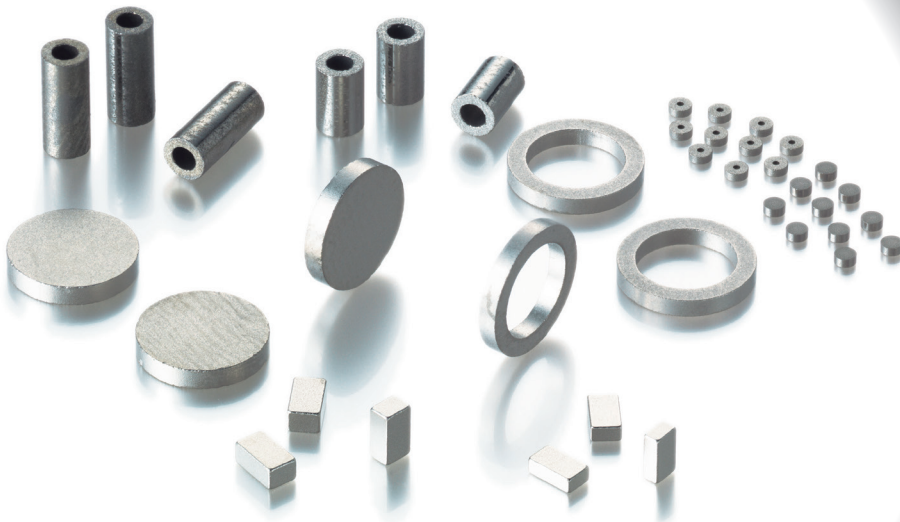


Rare Earth Magnet DIANET®



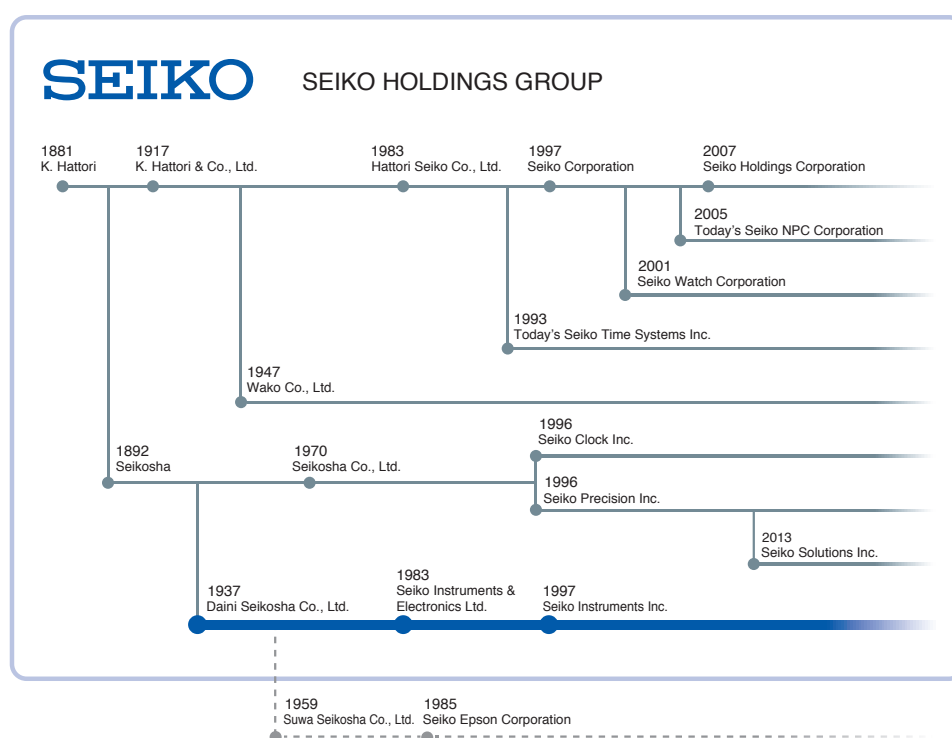
Creating Time - Optimizing Time - Enriching Time

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.



