



# **Separate Type Absolute Linear Scale**

## **ABS ST700/ST700L (Compact) Series**

### **User's Manual - Instructions for use -**

Read this User's Manual thoroughly before operating the instrument. After reading, retain it close at hand for future reference. This English language version of the User's Manual contains the original instructions.

No. 99MBE073B3  
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## ■ Correspondence of product names and model numbers

Product name	Model number
Separate Type Absolute Linear Scale	ABS ST7*8/ABS ST7*8L

## ■ Notice regarding this guide






- Mitutoyo Corporation assumes no responsibilities for any damage to the product, caused by its use not conforming to the procedure described in this User's Manual.
- Upon loan or transfer of this product, be sure to attach this User's Manual to the product.
- In the event of loss or damage to this manual, immediately contact a Mitutoyo sales office or your dealer.
- Before operating this product, thoroughly read this manual to comprehend its contents.
- Particularly, for full understanding of information, carefully read "Safety Precautions" and "Precautions for Use" at the outset of this manual before using the product.
- The contents in this manual are based on the information current as of January, 2021.
- No part or whole of this manual may be transmitted or reproduced by any means without prior written permission of Mitutoyo Corporation.
- The corporation, organization and product names that appear in this manual are their trademarks or registered trademarks.

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## Conventions Used in Manuals

Conventions used in this User's Manual are roughly divided into three types (safety reminders, prohibited actions/mandatory actions, referential information/referential locations). Moreover, these safety symbols include general warnings and specific warnings. Specific warning symbols are provided with concrete pictograms inside of them.

### ■ Safety reminder conventions and wording warning against potential hazards

	Indicates an immediately hazardous situation which, if not avoided, will result in serious injury or death.
	Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.
	Indicates a potentially hazardous situation which, if not avoided, may result in minor injury.
	Indicates a potentially hazardous situation which, if not avoided, may result in property damage.
	Alerts the user to a specific hazardous situation that means "Caution, risk of electric shock".

### ■ Conventions and wording indicating prohibited and mandatory actions


	Indicates concrete information about prohibited actions.
	Indicates concrete information about mandatory actions.
	Indicates that grounding needs to be implemented.

### ■ Conventions and wording indicating referential information or referential locations

**Tips** Indicates reference and other information to use when applying the operation method or procedure described in the text to specific conditions.



Indicates referential locations if there is information that should be referred to in this document or an extraneous manual.

E.g.: For further details on xxx, refer to  "1.2 System Configuration and Part Names" (page 2)

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# Safety Precautions

Observe the following descriptions to make full use of the performance of this product:

## NOTICE

- Read this User's Manual thoroughly before operating this product.
- Before connecting this product to the machine main unit, make sure that the power for the control unit is turned off.
- To maintain the shielding effect, firmly tighten the screws on the connectors of each connecting cable.
- To prevent defective contacts, do not touch the connecting terminals of the connectors with bare hands.

## Precautions for Use

### ■ Application and handling of this product

- This product is a measurement instrument.  
Do not use it for any other purpose than measurement.
- This product is an industrial product.  
Do not use it for any other purpose than industrial use.
- This product is a precision instrument.  
Use it with extreme caution. Do not apply impact or excessive force to the product's parts during operation.

### ■ Installation environments

#### ● Vibration

To install this product onto a machine main unit, select a location where there is as little vibration as possible.

If the scale unit is used for an extended period of time on a machine where there is a substantial amount of vibration, the built-in precision parts may be damaged, thereby adversely influencing the performance of the unit.

#### ● Shock, dust, water protection

To protect the scale unit from being directly exposed to machining oil and chips, or from being bumped by a workpiece, etc., prepare a cover that protects the entire unit.

#### ● Ambient temperature and humidity

This product should be operated in an environment as shown below; however, avoid using it in a place where a sudden change in temperature or humidity can be observed.

Operating environment	(Effective measurement length : 3m or less)	(Effective measurement length : 3.2–6m)
	Temperature: 0 °C–50 °C Humidity: 20 %–80 % RH (non condensation)	Temperature: 0 °C–50 °C Humidity: 20 %–70 % RH (non condensation)

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## Electromagnetic Compatibility (EMC)

This product complies with the EU EMC Directive. Note that in environments where electromagnetic interference exceeds EMC requirements defined in this directive, appropriate countermeasures are required to ensure product performance.

