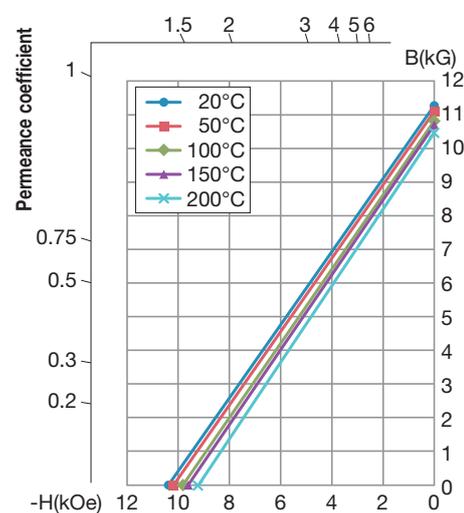
■ DM-30S B-H



■ DM-30L B-H



■ DM-R32 B-H



# Surface Processing and Measurement

## ■ Surface Processing

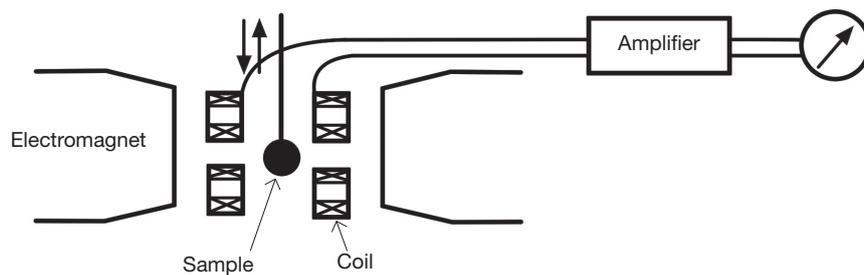
Depending on usage, we recommend nickel electroplating to be conducted.

- Protects the surface of the magnet, and prevents chipping.
- Prevents generating magnetic powder due to breakage or chipping, and eases handling.

## ■ Measurement of Demagnetization Curves

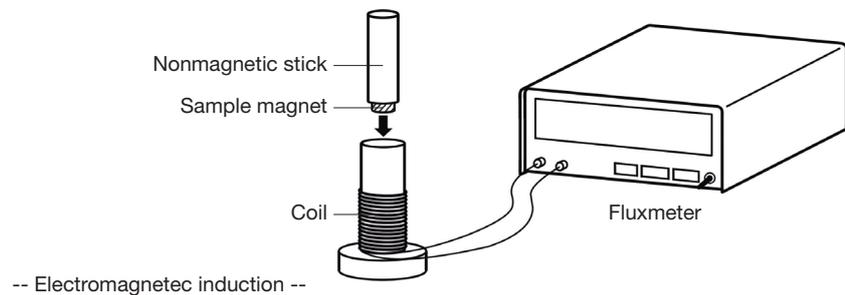
Vibrating sample magnetometer

Vibrating sample magnetometers measure residual flux density, coercive force, and maximum energy product.



### 1. Measurement of the Total Magnetic Flux.

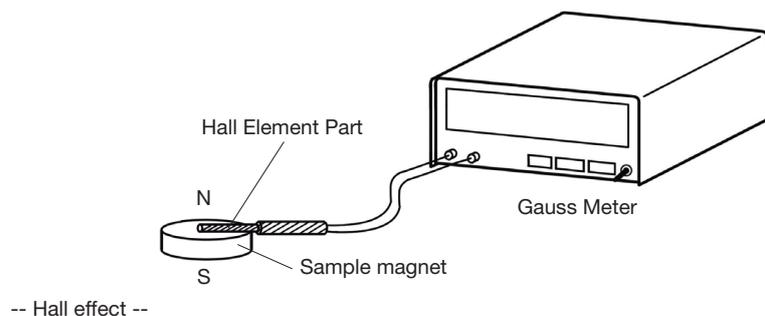
Flux  
Unit: Weber (Wb)  
Maxwell (Mx)



Measures the amount of entire magnetic flux of the sample magnet.

