

Linear Encoder

NC Linear Scale Systems

Catalog No. E13005



Linear Encoders for
Numerical Motion/Position Control System

Mitutoyo

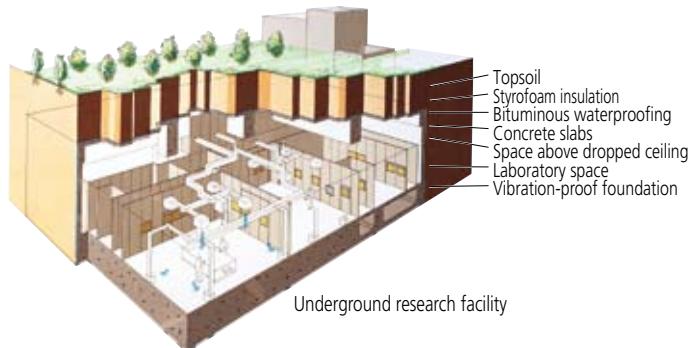
Integrated Production System for...

The Utsunomiya Operations Kiyohara Production Department presents a complete manufacturing environment where linear encoders for Mitutoyo measuring equipment as well as linear scales for the general market are produced. The whole production process including the manufacturing of glass scales for linear encoders, assembly of electronic components and products, and inspection is performed here. Conditions are continuously being optimized for further enhanced scale accuracy and even higher quality. The underground research laboratory at the Kiyohara Production Department has been specially designed and constructed to provide the environment required for the high-level scale graduation process as well as for high-accuracy measurements.

Located on a solid bedrock foundation nine meters underground, the facility maintains a stable and tightly controlled environment all year round. Temperature and humidity fluctuations as well as external vibrations are kept to an absolute minimum. In this laboratory, we produce master scales, perform accuracy evaluation, and pursue various kinds of research that provide the underpinning for the accuracy and quality of our linear scales.



Sputtering equipment



Linear Encoder Accuracy Calibration Technology

To assure high accuracy in linear encoders, a highly reliable calibration system is indispensable. The ultra-precision length measuring machine developed by Mitutoyo and installed in the underground research facility at the Kiyohara Production Department benefits from the highly stable underground environment. In addition, the light path of the laser interferometer used to measure lengths is placed in a vacuum to further eliminate any causes of uncertainty. The result is a linear encoder calibration system of world-leading precision, internationally recognized by mutual interlaboratory comparisons. In recognition of the high technological standard realized by this system, it received the Best Paper Award of the Japan Society of Precision Engineering in 2004 and the FA Paper Award of the FANUC FA and Robot Foundation in 2005.



Ultra-precision length measuring machine with vacuum laser interferometer

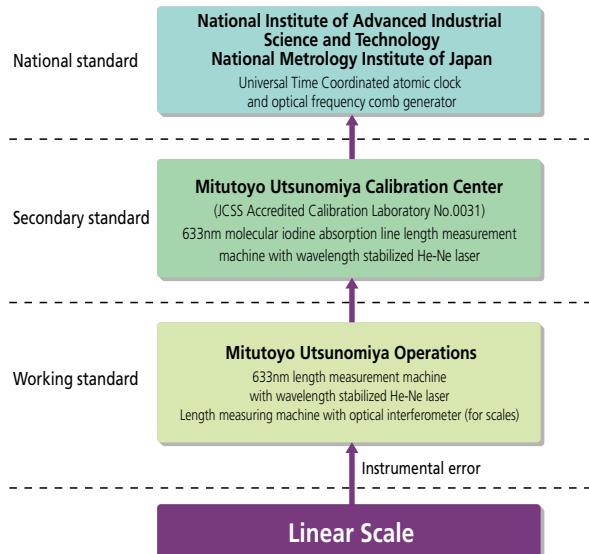
Mitutoyo

NC Linear Scale Systems

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Linear Scale is a registered trademark of Mitutoyo Corporation for its linear encoder products.

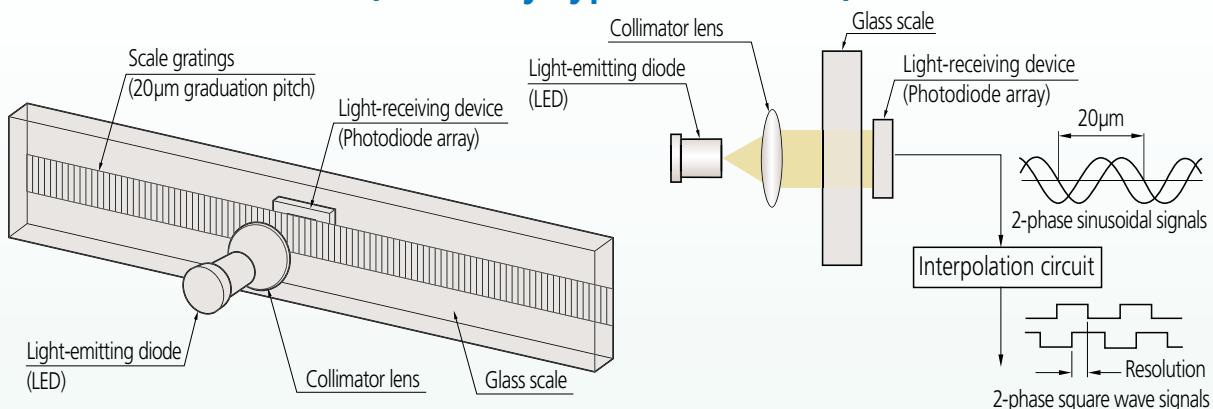
Linear Scales from Mitutoyo are traceable to national standards



Linear Scale Traceability System Chart

Detection Principle

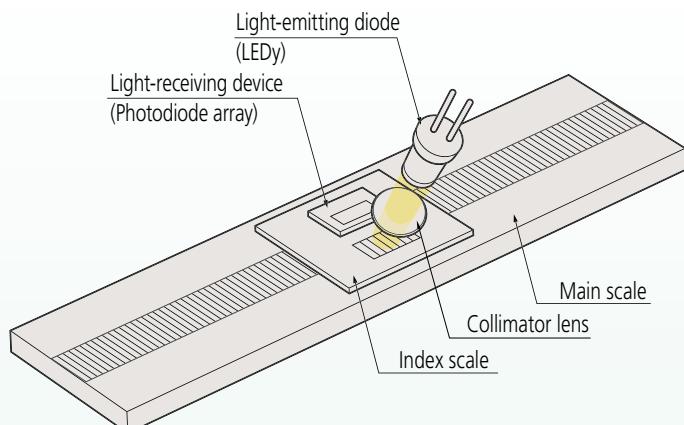
Detection principle of the transmission photoelectric scale (Assembly Type Linear Scale)



The assembly type linear scale uses a graduated glass scale as measuring length reference. A light-emitting diode (LED) and light-receiving device mounted on opposite sides of the scale serve to detect produce and detect changes in light intensity and output a value representing the displacement magnitude. Because the change in transmitted light intensity of the glass scale is converted into an electrical signal, the setup is called a transmission photoelectric system. A parallel light beam generated by the LED and collimator lens is directed through the scale gratings. A light-receiving device consisting of a photodiode array on the other side of the scale receives the parallel light beam and produces interference fringes with a cycle that corresponds to the scale grating pitch. When the glass scale is displaced in the measuring direction, the interference fringes shift, and a 2-phase sinusoidal signal with a cycle that corresponds to the 20µm pitch of the scale gratings is output by the light-receiving device.

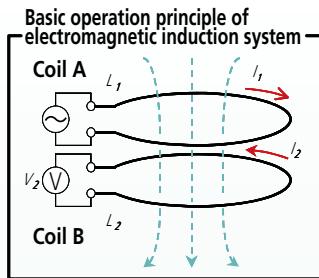
An interpolation circuit electrically divides the output sinusoidal signal, resulting in a square wave (pulse) signal representing the limiting resolution.

Detection principle of the reflective photoelectric scale (ST36, etc.)



The separate type photoelectric linear scale also uses a graduated glass scale as measuring length reference. An LED and light-receiving device together with gratings on an index scale produce and detect changes in light intensity and output a value representing the displacement magnitude. Because the change in reflected light intensity of the glass scale is converted into an electrical signal, the setup is called a reflective type photoelectric system. A parallel light beam generated by the LED and collimator lens is directed onto the index scale gratings and the glass scale gratings. The light reflected from the scale gratings produces interference fringes on the photodiode array of the light-receiving device. When the glass scale is displaced in the measuring direction, the interference fringes shift, and a sinusoidal signal with a cycle that is the same as, or one-half of, the scale grating pitch is output by the light-receiving device.

Detection principle of electromagnetic induction system (ABS ST700)

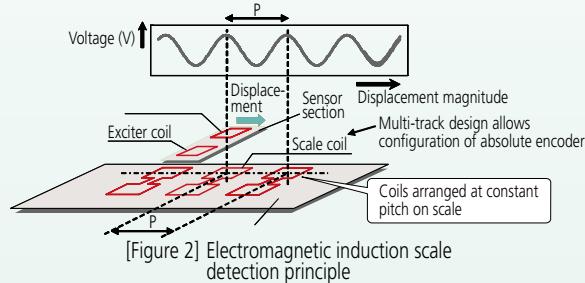


[Figure 1] Electromagnetic induction system encoder principle

When a current (I_1) that changes over time is passed through coil A, a magnetic flux is created in the vicinity of coil A. This causes an inductive current (I_2) to flow in coil B, in a direction that cancels out the magnetic field.

Magnetic permeability between coils is largely identical in air, water, or oil.

Electromagnetic induction type sensor has excellent water resistance and oil resistance.



[Figure 2] Electromagnetic induction scale detection principle

Electromagnetic induction is a phenomenon that occurs, for example, when two coils are arranged facing each other, as shown in Figure 1, and a time-varying current (I_1) is passed through coil A. This will cause an induced current (I_2) to flow in coil B, in a direction that cancels out the magnetic field.

The electromagnetic induction type linear scale uses this phenomenon to convert a displacement magnitude into an electrical signal. The operational principle of the sensor section is shown in Figure 2. A number of scale coils are arranged with precise spacing on the main scale. The moveable sensor section that detects displacement carries an exciter coil and a corresponding detector coil. A current is sent through the exciter coil, thereby creating a magnetic flux that induces a current in the facing scale coil. The magnetic flux created in turn by that current induces a current in the facing detector coil. The degree of inductive coupling between the coils changes according to the displacement magnitude of the sensor section, allowing a sinusoidal signal with a cycle that corresponds to the pitch of the scale coils to be obtained.

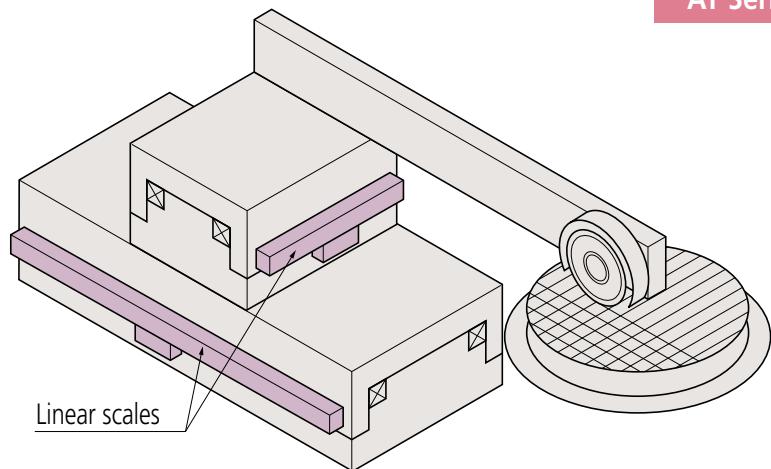
By using an electrical circuit that performs interpolation (division) of this sinusoidal signal, displacement can be measured with fine resolution.

Applications

Semiconductor fabrication equipment

Dicing saw positioning

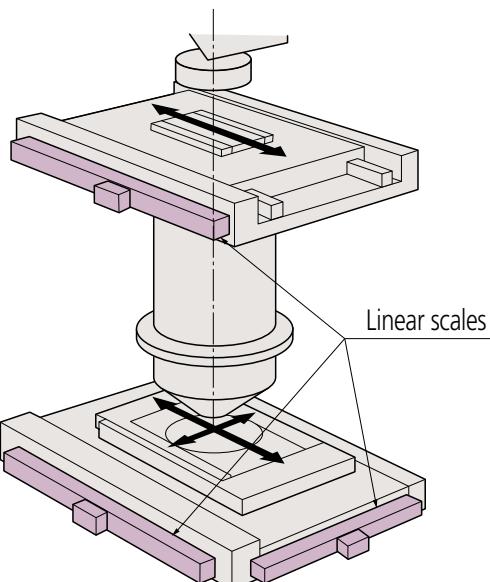
AT Series - Reference



Lithography equipment

Scanning stage positioning

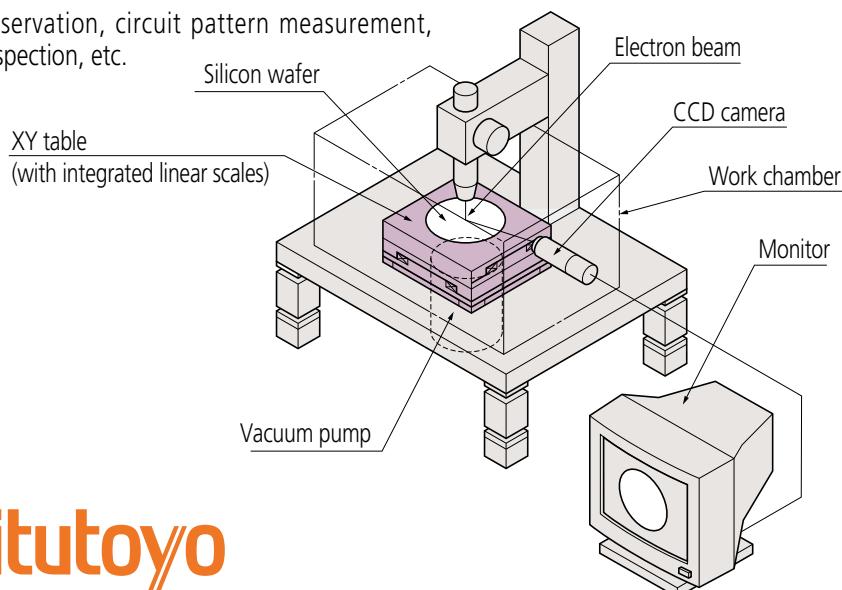
ST Series - Reference



Electron microscope

Mask observation, circuit pattern measurement,
defect inspection, etc.

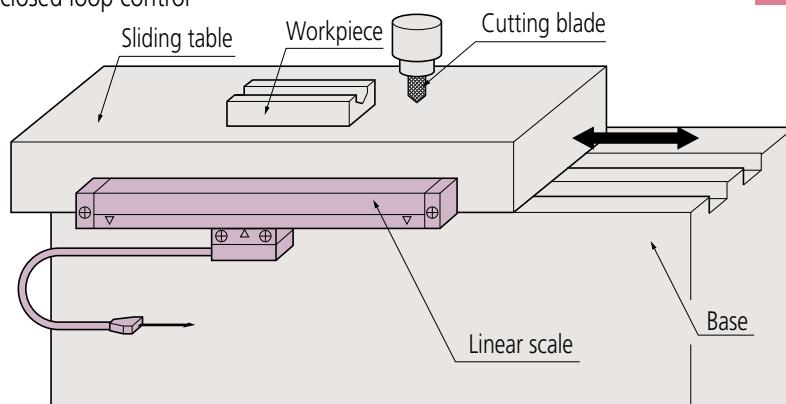
ST Series - Reference



Various NC machine tools

High-precision fully closed loop control

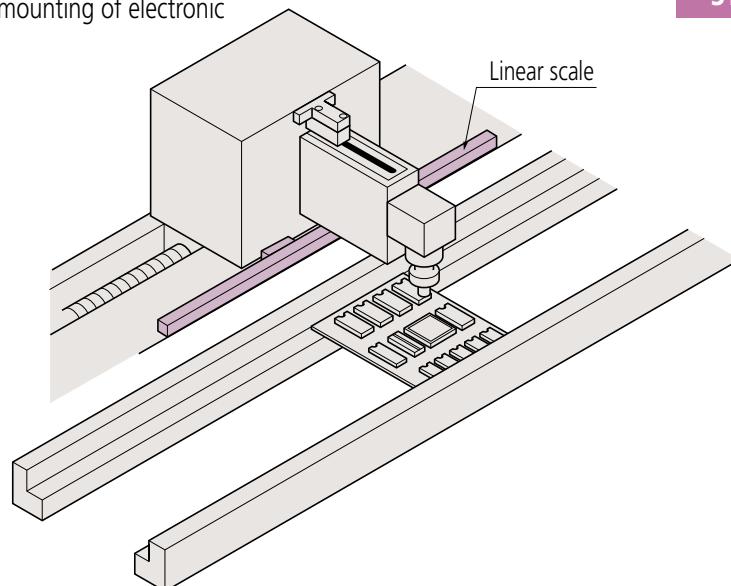
AT Series - Reference



Electronic component inserter

High-speed, high-precision mounting of electronic components

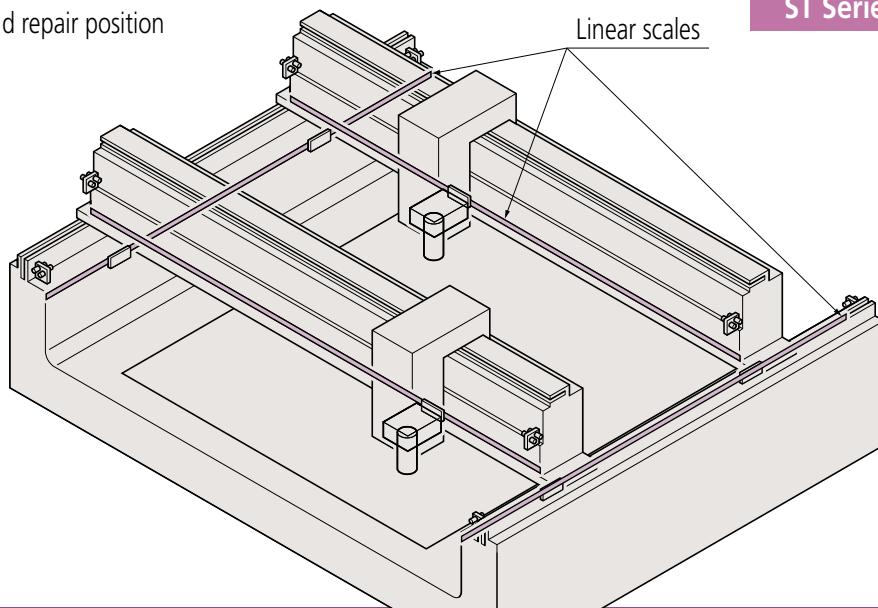
ST Series - Reference



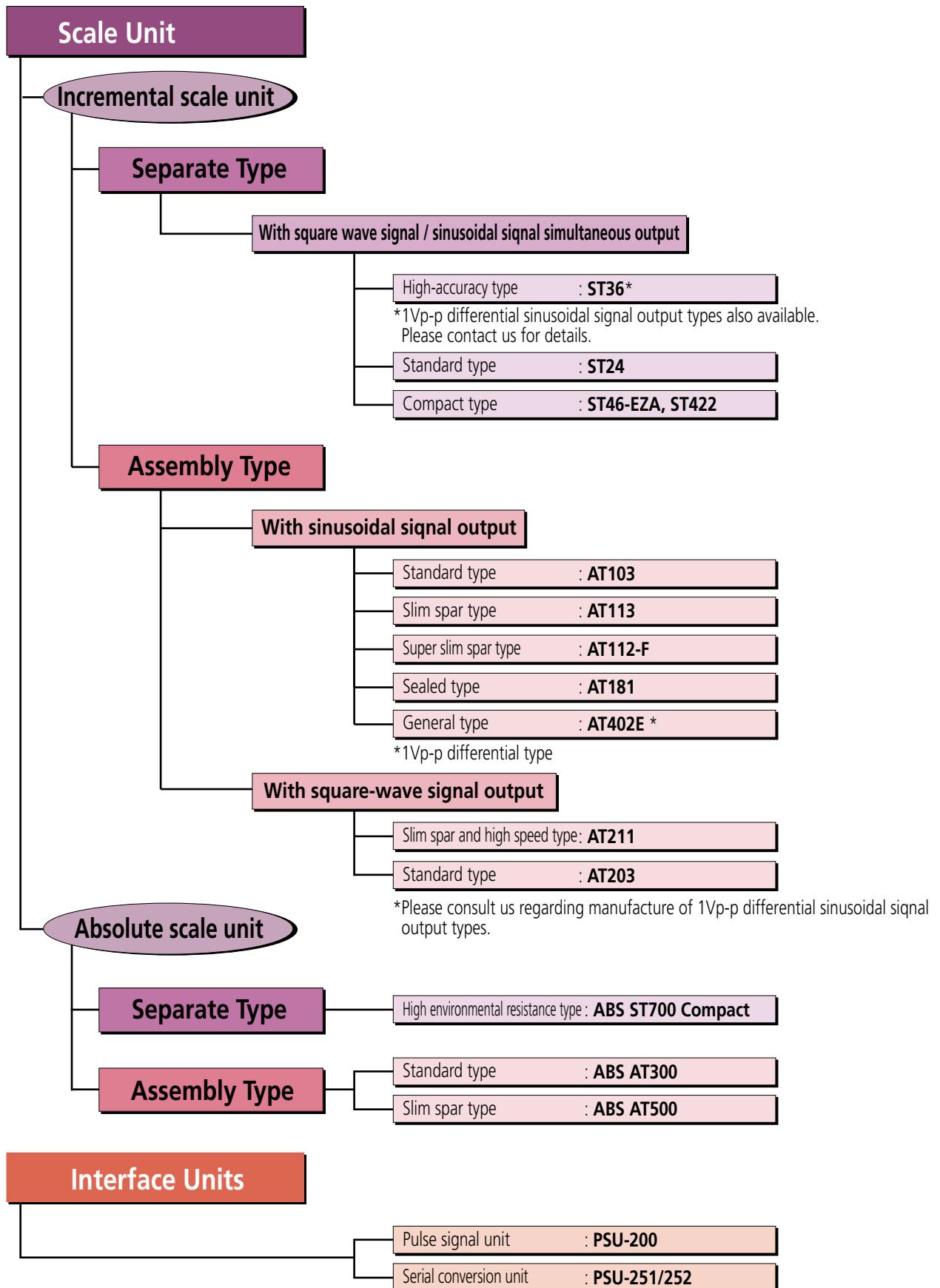
FPD inspection equipment

Defect inspection and repair position determination

ST Series - Reference



NC Linear Scale Systems – System Diagram



NC Linear Scale Systems – Overview

| | Scale name (Code) | Reference point | Absolute function | Main scale grating pitch | Signal output pitch | Signal unit | No. of divisions | Resolution | Maximum response speed* ¹ | Minimum edge interval* ² | See page | | |
|-----------------------------|--|-----------------|-------------------|--------------------------|---------------------|-------------|------------------|------------|--------------------------------------|-------------------------------------|----------|--|--|
| Separate Type Linear Scales | ST36B ST36C (ST36A) (ST36D) | ○ | × | 8µm | 4µm | (PSU-200) | 400 | 0.01µm | 70mm/s | 125ns | P9 - 12 | | |
| | | | | | | | 200 | 0.02µm | 150mm/s | | | | |
| | | | | | | | 80 | 0.05µm | 260mm/s | | | | |
| | | | | | | | 40 | 0.1µm | 720mm/s | | | | |
| | ST24B ST24C | ○ | × | 20µm | 10µm | - | 200 | 0.05µm | 360mm/s | 125ns | P13 - 16 | | |
| | | | | | | | 100 | 0.1µm | 720mm/s | | | | |
| | | | | | | | 20 | 0.5µm | 1200mm/s | | | | |
| | | | | | | | 10 | 1µm | 1200mm/s | | | | |
| | ST46-EZA | ○ | × | 20µm | 20µm | - | 400 | 0.05µm | 900mm/s | 50ns | P17 - 20 | | |
| | | | | | | | 200 | 0.1µm | 1800mm/s | | | | |
| | | | | | | | 40 | 0.5µm | 2600mm/s | | | | |
| | | | | | | | 20 | 1µm | 2600mm/s | | | | |
| Assembly Type Linear Scales | ST422 | ○ | × | 40µm | 40µm | - | 200 | 0.2µm | 1500mm/s | 125ns | P21, 22 | | |
| | | | | | | | 80 | 0.5µm | 3600mm/s | | | | |
| | | | | | | | 40 | 1µm | 5000mm/s | | | | |
| | | | | | | | 8 | 5µm | 5000mm/s | | | | |
| | | | | | | | 30720 | 0.1µm | 5000mm/s | | | | |
| | | | | | | | - | - | - | | | | |
| | | | | | | | 200 | 0.1µm | 800mm/s | 125ns | P23 - 26 | | |
| | | | | | | | 100 | 0.2µm | 1600mm/s | | | | |
| Assembly Type Linear Scales | AT103 AT113 AT112-F AT181 | ○ | × | 20µm | 20µm | PSU-200 | 80 | 0.25µm | 2000mm/s* ³ | | | | |
| | | | | | | | 40 | 0.5µm | | | | | |
| | | | | | | | 20 | 1µm | | | | | |
| | | | | | | | 10 | 2µm | | | | | |
| | | | | | | | 8 | 2.5µm | | | | | |
| | | | | | | | 4 | 5µm | | | | | |
| | | | | | | | - | - | 2000mm/s | 125ns | P27 - 30 | | |
| | | | | | | | - | - | 1Vp-p differential sine wave | | | | |
| | AT402E | ○ | △ | 20µm | 20µm | - | 200 | 0.1µm | 710mm/s | 125ns | P31 - 36 | | |
| | | | | | | | 100 | 0.2µm | 1400mm/s | | | | |
| | | | | | | | 40 | 0.5µm | 2000mm/s | | | | |
| | | | | | | | 20 | 1µm | | | | | |
| | | | | | | | 8 | 2.5µm | | | | | |
| | | | | | | | 4 | 5µm | | | | | |
| | | | | | | | - | - | 2000mm/s | 250ns | P37 - 40 | | |
| | | | | | | | - | - | 1000ns | | | | |
| | AT203 | ○ | × | 20µm | 20µm | - | 200 | 0.1µm | 333mm/s | 250ns | P37 - 40 | | |
| | | | | | | | 40 | 0.5µm | 1833mm/s | | | | |
| | | | | | | | 20 | 1µm | 2000mm/s | | | | |
| | ABS AT500 | - | ○ | 20µm | 20µm | - | 4096 | 0.005µm | 2500mm/s* ⁴ | - | P53 - 76 | | |
| | | | | | | | 400 | 0.05µm | | | | | |
| | ABS AT300 | - | ○ | 20µm | 20µm | - | 400 | 0.05µm | 2000mm/s | - | P77 - 80 | | |

*¹ Maximum response speed of pulse output type uses the logical value (IC specification) with a margin of about 10%.

*² For information on minimum edge interval, see "Explanation of Terms" on page 86.

The guaranteed value for minimum edge interval is +0%, -10%.

For some models, values other than shown above can also be selected.

*³ Maximum response speed is 2000mm/s for AT113 and 830mm/s (50m/min) for AT112, AT181, AT103-3250 and higher.

*⁴ Maximum response speed of H type with 0.005µm resolution is 1200mm/s.

Separate Type ST Series

Sinusoidal signal & Square-Wave Signal Output Scale Unit (High Accuracy Type)

ST36



Features

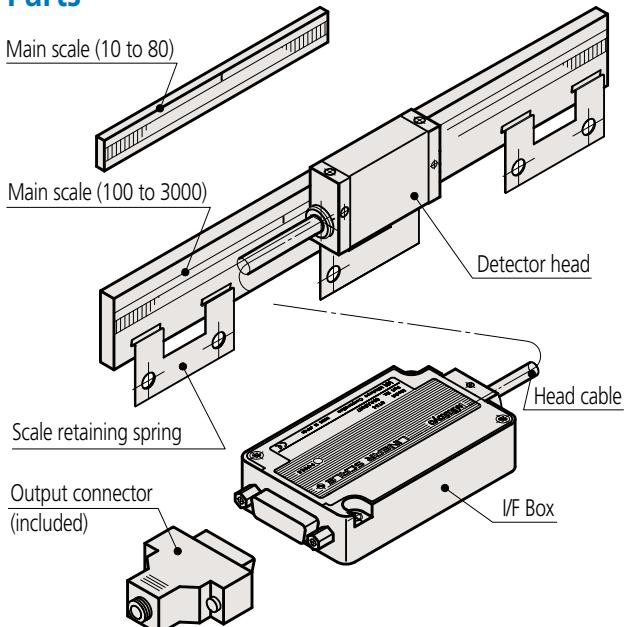
- High accuracy type, 0.5 μ m class (effective range up to 300mm)
- Has a thinner detector head (thickness 11.5mm).
- The maximum effective measurement length of 3000mm enables use on large machines.
- 4 different types available for each signal output specification.
- LED display function for indicating signal errors.

Specifications

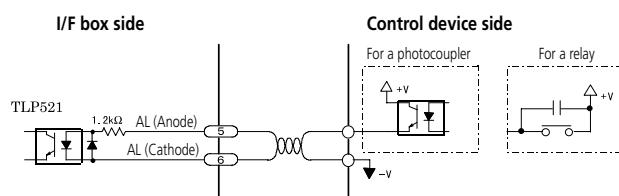
| Item | Code | ST36A | ST36B | ST36C | ST36D |
|--------------------------------|------|---|--|---|---------------------------------------|
| Detection method | | | Reflective photoelectric linear encoder | | |
| Main scale grating pitch | | | 8 μ m | | |
| Signal output pitch | | | 4 μ m | | |
| Output signal | | 2-phase sinusoidal signals | 2-phase square wave signals (reset input type) | 2-phase square wave signals 2-phase sinusoidal signals | 1Vp-p differential sinusoidal signals |
| Effective range | | | 10 - 3000mm | | |
| Accuracy (20°C) | | | Effective range 10 to 300mm: $\pm 0.5 \mu$ m Effective range 350 to 500mm: $\pm 1.0 \mu$ m Effective range 600 to 1000mm: $\pm 2.0 \mu$ m Effective range 1100 to 3000mm: $\pm 2.0 \mu$ m/m | | |
| Thermal expansion coefficient | | | (8 ± 1) $\times 10^{-6}$ / °C | | |
| Maximum response speed | | 1200mm/s (with sinusoidal signals output) (For 2-phase square wave signal types, see page 11) | | | |
| Scale reference point* | | | With scale reference point (50mm pitch, 10 to 80mm: Center point) | | |
| Power supply | | | 5VDC $\pm 5\%$ | | |
| Maximum current consumption | | 120mA | 250mA | 190mA | |
| Operating temperature/humidity | | | 0 to 40°C, 20 to 80% RH (no condensation) | | |
| Storage temperature/humidity | | | -20 to 60°C, 20 to 80%RH (no condensation) | | |
| Alarm indication | | | A scale alarm is indicated with an LED on the I/F box | | |

*Maximum speed for scale reference point detection is 20mm/s.

Parts



Alarm reset transmission/reception signal circuit (B Type)

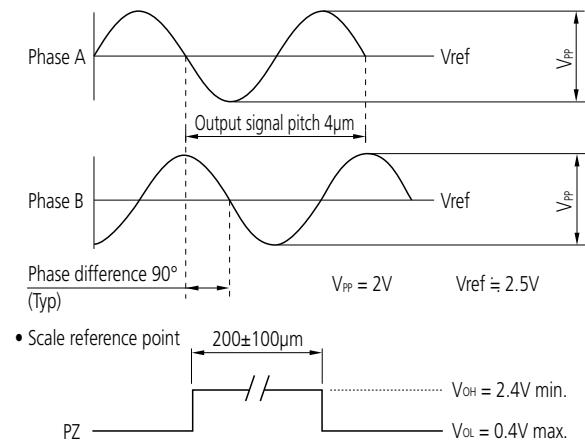


Reset input

Connect the alarm reset input circuit so that the current is 3 to 10mA. Also, the device has an internal resistor (1.2kΩ), so by applying 5 to 12V with a pulse width of at least 10ms across AL (anode)-AL (cathode), the alarm can be reset. When applying 12V or more, add an external resistance to limit the current to within the range stated above.

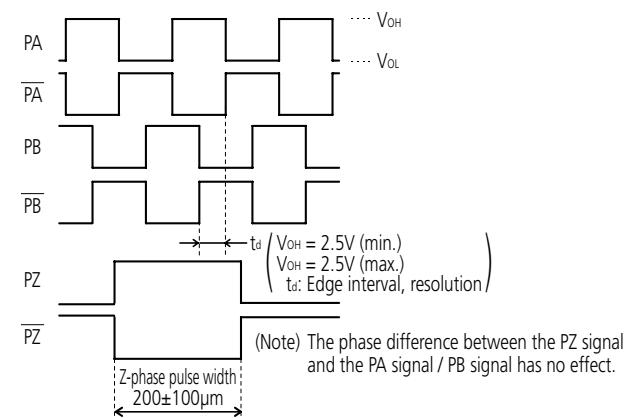
Output signal waveform

- 2-phase sinusoidal signals (Type A, C)

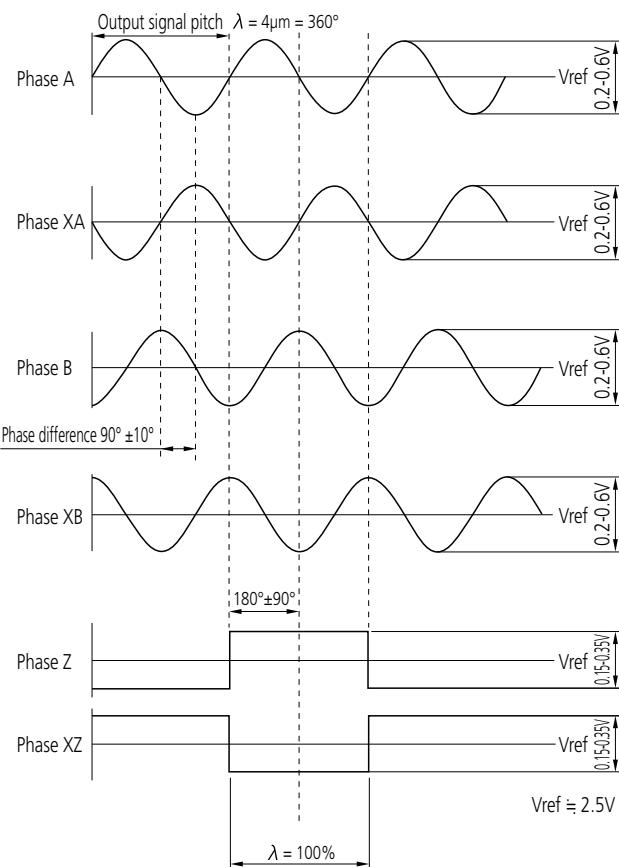


(Note) The phase difference between the PZ signal and the Phase A signal (and the Phase B signal) are not defined.

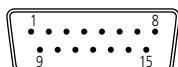
- 2-phase square wave signals (Type B, C)



- 1Vp-p differential sinusoidal signals (Type D)



Output specification



1. Output connector specification (Type A, B, C)

- Output connector (pin type): RDAD-15P-LNA(05) (Hirose Electric or equivalent)
- Applicable connector (standard accessory): D15-403N-110 (Technical Electron or equivalent)

2. Output connector specification (Type D)

- Output connector (pin type): RDAD-15P-LNA(05) inch screws (Hirose Electric or equivalent)
- Applicable connector (standard accessory): D15-403N-150 inch screws (Technical Electron or equivalent)

| Pin No. | Type A Signal | Type B Signal | Type C Signal | Type D Signal |
|---------|----------------------------|-----------------------------|-----------------------------|------------------------|
| 1 | 0V (GND) | 0V (GND) | 0V (GND) | Phase XA |
| 2 | 0V (GND) | 0V (GND) | 0V (GND) | Phase XB |
| 3 | +5V | +5V | +5V | Phase Z |
| 4 | +5V | +5V | +5V | +5V (V _{DD}) |
| 5 | Phase A | Reset input (anode) | Phase A | +5V (V _{DD}) |
| 6 | Phase B | Reset input (cathode) | Phase B | N.C |
| 7 | V _{ref} | V _{ref} | V _{ref} | N.C |
| 8 | PZ (scale reference point) | PZ (scale reference point) | PZ (scale reference point) | N.C |
| 9 | N.C | ALM (alarm, negative logic) | ALM (alarm, negative logic) | Phase A |
| 10 | V _{ref} | PA | PA | Phase B |
| 11 | N.C | PA | PA | Phase XZ |
| 12 | N.C | PB | PB | 0V (GND) |
| 13 | N.C | PB | PB | 0V (GND) |
| 14 | N.C | PZ | PZ | N.C |
| 15 | F.G | F.G (= 0V) | F.G (= 0V) | 0V (GND) |

Specification Selection Method

How to read the code

ST36 [] - [] [] [] - [] [] [] - [] - []

Signal output

| Code | Output |
|------|---|
| A | Sinusoidal signal |
| B | Square wave signal + external reset input |
| C | Sinusoidal signal + Square wave signal |
| D | 1Vp-p differential |

Effective range

| Code | Effective range (mm) | Code | Effective range (mm) |
|------|----------------------|------|----------------------|
| 0010 | 10 | 0900 | 900 |
| 0025 | 25 | 1000 | 1000 |
| 0050 | 50 | 1100 | 1100 |
| 0075 | 75 | 1200 | 1200 |
| 0080 | 80 | 1300 | 1300 |
| 0100 | 100 | 1400 | 1400 |
| 0150 | 150 | 1500 | 1500 |
| 0200 | 200 | 1600 | 1600 |
| 0250 | 250 | 1700 | 1700 |
| 0300 | 300 | 1800 | 1800 |
| 0350 | 350 | 2000 | 2000 |
| 0400 | 400 | 2200 | 2200 |
| 0450 | 450 | 2400 | 2400 |
| 0500 | 500 | 2500 | 2500 |
| 0600 | 600 | 2600 | 2600 |
| 0700 | 700 | 2800 | 2800 |
| 0800 | 800 | 3000 | 3000 |

Note: For the standard specification, the indicated effective range depends on the product code.

Example of standard specification

Effective range 10mm: ST36□-0010

Effective range 250mm: ST36□-0250

Scale reference point

| Code | Details |
|------|--------------------------------|
| ●A | 50mm pitch (100 to 3000) |
| ○B | Center point (10 to 3000) |
| Z | Special position specification |

Note: For reference positions in the effective range of 10 to 80mm, [B: Center point] is the standard specification.

Resolution / Minimum edge interval

| Resolution | Minimum edge interval | | | |
|------------|--|-------------|------------|-----------|
| | 125ns | 250ns | 500ns | 1000ns |
| 0.01μm | A: 70mm/s | B: 30mm/s | C: 15mm/s | D: 8mm/s |
| 0.02μm | E: 150mm/s | F: 70mm/s | G: 30mm/s | H: 15mm/s |
| 0.05μm | J: 360mm/s | K: 180mm/s | L: 90mm/s | M: 45mm/s |
| 0.1 μm | N: 720mm/s | ●P: 360mm/s | Q: 180mm/s | R: 90mm/s |
| — | ○Z: When [Signal output] is [A][D], maximum response speed at Sinusoidal signal -3 dB attenuation is 1.2m/s. | | | |

Note: The minimum edge interval varies 0 to -10% based on the operating environmental conditions.

- There is an extensive selection of specifications for ST36.
 - Choose the appropriate numbers and letters below according to specification required.
- If standard specifications (recommended items marked with ●/○ symbols below) meet your requirements, please order using the code numbers shown on page 12.

Special codes

| Code | Details |
|-------|----------------------------------|
| ●None | Standard selection specification |
| Z | Special specification |

Note: If there are special details, please select Z.

Head cable length

| Code | Length |
|------|--|
| ●A | 1m (High flex) |
| B | 0.5m (High flex) |
| Z | Special length specification (max. 2.5m) |

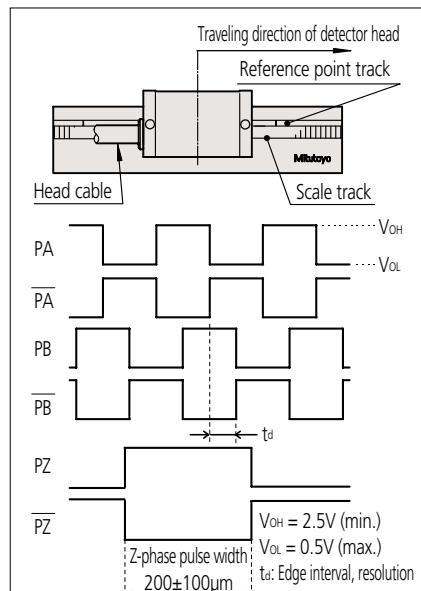
Note: If there are special details, please select Z.

Alarm output

| Code | Details |
|------|------------------------------------|
| ●S | Alarm signal |
| H | High impedance |
| ○Z | When [Signal output] is [A] or [D] |

Direction

| Code | Details |
|------|------------------------------------|
| ●1 | Normal: PA goes ahead |
| 2 | Reverse: PB goes ahead |
| ○Z | When [Signal output] is [A] or [D] |



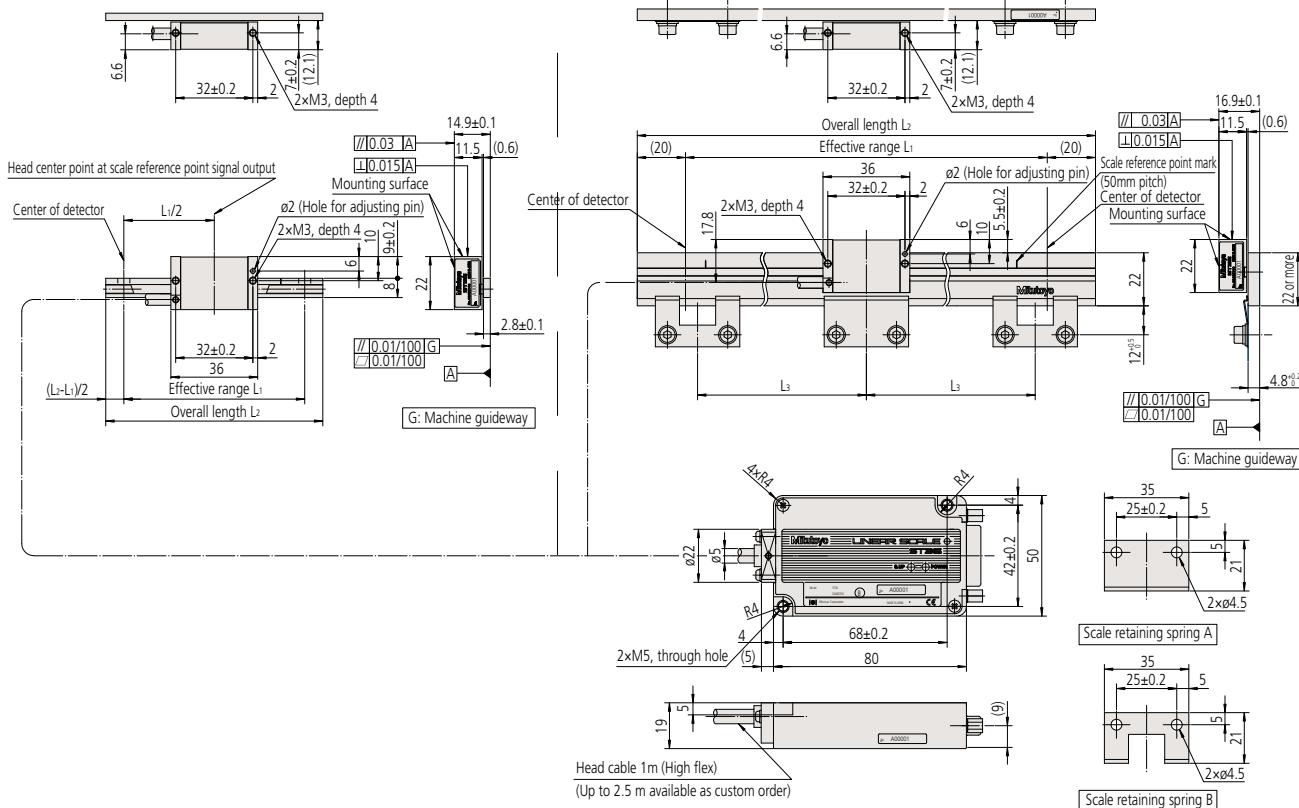
This is the waveform that results when the detector head moves as shown in the figure above.

Mounting dimensions

- 10 to 80mm (Adhesive fixing type)

- 100 to 3000mm

Unit: mm



Dimensions of scale units

| Order No.* | Code* | Effective range L_1 (mm) | Overall length L_2 (mm) | Scale fixing pitch L_3 (mm) | Retaining spring A | Retaining spring B |
|------------|-----------|----------------------------|---------------------------|-------------------------------|--------------------|--------------------|
| 579-501-0□ | ST36◇-10 | 10 | 30 | — | — | — |
| 579-502-0□ | ST36◇-25 | 25 | 45 | — | — | — |
| 579-503-0□ | ST36◇-50 | 50 | 70 | — | — | — |
| 579-504-0□ | ST36◇-75 | 75 | 90 | — | — | — |
| 579-505-0□ | ST36◇-80 | 80 | 100 | — | — | — |
| 579-506-0□ | ST36◇-100 | 100 | 140 | 50 | 1 pc. | 2 pcs. |
| 579-507-0□ | ST36◇-150 | 150 | 190 | 75 | 1 pc. | 2 pcs. |
| 579-508-0□ | ST36◇-200 | 200 | 240 | 100 | 1 pc. | 2 pcs. |
| 579-509-0□ | ST36◇-250 | 250 | 290 | 60 | 1 pc. | 4 pcs. |
| 579-510-0□ | ST36◇-300 | 300 | 340 | 75 | 1 pc. | 4 pcs. |
| 579-511-0□ | ST36◇-350 | 350 | 390 | 85 | 1 pc. | 4 pcs. |
| 579-512-0□ | ST36◇-400 | 400 | 440 | 100 | 1 pc. | 4 pcs. |
| 579-513-0□ | ST36◇-450 | 450 | 490 | 75 | 1 pc. | 6 pcs. |
| 579-514-0□ | ST36◇-500 | 500 | 540 | 80 | 1 pc. | 6 pcs. |
| 579-515-0□ | ST36◇-600 | 600 | 640 | 100 | 1 pc. | 6 pcs. |
| 579-516-0□ | ST36◇-700 | 700 | 740 | 85 | 1 pc. | 8 pcs. |
| 579-517-0□ | ST36◇-800 | 800 | 840 | 100 | 1 pc. | 8 pcs. |

* The above code numbers are for recommended items marked with ● / ○ symbols.

If recommended specifications meet your requirements, use these code numbers to order.

* The □ and ◇ symbols in the tables above have the following meanings:

- ◇ → A (2-phase sinusoidal signals) : □ → 1
- ◇ → B (2-phase square wave signals + reset input) : □ → 2
- ◇ → C (2-phase sinusoidal signals + 2-phase square wave signals) : □ → 3
- ◇ → D (1Vp-p differential) : □ → 4

| Order No.* | Code* | Effective range L_1 (mm) | Overall length L_2 (mm) | Scale fixing pitch L_3 (mm) | Retaining spring A | Retaining spring B |
|------------|------------|----------------------------|---------------------------|-------------------------------|--------------------|--------------------|
| 579-518-0□ | ST36◇-900 | 900 | 940 | 90 | 1 pc. | 10 pcs. |
| 579-519-0□ | ST36◇-1000 | 1000 | 1040 | 100 | 1 pc. | 10 pcs. |
| 579-520-0□ | ST36◇-1100 | 1100 | 1140 | 90 | 1 pc. | 12 pcs. |
| 579-521-0□ | ST36◇-1200 | 1200 | 1240 | 100 | 1 pc. | 12 pcs. |
| 579-522-0□ | ST36◇-1300 | 1300 | 1340 | 130 | 1 pc. | 10 pcs. |
| 579-523-0□ | ST36◇-1400 | 1400 | 1440 | 100 | 1 pc. | 14 pcs. |
| 579-524-0□ | ST36◇-1500 | 1500 | 1540 | 125 | 1 pc. | 12 pcs. |
| 579-525-0□ | ST36◇-1600 | 1600 | 1640 | 100 | 1 pc. | 16 pcs. |
| 579-526-0□ | ST36◇-1700 | 1700 | 1740 | 120 | 1 pc. | 14 pcs. |
| 579-527-0□ | ST36◇-1800 | 1800 | 1840 | 100 | 1 pc. | 18 pcs. |
| 579-528-0□ | ST36◇-2000 | 2000 | 2040 | 100 | 1 pc. | 20 pcs. |
| 579-529-0□ | ST36◇-2200 | 2200 | 2240 | 100 | 1 pc. | 22 pcs. |
| 579-530-0□ | ST36◇-2400 | 2400 | 2440 | 100 | 1 pc. | 24 pcs. |
| 579-531-0□ | ST36◇-2500 | 2500 | 2540 | 95 | 1 pc. | 26 pcs. |
| 579-532-0□ | ST36◇-2600 | 2600 | 2640 | 100 | 1 pc. | 26 pcs. |
| 579-533-0□ | ST36◇-2800 | 2800 | 2840 | 100 | 1 pc. | 28 pcs. |
| 579-534-0□ | ST36◇-3000 | 3000 | 3040 | 100 | 1 pc. | 30 pcs. |

Separate Type ST Series

Sinusoidal signal & Square-Wave Signal Output Scale Unit (Standard Type)

ST24

Features

- Has a thinner detector head (thickness 11mm).
- The maximum effective measurement length of 3000mm enables use on large machines.
- 2 different types available for each signal output specification
- LED display function for indicating signal errors.

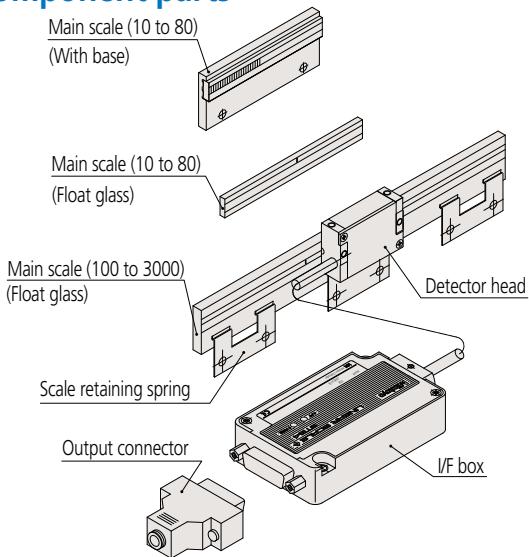


Specifications

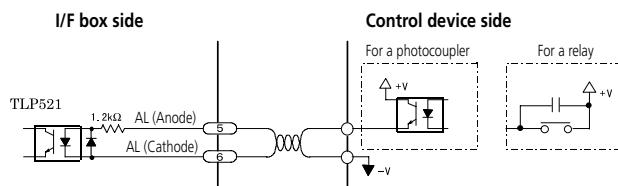
| Item | Code | ST24B | ST24C |
|--------------------------------|------|---|---|
| Detection method | | Reflective photoelectric linear encoder | |
| Main scale grating pitch | | 20µm | |
| Signal output pitch | | 10µm | |
| Output signal | | 2-phase square wave signals (reset input type) | 2-phase square wave signals 2-phase sinusoidal signals |
| Effective range | | 10 to 3000mm | |
| Accuracy (20°C) | | Effective range 10 to 300mm: ±1.0µm Effective range 350 to 500mm: ±2.0µm Effective range 600 to 1000mm: ±3.0µm Effective range 1100 to 3000mm: ±3.0 µm/m | |
| Thermal expansion coefficient | | (8±1) x10 ⁻⁶ /°C | |
| Maximum response speed | | 1200mm/s (with sinusoidal signal output) (For 2-phase square wave signal types, see page 15) | |
| Scale reference point* | | With scale reference point (50mm pitch, 10 to 80mm: Center point) | |
| Power supply | | 5VDC±5% | |
| Maximum current consumption | | 250mA | |
| Operating temperature/humidity | | 0 to 40°C, 20 to 80%RH (no condensation) | |
| Storage temperature/humidity | | -20 to 60°C, 20 to 80%RH (no condensation) | |
| Alarm indication | | LED illumination on the I/F box | |

* Maximum speed for scale reference point detection is 20mm/s.

Component parts



Alarm reset transmission/reception signal circuit (B Type)

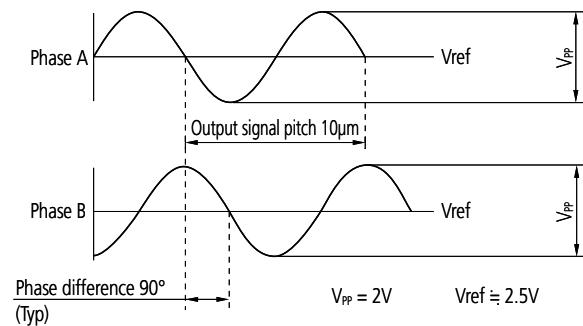


Reset input

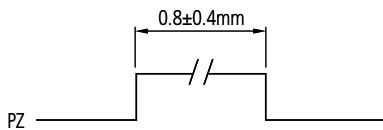
Connect the alarm reset input circuit so that the current is 3 to 10mA. Also, the device has an internal resistor (1.2kΩ), so by applying 5 to 12V with a pulse width of at least 10ms across AL (anode)-AL (cathode), the alarm can be reset. When applying 12V or more, add an external resistance to limit the current to within the range stated above.

