Magnescale

スケールセット / Scale set / Maßstabsatz

SR24, CH23

お買い上げいただき、ありがとうございます。
ご使用の前に、この取扱説明書を必ずお読みください。
ご使用に際しては、この取扱説明書どおりお使いください。
お読みになった後は、後日お役に立つこともございますので、必ず保管してください。

Read all the instructions in the manual carefully before use and strictly follow them.
Keep the manual for future references.

Lesen Sie die ganze Anleitung vor dem Betrieb aufmerksam durch und folgen Sie beim Betrieb des Geräts den Anweisungen.
Bewahren Sie diese Bedienungsanleitung zum späteren Nachlesen griffbereit auf.

取扱説明書 / Instruction Manual / Bedienungsanleitung

Safety Precautions

Magnescale Co., Ltd. products are designed in full consideration of safety. However, improper handling during operation or installation is dangerous and may lead to fire, electric shock or other accidents resulting in serious injury or death. In addition, these actions may also worsen machine performance.
Therefore, be sure to observe the following safety precautions in order to prevent these types of accidents, and to read these "Safety Precautions" before operating, installing, maintaining, inspecting, repairing or otherwise working on this unit.

Warning indication meanings

The following indications are used throughout this manual, and their contents should be understood before reading the text.

⚠ Warning

Failure to observe these precautions may lead to fire, electric shock or other accidents resulting in serious injury or death.

⚠ Caution

Failure to observe these precautions may lead to electric shock or other accidents resulting in injury or damage to surrounding objects.

Symbols requiring attention


CAUTION


FIRE


ELECTRICAL SHOCK


FINGER JAM

Symbols prohibiting actions


DO NOT DISASSEMBLE

Symbols specifying actions


UNPLUGGING

⚠ Warning

Do not use with other than the specified power voltage.
Do not use the rotary magnescale with other than the indicated power voltage.

➡ **Failure to observe this precaution may result in burns or electric shock.**

Do not install with wet hands.
Do not perform installation work with wet hands.

➡ **Failure to observe this precaution may result in electric shock.**

Do not disassemble.
Do not disassemble or modify the unit.

➡ **Failure to observe this precaution may result in injury.**
* The internal circuits may also be damaged.

⚠ Caution

Ensure work safety.
Be sure to check the machine and device condition to ensure work safety before working on the machine.

➡ **Failure to observe this precaution may result in injury.**

Do not perform any work with the power still supplied.
Be sure to cut off the power supply or other drive sources before proceeding with the work.

➡ **Failure to observe this precaution may result in burns or injury.**

Take care not to catch your fingers.
When turning on the power supply or other drive sources, take care not to catch your fingers in the peripheral machines and devices.

➡ **Failure to observe this precaution may result in injury.**

General precautions

When using Magnescale Co., Ltd. products, observe the following general precautions along with those given specifically in this manual to ensure proper use of the products.

- Before and during operations, be sure to check that our products function properly.
- Provide adequate safety measures to prevent damages in case our products should develop malfunctions.
- Use outside indicated specifications or purposes and modification of our products will void any warranty of the functions and performance as specified of our products.
- When using our products in combination with other equipment, the functions and performances as noted in this manual may not be attained, depending on operating and environmental conditions.

Contents

1. Product Overview

1-1. Overview

This product is a scale system that outputs position signals for machine tools and other equipment that require high-precision positioning.

1-2. Features

- The scale unit uses a shielded case made of steel to achieve a high rigidity despite its small cross-section.
- The scale unit and connecting cable are separated by connectors. This simplifies installing the scale unit and connecting the cable.
- The connection cable is designed to allow connection to either end of the scale head. The cable can therefore be routed from the left or right depending on the installation location.
- Includes a built-in function for correcting variations in scale signal levels for enabling high-precision positioning. High-precision correction function developed exclusively by Magnescale Co., Ltd. is used to realize high precision and high resolution.

1-3. System Configuration

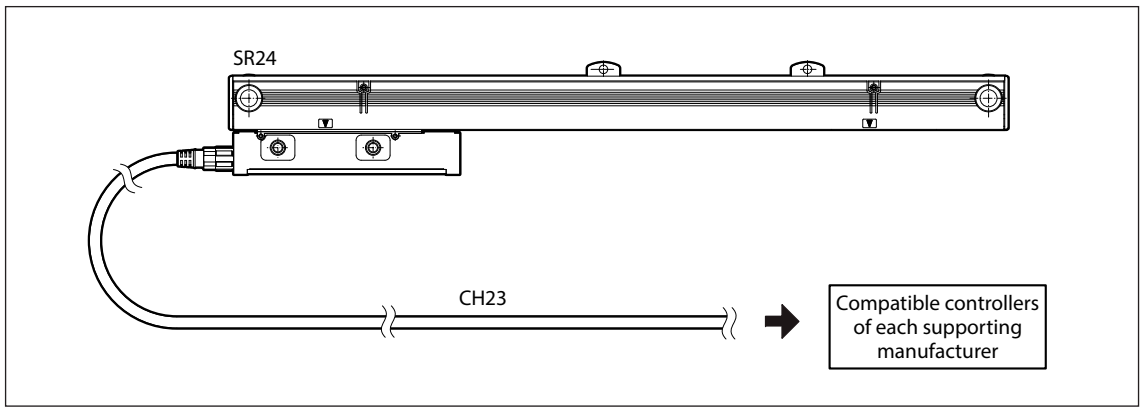

Fig. 1-1

1-4. Model Name

S R 2 4 - × × × ○ □ △ X

Reference point
X: Center

Minimum phase difference

A: 50 ns	F : 300 ns	L : 1250 ns
B : 100 ns	G : 400 ns	M: 2500 ns
C : 150 ns	H : 500 ns	N : 3000 ns
D: 200 ns	J : 650 ns	
E : 250 ns	K : 1000 ns	

Resolution and polarity

B : 0.05 µm	Polarity +	G: 0.05 µm	Polarity –
C : 0.1 µm	Polarity +	H: 0.1 µm	Polarity –
D: 0.5 µm	Polarity +	J : 0.5 µm	Polarity –
E : 1 µm	Polarity +	K : 1 µm	Polarity –

Precision grade
A: 5 + 5L/1000 µm p-p
S : 3 + 3L/1000 µm p-p

Effective length
Expressed in cm units
(See 7-1 for type)

C H 2 3 - × × × ○ □ △ #

Terminal A specification
None: Original of Magnescale
C : 12P ER04 (female) made by Tajimi Electronics
W : 11P LF13WB (female) made by Hirose Electric

Terminal B specification
None: Unterminated end
D : 9P D-Sub
L : 10P made by 3M
N : 12P ER04 (male) made by Tajimi Electronics
P : 20P made by Honda Tsushin Kogyo Straight case
R : 20P made by Hirose Electric Horizontal drawing case
U : 11P LF13WB (male) made by Hirose Electric

Cable specification
C : Polyurethane ϕ6.8
E : Polyurethane ϕ8
P : PVC ϕ8
V : PVC ϕ6.8

Conduit specification
C : Including conduit
N : Not including conduit

Cable length
(Example) 010 1.0 m
105 10.5 m
(See 7-2 for type)

(Short form of company names)

(Note) Please contact our sales representative for the model names of the special-order products

2. Handling Precautions

Be sure to observe the following safety precautions in order to maintain the product's functions and performance.

- This product should be handled and installed by operators who have read and understood this Instruction Manual.
- Handle with care so that the output connector of the connection cable does not hit the scale and scale head.

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- Do not bring magnets or other magnetically charged objects. Doing so may destroy the magnetic recording.
- When coupled with equipment powered by a linear motor, make sure that the magnetic flux density at the exterior parts of the scale and scale head is 5 mT or less.
- Use a clean cloth, etc. to wipe the surface gently when cleaning it. Do not use any organic solvents other than alcohol. Even when using alcohol to clean the surface, simply wipe it gently.