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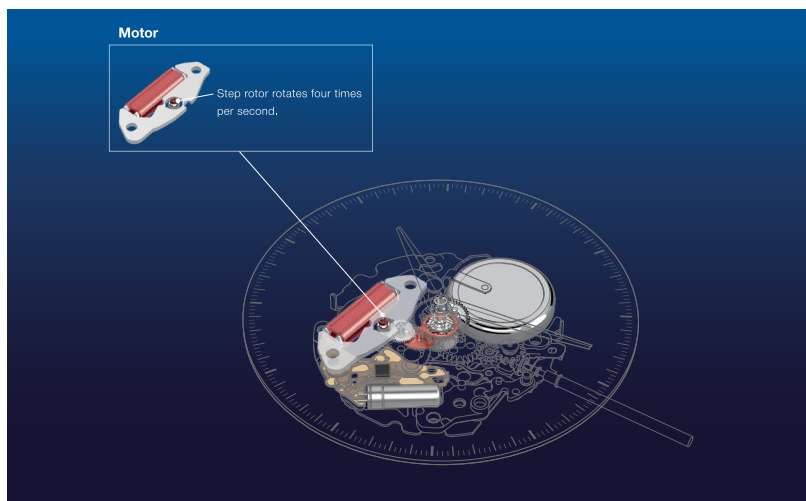
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DIANET® Samarium Cobalt Magnet