### 2. Measurement of the Magnetic Flux density on the magnet surface (Bd)

Bd  
Unit: Tesla (T)  
Gauss (G)

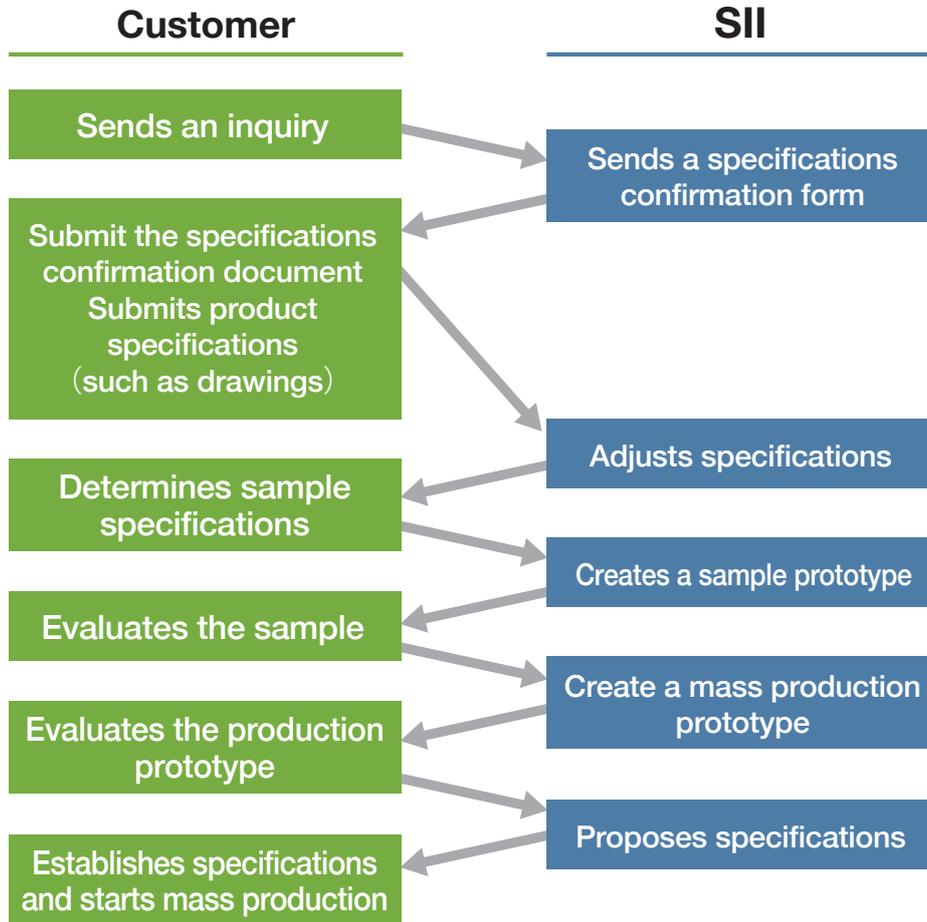


Measures the amount of magnetic flux per unit area on the surface of the sample magnet.

# Business Flowchart

## ■ Business Flowchart (a typical example)

A typical business flowchart of a rare-earth magnet (DIANET), from inquiry to mass production, is shown below.



## Contact us

Inquiries about Rare Earth Magnets

<https://www.sii.co.jp/en/me/magnet/contact>



Seiko Instruments Inc.  
Electric Components Business Management Head Office

# Check Sheet for Quotation

Please fill out the following form to receive a quotation.

## 1. Specifications

### 1-1. Dimensions and tolerance

	Dimensions	Tolerance
D or L <sub>1</sub>		
d or L <sub>2</sub>		
t		

### 1-2. Characteristics

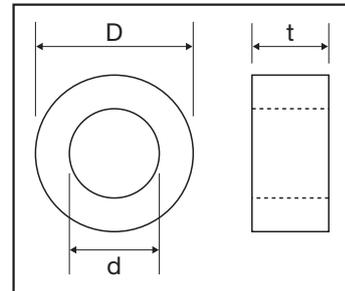
Br:

iHc:

bHc:

BHmax:

· Simplified schematic



### 1-3. Magnetic or nonmagnetic

### 1-4. Magnetization direction (D·L<sub>1</sub>·L<sub>2</sub>·t)

### 1-5. With/without markings

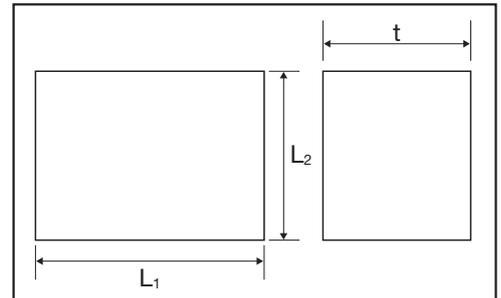
### 1-6. With/without surface treatment

### 1-7. Usage temperature: Min. / Max.

### 1-8. High temperature conditions: Time: / No. of times: / Frequency:

### 1-9. Mounting method (bonding, insertion, caulking, etc.)

### 1-10. With/without reflow soldering



## 2. Number of samples

## 3. Mass production quantity

## 4. Mass production timing

## 5. Usage

## 6. Desired price (yen/piece)

## Environmental Policy

The Seiko Group recognizes that the preservation of the global environment is one of the most important issues in the world today. We will constantly strive to help realize a sustainable society that will benefit everyone.