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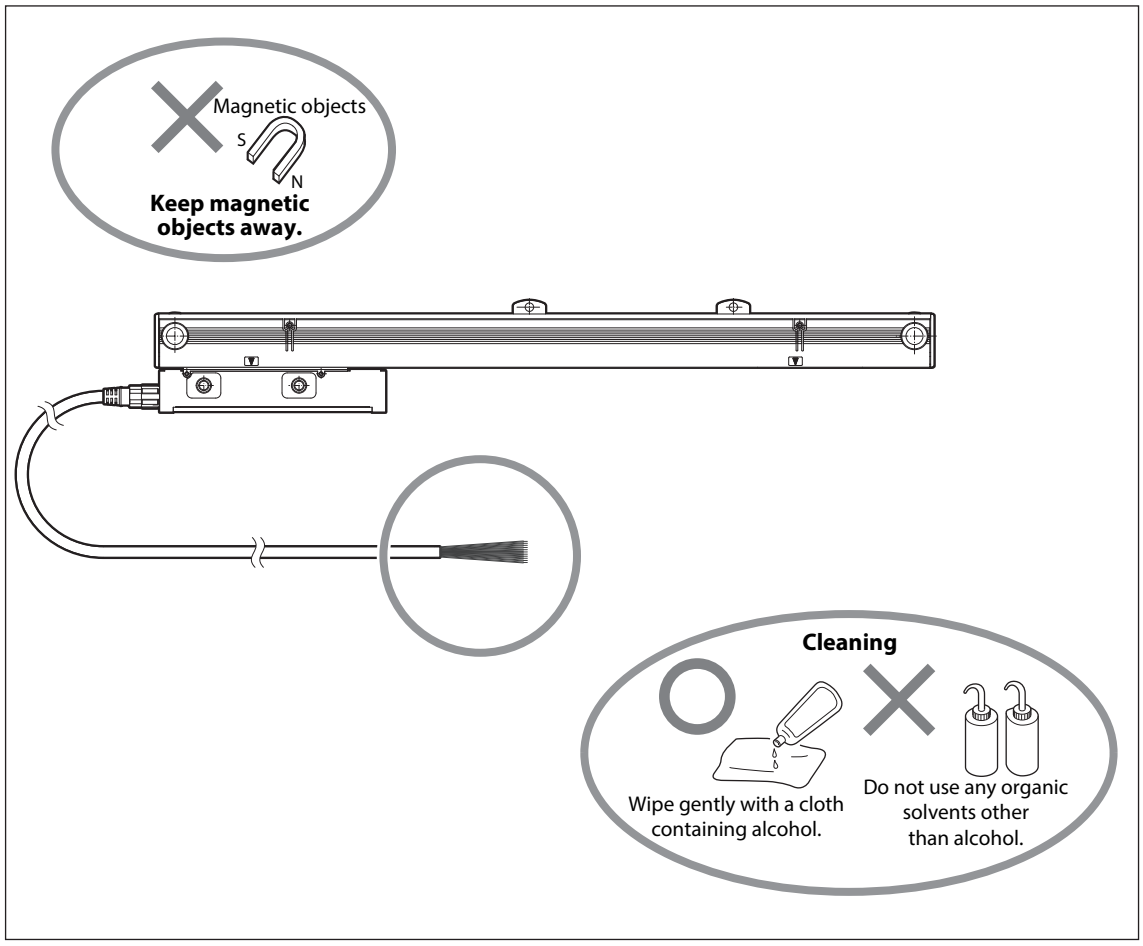


Handling precautions

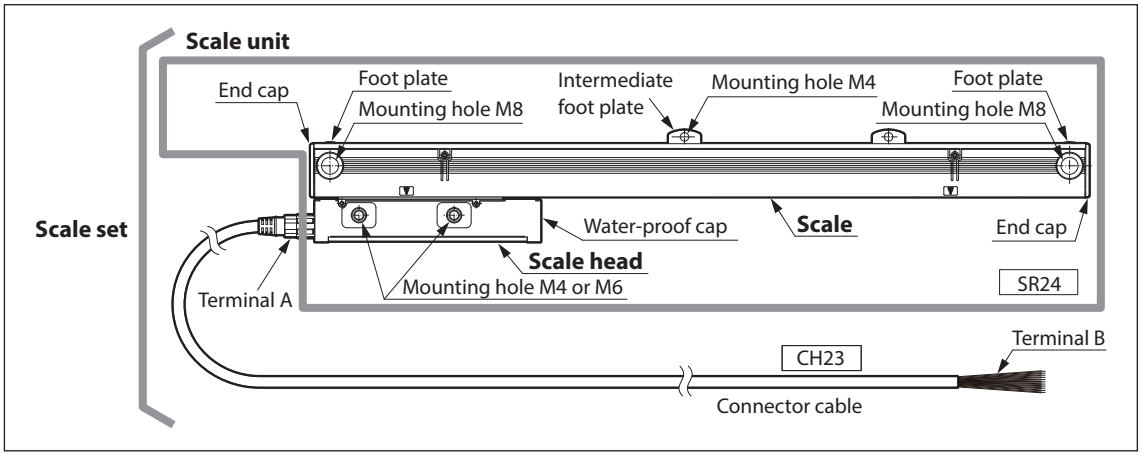
When storing or transporting the unit

- Store or transport the unit using the packaging materials in which the product was shipped.

3. Installation

For the installation dimensions, refer to section 8, “Dimensional Diagrams.”

3-1. Names of Parts



3-2. Installing the Scale Unit

Notes

- Do not turn on the power before installing the scale unit.
- Do not take off the head holders, if possible, until immediately before securing the scale head.
  Even if the head holders are removed, the approximate positional relationship of the scale and scale head will be maintained. However, the plastic hook can come off if the scale head is forcibly twisted or other excessive force is applied. If the plastic hook comes off, return the plastic hook back to its original position before performing the installation.

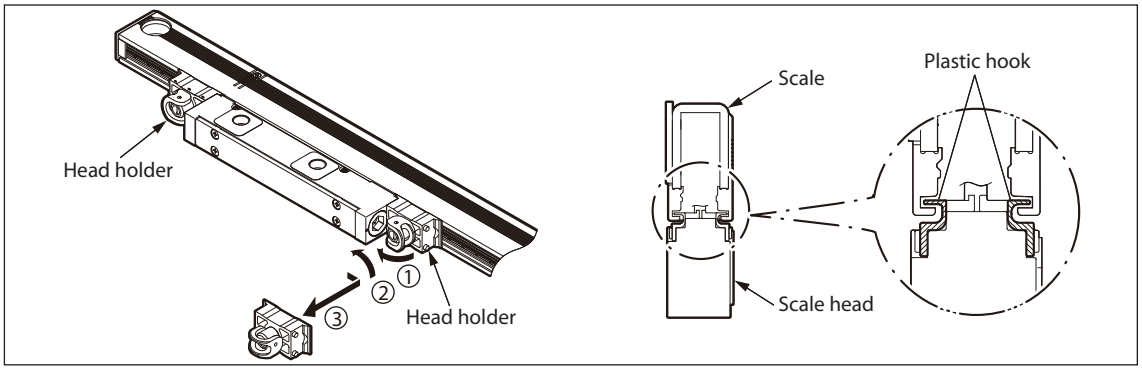


Fig. 3-1

- The scale head will be damaged if the scale head is moved outside the effective length (L). The scale head must always be moved within the effective length.
- Install the scale unit so that the scale is on the upper side of the scale head.
  If the upper side is not available, set it to face horizontally. (Fig. 3-2)

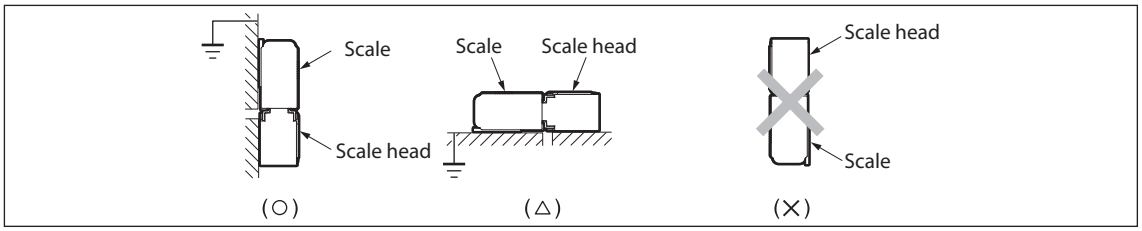


Fig. 3-2

- Use a scale installation bracket, where applicable, having length covering the entire scale length. The parallelism of the scale may be harmed if only using a bracket divided for the installation section.

Before installation

- Check that the alignment of the installation surface (or installation brackets) is within the standards. (For the standards, see the later-described illustration of the Installation example)
- Remove off the coating around the tap hole to ground the scale unit using the installation surface contact with the scale.