This is an industrial product. Not intended for use in a residential environment. Use of this product in a residential environment may cause an electromagnetic interference with other instruments. In such a case, appropriate measures against electromagnetic interference are required.

## Export Control Compliance

This product falls into the Catch-All-Controlled Goods and/or Catch-All-Controlled Technologies (including Programs) under Category 16 of Appended Table 1 of the Export Trade Control Order or under Category 16 of the Appended Table of Foreign Exchange Control Order, based on the Foreign Exchange and Foreign Trade Act of Japan.

If you intend re-export of the product from a country other than Japan, re-sale of the product in a country other than Japan, or re-provision of the technology (including program), you are obligated to observe the regulations of your country.

Also, if an option is added or modified to add a function to this product, this product may fall under the category of List-Control Goods and/or List-Control Technology (including Programs) under Category 1 - 15 of Appended Table 1 of the Export Trade Control Order or under Category 1 - 15 of the Appended Table of Foreign Exchange Control Order, based on Foreign Exchange and Foreign Trade Act of Japan. In that case, if you intend re-export of the product from a country other than Japan, re-sale of the product in a country other than Japan, or re-provision of the technology (including program), you are obligated to observe the regulations of your country. Please contact Mitutoyo in advance.

## Notes on Export to EU Member Countries

When you intend to export this product to any of the EU member countries, you may be required to provide User's Manual(s) in English and EU Declaration of Conformity in English (under certain circumstances, User's Manual(s) in the destination country's official language and EU Declaration of Conformity in the destination country's official language). For detailed information, please contact Mitutoyo in advance.


## Disposal of Products outside the European Union and other European Countries

Please follow the official instruction in each community and country.

# Disposal of Old Electrical & Electronic Equipment (applicable in the European Union and other European countries with separate collection systems)



This symbol on the product or on its packaging is based on WEEE Directive (Directive on Waste Electrical and Electronic Equipment), which is a regulation in EU member countries, and indicates that this product shall not be treated as household waste.

 To reduce environmental impact and minimize the volume of landfill, please cooperate in reuse and recycling.

For information on how to dispose of the product, please contact your dealer or the nearest Mitutoyo sales office.

## China RoHS Compliance Information

This product meets China RoHS requirements. See the table below.

产品中有害物质的名称及含量

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
本体	○	○	○	○	○	○
电气设备部分	×	○	○	○	○	○
配件	○	○	○	○	○	○

本表格依据 SJ/T 11364 的规定编制。

○: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

×: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。



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另外,此期限不同于质量/功能的保证期限。

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# Warranty

In the event that this product should prove defective in workmanship or material, within one year from the date of original purchase for use, it will be repaired or replaced, at Mitutoyo's option, free of charge upon its prepaid return to Mitutoyo, without prejudice to the provisions of the Mitutoyo Software End User License Agreement.

If this product fails or is damaged for any of the following reasons, it will be subject to a repair charge, even if it is still under warranty.

- Failure or damage owing to ordinary wear and tear
- Failure or damage owing to inappropriate handling, maintenance or repair, or to unauthorized modifications
- Failure or damage owing to transport, dropping, or relocation of the instrument after purchase
- Failure or damage owing to fire, salt, gas, abnormal voltage, lightning surge, or natural disaster
- Failure or damage owing to use in combination with hardware or software other than those designated or permitted by Mitutoyo
- Failure or damage owing to use in ultra-hazardous activities

This warranty is effective only where the instrument is properly installed and operated in conformance with the instructions in this manual within the original country of the installation.

EXCEPT AS SPECIFIED IN THIS WARRANTY, ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS, AND WARRANTIES OF ANY NATURE WHATSOEVER INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT OR WARRANTY ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE, ARE HEREBY EXCLUDED TO THE MAXIMUM EXTENT ALLOWED BY APPLICABLE LAW.

You assume all responsibility for all results arising out of its selection of this product to achieve its intended results.

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# About This Document

## ■ Positioning of this document in document map

In addition to this document, a linear scale-related and a software-related manuals are available.