Output signal waveform

- 2-phase sinusoidal signals (Type C)

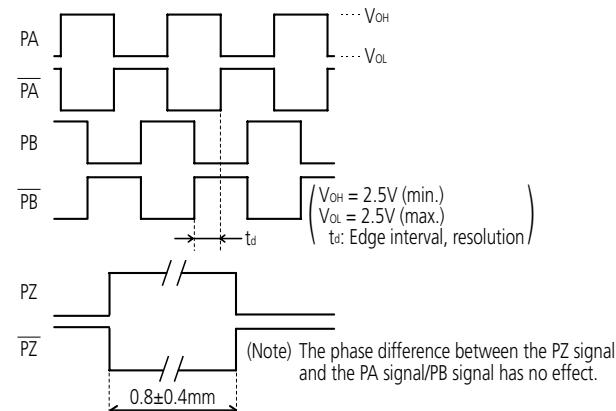


- Scale reference point

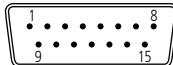


(Note) The phase difference between the PZ signal and the Phase A signal (and the Phase B signal) are not defined.

- 2-phase square wave signals (Type B, C)



Output specification



Output connector specification

- Output connector (pin type): RDAD-15P-LNA(05) (Hirose Electric or equivalent)
- Suitable (standard accessory): D15-403N-110 (Technical Electron or equivalent)

| Pin No. | Type B Signal | Type C Signal |
|---------|-----------------------------|-----------------------------|
| 1 | 0V (GND) | 0V (GND) |
| 2 | 0V (GND) | 0V (GND) |
| 3 | +5V | +5V |
| 4 | +5V | +5V |
| 5 | Reset input (anode) | Phase A |
| 6 | Reset input (cathode) | Phase B |
| 7 | V _{ref} | V _{ref} |
| 8 | PZ | PZ |
| 9 | ALM (alarm, negative logic) | ALM (alarm, negative logic) |
| 10 | PA | PA |
| 11 | PA | PA |
| 12 | PB | PB |
| 13 | PB | PB |
| 14 | PZ | PZ |
| 15 | F.G | F.G |

Specification Selection Method

How to read the code

ST24 [] - [] [] [] [] - [] [] [] - [] - []

Signal output

| Code | Output |
|------|---|
| B | Square wave signal + external reset input |
| C | Sinusoidal signal + Square wave signal |

Effective range

| Code | Effective range (mm) | Code | Effective range (mm) |
|------|----------------------|------|----------------------|
| 0010 | 10 | 0900 | 900 |
| 0025 | 25 | 1000 | 1000 |
| 0050 | 50 | 1100 | 1100 |
| 0075 | 75 | 1200 | 1200 |
| 0080 | 80 | 1300 | 1300 |
| 0100 | 100 | 1400 | 1400 |
| 0150 | 150 | 1500 | 1500 |
| 0200 | 200 | 1600 | 1600 |
| 0250 | 250 | 1700 | 1700 |
| 0300 | 300 | 1800 | 1800 |
| 0350 | 350 | 2000 | 2000 |
| 0400 | 400 | 2200 | 2200 |
| 0450 | 450 | 2400 | 2400 |
| 0500 | 500 | 2500 | 2500 |
| 0600 | 600 | 2600 | 2600 |
| 0700 | 700 | 2800 | 2800 |
| 0800 | 800 | 3000 | 3000 |

Note: For the standard specification, the indicated effective range depends on the product code.

Example of standard specification

Effective range 10mm: ST24□-0010

Effective range 250mm: ST24□-0250

Scale reference point

| Code | Details |
|------|--------------------------------|
| ●A | 50mm pitch (100 to 3000) |
| ○B | Center point (10 to 3000) |
| Z | Special position specification |

Note: For reference positions in the effective range of 10 to 80mm, [B: Center point] is the standard specification.

Scale shape

| Code | Detail - Cross-section (Effective range) |
|------|---|
| ●A | Glass, separate: t4.8 x w22 (100 to 3000mm) |
| ●B | Glass, separate: t2.8 x w8 (10 to 80mm) |
| C | With aluminum base: t5.1 x w23 (10 to 80mm) |

- There is an extensive selection of specifications for the ST24.
 - Choose the appropriate numbers and letters below according to specification required.
- If standard specifications (recommended items marked with ●/○ symbols below) meet your requirements, please use the code numbers shown on page 16 to order.

Special codes

| Code | Details |
|-------|----------------------------------|
| ●None | Standard selection specification |
| Z | Special specification |

Note: If there are special details, please select Z.

Head cable length

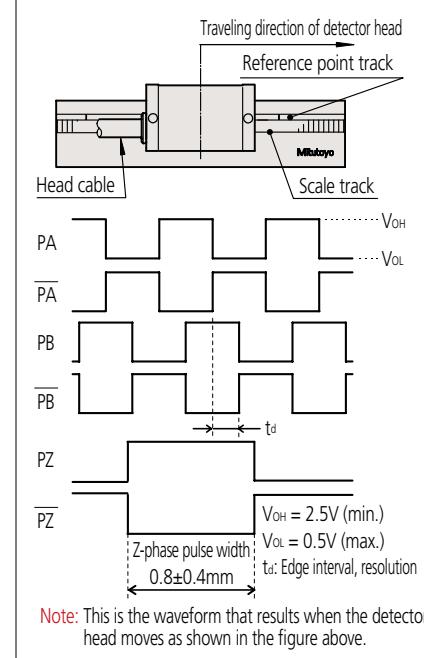
| Code | Length |
|------|--|
| ●A | 1m |
| B | 0.5m |
| Z | Special length specification (max. 2.5m) |

Alarm output

| Code | Details |
|------|----------------|
| ●S | Alarm signal |
| H | High impedance |

Direction

| Code | Details |
|------|------------------------|
| ●1 | Normal: PA goes ahead |
| 2 | Reverse: PB goes ahead |



Note: This is the waveform that results when the detector head moves as shown in the figure above.

Resolution / Minimum edge interval

| Resolution | 125ns | 250ns | 500ns | 1000ns |
|------------|--|-------------|-------------|------------|
| 0.05μm | A: 360mm/s | B: 180mm/s | C: 90mm/s | D: 45mm/s |
| 0.1μm | E: 720mm/s | F: 360mm/s | G: 180mm/s | H: 90mm/s |
| 0.5μm | J: 1200mm/s | K: 1200mm/s | L: 900mm/s | M: 450mm/s |
| 1 μm | N: 1200mm/s | P: 1200mm/s | Q: 1200mm/s | R: 900mm/s |
| — | — | — | — | — |
| | ○Z: When [Signal output] is [A][D], maximum response speed at sine wave -3 dB attenuation is 1200mm/s. | | | |

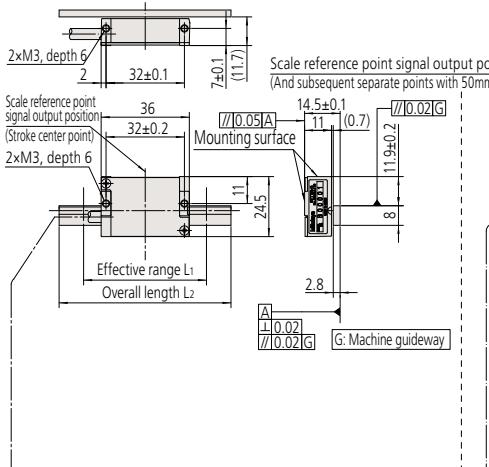
Note: The minimum edge interval varies 0 to -10% based on the operating environmental conditions.

Mounting dimensions

ST24 Specifications

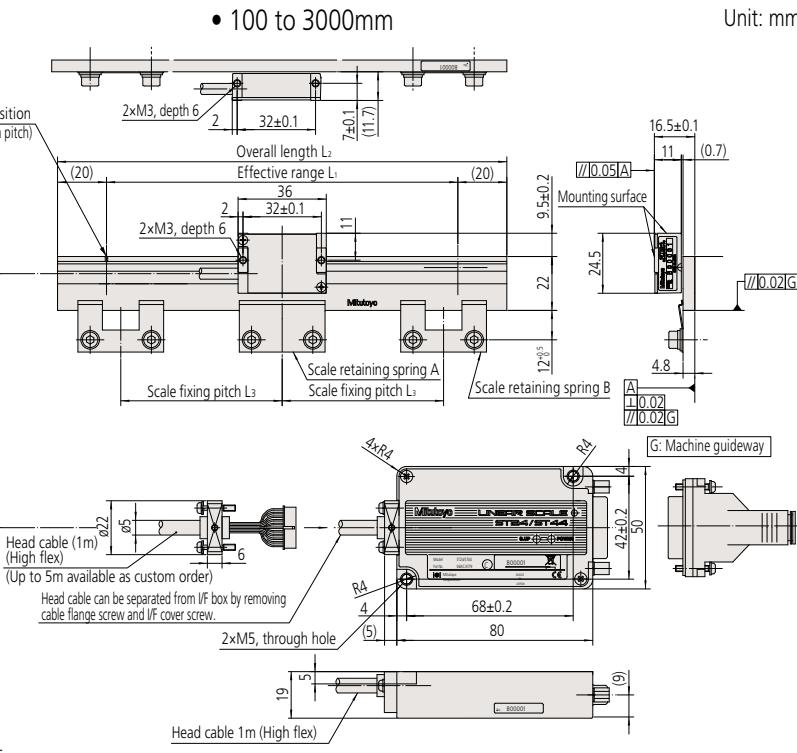
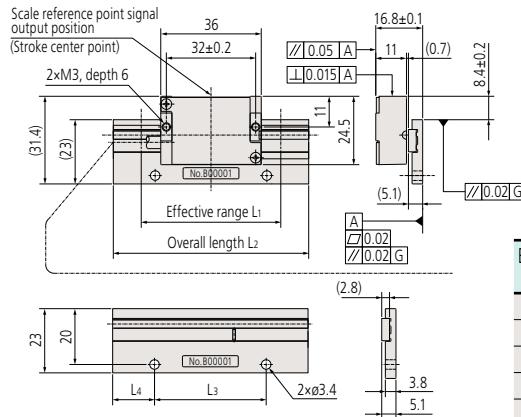
ST24 Mounting dimensions

- 10 to 80mm (Adhesive fixing type) *

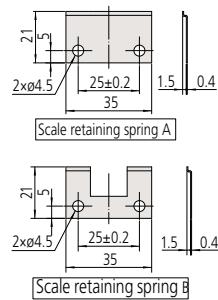


*For information on fixing methods for adhesive fixing type, see "Handling linear scales: Mounting scales" on page 82.

- 10 to 80mm (With base) Special Specification



| Effective range L ₁ (mm) | Overall length L ₂ (mm) | Scale fixing pitch L ₃ (mm) | L ₄ (mm) |
|-------------------------------------|------------------------------------|--|---------------------|
| 10 | 30 | 15 | 7.5 |
| 25 | 45 | 25 | 10 |
| 50 | 70 | 40 | 15 |
| 75 | 90 | 60 | 15 |
| 80 | 100 | 70 | 15 |



Dimensions of scale units

| Order No. * | Code* | Effective range L ₁ (mm) | Overall length L ₂ (mm) | Scale fixing pitch L ₃ (mm) | Retaining spring A | Retaining spring B |
|-------------|-----------|-------------------------------------|------------------------------------|--|--------------------|--------------------|
| 579-551-0□ | ST24◇- 10 | 10 | 30 | - | - | - |
| 579-552-0□ | ST24◇- 25 | 25 | 45 | - | - | - |
| 579-553-0□ | ST24◇- 50 | 50 | 70 | - | - | - |
| 579-554-0□ | ST24◇- 75 | 75 | 90 | - | - | - |
| 579-555-0□ | ST24◇- 80 | 80 | 100 | - | - | - |
| 579-556-0□ | ST24◇-100 | 100 | 140 | 50 | 1 pc. | 2 pcs. |
| 579-557-0□ | ST24◇-150 | 150 | 190 | 75 | 1 pc. | 2 pcs. |
| 579-558-0□ | ST24◇-200 | 200 | 240 | 100 | 1 pc. | 2 pcs. |
| 579-559-0□ | ST24◇-250 | 250 | 290 | 60 | 1 pc. | 4 pcs. |
| 579-560-0□ | ST24◇-300 | 300 | 340 | 75 | 1 pc. | 4 pcs. |
| 579-561-0□ | ST24◇-350 | 350 | 390 | 85 | 1 pc. | 4 pcs. |
| 579-562-0□ | ST24◇-400 | 400 | 440 | 100 | 1 pc. | 4 pcs. |
| 579-563-0□ | ST24◇-450 | 450 | 490 | 75 | 1 pc. | 6 pcs. |
| 579-564-0□ | ST24◇-500 | 500 | 540 | 80 | 1 pc. | 6 pcs. |
| 579-565-0□ | ST24◇-600 | 600 | 640 | 100 | 1 pc. | 6 pcs. |
| 579-566-0□ | ST24◇-700 | 700 | 740 | 85 | 1 pc. | 8 pcs. |
| 579-567-0□ | ST24◇-800 | 800 | 840 | 100 | 1 pc. | 8 pcs. |

*The □ and ◇ symbols in the tables above have the following meanings:

◇→B (2-phase square wave signals + external reset input) : □→2

◇→C (2-phase sinusoidal signals + 2-phase square wave signals) : □→3

| Order No. * | Code* | Effective range L ₁ (mm) | Overall length L ₂ (mm) | Scale fixing pitch L ₃ (mm) | Retaining spring A | Retaining spring B |
|-------------|------------|-------------------------------------|------------------------------------|--|--------------------|--------------------|
| 579-568-0□ | ST24◇- 900 | 900 | 940 | 90 | 1 pc. | 10 pcs. |
| 579-569-0□ | ST24◇-1000 | 1000 | 1040 | 100 | 1 pc. | 10 pcs. |
| 579-570-0□ | ST24◇-1100 | 1100 | 1140 | 90 | 1 pc. | 12 pcs. |
| 579-571-0□ | ST24◇-1200 | 1200 | 1240 | 100 | 1 pc. | 12 pcs. |
| 579-572-0□ | ST24◇-1300 | 1300 | 1340 | 130 | 1 pc. | 10 pcs. |
| 579-573-0□ | ST24◇-1400 | 1400 | 1440 | 100 | 1 pc. | 14 pcs. |
| 579-574-0□ | ST24◇-1500 | 1500 | 1540 | 125 | 1 pc. | 12 pcs. |
| 579-575-0□ | ST24◇-1600 | 1600 | 1640 | 100 | 1 pc. | 16 pcs. |
| 579-576-0□ | ST24◇-1700 | 1700 | 1740 | 120 | 1 pc. | 14 pcs. |
| 579-577-0□ | ST24◇-1800 | 1800 | 1840 | 100 | 1 pc. | 18 pcs. |
| 579-578-0□ | ST24◇-2000 | 2000 | 2040 | 100 | 1 pc. | 20 pcs. |
| 579-579-0□ | ST24◇-2200 | 2200 | 2240 | 100 | 1 pc. | 22 pcs. |
| 579-580-0□ | ST24◇-2400 | 2400 | 2440 | 100 | 1 pc. | 24 pcs. |
| 579-581-0□ | ST24◇-2500 | 2500 | 2540 | 95 | 1 pc. | 26 pcs. |
| 579-582-0□ | ST24◇-2600 | 2600 | 2640 | 100 | 1 pc. | 26 pcs. |
| 579-583-0□ | ST24◇-2800 | 2800 | 2840 | 100 | 1 pc. | 28 pcs. |
| 579-584-0□ | ST24◇-3000 | 3000 | 3040 | 100 | 1 pc. | 30 pcs. |

Separate Type ST Series

Sinusoidal signal & Square-Wave Signal Output Scale Unit (Compact Type)

ST46-EZA

Features

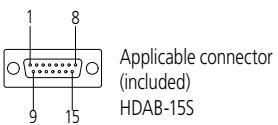
- Ultra-compact, high-accuracy separate type linear scale great for applications where space is limited.
- Detector head mounting and signal adjustment possible without oscilloscope. Setup indicator for checking signal strength. Auto-tuning function activated by push switch.
- I/F circuit integrated in connector shell reduces volume to 60% compared to conventional interface.
- Self-diagnosis function with USB connectivity facilitates signal strength checking and parameter setup.
- Can be used for metal tape scale manufacture.

Specifications

| Item | Code | ST46-EZA |
|--------------------------------|------|---|
| Detection method | | Reflective photoelectric linear encoder |
| Scale specifications | | Grating pitch: 20µm, Material: glass |
| Main scale grating pitch | | 20µm |
| Output signal | | Type B: 2-phase square wave signals, reference point pulse, external reset input Type C: 2-phase square wave signals, reference point pulse, 2-phase sinusoidal signals |
| Effective range | | 10 to 3000mm |
| Accuracy (20°C) | | Effective range 10 to 300mm: $\pm 1\mu\text{m}$ Effective range 350 to 500mm: $\pm 2\mu\text{m}$ Effective range 600 to 1000mm: $\pm 3\mu\text{m}$ Effective range 1100 to 3000mm: $\pm 3\mu\text{m}/\text{m}$ |
| Thermal expansion coefficient | | $(8\pm 1) \times 10^{-6}/^\circ\text{C}$ |
| Scale reference point | | With scale reference point (50mm pitch, 10 to 80mm: Center point) |
| Maximum response speed | | 2.6m/s (at sine wave amplitude -3dB) |
| Power supply voltage | | 5VDC $\pm 5\%$ |
| Maximum current consumption | | 250mA |
| Operating temperature/humidity | | 0 to 40°C, 20 to 80%RH (no condensation) |
| Storage temperature/humidity | | -20 to 60°C, 20 to 80%RH (no condensation) |

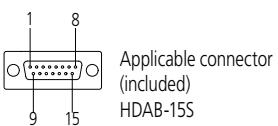
Output specification

- Connector pin assignment (Type B)

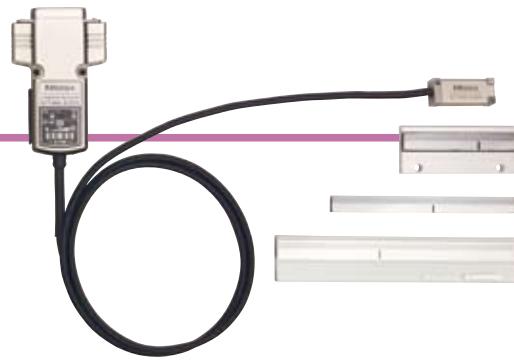


| Pin No. | Signal | Pin No. | Signal |
|---------|---|---------|--|
| 1, 2 | 0V (GND) | 10 | PA (main signal pulse_Normal phase) |
| 3, 4 | +5V (Vcc) | 11 | PA (main signal pulse_Reverse phase) |
| 5 | Reset input AL (anode) | 12 | PB (main signal pulse_Normal phase) |
| 6 | Reset input AL (cathode) | 13 | PB (main signal pulse_Reverse phase) |
| 7 | NC | 14 | PZ (reference point pulse_Reverse phase) |
| 8 | PZ (reference point pulse_Normal phase) | 15 | F. G |
| 9 | ALM (alarm) | | |

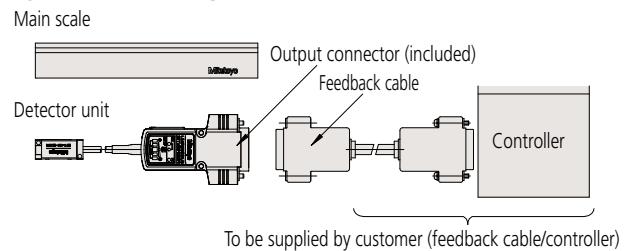
- Connector pin assignment (Type C)



| Pin No. | Signal | Pin No. | Signal |
|---------|---|---------|--|
| 1, 2 | 0V (GND) | 10 | PA (main signal pulse_Normal phase) |
| 3, 4 | +5V (Vcc) | 11 | PA (main signal pulse_Reverse phase) |
| 5 | Phase A (sinusoidal signal) | 12 | PB (main signal pulse_Normal phase) |
| 6 | Phase B (sinusoidal signal) | 13 | PB (main signal pulse_Reverse phase) |
| 7 | Vref ($\frac{1}{2} V_{cc}$) | 14 | PZ (reference point pulse_Reverse phase) |
| 8 | PZ (reference point pulse_Normal phase) | 15 | F. G |
| 9 | ALM (alarm) | | |

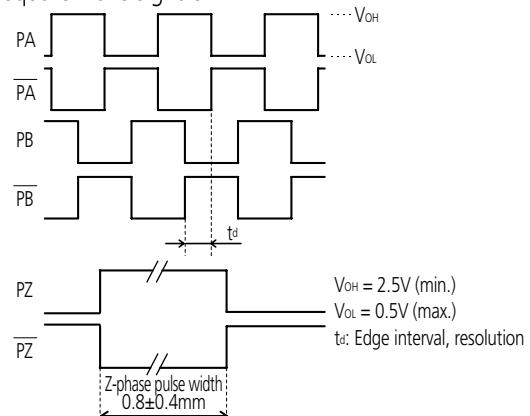


System Configuration

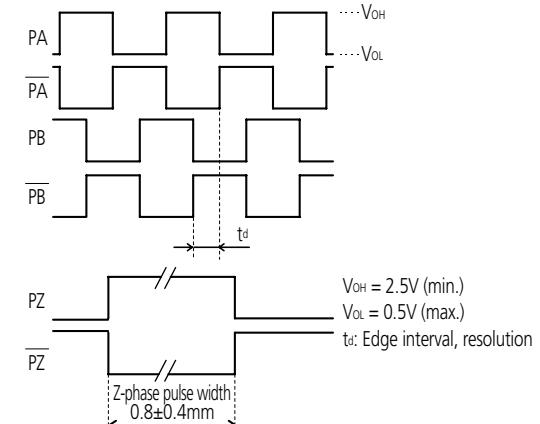
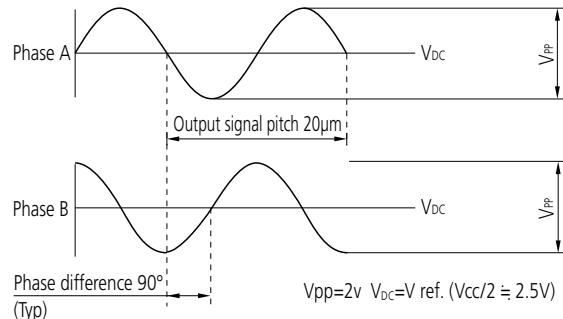


Output signal waveform and specification

- 2-phase square wave signals (Type B)



- 2-phase sinusoidal signals, 2-phase square wave signals (Type C)



Specification Selection Method

- There is an extensive selection of specifications for the ST46-EZA.
 - Choose the appropriate numbers and letters below according to specification required.
- If standard specifications (recommended items marked with ● symbol below) meet your requirements, please order using the code numbers shown on pages 19 - 20.

How to read the code

ST46-EZA



Signal output

| Code | Details |
|------|---|
| B | Square wave signal + external reset input |
| C | Sinusoidal signal + Square wave signal |

Effective range

| Code | Effective range (mm) | Code | Effective range (mm) | Code | Effective range (mm) |
|------|----------------------|------|----------------------|------|----------------------|
| 0010 | 10 | 0450 | 450 | 1600 | 1600 |
| 0025 | 25 | 0500 | 500 | 1700 | 1700 |
| 0050 | 50 | 0600 | 600 | 1800 | 1800 |
| 0075 | 75 | 0700 | 700 | 2000 | 2000 |
| 0080 | 80 | 0800 | 800 | 2200 | 2200 |
| 0100 | 100 | 0900 | 900 | 2400 | 2400 |
| 0150 | 150 | 1000 | 1000 | 2500 | |
| 0200 | 200 | 1100 | 1100 | 2600 | |
| 0250 | 250 | 1200 | 1200 | 2800 | |
| 0300 | 300 | 1300 | 1300 | 3000 | |
| 0350 | 350 | 1400 | 1400 | | |
| 0400 | 400 | 1500 | 1500 | | |

Note: For the standard specification, the indicated effective range depends on the product code.

Example of standard specification

Effective range 10mm: **ST46EZA□-0010**

Effective range 250mm: **ST46EZA□-0250**

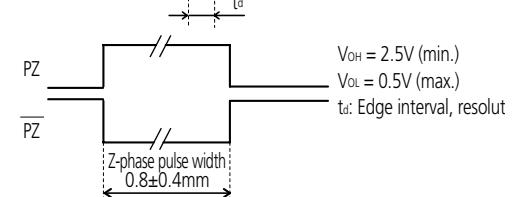
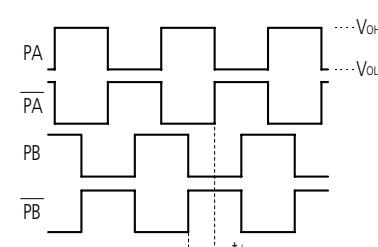
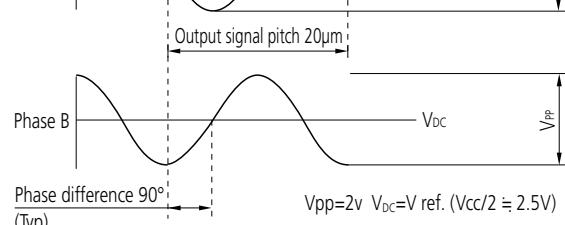
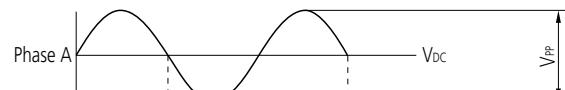
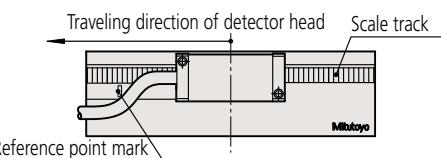
Reference point/ Scale shape

| Code | Details (Effective range) | Details - Cross-section (Effective range) |
|------|--------------------------------|---|
| ●A | 50mm pitch (100 to 3000mm) | Glass, separate: t4.8 x w22 (100 to 3000mm) |
| ●B | Center point (10 to 80mm) | Glass, separate: t2.8 x w8 (10 to 80mm) |
| ●C | Center point (10 to 80mm) | With aluminum base: t5.1 x w23 (10 to 80mm) |
| Z | Special position specification | Special shape |

Resolution / Minimum edge interval

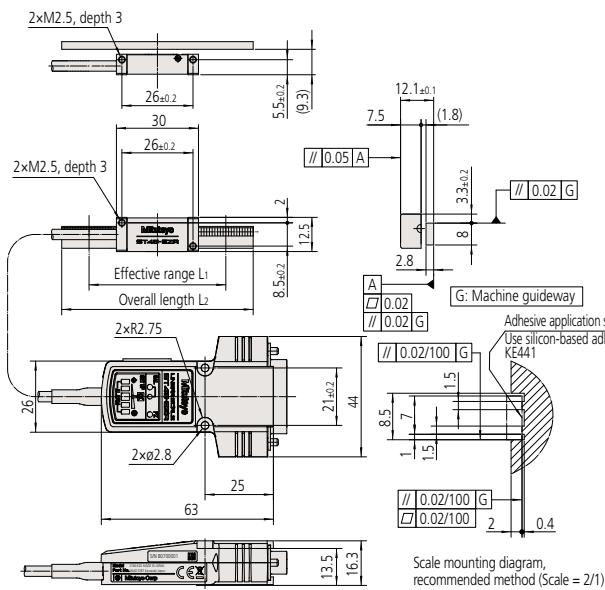
| Code | Resolution | Minimum edge interval | Maximum response speed |
|------|------------|-----------------------|------------------------|
| A | 0.05 μm | 100 ns | 450 mm/s |
| B | | 200 ns | 225 mm/s |
| C | | 400 ns | 112 mm/s |
| D | | 800 ns | 56 mm/s |
| E | 0.1 μm | 100 ns | 900 mm/s |
| ●F | | 200 ns | 450 mm/s |
| G | | 400 ns | 225 mm/s |
| H | | 800 ns | 112 mm/s |
| J | 0.5 μm | 100 ns | 2600 mm/s |
| K | | 200 ns | 2250 mm/s |
| L | | 400 ns | 1125 mm/s |
| M | | 800 ns | 562 mm/s |
| N | 1 μm | 100 ns | 2600 mm/s |
| P | | 200 ns | 2600 mm/s |
| Q | | 400 ns | 2250 mm/s |
| R | | 800 ns | 1125 mm/s |
| S | 5 μm | 100 ns | 2600 mm/s |
| T | | 200 ns | 2600 mm/s |
| U | | 400 ns | 2600 mm/s |
| V | | 800 ns | 2600 mm/s |

When the direction is normal, the sinusoidal signal, the 2-phase square wave output signal (Phase A, Phase B) and the reference point signal waveform are as shown below.



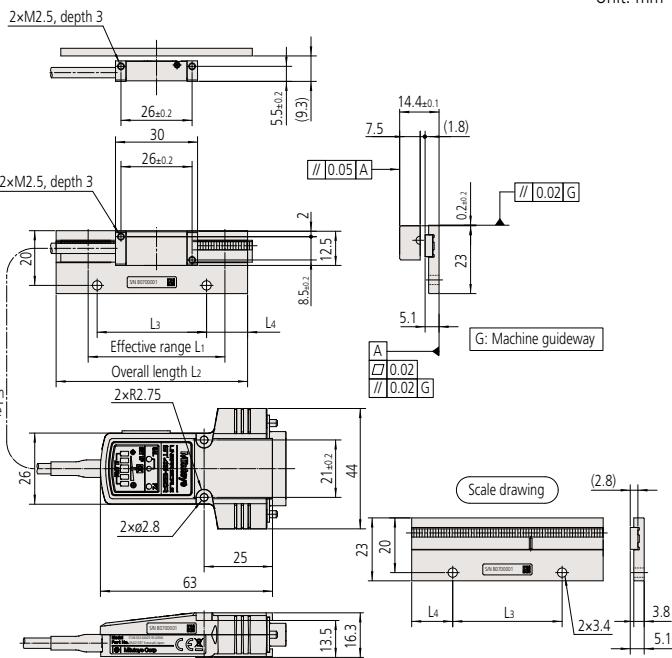
ST46-EZA Scale unit mounting dimensions

- Effective range 10 to 80mm (No aluminum base)



- Effective range 10 to 80mm (With aluminum base)

Unit: mm



Dimensions of scale units

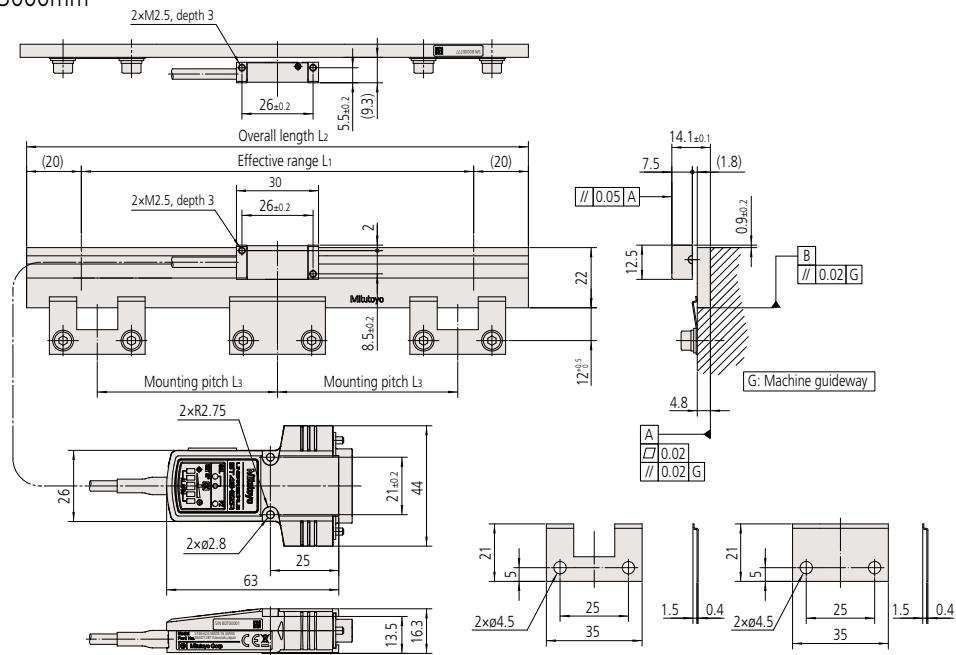
- 10 to 80mm (No aluminum base)

| Order No. | Code | Effective range L ₁ (mm) | Overall length L ₂ (mm) |
|------------|--------------|-------------------------------------|------------------------------------|
| 579-665-12 | ST46EZAB-10B | 10 | 30 |
| 579-666-12 | ST46EZAB-25B | 25 | 45 |
| 579-667-12 | ST46EZAB-50B | 50 | 70 |
| 579-668-12 | ST46EZAB-75B | 75 | 90 |
| 579-669-12 | ST46EZAB-80B | 80 | 100 |
| 579-665-22 | ST46EZAC-10B | 10 | 30 |
| 579-666-22 | ST46EZAC-25B | 25 | 45 |
| 579-667-22 | ST46EZAC-50B | 50 | 70 |
| 579-668-22 | ST46EZAC-75B | 75 | 90 |
| 579-669-22 | ST46EZAC-80B | 80 | 100 |

- 10 to 80 mm (With aluminum base)

| Order No. | Code | Effective range L ₁ (mm) | Overall length L ₂ (mm) | L ₃ (mm) | L ₄ (mm) |
|------------|--------------|-------------------------------------|------------------------------------|---------------------|---------------------|
| 579-665-13 | ST46EZAB-10C | 10 | 30 | 15 | 7.5 |
| 579-666-13 | ST46EZAB-25C | 25 | 45 | 25 | 10 |
| 579-667-13 | ST46EZAB-50C | 50 | 70 | 40 | 15 |
| 579-668-13 | ST46EZAB-75C | 75 | 90 | 60 | 15 |
| 579-669-13 | ST46EZAB-80C | 80 | 100 | 70 | 15 |
| 579-665-23 | ST46EZAC-10C | 10 | 30 | 15 | 7.5 |
| 579-666-23 | ST46EZAC-25C | 25 | 45 | 25 | 10 |
| 579-667-23 | ST46EZAC-50C | 50 | 70 | 40 | 15 |
| 579-668-23 | ST46EZAC-75C | 75 | 90 | 60 | 15 |
| 579-669-23 | ST46EZAC-80C | 80 | 100 | 70 | 15 |

- Effective range 100 to 3000mm



Dimensions of scale units

| Order No.* | Code* | Effective range L ₁ (mm) | Overall length L ₂ (mm) | Scale fixing pitch L ₃ (mm) | Scale retaining spring A (pcs.) | Scale retaining spring B (pcs.) |
|------------|----------------|---|--|--|---------------------------------------|---------------------------------------|
| 579-670-□1 | ST46EZA◇- 100A | 100 | 140 | 50 | | 2 |
| 579-671-□1 | ST46EZA◇- 150A | 150 | 190 | 75 | | 2 |
| 579-672-□1 | ST46EZA◇- 200A | 200 | 240 | 100 | | 2 |
| 579-673-□1 | ST46EZA◇- 250A | 250 | 290 | 60 | | 4 |
| 579-674-□1 | ST46EZA◇- 300A | 300 | 340 | 75 | | 4 |
| 579-675-□1 | ST46EZA◇- 350A | 350 | 390 | 85 | | 4 |
| 579-676-□1 | ST46EZA◇- 400A | 400 | 440 | 100 | | 4 |
| 579-677-□1 | ST46EZA◇- 450A | 450 | 490 | 75 | | 6 |
| 579-678-□1 | ST46EZA◇- 500A | 500 | 540 | 80 | | 6 |
| 579-679-□1 | ST46EZA◇- 600A | 600 | 640 | 100 | | 6 |
| 579-680-□1 | ST46EZA◇- 700A | 700 | 740 | 85 | | 8 |
| 579-681-□1 | ST46EZA◇- 800A | 800 | 840 | 100 | | 8 |
| 579-682-□1 | ST46EZA◇- 900A | 900 | 940 | 90 | | 10 |
| 579-683-□1 | ST46EZA◇-1000A | 1000 | 1040 | 100 | | 10 |
| 579-684-□1 | ST46EZA◇-1100A | 1100 | 1140 | 90 | | 12 |
| 579-685-□1 | ST46EZA◇-1200A | 1200 | 1240 | 100 | | 12 |
| 579-686-□1 | ST46EZA◇-1300A | 1300 | 1340 | 130 | | 10 |
| 579-687-□1 | ST46EZA◇-1400A | 1400 | 1440 | 100 | | 14 |
| 579-688-□1 | ST46EZA◇-1500A | 1500 | 1540 | 125 | | 12 |
| 579-689-□1 | ST46EZA◇-1600A | 1600 | 1640 | 100 | | 16 |
| 579-690-□1 | ST46EZA◇-1700A | 1700 | 1740 | 120 | | 14 |
| 579-691-□1 | ST46EZA◇-1800A | 1800 | 1840 | 100 | | 18 |
| 579-692-□1 | ST46EZA◇-2000A | 2000 | 2040 | 100 | | 20 |
| 579-693-□1 | ST46EZA◇-2200A | 2200 | 2240 | 100 | | 22 |
| 579-694-□1 | ST46EZA◇-2400A | 2400 | 2440 | 100 | | 24 |
| 579-695-□1 | ST46EZA◇-2500A | 2500 | 2540 | 95 | | 26 |
| 579-696-□1 | ST46EZA◇-2600A | 2600 | 2640 | 100 | | 26 |
| 579-697-□1 | ST46EZA◇-2800A | 2800 | 2840 | 100 | | 28 |
| 579-698-□1 | ST46EZA◇-3000A | 3000 | 3040 | 100 | | 30 |

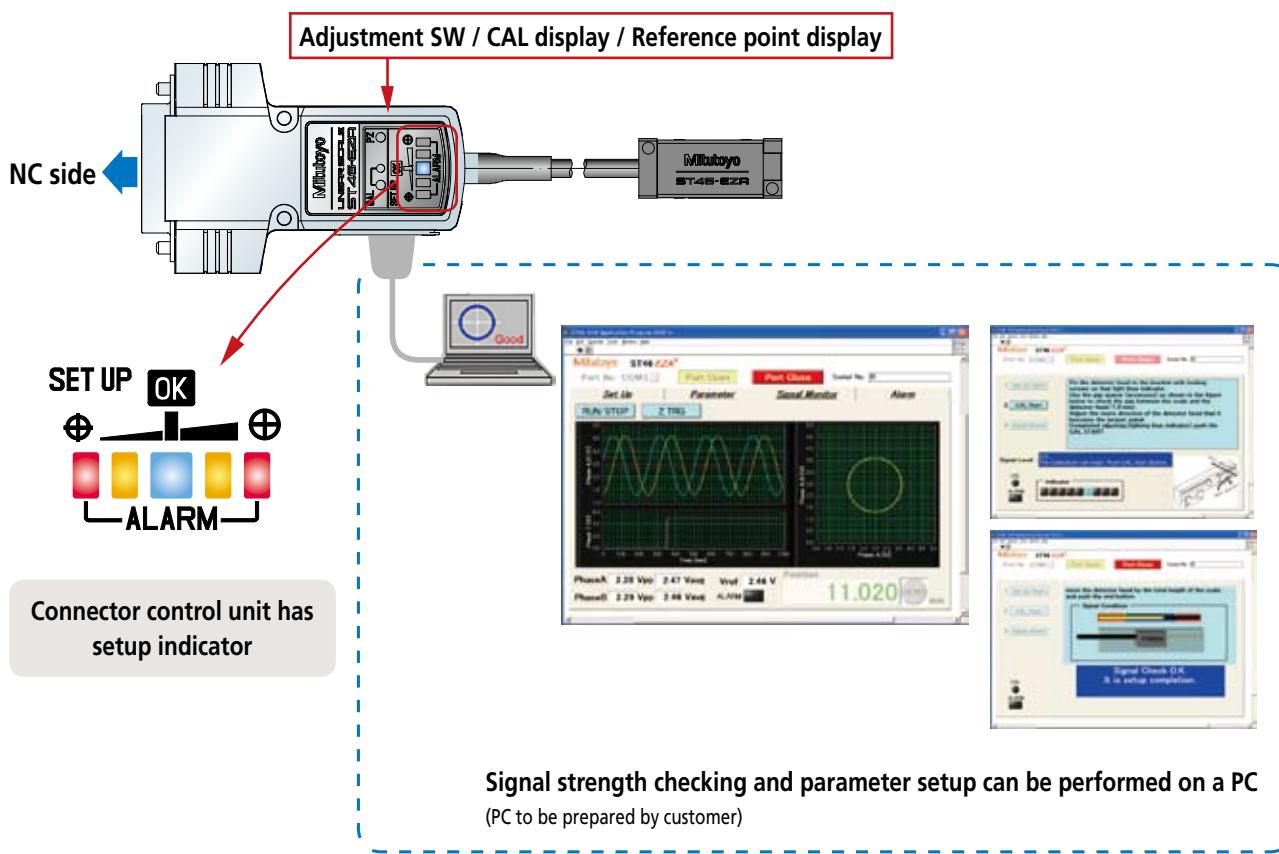
1

* The above code numbers are for recommended items marked with ● symbol. If recommended specifications meet your requirements, please use these code numbers to order.

◇ → B (2-phase square wave signals + external reset input): □→1

◇ → C (2-phase square wave signals + 2-phase sinusoidal signals): □→2

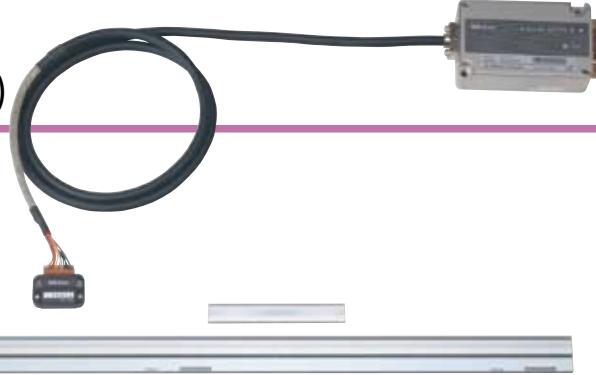
- Application program (Option, Part No.06AEF800)



Separate Type ST Series

Sinusoidal signal & Square wave signal Output Scale Unit (Compact Type)

ST422



Features

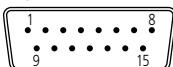
- The maximum response speed is 5000mm/s.
(When resolution is 1μm and the minimum edge interval is 125ns)
- Compact detector unit control unit allow use in applications where space-saving design is important.
- The maximum effective measurement length of 3000mm enables use on large machines.
- LED display function for indicating signal errors.

Specifications

| Item | Code | ST422 |
|--------------------------------|------|--|
| Detection method | | Reflective photoelectric linear encoder |
| Main scale grating pitch | | 40μm |
| Signal output pitch | | 40μm |
| Output signal | | Two 90° phase-shifted sinusoidal signals and two 90° phase-shifted square wave signals, scale reference point signal, alarm signal |
| Effective range | | 10 to 3000mm |
| Accuracy (20°C) | | Effective range 10 to 300mm: ±1.0μm Effective range 350 to 500mm: ±2.0μm Effective range 600 to 1000mm: ±3.0μm Effective range 1100 to 3000mm: ±3.0μm/m |
| Thermal expansion coefficient | | (8±1) x10 ⁻⁶ / °C |
| Maximum response speed | | 5000mm/s (depending on setting) |
| Scale reference point | | With scale reference point (50mm pitch, 10 to 75mm: Center point) |
| Power supply | | 5VDC±5% |
| Maximum current consumption | | 200mA (Max) |
| Operating temperature/humidity | | 0 to 40°C, 20 to 80%RH (no condensation) |
| Storage temperature/humidity | | -20 to 60°C, 20 to 80%RH (no condensation) |
| Alarm indication | | LED illumination on the I/F box |
| Head cable length | | 1m* |

* For high flex type head cable, please contact us.

- I/F box output connector pin assignment

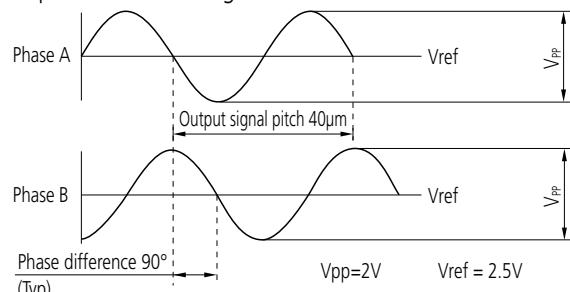


Output connector (pin type): RDAD-15P-LNA(05) (Hirose Electric or equivalent)
Suitable plug (standard accessory): D15-403N-110 (Technical Electron or equivalent)

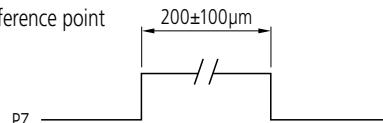
| Pin No. | Signal |
|---------|-----------------------------|
| 1 | 0V (GND) |
| 2 | 0V (GND) |
| 3 | +5V (Vcc) |
| 4 | +5V (Vcc) |
| 5 | Phase A (Sinusoidal signal) |
| 6 | Phase B (Sinusoidal signal) |
| 7 | Vref |
| 8 | PZ (scale reference point) |
| 9 | ALM (alarm, negative logic) |
| 10 | PA |
| 11 | PA |
| 12 | PB |
| 13 | PB |
| 14 | PZ |
| 15 | F. G |

Output signal waveform

- 2-phase sinusoidal signals

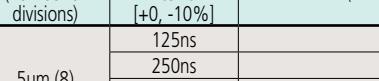
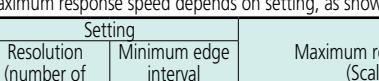
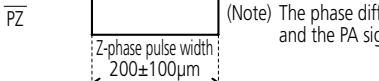
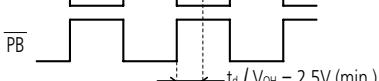
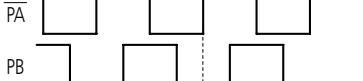
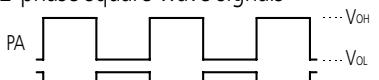


- Scale reference point



(Note) The phase difference between the PZ signal and the Phase A signal (and the Phase B signal) are not defined.

- 2-phase square wave signals



Maximum response speed

Maximum response speed depends on setting, as shown below.

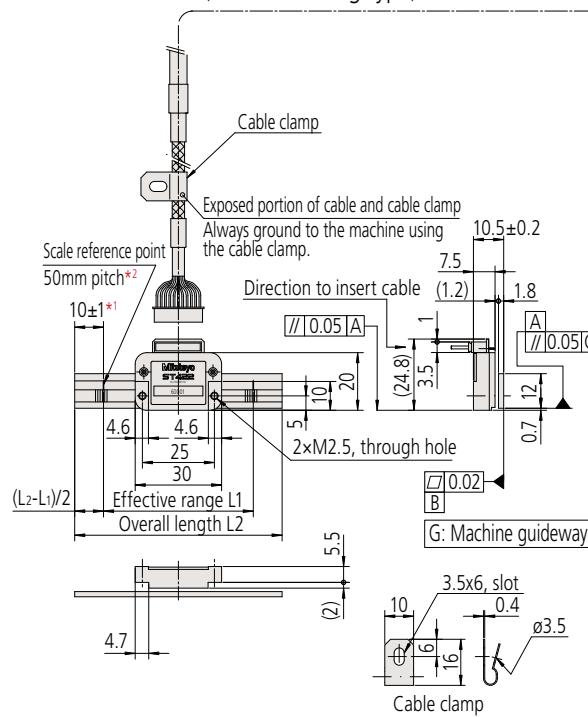
| Setting | | Maximum response speed (mm/s) (Scale pitch: 40μm) |
|-------------------------------------|-------------------------------------|--|
| Resolution (number of divisions) | Minimum edge interval [+0, -10%] | |
| 5μm (8) | 125ns | 5000 |
| | 250ns | 5000 |
| | 500ns | 3600 |
| | 1000ns | 1800 |
| 1μm (40) | 125ns | 5000 |
| | 250ns | 3600 |
| | 500ns | 1800 |
| | 1000ns | 900 |
| 0.5μm (80) | 125ns | 3600 |
| | 250ns | 1800 |
| | 500ns | 900 |
| | 1000ns | 450 |
| 0.2μm (200) | 125ns | 1500 |
| | 250ns | 700 |
| | 500ns | 300 |
| | 1000ns | 150 |

Note: The minimum edge interval varies 0 to -10% based on the operating environmental conditions.

Mitutoyo

ST422 Scale unit mounting dimensions

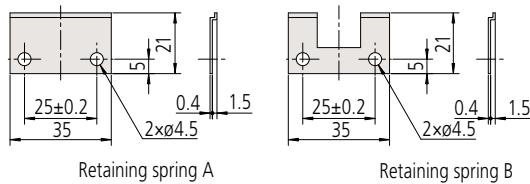
- ST422-10 to 350 (Adhesive fixing type) *3



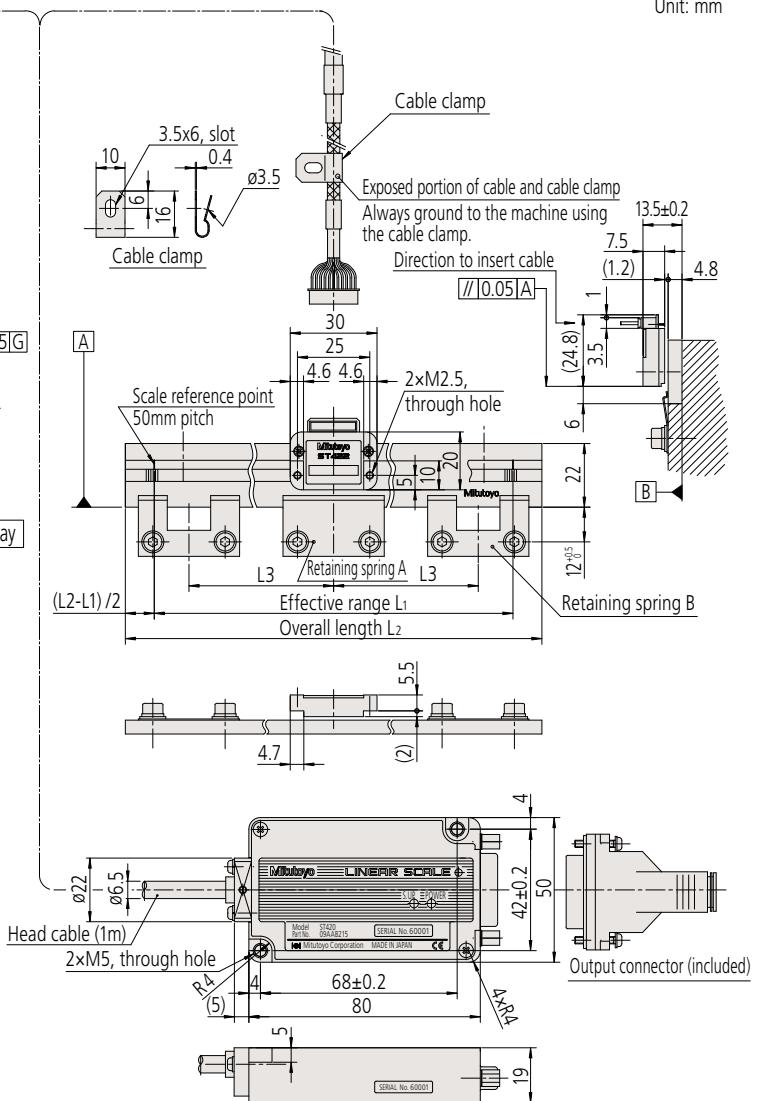
*1 When stroke is 100mm or longer

*2 One center point when stroke is 10 to 75mm

*3 For information on fixing methods for adhesive fixing type, see "Handling linear scales Mounting scales" on page 82



- ST422-400 to 3000



Dimensions of scale units

| Order No. | Code | Effective range L ₁ (mm) | Overall length L ₂ (mm) | Scale fixing pitch L ₃ (mm) | Retaining spring A | Retaining spring B |
|-----------|-----------|-------------------------------------|------------------------------------|--|--------------------|--------------------|
| 579-631 | ST422-10 | 10 | 30 | — | — | — |
| 579-632 | ST422-25 | 25 | 45 | — | — | — |
| 579-633 | ST422-50 | 50 | 70 | — | — | — |
| 579-634 | ST422-75 | 75 | 95 | — | — | — |
| 579-635 | ST422-100 | 100 | 120 | — | — | — |
| 579-636 | ST422-150 | 150 | 170 | — | — | — |
| 579-637 | ST422-200 | 200 | 220 | — | — | — |
| 579-638 | ST422-250 | 250 | 270 | — | — | — |
| 579-639 | ST422-300 | 300 | 320 | — | — | — |
| 579-640 | ST422-350 | 350 | 370 | — | — | — |
| 579-641 | ST422-400 | 400 | 440 | 100 | 1 pc. | 4 pcs. |
| 579-642 | ST422-450 | 450 | 490 | 75 | 1 pc. | 6 pcs. |
| 579-643 | ST422-500 | 500 | 540 | 80 | 1 pc. | 6 pcs. |
| 579-644 | ST422-600 | 600 | 640 | 100 | 1 pc. | 6 pcs. |
| 579-645 | ST422-700 | 700 | 740 | 85 | 1 pc. | 8 pcs. |
| 579-646 | ST422-800 | 800 | 840 | 100 | 1 pc. | 8 pcs. |
| 579-647 | ST422-900 | 900 | 940 | 90 | 1 pc. | 10 pcs. |

| Order No. | Code | Effective range L ₁ (mm) | Overall length L ₂ (mm) | Scale fixing pitch L ₃ (mm) | Retaining spring A | Retaining spring B |
|-----------|------------|-------------------------------------|------------------------------------|--|--------------------|--------------------|
| 579-648 | ST422-1000 | 1000 | 1040 | 100 | 1 pc. | 10 pcs. |
| 579-649 | ST422-1100 | 1100 | 1140 | 90 | 1 pc. | 12 pcs. |
| 579-650 | ST422-1200 | 1200 | 1240 | 100 | 1 pc. | 12 pcs. |
| 579-651 | ST422-1300 | 1300 | 1340 | 130 | 1 pc. | 10 pcs. |
| 579-652 | ST422-1400 | 1400 | 1440 | 100 | 1 pc. | 14 pcs. |
| 579-653 | ST422-1500 | 1500 | 1540 | 125 | 1 pc. | 12 pcs. |
| 579-654 | ST422-1600 | 1600 | 1640 | 100 | 1 pc. | 16 pcs. |
| 579-655 | ST422-1700 | 1700 | 1740 | 120 | 1 pc. | 14 pcs. |
| 579-656 | ST422-1800 | 1800 | 1840 | 100 | 1 pc. | 18 pcs. |
| 579-657 | ST422-2000 | 2000 | 2040 | 100 | 1 pc. | 20 pcs. |
| 579-658 | ST422-2200 | 2200 | 2240 | 100 | 1 pc. | 22 pcs. |
| 579-659 | ST422-2400 | 2400 | 2440 | 100 | 1 pc. | 24 pcs. |
| 579-660 | ST422-2500 | 2500 | 2540 | 95 | 1 pc. | 26 pcs. |
| 579-661 | ST422-2600 | 2600 | 2640 | 100 | 1 pc. | 26 pcs. |
| 579-662 | ST422-2800 | 2800 | 2840 | 100 | 1 pc. | 28 pcs. |
| 579-663 | ST422-3000 | 3000 | 3040 | 100 | 1 pc. | 30 pcs. |

Assembly Type AT Series

Sinusoidal signal Output Type Scale Unit

AT100 Series



Specifications

| Item | Code | AT103 | AT113 | AT112-F | AT181 |
|--|--|----------|------------------|--------------|-------|
| Detection method | Photoelectric type transmission linear encoder Light source: Light-emitting diode Light-receiving element: Phototransistor (Photodiode for AT112-F only) | | | | |
| Output | Two 90° phase-shifted sinusoidal signals | | | | |
| Main scale grating pitch | 20μm | | | | |
| Signal output pitch | 20μm | | | | |
| Maximum effective measurement length | 6000mm | 1500mm | 1020mm | 600mm | |
| Accuracy (20°C)*1 | (5+5L ₀ /1000) μm, L ₀ : Effective range (mm)*2 | | | | |
| Maximum response speed*3 | 120m/min*4 | 120m/min | 50m/min | | |
| Scale reference point | With scale reference point (50mm pitch) | | | | |
| Main scale thermal expansion coefficient | (8±1)×10 ⁻⁶ / °C | | | | |
| Power supply voltage | 5VDC±5% | | | | |
| Maximum current consumption | 70mA | 60mA | 70mA | | |
| Operating/storage temperature | 0 to 45°C-20°C to 70°C | | | | |
| Operating/storage humidity (relative humidity) | 20 to 80%RH (no condensation) | | | | |
| Head cable length | None | 0.3m | | None | |
| Protection rating | IP53 | | | | |
| Sliding force | 5N max. | | | | |
| Signal cable *5 | Standard accessory (The length is shown in the dimension chart for each type) | | | | |
| Extension cable (sold separately) *5 | | Length | Part No. | Remarks | |
| | | 2m | 09AAA033A | | |
| | | 5m | 09AAA033B | Conduit type | |
| | | 7m | 09AAA033C | | |

*1 Depending on the model, we also have high-accuracy types available. (See notes in the scale unit dimension chart.)