1. We are committed to a wide range of environmentally responsible activities, and we will continue to make unceasing efforts to improve our environmental performance, thereby providing increased value for all our stakeholders.
2. We not only comply with all relevant laws and regulations, but also go far beyond legal compliance in our efforts to reduce environmental risks and prevent pollution.
3. Being acutely aware of the part we have to play in mitigating climate change, we are working hard to reduce greenhouse gas emissions.
4. Because we recognize the limits of our precious natural resources, we are increasing our efforts to reuse and recycle every resource possible.
5. We are also working to preserve biodiversity, recognizing that our business activities inevitably affect surrounding ecosystems, and that we also benefit from the health and diversity of those systems.
6. We rigorously ensure proper management of all chemical substances used in production as well as any that are contained in our finished products.
7. We consider the environment throughout the entire life cycle of our products. We are proud that our products and services actively contribute to environmental conservation.
8. Environmental responsibility starts as a management imperative, but to effectively carry out that mission requires the understanding and cooperation of every employee throughout our Group. With that in mind, we are working to raise everyone's environmental awareness so that all of us can work together to protect and nurture our natural environment.
9. Transparency is another part of our social responsibility. We are therefore promoting active disclosure of material information about our environmental activities and promoting increased communication with local, regional, and global stakeholders.
10. In order to derive maximum benefits from these policies, we establish clear environmental targets and strategies to attain them. Then we steadily improve our efforts by constantly re-examining both our targets and our progress towards achieving them.

## Cautions When Using Magnets

### WARNING

- It is extremely dangerous to place magnets near persons who have electronic medical devices such as pacemakers installed. There is a risk of damage to normal operation status of the medical device. Please use with highest caution.
- Be careful not to swallow magnets. If a magnet has been swallowed, consult a physician immediately. Keep magnets out of the reach of children.

### CAUTION

- Depending on the size and shape used, a magnet may not achieve the magnetic characteristics values noted in the catalogue. Confirm in advance by using a sample, etc.
- When magnetization is performed by the customer, allocate sufficient magnetic field for the material and coercive force. When the strength of the magnetic field is insufficient, magnetic characteristics of the original design specifications may not be obtained. Consult with the manufacture for the size of the magnetic field needed for magnetization.
- Avoid using and storing magnets in the following environments. Weather resistance differs according to the material of each magnet, so consult in advance about corrosion prevention, etc.
  1. Corrosive gas atmosphere (Cl, NH<sub>3</sub>, SO<sub>x</sub>, NO<sub>x</sub>)
  2. Highly conductive environment (in water containing electrolytes, etc.)
  3. Hydrogen atmosphere
  4. Acidic, alkaline, or organic solvents, etc.
  5. In water or oil
- When using an adhesive to bond the yoke and hole piece, etc., of two magnets, confirm reliability by inspecting the type, volume, conditions, and strength, etc., of the adhesive.
- When performing processes such as press fitting or shrink fitting, there is a risk of degradation of the magnetic characteristics or cracking of the magnet or its counterpart materials. Be sure to confirm in advance by using a sample.
- A magnetized magnet absorbs debris such as iron powder, so remove it from its packing case in a dust free environment.
- Magnets are susceptible to shock, and cracking and chipping occur easily, so handle with care. When cracking or chipping occur during handling, there is a risk of degradation of characteristics or strength.
- Magnets are generally made from materials that chip easily, so handle with care. Store in a place where shock will not occur. In addition, be sure to store in a location where the magnet will not come into contact with rain-water, etc.
- Magnetized magnets should be covered with a non-magnetic material such as a wooden box after clearly marking the fact that the magnet is magnetized.
- When a magnet is placed close to a magnetic tape, floppy disk, prepaid card, ticket, or electronic watch, there is a risk that the magnetic recording will be damaged and that the item will become magnetized and no longer be usable. There is also a risk of cards and tickets becoming unusable due to the effect of an electronic key, so do not place electronic keys in your pocket together with cards, tickets, etc.

