

SONY[®]

Scale Unit

SH12 Series

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

Instruction Manual

■ Precautions on use

When using Sony Manufacturing Systems Corporation 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.
- Absolutely do not disassemble parts other than those specified, as this may cause malfunctions.
- Sony Manufacturing Systems Corporation reserves the right to change specifications and functions without notice.

[For EU and EFTA countries]

CE Notice

Making by the symbol CE indicates compliance of the EMC directive of the European Community. Such marking is indicative meets or exceeds the following technical standards.

EN 55 011 Group 1 Class A :

"Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment"

EN 50 082-2 :

"Electromagnetic compatibility - Generic immunity standard Part 2 : Industrial environment"

警告

本装置を機械指令 (EN 60 204-1) の適合を受ける機器にご使用の場合は、その規格に適合するように方策を講じてから、ご使用ください。

Warning

When using this device with equipment governed by Machine Directives EN 60 204-1, measures should be taken to ensure conformance with those directives.

Warnung

Wenn dieses Gerät mit Ausrüstungsteilen verwendet wird, die von die Maschinenrichtlinien EN 60 204-1 geregelt werden, müssen Maßnahmen ergriffen werden, um Übereinstimmung mit diesen Normen zu gewährleisten.

Safety Precautions

Sony Manufacturing Systems Corporation 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.

Note

This indicates precautions which should be observed to ensure proper handling of the equipment.

Warning



- Do not use this unit with voltages other than the specified supply voltage as this may result in fire or electric shock.



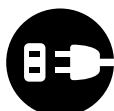
- Do not perform installation work with wet hands as this may result in electric shock.

- Do not disassemble or modify the unit as this may result in injury or damage the internal circuits.

Caution



- Be sure to check the machine and device conditions to ensure work safety before working on the machine.



- Be sure to cut off the power supply, air and other sources of drive power before working on the machine. Failure to do so may result in fire or accidents.



- When turning on the power supply, etc. to operate the machine, take care not to catch your fingers in peripheral machines and devices.

Handling Precautions

Installation precautions

When installing this unit, care should be given to the following points to prevent noise and electromagnetic wave interference from other equipment.

1. Do not pass lead and connection cables through the same ducts as power lines.
2. Be sure to install the unit at least 0.5 m or more away from high voltage or large current sources or high-power relays.
3. Absolutely do not bring the unit near magnets or sources of electromagnetic waves.

Installation place precautions

1. The scale unit should be used within an ambient temperature range of 0 to 45°C (113°F). Avoid use in places exposed to direct sunlight or hot winds or near heating equipment.
2. Avoid use in places subject to strong vibrations or impacts.
3. If there is the chance that the scale unit may come into contact with cut or measured objects, tools or jigs, be sure to protect the unit with a sufficiently strong cover.

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Introduction

Introduction

Thank you for purchasing this SH12 scale.

Please note that improper usage and handling may not only prevent this unit from functioning to its fullest potential, but may also cause unexpected breakdowns or shorten the life of the unit.

Be sure to read this instruction manual carefully and take the greatest care in handling the unit.

The precautions listed below are important for the proper handling of this product. Therefore, be sure to comply with the items and explanations in this instruction manual that advise caution.

In this instruction manual, we have endeavored to state wherever possible, the individual specifications and functions, and their interrelationships. Please assume that aspects not covered in this manual are not permitted.

Every care has been taken to make this manual as comprehensive as possible, but if you have any unanswered questions, do not hesitate to contact our sales center.

Checklist for Unpacking and Accessories

After unpacking this product, confirm the following:

- Is the article the one you ordered?
- Has any damage occurred during transit?

Check to make sure the following accessories are included:

- Standard Accessories

| Accessory name | Dimensions | Number | Application |
|---------------------------------|------------|-------------------|-----------------------------|
| Certificate of inspection | | 1 | |
| Installation manual | | 1 | |
| Hexagonal socket head cap screw | M4×22 | 4 | For installing the scale |
| Cable clamp | | 2 | For securing the head cable |
| Pan-head machine screw | M4×10 | 2 | For securing the head cable |
| Support bracket components | | (See table below) | |

- Support bracket components (The number of articles may differ depending on the scale model.)

| Scale model | Support bracket | | Hexagonal socket head cap screws, etc. for securing | | |
|-------------------------------|-----------------|---|--|-------|---------|
| | A | B | M3×6 | M4×18 | Washers |
| SH12-007 □□□□ to -047 □□□□ | — | — | — | — | — |
| SH12-052 □□□□ to -092 □□□□ | 1 | 1 | 2 | 1 | 1 |
| SH12-102 □□□□ to -124 □□□□ | 2 | 2 | 4 | 2 | 2 |

Chapter 1 Overview

1-1. Special Features

The SH12 Series is a compact unit-type scale for easy installation, making it ideal for the positioning of industrial machines such as machine tools and hydraulic cylinders.

The output signal consists of A and B-phase 1 V_{p-p} analog outputs with a 20 μm cycle and a phase of 90°, allowing the resolution to be set freely on the reception circuit side. The recommended scale resolutions are 0.1 μm (0.0000039 in), 0.5 μm (0.00002 in) and 1.0 μm (0.000039 in), but even higher resolutions can be supported.

Installation is easy for this unit-type scale. For scales with a measuring length of 520 mm (20.47 in) or more, use standard accessory support bracket A or B to increase the rigidity at the intermediate position.

Wide Variation

Twenty measuring lengths are available in the range of 70 to 1,240 mm (2.76 to 48.82 in).

Choose the optimum scale length to match the required stroke.

High Precision

The recommended scale resolutions are 0.1 μm (0.0000039 in), 0.5 μm (0.00002 in) and 1.0 μm (0.000039 in).

This unit uses an advanced detection system, so it can also be used with high-precision applications.

Excellent Resistance to Working Environment

The detector component employs a large-area optical exchange device using Moiré interference fringes. Employing our unique stable Moiré detection system, the effects of dust can be minimized and reading errors reduced.

Durable Construction

The detector component employs sturdy, precision die-cast aluminum, making it possible to obtain stable Moiré fringes. A bearing guide system enables maintenance of ideal traveling conditions.

Minimum Wiring

Position detection signals are provided for only the following three pairs.

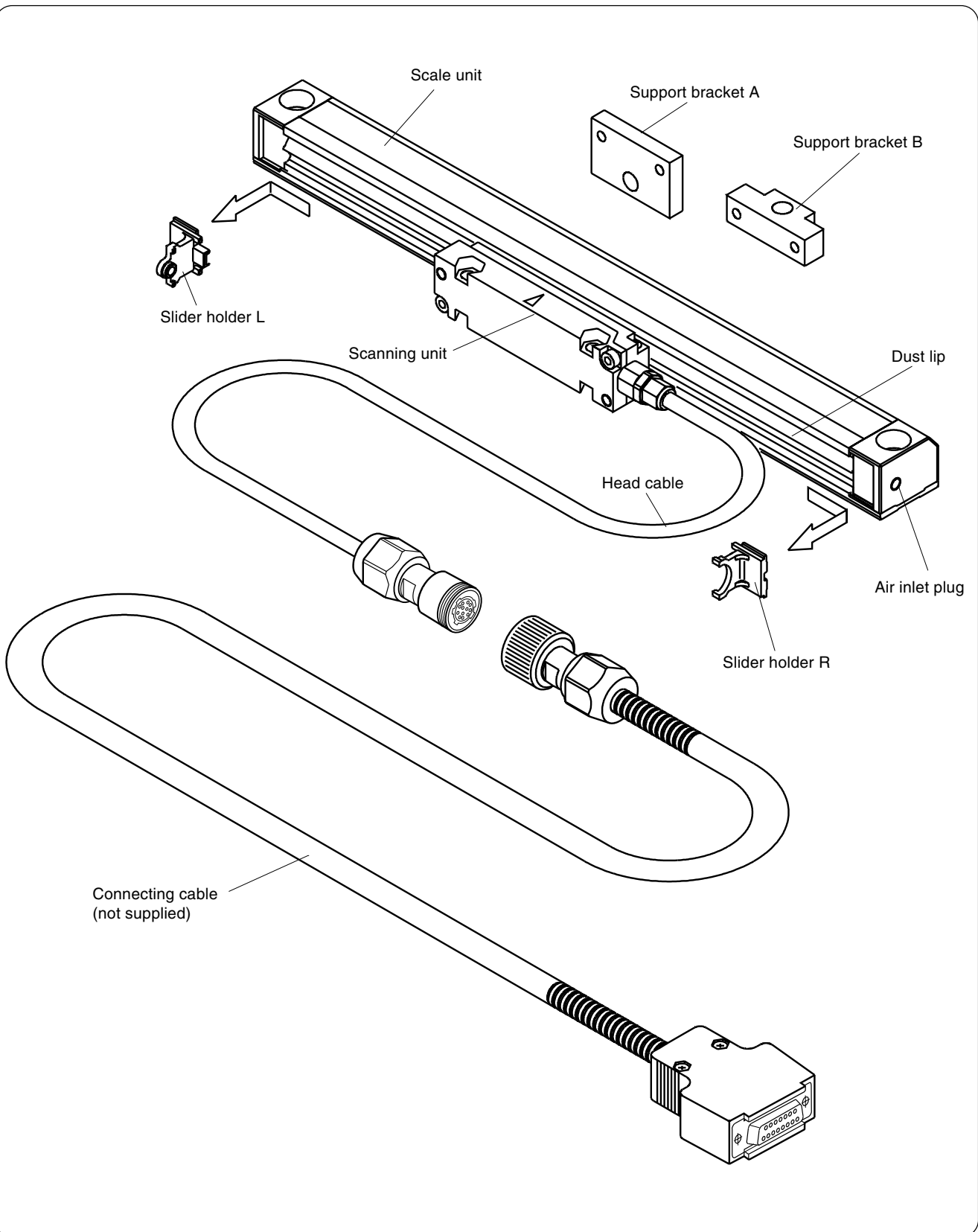
- Position signal A phase, \bar{A} phase, B phase, \bar{B} phase
- Zero point signal Z phase, \bar{Z} phase

All signals are differential output.