*2 For AT103-3250 and above, this is (5+8L₀/1000) μm. For AT112-F, this is (3+3L₀/1000) μm. L₀: mm

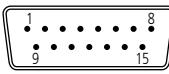
*3 Depends on the control unit electrical unit to which it is connected.

*4 For AT103-3250 and above, this is 50m/min.

*5 PVC sheathed signal cables and extension cables will be made to order.

Output specification

Output connector (pin type)



Applicable plug

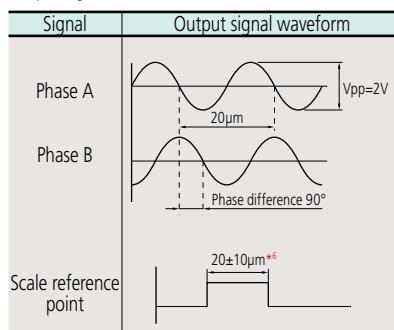
DA-15S-NR(JAE) or equivalent

| Pin No. | Signal |
|---------|-----------------------|
| 1 | 0V |
| 2 | 0V |
| 3 | +5V |
| 4 | +5V |
| 5 | Phase A |
| 6 | Phase B |
| 7 | Standard voltage |
| 8 | Scale reference point |
| 9 | ALM (Alarm) |
| 10 - 14 | Not used |
| 15 | F. G |

In the AT112-F series, Pin No. 9 is not used.

Common specification

Output signal waveform

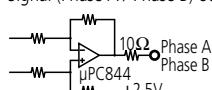


*6 The reference point signal for AT103 and AT113 is "70μm±10μm".

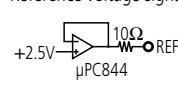
Output signal

Signal output circuit

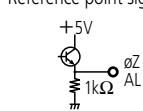
Signal (Phase A / Phase B) output circuit



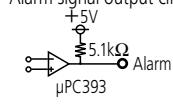
Reference voltage signal (REF) output circuit



Reference point signal (øZ) output circuit



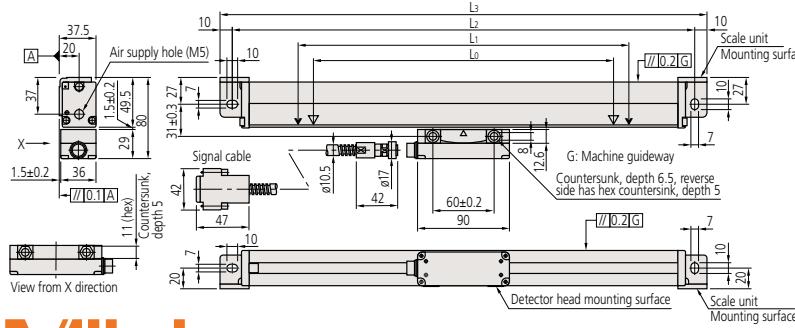
Alarm signal output circuit



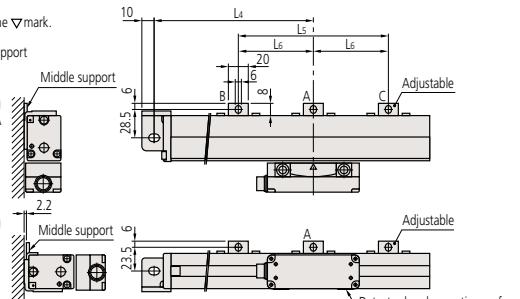
Mounting dimensions (Effective range:100 to 3000mm)

AT103 (Standard type)

The scale reference points are output at a 50mm pitch from the end of the effective range (L₀), which is shown with the △ mark.



Unit: mm



Mitutoyo

- Dimensions L4, L5, and L6 indicate the recommended mounting positions for the middle supports included with scale units with an effective range of 1000mm and more. (The position of the middle support is adjustable in the measuring length direction.)

| Effective range (mm) | Middle support |
|----------------------|----------------|
| 1000 - 1500 | (1 place) |
| 1600 - 2200 | BC (2 places) |
| 2400 - 3000 | ABC (3 places) |

Dimensions of scale units

| AT103 | | Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Mounting hole pitch L_2 (mm) | Overall length L_3 (mm) | Middle support L_4 (mm) | Middle support L_5 (mm) | Middle support L_6 (mm) | Signal cable length (m) |
|------------|------------|-------------------------------|-------------------------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------|
| Order No. | Code | | | | | | | | |
| 539-111-30 | AT103- 100 | 100 | 120 | 248 | 268 | | | | |
| 539-112-30 | AT103- 150 | 150 | 170 | 298 | 318 | | | | |
| 539-113-30 | AT103- 200 | 200 | 220 | 348 | 368 | | | | |
| 539-114-30 | AT103- 250 | 250 | 270 | 398 | 418 | | | | |
| 539-115-30 | AT103- 300 | 300 | 330 | 458 | 478 | | | | |
| 539-116-30 | AT103- 350 | 350 | 380 | 508 | 528 | | | | |
| 539-117-30 | AT103- 400 | 400 | 430 | 558 | 578 | | | | |
| 539-118-30 | AT103- 450 | 450 | 480 | 608 | 628 | | | | |
| 539-119-30 | AT103- 500 | 500 | 540 | 668 | 688 | | | | |
| 539-121-30 | AT103- 600 | 600 | 650 | 778 | 798 | | | | |
| 539-123-30 | AT103- 700 | 700 | 760 | 888 | 908 | | | | |
| 539-124-30 | AT103- 750 | 750 | 810 | 938 | 958 | | | | |
| 539-125-30 | AT103- 800 | 800 | 860 | 988 | 1008 | | | | |
| 539-126-30 | AT103- 900 | 900 | 960 | 1088 | 1108 | | | | |
| 539-127-30 | AT103-1000 | 1000 | 1060 | 1188 | 1208 | 594 | | | |
| 539-128-30 | AT103-1100 | 1100 | 1160 | 1288 | 1308 | 644 | | | |
| 539-129-30 | AT103-1200 | 1200 | 1260 | 1388 | 1408 | 694 | | | |
| 539-130-30 | AT103-1300 | 1300 | 1360 | 1488 | 1508 | 744 | | | |
| 539-131-30 | AT103-1400 | 1400 | 1460 | 1488 | 1608 | 794 | | | |
| 539-132-30 | AT103-1500 | 1500 | 1560 | 1688 | 1708 | 844 | | | |
| 539-133-30 | AT103-1600 | 1600 | 1690 | 1818 | 1838 | | 610 | | |
| 539-134-30 | AT103-1700 | 1700 | 1790 | 1918 | 1938 | | 650 | | |
| 539-135-30 | AT103-1800 | 1800 | 1890 | 2018 | 2038 | | 670 | | |
| 539-136-30 | AT103-2000 | 2000 | 2100 | 2228 | 2248 | | 740 | | |
| 539-137-30 | AT103-2200 | 2200 | 2300 | 2428 | 2448 | | 800 | | |
| 539-138-30 | AT103-2400 | 2400 | 2500 | 2628 | 2648 | 1314 | 1300 | 650 | |
| 539-139-30 | AT103-2500 | 2500 | 2600 | 2728 | 2748 | 1364 | 1340 | 670 | |
| 539-140-30 | AT103-2600 | 2600 | 2700 | 2828 | 2848 | 1414 | 1400 | 700 | |
| 539-141-30 | AT103-2800 | 2800 | 2900 | 3028 | 3048 | 1514 | 1500 | 750 | |
| 539-142-30 | AT103-3000 | 3000 | 3100 | 3228 | 3248 | 1614 | 1600 | 800 | |

Note 1: For effective ranges of 100 to 2000mm, we also have the high-accuracy AT103F JIS Class 0 ($3+3L_0/1000$) μm models available.

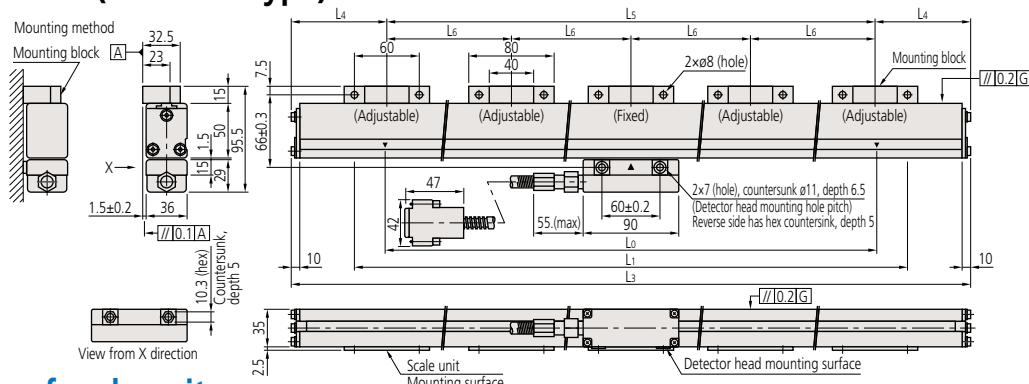
Note 2: The ultra-high-accuracy AT103S ($2+2L_0/1000$) μm models for effective ranges of 100 to 500mm may be custom-ordered on request.

Note 3: The accuracy does not include quantizing error; L_0 is the effective range (mm).

Mounting dimensions (Effective range: 3250 to 6000mm)

AT103 (Standard type)

Unit: mm



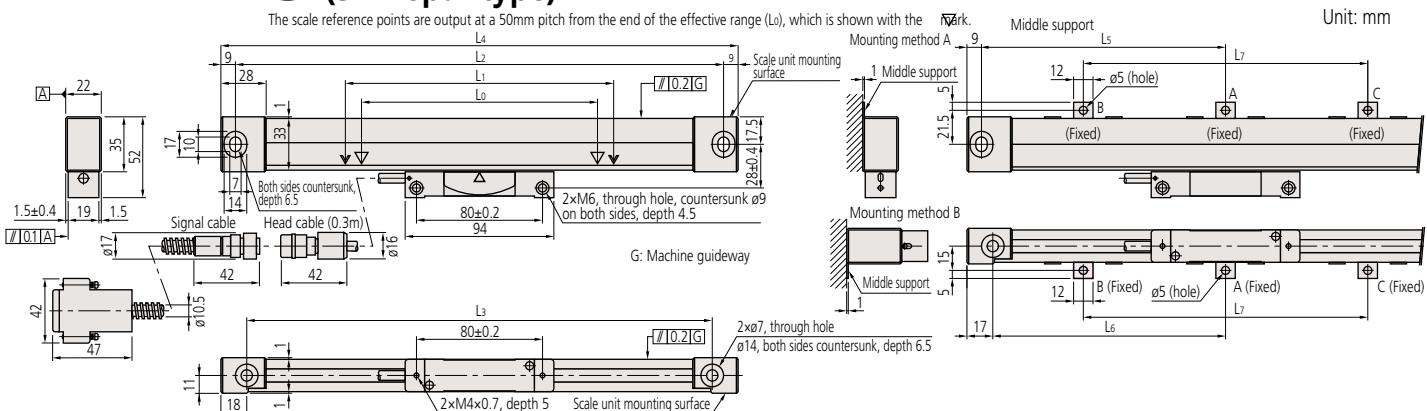
Dimensions of scale units

| Order No. | Code | Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_3 (mm) | Mounting block L_4 (mm) | Mounting block L_5 (mm) | Mounting block L_6 (mm) | Signal cable length (m) |
|------------|------------|-------------------------------|-------------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------|
| 539-143-30 | AT103-3250 | 3250 | 3350 | 3470 | 135 | 3200 | 800 | |
| 539-144-30 | AT103-3500 | 3500 | 3600 | 3720 | 160 | 3400 | 850 | |
| 539-145-30 | AT103-3750 | 3750 | 3850 | 3970 | 125 | 3720 | 930 | |
| 539-146-30 | AT103-4000 | 4000 | 4100 | 4220 | 110 | 4000 | 1000 | |
| 539-147-30 | AT103-4250 | 4250 | 4350 | 4470 | 135 | 4200 | 1050 | |
| 539-148-30 | AT103-4500 | 4500 | 4600 | 4720 | 160 | 4400 | 1100 | |
| 539-149-30 | AT103-4750 | 4750 | 4850 | 4970 | 85 | 4800 | 800 | |
| 539-150-30 | AT103-5000 | 5000 | 5100 | 5220 | 120 | 4980 | 830 | |
| 539-151-30 | AT103-5250 | 5250 | 5350 | 5470 | 125 | 5220 | 870 | |
| 539-152-30 | AT103-5500 | 5500 | 5600 | 5720 | 130 | 5460 | 910 | |
| 539-153-30 | AT103-5750 | 5750 | 5850 | 5970 | 135 | 5700 | 950 | |
| 539-154-30 | AT103-6000 | 6000 | 6100 | 6220 | 110 | 6000 | 1000 | |

Note: Accuracy is $(5+8L_0/1000)$ μm.

Mounting dimensions (Effective range: 100 to 1500mm)

AT113 (Slim spar type)



- Dimensions L_5 , L_6 , and L_7 indicate the recommended mounting positions for the middle supports included with scale units with an effective range of 500mm and more. (The position of the middle support is adjustable in the measuring length direction.)

| Effective range (mm) | Middle support |
|----------------------|----------------|
| 500 - 1000 | A (1 place) |
| 1100 - 1500 | BC (2 places) |

Dimensions of scale units

| AT113 | | Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Mounting hole pitch L_2 (mm) | Mounting hole pitch L_3 (mm) | Overall length L_4 (mm) | Middle support L_5 (mm) | Middle support L_6 (mm) | Middle support L_7 (mm) | Signal cable length (m) |
|------------|------------|-------------------------------|-------------------------------------|-----------------------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|----------------------------|
| Order No. | Code | | | | | | | | | |
| 539-201-30 | AT113- 100 | 100 | 120 | 258 | 242 | 276 | | | | |
| 539-202-30 | AT113- 150 | 150 | 170 | 308 | 292 | 326 | | | | |
| 539-203-30 | AT113- 200 | 200 | 220 | 358 | 342 | 376 | | | | |
| 539-204-30 | AT113- 250 | 250 | 270 | 408 | 392 | 426 | | | | |
| 539-205-30 | AT113- 300 | 300 | 330 | 468 | 452 | 486 | | | | |
| 539-206-30 | AT113- 350 | 350 | 380 | 518 | 502 | 536 | | | | |
| 539-207-30 | AT113- 400 | 400 | 430 | 568 | 552 | 586 | | | | |
| 539-208-30 | AT113- 450 | 450 | 480 | 618 | 602 | 636 | | | | |
| 539-209-30 | AT113- 500 | 500 | 540 | 678 | 662 | 696 | 339 | 331 | | |
| 539-211-30 | AT113- 600 | 600 | 640 | 778 | 762 | 796 | 389 | 381 | | |
| 539-213-30 | AT113- 700 | 700 | 740 | 878 | 862 | 896 | 439 | 431 | | |
| 539-214-30 | AT113- 750 | 750 | 780 | 918 | 902 | 936 | 459 | 451 | | |
| 539-215-30 | AT113- 800 | 800 | 840 | 978 | 962 | 996 | 489 | 481 | | |
| 539-216-30 | AT113- 900 | 900 | 940 | 1078 | 1062 | 1096 | 539 | 531 | | |
| 539-217-30 | AT113-1000 | 1000 | 1040 | 1178 | 1162 | 1196 | 589 | 581 | | |
| 539-218-30 | AT113-1100 | 1100 | 1140 | 1278 | 1262 | 1296 | | | 430 | |
| 539-219-30 | AT113-1200 | 1200 | 1240 | 1378 | 1362 | 1396 | | | 460 | |
| 539-220-30 | AT113-1300 | 1300 | 1340 | 1478 | 1462 | 1496 | | | 490 | |
| 539-221-30 | AT113-1400 | 1400 | 1440 | 1578 | 1562 | 1596 | | | 530 | |
| 539-222-30 | AT113-1500 | 1500 | 1540 | 1678 | 1662 | 1696 | | | 560 | |

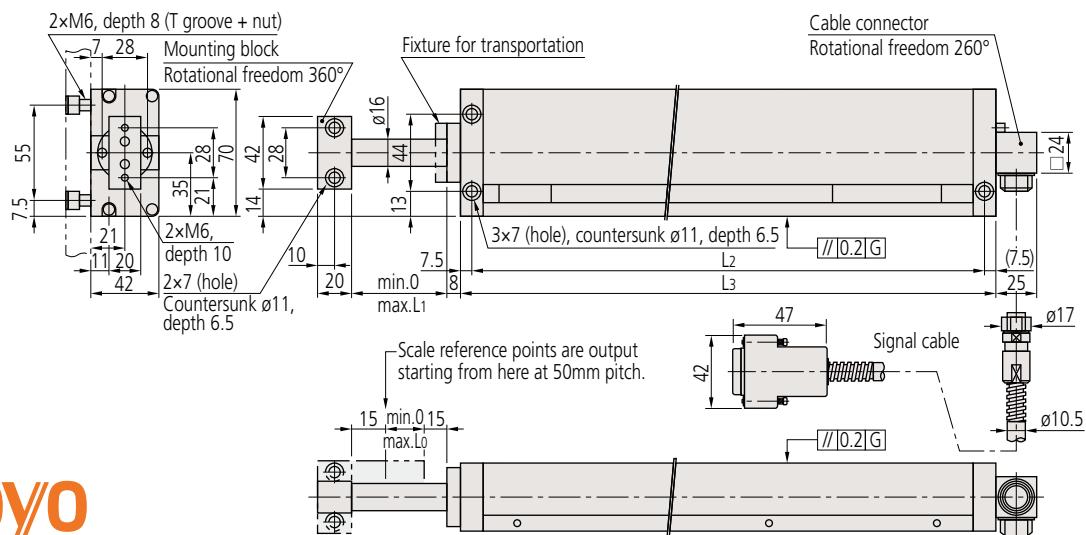
Note 1: For effective ranges of 100 to 2000mm, we also have the high-accuracy AT113F JIS Class 0 ($3+3L_0/1000$) μm models available.

Note 2: The ultra-high-accuracy AT113S ($2+2L_0/1000$) μm models for effective ranges of 100 to 500mm may be custom-ordered on request.

Note 3: The accuracy does not include quantizing error; L_0 is the effective range (mm).

Mounting dimensions (Effective range: 100 to 600mm)

AT181 (Sealed type)



Mitutoyo

Dimensions of scale units

| AT181 | | Effective range Lo (mm) | Maximum travel length L1 (mm) | Mounting hole pitch L2 (mm) | Unit (frame) length L3 (mm) | Signal cable length (m) |
|-----------|-----------|----------------------------|----------------------------------|--------------------------------|--------------------------------|----------------------------|
| Order No. | Code | | | | | |
| 539-301 | AT181-100 | 100 | 130 | 255 | 270 | |
| 539-302 | AT181-150 | 150 | 180 | 305 | 320 | |
| 539-303 | AT181-200 | 200 | 230 | 355 | 370 | |
| 539-304 | AT181-250 | 250 | 280 | 405 | 420 | |
| 539-305 | AT181-300 | 300 | 330 | 455 | 470 | |
| 539-306 | AT181-350 | 350 | 380 | 505 | 520 | |
| 539-307 | AT181-400 | 400 | 430 | 555 | 570 | |
| 539-308 | AT181-450 | 450 | 480 | 605 | 620 | |
| 539-309 | AT181-500 | 500 | 530 | 655 | 670 | |
| 539-310 | AT181-550 | 550 | 580 | 705 | 720 | |
| 539-311 | AT181-600 | 600 | 630 | 755 | 770 | |

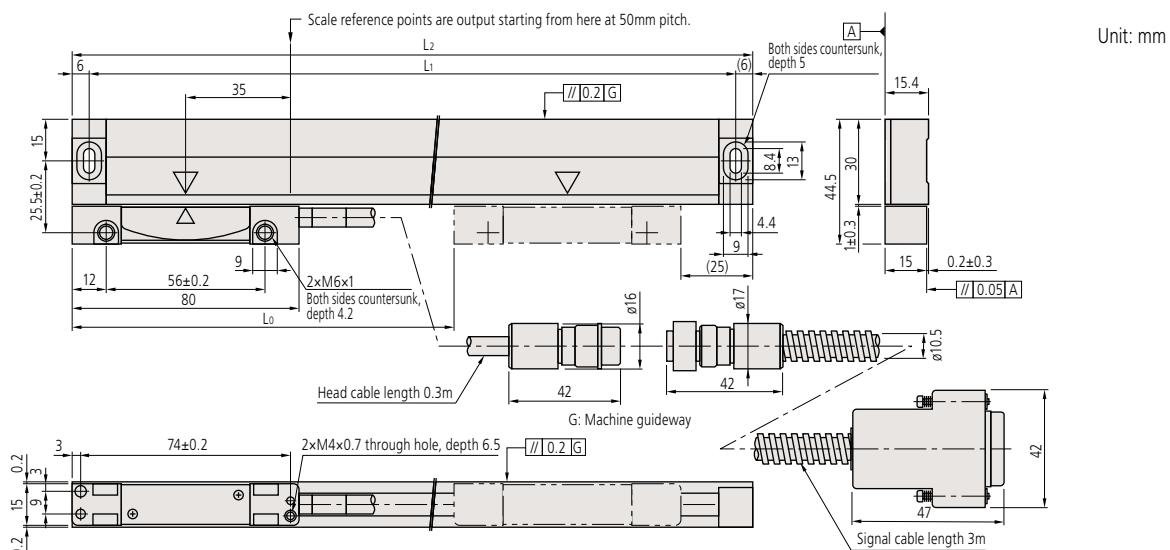
Note 1: We have no high-accuracy AT181F JIS Class 0 ($3+3L_0/1000$) μm models.

Note 2: The accuracy does not include quantizing error; Lo is the effective range (mm).

3

Mounting dimensions (Effective range: 50 to 1020mm)

AT112-F (Super slim spar type)



Dimensions of scale units

| AT112 | | Effective range Lo (mm) | Mounting hole pitch L1 (mm) | Overall length L2 (mm) | Signal cable length (m) |
|------------|-------------|----------------------------|--------------------------------|---------------------------|----------------------------|
| Order No. | Code | | | | |
| 539-251-10 | AT112- 50F | 50 | 143 | 155 | |
| 539-252-10 | AT112- 70F | 70 | 163 | 175 | |
| 539-253-10 | AT112- 120F | 120 | 213 | 225 | |
| 539-254-10 | AT112- 170F | 170 | 263 | 275 | |
| 539-255-10 | AT112- 220F | 220 | 313 | 325 | |
| 539-256-10 | AT112- 270F | 270 | 363 | 375 | |
| 539-257-10 | AT112- 320F | 320 | 413 | 425 | |
| 539-258-10 | AT112- 370F | 370 | 463 | 475 | |
| 539-259-10 | AT112- 420F | 420 | 513 | 525 | |
| 539-260-10 | AT112- 470F | 470 | 563 | 575 | |
| 539-261-10 | AT112- 520F | 520 | 613 | 625 | |
| 539-262-10 | AT112- 570F | 570 | 663 | 675 | |
| 539-263-10 | AT112- 620F | 620 | 713 | 725 | |
| 539-264-10 | AT112- 670F | 670 | 763 | 775 | |
| 539-265-10 | AT112- 720F | 720 | 813 | 825 | |
| 539-266-10 | AT112- 770F | 770 | 863 | 875 | |
| 539-267-10 | AT112- 820F | 820 | 913 | 925 | |
| 539-268-10 | AT112- 920F | 920 | 1013 | 1025 | |
| 539-269-10 | AT112-1020F | 1020 | 1113 | 1125 | |

Note 1: The ultra-high-accuracy AT112S ($2+2L_0/1000$) μm models for effective ranges of 50 to 320mm may be custom-ordered on request.

Note 2: The accuracy does not include quantizing error; Lo is the effective range (mm).

Note 3: For AT112-50F and 70F only, there is one scale reference point at the midpoint.

Assembly Type AT Series

1Vpp Differential Signal Output Type Scale Unit

AT402E



Features

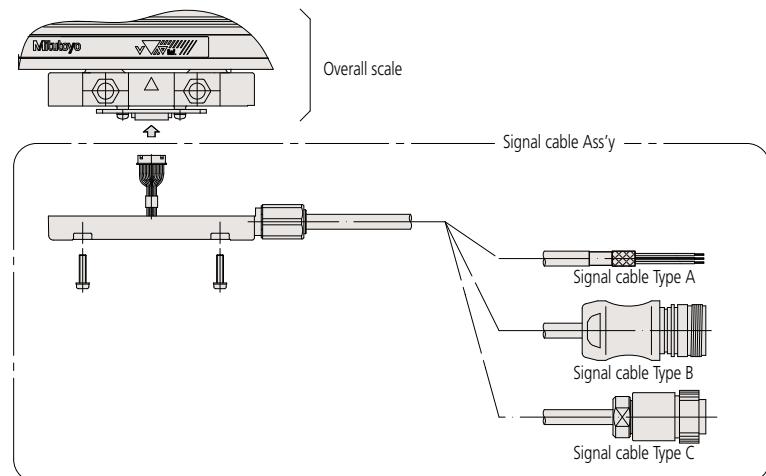
- Ideal for machine tools for heavy cutting as well as linear motors.
- Has multi-point elastic fixing for excellent vibration resistance (200m/s^2), shock resistance (400m/s^2), and temperature characteristics.
- The adoption of the Absolute Interval Code has enabled a simplified, low-cost ABS system.

Specifications

| Item | Code | AT402E-A Type | AT402E-B Type | AT402E-C Type |
|--|------|--|---|-----------------------------|
| Cable configuration | | 3m single wire | 3m European CNC manufacturers' specification | 3m FANUC LTD. specification |
| Detection method | | | Photoelectric linear encoder | |
| Base position of elongation due to temperature changes | | | Midpoint of the screws used for rigid fixing near the midpoint of the effective range. | |
| Effective range | | | 140 to 3040mm | |
| Output signal | | Signal: 1Vpp differential Sinusoidal signal, differential reference point pulse: Absolute Interval Code compatible | | |
| Signal output pitch | | | 20µm | |
| Maximum response speed | | | 120m/min (with Sinusoidal signal amplitude of -3db) | |
| Accuracy (20°C) | | | Effective range 140 to 540mm : $\pm 2\mu\text{m}$ Effective range 640 to 940mm : $\pm 3\mu\text{m}$ Effective range 1040 to 1040mm : $\pm 3\mu\text{m}/\text{m}$ $(8\pm 1)\times 10^{-6} / ^\circ\text{C}$ | |
| Thermal expansion coefficient | | | | |
| Operating temperature/humidity | | | 0 to 45°C 20 to 80% RH (no condensation) | |
| Storage temperature/humidity | | | -20 to 70°C 20 to 80% RH (no condensation) | |
| Vibration resistance | | | 200m/s ² (55 to 2000Hz) | |
| Shock resistance | | | 400m/s ² (half-sine 11ms) | |
| Power supply voltage | | | 5VDC $\pm 5\%$ | |
| Maximum current consumption | | | 120mA | |
| Maximum sliding force | | | 4N | |
| Protection rating | | | Equivalent to IP53 | |
| Air supply hole | | With air supply hole (end of scale frame/detector head) | | |

Note 1: For details regarding the applicable system, please consult with the individual manufacturer.

Cable configuration



Pin assignment

(1) Signal cable A (single wire specification)

| Wire color | Signal | Wire color | Signal |
|------------|----------|------------|----------|
| White | +5V | Yellow | Phase XB |
| Black | GND | Green | Phase Z |
| Brown | Phase A | Blue | Phase XZ |
| Red | Phase XA | Shield | FG |
| Orange | Phase B | | |

Note 1: Ground the shield to the earth bar

(2) Signal cable B (European CNC manufacturer's specification)

12-pin Type Connector without locking ring

| Pin | Signal | Pin | Signal |
|-------|----------|-------|----------|
| 2,12 | +5V | 1 | Phase XB |
| 10,11 | GND | 3 | Phase Z |
| 5 | Phase A | 4 | Phase XZ |
| 6 | Phase XA | Shell | FG |
| 8 | Phase B | 7,9 | Not used |

(3) Signal cable C (FANUC LTD. specification)

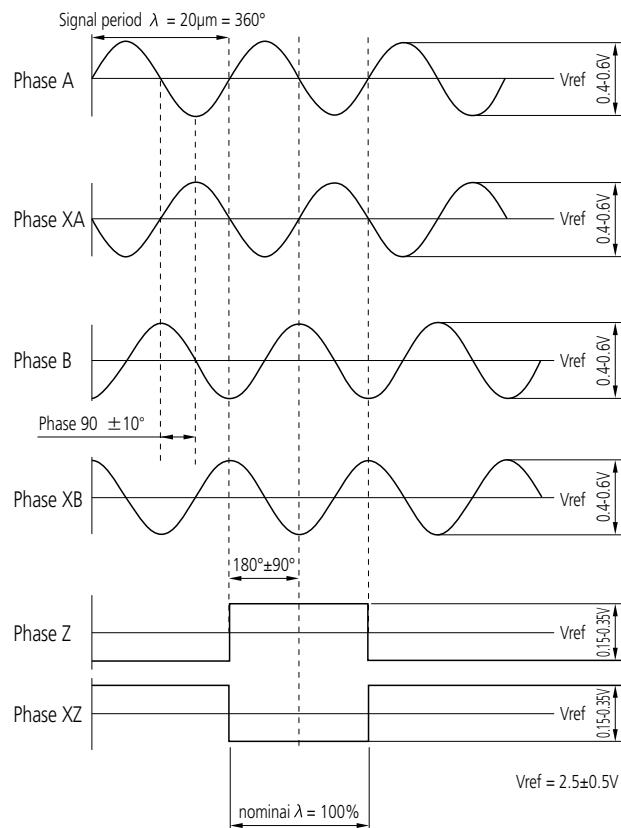
12-pin Type Connector

| Pin | Signal | Pin | Signal |
|-----|----------|-----------|----------|
| 1,2 | +5V | 8 | Phase XB |
| 3,4 | GND | 9 | Phase Z |
| 5 | Phase A | 10 | Phase XZ |
| 6 | Phase XA | 11, shell | FG |
| 7 | Phase B | 12 | Not used |

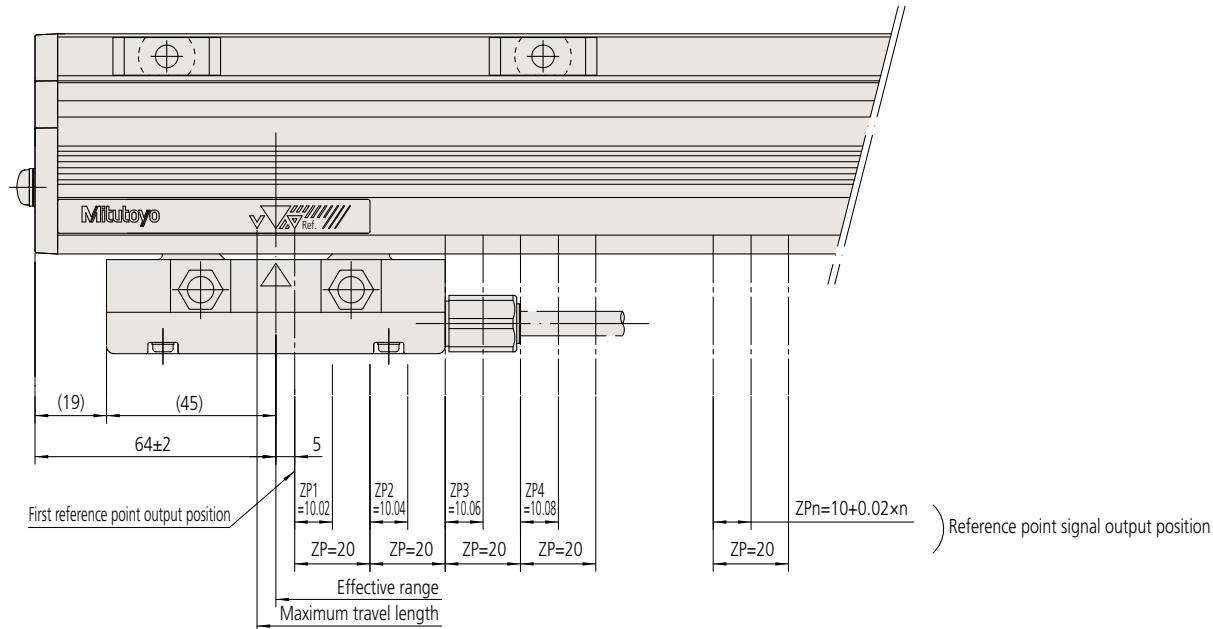
Note 1: Connector used: RM15WTP-12P

Note 2: Applicable connector: RM15WTR-12S
(Hirose Electric or equivalent product)

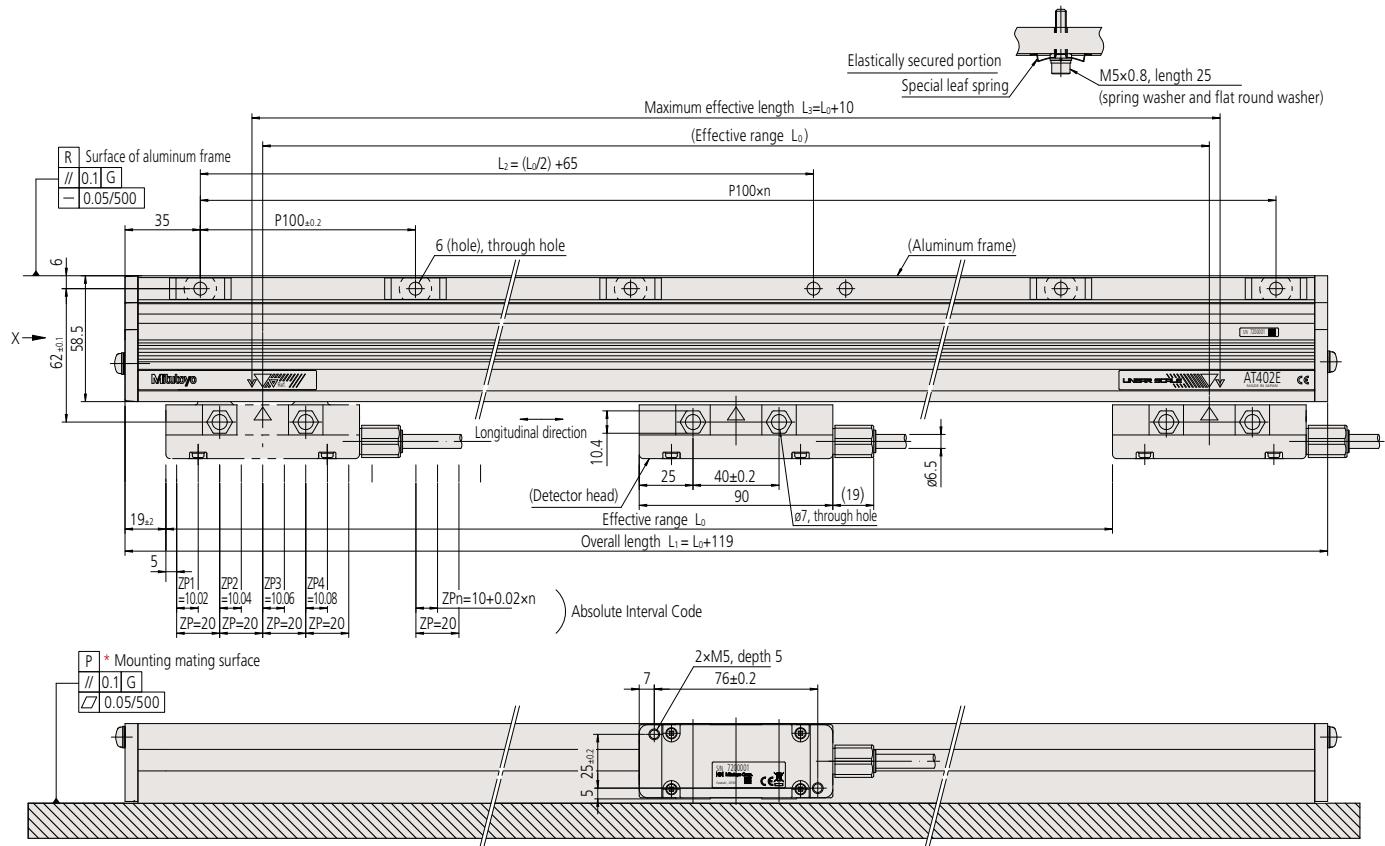
Output signal waveform



Absolute Interval Code



AT402E scale unit mounting dimensions

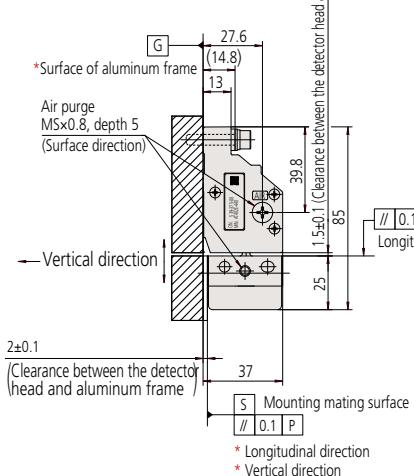


[Notes]

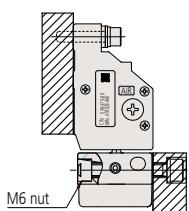
- G indicates the machine guideway.
- P indicates the mating surface for mounting the aluminum frame. S indicates the mating surface for mounting the detector head.
- Q and R indicate the datum surfaces for mounting this linear scale.

View from X direction

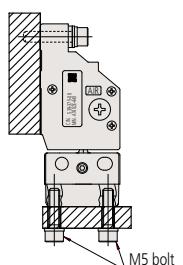
Mounting example 1



Mounting example 2



Mounting example 3



Dimensions of scale units

| Code | Effective range L ₀ (mm) | Overall length L ₁ (mm) | L ₂ (mm) | Maximum travel length L ₃ (mm) | n (pcs) |
|--------------------|--|---------------------------------------|---------------------|--|---------|
| AT402E-140 | 140 | 259 | 135 | 150 | 2 |
| AT402E-240 | 240 | 359 | 185 | 250 | 3 |
| AT402E-340 | 340 | 459 | 235 | 350 | 4 |
| AT402E-440 | 440 | 559 | 285 | 450 | 5 |
| AT402E-540 | 540 | 659 | 335 | 550 | 6 |
| AT402E-640 | 640 | 759 | 358 | 650 | 7 |
| AT402E-740 | 740 | 859 | 435 | 750 | 8 |
| AT402E-840 | 840 | 985 | 485 | 850 | 9 |
| AT402E-940 | 940 | 1059 | 535 | 950 | 10 |
| AT402E-1040 | 1040 | 1159 | 585 | 1050 | 11 |
| AT402E-1140 | 1140 | 1259 | 635 | 1150 | 12 |
| AT402E-1240 | 1240 | 1359 | 685 | 1250 | 13 |
| AT402E-1340 | 1340 | 1459 | 735 | 1350 | 14 |
| AT402E-1440 | 1440 | 1559 | 785 | 1450 | 15 |
| AT402E-1540 | 1540 | 1659 | 835 | 1550 | 16 |
| AT402E-1640 | 1640 | 1759 | 885 | 1650 | 17 |
| AT402E-1740 | 1740 | 1859 | 935 | 1750 | 18 |
| AT402E-1840 | 1840 | 1959 | 985 | 1850 | 19 |
| AT402E-2040 | 2040 | 2159 | 1085 | 2050 | 21 |
| AT402E-2240 | 2240 | 2359 | 1185 | 2250 | 23 |
| AT402E-2440 | 2440 | 2559 | 1285 | 2450 | 25 |
| AT402E-2640 | 2640 | 2759 | 1385 | 2650 | 27 |
| AT402E-2840 | 2840 | 2959 | 1485 | 2850 | 29 |
| AT402E-3040 | 3040 | 3159 | 1585 | 3050 | 31 |

Codes and Order Numbers

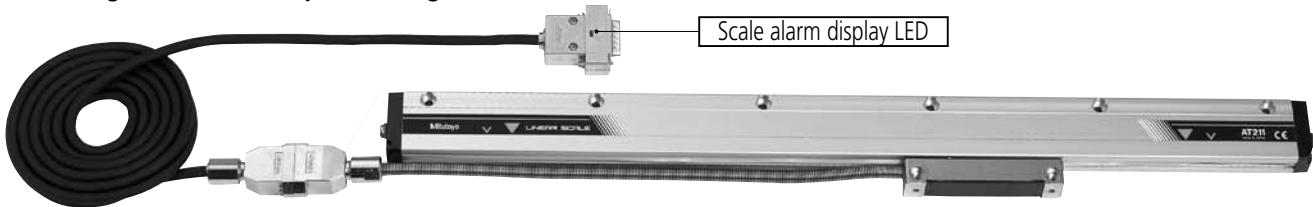
| Code | Scale unit + single wire cable 3m (A Type) | Scale unit + cable with European CNC manufacturer's connector 3m (B Type) | Scale unit + Cable with FANUC LTD. connector 3m (C Type) |
|--------------------|---|--|---|
| | Order No. | Order No. | Order No. |
| AT402E-140 | 539-371-01 | 539-371-02 | 539-371-03 |
| AT402E-240 | 539-373-01 | 539-373-02 | 539-373-03 |
| AT402E-340 | 539-374-01 | 539-374-02 | 539-374-03 |
| AT402E-440 | 539-375-01 | 539-375-02 | 539-375-03 |
| AT402E-540 | 539-376-01 | 539-376-02 | 539-376-03 |
| AT402E-640 | 539-377-01 | 539-377-02 | 539-377-03 |
| AT402E-740 | 539-378-01 | 539-378-02 | 539-378-03 |
| AT402E-840 | 539-379-01 | 539-379-02 | 539-379-03 |
| AT402E-940 | 539-380-01 | 539-380-02 | 539-380-03 |
| AT402E-1040 | 539-381-01 | 539-381-02 | 539-381-03 |
| AT402E-1140 | 539-382-01 | 539-382-02 | 539-382-03 |
| AT402E-1240 | 539-383-01 | 539-383-02 | 539-383-03 |
| AT402E-1340 | 539-384-01 | 539-384-02 | 539-384-03 |
| AT402E-1440 | 539-385-01 | 539-385-02 | 539-385-03 |
| AT402E-1540 | 539-386-01 | 539-386-02 | 539-386-03 |
| AT402E-1640 | 539-387-01 | 539-387-02 | 539-387-03 |
| AT402E-1740 | 539-388-01 | 539-388-02 | 539-388-03 |
| AT402E-1840 | 539-389-01 | 539-389-02 | 539-389-03 |
| AT402E-2040 | 539-390-01 | 539-390-02 | 539-390-03 |
| AT402E-2240 | 539-391-01 | 539-391-02 | 539-391-03 |
| AT402E-2440 | 539-392-01 | 539-392-02 | 539-392-03 |
| AT402E-2640 | 539-393-01 | 539-393-02 | 539-393-03 |
| AT402E-2840 | 539-394-01 | 539-394-02 | 539-394-03 |
| AT402E-3040 | 539-395-01 | 539-395-02 | 539-395-03 |

Assembly Type AT Series

Square-Wave Signal Output Type Scale Unit (Slim/High-speed types)

AT211

Mounting method: Multi-point fixing (excellent vibration and shock resistance)



Mounting method: Double-end fixing (space-saving type)



Features

- This is a slim, sealed scale that can be directly connected to the control unit.
- High speed response up to 120m/min, making it compatible with a wide range of resolutions from 0.1 to 5μm.
- The multi-point fixing type has excellent vibration resistance.
- Scale alarm display makes for easy maintenance.
- Wide range of specifications enables easy choice to best suit your application.



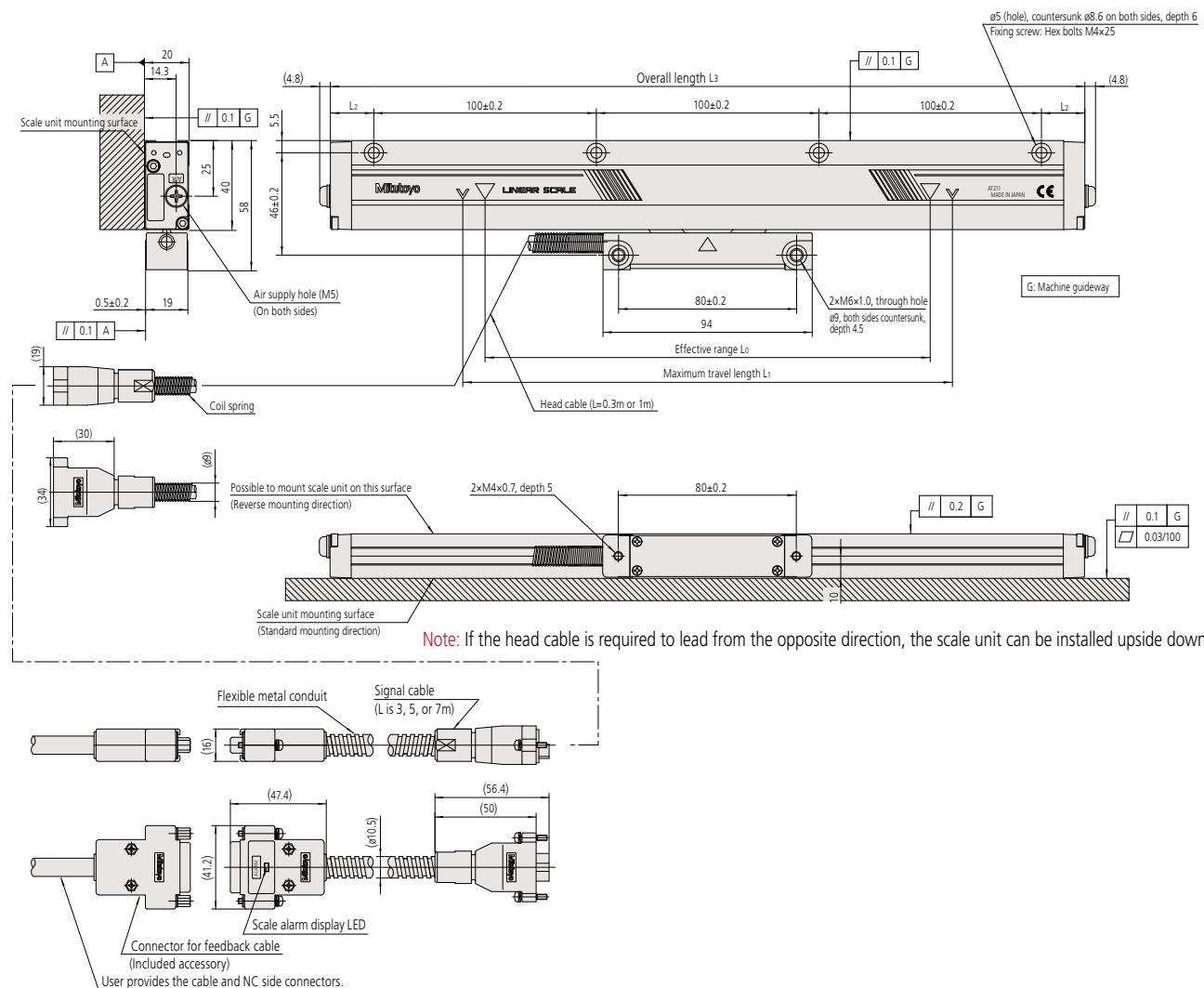
Single head cable type (no connector)

Specifications

| Item | Code | AT211 |
|-----------------------------|---------------------------|--|
| Effective range (L_0) | | 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500 mm |
| Scale reference point | | 50mm pitch, center point, left end, right end (fixed when shipped) |
| Accuracy (20°C) | | (3+3 L_0 /1000) μm (For L_0 500mm, we can also fabricate a high-accuracy type: (2+2 L_0 /1000) μm) Lo: Effective range (mm) |
| Vibration resistance | | 200 m/s ² (Conditions: 55 to 2000Hz) (Multi-point fixing type) |
| Shock resistance | | 250 m/s ² (Conditions: half-sine, 11ms) (Multi-point fixing type) |
| Air supply hole | | With air supply hole (Multi-point fixing type) |
| Output signal | Type | PA/PA, PB/PB, PZ/PZ |
| | Electrical specifications | Conforms to RS422 |
| Main scale grating pitch | | 20μm |
| Minimum resolution | | 0.1, 0.2, 0.5, 1, 2.5, 5μm (fixed when shipped) |
| Minimum edge interval | | 125, 250, 333, 500, 1000ns (fixed when shipped) |
| Maximum response speed | | 5.4 to 120 m/min (Determined by minimum resolution and minimum edge interval) |
| Power supply voltage | | 5VDC±5% |
| Maximum current consumption | | 200 mA |
| Protection rating | | Equivalent to IP53 (when the user's manual is followed) |
| Sliding force | | 5N max. |
| Operating temperature | | 0 to 45°C |
| Storage temperature | | -20 to 70°C |
| Operating/storage humidity | | 20 to 80%RH (no condensation) |
| Direction switching | | Standard/Reverse (set when shipped) |
| Alarm function | Alarm detection | Over-speed, scale signal error |
| | Alarm output | Output for PA/PA, PB/PB, and PZ/PZ are all high-impedance |
| | Alarm display | Red LED on NC side connector of signal cable turns on (this does not include single head cable types) |

Mounting dimensions for multi-point fixing type

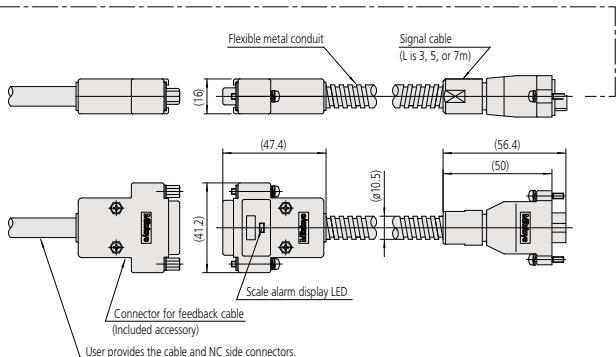
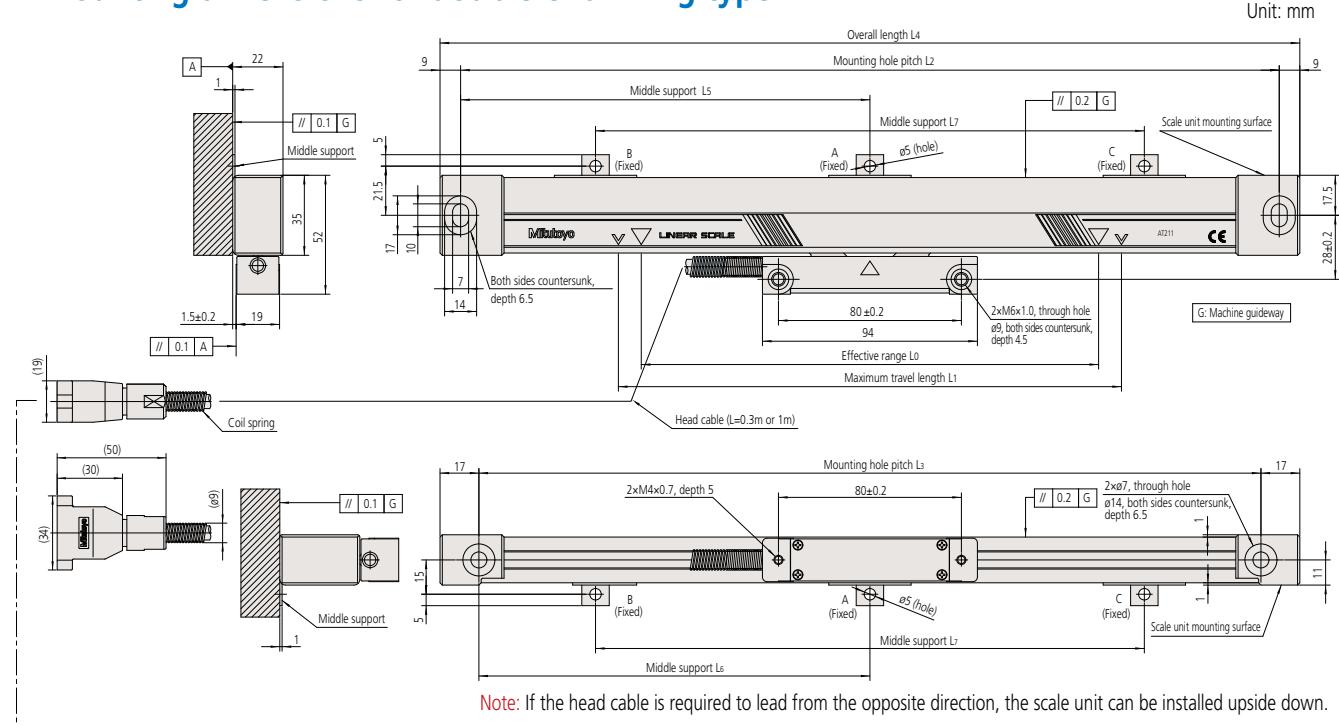
Unit: mm



Mounting dimensions for multi-point fixing type

| Scale unit | Effective range L_0 (mm) | Maximum travel length L_1 (mm) | End surface dimensions L_2 (mm) | Overall length L_3 (mm) | No. of mounting holes on scale unit (pcs) |
|-------------|-------------------------------|-------------------------------------|--------------------------------------|------------------------------|--|
| AT211- 100A | 100 | 120 | 19.5 | 239 | 3 |
| AT211- 150A | 150 | 170 | 44.5 | 289 | 3 |
| AT211- 200A | 200 | 220 | 19.5 | 339 | 4 |
| AT211- 250A | 250 | 270 | 44.5 | 389 | 4 |
| AT211- 300A | 300 | 330 | 24.5 | 449 | 5 |
| AT211- 350A | 350 | 380 | 49.5 | 499 | 5 |
| AT211- 400A | 400 | 430 | 24.5 | 549 | 6 |
| AT211- 450A | 450 | 480 | 49.5 | 599 | 6 |
| AT211- 500A | 500 | 540 | 29.5 | 659 | 7 |
| AT211- 600A | 600 | 640 | 29.5 | 759 | 8 |
| AT211- 700A | 700 | 740 | 29.5 | 859 | 9 |
| AT211- 750A | 750 | 780 | 49.5 | 899 | 9 |
| AT211- 800A | 800 | 840 | 29.5 | 959 | 10 |
| AT211- 900A | 900 | 940 | 29.5 | 1059 | 11 |
| AT211-1000A | 1000 | 1040 | 29.5 | 1159 | 12 |
| AT211-1100A | 1100 | 1140 | 29.5 | 1259 | 13 |
| AT211-1200A | 1200 | 1240 | 29.5 | 1359 | 14 |
| AT211-1300A | 1300 | 1340 | 29.5 | 1459 | 15 |
| AT211-1400A | 1400 | 1440 | 29.5 | 1559 | 16 |
| AT211-1500A | 1500 | 1540 | 29.5 | 1659 | 17 |

Mounting dimensions for double-end fixing type



User provides the cable and NC side connectors.