For details on the installation method, see the later-described example installation.

- The foot plates and intermediate foot plate(s) installed on the scale are used as the installation guides. The head holders are used for securing the scale head when transporting the head holders and cannot therefore be used as an installation guide.
- Loosely turn the mounting screws first. Determine the alignment and then tighten the screws to fasten the scale. (See Fig. 3-3)

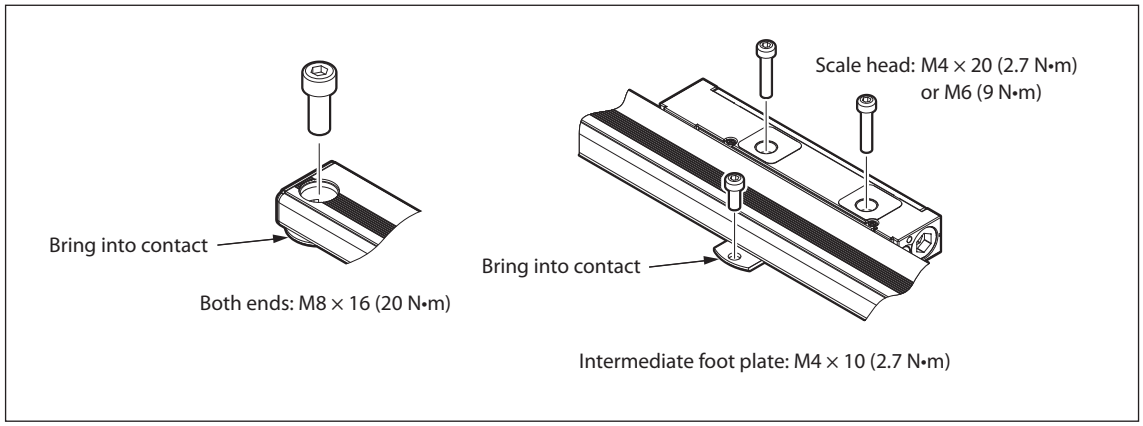


Fig. 3-3

- In environments where coolant can splash directly on the scale unit, be sure to mount a cover on the scale unit to protect the scale unit from splashing.

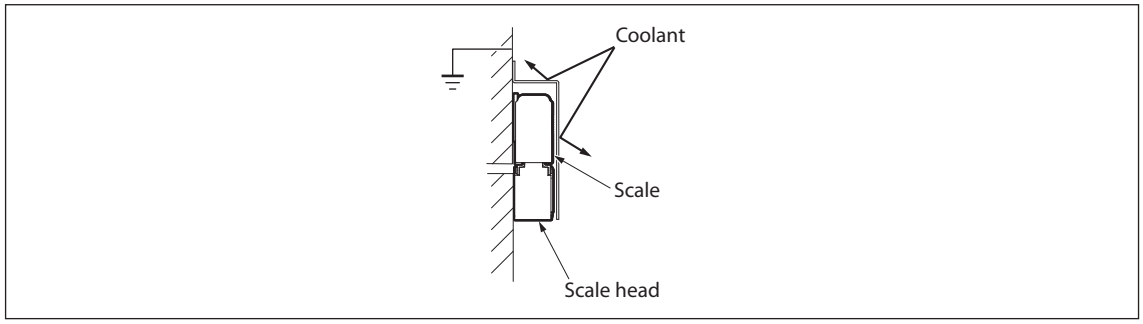


Fig. 3-4

Be sure to observe the following to prevent the scale set from being affected by noise from other devices.

- When coupling relays, solenoids, motors or other devices to this scale set, be sure to keep the scale unit and connection cable as far away from these devices as possible.
- Do not arrange the connection cable alongside or parallel to device power supply cables. Be sure to keep the connection cable 20 cm or more away from power supply cables.
- In the event that a device power supply cable and the connection cable cross each other, arrange the cables so they cross at as close to a right angle as possible.

Installation example

Example 1 (recommended): Installation when a stop surface of the scale and the scale head is made with the bracket.

Scale installation accuracy is improved when a stop surface is made. This also simplifies reinstallation of the scale.

1. Check and adjust the scale bracket's parallelism with respect to the machine guide, and then secure in place.
   As shown in the figure, adjust the parallelism over the entire bracket length even when making a difference in levels on the scale installation surface.
   * To use a scale bracket positioning jig, a screw hole (M8) must be added to the scale bracket. For more information on positioning jigs, please contact our sales representative.