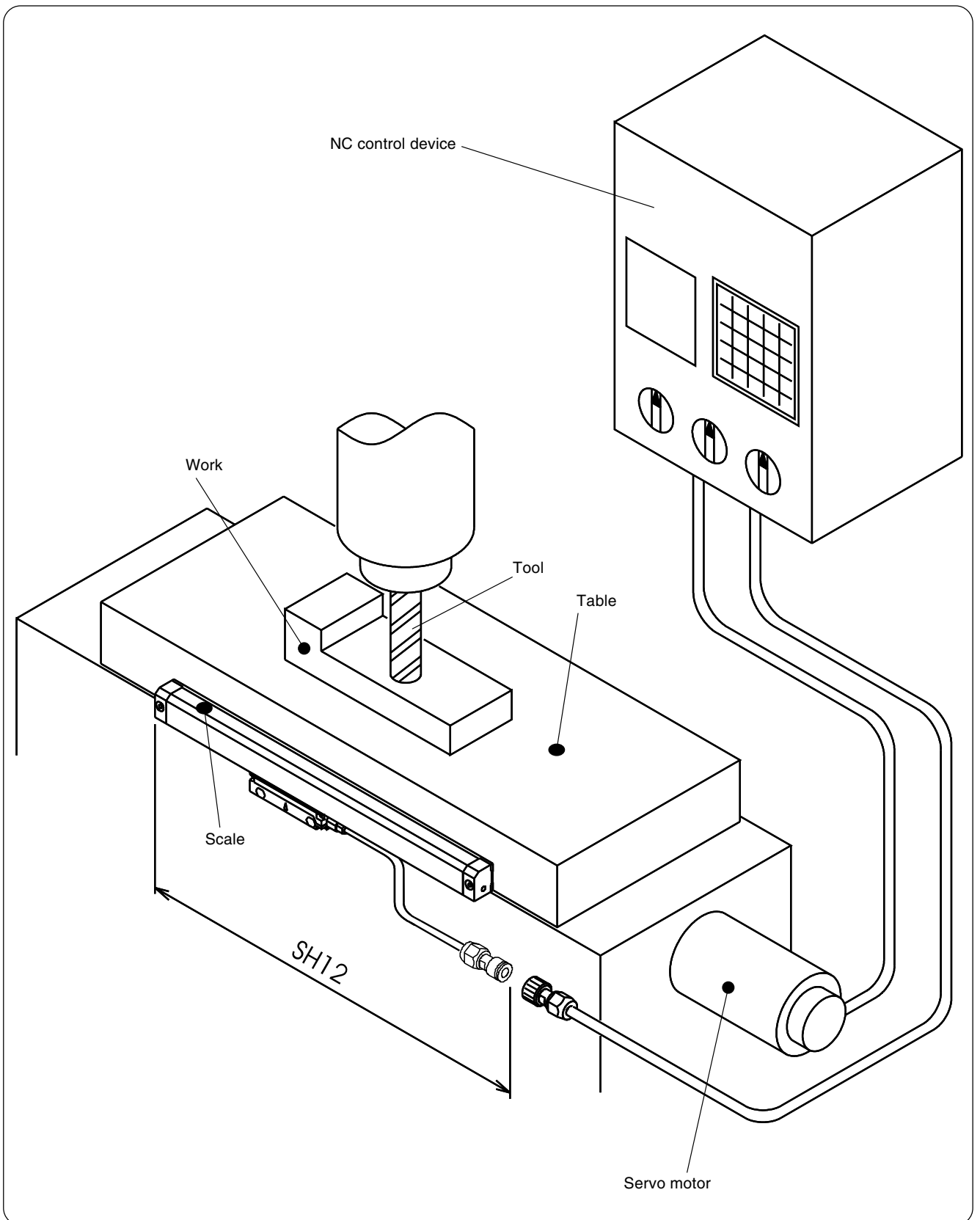
Simple Maintenance

The detector component is designed to be replaceable, so if a problem occurs, the scanning unit can be speedily replaced and normal operation resumed.

1-2. Part Names



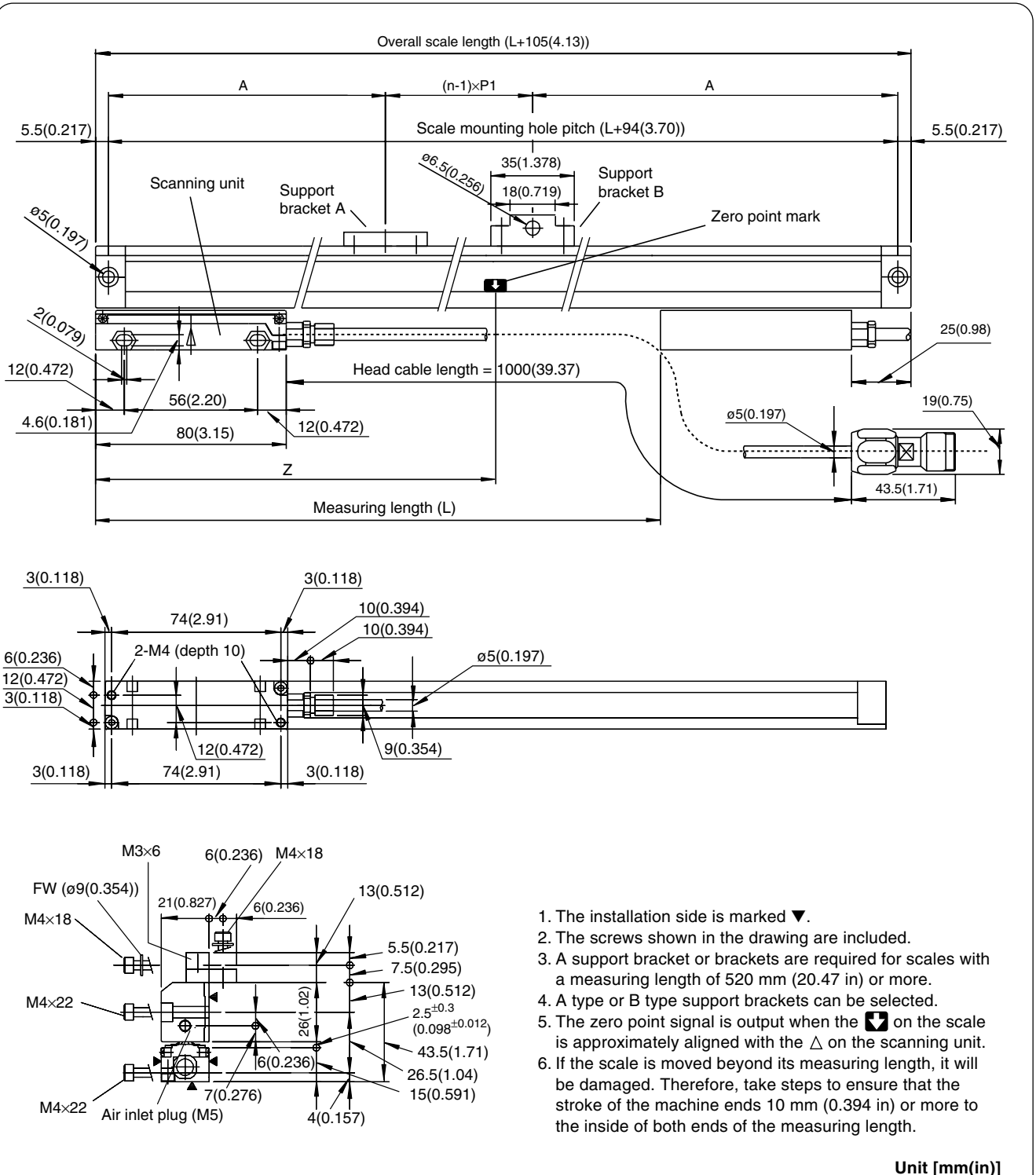
1-3. System Configuration



Chapter 2 Design and Installation

2-1. External Dimensions

External dimensions of scale unit



Scale Unit Dimensions

| Scale Model SH12- | | 007□□□□ | 012□□□□ | 017□□□□ | 022□□□□ |
|---------------------|--------------|----------|-----------|-----------|-----------|
| Measuring length | L [mm(in)] | 70(2.76) | 120(4.72) | 170(6.69) | 220(8.66) |
| Support bracket | n (No.) | — | — | — | — |
| Support bracket | A [mm(in)] | — | — | — | — |
| Mounting hole pitch | P 1 [mm(in)] | — | — | — | — |
| Zero point position | Z [mm(in)] | 35(1.38) | 60(2.36) | 85(3.35) | 110(4.33) |

| Scale Model SH12- | | 027□□□□ | 032□□□□ | 037□□□□ | 042□□□□ |
|---------------------|--------------|------------|------------|------------|------------|
| Measuring length | L [mm(in)] | 270(10.63) | 320(12.60) | 370(14.57) | 420(16.54) |
| Support bracket | n (No.) | — | — | — | — |
| Support bracket | A [mm(in)] | — | — | — | — |
| Mounting hole pitch | P 1 [mm(in)] | — | — | — | — |
| Zero point position | Z [mm(in)] | 135(5.31) | 160(6.30) | 185(7.28) | 210(8.27) |

| Scale Model SH12- | | 047□□□□ | 052□□□□ | 057□□□□ | 062□□□□ |
|---------------------|--------------|------------|------------|------------|------------|
| Measuring length | L [mm(in)] | 470(18.50) | 520(20.47) | 570(22.44) | 620(24.41) |
| Support bracket | n (No.) | — | 1 | 1 | 1 |
| Support bracket | A [mm(in)] | — | 307(12.09) | 332(13.07) | 357(14.06) |
| Mounting hole pitch | P 1 [mm(in)] | — | — | — | — |
| Zero point position | Z [mm(in)] | 235(9.25) | 260(10.24) | 285(11.22) | 310(12.20) |

| Scale Model SH12- | | 067□□□□ | 072□□□□ | 077□□□□ | 082□□□□ |
|---------------------|--------------|------------|------------|------------|------------|
| Measuring length | L [mm(in)] | 670(26.38) | 720(28.35) | 770(30.31) | 820(32.28) |
| Support bracket | n (No.) | 1 | 1 | 1 | 1 |
| Support bracket | A [mm(in)] | 382(15.04) | 407(16.02) | 432(17.01) | 457(17.99) |
| Mounting hole pitch | P 1 [mm(in)] | — | — | — | — |
| Zero point position | Z [mm(in)] | 335(13.19) | 360(14.17) | 385(15.16) | 410(16.14) |

| Scale Model SH12- | | 092□□□□ | 102□□□□ | 114□□□□ | 124□□□□ |
|---------------------|--------------|------------|-------------|-------------|-------------|
| Measuring length | L [mm(in)] | 920(36.22) | 1020(40.16) | 1140(44.88) | 1240(48.82) |
| Support bracket | n (No.) | 1 | 2 | 2 | 2 |
| Support bracket | A [mm(in)] | 507(19.96) | 380(14.96) | 420(16.54) | 450(17.72) |
| Mounting hole pitch | P 1 [mm(in)] | — | 354(13.94) | 394(15.51) | 434(17.09) |
| Zero point position | Z [mm(in)] | 460(18.11) | 510(20.08) | 570(22.44) | 620(24.40) |

2-2. Installation Design

Installing the product incorrectly may shorten its life or affect its performance. Design the installation surface and mounting bracket in accordance with the checkpoints given below.

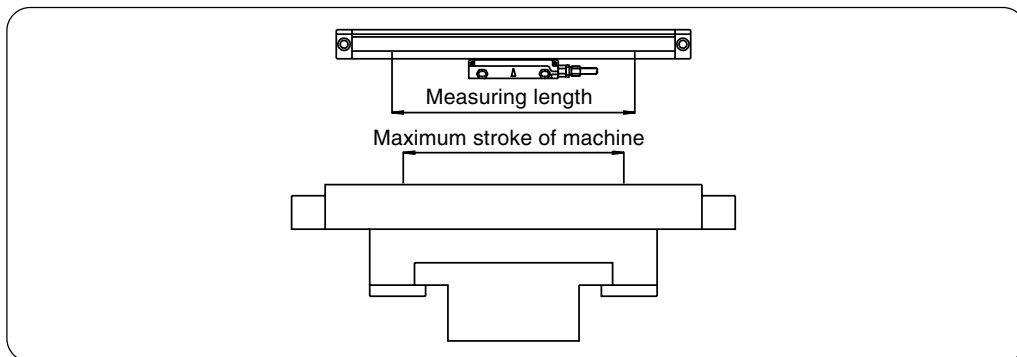
Selecting the Mounting Location

To obtain full performance from the scale unit, select a mounting location that satisfies the following criteria:

- Not subject to vibration or dust
- As close as possible to the machine's cutting tool to guarantee machining accuracy
- A place that ensures ease of scale unit maintenance
- A place that enables smooth installation

Checking the Measuring Length

Select a scale with a measuring length that extends at least 10 mm (0.394 in) from both ends of the machine's maximum stroke. If there is a possibility that the machine might exceed the scale measuring length, install mechanical stoppers or otherwise restrict the machine's range of movement.

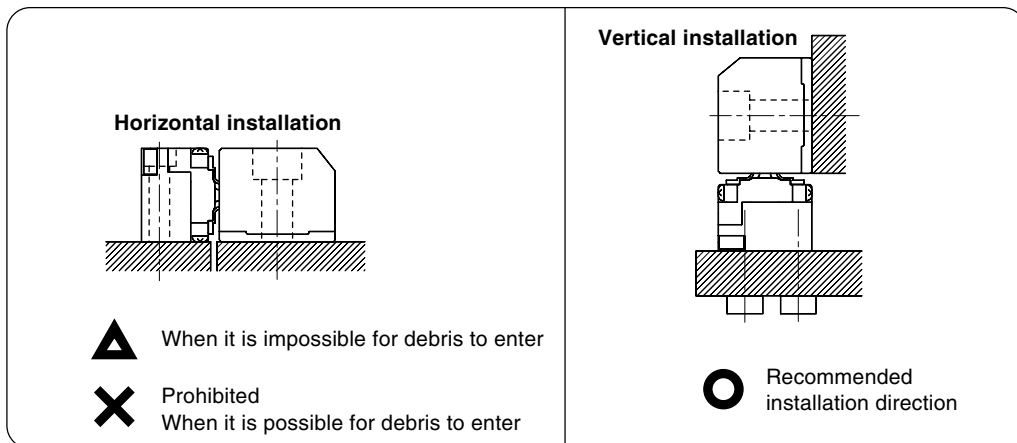


Note

The scale will be damaged if it moves beyond the measuring length.