Mounting dimensions for double-end fixing type

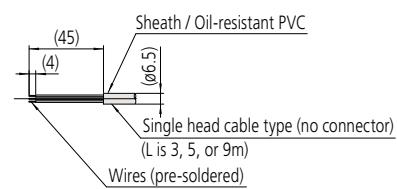
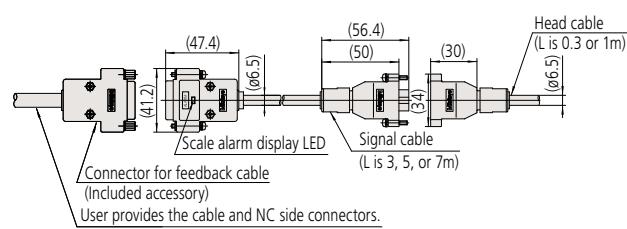
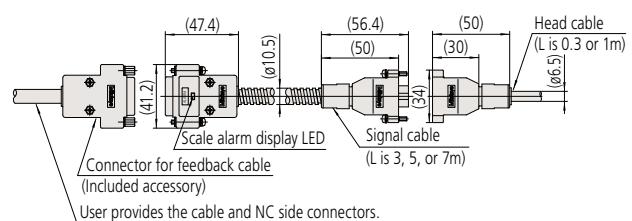
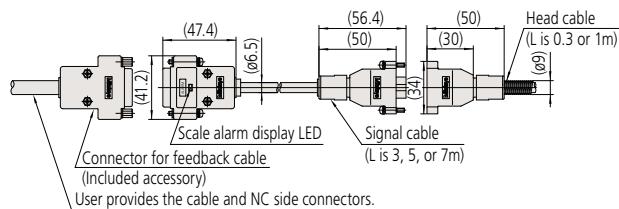
| Scale unit | Effective range L0 (mm) | Maximum travel length L1 (mm) | Mounting hole pitch (mm) | | Overall length L4 (mm) | Middle support (mm) | | |
|-------------|-------------------------|-------------------------------|--------------------------|---------|------------------------|---------------------|-----|-----|
| | | | L2 (mm) | L3 (mm) | | L5 | L6 | L7 |
| AT211- 100B | 100 | 120 | 258 | 242 | 276 | | | |
| AT211- 150B | 150 | 170 | 308 | 292 | 326 | | | |
| AT211- 200B | 200 | 220 | 358 | 342 | 376 | | | |
| AT211- 250B | 250 | 270 | 408 | 392 | 426 | | | |
| AT211- 300B | 300 | 330 | 468 | 452 | 486 | | | |
| AT211- 350B | 350 | 380 | 518 | 502 | 536 | | | |
| AT211- 400B | 400 | 430 | 568 | 552 | 586 | | | |
| AT211- 450B | 450 | 480 | 618 | 602 | 636 | | | |
| AT211- 500B | 500 | 540 | 678 | 662 | 696 | 339 | 331 | |
| AT211- 600B | 600 | 640 | 778 | 762 | 796 | 389 | 381 | |
| AT211- 700B | 700 | 740 | 878 | 862 | 896 | 439 | 431 | |
| AT211- 750B | 750 | 780 | 918 | 902 | 936 | 459 | 451 | |
| AT211- 800B | 800 | 840 | 978 | 962 | 996 | 489 | 481 | |
| AT211- 900B | 900 | 940 | 1078 | 1062 | 1096 | 539 | 531 | |
| AT211-1000B | 1000 | 1040 | 1178 | 1162 | 1196 | 589 | 581 | |
| AT211-1100B | 1100 | 1140 | 1278 | 1262 | 1296 | | | 430 |
| AT211-1200B | 1200 | 1240 | 1378 | 1362 | 1396 | | | 460 |
| AT211-1300B | 1300 | 1340 | 1478 | 1462 | 1496 | | | 490 |
| AT211-1400B | 1400 | 1440 | 1578 | 1562 | 1596 | | | 530 |
| AT211-1500B | 1500 | 1540 | 1678 | 1662 | 1696 | | | 560 |

- The number of middle supports attached depends on the effective range.

| Effective range (mm) | Middle support |
|----------------------|-----------------|
| 500 to 1000 | A (1 place) |
| 1100 to 1500 | B, C (2 places) |

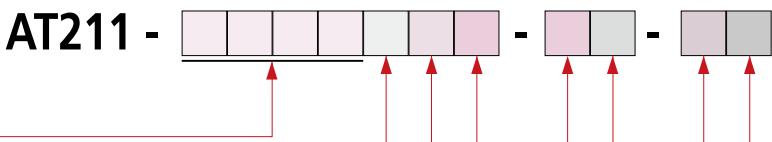
Cable pattern

Unit: mm



Specification Selection Method

How to read the code



Effective range list

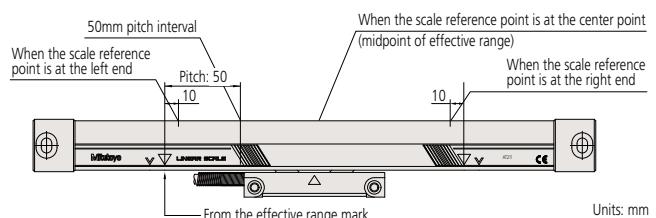
| Code | Effective range (mm) | Code | Effective range (mm) | Code | Effective range (mm) |
|------|----------------------|------|----------------------|------|----------------------|
| 0100 | 100 | 0450 | 450 | 1000 | 1000 |
| 0150 | 150 | 0500 | 500 | 1100 | 1100 |
| 0200 | 200 | 0600 | 600 | 1200 | 1200 |
| 0250 | 250 | 0700 | 700 | 1300 | 1300 |
| 0300 | 300 | 0750 | 750 | 1400 | 1400 |
| 0350 | 350 | 0800 | 800 | 1500 | 1500 |
| 0400 | 400 | 0900 | 900 | | |

Mounting method

| Code | |
|------|--------------------|
| A | Multi-point fixing |
| B | Double-end fixing |

Scale reference point

| Code | |
|------|--------------|
| ● 1 | 50mm pitch |
| 2 | Center point |
| 3 | Left end |
| 4 | Right end |



Accuracy (20°C)

| Code | |
|------|-----------------|
| ● S | (3+3Lo/1000) µm |
| H | (2+2Lo/1000) µm |

Note 1: Lo is the effective range (mm).
Note 2: Type H is used for effective ranges of 500mm or less.

Specification combination table (resolution, response speed, and minimum edge interval)

| Resolution (µm) | Minimum edge interval (ns)* | 125 | 250 | 333 | 500 | 1000 |
|-----------------|-----------------------------|--------------|--------------|---------------|--------------|------|
| 0.1 | A: 43 (710) | B: 22 (360) | C: 16 (260) | D: 11 (180) | E: 5.4 (90) | |
| 0.2 | F: 86 (1400) | G: 43 (710) | H: 32 (530) | J: 22 (360) | K: 11 (180) | |
| 0.5 | L:120 (2000) | M:110 (1800) | N: 81 (1300) | P: 54 (900) | Q: 27 (450) | |
| 1.0 | — | R:120 (2000) | S:120 (2000) | T:110 (1800) | U: 54 (900) | |
| 2.5 | — | — | — | W: 120 (2000) | X:120 (2000) | |
| 5.0 | — | — | — | — | Y:120 (2000) | |

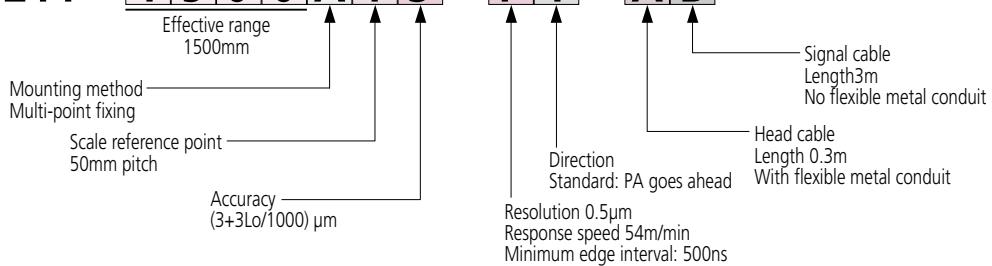
* Codes A to Y show the maximum response speed in m/min, values in () are mm/s.

Note: The minimum edge interval varies 0 to -10% based on the operating environmental conditions.

- There is an extensive selection of specifications for the AT211.
- Choose the appropriate numbers and letters below according to specification required.
- If you don't have a specification in mind, choose the option with the ●.

* For special applications not shown in the specifications, please contact us. Additionally, we are also able to meet the 1VP-P Sinusoidal signal output specification.

(Example) AT211 - 1500A1S - P1 - AB

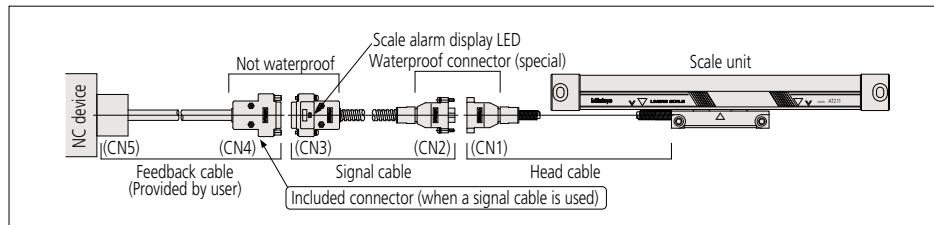


Signal cable

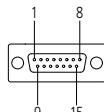
| Code | Length (L) | Flexible metal conduit ^{*1} |
|-----------------|-----------------|--------------------------------------|
| ● A | 3m | Yes |
| B | 3m | No |
| C | 5m | Yes |
| D | 5m | No |
| E | 7m | Yes |
| F | 7m | No |
| G ^{*2} | 3m | No |
| H ^{*2} | 5m | No |
| J ^{*2} | 7m | No |
| X | No signal cable | |

*1 The cable is enclosed in a flexible metal conduit or else is PVC sheathed.

*2 The connector (CN3) for signal cables G, H, and J are half-pitch connectors.



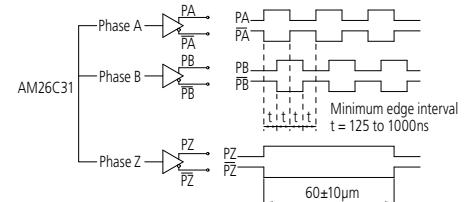
Connector for signal cable (CN3) (pin type)



| Pin No. | Signal | Pin No. | Signal |
|----------|--------|---------|----------|
| 1, 2, 13 | OV | 8 | PB |
| 3, 4, 11 | +5V | 9 | PZ |
| 5 | PA | 10 | PZ |
| 6 | PA | 12, 14 | Not used |
| 7 | PB | 15 | F.G |

Applicable connector (CN4):
HDAB-15S (Hirose Electric or equivalent product (D-sub series)) may be used

Output circuit specification

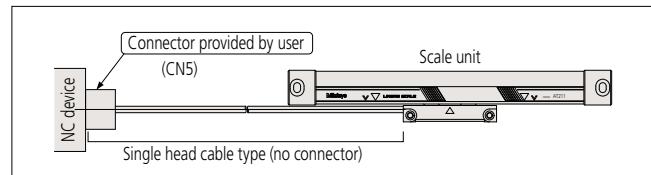
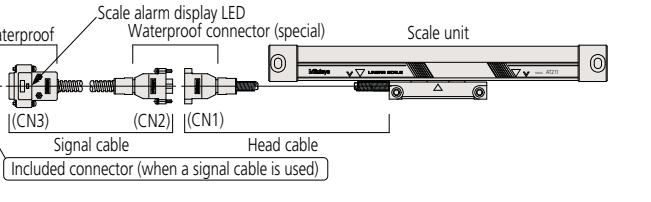
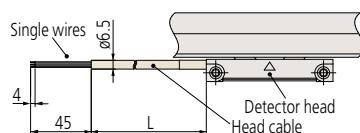


Head cable

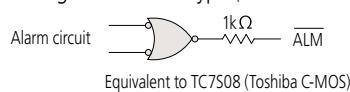
| Code | Length (L) | Flexible metal conduit | Connector (CN1) |
|------|------------|------------------------|--------------------|
| ● A | 0.3m | Yes | Special waterproof |
| B | 0.3m | No | Special waterproof |
| C | 1m | No | Special waterproof |
| D | 3m | | |
| E | 4m | | |
| F | 5m | | |
| H | 7m | | |
| J | 8m | | |
| K | 9m | | |

Note: The cable is enclosed in a flexible metal conduit or else is PVC sheathed.

Single head cable type (no connector)



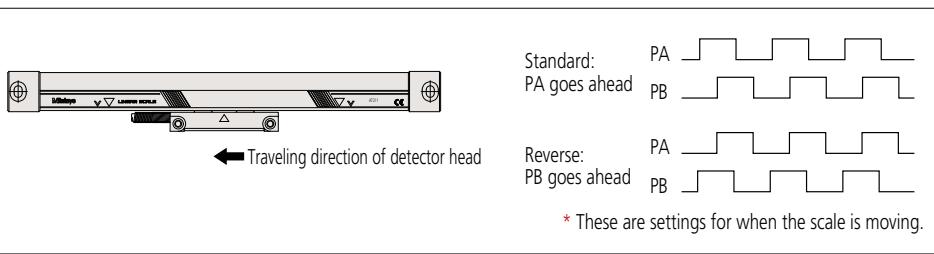
ALM signal for single head cable type (no connector)



| Wire color | Signal | Wire color | Signal |
|--------------|--------|------------|--------|
| White, black | OV | Blue | PB |
| Brown, red | +5V | Purple | PZ |
| Orange | PA | Gray | PZ |
| Yellow | PA | Pink | ALM |
| Green | PB | | |

Direction

| Code | Description |
|------|-------------------------|
| ● 1 | Standard: PA goes ahead |
| 2 | Reverse: PB goes ahead |



Assembly Type AT Series

Square Wave Signal Output Type Scale Unit (Standard type)

AT203



Features

- The maximum effective measurement length of 6000mm enables use on large machines (such as for LCD production).
- The travel length of the linear scale is output with 2-phase square wave signals, which can be used as a feedback signal for NC machine tools.
- The pulse signal unit (PSU) is no longer needed, and the AT203 can be directly connected to the NC machine tool.
- The maximum response speed is 2000mm/s. (When resolution is 1µm and the minimum edge interval is 250ns)

Specifications

| Item | Code | AT203 |
|--|------|--|
| Detection method | | Photoelectric type transmission linear encoder |
| Output | | Two 90° phase-shifted square wave signals |
| Output method | | Differential line driver |
| Signal output pitch | | 20µm |
| Resolution | | 1, 0.5, 0.1µm (switched using DIP switches) |
| Effective range | | 100 to 6000mm |
| Accuracy (20°C) | | Effective range 100 to 1500mm ($3+3L_0/1000$) µm Effective range 1600 to 3000mm ($5+5L_0/1000$) µm Effective range 3250 to 6000mm ($5+8L_0/1000$) µm L_0 : Effective range (mm) |
| Maximum response speed | | 11 to 120m/min (Depends on the resolution and minimum edge interval) (See separate table) |
| Scale reference point pitch | | 50mm |
| Main scale thermal expansion coefficient | | (8±1) × 10 ⁻⁶ /°C |
| Power supply voltage | | 5VDC±5% |
| Maximum current consumption | | 250mA |
| Operating/storage temperature | | 0 to 45°C, -20 to 70°C (no condensation) |
| Operating/storage humidity (relative humidity) | | 20 to 80% RH (no condensation) |
| Protection rating | | Equivalent to IP53 |
| Sliding force | | 5N max. |

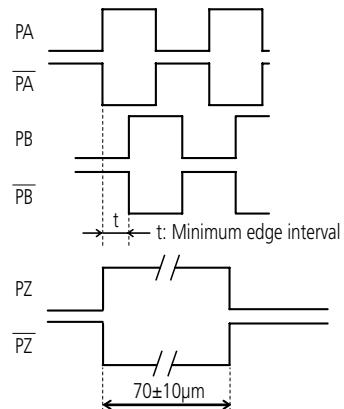
Signal cable 3m (optional accessory) **Part No.09AAA353B**
Signal cable 5m (included accessory) **Part No.09AAA353A**

Pin assignment

| Pin No. | Function |
|---------|----------|
| 1 | 0V |
| 2 | 0V |
| 3 | +5V |
| 4 | +5V |
| 5 | PA |
| 6 | PA |
| 7 | PB |
| 8 | PB |
| 9 | PZ |
| 10 | PZ |
| 11 | +5V |
| 12 | N.C. |
| 13 | 0V |
| 14 | N.C. |
| 15 | F.G |

Connector used: HDAB-15P (Hirose Electric)
Applicable selectable: HDAB-15S (Hirose Electric)

Output signal waveform



Maximum response speed*

| Minimum edge interval | Resolution | Maximum response speed (m/min) | | |
|-----------------------|------------|--------------------------------|----------|---------|
| | | 1 µm | 0.5 µm | 0.1 µm |
| 500ns | | ★110 (50) | 54 (50) | 11 (11) |
| 250ns | | 120 (50) | 110 (50) | 22 (22) |

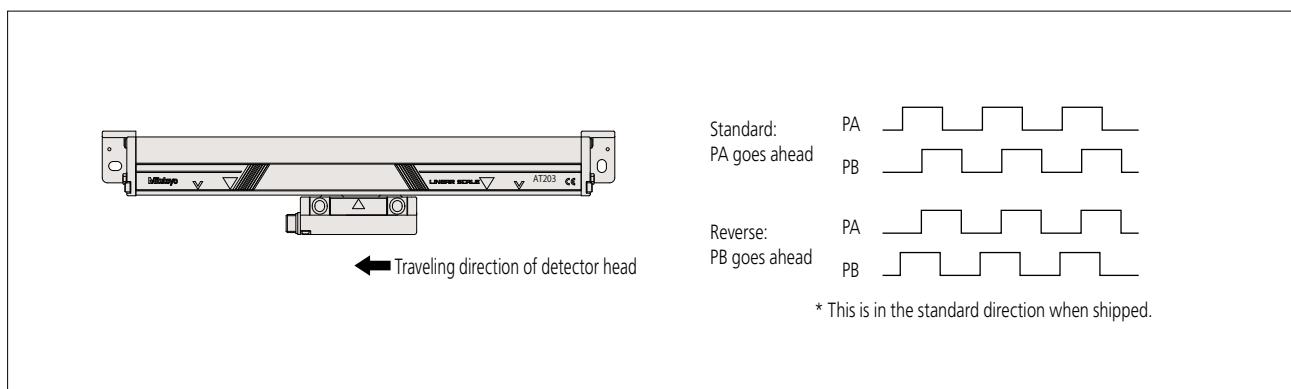
The ★ indicates the setting when shipped

* Values in () are for effective ranges of 3250mm and more.

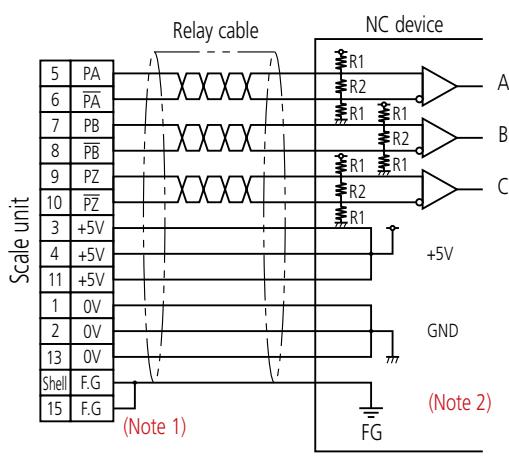
* The minimum edge interval varies 0 to -10% based on the operating environmental conditions.

Direction

Internal DIP switches can be used to switch between the standard and reverse directions.



Wiring example



Note 1: When the shield has a drain wire, connect it to Pin 15.

Note 2: Always ground the shield for relay cables by, for example, connecting it to an earth conductor.

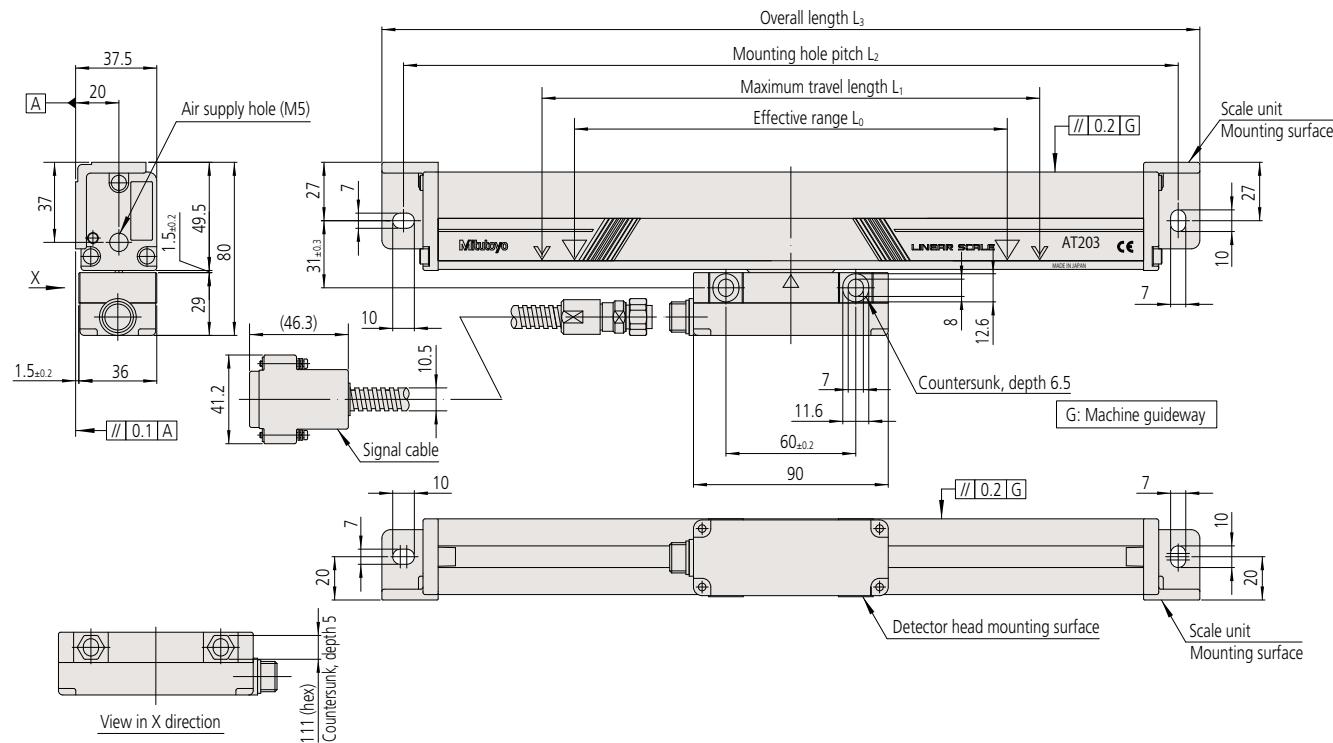
$$\begin{aligned} R1 &= 560\Omega \\ R2 &= 150\Omega \end{aligned}$$

Recommended receiver: SN75ALS195(TI)

AT203 scale unit mounting dimensions

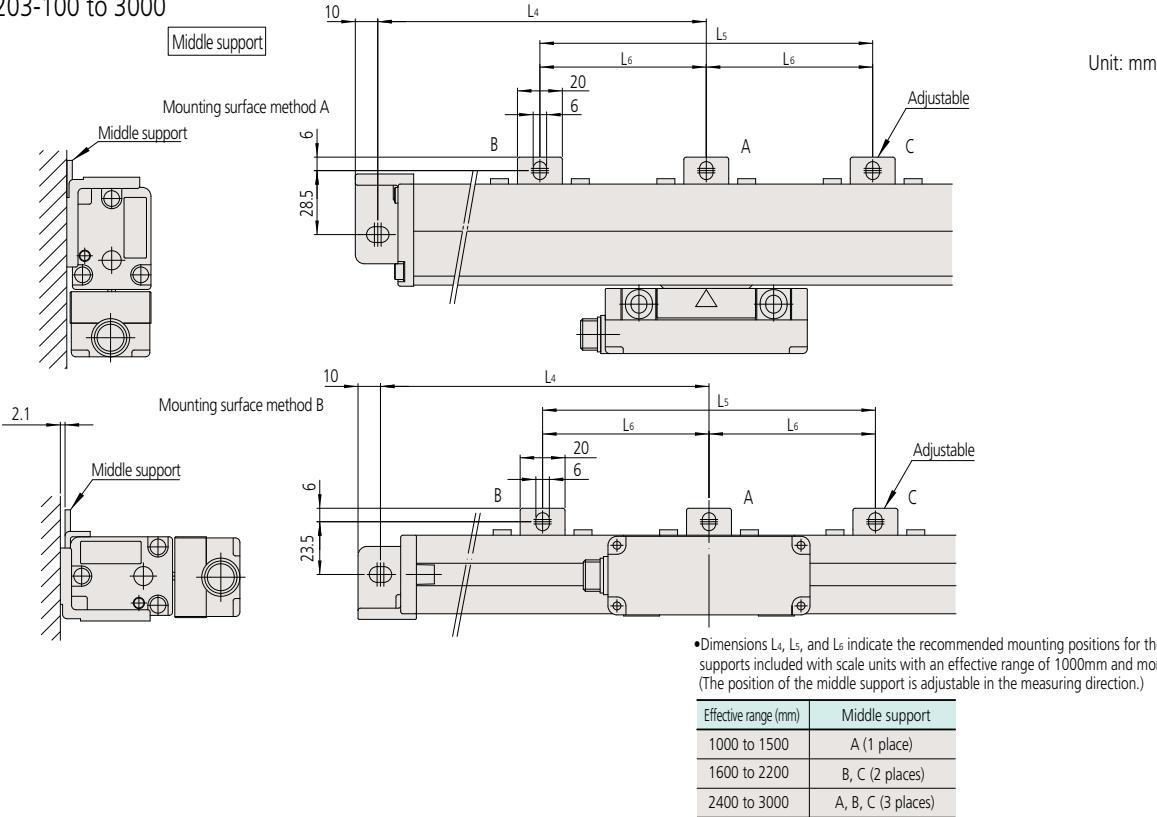
- AT203-100 to 3000

Unit: mm

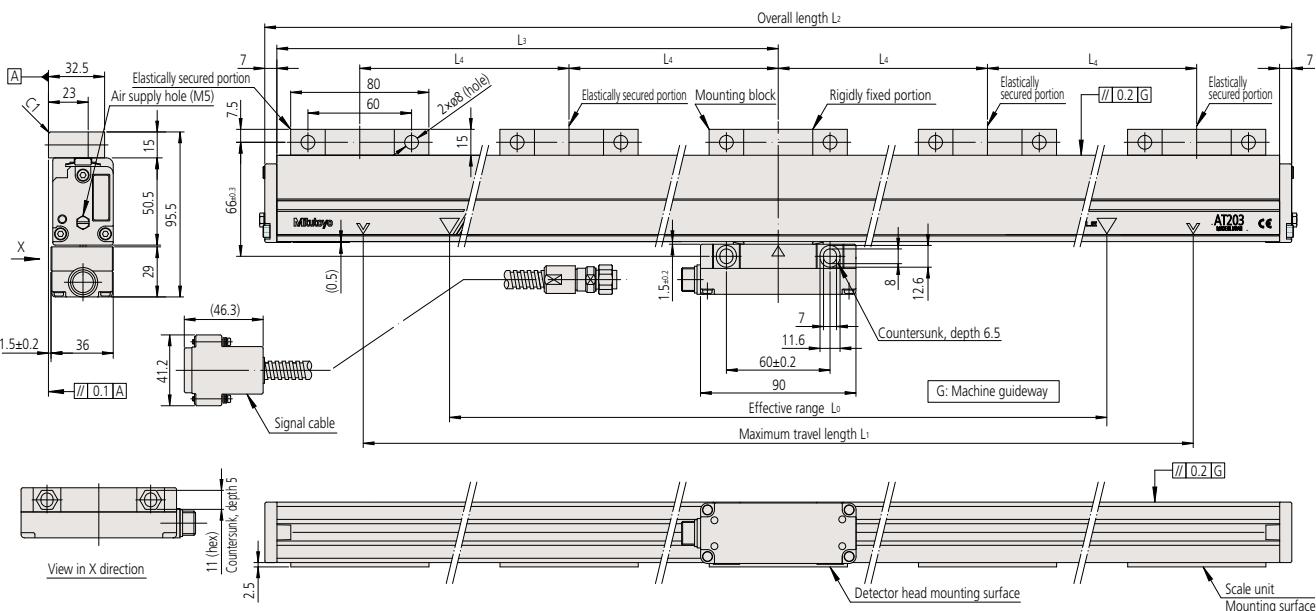


| Order No. | Code | Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Mounting hole pitch L_2 (mm) | Overall length L_3 (mm) | L_4 (mm) | L_5 (mm) | L_6 (mm) |
|------------|------------|-------------------------------|-------------------------------------|-----------------------------------|------------------------------|------------|------------|------------|
| 539-411-30 | AT203-100 | 100 | 120 | 248 | 268 | | | |
| 539-412-30 | AT203-150 | 150 | 170 | 298 | 318 | | | |
| 539-413-30 | AT203-200 | 200 | 220 | 348 | 368 | | | |
| 539-414-30 | AT203-250 | 250 | 270 | 398 | 418 | | | |
| 539-415-30 | AT203-300 | 300 | 330 | 458 | 478 | | | |
| 539-416-30 | AT203-350 | 350 | 380 | 508 | 528 | | | |
| 539-417-30 | AT203-400 | 400 | 430 | 558 | 578 | | | |
| 539-418-30 | AT203-450 | 450 | 480 | 608 | 628 | | | |
| 539-419-30 | AT203-500 | 500 | 540 | 668 | 688 | | | |
| 539-421-30 | AT203-600 | 600 | 650 | 778 | 798 | | | |
| 539-423-30 | AT203-700 | 700 | 760 | 888 | 908 | | | |
| 539-424-30 | AT203-750 | 750 | 810 | 938 | 958 | | | |
| 539-425-30 | AT203-800 | 800 | 860 | 988 | 1008 | | | |
| 539-426-30 | AT203-900 | 900 | 960 | 1088 | 1108 | | | |
| 539-427-30 | AT203-1000 | 1000 | 1060 | 1188 | 1208 | 594 | | |
| 539-428-30 | AT203-1100 | 1100 | 1160 | 1288 | 1308 | 644 | | |
| 539-429-30 | AT203-1200 | 1200 | 1260 | 1388 | 1408 | 694 | | |
| 539-430-30 | AT203-1300 | 1300 | 1360 | 1488 | 1508 | 744 | | |
| 539-431-30 | AT203-1400 | 1400 | 1460 | 1588 | 1608 | 794 | | |
| 539-432-30 | AT203-1500 | 1500 | 1560 | 1688 | 1708 | 844 | | |
| 539-433-30 | AT203-1600 | 1600 | 1690 | 1818 | 1838 | | 610 | |
| 539-434-30 | AT203-1700 | 1700 | 1790 | 1918 | 1938 | | 650 | |
| 539-435-30 | AT203-1800 | 1800 | 1890 | 2018 | 2038 | | 670 | |
| 539-436-30 | AT203-2000 | 2000 | 2100 | 2228 | 2248 | | 740 | |
| 539-437-30 | AT203-2200 | 2200 | 2300 | 2428 | 2448 | | 800 | |
| 539-438-30 | AT203-2400 | 2400 | 2500 | 2628 | 2648 | 1314 | 1300 | 650 |
| 539-439-30 | AT203-2500 | 2500 | 2600 | 2728 | 2748 | 1364 | 1340 | 670 |
| 539-440-30 | AT203-2600 | 2600 | 2700 | 2828 | 2848 | 1414 | 1400 | 700 |
| 539-441-30 | AT203-2800 | 2800 | 2900 | 3028 | 3048 | 1514 | 1500 | 750 |
| 539-442-30 | AT203-3000 | 3000 | 3100 | 3228 | 3248 | 1614 | 1600 | 800 |

• AT203-100 to 3000



• AT203-3250 to 6000



| Order No. | Code | Effective range L ₀ (mm) | Maximum travel length L ₁ (mm) | Overall length L ₂ (mm) | L ₃ (mm) | L ₄ (mm) | No. of mounting blocks |
|-------------------|-------------------|-------------------------------------|---|------------------------------------|---------------------|---------------------|------------------------|
| 539-443-30 | AT203-3250 | 3250 | 3350 | 3464 | 1725 | 800 | 5 |
| 539-444-30 | AT203-3500 | 3500 | 3600 | 3714 | 1850 | 850 | |
| 539-445-30 | AT203-3750 | 3750 | 3850 | 3964 | 1975 | 930 | |
| 539-446-30 | AT203-4000 | 4000 | 4100 | 4214 | 2100 | 1000 | |
| 539-447-30 | AT203-4250 | 4250 | 4350 | 4464 | 2225 | 1050 | |
| 539-448-30 | AT203-4500 | 4500 | 4600 | 4714 | 2350 | 1100 | |
| 539-449-30 | AT203-4750 | 4750 | 4850 | 4964 | 2475 | 800 | |
| 539-450-30 | AT203-5000 | 5000 | 5100 | 5214 | 2600 | 830 | 7 |
| 539-451-30 | AT203-5250 | 5250 | 5350 | 5464 | 2725 | 870 | |
| 539-452-30 | AT203-5500 | 5500 | 5600 | 5714 | 2850 | 910 | |
| 539-453-30 | AT203-5750 | 5750 | 5850 | 5964 | 2975 | 950 | |
| 539-454-30 | AT203-6000 | 6000 | 6100 | 6214 | 3100 | 1000 | |

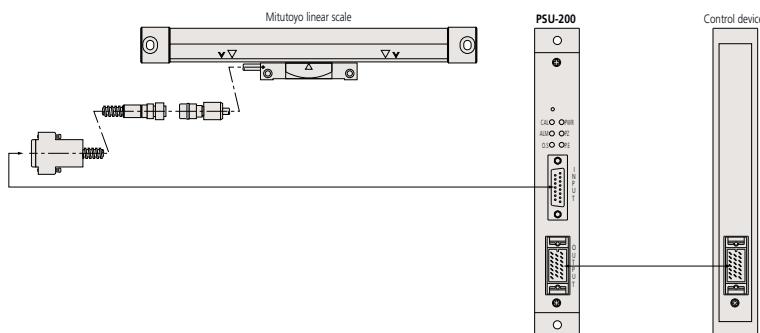
Interface Unit

Pulse signal conversion unit

PSU-200

- The PSU-200 splits the sinusoidal signal output by Mitutoyo linear scales into a minimum of four and a maximum of 200 divisions, and converts the signal to a square wave signal so that NC feedback systems, measurement control devices, etc., can be used with linear scales in order to achieve highly accurate positioning.

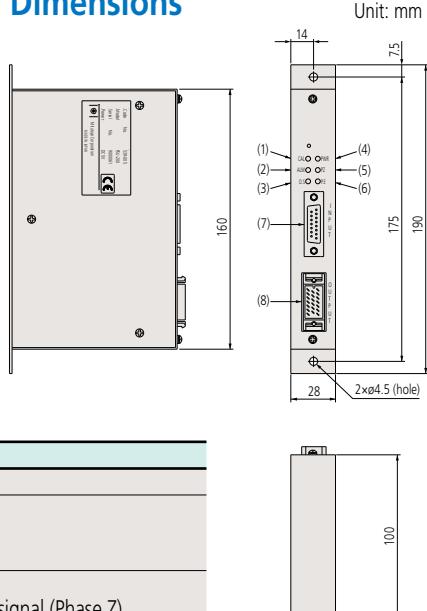
System configuration



Connector and indicator functions

| No. | Name | Function |
|-----|------------------|---|
| (1) | CAL light | Typically not used |
| (2) | ALM light | Turns on when broken wires or short circuits are detected, or when a signal abnormality is detected. |
| (3) | O.S. light | Turns on when over-speed is detected. |
| (4) | PWR light | Turns on only when power is supplied to the PSU. Power is supplied at 5VDC, from an external device. |
| (5) | PZ light | Turns on when the scale goes past the reference point. |
| (6) | P.E. light | Turns on when the +5VDC power supply voltage from the external device decreases, or if noise is detected. |
| (7) | INPUT connector | For connecting to the linear scale. |
| (8) | OUTPUT connector | Output connector for connecting to an external device. |

Dimensions



Specifications

| Item | Details of function |
|-----------------------|---|
| Number of axes | 1 axis |
| Input | Input connector DA-15S-NR (JAE) or equivalent Input signal: 2-phase sinusoidal signals and standard voltage Reference point signal, scale alarm signal |
| Output | Output connector MR-20RM (Honda Tsushin) Output signal: 2-phase square wave signals (Phase A, Phase B), reference point signal (Phase Z) Alarm signal, alarm reset signal, photocoupler |
| Number of divisions | 4, 8, 10, 20, 40, 80, 100, 200 (chosen with switch) |
| Function | Setting the number of divisions, setting the minimum edge interval, and maximum response speed Detection of broken wires or short circuits and abnormalities (alarm), detection of signal errors (alarm) Power supply voltage low alarm (warning light only), switching between high-impedance mode and alarm signal output mode. Reference position detection light, hysteresis width settings (directly linked to No. of divisions), external alarm reset input (photocoupler), switching directions |
| Power supply | 5VDC±5% |
| Current consumption | 200mA |
| Storage temperature | -20°C to 70°C |
| Operating temperature | 0°C to 50°C |
| Dimensions | Width 160mm x Thickness 28mm x Depth 100mm |
| Mass | Approx. 620g |

Mitutoyo

Output specifications

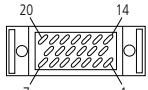
Output connector (pin type)
MR-20RM (Honda Tsushin Kogyo)

Applicable plug

Connector: MR-20F (Honda Tsushin Kogyo)

Case: MR-20L (Honda Tsushin Kogyo)

Standard accessories



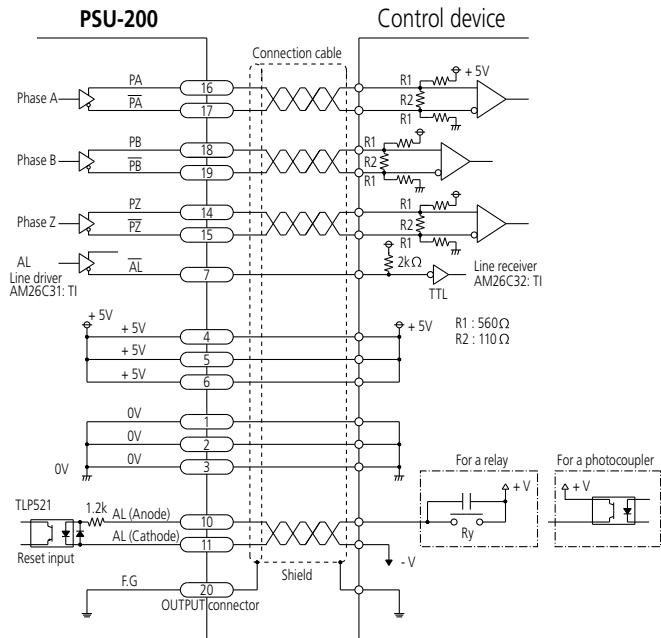
| Pin No. | Signal | Signal function |
|---------|---------------|-----------------|
| 1 to 3 | 0V | Signal GND |
| 4 to 6 | +5V | Power supply |
| 7 | ALM | Alarm output |
| 8, 9 | N.C. | |
| 10 | RST (Anode) | |
| 11 | RST (Cathode) | Reset input |
| 12, 13 | N.C. | |
| 14 | PZ | |
| 15 | PZ | Phase Z output |
| 16 | PA | |
| 17 | PA | Phase A output |
| 18 | PB | |
| 19 | PB | Phase B output |
| 20 | FG | Frame GND |

| No. of divisions | Minimum edge interval | Maximum response speed (m/min) | | | | Maximum input frequency (kHz) |
|------------------|-----------------------|--------------------------------|------|------|------|-------------------------------|
| | | 4μm | 10μm | 20μm | 40μm | |
| 4 | 62.5ns | 120 | 300 | 600 | 1200 | 500 |
| | 125 ns | 120 | 300 | 600 | 1200 | 500 |
| | 250 ns | 120 | 300 | 600 | 1200 | 500 |
| | 500 ns | 120 | 300 | 600 | 1200 | 500 |
| | 1000 ns | 60 | 150 | 300 | 600 | 250 |
| 8 | 62.5ns | 120 | 300 | 600 | 1200 | 500 |
| | 125 ns | 120 | 300 | 600 | 1200 | 500 |
| | 250 ns | 120 | 300 | 600 | 1200 | 500 |
| | 500 ns | 60 | 150 | 300 | 600 | 250 |
| | 1000 ns | 30 | 75 | 150 | 300 | 125 |
| 10 | 62.5ns | 120 | 300 | 600 | 1200 | 500 |
| | 125 ns | 120 | 300 | 600 | 1200 | 500 |
| | 250 ns | 96 | 240 | 480 | 960 | 400 |
| | 500 ns | 48 | 120 | 240 | 480 | 200 |
| | 1000 ns | 24 | 60 | 120 | 240 | 100 |
| 20 | 62.5ns | 120 | 300 | 600 | 1200 | 500 |
| | 125 ns | 96 | 240 | 480 | 960 | 400 |
| | 250 ns | 48 | 120 | 240 | 480 | 200 |
| | 500 ns | 24 | 60 | 120 | 240 | 100 |
| | 1000 ns | 12 | 30 | 60 | 120 | 50 |
| 40 | 62.5ns | 96 | 240 | 480 | 960 | 400 |
| | 125 ns | 48 | 120 | 240 | 480 | 200 |
| | 250 ns | 24 | 60 | 120 | 240 | 100 |
| | 500 ns | 12 | 30 | 60 | 120 | 50 |
| | 1000 ns | 6 | 15 | 30 | 60 | 25 |
| 80 | 62.5ns | 48 | 120 | 240 | 480 | 200 |
| | 125 ns | 24 | 60 | 120 | 240 | 100 |
| | 250 ns | 12 | 30 | 60 | 120 | 50 |
| | 500 ns | 6 | 15 | 30 | 60 | 25 |
| | 1000 ns | 3 | 7.5 | 15 | 30 | 12.5 |
| 100 | 62.5ns | 38.4 | 96 | 192 | 384 | 160 |
| | 125 ns | 19.2 | 48 | 96 | 192 | 80 |
| | 250 ns | 9.6 | 24 | 48 | 96 | 40 |
| | 500 ns | 4.8 | 12 | 24 | 48 | 20 |
| | 1000 ns | 2.4 | 6 | 12 | 24 | 10 |
| 200 | 62.5ns | 19.2 | 48 | 96 | 192 | 80 |
| | 125 ns | 9.6 | 24 | 48 | 96 | 40 |
| | 250 ns | 4.8 | 12 | 24 | 48 | 20 |
| | 500 ns | 2.4 | 6 | 12 | 24 | 10 |
| | 1000 ns | 1.2 | 3 | 6 | 12 | 5 |

The maximum response speed is limited by the scale response speed.

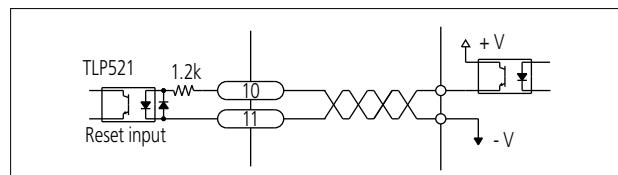
The minimum edge interval varies 0 to -10% based on the operating environmental conditions.

Arrangement of cable connections



- Connect the alarm reset input circuit so that the current is 3 to 10mA. Also, the device has an internal resistor (1.2kΩ), so by applying 5 to 12V with a pulse width of at least 100ms across the AL (anode)-AL (cathode), the alarm can be reset. When applying 12V or more, add an external resistance to limit the current to within the range stated above.
- Connection of alarm reset input when using a photocoupler

PSU-200



Interface Unit

Serial conversion unit

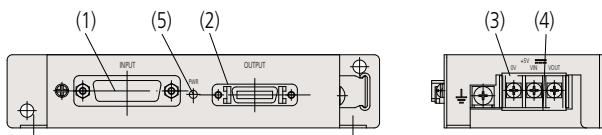
PSU-250 Series

- The PSU-250 series interface unit converts the sinusoidal signal output by Mitutoyo linear scales to a serial signal.
- The interface outputs serial data equivalent to 400 divisions from the signal (sinusoidal).
- The PSU-251 can be connected to Mitsubishi Electric Corporation's MR-J4/MR-J3 series servo amplifier.*¹
- The PSU-252 can be connected to Panasonic Corporation, Motor business unit's MINAS series servo amplifier.*¹



Connector and indicator functions

| No. | Name | Function |
|-----|------------------|--|
| (1) | INPUT connector | To connect the linear scale |
| (2) | OUTPUT connector | To connect the servo amplifier |
| (3) | Terminal block | Terminal block for input of 5VDC external power |
| (4) | Shorting link | Use when providing power from the servo amplifier. Do not use when not providing power from the servo amplifier |
| (5) | PWR light | Turns on when power is supplied to the PSU |



Specifications

| Order No. | 539-006 | 539-007 |
|-----------------------|--|---|
| Item | PSU-251 | PSU-252 |
| Number of axes | 1 axis | 1 axis |
| Input specifications | 2-phase sinusoidal signals and standard voltage, reference signal, scale alarm signal Maximum input frequency: 500kHz | |
| Output specifications | Mitsubishi Electric Corporation MR-J4/MR-J3 series High-speed serial data* ¹ | Panasonic Corporation, Motor business unit MINAS-A5, A5L, A5N, A5NL series* ¹ MINAS-A4, A4P, A4N, A4NL series* ¹ |
| Number of divisions | 400 divisions | |
| Function | Alarm detection: Broken wires, short circuits in the scale and abnormalities. Alarm output: Status data is output through serial communication and the PWR light blinks Also, the PWR light turns on. | |
| Power supply | Power supply from the servo amplifier: 5VDC±5% External power supply: 5VDC±5% Power supply is selected with the shorting link for the terminal block used to supply external power. To choose a servo amplifier or external power supply, please refer to the servo amplifier power specifications (in particular, the maximum supplied current) and the power supply specifications of the scale that is used. | |
| Current consumption | 150mA (not including the scale) | |
| Storage temperature | - 20°C to 70°C | |
| Operating temperature | 0°C to 40°C | |

*¹ For details regarding the applicable system, please consult with the individual manufacturer.

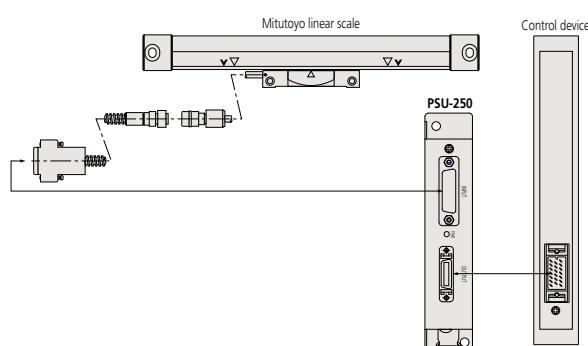
Resolution and maximum response speed when the scale is connected

| Scale model | Resolution | Maximum response speed |
|-------------|------------|----------------------------------|
| AT103 | 0.05 μm | 2000mm/s (830mm/s)* ² |
| AT113 | 0.05 μm | 2000mm/s |
| AT112 | 0.05 μm | 830mm/s |
| AT181 | 0.05 μm | 830mm/s |
| ST36A | 0.01 μm | 1200mm/s |
| ST24C | 0.025μm | 1200mm/s |
| ST46 | 0.05 μm | 2600mm/s |
| ST422 | 0.01 μm | 5000mm/s |

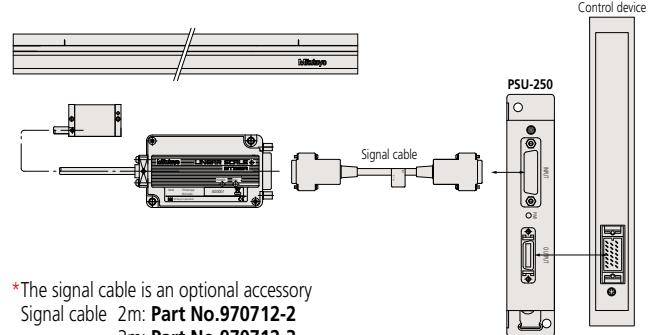
*² Response speeds for effective ranges of 3250mm or more

System configuration

- When connecting an AT scale



- When connecting an ST scale



Input specifications

- INPUT connector

- Connector (socket type): RDAD-15S-LNA (Hirose Electric)
- Applicable plug: HDAB-15P (Hirose Electric)

| Pin No. | Signal | Signal function |
|---------|--------|------------------|
| 1, 2 | 0V | Signal ground |
| 3, 4 | +5V | Power supply |
| 5 | PA | Phase A |
| 6 | PB | Phase B |
| 7 | Vref | Standard voltage |
| 8 | PZ | Phase Z |
| 9 | AL | Scale alarm |
| 10 - 14 | N.C | Not used |
| 15 | F.G | Frame ground |

- Terminal block for input of external power

| Pin No. | Signal | Signal function |
|---------|---------|-------------------|
| 1 | +5V OUT | +5V power output* |
| 2 | +5V IN | +5V power input* |
| 3 | 0V | Signal ground |
| 4 | F.G | Frame ground |

*When using the power supplied by the servo amplifier (supplied through output connector)
short Pin Nos. 1 and 2 using the attached shorting link.