### ● Linear scale related

ABS ST700/ST700L (Compact) Series  
User's Manual (this manual)

### ● Software related

ABS ST700/ST700L (Compact) Series  
Signal Adjustment Program  
User's Manual

ABS ST700/ST700L (Compact) Series  
System Parameter R/W Program  
User's Manual

## ■ Intended readers and purpose of this document

### ● Intended readers

This manual is intended for those who use the ABS ST700/ST700L (Compact) Series Separate Type Absolute Linear Scale for the first time.

This is also assumed to be able to understand individual instructions by reading screen displays.

### ● Purpose

This document is aimed at understanding of the ABS ST700/ST700L (Compact) Series Separate Type Absolute Linear Scale.

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# 1 Overview

This chapter describes the features of this product, names and functions of each part, and the flow of the main tasks to use this product.

## 1.1 Features

The linear scale will output a moving amount and displacement as digital amounts based on a linear scale graduated in certain fixed pitches.

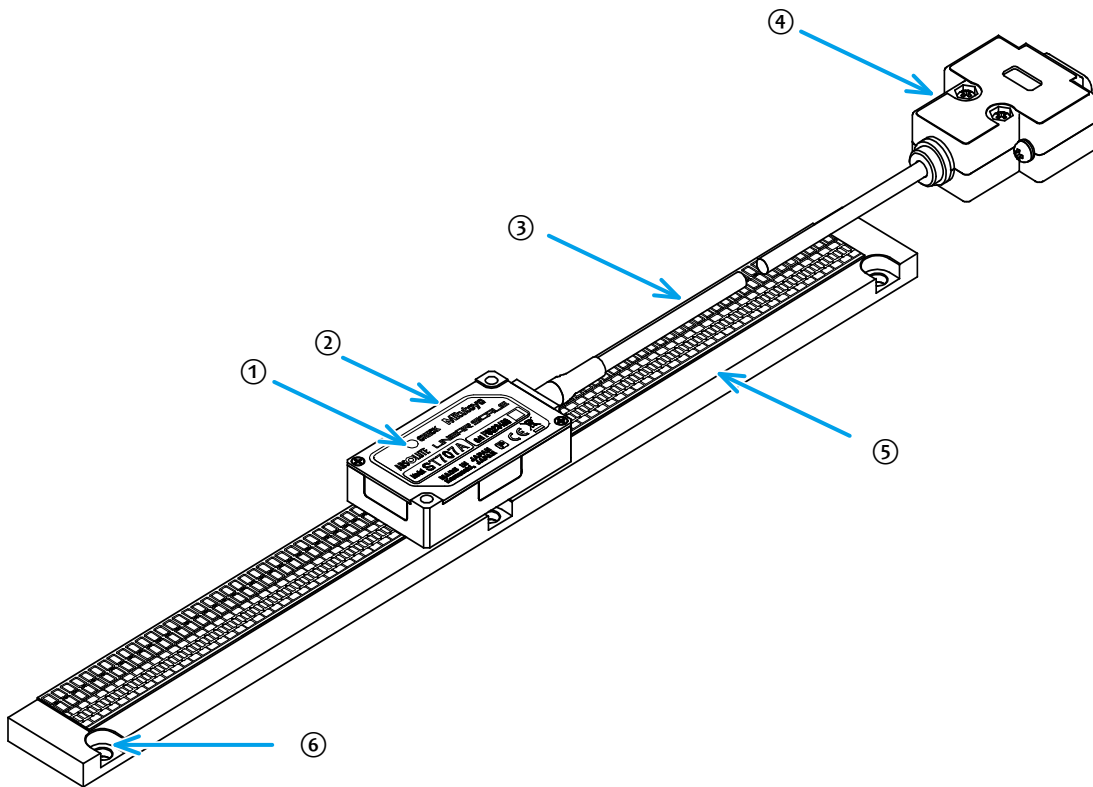
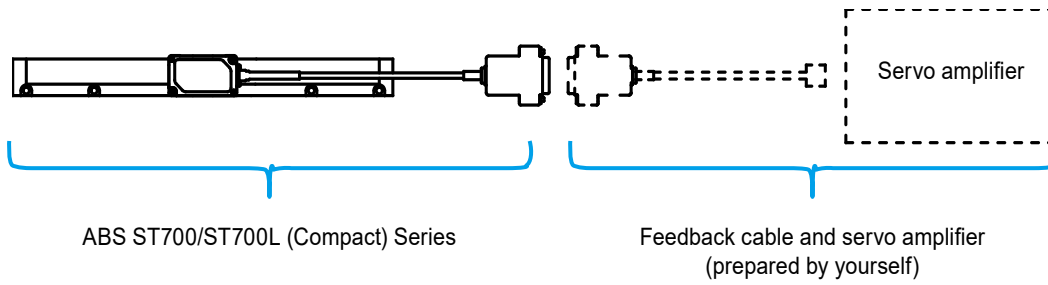
This can precisely measure moving amounts of various instruments including electronic/semiconductor manufacturing units and machine tools.