“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

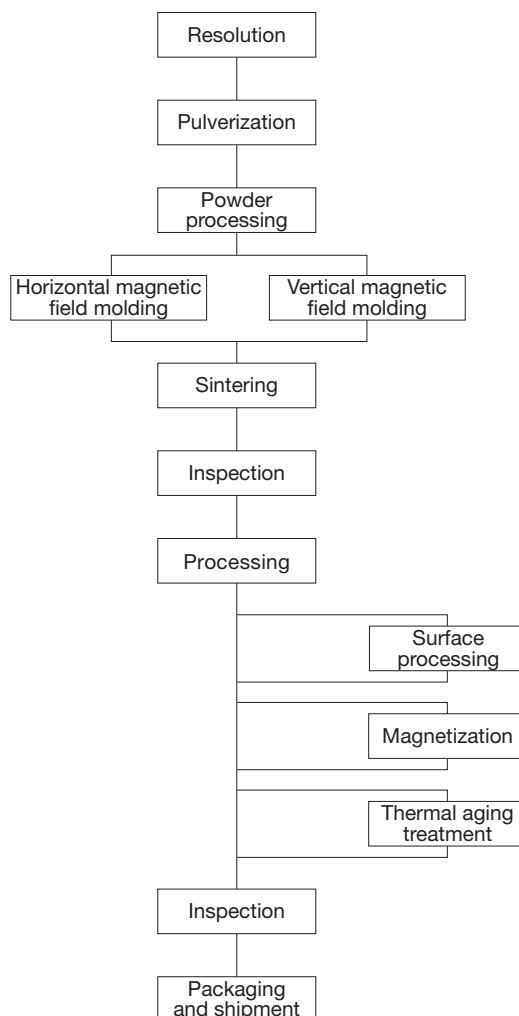


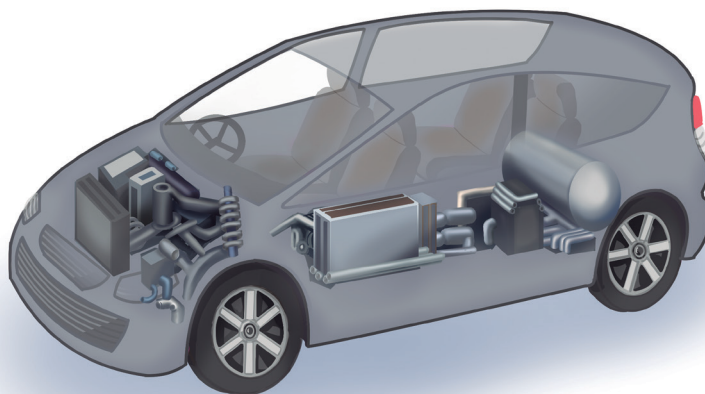
Quartz watch movement

■ 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



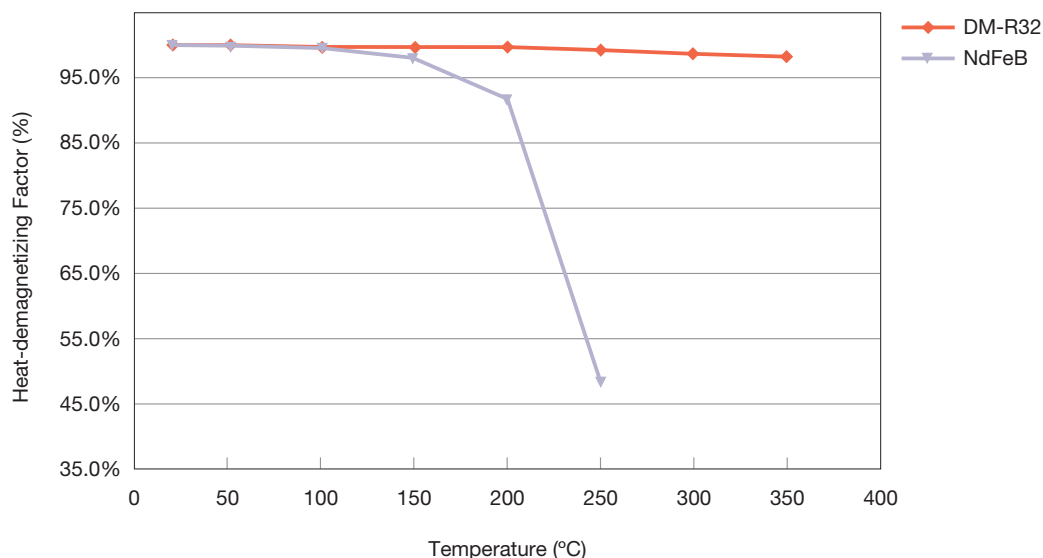


SII acquired **IATF16949** certification for its magnet products. **IATF16949** is an international standard specifying the requirements of a quality management system for automotive production.

■ DM-R32

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 ³)	(MGOe)
2-17 based (Sm ₂ Co ₁₇)	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

Comparison of Heat-demagnetizing Factor (FLUX value)