Installation Direction

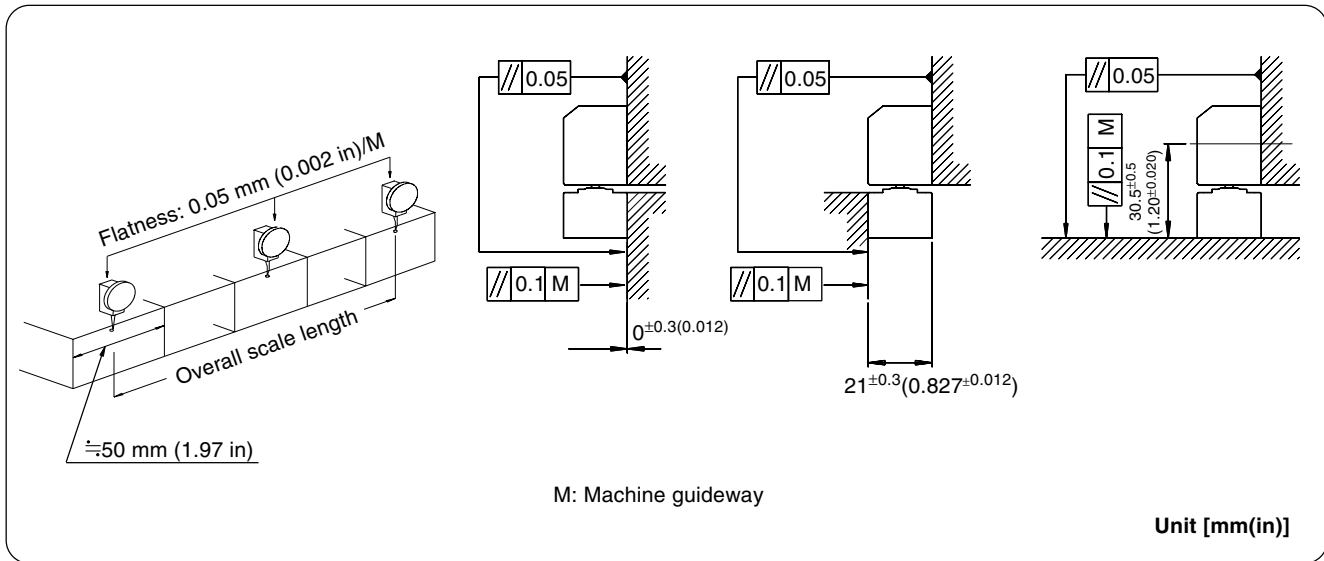
Although the traveling part of the scale unit is partially sealed, it is not completely sealed off for structural reasons. When mounting the scale to the horizontal axis, install it so that the opening points downwards. When mounting the scale to the vertical axis, install it so that the opening points to the outside, away from the cutting tool.



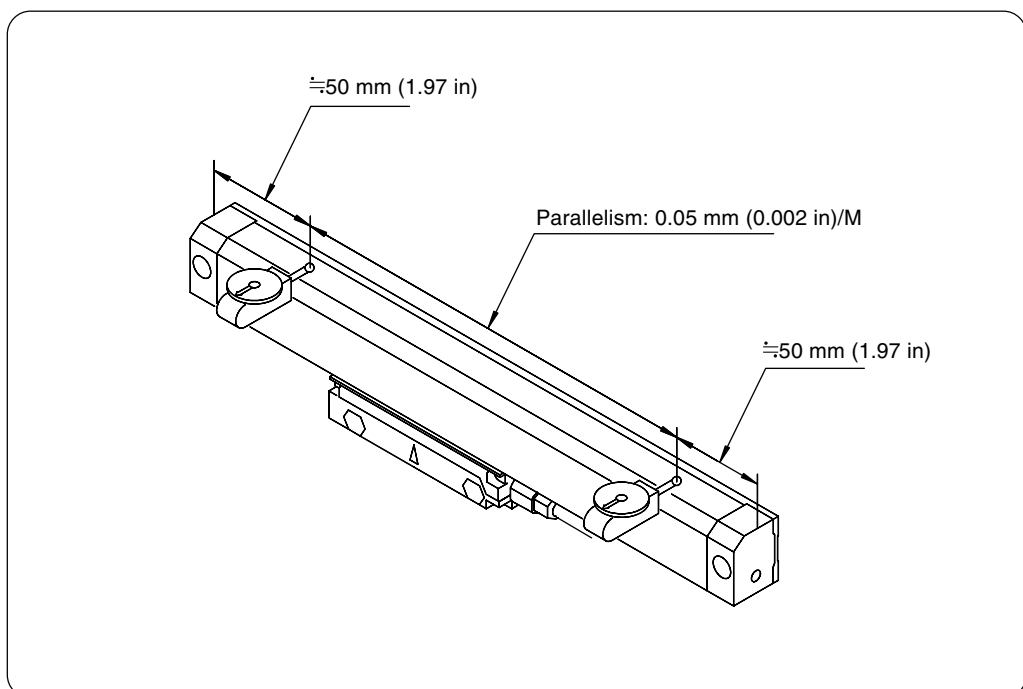
Flatness and Parallelism of the Installation Surface

- The installation surface of the scale unit should be finished along its entire length to finish symbol $\sqrt{6.3S}$ or better and should be machined to a flatness of 0.05 mm (0.002 in) /M (where M is the machine guide's length).

If the scale overhangs the machine, it must be reinforced with a backplate made of flat polished steel plate at least 12 mm (0.472 in) thick. Ensure that the installation surface is free of gouges or flaws.

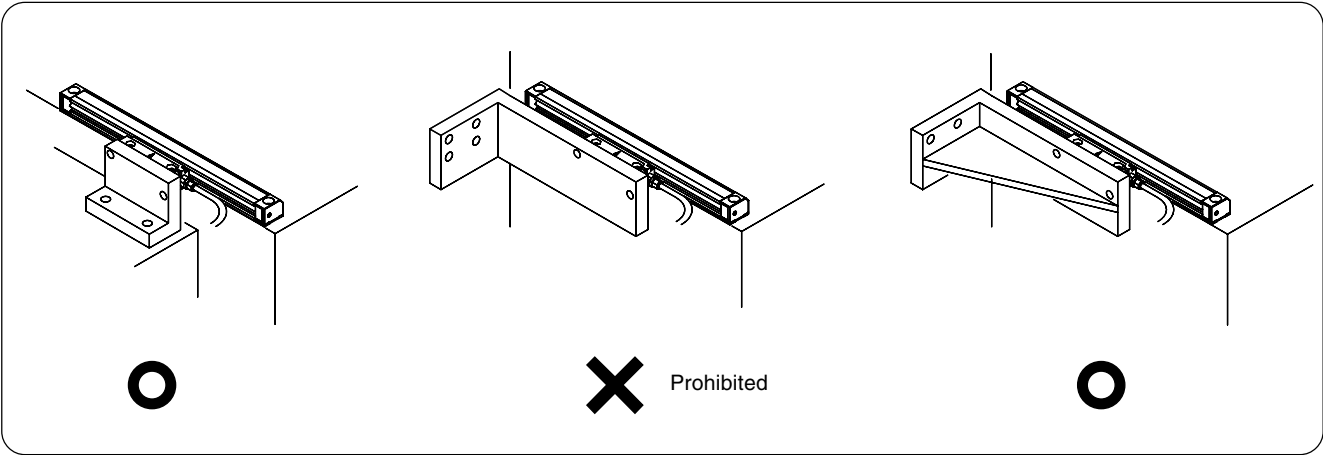


- Design the installation surface so that the parallelism of the installation surface and the scale in the vicinity of each scale mounting screw is 0.05 mm (0.002 in).



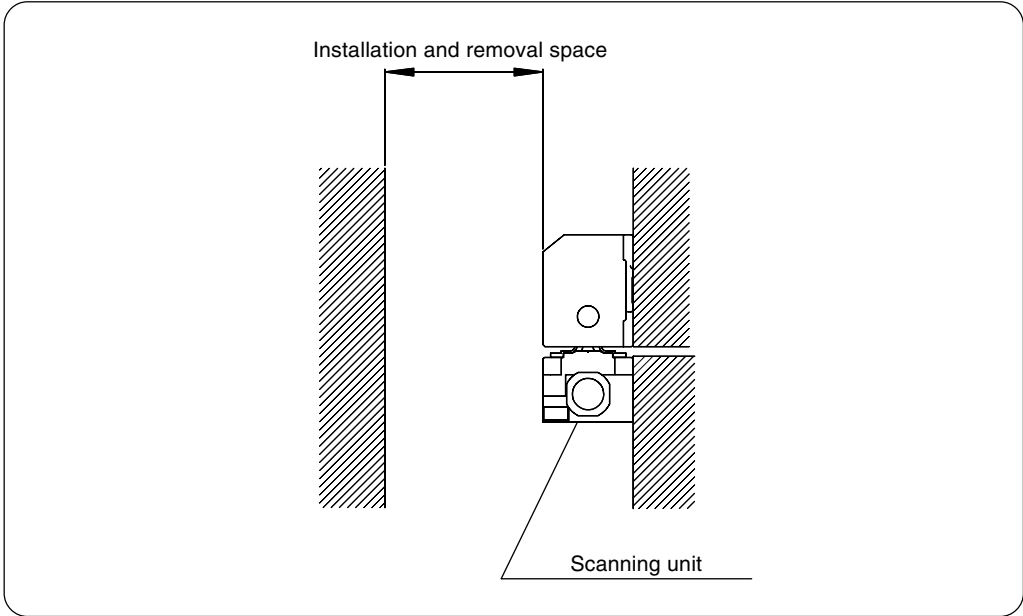
Designing the Scanning Unit Mounting Bracket

- The mounting bracket should be designed to have adequate rigidity relative to the direction of travel.



Ensuring Sufficient Maintenance Space

- Ensure sufficient space for replacing the scanning unit as shown in the figure.



2-3. Installation Procedure

The installation procedure for the scale unit is explained below. Note that the following components must not be disassembled, as doing so may cause breakdowns.

- [Do not Disassemble the Following]**
- Mechanical and electrical components of the scanning unit
 - Scale unit cable connectors
 - Glass scale

The scale unit is composed of precision components, so applying undue force may adversely affect the precision and life of the unit. Ensure that undue force is not exerted on the scale unit during operation.

Support the main body of the scale unit and scanning unit during transport. Do not lift by the cables or connectors.

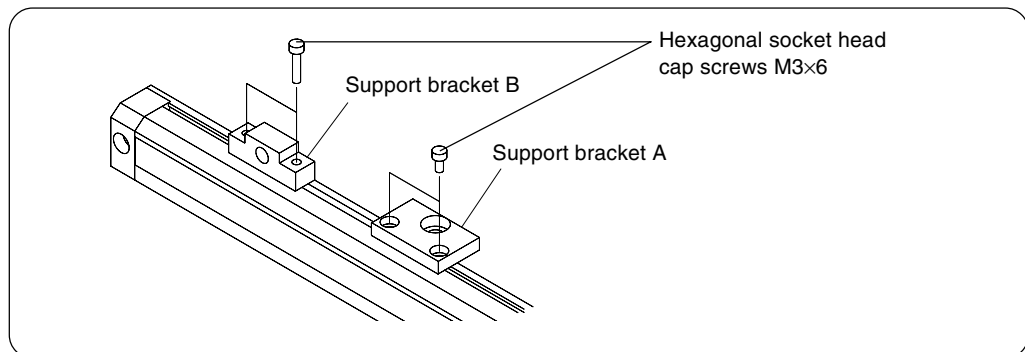
2-3-1. Installing the Scale Unit

1. Checking the Flatness of the Scale Unit Installation Surface

- Check that the installation surface of the scale unit is finished along its entire length to finish symbol $\sqrt{6.3S}$ or better, and check that it has a flatness of 0.05 mm (0.002 in) /M (where M is the machine guide's length).