- Persons who are sensitive to or have allergic reactions to metal may develop rashes or redness of the skin if they come into contact with a magnet. If such reactions are known to occur, do not touch magnets.
- Typically, components of a magnet may begin to dissolve in water, so do not drink water that has been in contact with a magnet.
- Magnets typically crack easily. A magnet fragment may enter the eye or cause injury, so use caution in handling.
- The absorption force of magnets is strong, so be careful not to let your hand get pinched.
- The alloy powder of rare earth magnets is specified by fire safety law as class II (flammable solid) and class I hazardous materials. There is a danger of ignition or inflammation of fine powder generated due to friction during use of a magnet, so do not use in such a way that risks generating magnetic powder.
- There is a danger of auto-ignition with fine particles of rare earth magnets, so when processed by the customer, do not leave chips or filings in the atmosphere, and be sure to store these in a container filled with water. As a preparation in case a fire starts, have sand available for use. If a fire begins, cover the fire with the sand, and remove flammable objects.
- Avoid storing in locations with high temperature and high humidity.

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# PRECISION, CRAFTSMANSHIP and MINIATURIZATION

Leveraging Watch Making Technology

🕒 With Precision, we apply our Craftsmanship to provide Miniaturization advantages to customers' product development around the world.

Stable and reliable  
**Rechargeable Battery & Capacitor**

For the IoT product

No corrosion, strong, ultra high elasticity and no magnetization  
Superior material  
**"SPRON"**

For material used in harsh environments

For magnetic applied sensor components

For wearable devices

Excellent heat and corrosion resistance  
**Samarium-cobalt Magnet**  
**"DIANET"**

Precise Timing with Lowest Power consumption

Small and powerful Silver Oxide Battery  
**Silver Oxide Battery**  
**"SEIZAIKEN"**

Precise Timing for Electronic Devices  
**Tuning Fork Quartz Crystal Resonator**



Micro-Energy Division who manufactures the products described in this catalog holds the ISO 9001 quality management system certificate, and the ISO 14001 environmental management systems certificate.



www.sii-me.com

**Seiko Instruments Inc.**

Electric Components Business Management Head Office  
 1-8, Nakase, Mihamaku, Chiba-shi, Chiba 261-8507, Japan  
 Telephone: +81-43-211-1735 Facsimile: +81-43-211-8034

**Asia**

**Seiko Instruments Trading (H.K.) Ltd.**  
 7/F, Ying Tung Industrial Building,  
 802 Lai Chi Kok Road, Kowloon, Hong Kong  
 Telephone: +852-2494-5111  
 Facsimile: +852-2424-0901

**Seiko Instruments (Shanghai) Inc.**  
 Room 2701, 27th Floor,  
 Shanghai Plaza,  
 138 Mid Huaihai Rd.,  
 Shanghai 200021, China  
 Telephone: +86-21-6375-6611  
 Facsimile: +86-21-6375-6727

**Seiko Instruments Taiwan Inc.**  
 2F., No. 143, Changchun Rd.,  
 Taipei, Taiwan R.O.C.  
 Telephone: +886-2-2563-5001  
 Facsimile: +886-2-2563-5580

**Seiko Instruments (Shanghai) Inc. Shenzhen Branch**  
 Room 2909, Office Tower, Shun Hing Square Di Wang Commercial Centre,  
 5002 Shen Nan Dong Road, Shenzhen,  
 518008, China  
 Telephone: +86-755-8246-2680  
 Facsimile: +86-755-8246-5140

**Europe**

**Seiko Instruments GmbH**  
 Siemensstrasse 9  
 D-63263 Neu Isenburg, Germany  
 Telephone: +49-6102-297-0  
 Facsimile: +49-6102-297-50100  
 Email: info@seiko-instruments.de  
 http://www.seiko-instruments.de

**North/Central/South America**

**Seiko Instruments U.S.A., Inc.**  
 21221 S. Western Ave., Suite 250,  
 Torrance, CA 90501, U.S.A.  
 Telephone: +1-310-517-7802  
 Facsimile: +1-310-517-7792  
 Email: info@seikoinstruments.com  
 http://www.sii-me.com

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**Released in March 2026**

Contact us