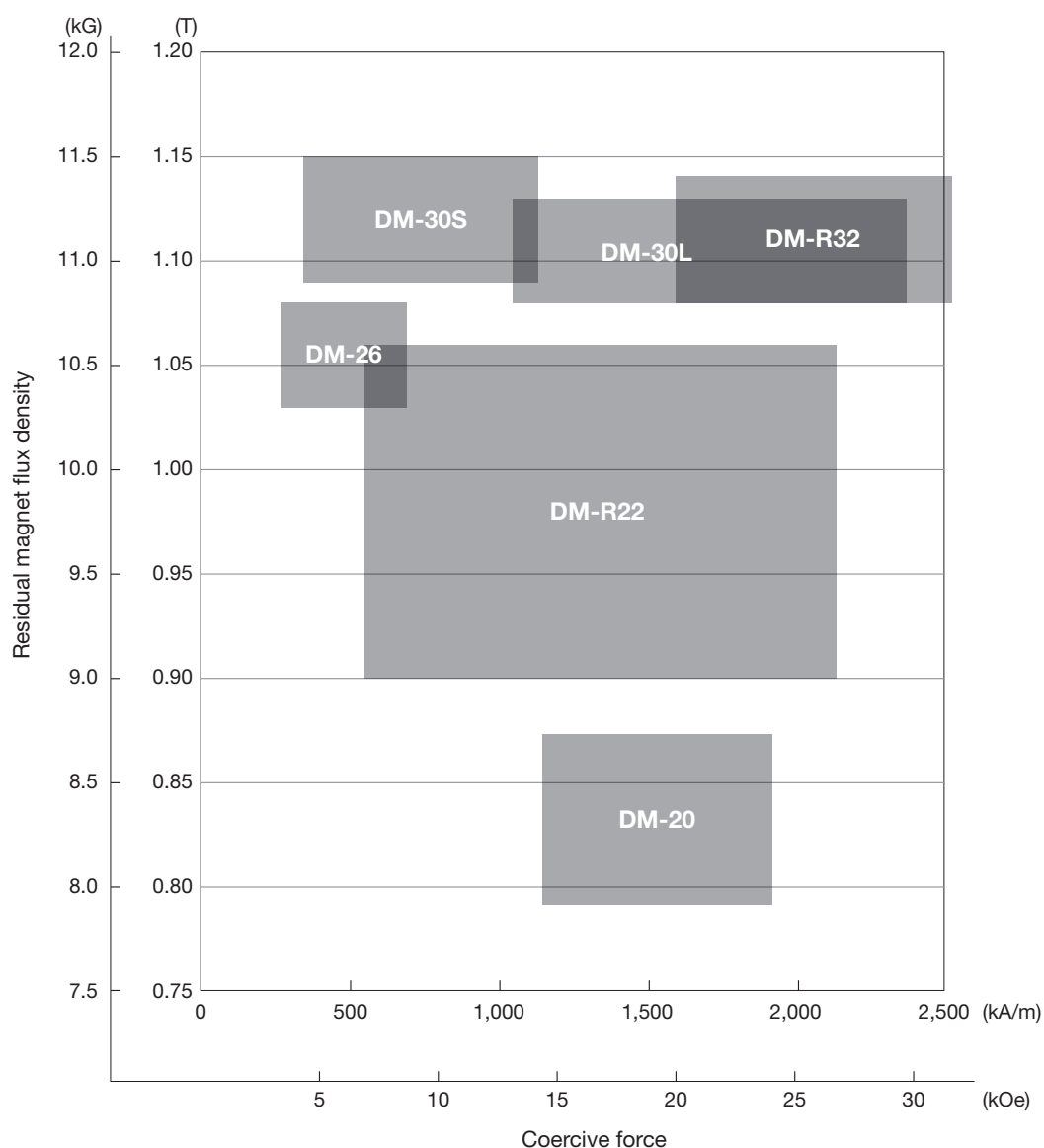


The heat-demagnetizing factor varies depending on the usage environment and conditions. This does not guarantee the heat-resistant temperature.

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 ³)	(MGOe)
1-5 based (SmCo ₅)	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 ₂ Co ₁₇)	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

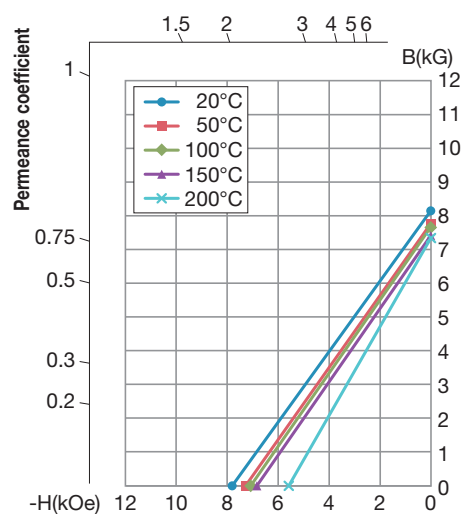
Range of Magnetic Characteristics



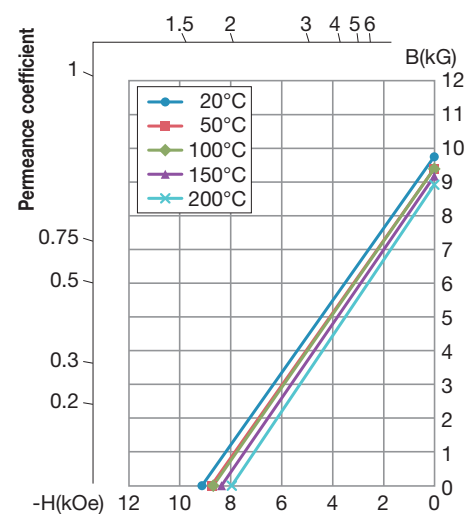
Note: Magnetic characteristics will vary depending upon the customer's specified dimensions and shape. Please contact us for details.