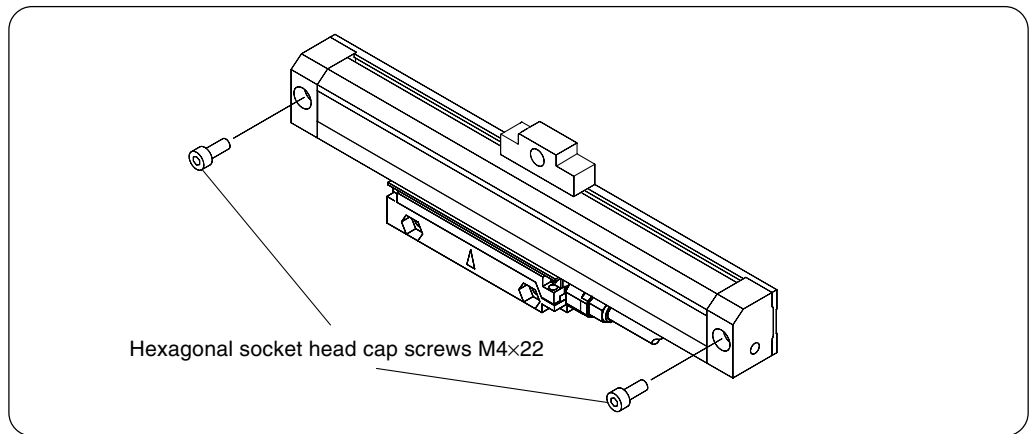
2. Installing the Support Bracket to the Scale

- A support bracket or brackets are supplied with scales which have a measuring length of 520 mm (20.47 in) or more.
- Fixing nuts for the support brackets are inserted in the slit on the top face of the scale. Install the support bracket or brackets using hexagonal socket head cap screws (M3×6). Using a torque wrench, tighten to a torque of 1.5 N•m.
- Position the support bracket at the center of the scale. For scales with a measuring length of 1020 mm (40.16 in) or more, position the support brackets so that the scale is divided into equal parts.
- Either support bracket A or B can be selected.



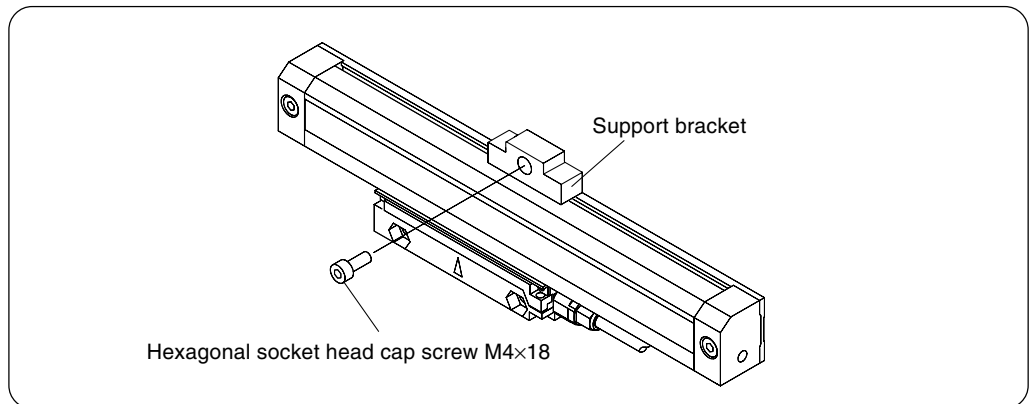
3. Temporarily Securing the Scale Unit

- Move the movable machine part to roughly the center of the stroke and lightly secure it with the supplied hexagonal socket head cap screws (M4×22).



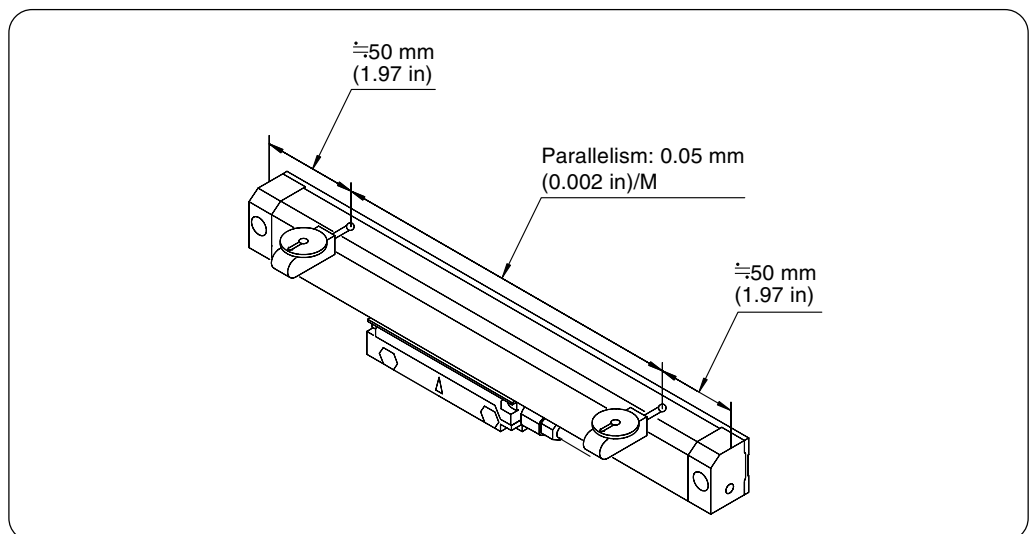
4. Temporarily Securing the Support Bracket

- Temporarily secure the scale unit, then lightly secure the support bracket with the supplied hexagonal socket head cap screws (M4x18).



5. Checking the Parallelism of the Scale Unit

- Place a dial gauge on the top face of the scale unit and check its parallelism.
- The tolerance for the parallelism is 0.05 mm (0.002 in) in the vicinity of each scale mounting screw. Adjust the scale unit so that the reading comes within this range.



6. Securing the Scale Unit

- After checking the flatness and parallelism, tighten the hexagonal socket head cap screws. Using a torque wrench, tighten to a torque of 2 N•m. Do not completely tighten the hexagonal socket head cap screws one by one; rather, tighten all screws evenly.

2-3-2. Securing the Scanning Unit to the Mounting Bracket

When mounting the scanning unit into the mounting bracket, always make sure both slider holders L and R are attached.

If slider holders L and R become detached, remount them.

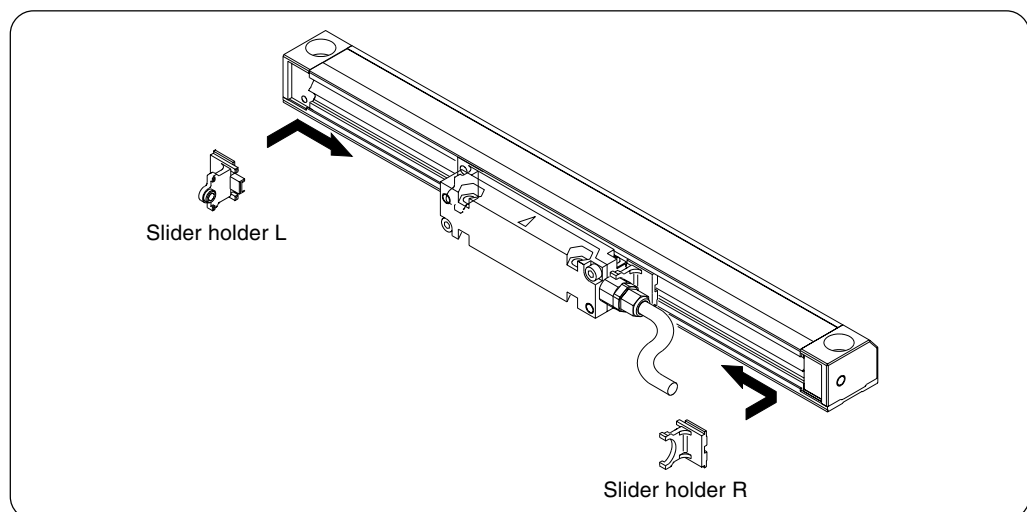
When installing slider holders L and R for the first time, insert them into the scale groove from the ends of the scale.

Inserting slider holders L and R into the scanning unit will determine the relative positions of the scale and scanning unit.

Twisting the scanning unit while the slider holders are not in use may dislodge the scanning unit dust seal from the dust seal guide groove. If the dust seal becomes dislodged, it can be refitted without any problems. However, be careful not to dislodge it during the installation work.

1. Checking Slider Holders L and R

- Check to make sure slider holders L and R are attached. If they have become detached, remount them.

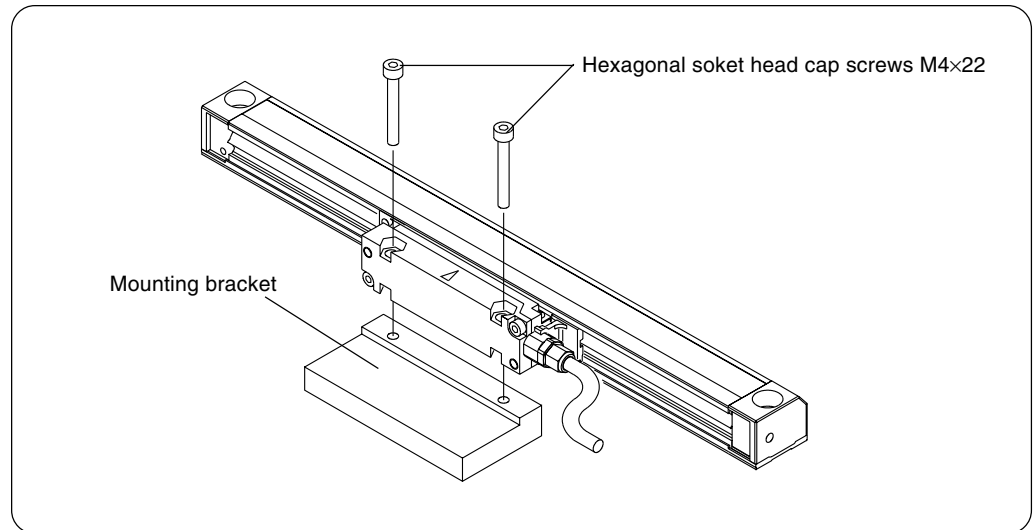


2. Checking for Installation Errors

- The mounting tolerance for the positions and height of the scale unit and scanning unit is ± 0.3 mm (0.012 in). If there is a gap between the scanning unit and the mounting bracket, adjust with spacers or similar items. If the mounting bracket is too high, switch to a lower mounting bracket.

3. Securing the Scanning Unit

- With the scanning unit supported by slider holders L and R, slide it into the installation position and secure it in place with the hexagonal socket head cap screws (M4×22). Using a torque wrench, tighten to a torque of 2 N•m.



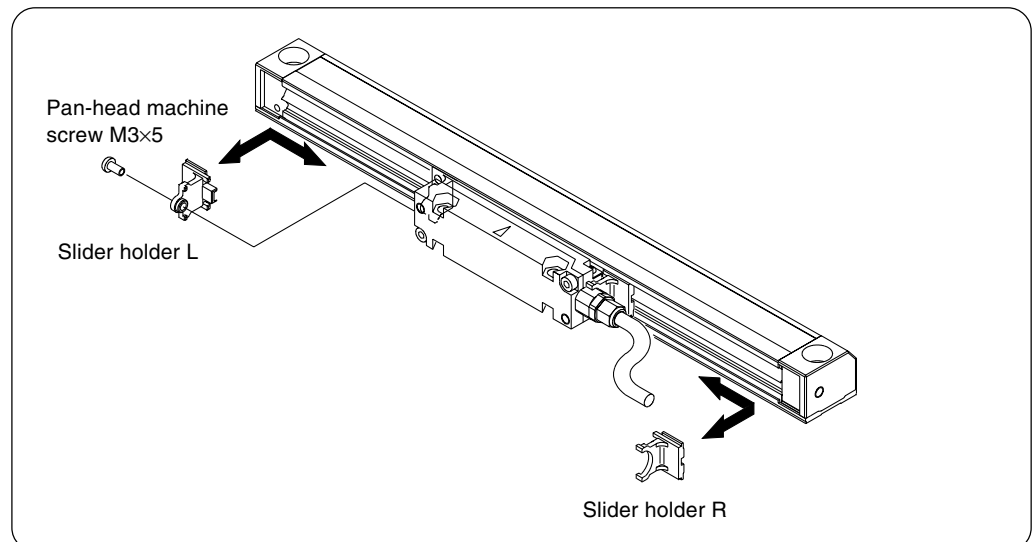
2-3-3. Removing the Slider Holders

1. Checking the Cap Screw Tightness

- Before removing the slider holders, double-check to make sure the scale and scanning unit mounting cap screws are tightened.