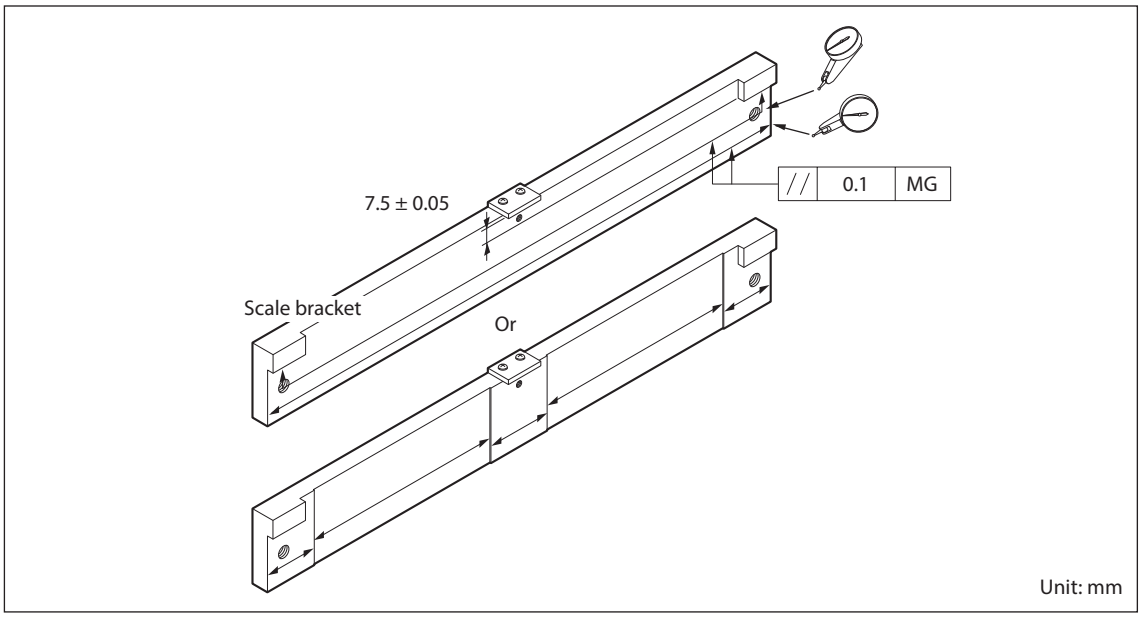


Fig. 3-5

2. Check and adjust the height and parallelism of the scale head bracket, and then secure in place.

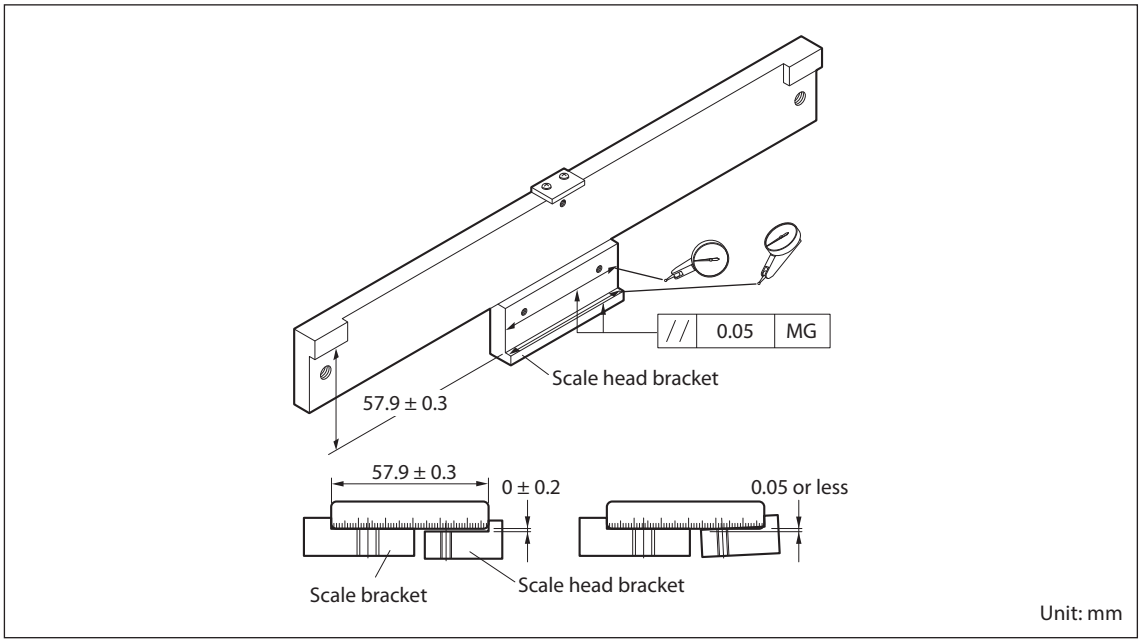


Fig. 3-6

3. Bring the scale into contact with the stop surfaces and install.

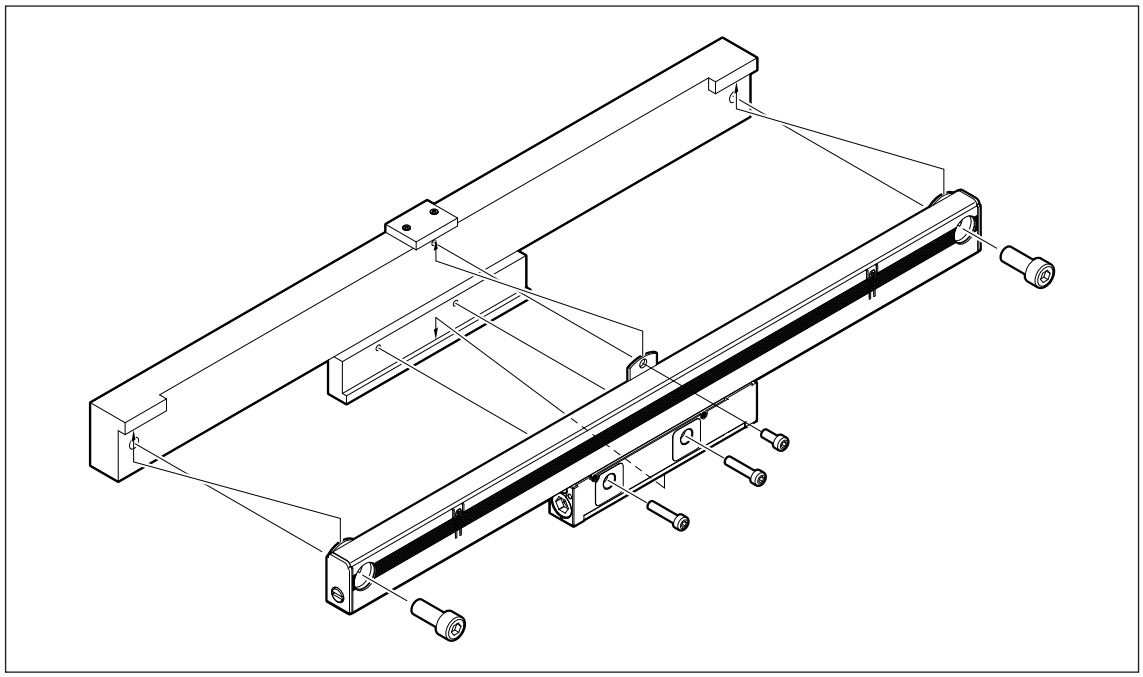


Fig. 3-7

Example 2: Installation when a stop surface of the scale and the scale head is not made with the bracket.

1. Adjust the parallelism of the scale bracket and scale head bracket with respect to the machine guide, and then secure in place.
   Adjust the height and parallelism of the scale head bracket with respect to the scale bracket, and then secure in place.
   * To use a scale bracket positioning jig, a screw hole (M8) must be added to the scale bracket. For more information on positioning jigs, please contact our sales representative.

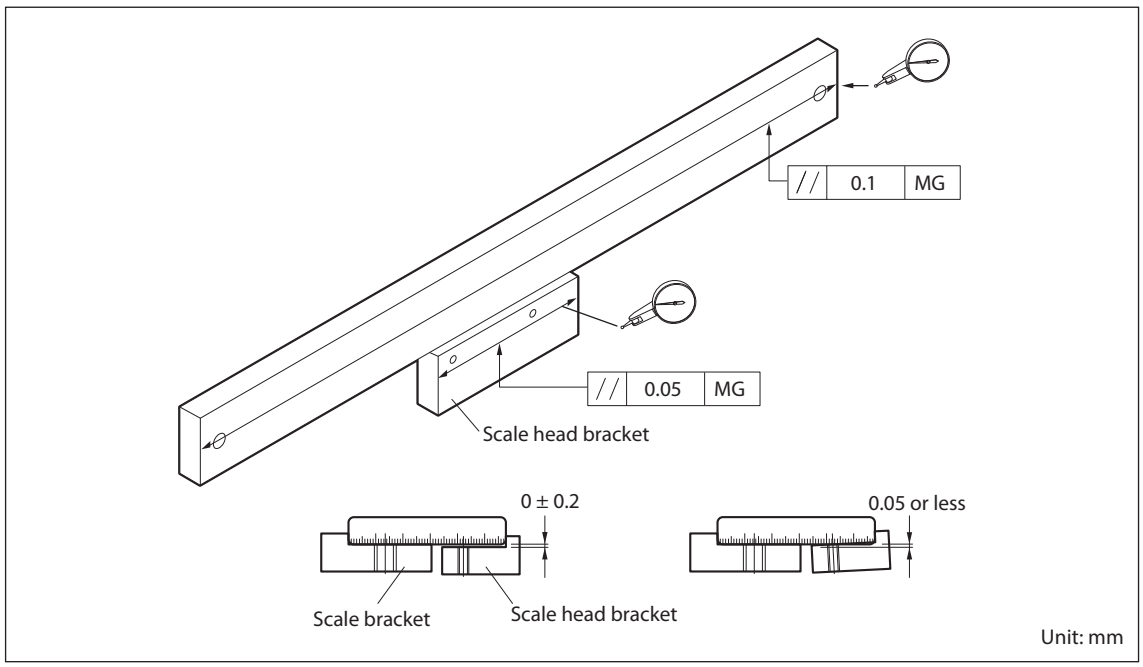


Fig. 3-8

2. Adjust the parallelism with respect to the machine guide of the scale rear while measuring the scale rear with a dial gauge. Tighten the set screws.

<Measurement method>

Measure at two points where the measurement distance is as wide as possible and at the same distance from the right and left scale ends. If using a scale with intermediate foot plate, be sure to also measure the intermediate foot plate.

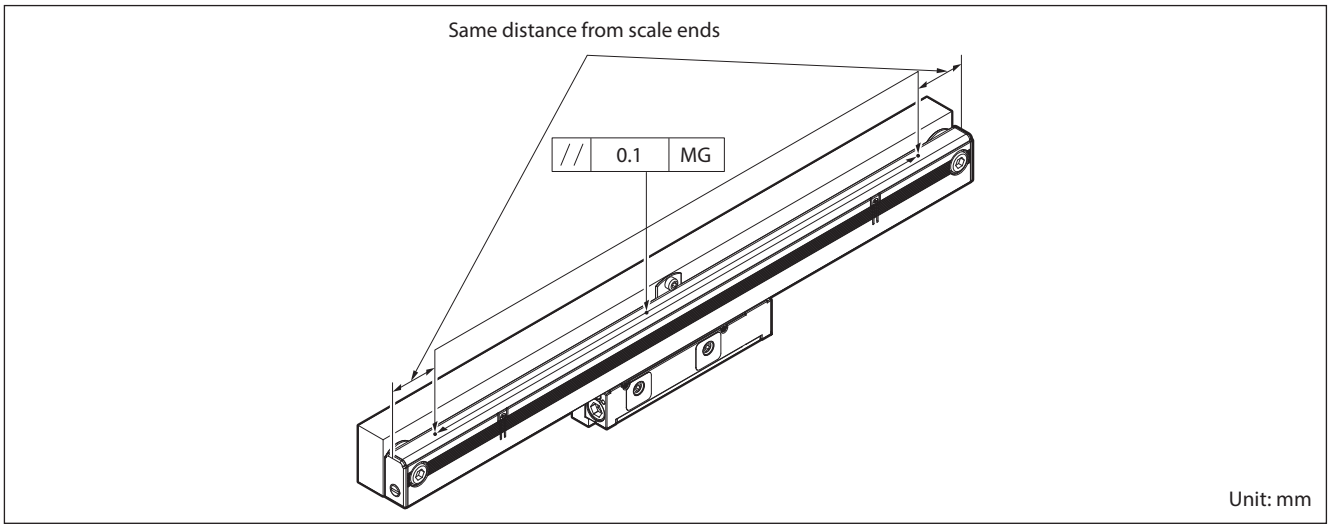


Fig. 3-9

3. Insert the supplied spacer (t = 1.0 mm) in the space between the scale and the scale head, and then adjust the scale head position while bringing the scale head into contact with the scale.