Temperature Characteristics

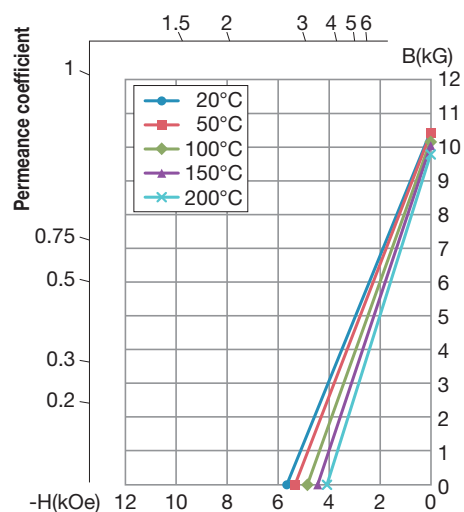
■ DM-20 B-H



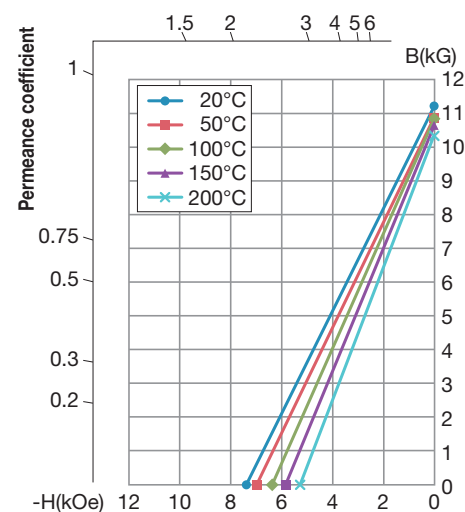
■ DM-R22 B-H



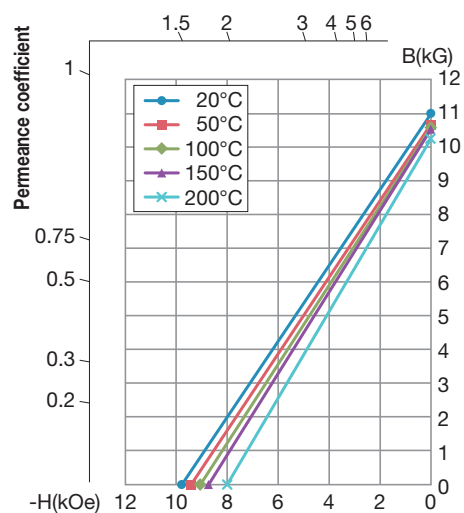
■ DM-26 B-H



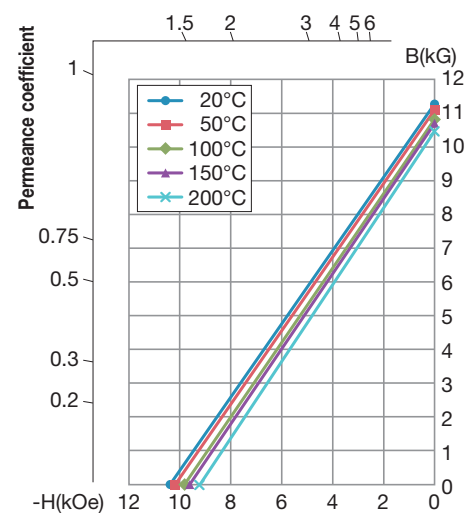
■ DM-30S B-H



■ DM-30L B-H



■ DM-R32 B-H

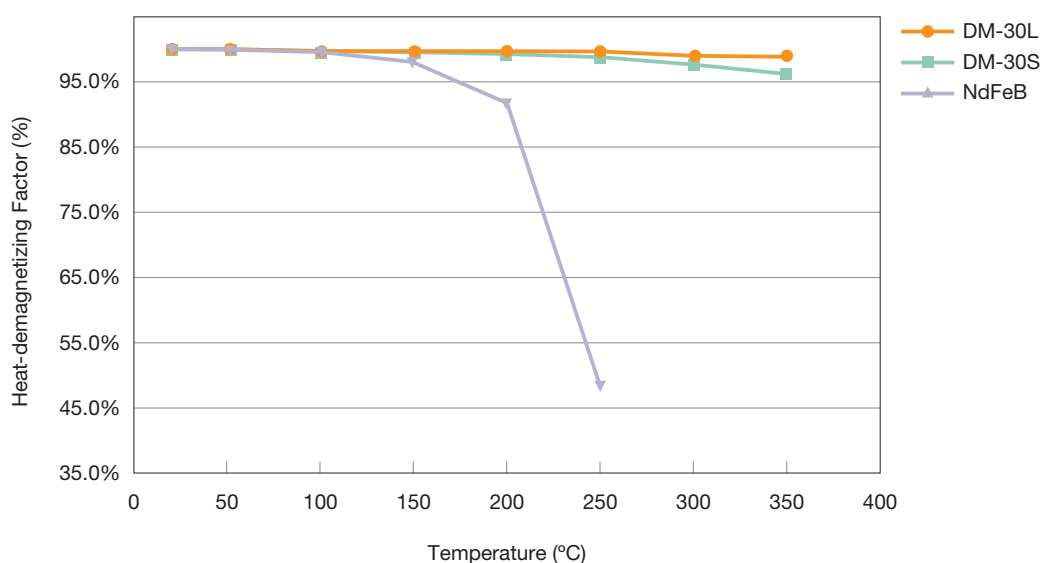


■ Heat-demagnetizing Factor

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_c): 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.