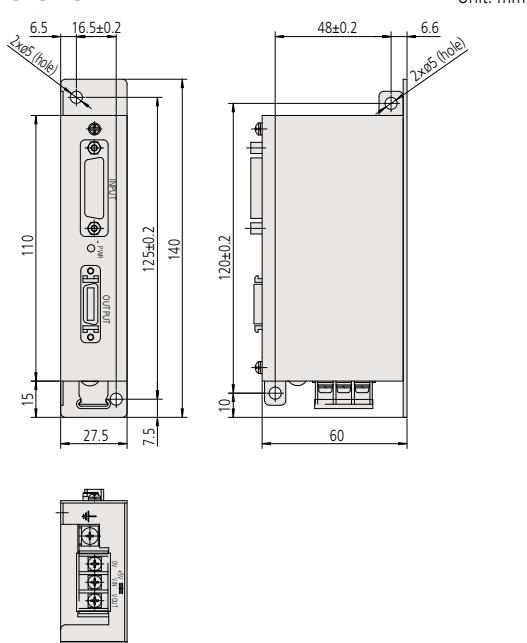
Output specifications

- OUTPUT connector

- Connector (socket type) 10220-52A2VC(3M)
- Applicable plug: 10120-3000VE(3M)

| Pin No. | Signal | Signal function |
|--------------|--------|-----------------------------|
| 1, 2, 11, 12 | 0V | Signal ground |
| 18, 19, 20 | +5V | +5V power |
| 6, 8 - 10 | N.C | Not used |
| 7 | RQ/DT | Standard phase request/data |
| 17 | RQ/DT | Reverse phase request/data |
| 3 | PA | Test signal |
| 4 | PB | Test signal |
| 5 | PZ | Test signal |
| 13 - 16 | N.C | Not used |

Dimensions



Absolute Scale Unit



Scale Format

| Applicable Systems ^{*1} | | Resolution | | |
|--|---|---------------------------------|----------------------------------|-------------------|
| | | 0.005μm ^{*2} | 0.05μm | 0.1μm |
| FANUC Ltd. NC control device | FS-i Series, POWER Mate i | ABS AT555 | ABS AT553 ABS AT353 | ABS ST758 |
| Mitsubishi Electric Corporation MITSUBISHI CNC Series | Applicable amplifier: MDS-D/MDS-DH Series | ABS AT545 | ABS AT543 ABS AT343 | ABS ST748 |
| Mitsubishi Electric Corporation MELSERVO Series | MR-J4/MR-J3 Series | ABS AT545A^{*3} | ABS AT543 ABS AT343 | ABS ST748A |
| Yaskawa Electric Corporation Σ-V, Σ-III Series | Servopack: SGDV, SGDS | — | — | ABS ST788A |
| Panasonic Corporation, Motor business unit MINAS Series | MINAS-A5, A5L, A5N, A5NL Series MINAS-A4, A4P, A4N, A4NL Series | — | ABS AT573A | ABS ST778A |
| Servo Amplifier supporting Mitutoyo ENSIS Interface | Nikki Denso Co., Ltd. VCII / VC / VPS Series Servaland Corporation SVF Series PMAC JAPAN Co., Ltd. UMAC-Turbo PMAC2 | — | ABS AT503A ABS AT303A | ABS ST708A |
| | Other control device manufacturers | ABS AT505 ABS AT505A | ABS AT503 ABS AT303 | |

*1 For details regarding the applicable system, please consult with the individual manufacturer.

*2 For the AT300 series, 0.005μm resolution is possible to special order.

*3 Only for the MR-J4/MR-J3 series

Specifications

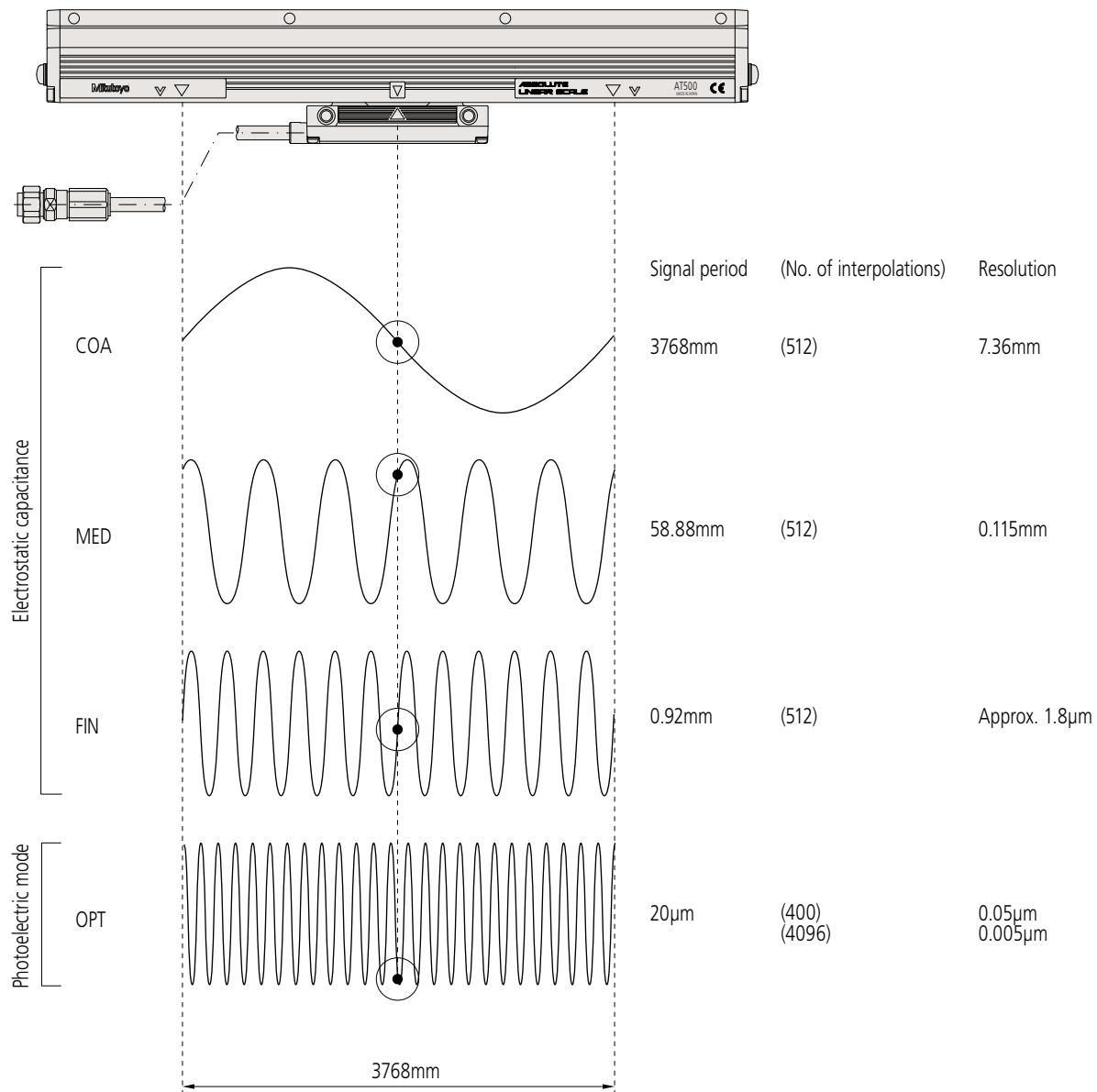
| Series | Scale Type | Maximum effective range | Maximum response speed | Accuracy (20°C) ^{*5} |
|-------------------------------|---------------|-------------------------|--------------------------------|--|
| ABS ST700 Compact Type Series | Separate Type | 6000mm | 5m/s | (5+5Lo/1000) μm |
| | | 2200mm | 2.5m/s | (3+3Lo/1000) μm |
| | Assembly Type | 1000mm | 2.5m/s (1.2m/s ^{*4}) | (2+2Lo/1000) μm |
| | | 350mm | | |
| ABS AT300 Series | Assembly Type | 3000mm | 2m/s (1.8m/s ^{*4}) | (3+3Lo/1000) μm However, at 1600mm (or greater) stroke is (5+5Lo/1000) μm |

*4 Maximum response speed of 0.005μm resolution type

*5 Lo=effective range (mm); scale base type accuracy for the ST700 compact type series

Absolute system, linear scale principle (e.g. ABS AT500 Series, ABS AT300 Series)

[Figure 1]



Absolute Scale Unit

As shown in Figure 1, when power is supplied to the linear scale the COA signal position is detected, and based on this the MED wavelength and position is detected.

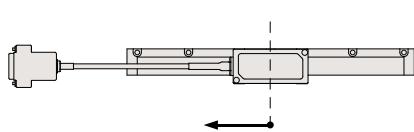
In the same way, from the microprocessor that detects the FIN and OPT signal positions, an ultimate absolute value of resolution of 0.05µm/0.005µm is obtained.

Direction of absolute unit scale data increase

- ABS ST700 Compact Type Series

- ABS AT500 Series

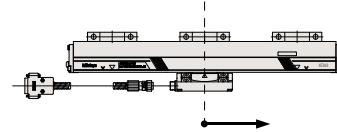
- ABS AT300 Series



The data will increase when the detector moves in this direction.



The data will increase when the detector moves in this direction.



The data will increase when the detector moves in this direction.

Separate Type ABS ST Series

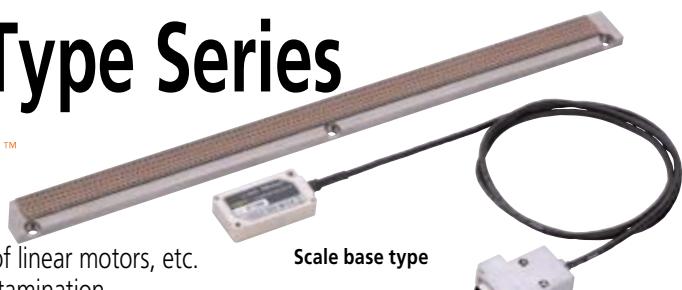
Absolute Scale Unit (High environmental resistance type)

ABS ST700 Compact Type Series

ABSOLUTE™

Features

- Absolute measurement with separate type scales
- Non-contact detection is optimal for high speed and high acceleration of linear motors, etc.
- Electromagnetic induction principle means scales are unaffected by contamination
- The detector head is approximately 1/3 the previous model size: 50mm (W) × 28mm (D) × 11mm (H)
- Cable outlets can be in four directions, with mounting holes on the top and sides
- Accuracy (5+5L/1000)µm (glass scale: (3+3L/1000)µm) is realized (previous models: (8+5L/1000) µm)
*L: Effective range (mm)
- Compatible with servo amplifiers from a range of companies (high-speed serial interfaces)



Scale base type



Glass scale type

How to read the code

ABS ST7 0 8 A L - 100 A - R

Absolute type

Series

Separate type Absolute linear scale

ABS ST700 compact type series (effective range ≤ 3m)

ABS ST700L compact type series (3.2m ≤ effective range ≤ 6m)

Interface specification^{*1}

0: For Mitutoyo ENSIS high-speed serial

ABS ST708A, ST708AL

4: Mitsubishi Electric Corporation high-speed serial

ABS ST748A, ST748AL

ABS ST748, ST748L

5: FANUC Ltd. high-speed serial

ABS ST758, ST758L

7: Panasonic Corporation, Motor business unit high-speed serial

ABS ST778A, ST778AL

8: Yaskawa Electric Corporation high-speed serial

ABS ST788A, ST788AL

A: Scale base type

C: Glass scale type

Blank: 100mm to 3000mm

L: 3200mm to 6000mm

Effective range: 100mm to 6000mm

Head cable outlets

R: Right

L: Left

U: Up

D: Down

Communication method

A: 2 wire

Blank: 4 wire

Detector head shape and resolution

8: Shape 50mm (W) × 28mm (D) × 11mm (H)

Resolution 0.1µm

9: Resolution 0.05µm (special order)

Applicable interfaces

| | |
|-------------------------------------|---|
| Applicable interfaces ^{*1} | FANUC Ltd. FS-i Series, POWER Mate i Series |
| | Mitsubishi Electric Corporation MELSERVO MR-J4/MR-J3 Series |
| | Mitsubishi Electric Corporation CNC Series MDS-D/MDS-DH Series |
| | Yaskawa Electric Corporation Σ -V Series, Σ - III Series |
| | Panasonic Corporation, Motor business unit MINAS-A5, A5L, A5N, A5NL Series, MINAS-A4, A4P, A4N, A4NL Series |
| | Mitutoyo Corporation ENSIS ^{*2} |
| | Nikki Denso Co., Ltd. VC II / VC / VPS Series |
| | Servoland Corporation SVF Series |
| | PMAC JAPAN Co., Ltd. UMAC-Turbo PMAC2 |
| | |

*1 For details (connectivity) regarding the applicable system, please consult with the individual manufacturer.

*2 ENSIS is a registered trademark of Mitutoyo Corporation.

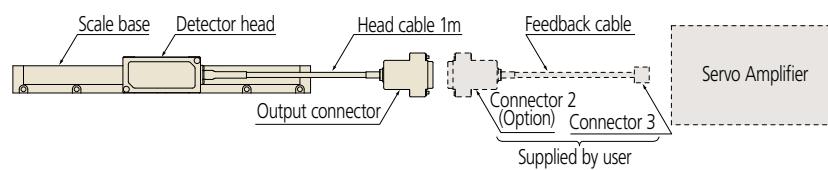
Mitutoyo

Specifications

| Item | Scale Type | Scale base type | Glass scale type |
|--|--|--|------------------|
| Resolution | 0.1µm (0.05µm: special order) | | |
| Detection method | Electromagnetic induction | Absolute position detection method* | |
| Shape | Separate type scale | | |
| Effective range (accuracy guarantee range) | 100 to 3000mm / 3200 to 6000mm | 100 to 1100mm | |
| Accuracy (20°C) | (5+5L/1000) µm L: Effective range mm | (3+3L/1000) µm L: Effective range mm | |
| Maximum feed speed | 5 m/s | | |
| Thermal expansion coefficient | (12.0±1.5) × 10 ⁻⁶ /°C (when attached to material equivalent to steel) | (8±1.0) × 10 ⁻⁶ /°C | |
| Operating conditions | Temperature Humidity | 0 to 50°C 20 to 80%RH | |
| Storage conditions | Temperature Humidity | -20 to 70°C 20 to 80%RH | |
| Power supply voltage | 5V±10% (at the detector head) (Ripple and spike noise should not exceed 100mV) | | |
| Current consumption | 270mA (Max.) | | |
| Vibration resistance | 300m/s ² (55 to 2000Hz) | 100m/s ² (55 to 2000Hz) | |
| Shock resistance | 500m/s ² (half-sine, 11ms) | 150m/s ² (half-sine, 11ms) | |
| Head cable | Length/cable diameter | 1m / ø3.8mm (high-flex cable) | |
| | Connector | 1) D-sub (15-pin pin type) connector (not waterproof) 2) D-sub (9-pin socket type) connector (not waterproof); for ST788A | |
| Maximum signal cable length | | Up to 29m (head cable length included) (Please consult the user's manual) | |
| Detector mounting | | 1 location each on top and sides | |
| Direction of cable outlet | | 4 sides (top, bottom, left, right) can be selected | |
| EMC standard | | CE mark standard | |

Note: If considering using in an environment in which cutting fluid, etc., is used, please consult our nearest sales department.

System configuration



Feedback cable

Yaskawa Electric Corporation serial cable can be used as the feedback cable for connecting to the Yaskawa Electric Corporation servo amplifier.
Cable type number: JZSP-CLP70-□□-E (03,05,10,15,20)

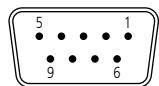
When wishing to connect a feedback cable to the Mitsubishi Electric Corporation MR-J4/MR-J3 series, please reference the code numbers below and order from our company.

For the MR-J4/MR-J3 series 5m: No.06ACF117A
10m: No.06ACF117B

Output specifications

• ST788A (L)

Output connector (socket type)



D-sub 9-pin

Applicable connector

17JE-23090-02 (D2C) (DDK)

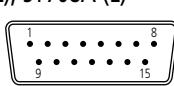
Alternately, an equivalent product (D-sub series) can be used

| Pin No. | Signal |
|-----------------|-----------|
| 1 | +5V (Vcc) |
| 2 | RQ/DT (S) |
| 3 | +5V (Vcc) |
| 4 | N.C |
| 5 | 0V (GND) |
| 6 | RQ/DT (S) |
| 7 | N.C |
| 8 | N.C |
| 9 | 0V (GND) |
| Connector shell | F.G |

Note: Leave test terminals (Pin No. 7 and 8) disconnected during use.

• ST748A (L), ST778A (L), ST708A (L)

Output connector (pin type)



D-sub 15-pin

Applicable connector

HDAB-15S (Hirose Electric)

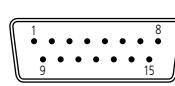
Alternately, an equivalent product (D-sub series) can be used

| Pin No. | Signal |
|-----------------|----------|
| 1 | 0V (GND) |
| 2 | 0V (GND) |
| 3 | +5V |
| 4 | +5V |
| 5 | N.C |
| 6 | N.C |
| 7 | RQ/DT |
| 8 | RQ/DT |
| 9 | N.C |
| 10 | N.C |
| 11 | +5V |
| 12 | N.C |
| 13 | 0V (GND) |
| 14 | N.C |
| 15 | F.G |
| Connector shell | F.G |

Note: Leave test terminals (Pin No. 9 and 10) disconnected during use.

• ST748 (L), ST758 (L)

Output connector (pin type)



D-sub 15-pin

Applicable connector

HDAB-15S (Hirose Electric)

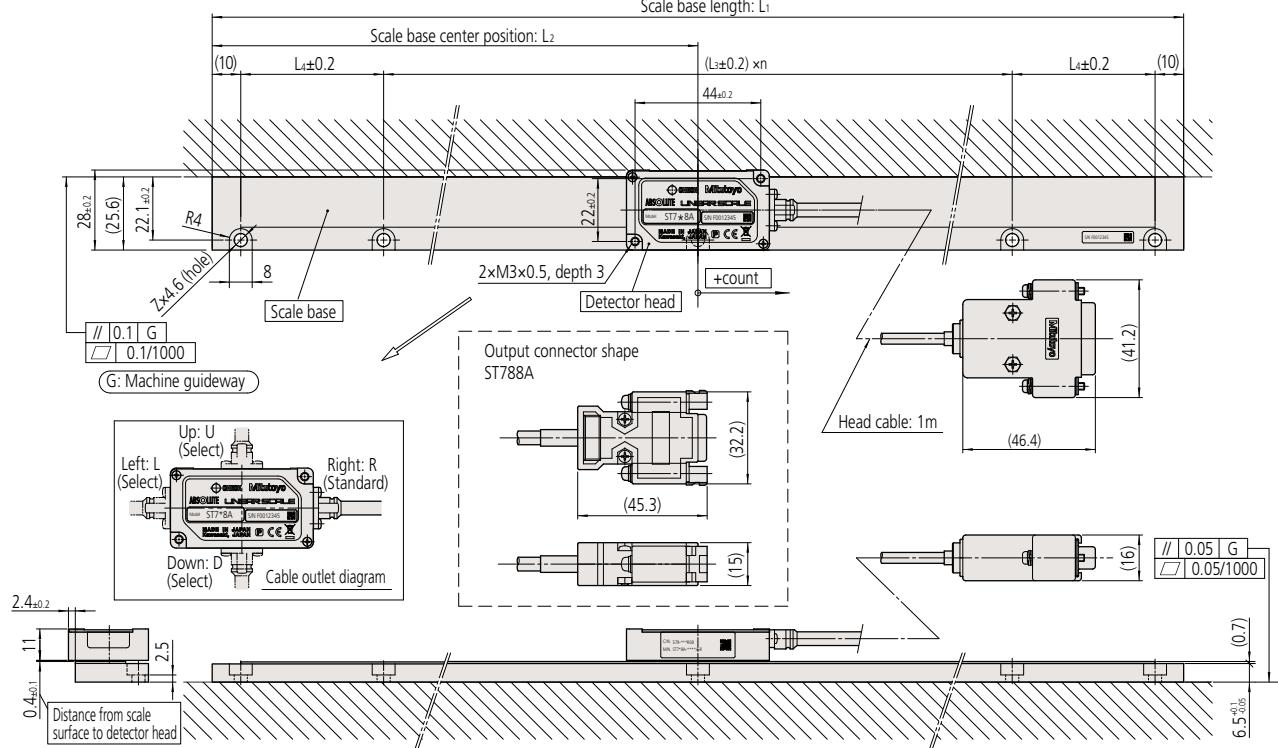
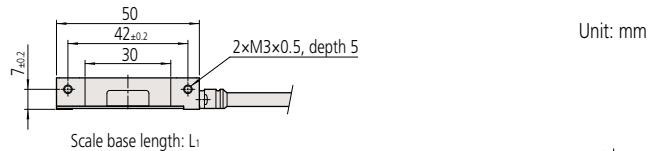
Alternately, an equivalent product (D-sub series) can be used

| Pin No. | Signal |
|-----------------|----------|
| 1 | 0V (GND) |
| 2 | 0V (GND) |
| 3 | +5V |
| 4 | +5V |
| 5 | DT |
| 6 | DT |
| 7 | RQ |
| 8 | RQ |
| 9 | N.C |
| 10 | N.C |
| 11 | +5V |
| 12 | N.C |
| 13 | 0V (GND) |
| 14 | N.C |
| 15 | F.G |
| Connector shell | F.G |

Note: Leave test terminals (Pin No. 9 and 10) disconnected during use.

Mounting dimensions

- Scale base type (100 to 3000mm)



Dimensions

| Order No. | Code | Effective range (mm) | Maximum travel length (mm) | L ₁ (mm) | L ₂ (mm) | L ₃ (mm) | n | L ₄ (mm) | No. of mounting holes Z |
|-------------|-------------------|----------------------|----------------------------|---------------------|---------------------|---------------------|----|---------------------|-------------------------|
| 579-301*□ 8 | ST7△8 (A)-100A-* | 100 | 110 | 180 | 90 | 80 | | — | 3 |
| 579-302*□ 8 | ST7△8 (A)-200A-* | 200 | 210 | 280 | 140 | 130 | | | |
| 579-303*□ 8 | ST7△8 (A)-300A-* | 300 | 310 | 380 | 190 | 180 | | | |
| 579-304*□ 8 | ST7△8 (A)-400A-* | 400 | 410 | 480 | 240 | 230 | | | |
| 579-305*□ 8 | ST7△8 (A)-500A-* | 500 | 510 | 580 | 290 | | 2 | 80 | |
| 579-306*□ 8 | ST7△8 (A)-600A-* | 600 | 610 | 680 | 340 | | | 130 | |
| 579-307*□ 8 | ST7△8 (A)-700A-* | 700 | 710 | 780 | 390 | | | 180 | |
| 579-308*□ 8 | ST7△8 (A)-800A-* | 800 | 810 | 880 | 440 | | | 230 | |
| 579-309*□ 8 | ST7△8 (A)-900A-* | 900 | 910 | 980 | 490 | | | | |
| 579-310*□ 8 | ST7△8 (A)-1000A-* | 1000 | 1010 | 1080 | 540 | | | | |
| 579-311*□ 8 | ST7△8 (A)-1100A-* | 1100 | 1110 | 1180 | 590 | | | | |
| 579-312*□ 8 | ST7△8 (A)-1200A-* | 1200 | 1210 | 1280 | 640 | | | | |
| 579-313*□ 8 | ST7△8 (A)-1300A-* | 1300 | 1310 | 1380 | 690 | | | | |
| 579-314*□ 8 | ST7△8 (A)-1400A-* | 1400 | 1410 | 1480 | 740 | | 4 | 80 | |
| 579-315*□ 8 | ST7△8 (A)-1500A-* | 1500 | 1510 | 1580 | 790 | | | 130 | |
| 579-316*□ 8 | ST7△8 (A)-1600A-* | 1600 | 1610 | 1680 | 840 | | | 180 | |
| 579-317*□ 8 | ST7△8 (A)-1700A-* | 1700 | 1710 | 1780 | 890 | | | 230 | |
| 579-318*□ 8 | ST7△8 (A)-1800A-* | 1800 | 1810 | 1880 | 940 | | | | |
| 579-319*□ 8 | ST7△8 (A)-1900A-* | 1900 | 1910 | 1980 | 990 | | | | |
| 579-320*□ 8 | ST7△8 (A)-2000A-* | 2000 | 2010 | 2080 | 1040 | | | | |
| 579-321*□ 8 | ST7△8 (A)-2100A-* | 2100 | 2110 | 2180 | 1090 | | | | |
| 579-322*□ 8 | ST7△8 (A)-2200A-* | 2200 | 2210 | 2280 | 1140 | | | | |
| 579-323*□ 8 | ST7△8 (A)-2300A-* | 2300 | 2310 | 2380 | 1190 | | 10 | 80 | |
| 579-324*□ 8 | ST7△8 (A)-2400A-* | 2400 | 2410 | 2480 | 1240 | | | 130 | |
| 579-325*□ 8 | ST7△8 (A)-2500A-* | 2500 | 2510 | 2580 | 1290 | | | 180 | |
| 579-326*□ 8 | ST7△8 (A)-2600A-* | 2600 | 2610 | 2680 | 1340 | | | 230 | |
| 579-327*□ 8 | ST7△8 (A)-2700A-* | 2700 | 2710 | 2780 | 1390 | | | | |
| 579-328*□ 8 | ST7△8 (A)-2800A-* | 2800 | 2810 | 2880 | 1440 | | | | |
| 579-329*□ 8 | ST7△8 (A)-2900A-* | 2900 | 2910 | 2980 | 1490 | | 14 | 80 | |
| 579-330*□ 8 | ST7△8 (A)-3000A-* | 3000 | 3010 | 3080 | 1540 | | | 130 | 17 |

The △ code indicates the interface specification (0, 4, 5, 7, 8).

The Order No. and the * code indicate the direction of the head cable (R, L, U, D).

The □ in the Order No. is as described below.

ST708A: 0

ST748A: 4

ST748: 3

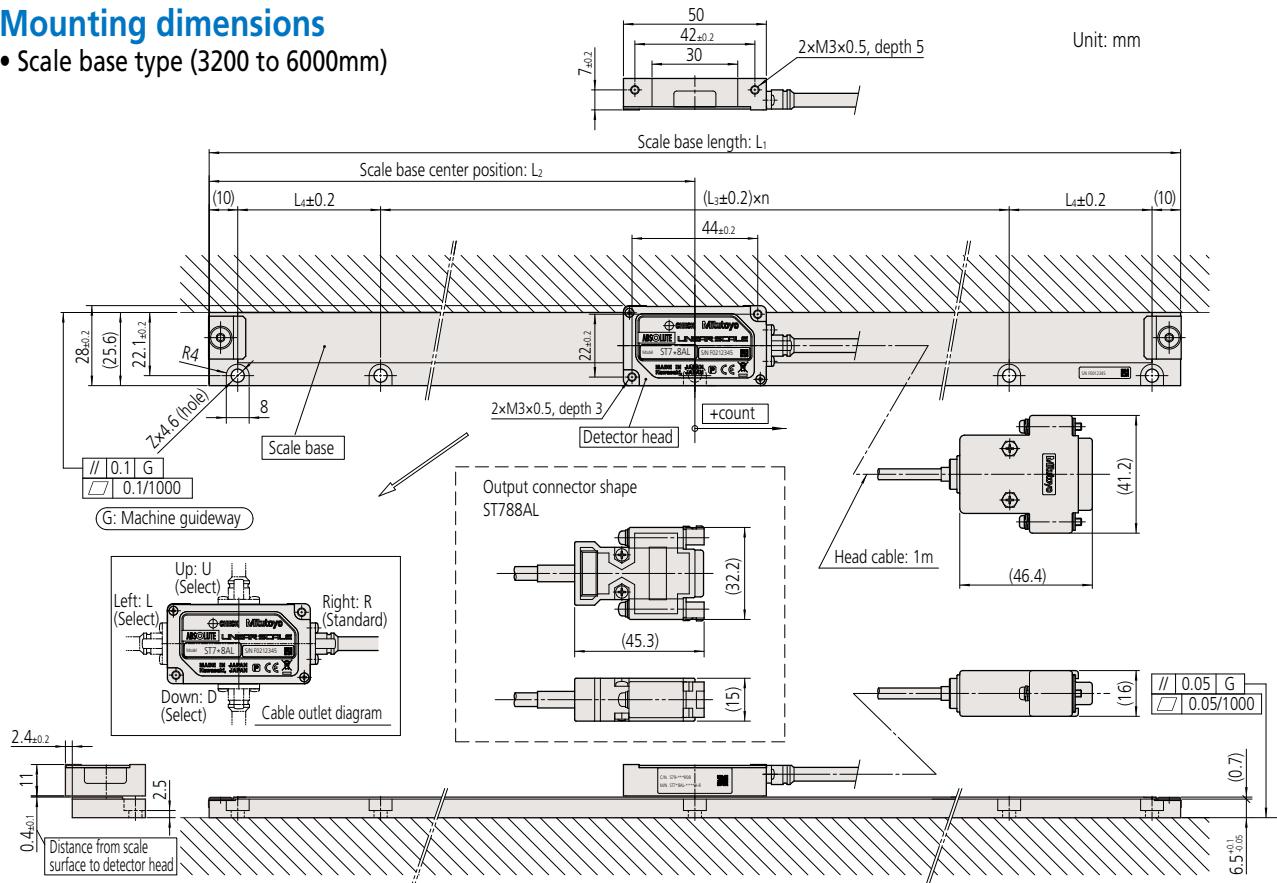
ST758: 5

ST778A: 7

ST788A: 8

Mounting dimensions

- Scale base type (3200 to 6000mm)



Dimensions

| Order No. | Code | Effective range (mm) | Maximum travel length (mm) | L_1 (mm) | L_2 (mm) | L_3 (mm) | n | L_4 (mm) | Z |
|--------------|---------------------|----------------------|----------------------------|------------|------------|------------|-----|------------|-----|
| 579-331* □ 8 | ST7◇8 (A) L-3200A-* | 3200 | 3210 | 3280 | 1640 | 200 | 14 | 230 | 17 |
| 579-332* □ 8 | ST7◇8 (A) L-3400A-* | 3400 | 3410 | 3480 | 1740 | | 16 | 130 | 19 |
| 579-333* □ 8 | ST7◇8 (A) L-3600A-* | 3600 | 3610 | 3680 | 1840 | | 16 | 230 | 19 |
| 579-334* □ 8 | ST7◇8 (A) L-3800A-* | 3800 | 3810 | 3880 | 1940 | | 18 | 130 | 21 |
| 579-335* □ 8 | ST7◇8 (A) L-4000A-* | 4000 | 4010 | 4080 | 2040 | | 18 | 230 | 21 |
| 579-336* □ 8 | ST7◇8 (A) L-4200A-* | 4200 | 4210 | 4280 | 2140 | | 20 | 130 | 23 |
| 579-337* □ 8 | ST7◇8 (A) L-4400A-* | 4400 | 4410 | 4480 | 2240 | | 20 | 230 | 23 |
| 579-338* □ 8 | ST7◇8 (A) L-4600A-* | 4600 | 4610 | 4680 | 2340 | | 22 | 130 | 25 |
| 579-339* □ 8 | ST7◇8 (A) L-4800A-* | 4800 | 4810 | 4880 | 2440 | | 22 | 230 | 25 |
| 579-340* □ 8 | ST7◇8 (A) L-5000A-* | 5000 | 5010 | 5080 | 2540 | | 24 | 130 | 27 |
| 579-341* □ 8 | ST7◇8 (A) L-5200A-* | 5200 | 5210 | 5280 | 2640 | | 24 | 230 | 27 |
| 579-342* □ 8 | ST7◇8 (A) L-5400A-* | 5400 | 5410 | 5480 | 2740 | | 26 | 130 | 29 |
| 579-343* □ 8 | ST7◇8 (A) L-5600A-* | 5600 | 5610 | 5680 | 2840 | | 26 | 230 | 29 |
| 579-344* □ 8 | ST7◇8 (A) L-5800A-* | 5800 | 5810 | 5880 | 2940 | | 28 | 130 | 31 |
| 579-345* □ 8 | ST7◇8 (A) L-6000A-* | 6000 | 6010 | 6080 | 3040 | | 28 | 230 | 31 |

The ◇ code indicates the interface specification (0,4,5,7,8).

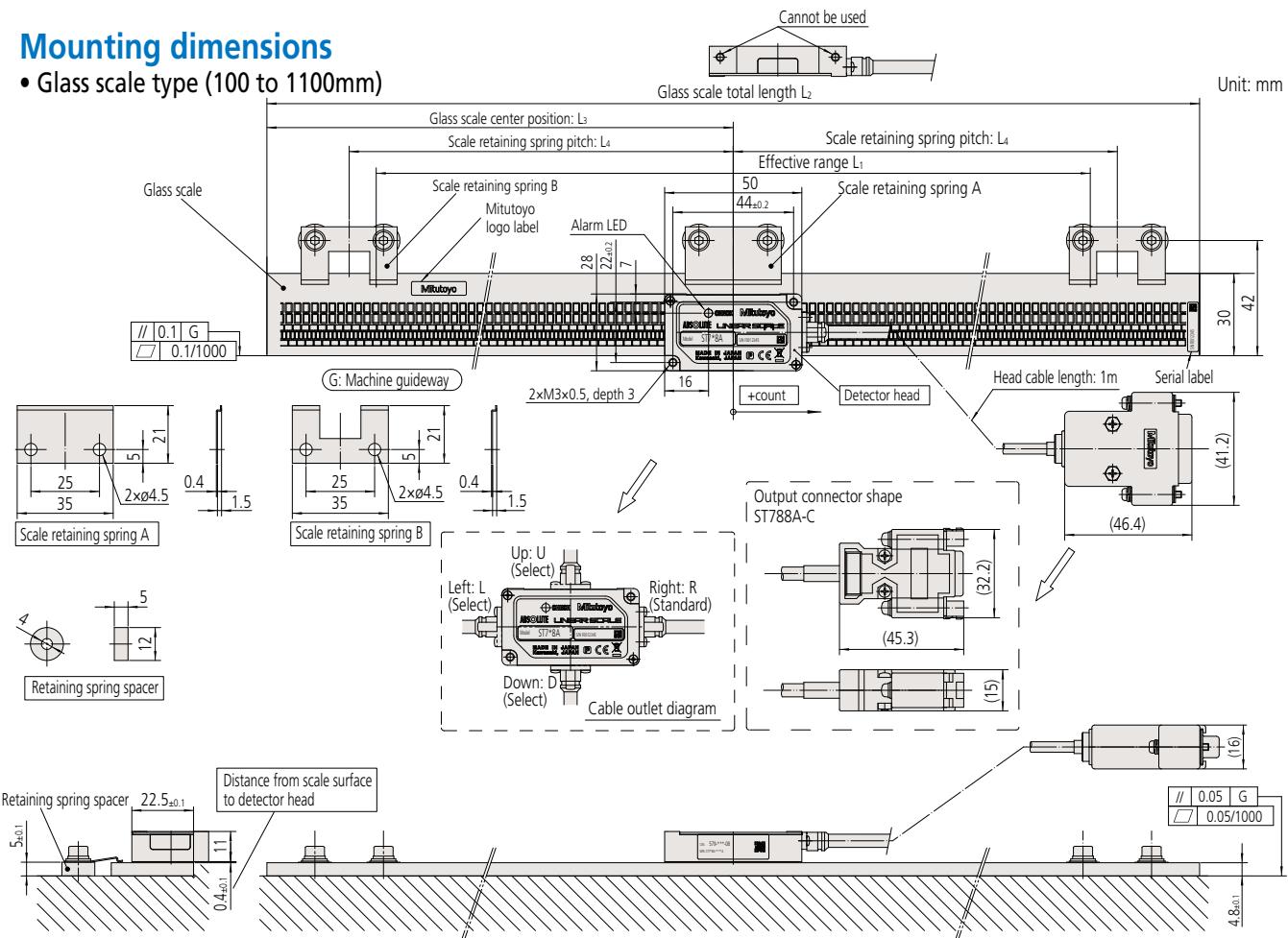
The Order No. and the * code indicate the direction of the head cable (R, L, U, D).

The □ in the Order No. is as described below.

ST708AL: 0
 ST748AL: 4
 ST748L: 3
 ST758L: 5
 ST778AL: 7
 ST788AL: 8

Mounting dimensions

- Glass scale type (100 to 1100mm)



Dimensions

- Glass scale type (100 to 1100mm)

| Order No. | Code | Effective range L_1 (mm) | L_2 (mm) | L_3 (mm) | L_4 (mm) | No. of scale retaining springs A | No. of scale retaining springs B | No. of retaining spring spacers |
|--------------|------------------|----------------------------------|---------------|---------------|---------------|--|--|---------------------------------------|
| 579-351* □ 8 | ST7 □ 8A-100C-* | 100 | 175 | 87.5 | 65 | 1 | 2 | 6 |
| 579-352* □ 8 | ST7 □ 8A-200C-* | 200 | 275 | 137.5 | 115 | | | |
| 579-353* □ 8 | ST7 □ 8A-300C-* | 300 | 375 | 187.5 | 160 | | 4 | 10 |
| 579-354* □ 8 | ST7 □ 8A-400C-* | 400 | 475 | 237.5 | 105 | | | |
| 579-355* □ 8 | ST7 □ 8A-500C-* | 500 | 575 | 287.5 | 127.5 | | | |
| 579-356* □ 8 | ST7 □ 8A-600C-* | 600 | 675 | 337.5 | 152.5 | | | |
| 579-357* □ 8 | ST7 □ 8A-700C-* | 700 | 775 | 387.5 | 120 | | | |
| 579-358* □ 8 | ST7 □ 8A-800C-* | 800 | 875 | 437.5 | 135 | | | |
| 579-359* □ 8 | ST7 □ 8A-900C-* | 900 | 975 | 487.5 | 150 | | | |
| 579-360* □ 8 | ST7 □ 8A-1000C-* | 1000 | 1075 | 537.5 | 125 | | | |
| 579-361* □ 8 | ST7 □ 8A-1100C-* | 1100 | 1200 | 600 | 140 | | | |

The order No. and the * code indicate the direction of the head cable (R, L, U, D).

The order No. and the □ code specify the interface specification (0, 4, 5, 7, 8).

Note: A thin type (adhesive fixing specification) is available to special order.

Signal Adjusting Method When Mounting ABS ST700 Series

- In order to perform signal adjustment and confirmation after the unit is mounted, conditioning is necessary using a PC and application software (ABS ST700 Signal Adjustment Program). (For conditioning, allow a travel distance of at least 60mm.) The following settings and confirmation are possible with this software:
 - 1) Scale signal automatic adjustment → It is necessary to mount the scale base and detector head detector with specified dimensions.
 - 2) Scale signal amplitude (signal strength) confirmation
 - 3) Scale origin (absolute position data of zero) setting
 - 4) Absolute position data confirmation
 - 5) Error history clear
 - 6) ABS resultant error checking (effective range 3200mm to 6000mm)

• Required items

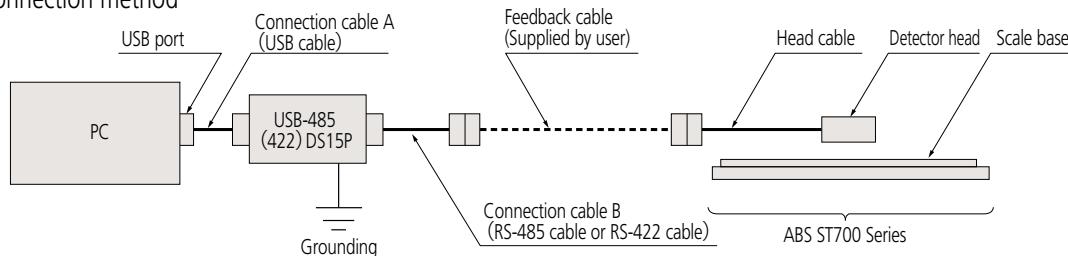
| Item | Quantity | Details | Notes |
|----------------------|----------|---|--------------------|
| PC* | 1 | DOS/V (Windows version) | Provided by user |
| Conversion unit | 1 | USB-485(422)DS15P (System Saicom Industry Corp.) | Option (bundle) |
| Connection cable A | 1 | USB cable | |
| Connection cable B | 1 | RS-485 cable or RS-422 cable | |
| Application software | 1 | ABS ST700 Signal Adjustment Program | |

* This program requires a PC with the following operating environment.
 PC: DOS/V with Pentium 200 MHz or faster (with USB port)
 Memory: 64MB min. (128MB recommended)
 Program size: 10MB
 OS: Windows95 or later
 Monitor: 256 colors, 800x600 or higher (1024x768 or higher is recommended)
 USB: COM1 is normally used (other ports can also be used)

• "Conversion unit, application software" set

| Set No. | Applicable model | Conversion unit | Connection cable B |
|-----------------|--|---------------------------|--------------------|
| 06ADZ751 | ST70 □ A, ST70 □ AL | USB-485 DS15P (main unit) | MIT cable |
| 06ADT457 | ST74 □ A, ST74 □ AL | USB-485 DS15P (main unit) | MEL-J4/J3 cable |
| 06ADP485 | ST77 □ A, ST77 □ AL ST78 □ A, ST78 □ AL | USB-485 DS15P (main unit) | Y/MAT cable |
| 06ADZ752 | ST74 □ , ST74 □ L | USB-422 DS15P (main unit) | MDS cable |
| 06ADR760 | ST75 □ , ST75 □ L | USB-422 DS15P (main unit) | FUNAC cable |

• Connection method



- * To prevent the possibility of electric shock the device must be grounded.
- * When using Part No.06ADZ751, connect the head cable and the connection cable B together.
- * The conversion unit's power source is supplied via connection cable A from the PC USB port.
- * In the "Applicable model" column, 1,2,3,4,8,9 apply to □. Prepare the appropriate conversion unit and connection cable B for the scale to be used.

Compatibility of Detector Head and Main Scale

- Note that for the ST700 series (compact type) with an effective range 3000 mm or less or 3200 mm or more, the main scale and the detector head are different so they are not compatible.
- The communication standards are different for the ST7 □ □ (L) and ST7 □□ A (L), so they are not compatible.

| Main scale | Detector head |
|---|---|
| For effective range of 3200mm to 6000mm | ← Compatible → For effective range of 3200mm to 6000mm |
| For effective range of 3000mm or less | ← Not compatible → For effective range of 3000mm or less |

Assembly Type ABS AT Series

Absolute Scale Unit (Slim Spar Type)

ABS AT500 Series

(Resolution 0.005μm)



Features

- This scale achieves the Absolute Linear Scale's highest level resolution of 0.005 μm
- The ABS AT500-S Series realizes vibration resistance of 196m/s² (20G) and shock-resistance of 343m/s² (35G), suitable for use with heavy cutting equipment and for high-speed machining.
- The ABS AT500-H Series has high repeatability, excellent temperature characteristics, and enables highly accurate and stable positioning.
- Slim shape is suitable for space-saving designs.
- Compatible with servo amplifiers from a range of companies (high-speed serial interfaces).

How to read the code

ABS AT5 □ 5 □ - □ □ □ - □ □

Effective range

Interface specification

| Applicable systems | Scale code |
|---|-------------------------|
| FANUC Ltd. control devices FS-i Series POWER Mate i | ABS AT555 |
| Mitsubishi Electric Corporation control devices MITSUBISHI CNC Series MDS-D/MDS-DH Series | ABS AT545 |
| Mitsubishi Electric Corporation MR-J4/MR-J3 Series | ABS AT545A ABS AT505 |
| Amplifier compatible with the Mitutoyo ENSIS interface | ABS AT505A |

Note: ABS AT5□5□

Communication method

Blank: Full-duplex communication
A: Half-duplex communication

Note: For details regarding the applicable system, please consult with the individual manufacturer.

Base position (the 'zero elongation' point)*

C: Midpoint of effective range

L: End of effective range (+ side end)

R: End of effective range (- side end)

Note: L and R are only for the high-accuracy type

* This refers to the fixed point on the scale around which clamping arrangements ensure that any expansion or contraction due to temperature change occurs.

Scale unit specifications

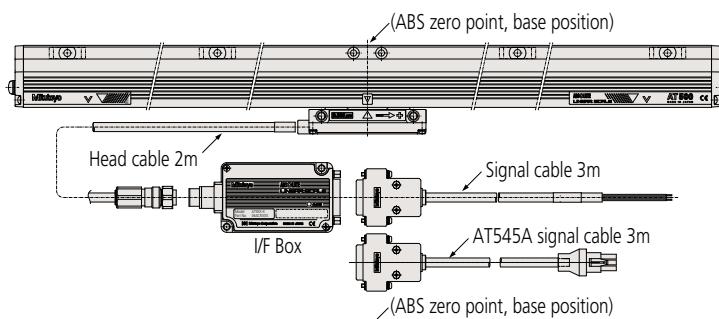
S: High-rigidity type

H: High-accuracy type

Scale configuration

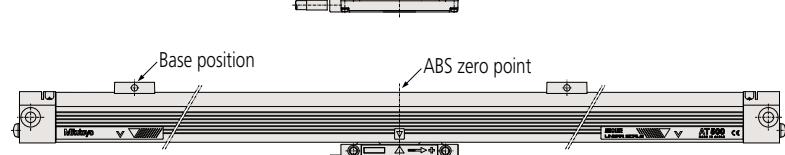
ABS AT500-S Series

ABS AT5□5-SC
ABS AT5□5A-SC

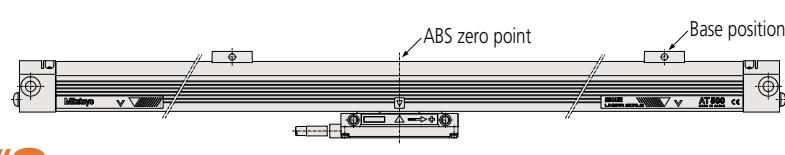


ABS AT500-H Series

ABS AT5□5-HC
ABS AT5□5A-HC



ABS AT5□5-HR
ABS AT5□5A-HR



ABS AT5□5-HL
ABS AT5□5A-HL

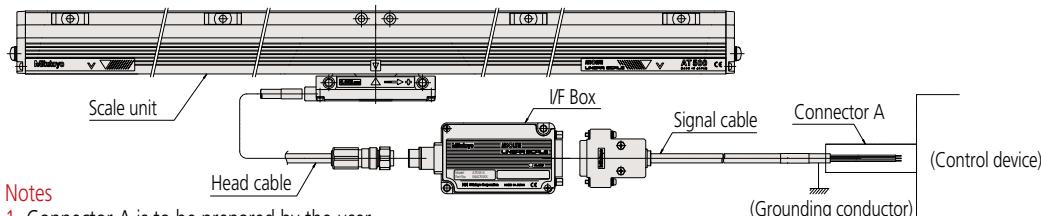
Specifications

| Item | Code | High-rigidity type ABS AT5□5-SC | High-accuracy type ABS AT5□5-HC | ABS AT5□5-HL/HR | | | |
|--------------------------------|--|--|---|------------------------|--|--|--|
| Detection method | Electrostatic capacitance type / photoelectric type composite ABS linear encoder | | | | | | |
| How to mount the scale unit | Multi-point elastic fixing | 3 or 5-point elastic fixing | 3 or 4-point elastic fixing | | | | |
| Base position | Midpoint of effective range | | | | | | |
| Effective range | 100 to 2200mm | 100 to 1000mm | 100 to 350mm | | | | |
| Resolution | 0.005μm (20μm/4096)* | | | | | | |
| Maximum response speed | 150m/min (2.5m/s) | 72m/min (1.2m/s) (3+3Lo/1000) μm | | | | | |
| Accuracy (20°C) | (Lo: Effective range (mm)) | | | | | | |
| Thermal expansion coefficient | (8.5±0.5) x 10 ⁻⁶ /°C | | | | | | |
| Vibration resistance | 196 m/s ² (20G) (55 to 2000Hz) | 147 m/s ² (15G) (55 to 2000Hz) | | | | | |
| Shock resistance | 343m/s ² (35G) (half-sine 11ms) | 196m/s ² (20G) (half-sine 11ms) | | | | | |
| Power supply voltage | 5VDC±5% | | | | | | |
| Maximum current consumption | 270mA (Max) | | | | | | |
| Maximum sliding force | 4N | | | | | | |
| Operating temperature/humidity | 0 to 45°C, 20 to 80%RH (no condensation) | | | | | | |
| Storage temperature/humidity | -20 to 70°C, 20 to 80%RH (no condensation) | | | | | | |
| Protection rating | Scale unit: Equivalent to IP53, I/F box: not waterproof | | | | | | |
| Alarm indication | Scale alarm indicated by LED on I/F Box | | | | | | |
| Head cable length | 2m | | | | | | |
| Signal cable length | 3m | | | | | | |

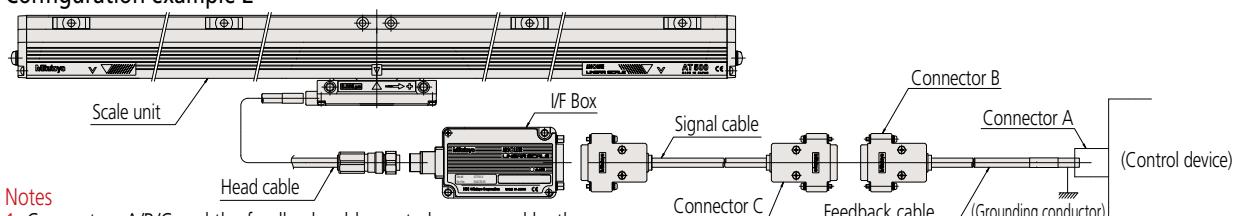
* Because the 20μm signal is divided by 4096, the actual value is 0.0048828125μm. When setting the minimum resolution on the controller, always enter the actual value.

System configuration (See instruction manual)

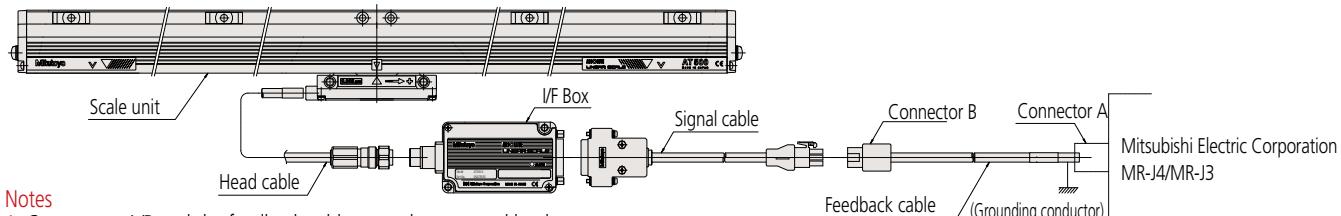
Configuration example 1



Configuration example 2



ABS AT545A



* When using the encoder cable, ensure that the total cable length is 10m or less.

* The feedback cable configuration depends on the system. Please contact Mitsubishi Electric Corporation for details.

Output specification

• ABS AT555/AT545/AT505 (flying leads)

| Wire color | Signal |
|-------------|------------|
| Brown/Red | +5V |
| White/Black | GND |
| Orange | \bar{DT} |
| Yellow | DT |
| Green | REQ |
| Blue | REQ |
| Purple | Phase A |
| Gray | Phase B |
| Shield | FG |

Notes

- 1: Phase A and Phase B are used as test signals.
Keep them disconnected during use.
- 2: Connect the shield wire to the grounding conductor.

• ABS AT545A

Output connector (pin type): Tyco Electronics Japan

Mini-Universal Mate-N-Lock Connector 9P

172169-9 (Housing: Black)

Applicable connector: 172161-9 (Housing: Black)

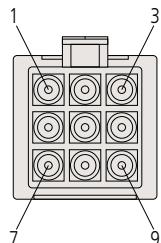
| Pin No. | Signal |
|---------|------------------------|
| 1 | MR (REQ/DT) |
| 2 | MRR (REQ/ \bar{DT}) |
| 4 | (DT) |
| 5 | (\bar{DT}) |
| 7 | PS (+5V) |
| 8 | OV (GND) |
| 9 | F.G |
| 3.6 | N.C |

• ABS AT505A (flying leads)

| Wire color | Signal |
|-------------|-----------------|
| Brown/Red | +5V |
| White/Black | GND |
| Orange | N.C |
| Yellow | N.C |
| Green | REQ/ \bar{DT} |
| Blue | REQ/DT |
| Purple | Phase A |
| Gray | Phase B |
| Shield | FG |

Notes

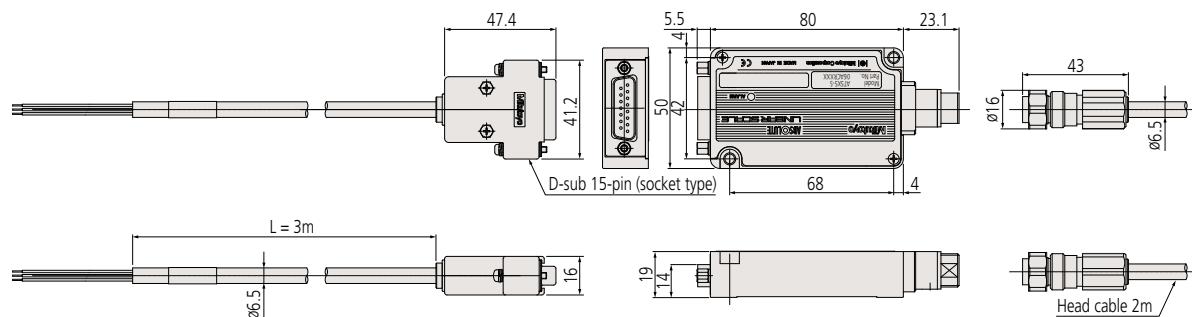
- 1: Phase A and Phase B are used as test signals.
Keep them disconnected during use.
- 2: Connect the shield wire to the grounding conductor.