This product is an absolute scale adopting the electromagnetic induction detection method. With non-contact detection, this is suitable for high-speed/high-acceleration control of linear motors. The Detector was compacted to about one third of a conventional head in volume, the cable outlet is selectable from four directions, and the installation holes are available in the top and side directions. In addition, the following interface specifications compatible with the high-speed serial interface of the companies are available.

- FANUC Corporation Specifications
- Mitsubishi Electric Corporation Specifications
- Yaskawa Electric Corporation Specifications
- Panasonic Corporation Specifications
- Mitutoyo Corporation ENSIS® Specifications

# 1.2 System Configuration and Part Names

The configuration and part names of the Linear Scale ABS ST700/ST700L (Compact) Series are shown below.

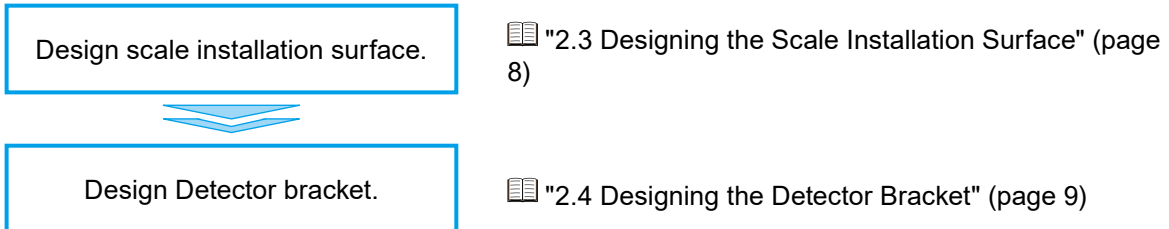


No.	Name
①	Power-on and alarm display LED
②	Detector
③	Detector cable (1 m)
④	Output connector
⑤	Scale base
⑥	Scale base installation screw countersunk hole