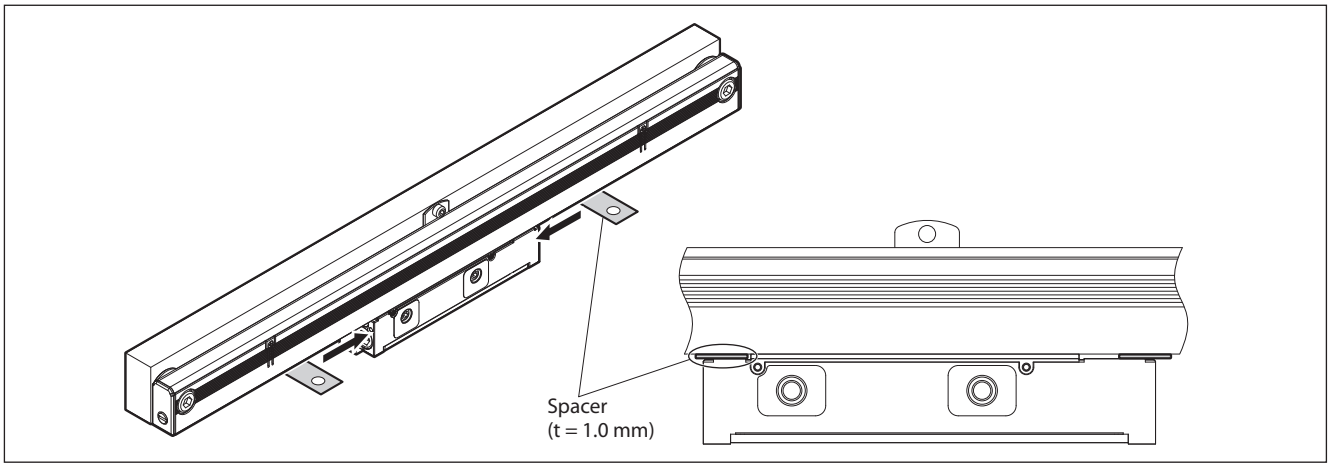


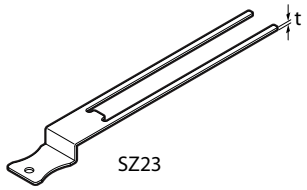
Fig. 3-10

Check that the gap at the two ends is 1 mm using a spacer (with a 1.0 mm thickness).

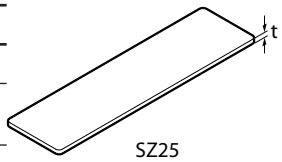
Accessories (optional) SZ23/SZ25

This product is a spacer used for mounting and verification of Magnescale's scale unit.

The spacer is used to establish the gap between the scale and scale head, and can easily verify the gap.



SZ23	t
Mounting spacer	1.0 mm
Maximum gap verification spacer	1.2 mm
Minimum gap verification spacer	0.8 mm



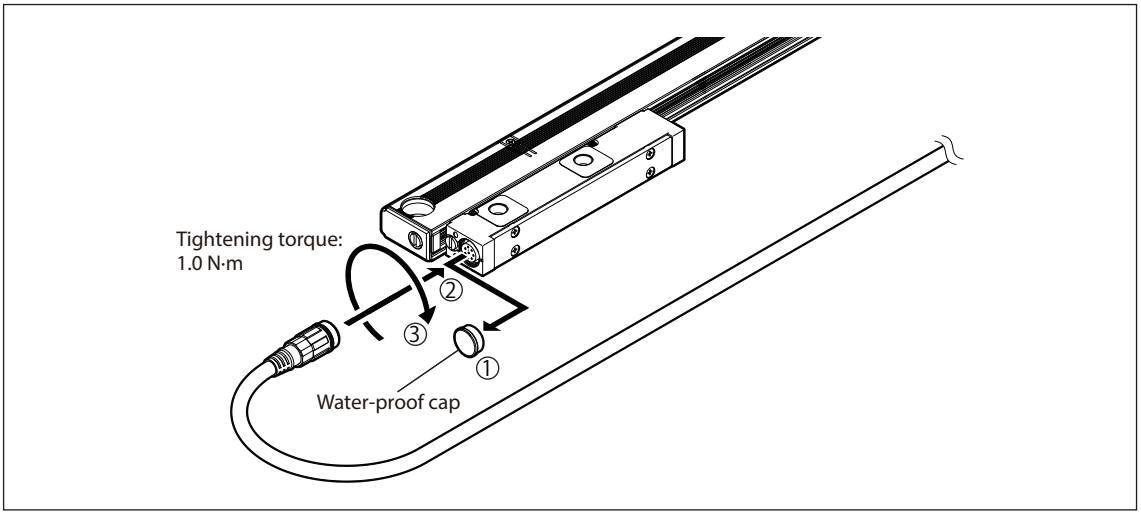
SZ25	t
Mounting spacer	1.0 mm
Maximum gap verification spacer	1.2 mm
Minimum gap verification spacer	0.8 mm
Height verification spacer	0.2 mm

3-3. Connection Cable Installation

- Connect the connection cable to the left or right of the scale head, selecting left or right depending on the installation location.
- A water-proof cap is fitted to both ends of the scale head. Remove the water-proof cap from the end where the cable is to be connected and connect the cable. (Water-proof cap hex. socket-head opposite side 5 mm)
- Use a tightening torque of 1.0 N·m for the connector that is used for the connection with the scale head.

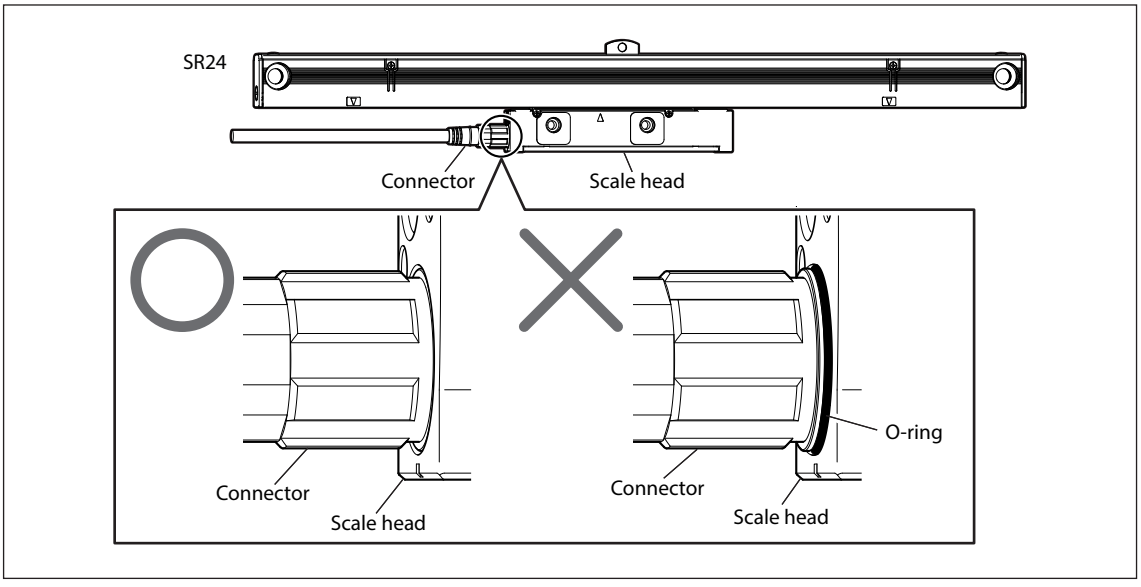
Notes

- Do not remove the water-proof cap from the end that is not connected. If the cap comes off, re-install it securely. Using the scale unit without the cap may result in damage to the scale head.
- If an additional tightness of cable connections is required, it is possible to use a thread locking adhesives to the threaded area of the connector, i.e. Loctite 242 or its equivalent.