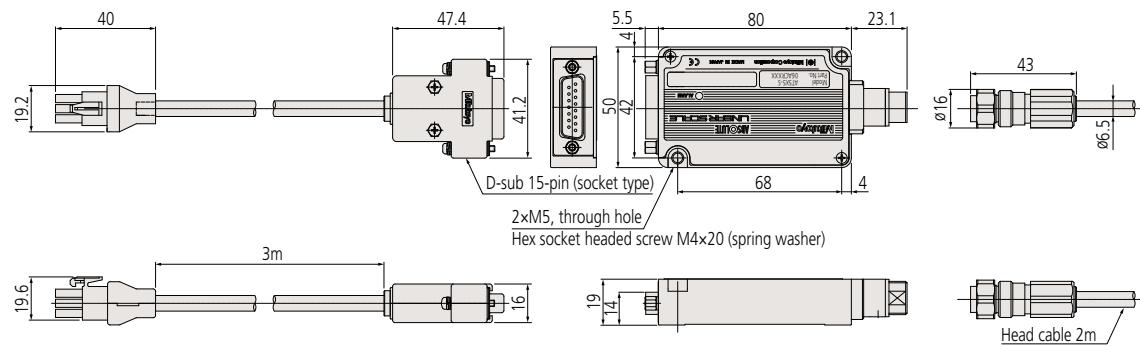
Cable dimensions

Unit: mm

• ABS AT555/505

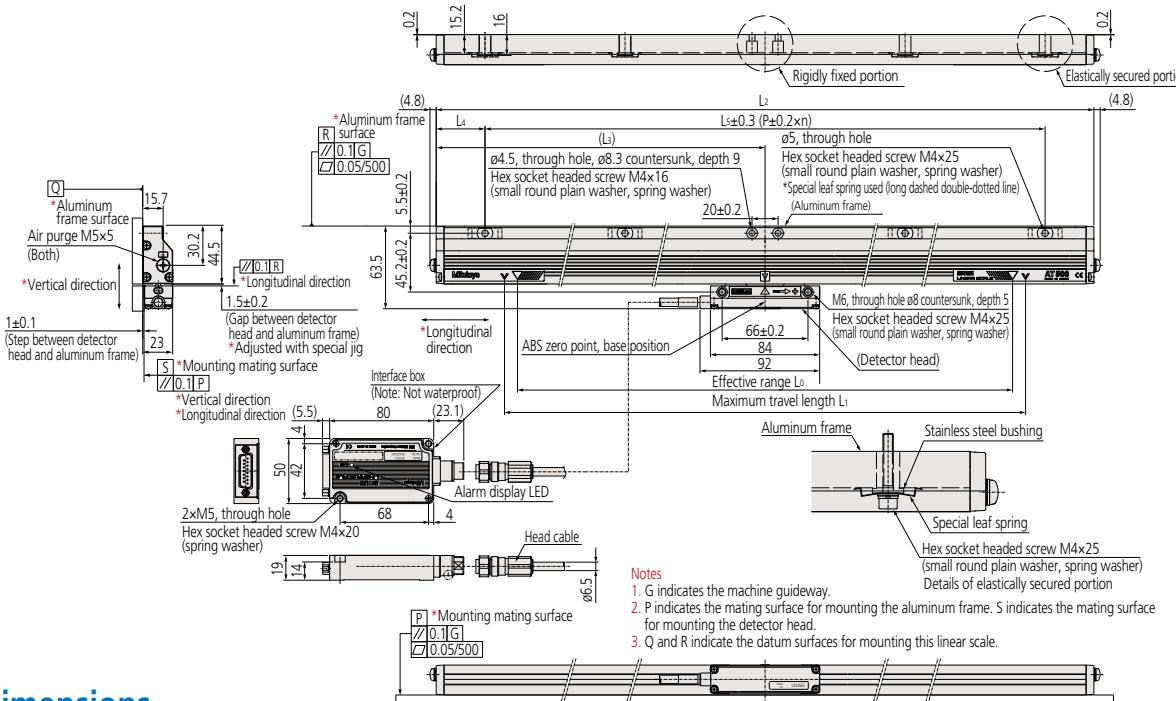


• ABS AT545A



Mounting dimensions (SC Type)

Unit: mm



Dimensions

| Effective range L ₀ (mm) | Maximum travel length L ₁ (mm) | Overall length L ₂ (mm) | Distance to center L ₃ (mm) | Mounting pitch | | | No. of mounting holes n |
|--|--|---------------------------------------|---|---------------------|---------------------|--------|----------------------------|
| | | | | L ₄ (mm) | L ₅ (mm) | P (mm) | |
| 100 | 120 | 225 | 112.5 | 37.5 | 150 | 75 | 2 |
| 200 | 220 | 325 | 162.5 | 37.5 | 250 | 125 | 2 |
| 300 | 320 | 425 | 212.5 | 37.5 | 350 | 175 | 2 |
| 400 | 420 | 525 | 262.5 | 62.5 | 400 | 200 | 2 |
| 500 | 520 | 625 | 312.5 | 62.5 | 500 | 125 | 4 |
| 600 | 620 | 725 | 362.5 | 62.5 | 600 | 150 | 4 |
| 700 | 720 | 825 | 412.5 | 62.5 | 700 | 175 | 4 |
| 800 | 820 | 925 | 462.5 | 62.5 | 800 | 200 | 4 |
| 900 | 920 | 1025 | 512.5 | 62.5 | 900 | 150 | 6 |
| 1000 | 1020 | 1125 | 562.5 | 37.5 | 1050 | 175 | 6 |
| 1100 | 1120 | 1225 | 612.5 | 87.5 | 1050 | 175 | 6 |
| 1200 | 1220 | 1325 | 662.5 | 62.5 | 1200 | 200 | 6 |
| 1300 | 1320 | 1425 | 712.5 | 112.5 | 1200 | 150 | 8 |
| 1400 | 1420 | 1525 | 762.5 | 62.5 | 1400 | 175 | 8 |
| 1500 | 1520 | 1625 | 812.5 | 112.5 | 1400 | 175 | 8 |
| 1600 | 1620 | 1725 | 862.5 | 62.5 | 1600 | 200 | 8 |
| 1800 | 1820 | 1925 | 962.5 | 87.5 | 1750 | 175 | 10 |
| 2000 | 2020 | 2125 | 1062.5 | 62.5 | 2000 | 200 | 10 |
| 2200 | 2220 | 2325 | 1162.5 | 112.5 | 2100 | 175 | 12 |

Codes and Order Numbers

• ABS AT555-SC

| Order No. | Code |
|------------|---------------|
| 539-761-50 | AT555- 100-SC |
| 539-763-50 | AT555- 200-SC |
| 539-765-50 | AT555- 300-SC |
| 539-767-50 | AT555- 400-SC |
| 539-769-50 | AT555- 500-SC |
| 539-771-50 | AT555- 600-SC |
| 539-773-50 | AT555- 700-SC |
| 539-775-50 | AT555- 800-SC |
| 539-776-50 | AT555- 900-SC |
| 539-777-50 | AT555-1000-SC |
| 539-778-50 | AT555-1100-SC |
| 539-779-50 | AT555-1200-SC |
| 539-780-50 | AT555-1300-SC |
| 539-781-50 | AT555-1400-SC |
| 539-782-50 | AT555-1500-SC |
| 539-783-50 | AT555-1600-SC |
| 539-785-50 | AT555-1800-SC |
| 539-786-50 | AT555-2000-SC |
| 539-787-50 | AT555-2200-SC |

• ABS AT545/AT545A-SC

| Order No. | Code |
|------------|------------------|
| 539-731-□□ | AT545(A)- 100-SC |
| 539-733-□□ | AT545(A)- 200-SC |
| 539-735-□□ | AT545(A)- 300-SC |
| 539-737-□□ | AT545(A)- 400-SC |
| 539-739-□□ | AT545(A)- 500-SC |
| 539-741-□□ | AT545(A)- 600-SC |
| 539-743-□□ | AT545(A)- 700-SC |
| 539-745-□□ | AT545(A)- 800-SC |
| 539-746-□□ | AT545(A)- 900-SC |
| 539-747-□□ | AT545(A)-1000-SC |
| 539-748-□□ | AT545(A)-1100-SC |
| 539-749-□□ | AT545(A)-1200-SC |
| 539-750-□□ | AT545(A)-1300-SC |
| 539-751-□□ | AT545(A)-1400-SC |
| 539-752-□□ | AT545(A)-1500-SC |
| 539-753-□□ | AT545(A)-1600-SC |
| 539-755-□□ | AT545(A)-1800-SC |
| 539-756-□□ | AT545(A)-2000-SC |
| 539-757-□□ | AT545(A)-2200-SC |

• ABS AT505/AT505A-SC

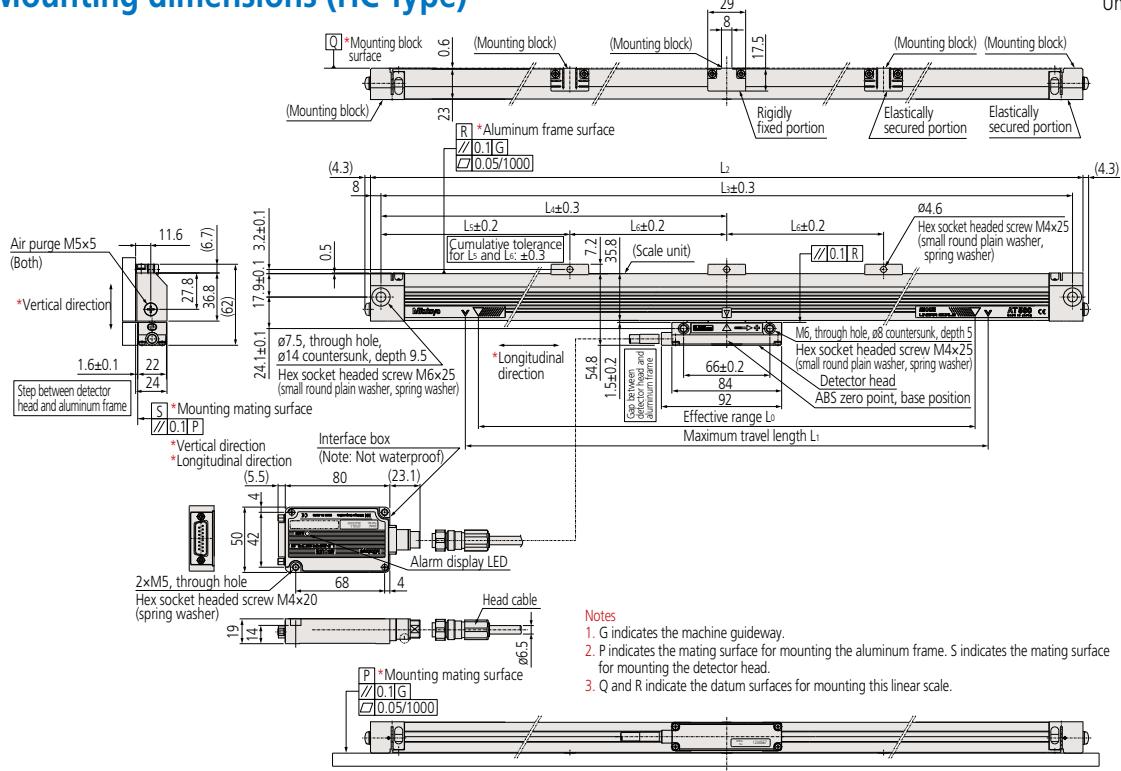
| Order No. | Code |
|------------|------------------|
| 539-161-□□ | AT505(A)- 100-SC |
| 539-163-□□ | AT505(A)- 200-SC |
| 539-165-□□ | AT505(A)- 300-SC |
| 539-167-□□ | AT505(A)- 400-SC |
| 539-169-□□ | AT505(A)- 500-SC |
| 539-171-□□ | AT505(A)- 600-SC |
| 539-173-□□ | AT505(A)- 700-SC |
| 539-175-□□ | AT505(A)- 800-SC |
| 539-176-□□ | AT505(A)- 900-SC |
| 539-177-□□ | AT505(A)-1000-SC |
| 539-178-□□ | AT505(A)-1100-SC |
| 539-179-□□ | AT505(A)-1200-SC |
| 539-180-□□ | AT505(A)-1300-SC |
| 539-181-□□ | AT505(A)-1400-SC |
| 539-182-□□ | AT505(A)-1500-SC |
| 539-183-□□ | AT505(A)-1600-SC |
| 539-185-□□ | AT505(A)-1800-SC |
| 539-186-□□ | AT505(A)-2000-SC |
| 539-187-□□ | AT505(A)-2200-SC |

* The □□ in the Order No. is as follows. AT545 : 50
AT545A : 51

* The □□ in the Order No. is as follows. AT505 : 50
AT505A : 51

Mounting dimensions (HC Type)

Unit: mm



Dimensions

| Effective range L ₀ (mm) | Maximum travel length L ₁ (mm) | Overall length L ₂ (mm) | Mounting pitch | | | |
|--|--|---------------------------------------|---------------------|---------------------|---------------------|---------------------|
| | | | L ₃ (mm) | L ₄ (mm) | L ₅ (mm) | L ₆ (mm) |
| 100 | 120 | 265 | 249 | 124.5 | — | — |
| 150 | 170 | 315 | 299 | 149.5 | — | — |
| 200 | 220 | 365 | 349 | 174.5 | — | — |
| 250 | 270 | 415 | 399 | 199.5 | — | — |
| 300 | 320 | 465 | 449 | 224.5 | — | — |
| 350 | 370 | 515 | 499 | 249.5 | — | — |
| 400 | 420 | 565 | 549 | 274.5 | — | — |
| 450 | 470 | 615 | 599 | 299.5 | — | — |
| 500 | 520 | 665 | 649 | 324.5 | — | — |
| 600 | 620 | 765 | 749 | (374.5) | 204.5 | 170 |
| 700 | 720 | 865 | 849 | (424.5) | 224.5 | 200 |
| 750 | 770 | 915 | 899 | (449.5) | 224.5 | 225 |
| 800 | 820 | 965 | 949 | (474.5) | 244.5 | 230 |
| 900 | 920 | 1065 | 1049 | (524.5) | 264.5 | 260 |
| 1000 | 1020 | 1165 | 1149 | (574.5) | 284.5 | 290 |

Codes and Order Numbers

• ABS AT555-HC

| Order No. | Code |
|------------|---------------|
| 539-761-60 | AT555- 100-HC |
| 539-762-60 | AT555- 150-HC |
| 539-763-60 | AT555- 200-HC |
| 539-764-60 | AT555- 250-HC |
| 539-765-60 | AT555- 300-HC |
| 539-766-60 | AT555- 350-HC |
| 539-767-60 | AT555- 400-HC |
| 539-768-60 | AT555- 450-HC |
| 539-769-60 | AT555- 500-HC |
| 539-771-60 | AT555- 600-HC |
| 539-773-60 | AT555- 700-HC |
| 539-774-60 | AT555- 750-HC |
| 539-775-60 | AT555- 800-HC |
| 539-776-60 | AT555- 900-HC |
| 539-777-60 | AT555-1000-HC |

• ABS AT545/AT545A-HC

| Order No. | Code |
|------------|------------------|
| 539-731-□□ | AT545(A)- 100-HC |
| 539-732-□□ | AT545(A)- 150-HC |
| 539-733-□□ | AT545(A)- 200-HC |
| 539-734-□□ | AT545(A)- 250-HC |
| 539-735-□□ | AT545(A)- 300-HC |
| 539-736-□□ | AT545(A)- 350-HC |
| 539-737-□□ | AT545(A)- 400-HC |
| 539-738-□□ | AT545(A)- 450-HC |
| 539-739-□□ | AT545(A)- 500-HC |
| 539-741-□□ | AT545(A)- 600-HC |
| 539-743-□□ | AT545(A)- 700-HC |
| 539-744-□□ | AT545(A)- 750-HC |
| 539-745-□□ | AT545(A)- 800-HC |
| 539-746-□□ | AT545(A)- 900-HC |
| 539-747-□□ | AT545(A)-1000-HC |

* The □□ in the Order No. is as follows. AT545 : 60
AT545A: 61

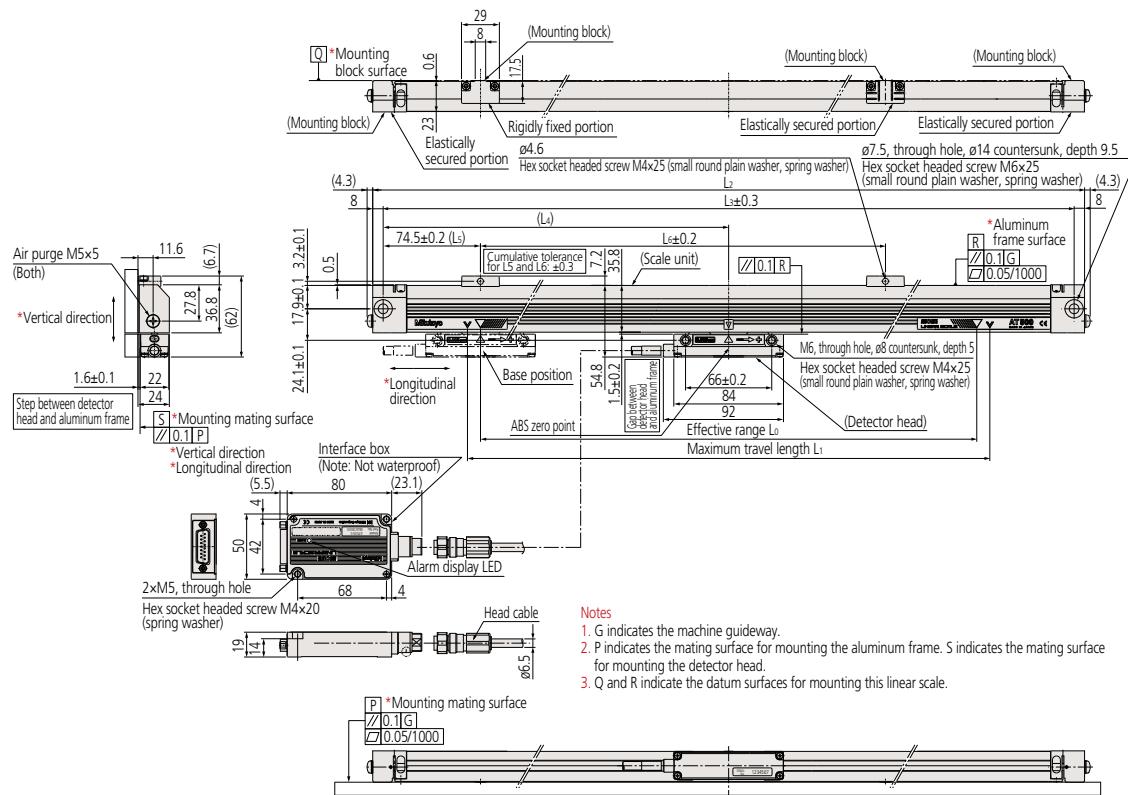
• ABS AT505/AT505A-HC

| Order No. | Code |
|------------|------------------|
| 539-161-□□ | AT505(A)- 100-HC |
| 539-162-□□ | AT505(A)- 150-HC |
| 539-163-□□ | AT505(A)- 200-HC |
| 539-164-□□ | AT505(A)- 250-HC |
| 539-165-□□ | AT505(A)- 300-HC |
| 539-166-□□ | AT505(A)- 350-HC |
| 539-167-□□ | AT505(A)- 400-HC |
| 539-168-□□ | AT505(A)- 450-HC |
| 539-169-□□ | AT505(A)- 500-HC |
| 539-171-□□ | AT505(A)- 600-HC |
| 539-173-□□ | AT505(A)- 700-HC |
| 539-174-□□ | AT505(A)- 750-HC |
| 539-175-□□ | AT505(A)- 800-HC |
| 539-176-□□ | AT505(A)- 900-HC |
| 539-177-□□ | AT505(A)-1000-HC |

* The □□ in the Order No. is as follows. AT545 : 60
AT545A: 61

Mounting dimensions (HR Type)

Unit: mm



Dimensions

| Effective range L ₀ (mm) | Maximum travel length L ₁ (mm) | Overall length L ₂ (mm) | Mounting pitch | | |
|--|--|---------------------------------------|---------------------|---------------------|---------------------|
| | | | L ₃ (mm) | L ₄ (mm) | L ₆ (mm) |
| 100 | 120 | 265 | 249 | 124.5 | — |
| 150 | 170 | 315 | 299 | 149.5 | 100 |
| 200 | 220 | 365 | 349 | 174.5 | 130 |
| 250 | 270 | 415 | 399 | 199.5 | 160 |
| 300 | 320 | 465 | 449 | 224.5 | 190 |
| 350 | 370 | 515 | 499 | 249.5 | 220 |

Codes and Order Numbers

• ABS AT555-HR

| Order No. | Code |
|------------|--------------|
| 539-761-70 | AT555-100-HR |
| 539-762-70 | AT555-150-HR |
| 539-763-70 | AT555-200-HR |
| 539-764-70 | AT555-250-HR |
| 539-765-70 | AT555-300-HR |
| 539-766-70 | AT555-350-HR |

• ABS AT545/AT545A-HR

| Order No. | Code |
|------------|-----------------|
| 539-731-□□ | AT545(A)-100-HR |
| 539-732-□□ | AT545(A)-150-HR |
| 539-733-□□ | AT545(A)-200-HR |
| 539-734-□□ | AT545(A)-250-HR |
| 539-735-□□ | AT545(A)-300-HR |
| 539-736-□□ | AT545(A)-350-HR |

* The □□ in the Order No. is as follows. AT545 : 70
AT545A: 71

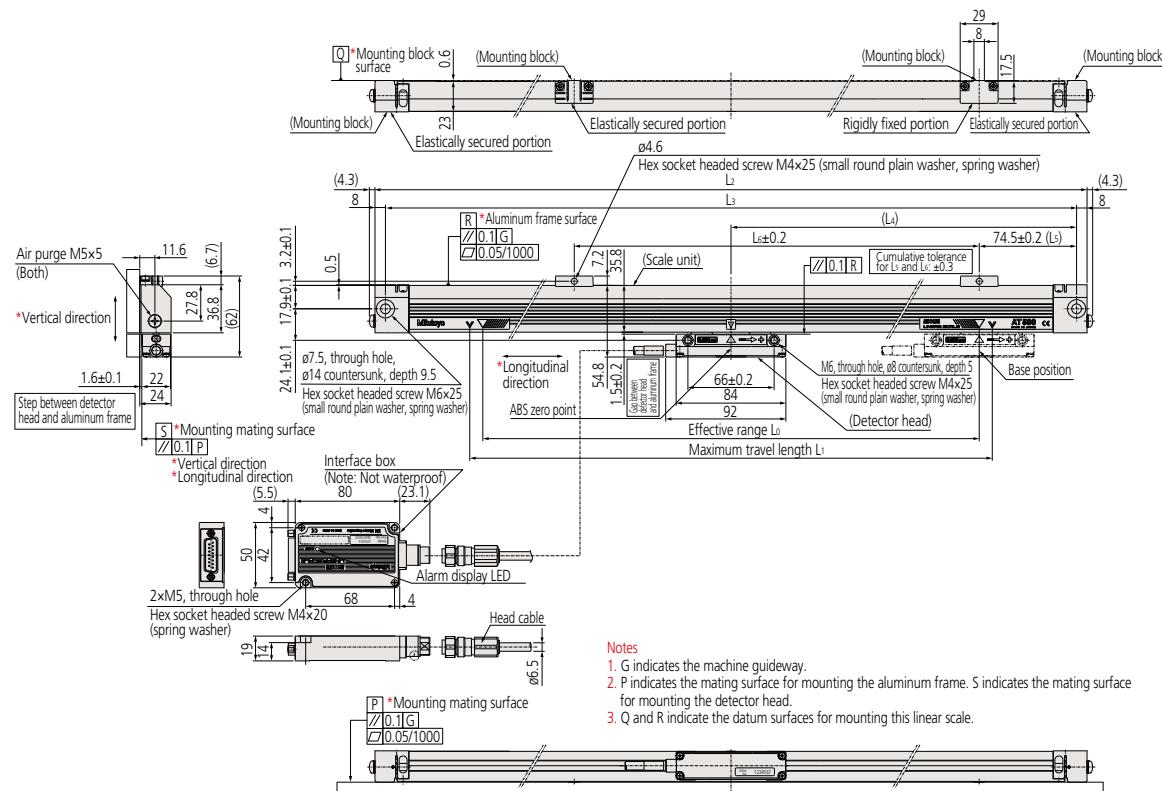
• ABS AT505/AT505A-HR

| Order No. | Code |
|------------|-----------------|
| 539-161-□□ | AT505(A)-100-HR |
| 539-162-□□ | AT505(A)-150-HR |
| 539-163-□□ | AT505(A)-200-HR |
| 539-164-□□ | AT505(A)-250-HR |
| 539-165-□□ | AT505(A)-300-HR |
| 539-166-□□ | AT505(A)-350-HR |

* The □□ in the Order No. is as follows. AT505 : 70
AT505A: 71

Mounting dimensions (HL Type)

Unit: mm



Dimensions

| Effective range Lo (mm) | Maximum travel length L1 (mm) | Overall length L2 (mm) | Mounting pitch | | |
|----------------------------|----------------------------------|---------------------------|----------------|---------|---------|
| | | | L3 (mm) | L4 (mm) | L6 (mm) |
| 100 | 120 | 265 | 249 | 124.5 | — |
| 150 | 170 | 315 | 299 | 149.5 | 100 |
| 200 | 220 | 365 | 349 | 174.5 | 130 |
| 250 | 270 | 415 | 399 | 199.5 | 160 |
| 300 | 320 | 465 | 449 | 224.5 | 190 |
| 350 | 370 | 515 | 499 | 249.5 | 220 |

Codes and Order Numbers

• ABS AT555-HL

| Order No. | Code |
|------------|--------------|
| 539-761-80 | AT555-100-HL |
| 539-762-80 | AT555-150-HL |
| 539-763-80 | AT555-200-HL |
| 539-764-80 | AT555-250-HL |
| 539-765-80 | AT555-300-HL |
| 539-766-80 | AT555-350-HL |

• ABS AT545/AT545A-HL

| Order No. | Code |
|------------|-----------------|
| 539-731-□□ | AT545(A)-100-HL |
| 539-732-□□ | AT545(A)-150-HL |
| 539-733-□□ | AT545(A)-200-HL |
| 539-734-□□ | AT545(A)-250-HL |
| 539-735-□□ | AT545(A)-300-HL |
| 539-736-□□ | AT545(A)-350-HL |

* The □□ in the Order No. is as follows. AT545 : 80
AT545A: 81

• ABS AT505/AT505A-HL

| Order No. | Code |
|------------|-----------------|
| 539-161-□□ | AT505(A)-100-HR |
| 539-162-□□ | AT505(A)-150-HR |
| 539-163-□□ | AT505(A)-200-HR |
| 539-164-□□ | AT505(A)-250-HR |
| 539-165-□□ | AT505(A)-300-HR |
| 539-166-□□ | AT505(A)-350-HR |

* The □□ in the Order No. is as follows. AT505 : 80
AT505A: 81

Assembly Type ABS AT Series

Absolute Scale Unit (Slim Spar Type)

ABS AT500 Series

(Resolution 0.05μm)



Features

- High-performance Absolute Linear Scale with a resolution of 0.05μm and maximum response speed of 150 m/min.
- The ABS AT500-S Series realizes vibration resistance of 196m/s² (20G) and shock-resistance of 343m/s² (35G), suitable for use with heavy cutting equipment and for high-speed machining.
- The ABS AT500-H Series has high repeatability, excellent temperature characteristics, and enables highly accurate and stable positioning.
- Slim shape is suitable for space-saving designs.
- Compatible with servo amplifiers from a range of companies (high-speed serial interfaces).

How to read the code

ABS AT5 □ 3 □ - □ □ □ - □ □

Interface specification —

Effective range

| Applicable systems | Scale code |
|---|-------------------|
| FANUC Ltd. control devices FS-i Series POWER Mate i | ABS AT553 |
| Mitsubishi Electric Corporation control devices MITSUBISHI CNC Series MDS-D/MDS-DH Series | ABS AT543 |
| Mitsubishi Electric Corporation MR-J4/MR-J3 Series | ABS AT543A |
| Panasonic Corporation, Motor business unit MINAS-A5, A5L, A5N, A5NL Series MINAS-A4, A4P, A4N, A4NL Series | ABS AT573A |
| Amplifier compatible with the Mitutoyo ENSIS interface Nikki Denso Co., Ltd. VCII/VC/VPS Series* ¹ Servoland Corporation SVF Series* ¹ PMAC JAPAN Co., Ltd. UMAC-Turbo PMAC2 | ABS AT503A |
| Other machine types | ABS AT503 |

*¹ For connection to ABS AT503A

Note: ABS AT5□3□

Communication method

Blank: Full-duplex communication
A: Half-duplex communication

Note: For details regarding the applicable system, please consult with the individual manufacturer.

Base position (the 'zero elongation' point)*

C: Midpoint of effective range

L: End of effective range (+ side end)

R: End of effective range (- side end)

Note: L and R are only for the high-accuracy type

* This refers to the base point of fixed point on the scale around which clamping arrangements ensure that any expansion or contraction due to temperature change occurs.

Scale unit specifications

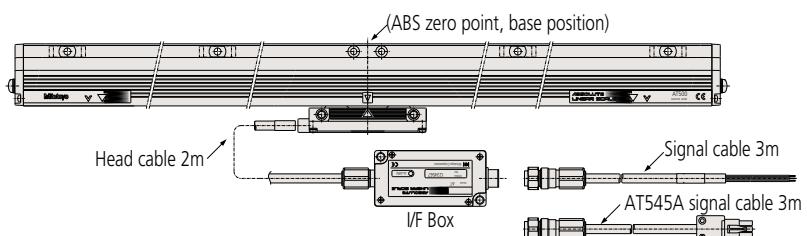
S: High-rigidity type

H: High-accuracy type

Scale configuration

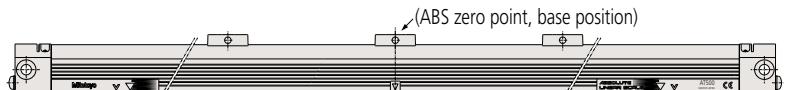
ABS AT500-S Series

ABS AT5□3-SC
ABS AT5□3A-SC

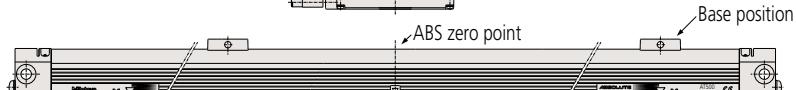


ABS AT500-H Series

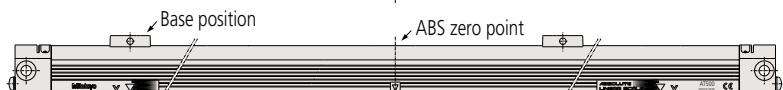
ABS AT5□3-HC
ABS AT5□3A-HC



ABS AT5□3-HL
ABS AT5□3A-HL



ABS AT5□3-HR
ABS AT5□3A-HR



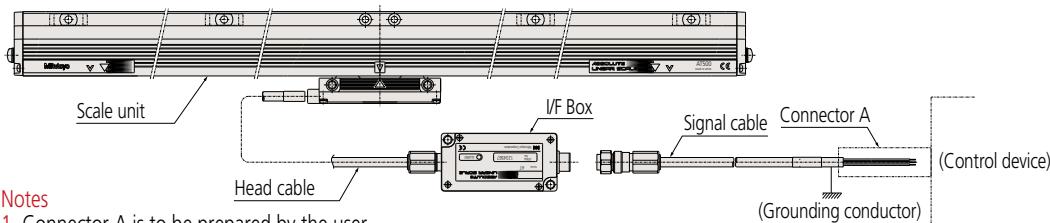
Mitutoyo

Specifications

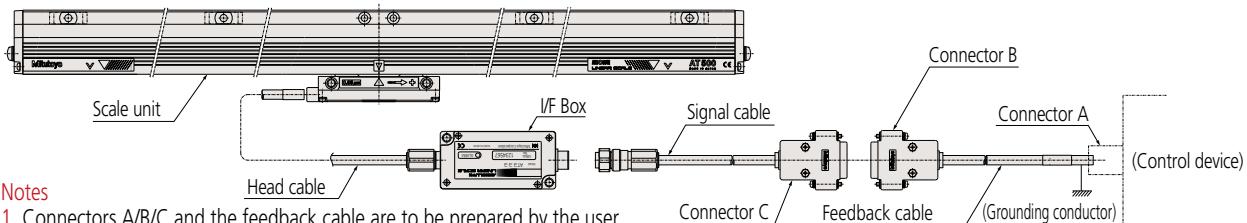
| Item | Code | High-rigidity type ABS AT5□3-SC | High-accuracy type ABS AT5□3-HC | ABS AT5□3-HL/HR |
|--------------------------------|--|---|--|------------------------|
| Detection method | Electrostatic capacitance type / photoelectric type composite ABS linear encoder | | | |
| How to mount the scale unit | Multi-point elastic fixing | 3 or 5-point elastic fixing | 3 or 4-point elastic fixing | |
| Base position | Midpoint of effective range | | | |
| Effective range | 100 to 2200mm | 100 to 1000mm | 100 to 350mm | |
| Resolution | 0.05μm | | | |
| Maximum response speed | 150m/min (2.5m/s) | | | |
| Accuracy (20°C) | (3+3Lo/1000) μm Lo: Effective range (mm) | (2+2Lo/1000) μm Lo: Effective range (mm) | | |
| Thermal expansion coefficient | $(8.5 \pm 0.5) \times 10^{-6}/^{\circ}\text{C}$ | | | |
| Vibration resistance | 196 m/s ² (20G) (55 to 2000Hz) | 147 m/s ² (15G) (55 to 2000Hz) | 196m/s ² (20G) (half-sine 11ms) | |
| Shock resistance | 343m/s ² (35G) (half-sine 11ms) | 196m/s ² (20G) (half-sine 11ms) | | |
| Power supply voltage | 5VDC±5% | | | |
| Maximum current consumption | 270mA (Max) | | | |
| Maximum sliding force | 4N | | | |
| Operating temperature/humidity | 0 to 45°C, 20 to 80%RH (no condensation) | | | |
| Storage temperature/humidity | -20 to 70°C, 20 to 80%RH (no condensation) | | | |
| Protection rating | Scale unit: Equivalent to IP53, I/F box: not waterproof | | | |
| Alarm indication | Scale alarm indicated by LED on I/F Box | | | |
| Head cable length | 2m | | | |
| Signal cable length | 3m | | | |

System configuration (See instruction manual)

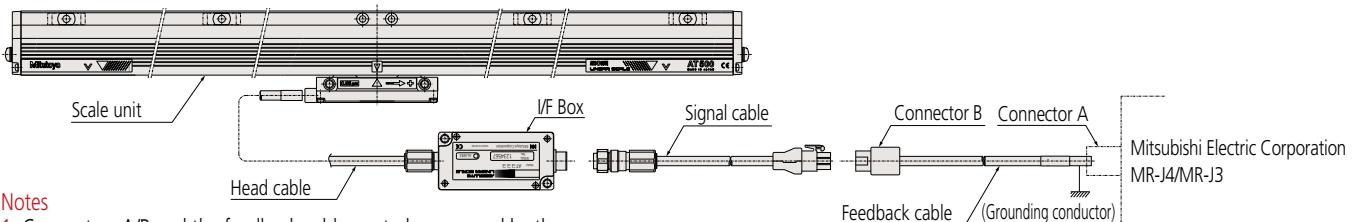
Configuration example 1



Configuration example 2



[ABS AT543A]



* When using the encoder cable, ensure that the total cable length is 10m or less.

* The feedback cable configuration depends on the system. Please contact Mitsubishi Electric Corporation for details.

Output specification

• ABS AT553/AT543/AT503 (flying leads)

| Wire color | Signal |
|-------------|---------|
| Brown/Red | +5V |
| White/Black | GND |
| Orange | DT |
| Yellow | DT |
| Green | REQ |
| Blue | REQ |
| Purple | Phase A |
| Gray | Phase B |
| Shield | FG |

Notes

- 1: Phase A and Phase B are used as test signals.
Keep them disconnected during use.
- 2: Connect the shield wire to the grounding conductor.

• ABS AT545A

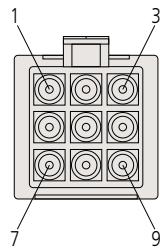
Output connector (pin type): Tyco Electronics Japan

Mini-Universal Mate-N-Lock Connector 9P

172169-9 (Housing: Black)

Applicable connector: 172161-9 (Housing: Black)

| Pin No. | Signal |
|---------|--------------|
| 1 | MR (REQ/DT) |
| 2 | MRR (REQ/DT) |
| 4 | (DT) |
| 5 | (DT) |
| 7 | PS (+5V) |
| 8 | LG (GND) |
| 9 | F.G |
| 3.6 | N.C |



• ABS AT573A/AT503A (flying leads)

| Wire color | Signal |
|-------------|---------|
| Brown/Red | +5V |
| White/Black | GND |
| Orange | N.C |
| Yellow | N.C |
| Green | REQ/DT |
| Blue | REQ/DT |
| Purple | Phase A |
| Gray | Phase B |
| Shield | FG |

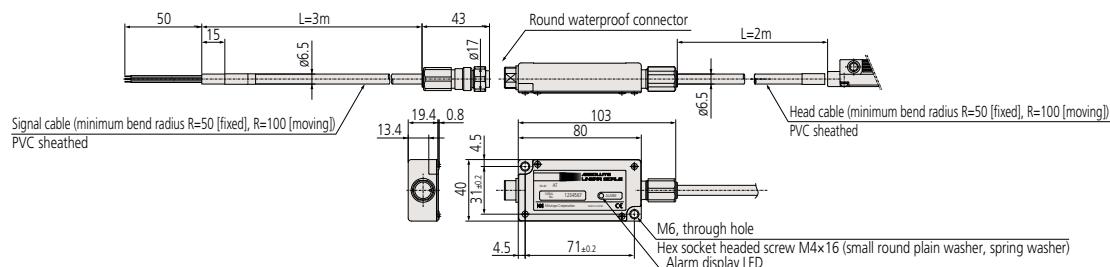
Notes

- 1: Phase A and Phase B are used as test signals.
Keep them disconnected during use.
- 2: Connect the shield wire to the grounding conductor.

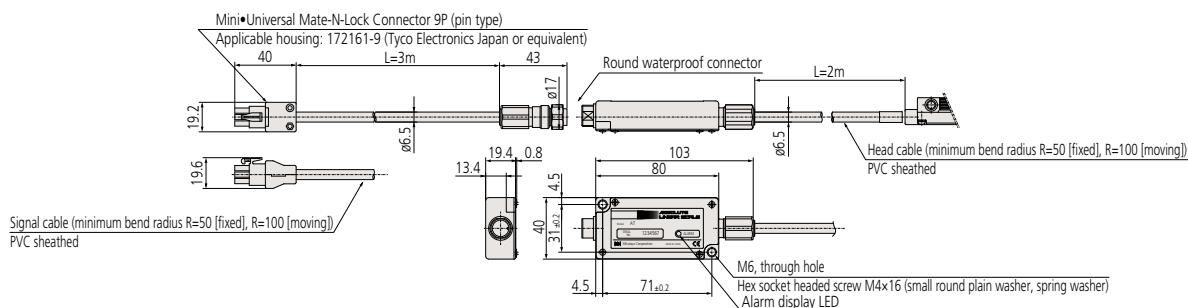
Cable dimensions

• ABS AT553/AT543/AT573A/AT503 (A)

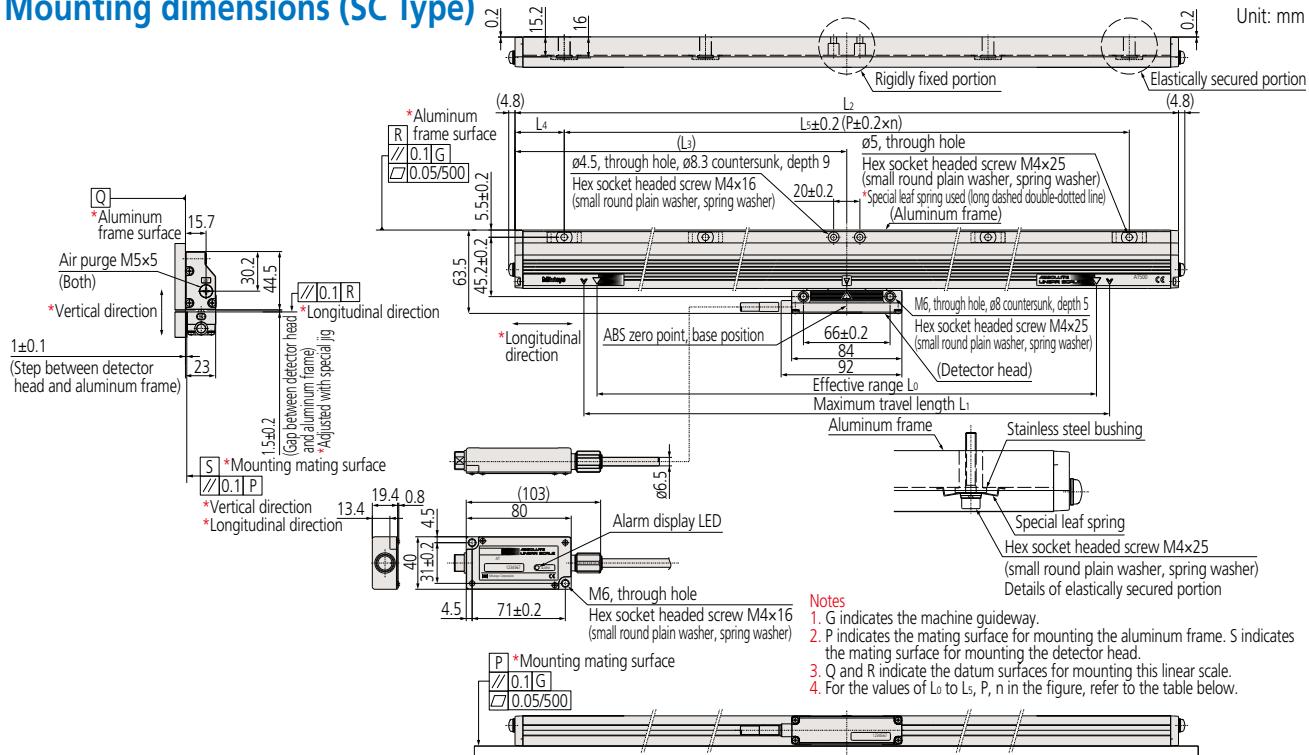
Unit: mm



• ABS AT543A



Mounting dimensions (SC Type)



Dimensions

| Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_2 (mm) | Distance to center L_3 (mm) | Mounting pitch | | | No. of mounting holes n |
|-------------------------------|-------------------------------------|------------------------------|----------------------------------|----------------|------------|--------|----------------------------|
| | | | | L_4 (mm) | L_5 (mm) | P (mm) | |
| 100 | 120 | 225 | 112.5 | 37.5 | 150 | 75 | 2 |
| 200 | 220 | 325 | 162.5 | 37.5 | 250 | 125 | 2 |
| 300 | 320 | 425 | 212.5 | 37.5 | 350 | 175 | 2 |
| 400 | 420 | 525 | 262.5 | 62.5 | 400 | 200 | 2 |
| 500 | 520 | 625 | 312.5 | 62.5 | 500 | 125 | 4 |
| 600 | 620 | 725 | 362.5 | 62.5 | 600 | 150 | 4 |
| 700 | 720 | 825 | 412.5 | 62.5 | 700 | 175 | 4 |
| 800 | 820 | 925 | 462.5 | 62.5 | 800 | 200 | 4 |
| 900 | 920 | 1025 | 512.5 | 62.5 | 900 | 150 | 6 |
| 1000 | 1020 | 1125 | 562.5 | 37.5 | 1050 | 175 | 6 |
| 1100 | 1120 | 1225 | 612.5 | 87.5 | 1050 | 175 | 6 |
| 1200 | 1220 | 1325 | 662.5 | 62.5 | 1200 | 200 | 6 |
| 1300 | 1320 | 1425 | 712.5 | 112.5 | 1200 | 150 | 8 |
| 1400 | 1420 | 1525 | 762.5 | 62.5 | 1400 | 175 | 8 |
| 1500 | 1520 | 1625 | 812.5 | 112.5 | 1400 | 175 | 8 |
| 1600 | 1620 | 1725 | 862.5 | 62.5 | 1600 | 200 | 8 |
| 1800 | 1820 | 1925 | 962.5 | 87.5 | 1750 | 175 | 10 |
| 2000 | 2020 | 2125 | 1062.5 | 62.5 | 2000 | 200 | 10 |
| 2200 | 2220 | 2325 | 1162.5 | 112.5 | 2100 | 175 | 12 |

Codes and Order Numbers

• ABS AT553-SC

| Order No. | Code |
|------------|---------------|
| 539-761-10 | AT553- 100-SC |
| 539-763-10 | AT553- 200-SC |
| 539-765-10 | AT553- 300-SC |
| 539-767-10 | AT553- 400-SC |
| 539-769-10 | AT553- 500-SC |
| 539-771-10 | AT553- 600-SC |
| 539-773-10 | AT553- 700-SC |
| 539-775-10 | AT553- 800-SC |
| 539-776-10 | AT553- 900-SC |
| 539-777-10 | AT553-1000-SC |
| 539-778-10 | AT553-1100-SC |
| 539-779-10 | AT553-1200-SC |
| 539-780-10 | AT553-1300-SC |
| 539-781-10 | AT553-1400-SC |
| 539-782-10 | AT553-1500-SC |
| 539-783-10 | AT553-1600-SC |
| 539-785-10 | AT553-1800-SC |
| 539-786-10 | AT553-2000-SC |
| 539-787-10 | AT553-2200-SC |

• ABS AT543/AT543A-SC

| Order No. | Code |
|------------|------------------|
| 539-731-□□ | AT543(A)- 100-SC |
| 539-733-□□ | AT543(A)- 200-SC |
| 539-735-□□ | AT543(A)- 300-SC |
| 539-737-□□ | AT543(A)- 400-SC |
| 539-739-□□ | AT543(A)- 500-SC |
| 539-741-□□ | AT543(A)- 600-SC |
| 539-743-□□ | AT543(A)- 700-SC |
| 539-745-□□ | AT543(A)- 800-SC |
| 539-746-□□ | AT543(A)- 900-SC |
| 539-747-□□ | AT543(A)-1000-SC |
| 539-748-□□ | AT543(A)-1100-SC |
| 539-749-□□ | AT543(A)-1200-SC |
| 539-750-□□ | AT543(A)-1300-SC |
| 539-751-□□ | AT543(A)-1400-SC |
| 539-752-□□ | AT543(A)-1500-SC |
| 539-753-□□ | AT543(A)-1600-SC |
| 539-755-□□ | AT543(A)-1800-SC |
| 539-756-□□ | AT543(A)-2000-SC |
| 539-757-□□ | AT543(A)-2200-SC |

• ABS AT573A-SC

| Order No. | Code |
|------------|----------------|
| 539-871-11 | AT573A- 100-SC |
| 539-873-11 | AT573A- 200-SC |
| 539-875-11 | AT573A- 300-SC |
| 539-877-11 | AT573A- 400-SC |
| 539-879-11 | AT573A- 500-SC |
| 539-881-11 | AT573A- 600-SC |
| 539-883-11 | AT573A- 700-SC |
| 539-885-11 | AT573A- 800-SC |
| 539-886-11 | AT573A- 900-SC |
| 539-887-11 | AT573A-1000-SC |
| 539-888-11 | AT573A-1100-SC |
| 539-889-11 | AT573A-1200-SC |
| 539-890-11 | AT573A-1300-SC |
| 539-891-11 | AT573A-1400-SC |
| 539-892-11 | AT573A-1500-SC |
| 539-893-11 | AT573A-1600-SC |
| 539-895-11 | AT573A-1800-SC |
| 539-896-11 | AT573A-2000-SC |
| 539-897-11 | AT573A-2200-SC |

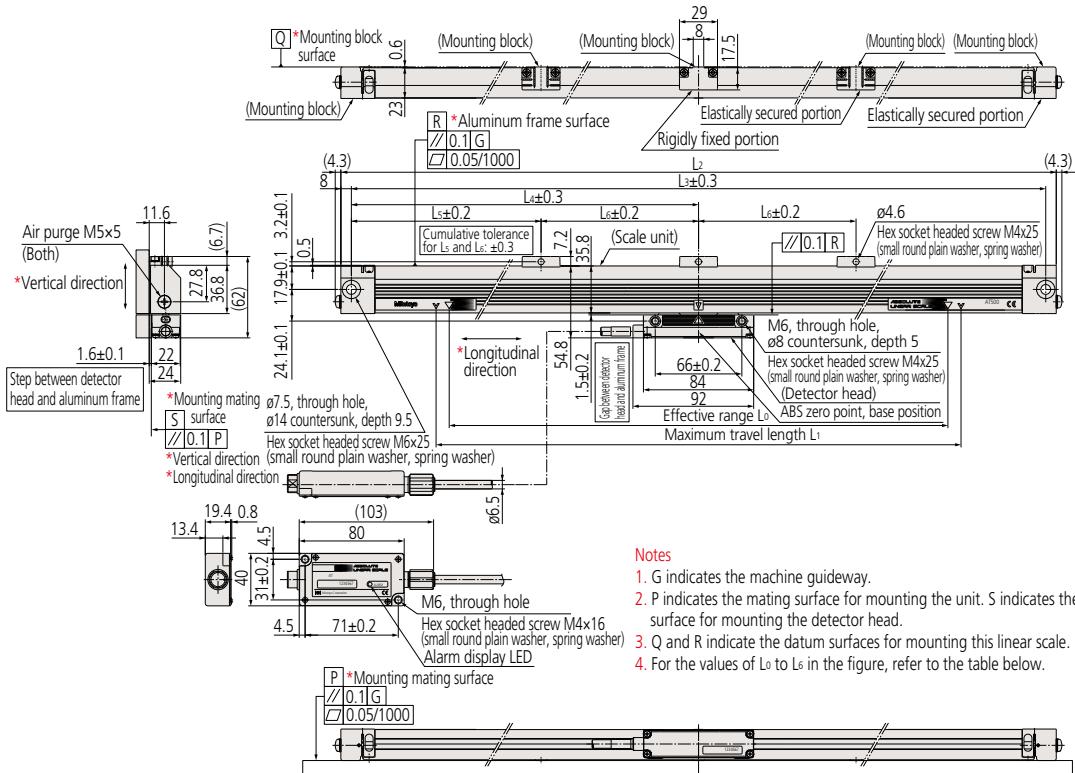
• ABS AT503/AT503A-SC

| Order No. | Code |
|------------|------------------|
| 539-161-□□ | AT503(A)- 100-SC |
| 539-163-□□ | AT503(A)- 200-SC |
| 539-165-□□ | AT503(A)- 300-SC |
| 539-167-□□ | AT503(A)- 400-SC |
| 539-169-□□ | AT503(A)- 500-SC |
| 539-171-□□ | AT503(A)- 600-SC |
| 539-173-□□ | AT503(A)- 700-SC |
| 539-175-□□ | AT503(A)- 800-SC |
| 539-176-□□ | AT503(A)- 900-SC |
| 539-177-□□ | AT503(A)-1000-SC |
| 539-178-□□ | AT503(A)-1100-SC |
| 539-179-□□ | AT503(A)-1200-SC |
| 539-180-□□ | AT503(A)-1300-SC |
| 539-181-□□ | AT503(A)-1400-SC |
| 539-182-□□ | AT503(A)-1500-SC |
| 539-183-□□ | AT503(A)-1600-SC |
| 539-185-□□ | AT503(A)-1800-SC |
| 539-186-□□ | AT503(A)-2000-SC |
| 539-187-□□ | AT503(A)-2200-SC |

* The □ in the Order No. is as follows. AT543 : 10
AT543A: 11

Mounting dimensions (HC Type)

Unit: mm



Notes

- G indicates the machine guideway.
- P indicates the mating surface for mounting the unit. S indicates the mating surface for mounting the detector head.
- Q and R indicate the datum surfaces for mounting this linear scale.
- For the values of L₀ to L₆ in the figure, refer to the table below.