2. Removing Slider Holders L and R

- Take out slider holders L and R from the ends of the scale.
- Trying to move the scale before removing the slider holders may damage the scale.



2-3-4. Cable Management

Managing Cables

- Manage cables so that they do not hinder machine operations or become entangled. Handle cables carefully, as forceful pulling or repeated bending may damage them.
- The connector of the head cable has been waterproofed, but ensure that it is fitted in a location where it is not exposed to chips or cutting fluid.

Minimum Cable Bending Radius

- Ensure that cables are arranged so that their bending radius tolerances are not exceeded.
- The cable bending radii are as follows:

Head Cable

When the cable does not move during use ... Bending radius: 30 mm (1.18 in) or more
When the cable moves during use Repeated bending not permitted
(Secure with a bending radius of 30 mm
(1.18 in) or more.)

Connecting Cable

When the cable does not move during use ... Bending radius: 50 mm (1.969 in) or more
When the cable moves during use Bending radius: 100 mm (3.937 in) or more

Securing Cables

- Secure the head cable with cable clamps or similar items near the outlet. Also, secure the connecting cable firmly so that it does not hinder machine operations or become entangled.

2-3-5. Precautions when the Scanning Unit is Connected to a Movable Component

Mounting the scale unit to a movable part and the scanning unit to a fixed part is ideal, but if the reverse is necessary for structural reasons, the following points should be noted:

Managing the Head Cable

- Secure the head cable and allow the connecting cable to bend.
- Secure the largest bending radius possible for the head cable.
- The allowable bending radius for the head cable is 30 mm (1.18 in) or more.

Managing the Connecting Cable

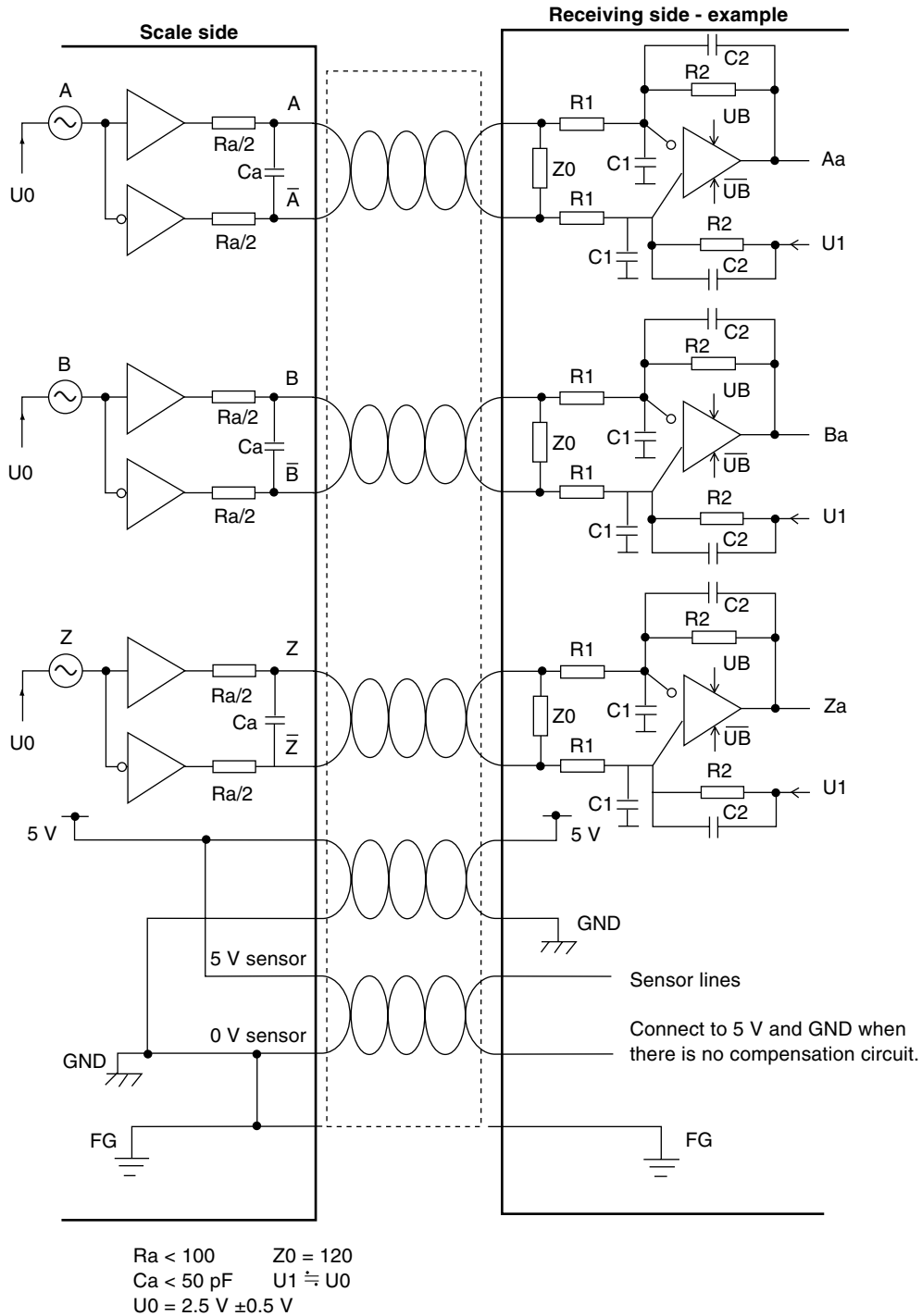
- Secure the connecting cable firmly so that it does not hinder machine operations or become entangled. The cable getting caught on the operator or objects in the vicinity presents a hazard. Furthermore, even if it does not appear so from the outside, the internal core wire may be severed.
- The allowable bending radius of the connecting cable is 100 mm (3.937 in) or more. The cable wires may be severed if subjected to repeated bending at radii smaller than this.

Extending the Connecting Cable

- Do not extend the connecting cable to a length of more than 30 m (1181.10 in).

2-4. Connection Example (Reference)

The drawing below shows an example of an interface.



Recommended element

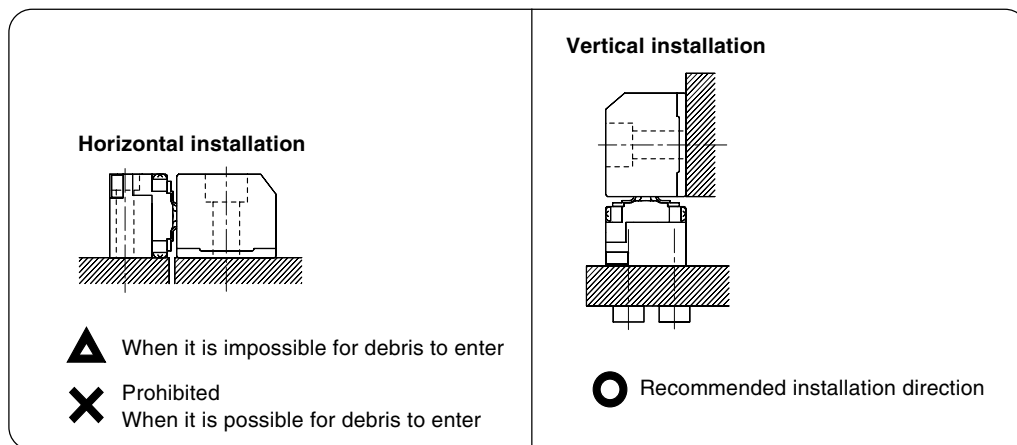
Differential receiver RC4157

$R_1 = 10 \text{ k}$, $R_2 = 34.8 \text{ k}$, $C_1 = 220 \text{ pF}$, $C_2 = 10 \text{ pF}$, $U_B = 15 \text{ V}$

2-5. Managing the Operating Environment

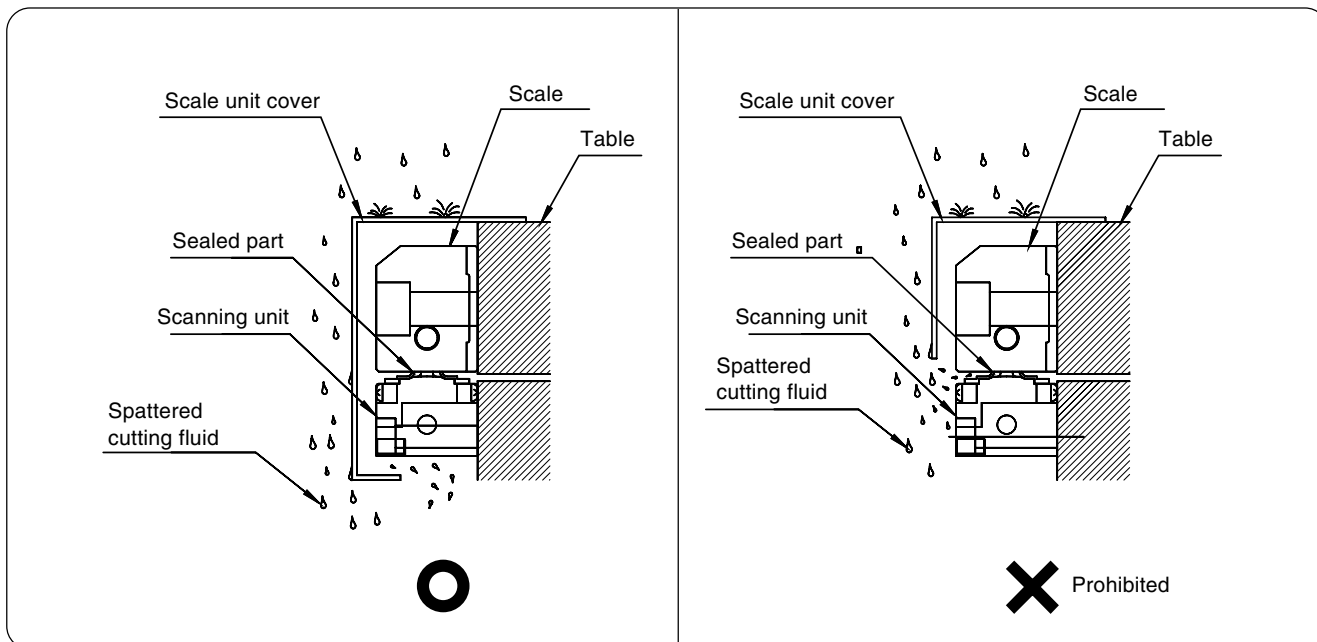
Installation Direction

- Although the traveling part of the scale unit is partially sealed, it cannot be completely sealed off for structural reasons. When mounting the scale to the horizontal axis, install it so that the opening points downwards. When mounting the scale to the vertical axis, install it so that the opening points to the outside, away from the cutting tool.



Protective Cover

- Attach a protective cover with the necessary strength if the scale is installed in a location where the operator may place his elbows or legs.
- Preferably, choose a mounting location where the scale will not be exposed to chips or cutting fluid. If that is impossible, attach an appropriate cover.



2-6. Air Purge

Air can be introduced from the scale side covers on both sides.