Notes

When the connector has been connected with a torque of 1.0 N·m, check to see that the O-ring of the connector is correctly placed inside the scale head as indicated below.



3-4. Connection Cable (CH23)

Note

Be sure to use CH23 to satisfy safety standards.
The CH23 has a cable with unterminated ends and a cable with connectors compatible with various controller manufacturers.

Before making any inquiries, find the specific model name from the correspondence table below.

Controller Manufacturer Correspondence Table

(Short form of company names)

	CH23
Unterminated end	◯
FANUC	◯
Mitsubishi Electric	◯

◯: Enables connection with controller

3-4-1. CH23 Signal Specifications

Cable color	Signal Specifications
Brown	0 V
Black	0 V
Green	+5 V
Violet	+5 V
Blue	A
Yellow	-A
Orange	B
Gray	-B
Red	Z
White	-Z

There are always two cables each for +5 V and 0 V, and so be sure to connect these cables in pairs. If only one cable is connected, the scale may not operate due to the voltage drop in the cable.

4. Output Signal

4-1. Signal Specification

When the scale head is moved in the direction of the arrow, the A signal is ahead when the polarity is "positive," and the B signal is ahead when the polarity is "negative." The polarity is selected when ordering.

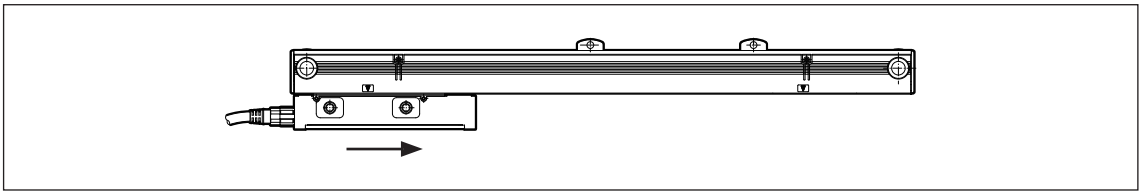


Fig. 4-1

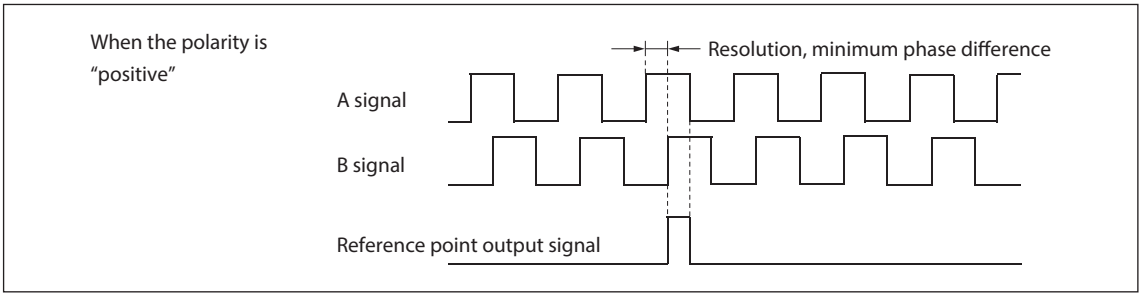


Fig. 4-2

The scale movement is detected every 50 ns, and a signal is output at a phase differential time proportional to the movement. The phase differential time varies in integer multiples of 50 ns.

An alarm signal is output, and the AB quadrature signal becomes high impedance in the following cases. The alarm is reset by turning the power off and then on again.

- When the phase differential time of the AB quadrature signal is less than the minimum phase differential time setting
- When malfunctions occur due to noise, etc.

Maximum response speed (m/min)

Resolution (μm)	Minimum phase differential time setting (ns)					
	50	100	150	200	250	300
0.05	25	12	8	6	5	4
0.1	50	25	16	12	10	8
0.5	180	125	80	60	50	40
1	180	180	160	120	100	80

Please contact our sales representative for minimum phase differential times other than those above.

4-2. Controller Connection Specifications

Recommended Receiving Circuit

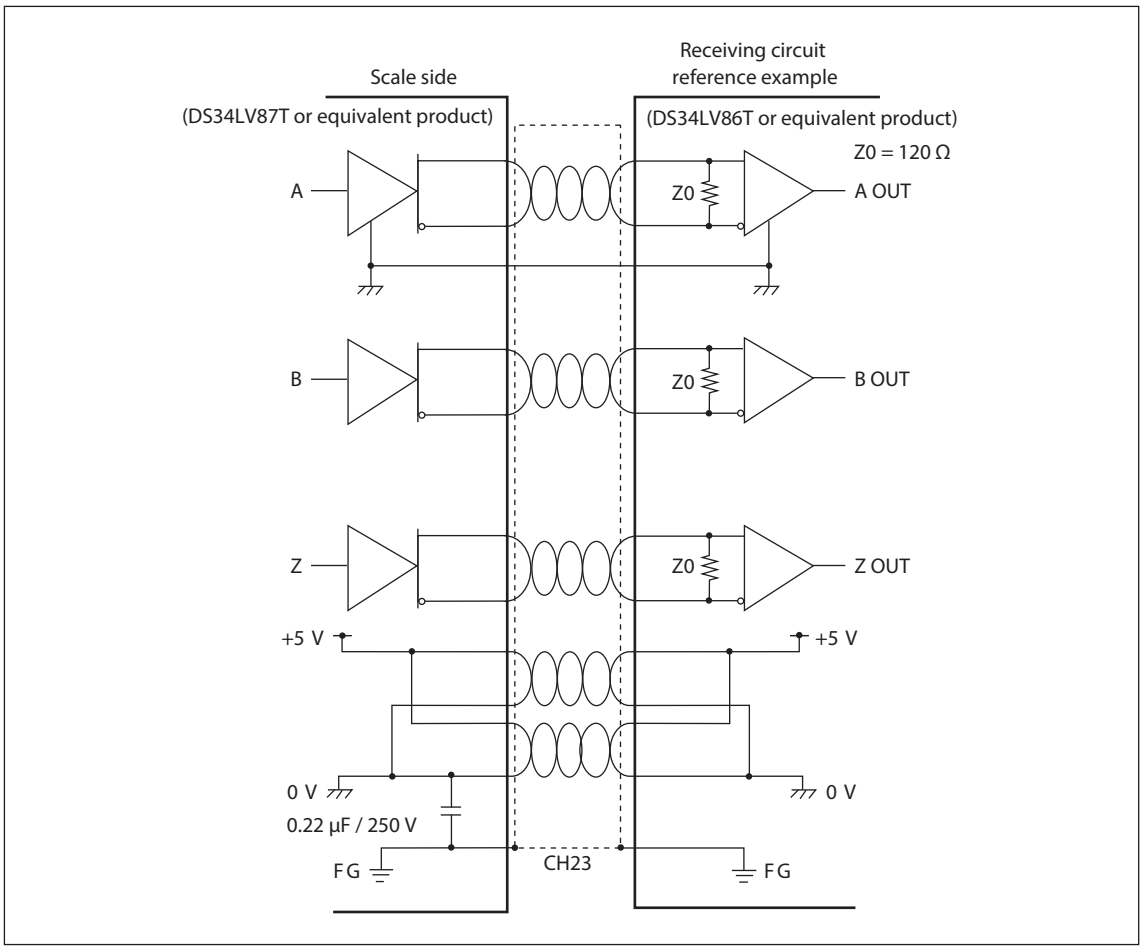


Fig. 4-3

5. Power Supply

Use a power supply that satisfies the specifications below.
Use of a power supply with a short-circuit protection device is recommended.

	SR24
Supply voltage	DC5 V (DC4.75 to 5.25 V)
Current consumption	250 mA (When 5 V is supplied) (In the condition with the controller connected)
Inrush current	2 A max.
Ripple voltage	50 mVp-p or less

*: When the power supply rise time is 10 ms.

Note

Do not turn on the power before installing the scale.
The scale begins functioning normally approximatelly 0.6 seconds after the power is turned on.
Also, a signal may be output momentarily when the power is turned on or off, and this signal can cause the entire system to malfunction. To prevent this, be sure to follow the proper power-on and power-off procedures.