Dimension

| Effective range L ₀ (mm) | Maximum travel length L ₁ (mm) | Overall length L ₂ (mm) | Mounting pitch | | | |
|--|--|---------------------------------------|---------------------|---------------------|---------------------|---------------------|
| | | | L ₃ (mm) | L ₄ (mm) | L ₅ (mm) | L ₆ (mm) |
| 100 | 120 | 265 | 249 | 124.5 | — | — |
| 150 | 170 | 315 | 299 | 149.5 | — | — |
| 200 | 220 | 365 | 349 | 174.5 | — | — |
| 250 | 270 | 415 | 399 | 199.5 | — | — |
| 300 | 320 | 465 | 449 | 224.5 | — | — |
| 350 | 370 | 515 | 499 | 249.5 | — | — |
| 400 | 420 | 565 | 549 | 274.5 | — | — |
| 450 | 470 | 615 | 599 | 299.5 | — | — |
| 500 | 520 | 665 | 649 | 324.5 | — | — |
| 600 | 620 | 765 | 749 | (374.5) | 204.5 | 170 |
| 700 | 720 | 865 | 849 | (424.5) | 224.5 | 200 |
| 750 | 770 | 915 | 899 | (449.5) | 224.5 | 225 |
| 800 | 820 | 965 | 949 | (474.5) | 244.5 | 230 |
| 900 | 920 | 1065 | 1049 | (524.5) | 264.5 | 260 |
| 1000 | 1020 | 1165 | 1149 | (574.5) | 284.5 | 290 |

Codes and Order Numbers

• ABS AT553-HC

| Order No. | Code |
|------------|---------------|
| 539-761-20 | AT553- 100-HC |
| 539-762-20 | AT553- 150-HC |
| 539-763-20 | AT553- 200-HC |
| 539-764-20 | AT553- 250-HC |
| 539-765-20 | AT553- 300-HC |
| 539-766-20 | AT553- 350-HC |
| 539-767-20 | AT553- 400-HC |
| 539-768-20 | AT553- 450-HC |
| 539-769-20 | AT553- 500-HC |
| 539-771-20 | AT553- 600-HC |
| 539-773-20 | AT553- 700-HC |
| 539-774-20 | AT553- 750-HC |
| 539-775-20 | AT553- 800-HC |
| 539-776-20 | AT553- 900-HC |
| 539-777-20 | AT553-1000-HC |

• ABS AT543/AT543A-HC

| Order No. | Code |
|------------|------------------|
| 539-731-□□ | AT543(A)- 100-HC |
| 539-732-□□ | AT543(A)- 150-HC |
| 539-733-□□ | AT543(A)- 200-HC |
| 539-734-□□ | AT543(A)- 250-HC |
| 539-735-□□ | AT543(A)- 300-HC |
| 539-736-□□ | AT543(A)- 350-HC |
| 539-737-□□ | AT543(A)- 400-HC |
| 539-738-□□ | AT543(A)- 450-HC |
| 539-739-□□ | AT543(A)- 500-HC |
| 539-741-□□ | AT543(A)- 600-HC |
| 539-743-□□ | AT543(A)- 700-HC |
| 539-744-□□ | AT543(A)- 750-HC |
| 539-745-□□ | AT543(A)- 800-HC |
| 539-746-□□ | AT543(A)- 900-HC |
| 539-747-□□ | AT543(A)-1000-HC |

• ABS AT573A-HC

| Order No. | Code |
|------------|----------------|
| 539-871-21 | AT573A- 100-HC |
| 539-872-21 | AT573A- 150-HC |
| 539-873-21 | AT573A- 200-HC |
| 539-874-21 | AT573A- 250-HC |
| 539-875-21 | AT573A- 300-HC |
| 539-876-21 | AT573A- 350-HC |
| 539-877-21 | AT573A- 400-HC |
| 539-878-21 | AT573A- 450-HC |
| 539-879-21 | AT573A- 500-HC |
| 539-881-21 | AT573A- 600-HC |
| 539-883-21 | AT573A- 700-HC |
| 539-884-21 | AT573A- 750-HC |
| 539-885-21 | AT573A- 800-HC |
| 539-886-21 | AT573A- 900-HC |
| 539-887-21 | AT573A-1000-HC |

• ABS AT503/AT503A-HC

| Order No. | Code |
|------------|------------------|
| 539-161-□□ | AT503(A)- 100-HC |
| 539-162-□□ | AT503(A)- 150-HC |
| 539-163-□□ | AT503(A)- 200-HC |
| 539-164-□□ | AT503(A)- 250-HC |
| 539-165-□□ | AT503(A)- 300-HC |
| 539-166-□□ | AT503(A)- 350-HC |
| 539-167-□□ | AT503(A)- 400-HC |
| 539-168-□□ | AT503(A)- 450-HC |
| 539-169-□□ | AT503(A)- 500-HC |
| 539-171-□□ | AT503(A)- 600-HC |
| 539-173-□□ | AT503(A)- 700-HC |
| 539-174-□□ | AT503(A)- 750-HC |
| 539-175-□□ | AT503(A)- 800-HC |
| 539-176-□□ | AT503(A)- 900-HC |
| 539-177-□□ | AT503(A)-1000-HC |

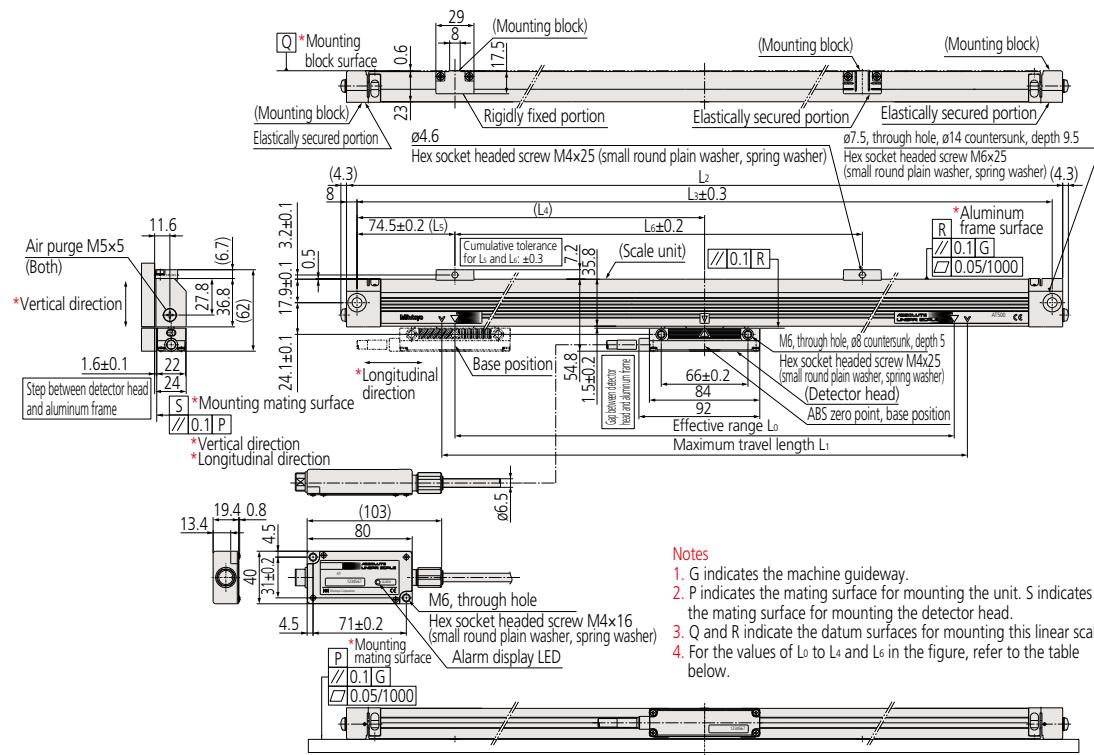
* The □□ in the Order No. is as follows. AT543 : 20
AT543A : 21

* The □□ in the Order No. is as follows. AT503 : 10
AT503A : 11

Mitutoyo

Mounting dimensions (HR Type)

Unit: mm



Dimensions

| Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_2 (mm) | Mounting pitch | | |
|-------------------------------|-------------------------------------|------------------------------|----------------|------------|------------|
| | | | L_3 (mm) | L_4 (mm) | L_6 (mm) |
| 100 | 120 | 265 | 249 | 124.5 | — |
| 150 | 170 | 315 | 299 | 149.5 | 100 |
| 200 | 220 | 365 | 349 | 174.5 | 130 |
| 250 | 270 | 415 | 399 | 199.5 | 160 |
| 300 | 320 | 465 | 449 | 224.5 | 190 |
| 350 | 370 | 515 | 499 | 249.5 | 220 |

Codes and Order Numbers

• ABS AT553-HR

| Order No. | Code |
|------------|--------------|
| 539-761-30 | AT553-100-HR |
| 539-762-30 | AT553-150-HR |
| 539-763-30 | AT553-200-HR |
| 539-764-30 | AT553-250-HR |
| 539-765-30 | AT553-300-HR |
| 539-766-30 | AT553-350-HR |

| Order No. | Code |
|------------|-----------------|
| 539-731-□□ | AT543(A)-100-HR |
| 539-732-□□ | AT543(A)-150-HR |
| 539-733-□□ | AT543(A)-200-HR |
| 539-734-□□ | AT543(A)-250-HR |
| 539-735-□□ | AT543(A)-300-HR |
| 539-736-□□ | AT543(A)-350-HR |

• ABS AT573A-HR

| Order No. | Code |
|------------|---------------|
| 539-871-31 | AT573A-100-HR |
| 539-872-31 | AT573A-150-HR |
| 539-873-31 | AT573A-200-HR |
| 539-874-31 | AT573A-250-HR |
| 539-875-31 | AT573A-300-HR |
| 539-876-31 | AT573A-350-HR |

• ABS AT503/AT503A-HR

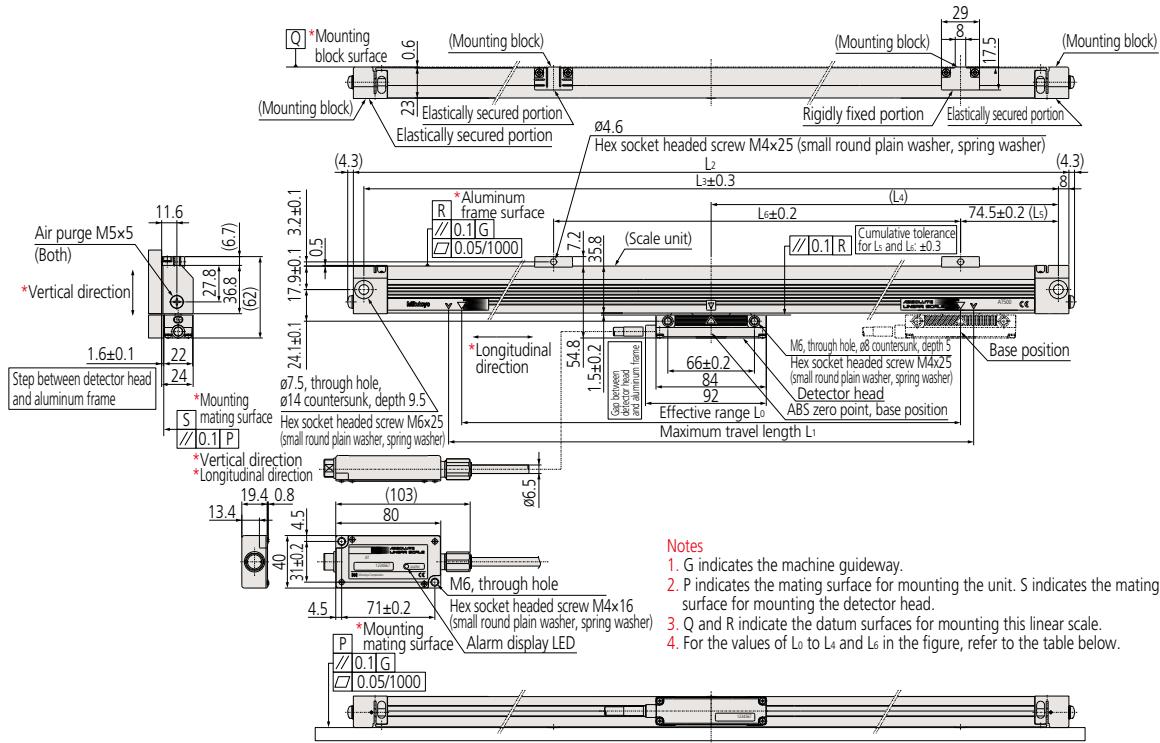
| Order No. | Code |
|------------|-----------------|
| 539-161-□□ | AT503(A)-100-HR |
| 539-162-□□ | AT503(A)-150-HR |
| 539-163-□□ | AT503(A)-200-HR |
| 539-164-□□ | AT503(A)-250-HR |
| 539-165-□□ | AT503(A)-300-HR |
| 539-166-□□ | AT503(A)-350-HR |

* The □□ in the Order No. is as follows. AT543 : 30
AT543A: 31

* The □□ in the Order No. is as follows. AT503 : 30
AT503A: 31

Mounting dimensions (HL Type)

Unit: mm



Notes

1. G indicates the machine guideway.
2. P indicates the mating surface for mounting the unit. S indicates the mating surface for mounting the detector head.
3. Q and R indicate the datum surfaces for mounting this linear scale.
4. For the values of L_0 to L_4 and L_6 in the figure, refer to the table below.

Dimensions

| Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_2 (mm) | Mounting pitch | | |
|-------------------------------|-------------------------------------|------------------------------|----------------|------------|------------|
| | | | L_3 (mm) | L_4 (mm) | L_6 (mm) |
| 100 | 120 | 265 | 249 | 124.5 | — |
| 150 | 170 | 315 | 299 | 149.5 | 100 |
| 200 | 220 | 365 | 349 | 174.5 | 130 |
| 250 | 270 | 415 | 399 | 199.5 | 160 |
| 300 | 320 | 465 | 449 | 224.5 | 190 |
| 350 | 370 | 515 | 499 | 249.5 | 220 |

Codes and Order Numbers

• ABS AT553-HL

| Order No. | Code |
|------------|--------------|
| 539-761-40 | AT553-100-HL |
| 539-762-40 | AT553-150-HL |
| 539-763-40 | AT553-200-HL |
| 539-764-40 | AT553-250-HL |
| 539-765-40 | AT553-300-HL |
| 539-766-40 | AT553-350-HL |

• ABS AT543/AT543A-HL

| Order No. | Code |
|------------|-----------------|
| 539-731-□□ | AT543(A)-100-HL |
| 539-732-□□ | AT543(A)-150-HL |
| 539-733-□□ | AT543(A)-200-HL |
| 539-734-□□ | AT543(A)-250-HL |
| 539-735-□□ | AT543(A)-300-HL |
| 539-736-□□ | AT543(A)-350-HL |

* The □□ in the Order No. is as follows. AT543 : 40
AT543A: 41

• ABS AT573A-HL

| Order No. | Code |
|------------|---------------|
| 539-871-41 | AT573A-100-HL |
| 539-872-41 | AT573A-150-HL |
| 539-873-41 | AT573A-200-HL |
| 539-874-41 | AT573A-250-HL |
| 539-875-41 | AT573A-300-HL |
| 539-876-41 | AT573A-350-HL |

• ABS AT503/AT503A-HL

| Order No. | Code |
|------------|-----------------|
| 539-161-□□ | AT503(A)-100-HL |
| 539-162-□□ | AT503(A)-150-HL |
| 539-163-□□ | AT503(A)-200-HL |
| 539-164-□□ | AT503(A)-250-HL |
| 539-165-□□ | AT503(A)-300-HL |
| 539-166-□□ | AT503(A)-350-HL |

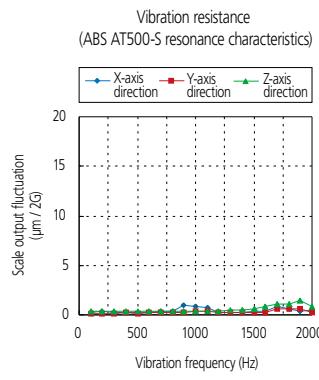
* The □□ in the Order No. is as follows. AT503 : 40
AT503A: 41

ABS AT500 Series

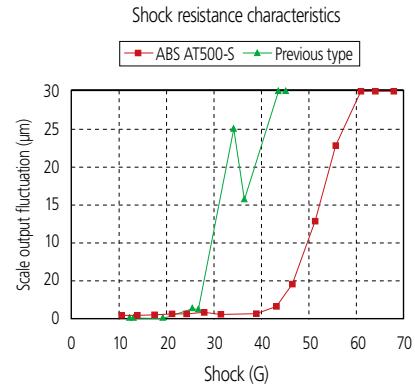
Structural Features

- **ABS AT500-S Series** combines high vibration resistance with shock resistance

1. Example of vibration resistance characteristics

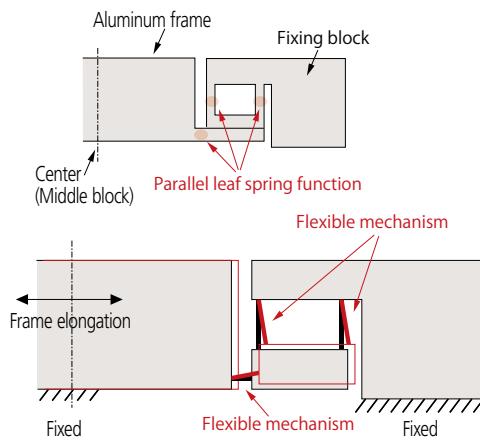


2. Vibration resistance

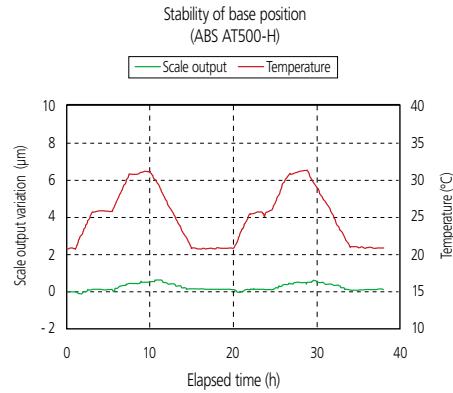


- **ABS AT500-H Series** combines outstanding thermal characteristics with high repeatability

1. Structural concept



2. Example of thermal characteristics



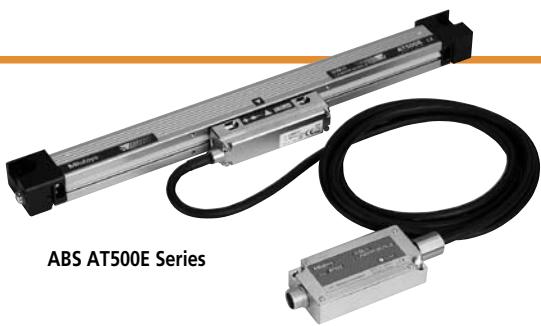
Note: This refers to the fixed point on the scale around which clamping arrangements ensure that any expansion or contraction due to temperature change occurs.

Assembly Type ABS AT Series

Absolute Scale Unit (Slim Spar Type)

ABS AT500E

(Resolution 0.005μm/0.05μm)



ABS AT500E Series

Features

- High-performance Absolute Linear Scale with 0.005μm/0.05μm resolution and high maximum response speed (72m/min, 150m/min).
- The ABS AT500E Series realizes vibration resistance of 147m/s² (15G) and shock-resistance of 343m/s² (35G), suitable for use with heavy cutting equipment and for high-speed machining.
- The ABS AT500E Series has high repeatability, excellent temperature characteristics, and enables highly accurate and stable positioning.
- Slim shape is suitable for space-saving designs.
- Compatible with servo amplifiers from a range of companies (high-speed serial interfaces).

How to read the code

| Interface specification | Applicable systems | Scale code |
|--|---|---|
| | FANUC Ltd. control devices FS-i Series POWER Mate i | ABS AT555E (Resolution 0.005μm) ABS AT553E (Resolution 0.05μm) |
| Mitsubishi Electric Corporation control devices MITSUBISHI CNC Series Applicable amplifier: MDS-D/MDS-DH Series | | ABS AT545E (Resolution 0.005μm) ABS AT543E (Resolution 0.05μm) |

Base position for elongation of scale *

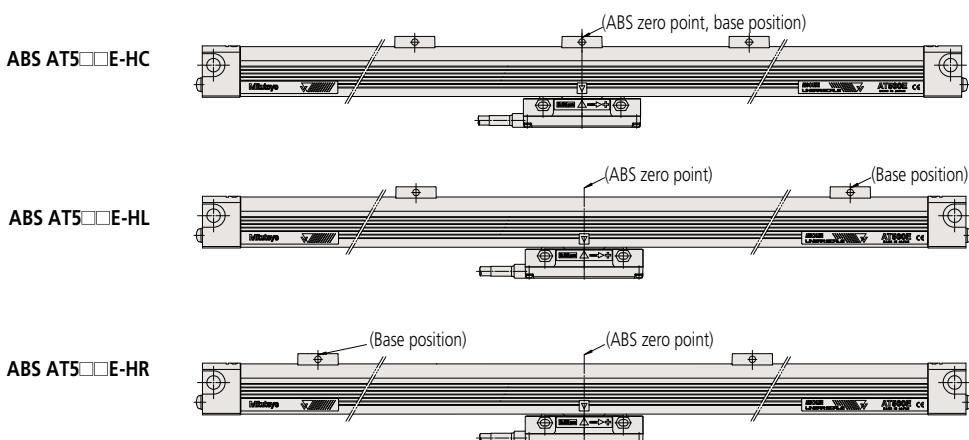
C: Midpoint of effective range

L: End of effective range (+ side end)

R: End of effective range (- side end)

* This refers to the fixed point on the scale around which clamping arrangements ensure that any expansion or contraction due to temperature change occurs.

Scale configuration



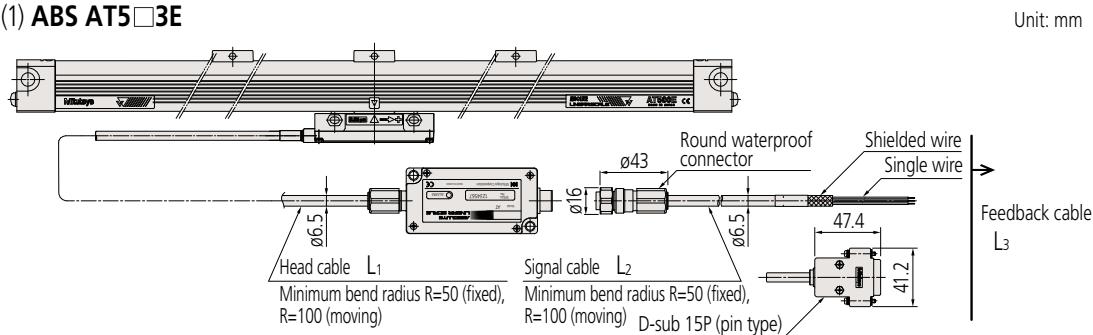
Specifications

| Item | Code | ABS AT5□□E-HC | ABS AT5□□E-HL/HR |
|--------------------------------|------|--|--|
| Detection method | | Electrostatic capacitance type / photoelectric type composite ABS linear encoder | |
| How to mount the scale unit | | 3, 5 or 7-point elastic fixing | 3 or 4-point elastic fixing |
| Base position | | Midpoint of effective range | End of effective range HL: (+ side of absolute value) HR: (- side of absolute value) |
| Effective range | | 100 to 1220mm | 100 to 350mm |
| Resolution | | 0.05μm/0.005μm (20μm/4096) *1 | |
| Maximum response speed | | 150m/min (Resolution 0.05μm) 72m/min (Resolution 0.005μm) | |
| Accuracy (20°C) | | (2+2L/1000)μm L: Effective range (mm) | |
| Thermal expansion coefficient | | (8.5±0.5) x 10 ⁻⁶ /°C | |
| Vibration resistance | | 147 m/s ² (15G) (55 to 2000Hz) | |
| Shock resistance | | 353m/s ² (35G) (half-sine 11ms) | |
| Power supply voltage | | DC5V±5% | |
| Maximum current consumption | | 270mA (Max) | |
| Maximum sliding force | | 4N | |
| Operating temperature/humidity | | 0 to 45°C, 20 to 80%RH (no condensation) | |
| Storage temperature/humidity | | -20 to 70°C, 20 to 80%RH (no condensation) | |
| Protection rating | | Scale unit: Equivalent to IP53, I/F box: not waterproof | |
| Alarm indication | | Scale alarm indicated by LED on I/F Box | |

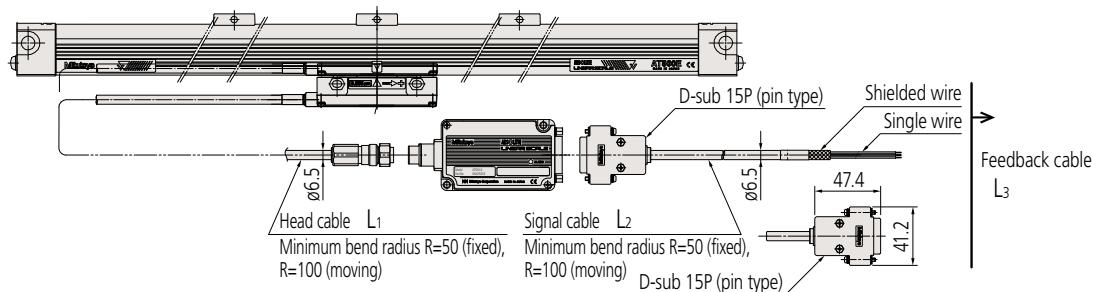
*1: Because the 20μm signal is divided by 4096, the actual value is 0.0048828125μm. When setting the minimum resolution on the controller, always enter the actual value.

System configuration example (cable length)

(1) ABS AT5□3E



(2) ABS AT5□5E



Allowable cable length for feedback cable L₃ (power supply voltage 5.0V)

1) Head cable L₁ = 2m (recommended standard length)

| | Signal cable L ₂ | | | |
|---|-----------------------------|----------------|----------------|-----------------|
| | 3m (06ACT652A) | 5m (06ACT652B) | 8m (06ACT652C) | 10m (06ACT652D) |
| Allowable length of cable L ₃ (Max.) | 24m | 19m | 11m | - (N/A) |
| Total cable length | 29m | 29m | 21m | 12m |

2) Head cable L₁ = 5m

| | Signal cable L ₂ | | | |
|---|-----------------------------|----------------|----------------|-----------------|
| | 3m (06ACT652A) | 5m (06ACT652B) | 8m (06ACT652C) | 10m (06ACT652D) |
| Allowable length of cable L ₃ (Max.) | 21m | 19m | 11m | - (N/A) |
| Total cable length | 29m | 29m | 24m | 15m |

3) Head cable L₁ = 10m

| | 信号ケーブルL ₂ | | | |
|---|----------------------|----------------|----------------|-----------------|
| | 3m (06ACT652A) | 5m (06ACT652B) | 8m (06ACT652C) | 10m (06ACT652D) |
| Allowable length of cable L ₃ (Max.) | 16m | 14m | 11m | - (N/A) |
| Total cable length | 29m | 29m | 29m | 20m |

Notes

1: Feedback cable part numbers 7m: 06ACD238B , 9m: 06ACD238C , 10m: 06ACD238A , 12m: 06ACD238D

2: Feedback cable material: PVC sheathed (standard) or high-flex type (special order)

3: Signal cable (output side): single wire (standard) or D-sub 15P (special order)

4: Applicable connector for D-sub 15P: HDAB-15S (Hirose Electric or equivalent)

Output specification

• Signal cable with flying leads

| Wire color | Signal |
|-------------|---------|
| Brown/Red | +5V |
| White/Black | GND |
| Orange | SD |
| Yellow | SD |
| Green | REQ |
| Blue | REQ |
| Purple | Phase A |
| Gray | Phase B |
| Shield | FG |

Notes

1: Phase A and Phase B are used as test signals.

Keep them disconnected during use.

2: Connect the shield wire to the grounding conductor.

• Signal cable with D-sub connector

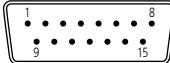
| Pin No. | Signal |
|-----------|----------|
| 1, 2, 13 | GND |
| 3, 4, 11 | +5V |
| 5 | SD |
| 6 | SD |
| 7 | REQ |
| 8 | REQ |
| 9 | Phase A |
| 10 | Phase B |
| 15, Shell | FG |
| 12, 14 | Not used |

Notes

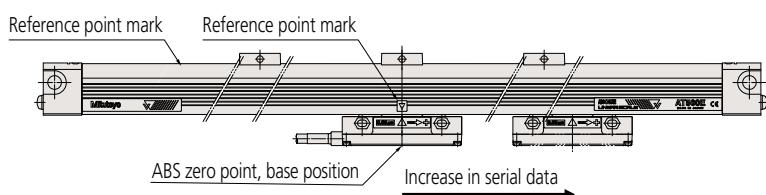
1: Phase A and Phase B are used as test signals.

Keep them disconnected during use.

2: Applicable connector: HDAB-15S (Hirose Electric or equivalent).



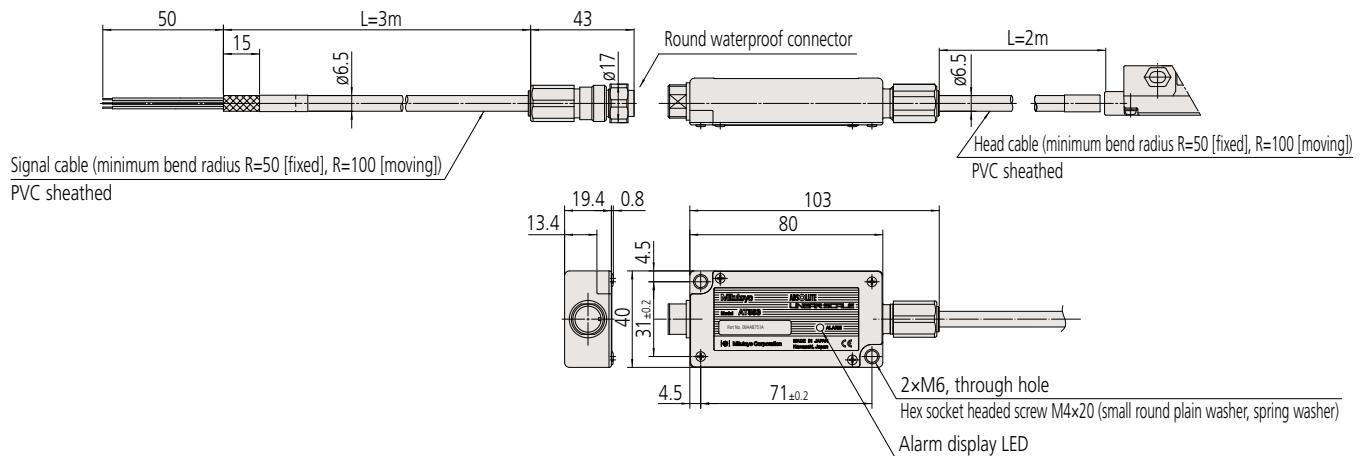
ABS zero point, base position and count direction



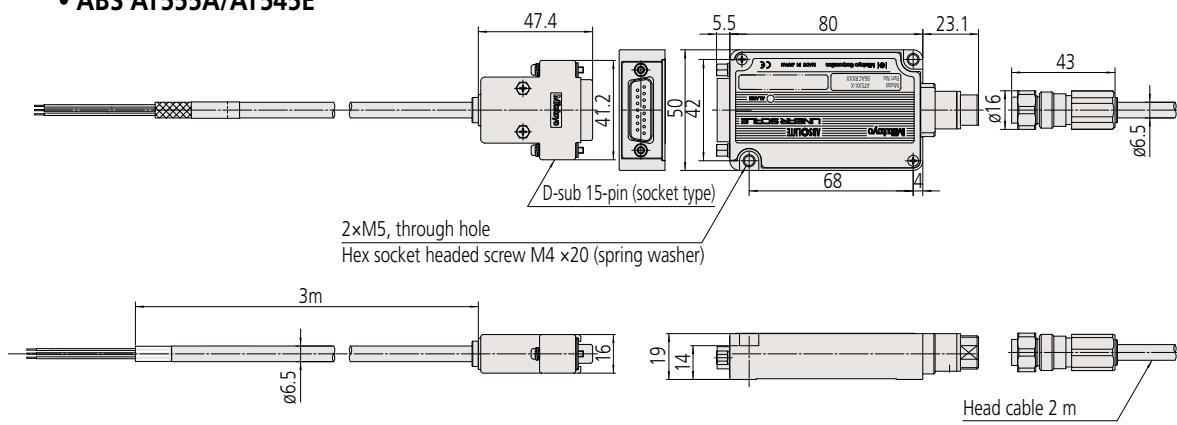
Cable dimensions

• ABS AT553E/AT543E

Unit: mm

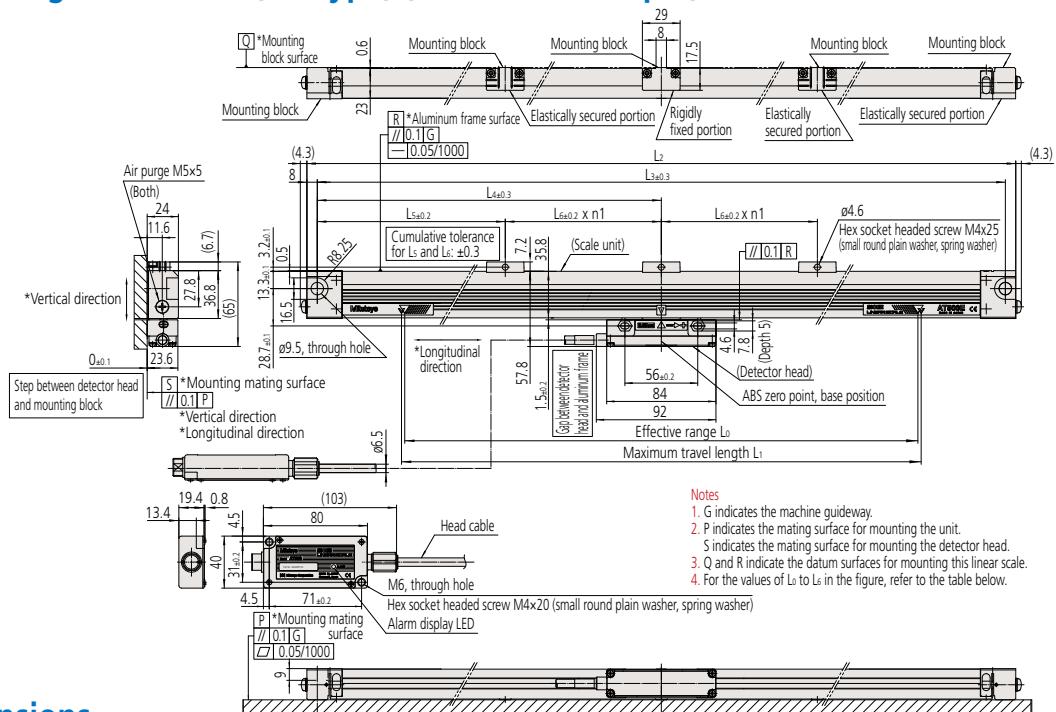


• ABS AT555A/AT545E



Mounting dimensions (HC Type) (Resolution 0.05μm)

Unit: mm



Dimensions

| Effective range L ₀ (mm) | Maximum travel length L ₁ (mm) | Overall length L ₂ (mm) | Mounting pitch | | | | No. of mounting holes n |
|--|--|---------------------------------------|---------------------|---------------------|---------------------|---------------------|----------------------------|
| | | | L ₃ (mm) | L ₄ (mm) | L ₅ (mm) | L ₆ (mm) | |
| 100 | 105 | 251 | 235 | 117.5 | — | — | 0 |
| 150 | 155 | 301 | 285 | 142.5 | — | — | 0 |
| 200 | 205 | 351 | 335 | 167.5 | — | — | 0 |
| 250 | 255 | 401 | 385 | 192.5 | — | — | 0 |
| 300 | 305 | 451 | 435 | 217.5 | — | — | 0 |
| 350 | 355 | 501 | 485 | 242.5 | — | — | 0 |
| 400 | 405 | 551 | 535 | 267.5 | — | — | 0 |
| 450 | 455 | 601 | 585 | 292.5 | — | — | 0 |
| 500 | 505 | 651 | 635 | 317.5 | — | — | 0 |
| 550 | 555 | 701 | 685 | (342.5) | 177.5 | 165 | 1 |
| 600 | 605 | 751 | 735 | (367.5) | 197.5 | 170 | 1 |
| 650 | 655 | 801 | 785 | (392.5) | 197.5 | 195 | 1 |
| 700 | 705 | 851 | 835 | (417.5) | 217.5 | 200 | 1 |
| 750 | 755 | 901 | 885 | (442.5) | 217.5 | 225 | 1 |
| 800 | 805 | 951 | 935 | (467.5) | 237.5 | 230 | 1 |
| 900 | 905 | 1051 | 1035 | (517.5) | 257.5 | 260 | 1 |
| 1000 | 1005 | 1151 | 1135 | (567.5) | 277.5 | 290 | 1 |
| 1120 | 1125 | 1274 | 1255 | (627.5) | 227.5 | 200 | 2 |
| 1220 | 1225 | 1371 | 1355 | (677.5) | 217.5 | 230 | 2 |

Codes and Order Numbers

• ABS AT553E-HC

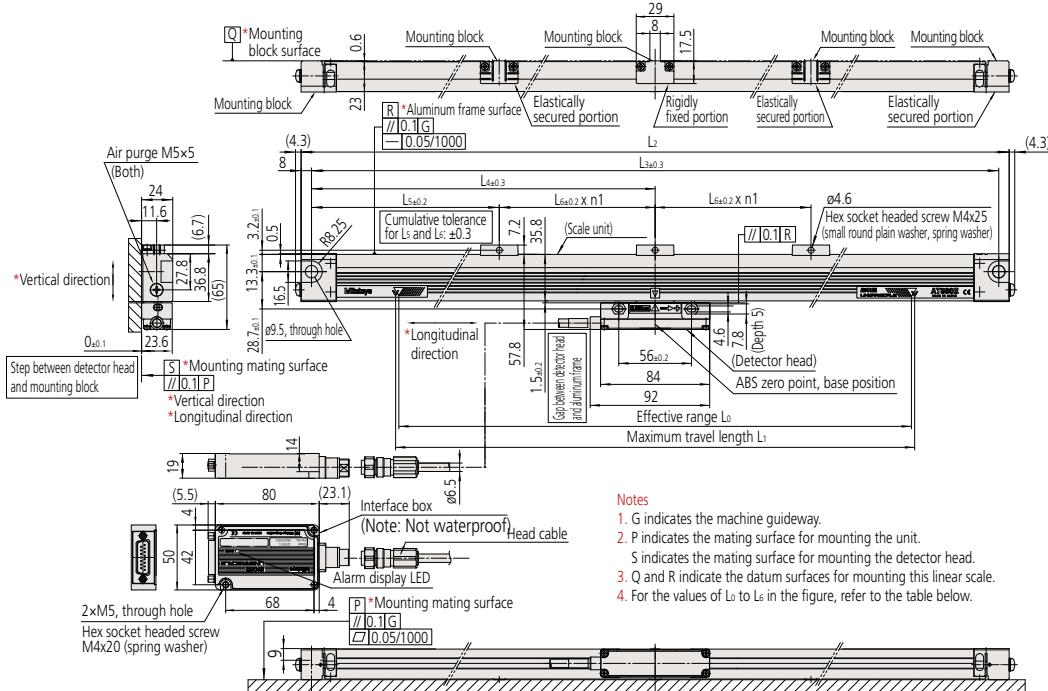
| Order No. | Code |
|------------|----------------|
| 539-761-22 | AT553E- 100-HC |
| 539-762-22 | AT553E- 150-HC |
| 539-763-22 | AT553E- 200-HC |
| 539-764-22 | AT553E- 250-HC |
| 539-765-22 | AT553E- 300-HC |
| 539-766-22 | AT553E- 350-HC |
| 539-767-22 | AT553E- 400-HC |
| 539-768-22 | AT553E- 450-HC |
| 539-769-22 | AT553E- 500-HC |
| 539-770-22 | AT553E- 550-HC |
| 539-771-22 | AT553E- 600-HC |
| 539-772-22 | AT553E- 650-HC |
| 539-773-22 | AT553E- 700-HC |
| 539-774-22 | AT553E- 750-HC |
| 539-775-22 | AT553E- 800-HC |
| 539-776-22 | AT553E- 900-HC |
| 539-777-22 | AT553E-1000-HC |
| 539-778-22 | AT553E-1120-HC |
| 539-779-22 | AT553E-1220-HC |

• ABS AT543E-HC

| Order No. | Code |
|------------|----------------|
| 539-731-22 | AT543E- 100-HC |
| 539-732-22 | AT543E- 150-HC |
| 539-733-22 | AT543E- 200-HC |
| 539-734-22 | AT543E- 250-HC |
| 539-735-22 | AT543E- 300-HC |
| 539-736-22 | AT543E- 350-HC |
| 539-737-22 | AT543E- 400-HC |
| 539-738-22 | AT543E- 450-HC |
| 539-739-22 | AT543E- 500-HC |
| 539-740-22 | AT543E- 550-HC |
| 539-741-22 | AT543E- 600-HC |
| 539-742-22 | AT543E- 650-HC |
| 539-743-22 | AT543E- 700-HC |
| 539-744-22 | AT543E- 750-HC |
| 539-745-22 | AT543E- 800-HC |
| 539-746-22 | AT543E- 900-HC |
| 539-747-22 | AT543E-1000-HC |
| 539-748-22 | AT543E-1120-HC |
| 539-749-22 | AT543E-1220-HC |

Mounting dimensions (HC Type) (Resolution 0.005μm)

Unit: mm



Dimensions

| Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_2 (mm) | Mounting pitch | | | | No. of mounting holes n |
|-------------------------------|-------------------------------------|------------------------------|----------------|------------|------------|------------|----------------------------|
| | | | L_3 (mm) | L_4 (mm) | L_5 (mm) | L_6 (mm) | |
| 100 | 105 | 251 | 235 | 117.5 | — | — | 0 |
| 150 | 155 | 301 | 285 | 142.5 | — | — | 0 |
| 200 | 205 | 351 | 335 | 167.5 | — | — | 0 |
| 250 | 255 | 401 | 385 | 192.5 | — | — | 0 |
| 300 | 305 | 451 | 435 | 217.5 | — | — | 0 |
| 350 | 355 | 501 | 485 | 242.5 | — | — | 0 |
| 400 | 405 | 551 | 535 | 267.5 | — | — | 0 |
| 450 | 455 | 601 | 585 | 292.5 | — | — | 0 |
| 500 | 505 | 651 | 635 | 317.5 | — | — | 0 |
| 550 | 555 | 701 | 685 | (342.5) | 177.5 | 165 | 1 |
| 600 | 605 | 751 | 735 | (367.5) | 197.5 | 170 | 1 |
| 650 | 655 | 801 | 785 | (392.5) | 197.5 | 195 | 1 |
| 700 | 705 | 851 | 835 | (417.5) | 217.5 | 200 | 1 |
| 750 | 755 | 901 | 885 | (442.5) | 217.5 | 225 | 1 |
| 800 | 805 | 951 | 935 | (467.5) | 237.5 | 230 | 1 |
| 900 | 905 | 1051 | 1035 | (517.5) | 257.5 | 260 | 1 |
| 1000 | 1005 | 1151 | 1135 | (567.5) | 277.5 | 290 | 1 |
| 1120 | 1125 | 1274 | 1255 | (627.5) | (227.5) | 200 | 2 |
| 1220 | 1225 | 1371 | 1355 | (677.5) | (217.5) | 230 | 2 |

Codes and Order Numbers

• ABS AT555E-HC

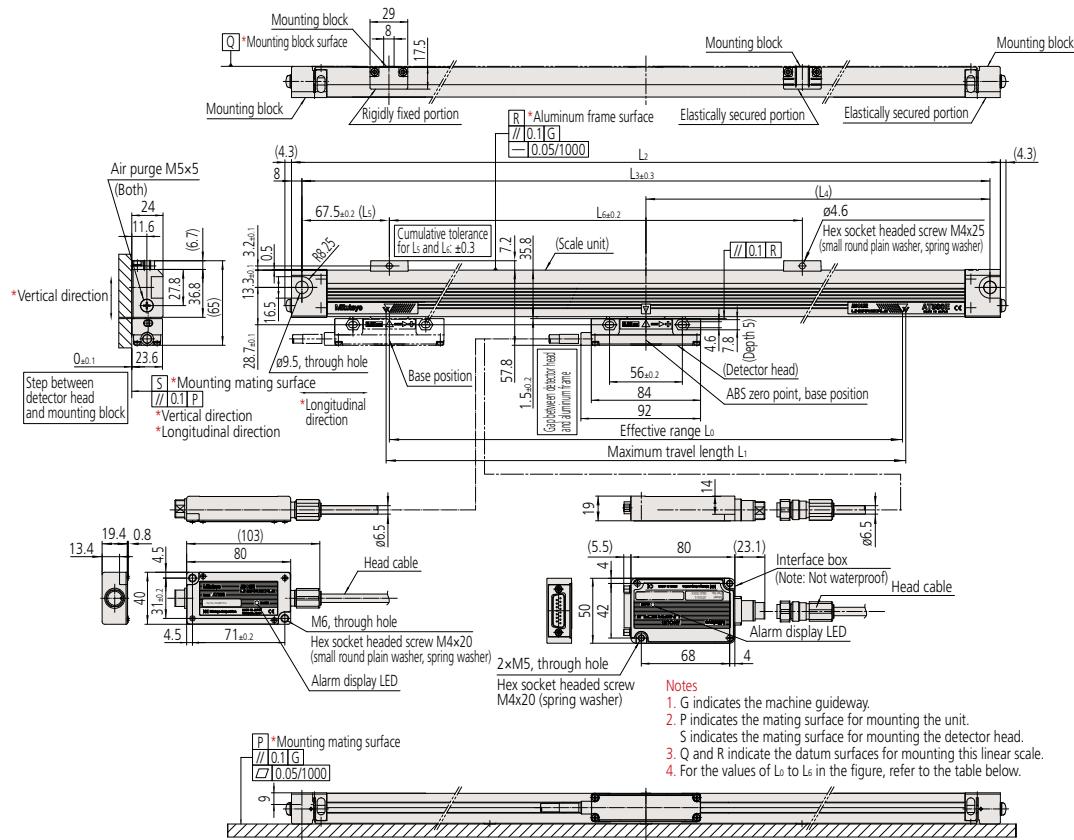
| Order No. | Code |
|------------|----------------|
| 539-761-62 | AT555E- 100-HC |
| 539-762-62 | AT555E- 150-HC |
| 539-763-62 | AT555E- 200-HC |
| 539-764-62 | AT555E- 250-HC |
| 539-765-62 | AT555E- 300-HC |
| 539-766-62 | AT555E- 350-HC |
| 539-767-62 | AT555E- 400-HC |
| 539-768-62 | AT555E- 450-HC |
| 539-769-62 | AT555E- 500-HC |
| 539-770-62 | AT555E- 550-HC |
| 539-771-62 | AT555E- 600-HC |
| 539-772-62 | AT555E- 650-HC |
| 539-773-62 | AT555E- 700-HC |
| 539-774-62 | AT555E- 750-HC |
| 539-775-62 | AT555E- 800-HC |
| 539-776-62 | AT555E- 900-HC |
| 539-777-62 | AT555E-1000-HC |
| 539-778-62 | AT555E-1120-HC |
| 539-779-62 | AT555E-1220-HC |

• ABS AT545E-HC

| Order No. | Code |
|------------|----------------|
| 539-731-62 | AT545E- 100-HC |
| 539-732-62 | AT545E- 150-HC |
| 539-733-62 | AT545E- 200-HC |
| 539-734-62 | AT545E- 250-HC |
| 539-735-62 | AT545E- 300-HC |
| 539-736-62 | AT545E- 350-HC |
| 539-737-62 | AT545E- 400-HC |
| 539-738-62 | AT545E- 450-HC |
| 539-739-62 | AT545E- 500-HC |
| 539-740-62 | AT545E- 550-HC |
| 539-741-62 | AT545E- 600-HC |
| 539-742-62 | AT545E- 650-HC |
| 539-743-62 | AT545E- 700-HC |
| 539-744-62 | AT545E- 750-HC |
| 539-745-62 | AT545E- 800-HC |
| 539-746-62 | AT545E- 900-HC |
| 539-747-62 | AT545E-1000-HC |
| 539-748-62 | AT545E-1120-HC |
| 539-749-62 | AT545E-1220-HC |

Mounting dimensions (HR Type) (Resolution 0.05 µm/0.005 µm)

Unit: mm



Dimensions

| Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_2 (mm) | Mounting pitch | | |
|-------------------------------|-------------------------------------|------------------------------|----------------|------------|------------|
| | | | L_3 (mm) | L_4 (mm) | L_6 (mm) |
| 100 | 150 | 251 | 235 | 117.5 | — |
| 150 | 155 | 301 | 285 | 142.5 | 100 |
| 200 | 205 | 351 | 335 | 167.5 | 130 |
| 250 | 255 | 401 | 385 | 192.5 | 160 |
| 300 | 305 | 451 | 435 | 217.5 | 190 |
| 350 | 355 | 501 | 485 | 242.5 | 220 |

Codes and Order Numbers

• ABS AT553E-HR

| Order No. | Code |
|------------|---------------|
| 539-761-32 | AT553E-100-HR |
| 539-762-32 | AT553E-150-HR |
| 539-763-32 | AT553E-200-HR |
| 539-764-32 | AT553E-250-HR |
| 539-765-32 | AT553E-300-HR |
| 539-766-32 | AT553E-350-HR |

• ABS AT543E-HR

| Order No. | Code |
|------------|---------------|
| 539-731-32 | AT543E-100-HR |
| 539-732-32 | AT543E-150-HR |
| 539-733-32 | AT543E-200-HR |
| 539-734-32 | AT543E-250-HR |
| 539-735-32 | AT543E-300-HR |
| 539-736-32 | AT543E-350-HR |

• ABS AT555E-HR

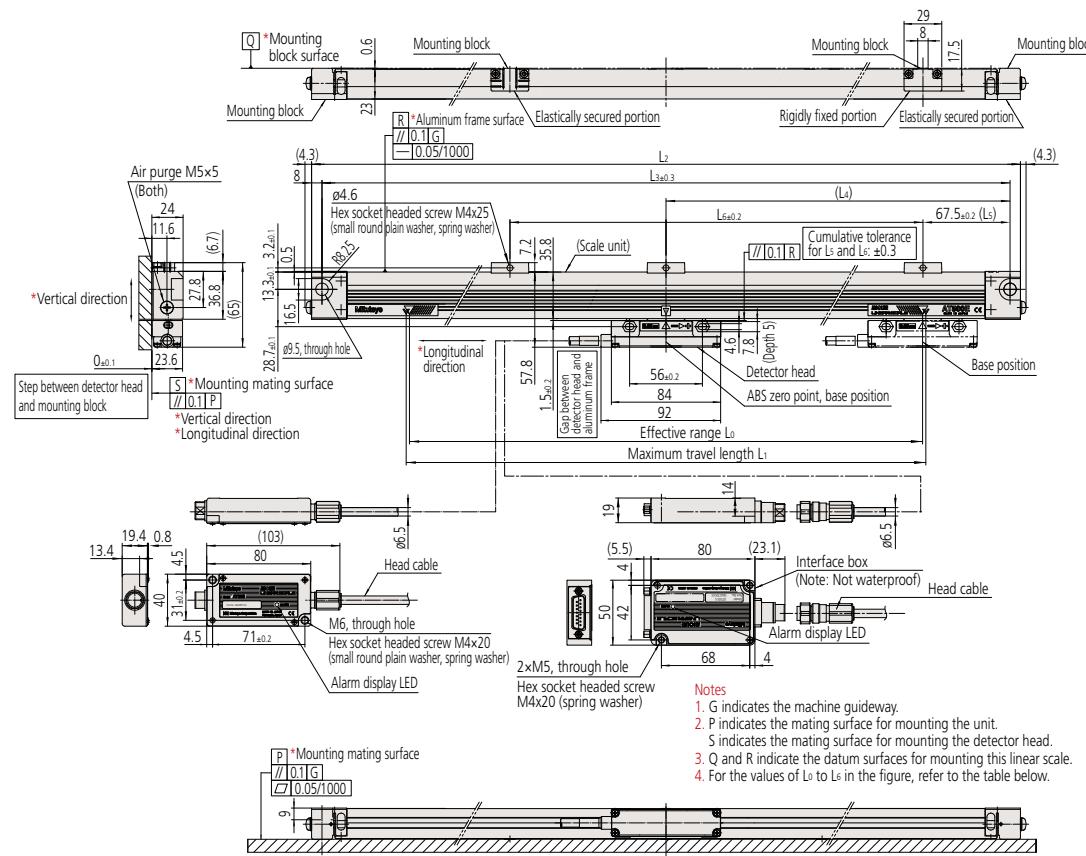
| Order No. | Code |
|------------|---------------|
| 539-761-72 | AT555E-100-HR |
| 539-762-72 | AT555E-150-HR |
| 539-763-72 | AT555E-200-HR |
| 539-764-72 | AT555E-250-HR |
| 539-765-72 | AT555E-300-HR |
| 539-766-72 | AT555E-350-HR |

• ABS AT545E-HR

| Order No. | Code |
|------------|---------------|
| 539-731-72 | AT545E-100-HR |
| 539-732-72 | AT545E-150-HR |
| 539-733-72 | AT545E-200-HR |
| 539-734-72 | AT545E-250-HR |
| 539-735-72 | AT545E-300-HR |
| 539-736-72 | AT545E-350-HR |

Mounting dimensions (HL Type) (Resolution 0.05μm/0.005μm)

Unit: mm



Dimensions

| Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_2 (mm) | Mounting pitch | | |
|-------------------------------|-------------------------------------|------------------------------|----------------|------------|------------|
| | | | L_3 (mm) | L_4 (mm) | L_6 (mm) |
| 100 | 105 | 251 | 235 | 117.5 | — |
| 150 | 155 | 303 | 285 | 142.5 | 100 |
| 200 | 205 | 351 | 335 | 165.5 | 130 |
| 250 | 255 | 401 | 385 | 192.5 | 160 |
| 300 | 305 | 451 | 435 | 217.5 | 190 |
| 350 | 355 | 501 | 485 | 242.5 | 220 |

Codes and Order Numbers

• ABS AT553E-HL

| Order No. | Code |
|------------|---------------|
| 539-761-42 | AT553E-100-HL |
| 539-762-42 | AT553E-150-HL |
| 539-763-42 | AT553E-200-HL |
| 539-764-42 | AT553E-250-HL |
| 539-765-42 | AT553E-300-HL |
| 539-766-42 | AT553E-350-HL |

• ABS AT543E-HL

| Order No. | Code |
|------------|---------------|
| 539-731-42 | AT543E-100-HL |
| 539-732-42 | AT543E-150-HL |
| 539-733-42 | AT543E-200-HL |
| 539-734-42 | AT543E-250-HL |
| 539-735-42 | AT543E-300-HL |
| 539-736-42 | AT543E-350-HL |

• ABS AT555E-HL

| Order No. | Code |
|------------|---------------|
| 539-761-82 | AT555E-100-HL |
| 539-762-82 | AT555E-150-HL |
| 539-763-82 | AT555E-200-HL |
| 539-764-82 | AT555E-250-HL |
| 539-765-82 | AT555E-300-HL |
| 539-766-82 | AT555E-350-HL |

• ABS AT545E-HL

| Order No. | Code |
|------------|---------------|
| 539-731-82 | AT545E-100-HL |
| 539-732-82 | AT545E-150-HL |
| 539-733-82 | AT545E-200-HL |
| 539-734-82 | AT545E-250-HL |
| 539-735-82 | AT545E-300-HL |
| 539-736-82 | AT545E-350-HL |

ABS AT300 Series



Features

- Complete absolute type linear scales.
- Easy operation because no recalibration is required at startup or after a power failure.
- Suitable for position feedback in machinery requiring high-accuracy, high-speed control.
- Compatible with servo amplifiers from a range of companies (high-speed serial interfaces).