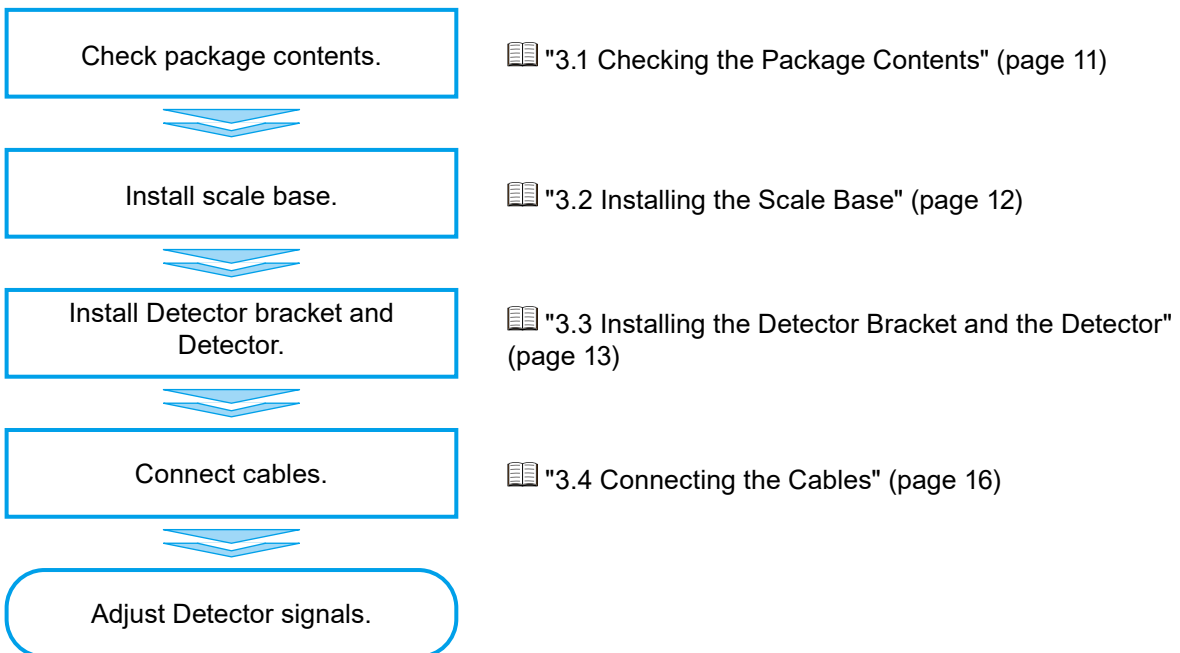
# 1.3 Flow of Main Tasks

The following chart shows the flow of preliminary preparation and installation onto the machine main unit as tasks to use this product.

## ■ Preliminary preparation



## ■ Installation onto the machine main unit



- After installing the scale unit, perform signal adjustment for the Detector according to "ABS ST700/ST700L (Compact) Series Signal Adjustment Program User's Manual". For details, refer to 📖 "ABS ST700/ST700L (Compact) Series Signal Adjustment Program User's Manual" (No. 99MBE040B).
- Use a pair of scale base and Detector that have the same Serial No. attached on them.
- Signal adjustment for the Detector after scale unit installation requires a PC and peripheral equipment. Prepare necessary equipment according to Chapter 1 in "ABS ST700/ST700L (Compact) Series Signal Adjustment Program User's Manual".

**MEMO**



# 2 Setup for Installation

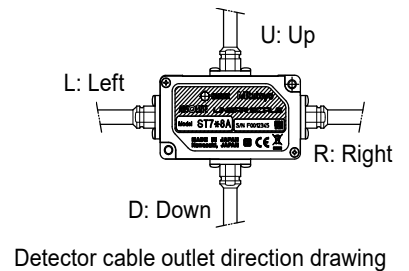
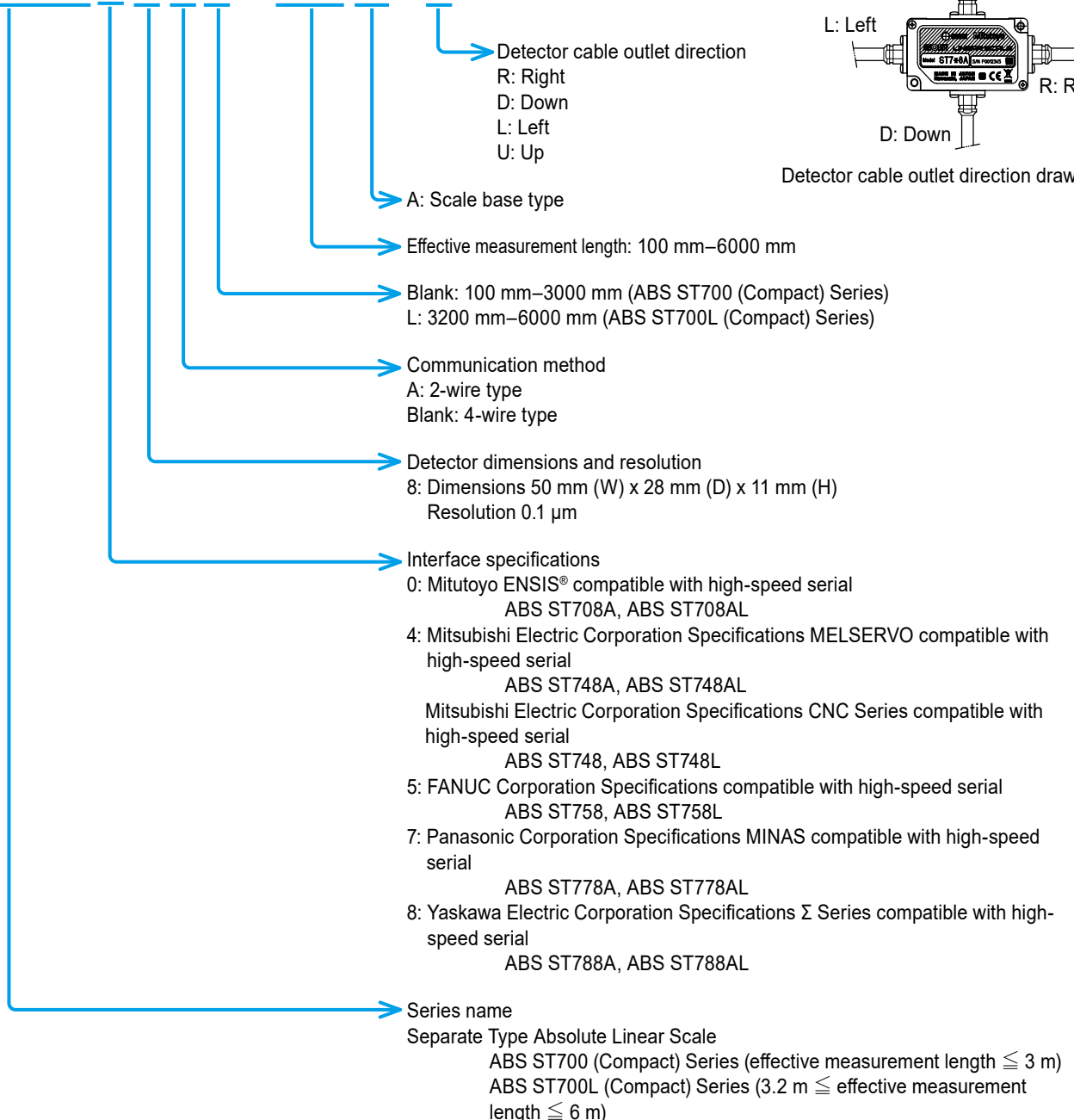
This chapter describes the preliminary preparation for installing this product onto the machine main unit.