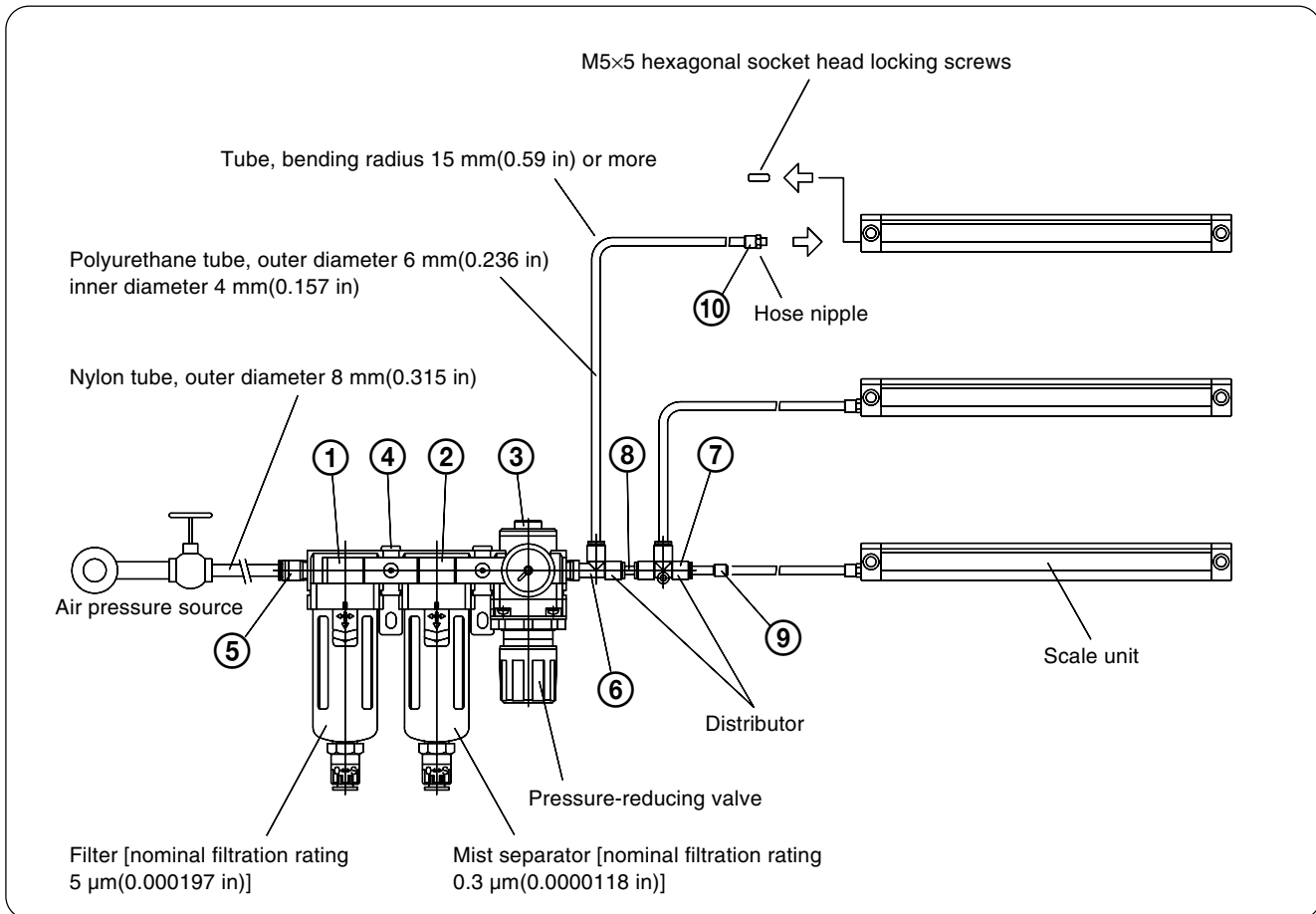
If the scale unit is to be used in the environments listed below, harmful effects can be reduced by blowing clean air into the unit.

- **Dusty locations**
- **Highly humid locations**
- **Locations where changes in temperature and humidity give rise to condensation**

As the efficacy of introducing air depends on the service conditions, do so only after verifying the effectiveness.

Air Tubing Route and Equipment Configuration

- Take into consideration the tubing route and other factors when choosing between the left and right air intake ports.
- Prepare the equipment and tubing as shown in the figure below to allow air to be introduced into the scale unit.



- The air supply unit and fittings should be provided by the customer.
The tables below provide standard equipment specifications and component parts (manufacturers) for reference.

Specifications

| Item | Specification |
|---|--|
| Proof pressure | 1.5 MPa |
| Maximum service pressure | 1020 kPa |
| Set pressure range | 20 to 200 kPa |
| Service fluid | Air |
| Ambient temperature and service fluid temperature | -5 to +60°C (33 to 140°F) (must not freeze) |
| Nominal filtration rating | Air filter: 5 µm (0.000197 in) Mist separator: 0.3 µm (0.0000118 in) |
| Pressure gauge connection diameter | 2-Rc (PT) 1/8 |
| Tubing connection diameter | IN side: Outer diameter of tube 8 mm (0.315 in) (one location) OUT side: Outer diameter of tube 6 mm (0.236 in) (three locations) |
| Auto drain differential pressure | 150 to 1020 kPa |

Component Parts

| Part No. | Model No. | Name | Quantity | Manufacturer |
|----------|--------------|--|----------|--------------|
| ① | AF3000-02C | Air filter (nominal filtration rating: 5 µm (0.000197 in)) | 1 | SMC |
| ② | AFM3000-02C | Mist separator (nominal filtration rating: 0.3 µm (0.0000118 in)) | 1 | SMC |
| ③ | AR3000-02G-1 | Pressure-reducing valve | 1 | SMC |
| ④ | Y30L | Spacer assembly with L-shaped bracket | 2 | SMC |
| ⑤ | KQH08-02S | Half-union | 1 | SMC |
| ⑥ | KQY06-02S | Service cheese union | 1 | SMC |
| ⑦ | KQT06-00 | Cheese | 1 | SMC |
| ⑧ | KQN06-99 | Nipple | 1 | SMC |
| ⑨ | KQP-06 | Plug | 3 | SMC |
| ⑩ | M-5H6 | Hose nipple | 3 | SMC |

Tubing

Tube Installation

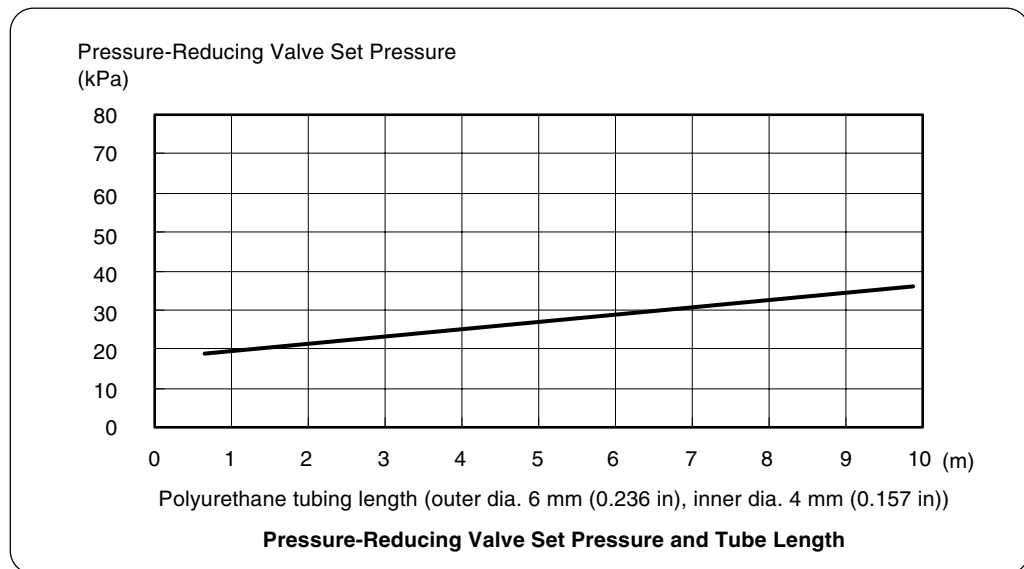
Ensure a tube bending radius of 15 mm (0.59 in) or more, and do not allow the tube to bend sharply. Also, when installing tubes in parallel in electrical, hydraulic or other ducts, make sure that the movement of the duct does not cause the tube to collapse.

Tube Length

To match the air intake pressure into each scale unit, always ensure that the tubes from the air supply unit distributors to the intake ports are the same length.

Pressure-Reducing Valve Set Pressure and Tube Length

If the intake air pressure into each scale unit is around 20 ± 10 kPa, the humidity of the air in the scale unit can be kept low. However, the length of the tube precludes the use of the pressure-reducing valve to obtain an intake air pressure of 20 ± 10 kPa. Determine the set pressure for the pressure-reducing valve with reference to the diagram below, "Pressure-Reducing Valve Set Pressure and Tube Length".



This diagram shows the relationship between the set pressure for the pressure-reducing valve and the tube length for an intake air pressure of 20 kPa.

Tube length here means the length from the distributor of the air supply unit to the intake port of the scale unit.

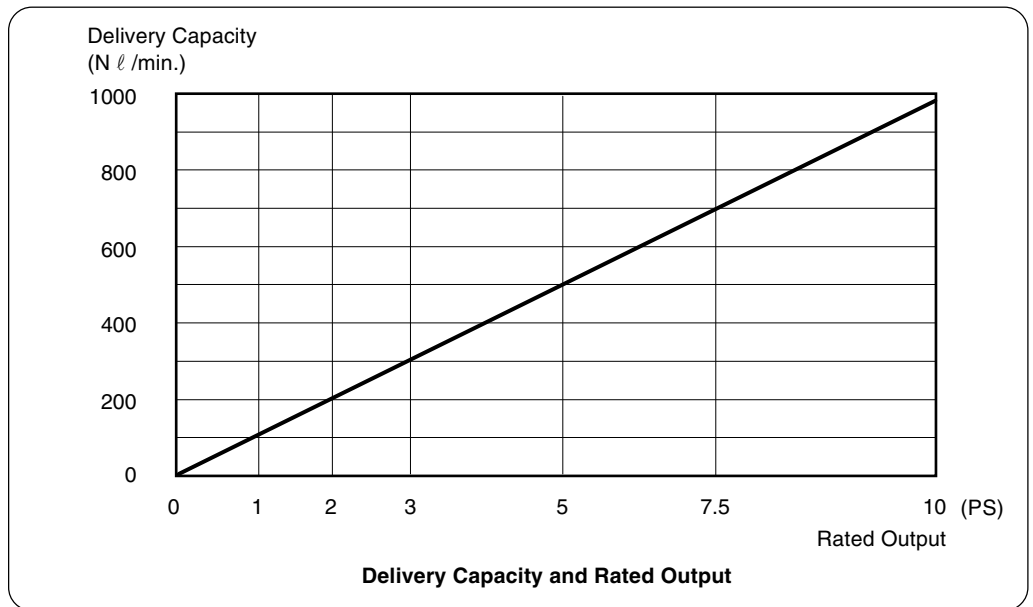
When the intake air pressure is 20 kPa, the amount of air consumed for each unit is approximately $30 \text{ N } \ell / \text{min}$.

Flushing the Tubing

Using the air source, flush the air supply unit connection and the inlet portion leading into the scale. This cleans the tubing, prevents debris from getting caught in the machinery, and also serves as a check for the tubing.

Air Pressure Source

When using a compressor as the air pressure source, select an appropriate compressor in consideration of the volume of air to be consumed (approx. 30 N ℓ /min. per unit). The following diagram, "Delivery Capacity and Rated Output", may provide some assistance in choosing the compressor, but note that specifications vary between different models.



Chapter 3 Maintenance

3-1. Start-up Inspection

Checking for Open Circuits

The scanning unit is normally connected to the control unit by a connecting cable through the cable (head cable) from the scanning unit. Both the head cable and connecting cable must be checked if there is an open circuit. Shake the movable parts of the head cable and connecting cable and confirm that the open circuit alarm is not displayed on the control unit. If it is, the severed cable unit must be repaired. It is extremely dangerous to continue operations without repairing the cable; immediately stop the machine and contact your Sony Manufacturing Systems Corporation distributor.