Surface Processing and Measurement

■ Surface Processing

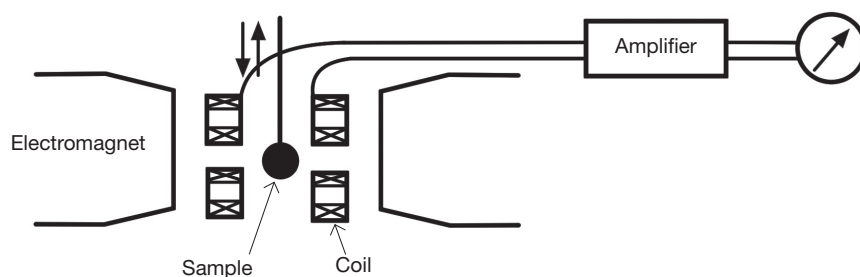
Depending on usage, we recommend nickel electroplating to be conducted.

- 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.

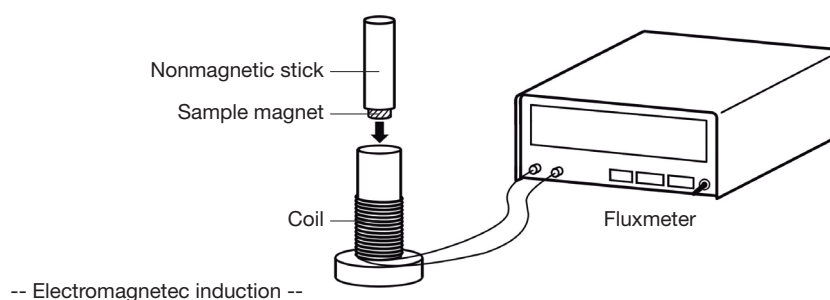


1. Measurement of the Total Magnetic Flux.

Flux

Unit: Weber (Wb)

Maxwell (Mx)



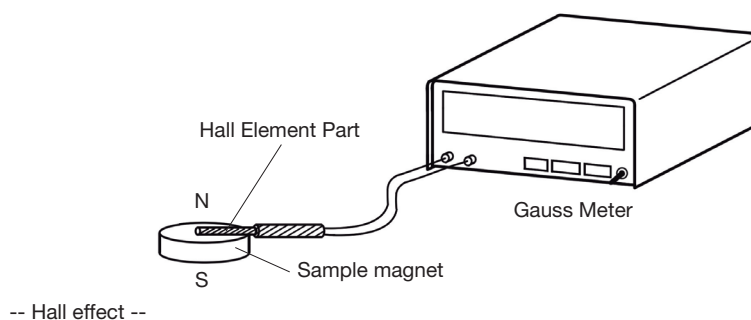
Measures the amount of entire magnetic flux of the sample magnet.