## 2.1 Checking the Equipment Model

You can specify the Linear Scale ABS ST700/ST700L (Compact) Series with a model number according to the interface specifications, effective measurement length, and Detector cable outlet direction.

Check if your linear scale supports a servo amplifier you want to use.

**ABS ST7 0 8 A L – 100 A – R**



## 2.1.1 System Parameters

The Linear Scale ABS ST700/ST700L (Compact) Series is designed to be used with the system parameters (scale-specific parameters) written into the Detector. If the system parameter values are incorrect, therefore, the unit cannot fully achieve the predetermined performance.

Normally, a scale is supplied in a pair with a Detector into which the system parameters are already written, so using this factory-shipped pair does not cause any problems. However, if the Detector fails or another Detector is added later (such as when adding two or more Detectors later to one scale), you need to write the system parameters of the target scale into the Detector(s).



- For the following conditions, contact the nearest Mitutoyo office/service center:
  - When the Detector currently used is malfunctioning
  - When a Detector needs to be in stock as a backup for failure
  - When a Detector is added later
- If the scale currently used is damaged, you need to replace both the scale and the Detector.

## 2.1.2 Compatibility between the Scale Base and the Detector

There is no scale base compatibility between the ABS ST700 (Compact) Series and the ABS ST700L (Compact) Series because each uses a dedicated Detector.

Scale base	Connection possibility	Detector
ABS ST700 (Compact) Series (for effective measurement length: 3 m or less)		ABS ST700 (Compact) Series (for effective measurement length: 3 m or less)
ABS ST700L (Compact) Series (for effective measurement length: 3.2 m–6 m)		ABS ST700L (Compact) Series (for effective measurement length: 3.2 m–6 m)

# 2.2 Installation Conditions

## 2.2.1 Dust and Water Protection

The ABS ST700/ST700L (Compact) Series uses a sensor that is not affected by cutting fluid or dust, but it is not designed to keep dust from entering between the Detector and the scale base, so the product has no IP (International Protection) code.

A little amount of cutting fluid or dust attached on the scale does not restrict the functions, but the scale should not be exposed to the above environment as much as possible because a serious malfunction may occur if iron dust enters the inside.

Please also note that the detection part of the scale pattern or Detector may be damaged if you scan the unit when there is an about 0.4 mm-thick foreign object in a gap between the Detector and the scale base.