While checking the head cable, pay close attention to the connection with the scanning unit and the junction connector. Also, when using a conduit connecting cable, check very carefully as there may be open circuits caused by microscopic chips.

Checking for Dust Lip Wear

Look at the underside of the scale, and check to see if the edge of the dust lip is worn. If it is, the scale glass and inside detector part must be cleaned and the dust lip replaced. Contact your Sony Manufacturing Systems Corporation distributor.

Checking for Odd Noises

Slowly move the machine and listen to see if any odd noises occur. If so, the scale main body and scanning unit may be in contact. Continuing operation in this condition may lead to major breakdowns, so stop the machine immediately and contact your Sony Manufacturing Systems Corporation distributor.

Strictly Enforce Cleaning

Ensure that chips are cleaned up before starting work and at the end of work each day to prevent them from building up around the scale. Otherwise, chip buildup may prevent the scale from sliding and cause breakdowns. **Avoid using air guns or similar devices** for cleaning, because while the traveling part of the scale unit is sealed, it cannot be completely sealed off for structural reasons. Use of an air gun may cause chips or other debris to penetrate into the scale and cause breakdowns.

3-2. Regular Inspections

Presence of Condensation

If mist, condensation, dust or coolant (water-miscible cutting fluid) are present on the dust lip of the scale unit, strengthen the cover and supply air to the unit.

Chapter 4 Specifications

4-1. General Specifications and Performance Specifications

General Specifications

| Item | Specification |
|---|---|
| Service temperature range | 0°C to +45°C (32°F to 113°F) |
| Storage temperature range | -10°C to +60°C (14°F to 141°F) |
| Service humidity range | Relative humidity 30% to 90% (no condensation) |
| Rate of change of temperature, humidity | A rate that does not cause condensation |
| Service environment | No corrosive gas |
| Vibration resistance | 98 m/s ² or less (30 to 1000 Hz for 30 min.) |
| Impact resistance | 294 m/s ² or less (11 ms X, Y, Z directions, three times each) |

Performance Specifications

| Item | Specification |
|---|--|
| Detection system | Optical Moiré fringe detection system (transmission model) |
| Output system | 1 Vp-p analog output Incremental: Two-phase signal (A • \bar{A} , B • \bar{B}) Zero point signal (Z • \bar{Z}) |
| Light source and light-receiving device | Infrared light-emitting diode, photodiode |
| Measuring length [mm(inch)] | 20 lengths: 70(2.76), 120(4.72), 170(6.69), 220(8.66), 270(10.63), 320(12.60), 370(14.57), 420(16.54), 470(18.50), 520(20.47), 570(22.44), 620(24.41), 670(26.38), 720(28.35), 770(30.31), 820(32.28), 920(36.22), 1020(40.16), 1140(44.88), 1240(48.82) |
| Maximum response speed | 120 m/min |
| Recommended scale resolution | 0.1 μm (0.0000039 in), 0.5 μm (0.00002 in), 1.0 μm (0.000039 in) |
| Glass grating pitch | 20 μm (0.00079 in) |
| Zero point position | One point in the center |
| Scale precision | $\pm 3 \mu\text{m}$ (± 0.00012 in) or $\pm 5 \mu\text{m}$ (± 0.00020 in) |
| Allowable mounting parallelism | 0.05 mm (0.0020 in) |
| Precision proof temperature | 20°C (68°F) |
| Glass thermal expansion coefficient | $(8.8 \pm 1) \times 10^{-6} / ^\circ\text{C}$ |
| Protection class | IP53 (when used in accordance with the instruction manual) |
| Power supply and current consumption | DC +5 V $\pm 5\%$, 150 mA |

4-2. Output Specifications

Output Specifications

(for the entire length and temperature ranges)

| Item | Symbol | Specifications | | | Unit | Remarks |
|--------------------------------|-------------------------------------|----------------|------|------|------|-----------|
| | | Min. | Typ. | Max. | | |
| Output signal amplitude | (+VA) – (–VA), (+VB) – (–VB) | 0.6 | 1 | 1.2 | Vp-p | *1 |
| Output signal phase difference | — | 87 | 90 | 93 | deg | |
| Zero point valid range | (+VZU1) – (–VZU1) | 0.3 | 0.5 | 0.6 | V | *1 |
| Zero point invalid range | (+VZU2) – (–VZU2) | 0.3 | 0.5 | 0.6 | V | *1 |
| Center level | +VOA, +VOB, +VOZ | 2.2 | 2.5 | 2.8 | V | |
| | –VOA, –VOB, –VOZ | | | | | |
| Offset voltage | (+VOA) – (–VOA), (+VOB) – (–VOB) | –50 | 0 | 50 | mV | |
| | (+VOZ) – (–VOZ) | | | | | |
| Gain imbalance | — | –4 | 0 | 4 | % | Formula 1 |
| Load resistance | — | 120 | | | | |

*1: When terminator $Z_0 = 120 \Omega$, supply voltage = $5 \pm 5\%$ (voltage at both ends of the load resistance)

*2: The output signal amplitude varies according to the supply voltage, cable voltage drop, and scanning frequency.

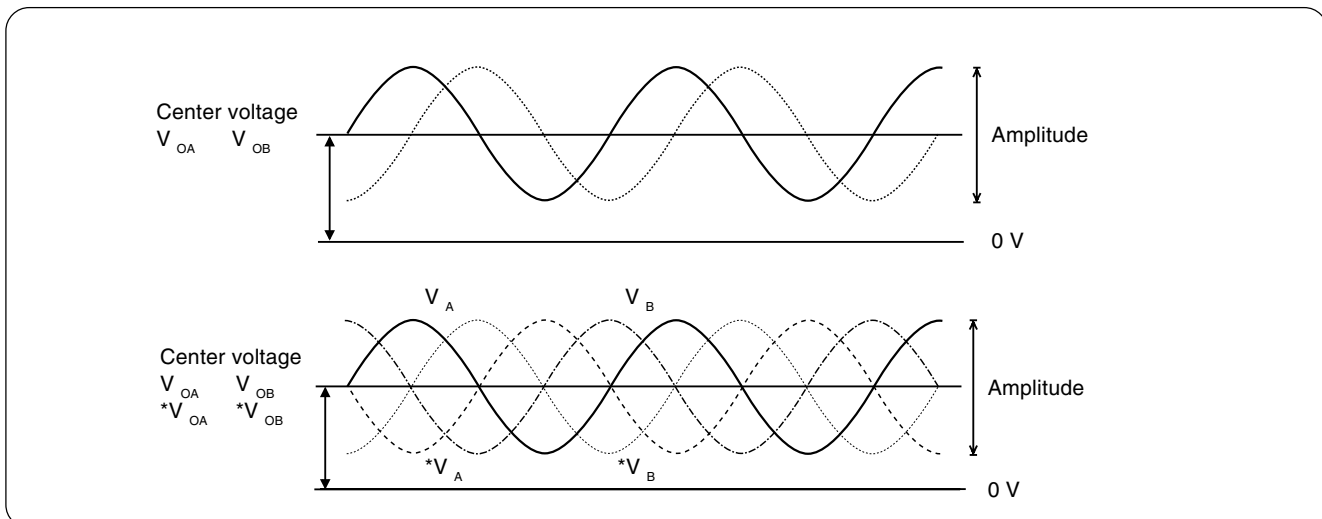
*3: The output signal becomes smaller as the scanning frequency increases.

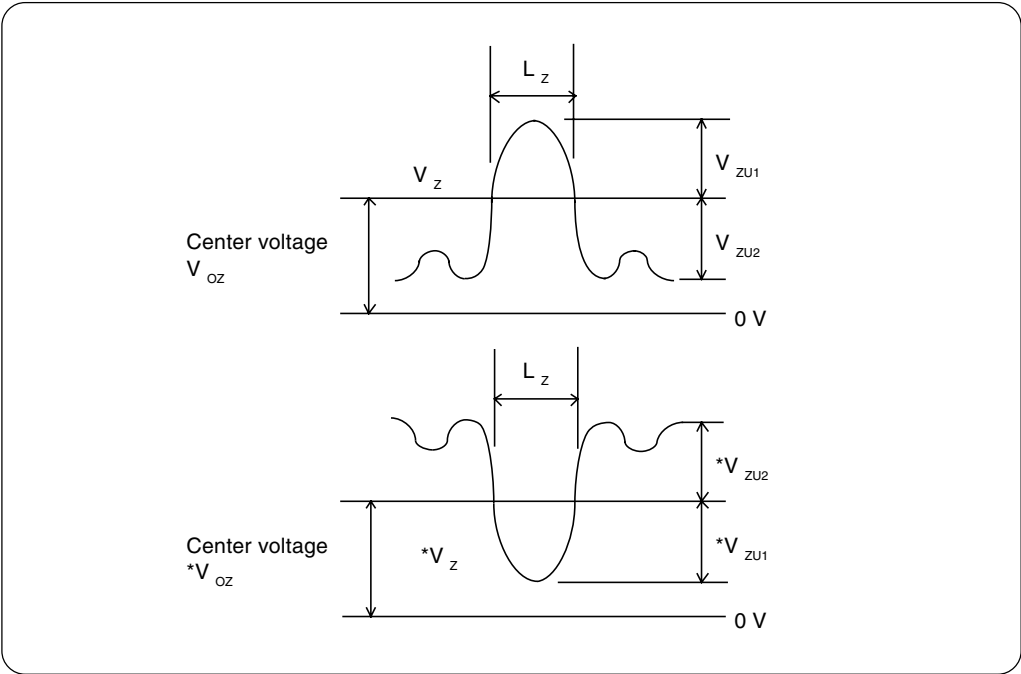
Formula 1:
$$\frac{\text{A-phase output voltage p-p value} - \text{AB-phase output average}}{\text{AB-phase output average}} \times 100$$

Where

AB-phase output average =
$$\frac{\text{A-phase output voltage p-p value} + \text{B-phase output voltage p-p value}}{2}$$

Output Waveform Diagrams (outputs as viewed with 0 V as the reference)

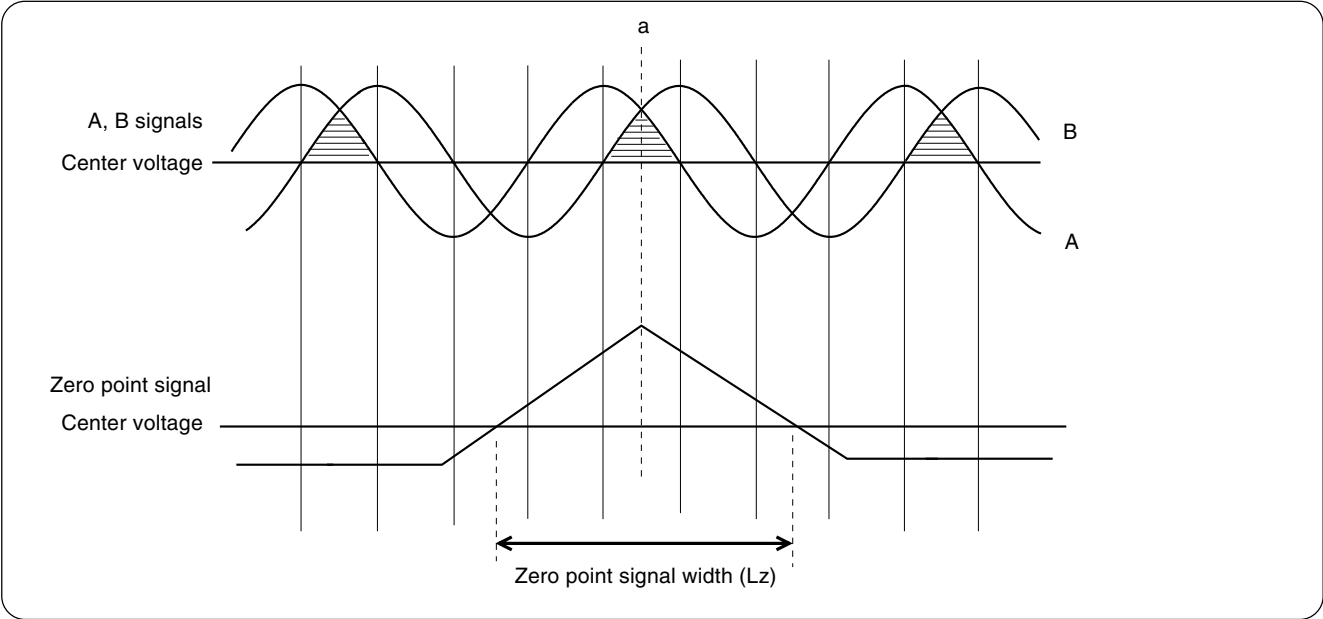




Zero Point Signal and A, B Signal Phases

| | Specifications | | |
|--|--------------------|-------------|--------------------|
| | Min. | Typ. | Max. |
| Zero point signal width (Lz) | 1/2 λ (10 μm) | 1 λ (20 μm) | 3/2 λ (30 μm) |
| Zero point signal peak a position with respect to A signal | a - 1/8 λ (2.5 μm) | 135° | a + 1/8 λ (2.5 μm) |

Zero Point Waveform Diagram



4-3. Cable Specifications/Models

A connecting cable is used to join the scale unit and the control unit.