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.

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 ₁		
d or L ₂		
t		

1-2. Characteristics

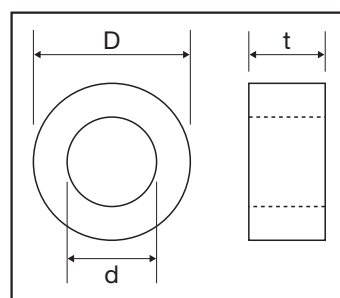
Br:

iHc:

bHc:

BHmax:

• Simplified schematic



1-3. Magnetic or nonmagnetic

1-4. Magnetization direction (D·L₁·L₂·t)

1-5. With/without markings

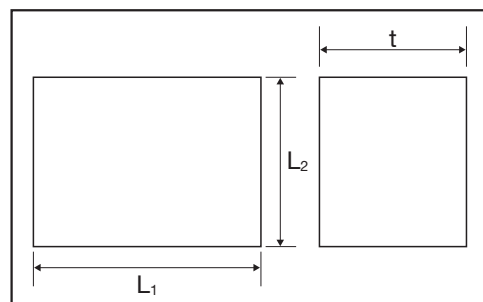
1-6. With/without surface treatment

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 Activities at Micro-Energy Division

Environment & Quality Policy

Seiko Instruments Inc., Micro-Energy Division is located in Ayashi, a city with beautiful nature, in Miyagi Prefecture. Our aim is to provide customer satisfaction and harmony with the environment through all our products, from Micro battery to other electronic products, and sales activities.

1. We adhere firmly to laws, regulations and customers' specified requirements.
2. We aim to prevent pollution, to reduce CO₂, and to conserve biodiversity.
3. We set goals, take actions, conduct regular reviews, and improve the system and performance continuously.
4. We contribute to the society by supporting green procurement, developing green products, and promoting green life activity.
5. We adhere to regulations and accommodations regarding Chemical substance content in our products and will promote reduction and replacement.
6. We vigorously educate ourselves and try to engage voluntarily in green life activity.

1. Enrich the line up of Eco-Products

- We introduced the SII Green Product Label System which is equivalent to the ISO 14021 Type II environmental label. At the end of FY2006, 100% of our products are certified as SII Green Products. In addition, 36 products are certified as SII "High Grade" Green Products.

2. Reduction of Greenhouse Gas

- We practice various CO₂ reduction measures like using Eco-machinery. Since 1997, we have successfully reduced a total of 50,300 tons of CO₂. We believe our efforts contribute to the prevention of global warming.

3. 3R Promotion Activity

- We have promoted the "reduce and reuse" activities and also promoted recycling at the end of the production process. With these activities, we achieved "Zero-emission" in 2004. We have reduced the non-recyclable wastes to less than 1 ton - less than 1% of our 1997 results.

4. Biodiversity Conservation

- We endeavor to deepen our understanding on the relevancy between biodiversity and our business activities, and to contribute to the conservation of biodiversity by participating local community activities.

5. Green Purchasing

- We adhere to a green purchasing campaign through the purchase of ingredients, manufacturing materials, and other necessary products, whenever appropriate.

6. Green Life

- With the participation of all of Micro-Energy Division members, we deploy a clean-up and beautification campaign in all areas surrounding our factory twice a year. In addition, we participate in the clean up activity at Hirose River once a year.

7. Conflict Minerals

- Recognizing the international importance of conflict minerals issue, we prohibit the use of such minerals.

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, NH₃, SO_x, NO_x)
 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

Excellent heat and
corrosion resistance

**Samarium-cobalt
Magnet**

"DIANET"

For wearable
devices

Small and powerful
Silver Oxide Battery

**Silver Oxide
Battery**

"SEIZAIKEN"

Precise Timing
with
Lowest Power
consumption

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.



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