It is recommended to put a cover on the scale base and the Detector to prevent water, oil, and dust.

## 2.2.2 Magnetism

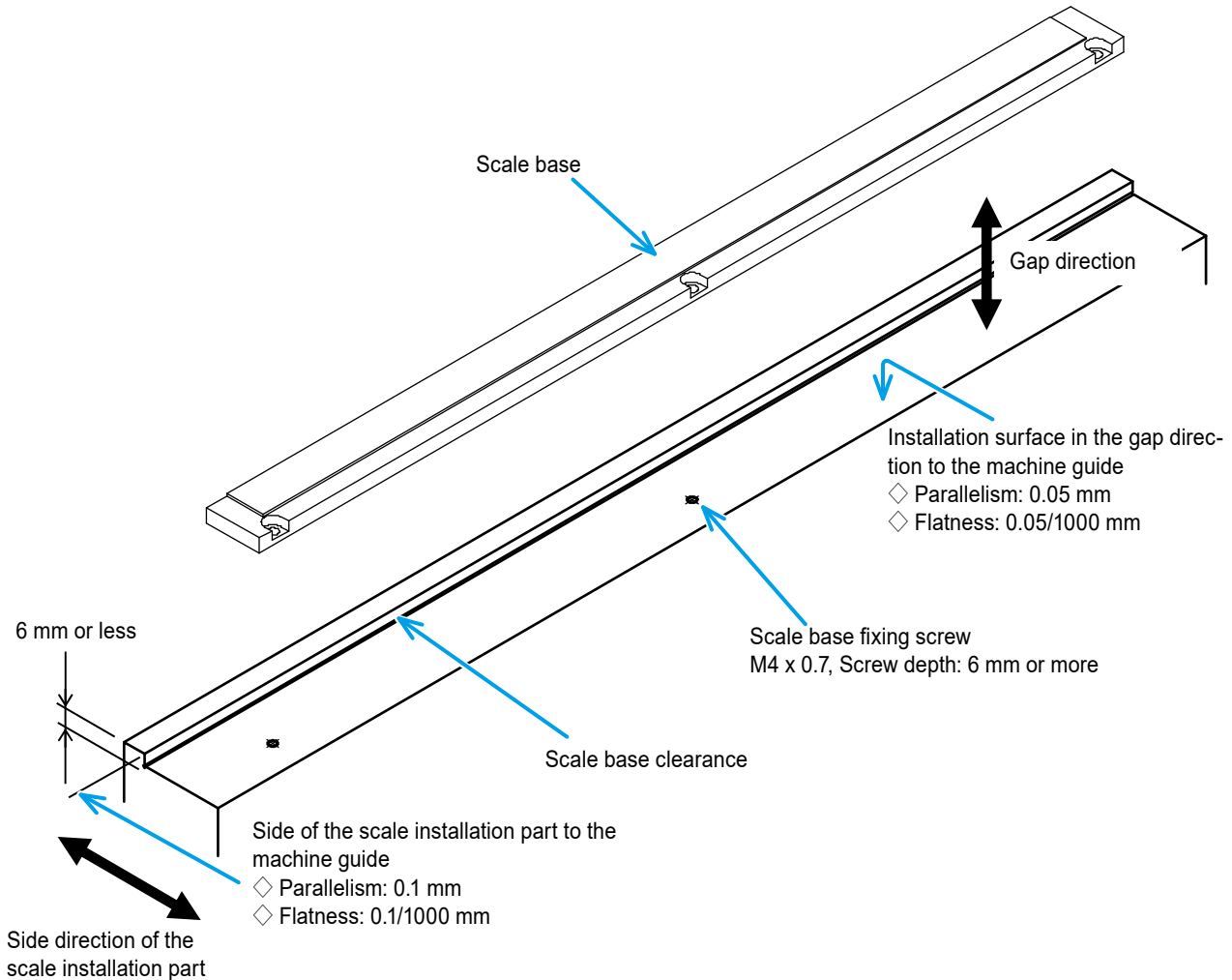
The Linear Scale ABS ST700/ST700L (Compact) Series uses a measurement sensor based on the electromagnetic induction method. Electromagnetic induction is a phenomenon where applying an electric current to one of two coils opposite to each other causes an electric flux on the target coil and induces an electric current on the other coil. By detecting an electric current induced according to displacement using this basic principle, the amount of displacement is determined. Therefore, in an environment where equipment (such as a linear motor) that generates strong magnetism is located near the scale, please note the following on installing the scale unit:

- It is recommended to install the scale unit in a location that is not affected by magnetism as much as possible.
- If you have no choice but to place the scale unit near the linear motor, select a location with magnetism of 3 mT or less.