How to read the code

| | | | | | | | | |
|--|--------------------------|--------------------------|--------------------------|---|--------------------------|--------------------------|--------------------------|--------------------------|
| ABS AT3 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | - | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Interface specification | | | | | | | | Effective range |
| Applicable systems | | | | | | | | Scale code |
| FANUC Ltd. control devices FS-i Series POWER Mate i | | | | | | | | ABS AT353 |
| Mitsubishi Electric Corporation control devices MITSUBISHI CNC Series Applicable amplifier: MDS-D/MDS-DH Series | | | | | | | | ABS AT343 |
| Mitsubishi Electric Corporation MR-J4/MR-J3 Series | | | | | | | | ABS AT343A |
| Amplifier compatible with the Mitutoyo ENSIS interface Nikki Denso Co., Ltd. VCII/ VC/ VPS Series *1 Servoland Corporation SVF Series *1 PMAC JAPAN Co., Ltd. UMAC-Turbo PMAC2 Other machine types | | | | | | | | ABS AT303A |
| | | | | | | | | ABS AT303 |

*1 For connection to ABS AT303A

*ABS AT3□3□

Communication method

Blank: Full-duplex communication
A: Half-duplex communication

* For details regarding the applicable system, please consult with the individual manufacturer.

Specifications

| Item | Code | ABS AT353/AT343(A)/AT303(A) |
|--------------------------------|------|--|
| Detection method | | Electrostatic capacitance type / photoelectric type composite ABS linear encoder |
| Effective range | | 100 to 3000mm |
| Resolution | | 0.05 µm |
| Maximum response speed | | 120m/min (2m/s) |
| Accuracy (20°C) | | 100 to 1500mm: (3+3L ₀ /1000) µm 1600 to 3000mm: (5+5L ₀ /1000) µm L ₀ : Effective range (mm) |
| Thermal expansion coefficient | | (8.0±1) x 10 ⁻⁶ /°C |
| Vibration resistance | | 98m/s ² (10G) (half-sine,11ms) |
| Shock resistance | | 147 m/s ² (15G) (55 to 2000Hz) |
| Power supply voltage | | DC5V±5% |
| Maximum current consumption | | 250mA (Max) |
| Maximum sliding force | | 5N |
| Operating temperature/humidity | | 0 to 45°C, 20 to 80%RH (no condensation) |
| Storage temperature/humidity | | -20 to 70°C, 20 to 80%RH (no condensation) |
| Protection rating | | Equivalent to IP53 |
| Signal cable length* | | 5m |

* The AT343A signal cable is sold as an option.

0.2 m: No.09BAA598A

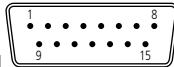
2 m: No.09BAA598B

3 m: No.09BAA598C

Output specification

• ABS AT353/AT343/AT303

Output connector (pin type): HDAB-15P (Hirose Electric)
Applicable connector (included): HDAB-15S (Hirose Electric)
Alternately, an equivalent product (D-sub series) can be used.



| Pin No. | Signal |
|-----------------|-----------------------|
| 1 | 0V (GND) |
| 2 | 0V (GND) |
| 3 | +5V |
| 4 | +5V |
| 5 | DT |
| 6 | DT |
| 7 | REQ |
| 8 | REQ |
| 9 | Phase A (for testing) |
| 10 | Phase B (for testing) |
| 11 | +5V |
| 12 | N.C |
| 13 | 0V (GND) |
| 14 | N.C |
| 15 | F.G |
| Connector shell | F.G |

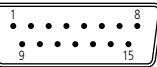
Note: Phase A and Phase B are used as test signals.
Keep them disconnected during use.

• ABS AT343A

Output connector (pin type): Tyco Electronics Japan
Mini•Universal Mate-N-Lock Connector 9P
172169-9 (Housing: Black)
Applicable connector: 172161-9 (Housing: Black)

| Pin No. | Signal |
|---------|------------|
| 1 | MR (RQ/DT) |
| 2 | MRR(RQ/DT) |
| 3 | N.C |
| 4 | (DT) |
| 5 | (DT) |
| 6 | N.C |
| 7 | P5 (+5V) |
| 8 | LG (GND) |
| 9 | F.G |

Note: Phase A and Phase B are used as test signals.
Keep them disconnected during use.



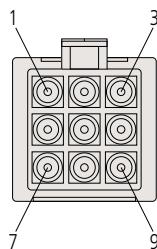
• ABS AT303A

Output connector (pin type): HDAB-15P (Hirose Electric)
Applicable connector (included): HDAB-15S (Hirose Electric)
Alternately, an equivalent product (D-sub series) can be used.



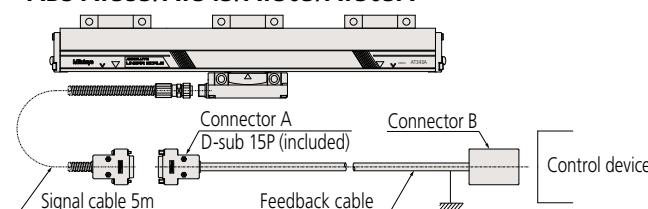
| Pin No. | Signal |
|-----------------|-----------------------|
| 1 | 0V (GND) |
| 2 | 0V (GND) |
| 3 | +5V |
| 4 | +5V |
| 5 | — |
| 6 | — |
| 7 | REQ/DT |
| 8 | REQ/DT |
| 9 | Phase A (for testing) |
| 10 | Phase B (for testing) |
| 11 | +5V |
| 12 | N.C |
| 13 | 0V (GND) |
| 14 | N.C |
| 15 | F.G |
| Connector shell | F.G |

Note: Phase A and Phase B are used as test signals.
Keep them disconnected during use.



System configuration (See instruction manual)

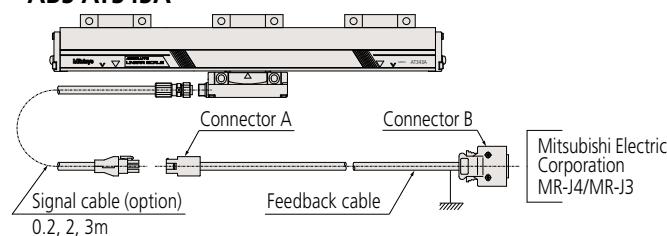
• ABS AT353/AT343/AT303/AT303A



Notes

1. Connector B and the feedback cable are to be prepared by the user.
2. Connectors A/B and the grounding bar are to be connected by the user.
3. When fabricating a feedback cable, ensure that the total cable length is 25m or less.

• ABS AT343A



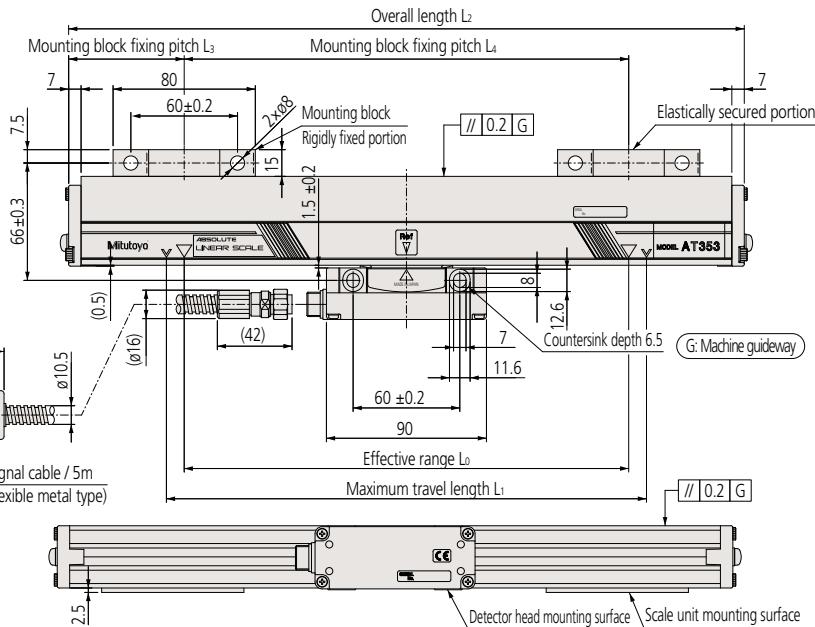
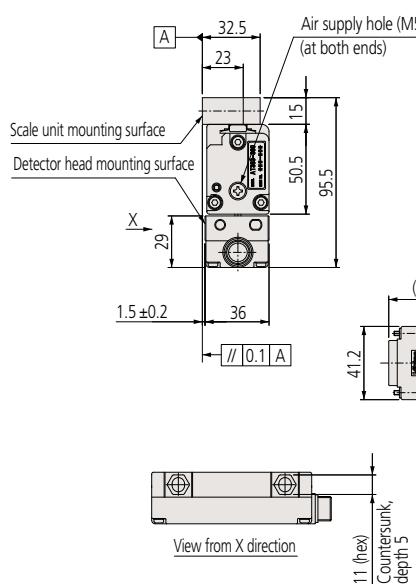
Notes

1. Connectors A/B and the feedback cable are to be prepared by the user.
 2. Connectors A/B and the grounding bar are to be connected by the user.
 3. A Mitsubishi Electric Corporation encoder cable can be used as the feedback cable.
MR-J4/MR-J3 series compatible model: MREKCB□M-H
□ indicates the cable length (2, 5, 10m)
- * Depending on the signal cable length, the encoder cable length is restricted as follows.
Signal cable 0.2 m: 2, 5, 10m
Signal cable 2m: 2, 5m
Signal cable 3m: 2m
- * The feedback cable configuration depends on the system. Please contact Mitsubishi Electric Corporation for details.

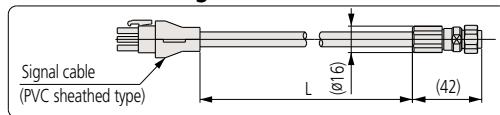
Mounting dimensions [ABS AT353/AT343(A)/AT303(A)]

Unit: mm

• Effective range 100 mm to 250mm

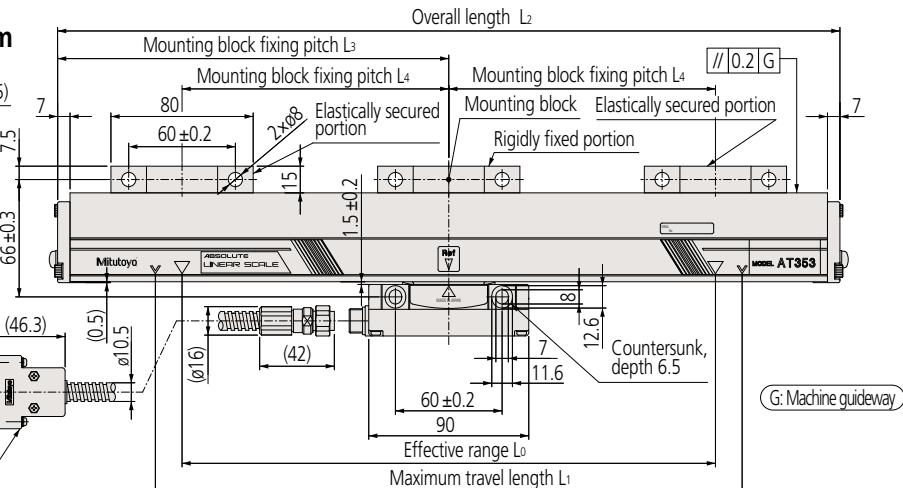
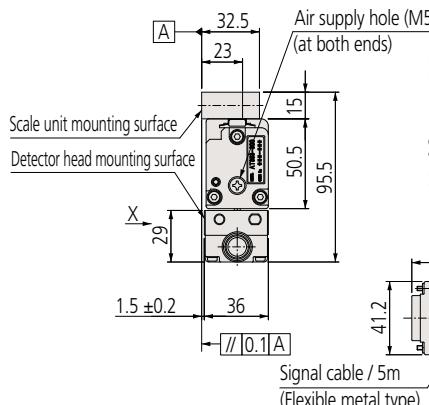


• ABS AT343A signal cable



*The signal cable has set options.
(Part No.09BA598A - C: 0.2m, 2m, 3m)

• Effective range 300mm to 3000mm



Dimensions

| Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_2 (mm) | Mounting block pitch | | No. of mounting blocks |
|-------------------------------|-------------------------------------|------------------------------|----------------------|------------|------------------------|
| | | | L_3 (mm) | L_4 (mm) | |
| 100 | 120 | 230 | 65 | 100 | |
| 150 | 170 | 280 | 65 | 150 | |
| 200 | 220 | 330 | 65 | 200 | 2 |
| 250 | 270 | 380 | 65 | 250 | |
| 300 | 330 | 440 | 220 | 150 | |
| 350 | 380 | 490 | 245 | 175 | 3 |
| 400 | 430 | 540 | 270 | 200 | |
| 450 | 480 | 590 | 295 | 225 | |
| 500 | 540 | 650 | 325 | 250 | |
| 600 | 650 | 760 | 380 | 300 | |
| 700 | 760 | 870 | 435 | 350 | |
| 750 | 810 | 920 | 460 | 375 | |
| 800 | 860 | 970 | 485 | 400 | |
| 900 | 960 | 1070 | 535 | 450 | |
| 1000 | 1060 | 1170 | 585 | 500 | |

| Effective range L_0 (mm) | Maximum travel length L_1 (mm) | Overall length L_2 (mm) | Mounting block pitch | | No. of mounting blocks |
|-------------------------------|-------------------------------------|------------------------------|----------------------|------------|------------------------|
| | | | L_3 (mm) | L_4 (mm) | |
| 1100 | 1160 | 1270 | 635 | 275 | 5 |
| 1200 | 1260 | 1370 | 685 | 300 | |
| 1300 | 1360 | 1470 | 735 | 325 | |
| 1400 | 1460 | 1570 | 785 | 350 | |
| 1500 | 1560 | 1670 | 835 | 375 | |
| 1600 | 1690 | 1800 | 900 | 400 | |
| 1700 | 1790 | 1900 | 950 | 425 | |
| 1800 | 1890 | 2000 | 1000 | 450 | 7 |
| 2000 | 2100 | 2210 | 1105 | 335 | |
| 2200 | 2300 | 2410 | 1205 | 370 | |
| 2400 | 2500 | 2610 | 1305 | 400 | |
| 2500 | 2600 | 2710 | 1355 | 315 | |
| 2600 | 2700 | 2810 | 1405 | 325 | |
| 2800 | 2900 | 3010 | 1505 | 350 | |
| 3000 | 3050 | 3210 | 1605 | 375 | |

Codes and Order Numbers

• ABS AT353

| Order No. | Code | Order No. | Code |
|------------|------------|------------|------------|
| 539-541-30 | AT353- 100 | 539-558-30 | AT353-1100 |
| 539-542-30 | AT353- 150 | 539-559-30 | AT353-1200 |
| 539-543-30 | AT353- 200 | 539-560-30 | AT353-1300 |
| 539-544-30 | AT353- 250 | 539-561-30 | AT353-1400 |
| 539-545-30 | AT353- 300 | 539-562-30 | AT353-1500 |
| 539-546-30 | AT353- 350 | 539-563-30 | AT353-1600 |
| 539-547-30 | AT353- 400 | 539-564-30 | AT353-1700 |
| 539-548-30 | AT353- 450 | 539-565-30 | AT353-1800 |
| 539-549-30 | AT353- 500 | 539-566-30 | AT353-2000 |
| 539-551-30 | AT353- 600 | 539-567-30 | AT353-2200 |
| 539-553-30 | AT353- 700 | 539-568-30 | AT353-2400 |
| 539-554-30 | AT353- 750 | 539-569-30 | AT353-2500 |
| 539-555-30 | AT353- 800 | 539-570-30 | AT353-2600 |
| 539-556-30 | AT353- 900 | 539-571-30 | AT353-2800 |
| 539-557-30 | AT353-1000 | 539-572-30 | AT353-3000 |

• ABS AT343/AT343A

| Order No. | Code | Order No. | Code |
|------------|---------------|------------|---------------|
| 539-601-□□ | AT343(A)-100 | 539-618-□□ | AT343(A)-1100 |
| 539-602-□□ | AT343(A)-150 | 539-619-□□ | AT343(A)-1200 |
| 539-603-□□ | AT343(A)-200 | 539-620-□□ | AT343(A)-1300 |
| 539-604-□□ | AT343(A)-250 | 539-621-□□ | AT343(A)-1400 |
| 539-605-□□ | AT343(A)-300 | 539-622-□□ | AT343(A)-1500 |
| 539-606-□□ | AT343(A)-350 | 539-623-□□ | AT343(A)-1600 |
| 539-607-□□ | AT343(A)-400 | 539-624-□□ | AT343(A)-1700 |
| 539-608-□□ | AT343(A)-450 | 539-625-□□ | AT343(A)-1800 |
| 539-609-□□ | AT343(A)-500 | 539-626-□□ | AT343(A)-2000 |
| 539-611-□□ | AT343(A)-600 | 539-627-□□ | AT343(A)-2200 |
| 539-613-□□ | AT343(A)-700 | 539-628-□□ | AT343(A)-2400 |
| 539-614-□□ | AT343(A)-750 | 539-629-□□ | AT343(A)-2500 |
| 539-615-□□ | AT343(A)-800 | 539-630-□□ | AT343(A)-2600 |
| 539-616-□□ | AT343(A)-900 | 539-631-□□ | AT343(A)-2800 |
| 539-617-□□ | AT343(A)-1000 | 539-632-□□ | AT343(A)-3000 |

*The □□ in the Order No. is as follows. AT343 : 30
AT343A : 31

• ABS AT303/AT303A

| Order No. | Code | Order No. | Code |
|------------|---------------|------------|---------------|
| 539-321-□□ | AT303(A)-100 | 539-336-□□ | AT303(A)-1100 |
| 539-322-□□ | AT303(A)-150 | 539-337-□□ | AT303(A)-1200 |
| 539-323-□□ | AT303(A)-200 | 539-338-□□ | AT303(A)-1300 |
| 539-324-□□ | AT303(A)-250 | 539-339-□□ | AT303(A)-1400 |
| 539-325-□□ | AT303(A)-300 | 539-340-□□ | AT303(A)-1500 |
| 539-326-□□ | AT303(A)-350 | 539-341-□□ | AT303(A)-1600 |
| 539-327-□□ | AT303(A)-400 | 539-342-□□ | AT303(A)-1700 |
| 539-328-□□ | AT303(A)-450 | 539-343-□□ | AT303(A)-1800 |
| 539-329-□□ | AT303(A)-500 | 539-344-□□ | AT303(A)-2000 |
| 539-330-□□ | AT303(A)-600 | 539-345-□□ | AT303(A)-2200 |
| 539-331-□□ | AT303(A)-700 | 539-346-□□ | AT303(A)-2400 |
| 539-332-□□ | AT303(A)-750 | 539-347-□□ | AT303(A)-2500 |
| 539-333-□□ | AT303(A)-800 | 539-348-□□ | AT303(A)-2600 |
| 539-334-□□ | AT303(A)-900 | 539-349-□□ | AT303(A)-2800 |
| 539-335-□□ | AT303(A)-1000 | 539-350-□□ | AT303(A)-3000 |

*The □□ in the Order No. is as follows. AT303 : Blank
AT303A : 01

Discontinued models and succession models specification compatibility

○: Compatible
 △: Compatible (with limitations)
 ×: Not compatible

Separate type ST scales

| Discontinued models | Current model | Scale grating pitch | Output signal specifications | Accuracy | Mounting dimensions | Output connector specification pin assignment |
|---------------------|----------------|---------------------|------------------------------|----------|---------------------|---|
| ST31A, ST32A | ST36A | ○ | ○ | ○ | × | ○ |
| ST33C | ST36C | ○ | ○ | ○ | × | × |
| ST41A/ST42A | ST24C | ○ | ○ | ○ | × | × |
| ST41B/ST42B | ST24C/ST24B | ○ | △*1 | ○ | × | × |
| ST52B | ST422/ST46-EZA | ○ | ○ | ○ | × | × |
| ST62C | ST422/ST46-EZA | ○ | △*1 | ○ | × | × |
| ST34C | ST36C | ○ | ○ | ○ | × | ○ |
| ST322 | ST422 | ○ | ○ | × | × | ○ |
| ST44B/ST44C | ST46-EZA | ○ | ○ | ○ | × | ○ |
| ST46 | ST46-EZA | ○ | ○ | ○ | × | ○ |
| LHS21/23C | None | — | — | — | — | — |

*1 Up/down pulse output cannot be supported.

Assembly type AT scales

| Discontinued models | Current model | Scale grating pitch | Output signal specifications | Accuracy | Mounting dimensions | Output connector specification pin assignment |
|---------------------|---------------|---------------------|------------------------------|----------|---------------------|---|
| AT2-N | AT103 | ○ | △*2 | ○ | ○ | △*2 |
| AT2-FN | | ○ | △*2 | ○ | ○ | △*2 |
| AT11-N | AT113 | ○ | △*2 | ○ | ○ | △*2 |
| AT11-FN | | ○ | △*2 | ○ | ○ | △*2 |
| AT12-N | AT112 | ○ | △*2 | ○ | ○ | △*2 |
| AT12 | | ○ | △*2 | ○ | ○ | △*2 |
| AT81-C | AT181 | ○ | X | △*3 | ○ | X |
| AT21-C | AT211 | ○ | △*4 | △*3 | × | X |
| AT21 | AT211 | × | △*4 | △*3 | × | X |
| AT25 | AT211 | × | △*4 | △*3 | × | X |
| AT102 | AT103 | ○ | ○ | ○ | ○ | ○ |
| AT111 | AT113 | ○ | ○ | ○ | ○ | ○ |
| AT212 | AT211 | ○ | ○ | △*3 | × | X |

*2 This can only be supported with an adapter when connected to an old counter.

*3 This must be checked for each scale effective range.

*4 Compatible with the output signal of the pulse signal unit.

Absolute scale unit

| Discontinued models | Current model | Interface | Resolution | Maximum response speed | Mounting dimensions | Output connector specification pin assignment |
|---------------------|--------------------|-----------|------------|------------------------|---------------------|---|
| AT3□2 | ABS AT3□3 | ○ | △*5 | ○ | × | △*6 |
| AT500 series | ABS AT500-S series | ○ | ○ | ○ | × | △*7 |
| | ABS AT500-H series | ○ | ○ | ○ | × | △*7 |

*5 You can control this by changing the NC parameter settings. For details, contact your NC manufacturer.

*6 Check that pins No. 9 and 10 of the AT353 output connector are not connected before you make the connection.

*7 The AT543A is compatible. Other current models have flying lead specifications.

Pulse signal units

| Discontinued models | Current model | Output signal specifications | Power supply specifications | Mounting dimensions | Output connector specification pin assignment |
|---------------------|---------------|------------------------------|-----------------------------|---------------------|---|
| PSU-1/2 | PSU-200*10 | △*8 | × | × | × |
| FPSU03 series | | △*8 | × | × | △*9 |
| FPSU05 series | | ○ | × | × | × |
| FPSU10 series | | ○ | × | × | × |
| FPSU4 | | ○ | ○ | × | ○ |
| FPSU21 series | | ○ | × | × | × |
| PSU11 | | △*8 | × | × | △*9 |
| PSU12/13 | | △*8 | × | × | △*9 |
| PSU14 | | ○ | ○ | × | ○ |
| PSU21 series | | △*8 | × | × | △*9 |
| PSU-100 series | | ○ | ○ | ○ | ○ |
| PSD11 | | △*8 | × | × | △*9 |

*8 Only the 2-phase square wave signals output specifications are compatible.

*9 Only the connector shape is compatible.

*10 When changing to the PSU-200, the scale may also have to be changed.

Note 1: The compatibilities listed above refer to compatibility with the standard specifications.

Note 2: When you change to a current model, check the direction before you make the connection. If the direction is different, the device may go out of control.

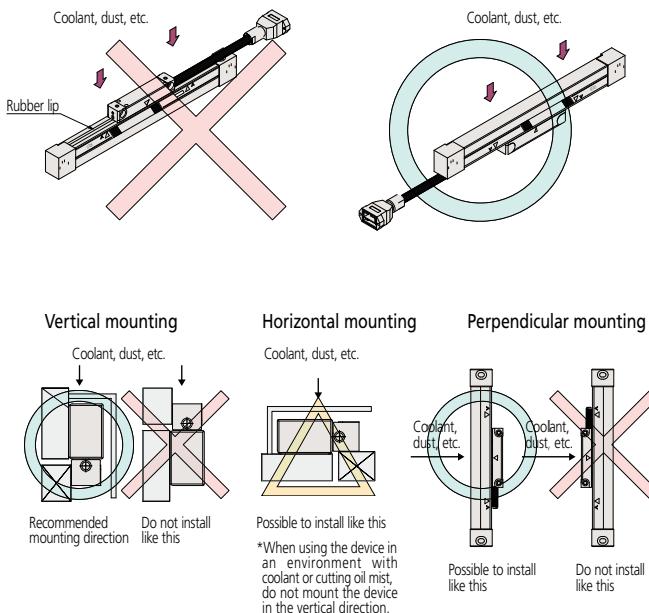
Note 3: Contact us for information on models not listed here.

Handling linear scales

Mounting scales

1. AT scale mounting posture

The scale unit is designed so that it is difficult for contamination to enter the unit, but determine the mounting posture after considering the arrival directions of coolant and dust so that these substances do not come into direct contact with the aperture. Also, be sure to prepare a scale cover.

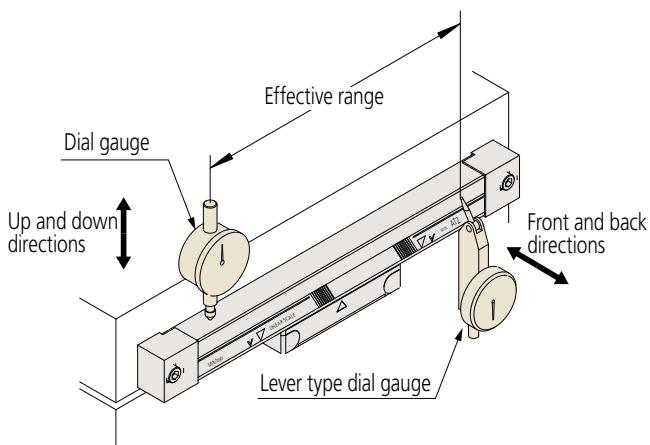


2. Mounting the AT scale unit

As shown in the following figure, use dial gauges or similar devices close to the two effective range marks to check and adjust their parallelism with the machine guideway.

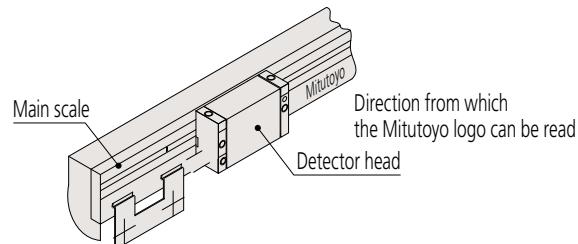
To adjust the parallelism: (1) move the mechanically movable parts such as the slide table to adjust the parallelism of the scale unit or (2) measure the position from the mechanism's guide rail or from a corresponding reference.

- Permissible parallelism value: Less than 0.1mm or less than 0.2mm
(This varies depending on the scale model.)

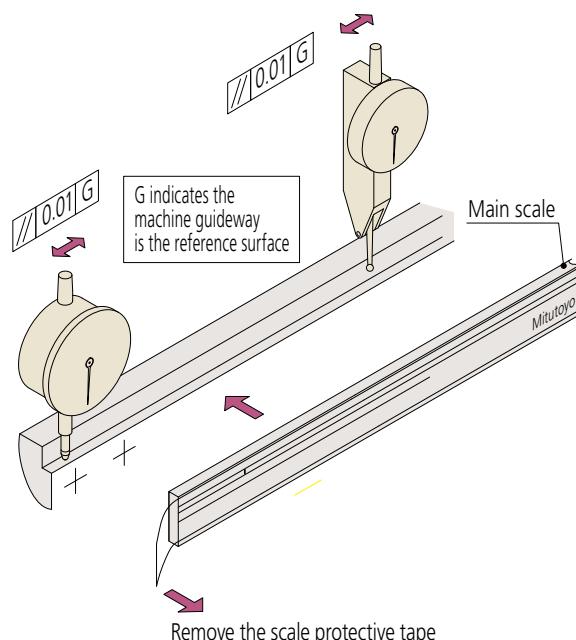


3. Cautions regarding mounting the ST scale (excluding the ABS ST700)

- Mount the main scale so that the detector head is facing the scale front surface (the surface on which rainbow colors are visible when light strikes the surface at an angle). (Models that have the Mitutoyo logo on the main scale are mounted correctly when the logo can be read from the detector head side.)
- Ambient light entering from the back of the main scale will cause incorrect operation, so the scale mounting design must ensure that ambient light does not enter.



- Use a tool such as a lever type indicator or dial gage to move the head bracket and the scale mounting relatively in order to check whether the scale mounting surface has been prepared as shown in the mounting diagram.
- Use flexible adhesive with adhesive type scales. We recommend that you use KE441T manufactured by Shin-Etsu Chemical Co, Ltd.
- Remove the protective tape attached to the glass scale and detector head when you install the device.

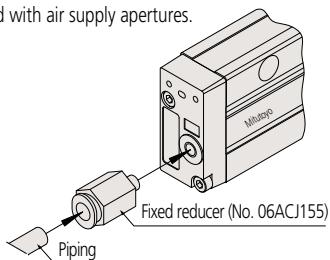


Handling linear scales

AT scale air supply

- One way to improve the environmental resistance (coolant resistance and dust resistance) of assembly type (AT) linear scales is to supply the scale unit with clean, compressed air through plastic tubing to one of the M5 screw holes that are present on both sides of the scale unit.

* The AT103, AT211, AT203, ABS AT500 series, and ABS AT300 series are standard-equipped with air supply apertures.



Note: Supplying air is an ancillary method. The mounting posture of the device is of primary importance. Be sure to properly orient the device as per the mounting posture described in the user's manual before you implement this method. Also, when supplying air, the air filter must be replaced periodically according to the contamination level of the air source in use. Note that a dirty filter continues to be used, malfunctions will be caused by dirt entering the scale (which is the opposite of the intended effect).

Air unit (option)

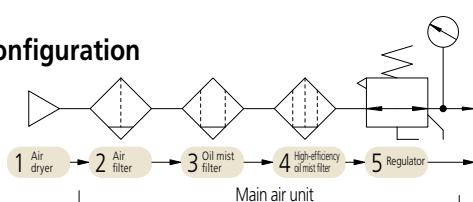
As an option, you can purchase an air supply unit.

Air supply unit specifications

- 1. Air delivery specifications** ISO 8573-1
Class1-4-1 or equivalent
- | | |
|---|------|
| Maximum particle diameter (μm) | 0.1 |
| Minimum pressure dew point (°C) | +3 |
| Oil concentration (mg/m ³) | 0.01 |
- 2. Air delivery pressure** 0.1MPa (approx. 1kgf/cm²)
Adjusted to the pressure stated above with a regulator described under "4. Air supply unit."
- 3. Airflow rate** 10 to 20L/min (per axis)
By using a fixed reducer (06ACJ155), an airflow rate of 12.7L/min with a pressure of 0.1MPa can be supplied.
- 4. Air supply to unit** Do not supply air directly from a compressor. Be sure to supply dry, compressed air that has passed through an air drier and a main line air filter. The replacement period for the filter elements is approximately one year.* Install the fixed reducer on the scale side.

*This varies depending on the air quality and usage conditions and on the environment.

Air equipment configuration

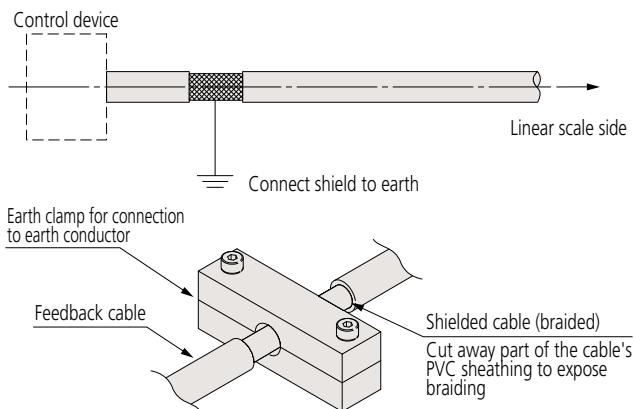


| No. | Name | Specifications |
|-----|---------------------------------|--|
| 1 | Air drier | |
| 2 | Air filter | Maximum particle diameter (nominal filtration rating): 5μm |
| 3 | Oil mist filter | Maximum particle diameter (nominal filtration rating): 0.3μm Secondary oil concentration: 0.1mg/m ³ |
| 4 | High-efficiency oil mist filter | Nominal filtration rating: 0.01μm; oil-removal ratio 99.999% Secondary oil concentration: 0.01mg/m ³ |
| 5 | Regulator | Set pressure: 0.1 to 0.7MPa |
| | Fixed reducer* | Flow rate when pressure is 0.1MPa: 12.7L/min |

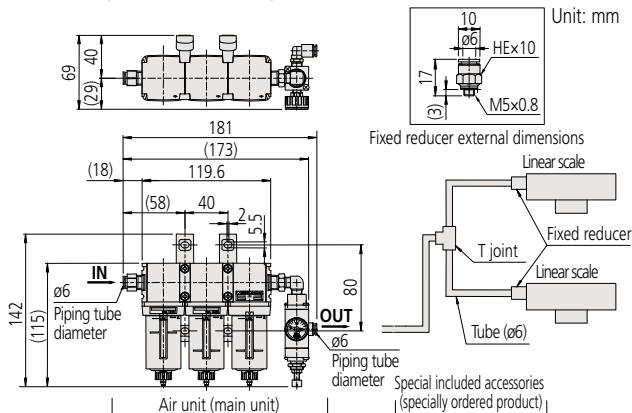
*Use Mitutoyo-specified fixed reducers (No. 06ACJ154).

Feedback cable earth processing

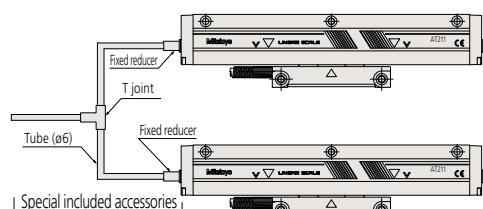
Be sure to ground the shield of the feedback cable to an earth conductor (using an earth clamp, or similar) immediately before the control device. (See the following figure.)



Air unit (No. 06ACJ154)



*Start supplying air to the scale approximately 30 minutes prior to the start of processing. We also recommend that you continue supplying air for approximately 30 minutes after processing is finished, as this will provide more favorable results. For details, contact your Mitutoyo sales representative.



| Part No. | Name | Remarks |
|----------|--|------------------------------|
| 06ACJ154 | Air unit | Main unit |
| 06ACJ162 | Included accessory set for two axes (two fixed reducers, one 20m ø6 urethane tube, and two T joints) | Special included accessories |
| 06ACJ163 | Included accessory set for three axes (three fixed reducers, one 20m ø6 urethane tube, and three T joints) | |
| 06ACJ155 | Fixed reducer | |
| 06ACJ159 | Air filter element | Maintenance parts |
| 06ACJ160 | Mist separator element | |
| 06ACJ161 | Micro mist separator element | |

Note: One air unit can supply up to five axes. Therefore, there is an included accessory set that supports connections for up to two axes and an included accessory set that supports connections for up to three axes. If you combine these two sets, you can connect up to four or five axes.

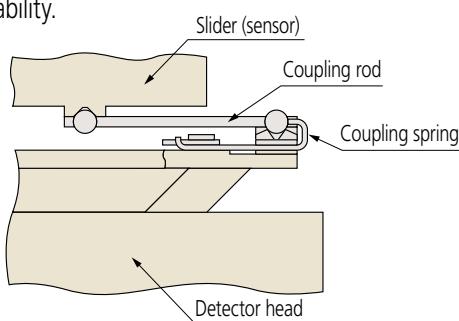
Technical Information

Structure and features of the assembly type linear scale (AT)

1. AT series detector joint mechanism

(Adoption of simple joint structure offering high rigidity)

The detector head and slider (sensor) of the scale unit are connected by the joint shown in the following figure. Because of this structure, if values are less than or equal to the scale mounting standard values, detector head mounting errors and parallelism differences between the scale unit and the machine guideway are absorbed, and normal operation is assured. Also, the simple and highly rigid structure provides superior durability.



2. Advantage of special waterproof connectors

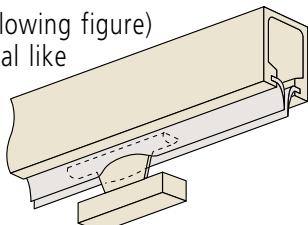
Adopting waterproof and oilproof connectors makes it possible to separate the signal cable. In turn, this makes installation and maintenance easy.

3. Signal cable conduit

Signal cables that are enclosed in a stainless-steel, spiral cover (conduit), for protection, are also available. The conduit will not rust or corrode, so these signal cables can be used over an extended period.

4. Adoption of rubber lip thrust method (Mitutoyo's proprietary technology)

The thrust part (see the following figure) pushes aside the rubber seal like a ship's keel pushes aside water.

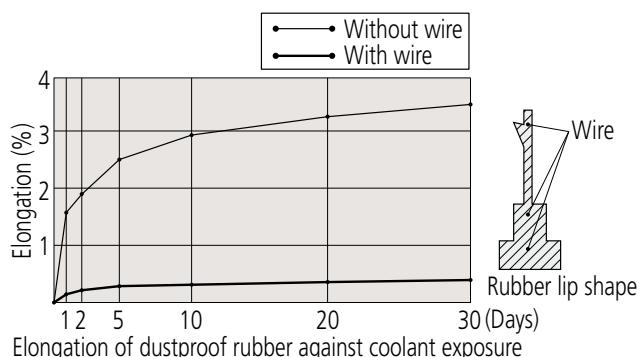


5. Adoption of specially formed urethane rubber lip with reinforcing wire

Resistance to oil and dust has been improved.

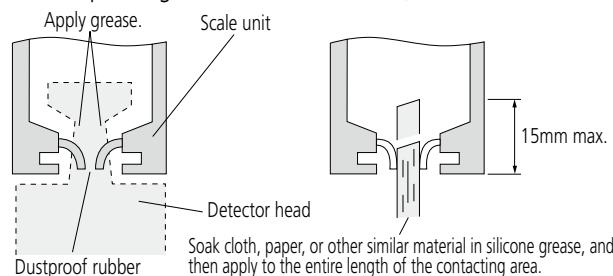
*Available with the AT103, AT203, ABS AT500, and ABS AT300.

*Can be specially ordered for the AT113 and AT211.



6. Maintenance of the seal

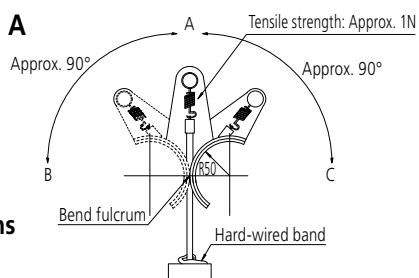
To maintain the dustproof property of the rubber seal and extend its life, apply a small amount of good-quality silicone grease (such as G-30L made by Shin-Etsu Chemical Co, Ltd.) to the contacting area of the rubber and detector head once a year. (The maintenance interval will vary slightly according to the operating conditions of the scale.)



Durability of cables used with the linear scale

The life expectancy of the linear scale cables has been tested using the methods shown below.

Test method A



Test conditions

Bend angle: $\pm 90^\circ$

Test speed: 30 times per minute

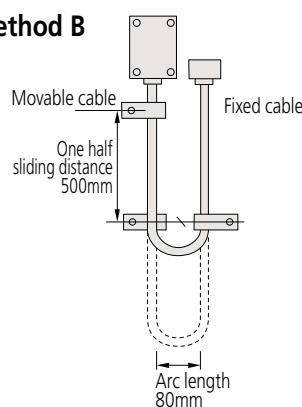
(For the number of bends, A, B, A, C, and then A represents one bend.)

Bend radius: R = 50mm

Evaluation standard value: 3,000,000 times

(No breaks in the signal wires or shield)

Test method B



Test conditions

Bend radius: R = 40mm

Speed: 2m/s

Travel distance: 1000mm

| Scales | Test method | Signal cable test result* ¹ |
|--------------|-------------|--|
| AT100 series | A | 3 million times |
| AT211 | A | 3 million times |
| AT202 | A | 3 million times |
| AT212 | A | 3 million times |
| AT300 series | A | 3 million times |
| AT500 series | A | 3 million times |
| ST700 series | B | 54 million times or more* ² |
| ST36 | B | 54 million times or more* ² |
| ST24 | B | 54 million times or more* ² |
| ST422 | A | 3 million times |

*1 Also including the head cable

*2 Testing still ongoing as of December 2008

Note 1: The test data stated above does not represent guaranteed values.
Depending on the bend conditions, the number of times that the cables can bend without failure may be less than indicated.

Note 2: When bending cables, the recommended bend radius is 100mm or more.

Technical Information

Alarm functions

1. Detection of detector disconnection and short-circuit errors

Disconnection of and short circuits to 0V of the phase A and phase B signal lines from the linear scale as well as other similar errors are detected.

2. Detection of excess response speed of detector feed (over-speed)

The feed speed of the linear scale (detector) exceeding the maximum feed speed as well as other similar errors are detected.

3. Detection of input signal errors

The amplitude voltage, DC voltage, or phase difference of the phase A and phase B signals from the linear scale being outside of the corresponding allowable range as well as other similar errors are detected.

4. Drop in line voltage

The line voltage supplied to the linear scale, PSU, and other devices (particularly devices that use a DC power supply) dropping below the allowable range is detected as an error.

Alarm detection functions available with each product

| (1) Alarm functions on the AT scales (sinusoidal signal output type) + PSU-200 | | | | | |
|--|---------------------------|-------------------------|-------------|------------|--------------------|
| Scale code | Alarm function | | | | |
| | Detected inside the scale | Detected inside the PSU | Scale error | Over-speed | Input signal error |
| AT103 | ○ | | | | |
| AT113 | ○ | | | | |
| AT112 | × | | | | |
| PSU-200 | | ○ | ○ | ○ | ○ |
| PSU-250 series | ○ | ○ | ○ | | ○ |

| (2) Alarm functions on the AT scales (square wave signal output type) | | | |
|---|---|------------|--------------------|
| Scale code | Alarm function | | |
| | Detected inside the detector head (inside the I/F on the AT212) | Over-speed | Input signal error |
| AT203 | ○ | | ○ |
| AT211 | ○ | | ○ |
| AT212 | ○ | | ○ |

| (3) Alarm functions on the ST scales (sinusoidal signal output type) + PSU-200 | | | | | |
|--|---------------------------|-------------------------|-------------|------------|--------------------|
| Scale code | Alarm function | | | | |
| | Detected inside the scale | Detected inside the PSU | Scale error | Over-speed | Input signal error |
| ST36A | ○ | | | | |
| ST24 | ○ | | | | |
| PSU-200 | | ○ | ○ | ○ | ○ |
| PSU-250 series | ○ | ○ | ○ | ○ | ○ |

5. Detection of momentary power failures

A momentary power failure or voltage drop greater than the allowable range occurring in the power supply that is being supplied to the PSU, counter, or other device (devices that use an AC power supply) is detected as an error.

6. Detection of scale errors

Errors that occur inside the linear scale are detected.

7. Detection of detector circuit errors

Errors caused by the incremental count or absolute count in absolute linear scales are detected.

8. Detection of CPU errors (detection of internal errors)

For linear scales, counters, and other devices that use CPUs, the CPU stopping operating normally is detected as an error.

Note: The alarm functions vary according to the product. For details, see the alarm functions available with each product. Also note that the allowable ranges used to detect alarms vary according to the product.

| (4) Alarm functions on the ST scales (square wave signal output type) | | | | |
|---|-------------------------|------------|--------------------|--|
| Scale code | Alarm function | | | |
| | Detected inside the I/F | Over-speed | Input signal error | Disconnection or short circuit in signal cable |
| ST24B(C) | ○ | | ○ | ○ |
| ST36 | ○ | | ○ | ○ |
| ST422 | ○ | | ○ | ○ |
| ST46-EZA | ○ | | ○ | ○ |

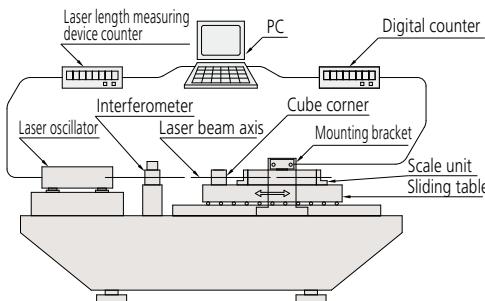
| (5) Alarm functions on the absolute scales | | | | | |
|--|-------------------------|-------------|------------|--------------------|------------------------|
| Scale code | Alarm function | | | | |
| | Detected inside the I/F | Scale error | Over-speed | Input signal error | Detector circuit error |
| ABS ST700 series | ○ | | ○ | ○ | ○ |
| ABS AT300 series | ○ | | ○ | ○ | ○ |
| ABS AT500 series | ○ | | ○ | ○ | ○ |

Explanation of terms

Linear scale accuracy

(1) Linear scale accuracy

As shown in Figure 1, the linear scale accuracy is determined by using an accuracy inspection device to perform comparisons at fixed intervals between the value measured with the linear scale and the reference value according to a laser length measuring device. The inspection environment temperature is 20°C, so the accuracy is at this temperature. The inspections are performed with other inspection conditions and standard values that comply with Mitutoyo's internal standards.



[Figure 1] Linear scale accuracy inspection device, overview

The accuracy (error) at each measured point is determined according to the following formula.

$$\text{Error} = \text{reference value of the laser length measuring device} - \text{value measured by the linear scale}$$

Here, the words "accuracy" and "error" have the same meaning.

We refer to the plot on a graph of the error at each measured point in the effective range as an accuracy chart.

Based on this accuracy chart, the accuracy of the linear scale is noted as the range between the maximum error and minimum error. There are the following two notation methods.

(1) Note the size of the range between the maximum error and minimum error as 'a'.

The value 'a' shown in Figure 2-1 indicates the accuracy. This standard value is indicated using the conversion formula $(\alpha + \beta L) \mu\text{m}$. Here, L is the effective range (in mm) and α and β are coefficients that are set on each model.

For example, for a linear scale with an accuracy standard value of $(3 + 3L/1000) \mu\text{m}$ and an effective range L of 1000mm, 'a' is 6μm.

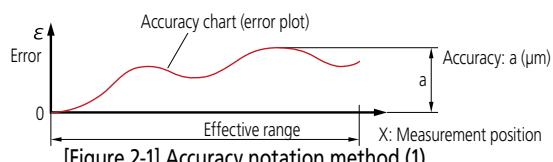
(2) Note the size of the range between the maximum error and minimum error as ' $\pm a/2$ '.

The center value between the maximum error and minimum error is 0, the maximum value is noted as ' $+a/2$ ', the minimum value is noted as ' $-a/2$ ', and the size of the error range is noted as ' $\pm a/2$ '. This notation is mainly applied to ST scales. In notations (1) and (2), 'a' in (1) and ' $\pm a/2$ ' in (2) are the same accuracy standard value.

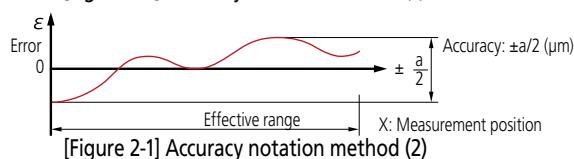
Linear scales use a straight-line scale that has fixed-pitch graduations as the reference to detect the amount of movement and the amount of change in position. By detecting graduations, a linear scale obtains 2-phase sinusoidal signals that have the same pitch as the graduations. The linear scale is designed so that it can perform readings with greater detail than the straight-line scale by interpolating this sine wave signal with an electronic circuit. Interpolation means that these 2-phase sinusoidal signals are interpolated, and the result is divided into pulse signals corresponding to the resolution. For example, if the graduation pitch is 20μm, readings can be performed with a resolution of 1μm.

Here, error within the graduation pitch range will occur according to the accuracy of this interpolation processing. This is called interpolation accuracy.

The accuracy standard value of a linear scale includes the aforementioned errors inspected at fixed intervals and interpolation accuracy.



[Figure 2-1] Accuracy notation method (1)



[Figure 2-1] Accuracy notation method (2)

Serial interface

This refers to a communication channel in which digital data is transmitted sequentially 1bit at a time. While it has inferior real-time characteristics, the advantages are that it requires less wiring and has high reliability. (This is the main communication method for feedback encoders.)

Line-driver output

This refers to signals that are output as square waves. A signal that has the inverted polarity of the output signal is generated, and the difference between these signals is set as the signal (differential signal output). This complies with EIA standards RS-422 and RS-485.

RS-422

This was standardized by the Electronic Industries Alliance (EIA) of the U.S. It is one of the balanced type serial communications standards, and it has excellent noise reducing characteristics. The maximum transmission speed is 10Mbps, but limitations on the transmission speed arise as the cable length increases.

RS-485

This was standardized by the Electronics Industries Alliance (EIA) of the U.S. It is one of the balanced type serial communications standards, and it ranks higher than RS-422. RS-422 is upwardly compatible with this standard. While RS-422 is a communication standard that supports point-to-point, multi-drop connections, this standard supports bus type multi-point connections and bidirectional communications.

Minimum edge interval

This refers to the minimum time between a rising edge or falling edge of a square wave being output (or input) and the next edge being output (or input). For square wave output type linear scales, even with the same resolution, the shorter the minimum edge interval, the faster the response speed.

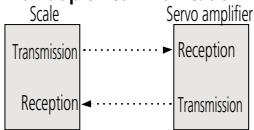
Thermal expansion coefficient

This refers to the thermal expansion of an object in response to a change in temperature, which is measured as elongation per unit length for each 1°C increase in temperature of the material.

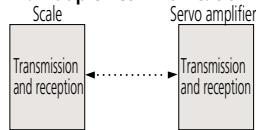
Full duplex communication and half duplex communication

Full duplex communication refers to a system in which devices (for example, a scale and a servo amplifier) each have two communication lines and can communicate with each other at the same time. On the other hand, half duplex communication refers to a system in which devices have a single communication line, so devices cannot communicate with each other at the same time, and communications can only be sent from a single device at any one time.

Full duplex communication



Half duplex communication



Protection rating definition

IP53 protection rating

| Type | Protection ratings: Summary | Definition |
|--|-------------------------------------|--|
| Protection rating for external objects | 5: Dustproof type | It is not possible to completely prevent the entry of dust, but dust cannot enter in amounts that interfere with the operation of electrical devices or that pose a safety hazard. |
| Protection rating for water | 3: Protected against spraying water | Water sprayed at an angle up to 60° from the vertical shall have no harmful effect. |

IP54 protection rating

| Type | Protection ratings: Summary | Definition |
|--|-------------------------------------|--|
| Protection rating for external objects | 5: Dustproof type | It is not possible to completely prevent the entry of dust, but dust cannot enter in amounts that interfere with the operation of electrical devices or that pose a safety hazard. |
| Protection rating for water | 4: Protected against water splashes | Exposure to splashing water from all directions produces no harmful effect. |

IP64 protection rating

| Type | Protection ratings: Summary | Definition |
|--|--------------------------------------|---|
| Protection rating for external objects | 6: Dustproof type | Prevents the entry of dust. |
| Protection rating for water | 4: Protected against water splashes. | Exposure to splashing water from all directions produces no harmful effect. |

IP65 protection rating

| Type | Protection ratings: Summary | Definition |
|--|---------------------------------|---|
| Protection rating for external objects | 6: Dustproof type | Prevents the entry of dust. |
| Protection rating for water | 5: Protected against water jets | Exposure to water projected from a nozzle from all directions produces no harmful effect. |

IP67 protection rating

| Type | Protection ratings: Summary | Definition |
|--|---|---|
| Protection rating for external objects | 6: Dustproof type | Prevents the entry of dust. |
| Protection rating for water | 7: Protection against the effects of immersion in water | Ingress of water in a harmful quantity shall not be possible when the enclosure is temporarily immersed in water under defined conditions of pressure and time. |

Note: For the test conditions used to evaluate the protection ratings, see IEC 60529:2001 and JIS C 0920.



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