Power-on procedure

1. Turn on the power for the scale.
2. Turn on the power for the receiving device.

Power-off procedure

1. Turn off the receiving device.
2. Turn off the scale.

6. Air Purge

In the standard configuration, an M5 tap hole for air purging is provided in the end cap section of the scale.
Air can be injected into the scale unit to reduce the effects of the environments shown below.
The actual effects, however, will vary depending on operating conditions. Therefore, be sure to fully check the effects before using air purge.

- Use in dusty area
- Use in locations close to coolants

Air Tube Route and Device Configuration

Prepare the devices as shown in the figure below, and air is injected into the scale by connecting the air tubes.

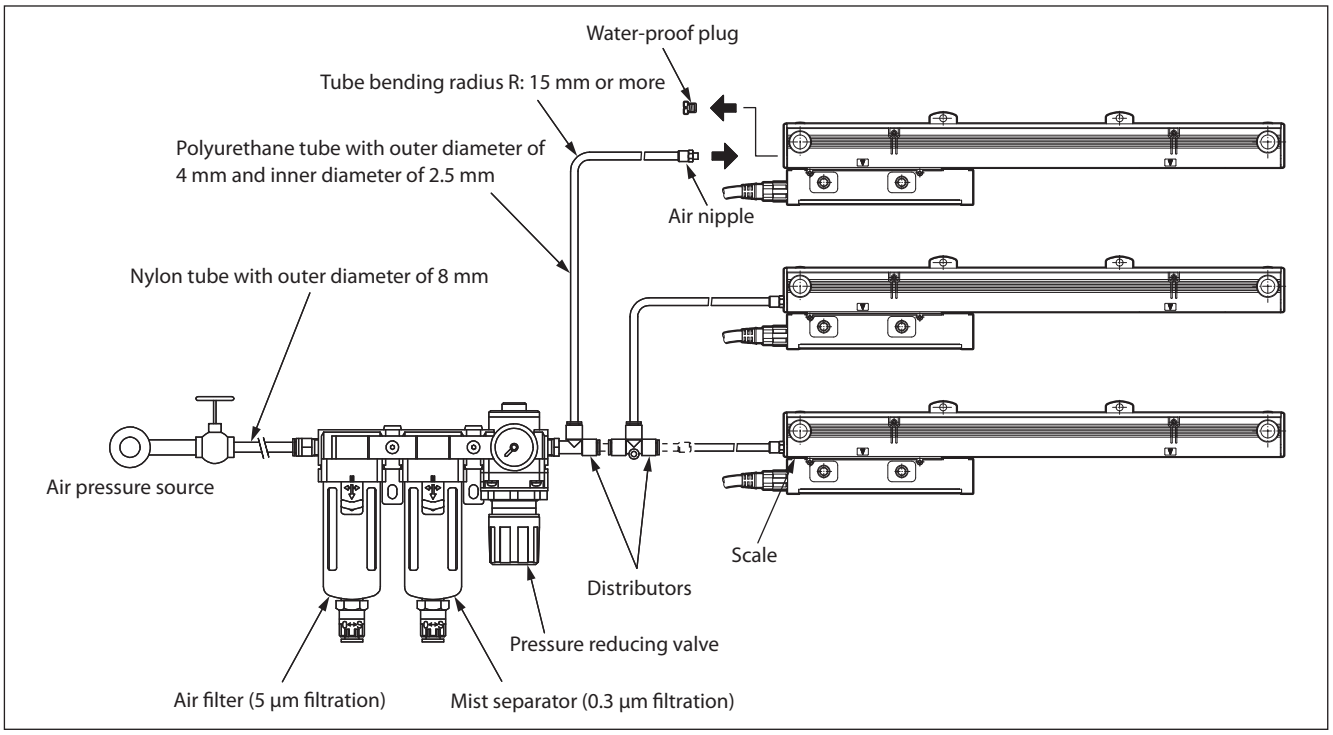


Fig. 6-1

The customer must obtain the air supply unit and input/output air tube. The recommended air supply unit specifications and main components are shown in the table below.

Specifications

Guaranteed pressure resistance	1.5 MPa
Maximum operating pressure	1.0 MPa
Minimum operating pressure	0.02 MPa
Pressure setting range	0.02 to 0.2 MPa
Operating temperature and operating fluid temperature	−5 to 60 °C (no freezing allowed)
Filtration	Air filter: 5 µm
	Mist separator: 0.3 µm
Pressure gauge connection port	2 × Rc (PT) 1/8
Tube connection port	Input side: Tube outer diameter of 8 mm (1 location), Output side: Tube outer diameter of 4 mm (3 locations)
Auto drain differential pressure	0.15 to 1.0 MPa

Main components

Manufacturer	Model	Name	Quantity
SMC Corporation	AF40-A	Air filter	1
SMC Corporation	AFM40-A	Mist separator	1
SMC Corporation	AR40-A	Regulator with 200 kPa pressure gauge	1
SMC Corporation	Y400T-A	Spacer assembly with L-type bracket	2
SMC Corporation	KQ2S04-M5N	Air nipple	1

Notes

The air filter and mist separator should incorporate a float-type auto drain (NC) mechanism.
Use a drain tube with a diameter of at least 4 mm and length of 5 m or less. Set the tubes so that there is no rising.

Tube Layout Notes

Tube arrangement

Use tubes with a bending radius of at least 15 mm and make sure that there are no sharp bends. Also, if the tubes are laid parallel within the ducts for the electrical wiring or hydraulic tubes, be careful that the tubes are not crushed by the movement of the ducts.

Tube length

To inject air simultaneously into multiple scales, make the tubes the same length from the distributor of the air supply unit to each scale so that the injection air pressure is uniform for each scale.

Pressure setting and tube length for pressure reducing valve

If the air injection pressure for each scale is around 0.1 MPa, the air in the scale can be maintained at a low humidity. However, setting the air injection pressure only via the pressure reducing valve will not result in an air injection pressure of 0.1 MPa due to pressure losses stemming from the tube length.
Determine the pressure setting of the pressure reducing valve.
Adjust the air injection pressure to around 0.1 MPa so that the air consumption for each scale becomes 10 to 20 ℓ/min.

Tube flushing

Flush the tube from the air pressure source to the air supply unit connectors and each scale connector.
Flushing cleans the tubes, prevents the embedding of foreign objects in the equipment, and is also useful to check the tubes.

Air pressure source

If a compressor is selected for use, take into consideration the air consumption amount (10 to 20 ℓ/min per scale).

7. Specifications

7-1. Scale

Item \ Model name	SR24-×××○□
Effective length (L)	70 to 2040 mm (27 types) 70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 570, 620, 670, 720, 770, 820, 920, 1020, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040
Thermal expansion coefficient	$12\pm1 \times 10^{-6}$/ °C
Output signal	A/B, Reference point line driver signal (compliant with EIA-422)
Minimum phase differential time	Selectable from 50/100/150/200/250/300/400/500/650/1000/1250/2500/3000 ns (set at factory shipping)
Accuracy (at 20 °C) L: Effective length (mm)	3 + 3L/1000 μmp-p or 5 + 5L/1000 μmp-p
Resolution	Selectable from 0.05, 0.1, 0.5, and 1 μm (set at factory shipping)
Reference point	• None • Center point • Multi-point (40 mm pitch) • User-selected point (1 mm pitch)
Power supply voltage range	DC5 V (DC4.75 to 5.25 V)
Current consumption	250 mA (When 5 V is supplied) (In the condition with the controller connected)
Maximun power consumption	1.3 W max. (When 4.75 to 5.25 V is supplied)
Inrush current	2 A max. (When the power supply rise time is 10 ms)
Maximum response speed	50 m/min (Resolution: 0.1 μm, Minimum phase difference: at 100 ns)
Maximum cable length	30 m max.
Vibration resistance	150 m/s^2 (50 Hz to 3 kHz)
Impact resistance	350 m/s^2 (11 ms)
Protective design grade	IP54 (Air purge not included), IP65 (Air purge included) For details, see section 6, “Air Purge.”
Power supply protection	In the case of errors such as a reverse-connected power supply or over-voltage, the internal fuse is cut to protect the power being supplied and wiring.
Safety standards/laws and regulations	CE RoHS EN / BS63000 (2011 / 65 / EU, (EU) 2015 / 863) CE EMC EN / BS61000-6-2 EN / BS61000-6-4 FCC Part15 Subpart B Class A ICES-003 Class A Not applicable because this product is a low-voltage equipment
Operating temperature range	0 to +50°C
Storage temperature range	–20 to +55°C
Mass	Approx. 0.39 kg + 1.53 kg/m
Scale head sliding resistance	1 N or less
Dimensions	See section 8, “Dimensional Diagrams.”