Whether or not to use a conduit connecting cable is specified by the shape of the terminal that leads to the control unit.

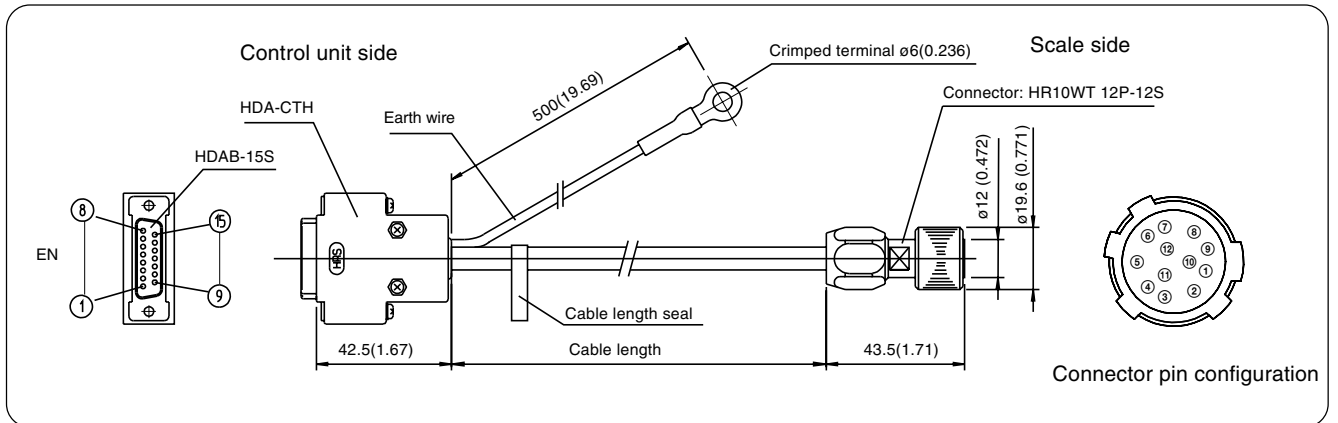
When used in an environment where there is a concern that the cable segment might be damaged, choose a conduit cable.

The connector has a dust-proof, drip-proof construction (except for the connector that leads to the control unit).

Connecting Cable

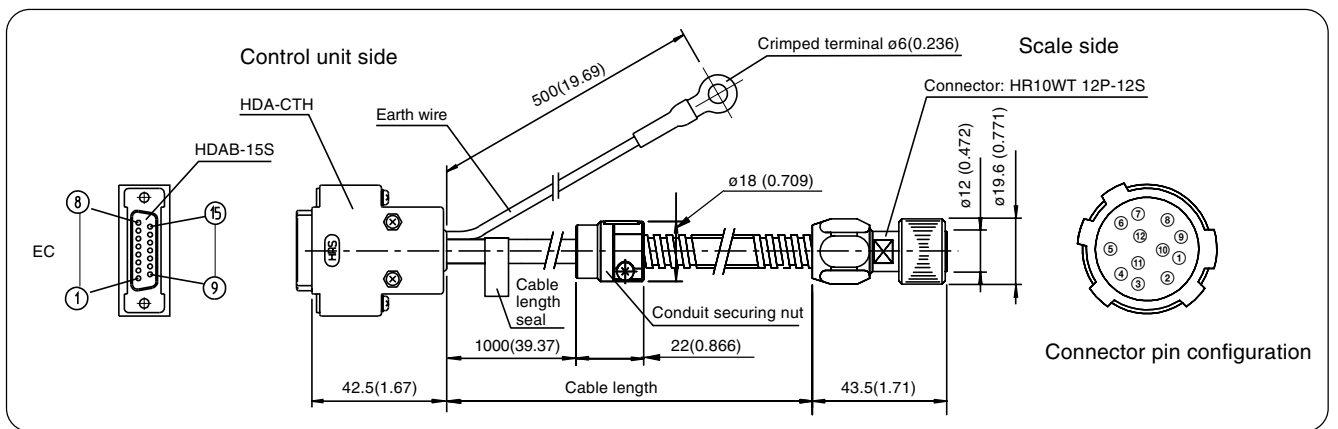
| Cable length | Model | | |
|------------------|-----------------------|---------------------|---------------------|
| | Dsub-15S connector: E | | Frayed tip: N |
| | Conduit cable: C | No conduit cable: N | No conduit cable: N |
| 2 m (78.7 in) | — | CR4-02EN | — |
| 3 m (118.1 in) | — | CR4-03EN | — |
| 5 m (196.9 in) | CR4-05EC | CR4-05EN | CR4-05NN |
| 7 m (275.6 in) | CR4-07EC | CR4-07EN | — |
| 10 m (393.7 in) | CR4-10EC | CR4-10EN | CR4-10NN |
| 15 m (590.6 in) | CR4-15EC | CR4-15EN | — |
| 20 m (787.4 in) | CR4-20EC | CR4-20EN | CR4-20NN |
| 30 m (1181.1 in) | CR4-30EC | CR4-30EN | CR4-30NN |

Model CR4-□□EN (Dsub-15S connector, No Conduit)



Unit [mm(in)]

Model CR4-□□EC (Dsub-15S connector, Conduit)

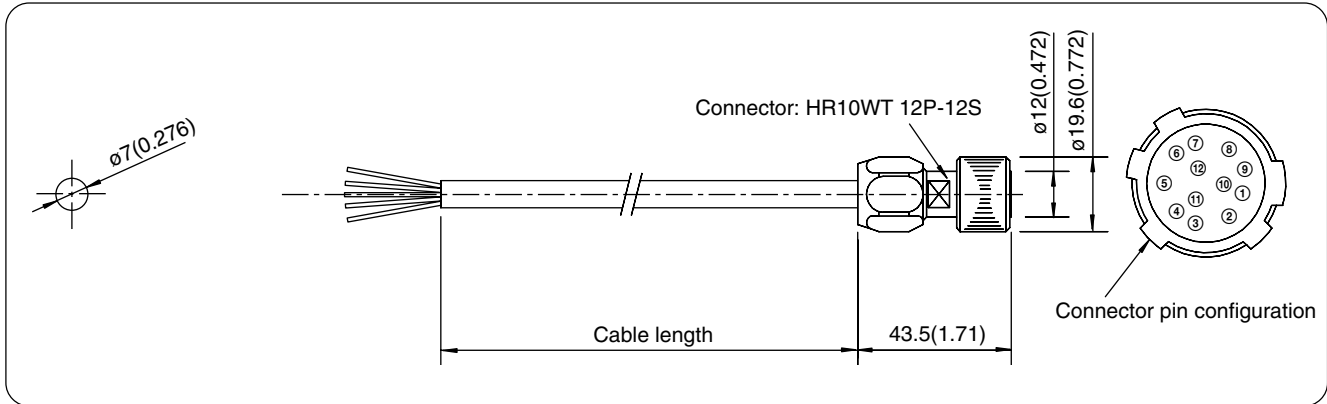


Unit [mm(in)]

Wiring Chart

| Wire Color | HDAB-15S Pin No. | Signal Name | HR10WT Pin No. |
|----------------|------------------|-----------------------|----------------|
| Blue | 1 | +5 V | 5 |
| Purple | 2 | 0 V | 11 |
| White | 9 | +5 V sensor | 12 |
| Gray | 11 | 0 V sensor | 6 |
| Red | 3 | Phase AD | 2 |
| Orange | 4 | Phase \overline{AD} | 8 |
| Yellow | 6 | Phase BD | 3 |
| Green | 7 | Phase \overline{BD} | 9 |
| Black | 10 | Phase ZD | 4 |
| Brown | 12 | Phase \overline{ZD} | 10 |
| Earth, shield, | Cable clamp | FG | 7 |

Model CR4-□□NN (Frayed tip, No Conduit)



Unit [mm(in)]

Wiring Chart

| Wire Color | Signal Name | HR10WT Pin No. |
|------------|-----------------------|----------------|
| Blue | +5 V | 5 |
| Purple | 0 V | 11 |
| White | +5 V sensor | 12 |
| Gray | 0 V sensor | 6 |
| Red | Phase AD | 2 |
| Orange | Phase \overline{AD} | 8 |
| Yellow | Phase BD | 3 |
| Green | Phase \overline{BD} | 9 |
| Black | Phase ZD | 4 |
| Brown | Phase \overline{ZD} | 10 |
| Shield | FG | 7 |

• **Minimum Connecting Cable Bending Radius**

The connecting cable bending radii are as follows:

When the cable does not move during use Bending radius: 50 mm (1.97 in) or more

When the cable moves during use Bending radius: 100 mm (3.94 in) or more

• **Extending the Connecting Cable**

Do not extend the connecting cable to a length of more than 30 m (1181.1 in).

Chapter 5 Appendix

5-1. Model Summary

Scale Unit (Scale precision: 3+3L/1000 μm)

| Measuring length | Model | Measuring length | Model |
|------------------|------------|------------------|------------|
| 70 (2.76) | SH12-007A3 | 570 (22.44) | SH12-057A3 |
| 120 (4.72) | SH12-012A3 | 620 (24.41) | SH12-062A3 |
| 170 (6.69) | SH12-017A3 | 670 (26.38) | SH12-067A3 |
| 220 (8.66) | SH12-022A3 | 720 (28.35) | SH12-072A3 |
| 270 (10.63) | SH12-027A3 | 770 (30.31) | SH12-077A3 |
| 320 (12.60) | SH12-032A3 | 820 (32.28) | SH12-082A3 |
| 370 (14.57) | SH12-037A3 | 920 (36.22) | SH12-092A3 |
| 420 (16.54) | SH12-042A3 | 1020 (40.16) | SH12-102A3 |
| 470 (18.50) | SH12-047A3 | 1140 (44.88) | SH12-114A3 |
| 520 (20.47) | SH12-052A3 | 1240 (48.82) | SH12-124A3 |

Unit [mm (in)]

Scale Unit (Scale precision: 5+5L/1000 μm)

| Measuring length | Model | Measuring length | Model |
|------------------|------------|------------------|------------|
| 70 (2.76) | SH12-007A5 | 570 (22.44) | SH12-057A5 |
| 120 (4.72) | SH12-012A5 | 620 (24.41) | SH12-062A5 |
| 170 (6.69) | SH12-017A5 | 670 (26.38) | SH12-067A5 |
| 220 (8.66) | SH12-022A5 | 720 (28.35) | SH12-072A5 |
| 270 (10.63) | SH12-027A5 | 770 (30.31) | SH12-077A5 |
| 320 (12.60) | SH12-032A5 | 820 (32.28) | SH12-082A5 |
| 370 (14.57) | SH12-037A5 | 920 (36.22) | SH12-092A5 |
| 420 (16.54) | SH12-042A5 | 1020 (40.16) | SH12-102A5 |
| 470 (18.50) | SH12-047A5 | 1140 (44.88) | SH12-114A5 |
| 520 (20.47) | SH12-052A5 | 1240 (48.82) | SH12-124A5 |

Unit [mm (in)]

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