The information here is subject to change without notice. When designing machines, please request the latest specifications from your nearest sales representative.

Multi-point reference signal position

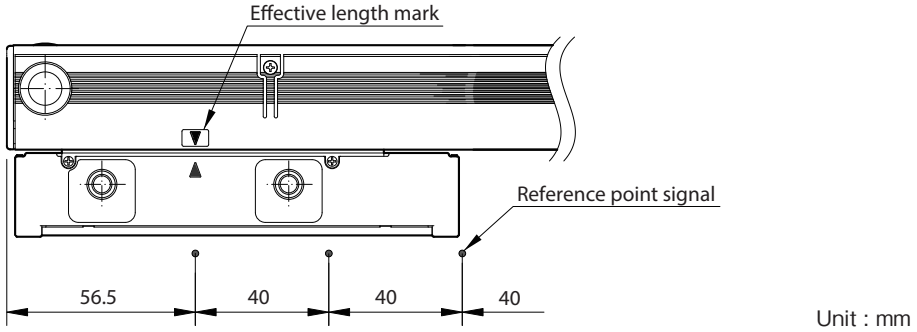


Fig. 7-1

7-2. Connection Cables

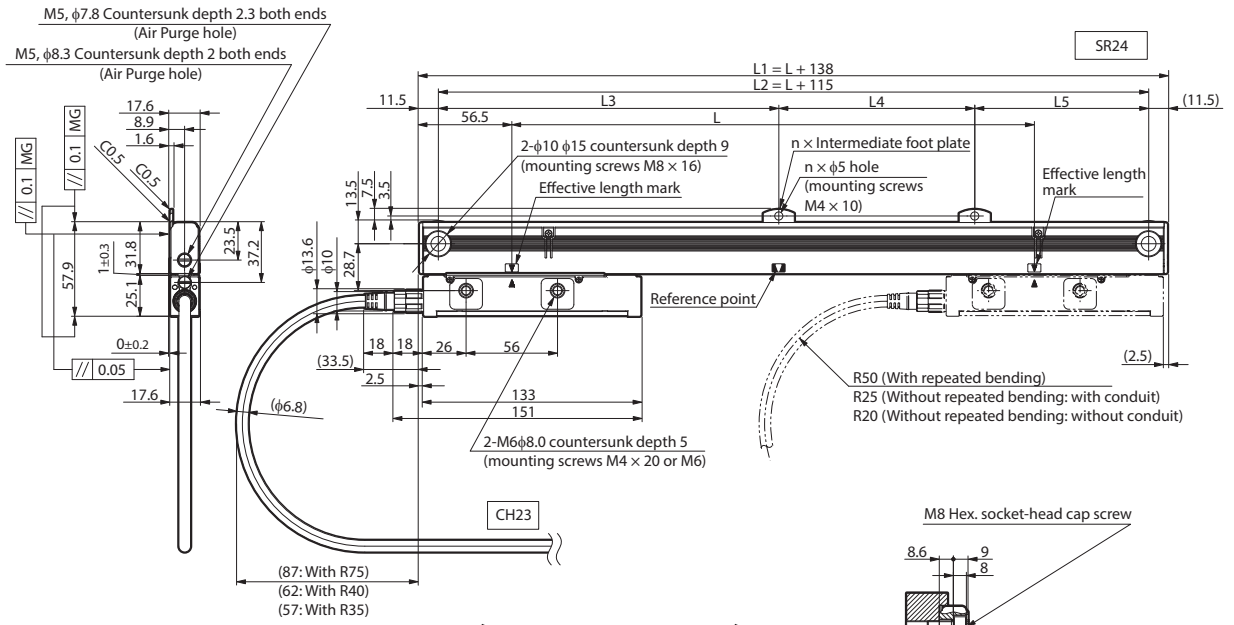
Model name / Item	CH23-×××NV△
Conduit	None
Cable sheath	PVC
Cable length	3 m, 5 m, 10 m (standard product), Supports only 0.5 m units from 1 to 13 m (special-order product) Maximum combined total 30 m
Protective design grade	IP65 (Connector of the controller side is not included)
Safety standards/laws and regulations	CE RoHS EN / BS63000 (2011 / 65 / EU, (EU) 2015 / 863)
Operating temperature range	0 to +50°C
Storage temperature range	–20 to +55°C
Mass	Approx. 0.1 kg + 0.157 kg/m
Recommended minimum bending radius	R50 mm (With repeated bending) R25 mm (Without repeated bending: with conduit) R20 mm (Without repeated bending: without conduit)
Dimensions	See section 8. “Dimensional Diagrams.”

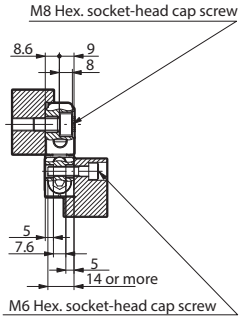
The information here is subject to change without notice. When designing machines, please request the latest specifications from your nearest sales representative.

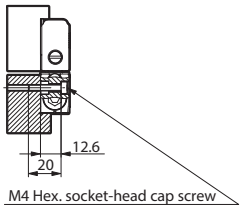
7-3. Accessories

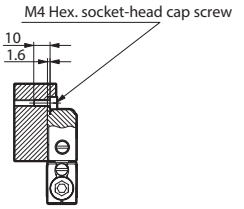
M4 × 10 Hex. socket-head cap screws (For intermediate foot plate installation)	2
M4 × 20 Hex. socket-head cap screws (For Scale head installation)	2
M4 × 25 Hex. socket-head cap screws (For Scale head installation)	2
M8 × 16 Hex. socket-head cap screws (For scale installation)	2
M4 Hex. nuts (For scale head rear surface installation)	2
Spacer (t = 0.1 mm)	1
Spacer (t = 0.2 mm)	1
Spacer (t = 0.4 mm)	1
Spacer (t = 1.0 mm)	1
Accuracy table	1
Instruction Manual	1

8. Dimensional Diagrams









* Intermediate foot plate : Installed in one location when L ≧ 670 mm and two locations when L ≧ 1440 mm

Unit: mm

L	L1	L2	L3	L4	L5	n
70	208	185	-	-	-	0
120	258	235	-	-	-	0
170	308	285	-	-	-	0
220	358	335	-	-	-	0
270	408	385	-	-	-	0
320	458	435	-	-	-	0
370	508	485	-	-	-	0
420	558	535	-	-	-	0
470	608	585	-	-	-	0
520	658	635	-	-	-	0
570	708	685	-	-	-	0
620	758	735	-	-	-	0
670	808	785	392.5	-	392.5	1
720	858	835	417.5	-	417.5	1
770	908	885	442.5	-	442.5	1
820	958	935	467.5	-	467.5	1
920	1058	1035	517.5	-	517.5	1
1020	1158	1135	567.5	-	567.5	1
1140	1278	1255	627.5	-	627.5	1
1240	1378	1355	677.5	-	677.5	1
1340	1478	1455	727.5	-	727.5	1
1440	1578	1555	520	520	515	2
1540	1678	1655	550	550	555	2
1640	1778	1755	585	585	585	2
1740	1878	1855	620	620	615	2
1840	1978	1955	650	650	655	2
2040	2178	2155	720	720	715	2

Unit: mm

Note 1) L : Effective length
Note 2) MG : Machine guide
Note 3) Please use air purging joints listed below for the scale.
Straight joint : KQ2S04-M5A/M5N, half union with hexagon holes, manufactured by SMC.
Angle joint : KQ2L06-M5A/M5N elbow union, manufactured by SMC.
Note 4) Please use air purging joints listed below for the scale head.
Straight joint : KQ2S04-M5A/M5N, half union with hexagon holes, manufactured by SMC.

9. Troubleshooting

If a problem with this product is suspected, be sure to check the following contents.

- Check that the connectors of the cables are firmly connected.
- Check whether the scale has been properly installed.

保　証　書

お客様	お名前	フリガナ 様	
	ご住所	〒　　電話　　-　　-	
保証期間	お買上げ日	年　　月　　日	
	本　体	1　　年	
型名		**SR24, CH23**	

お買上げ店住所・店名
電話　　-　　-　　印

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