## 2.3 Designing the Scale Installation Surface



Design the scale installation part as shown in the figure below according to "4.4 Dimensional Drawings".



### Tips

If you cannot set the side of the scale installation part (shown in the figure above), you can use the positioning reference pin instead. In such a case, set the reference pin according to the installation hole pitch. Even in this case, the above standard values must be secured for the parallelism to the machine guide.

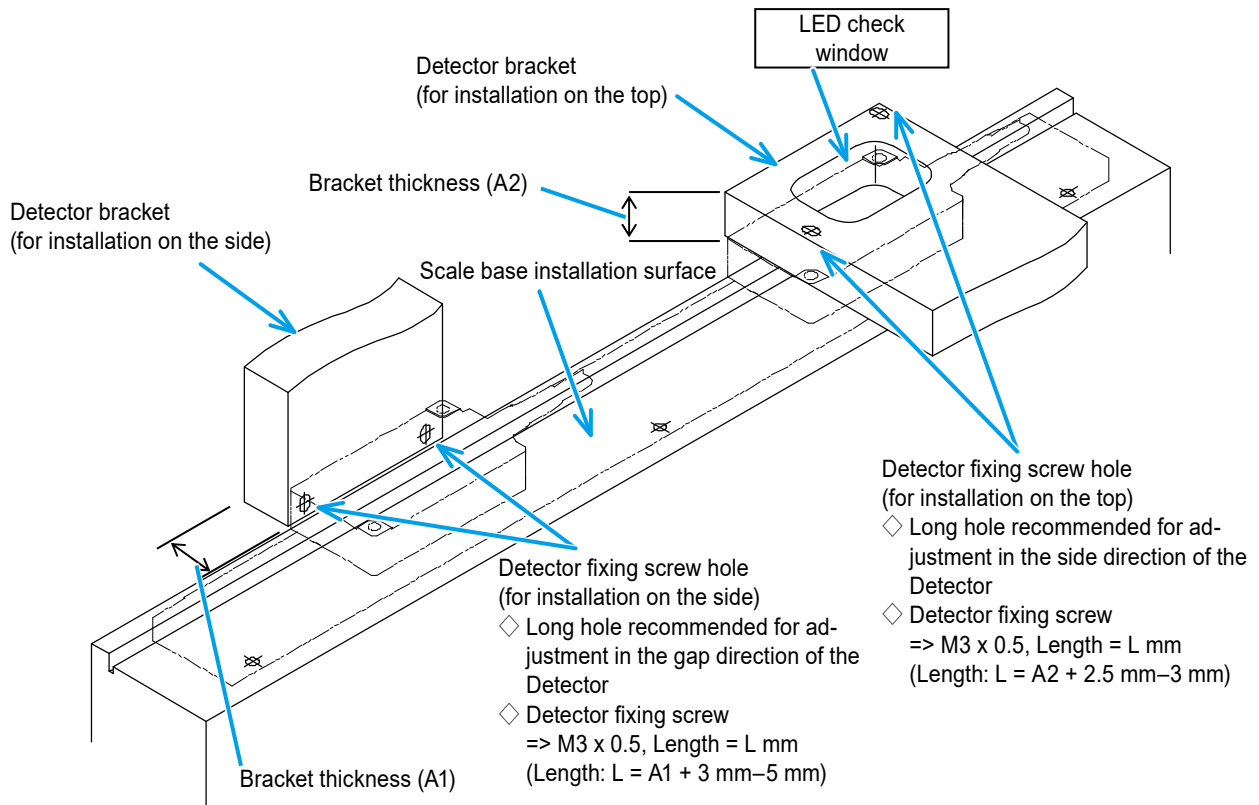
### 2.3.1 Selecting the Material of the Scale Installation Part

It is recommended to use an iron material similar to the material of the scale base as the material of the scale installation part by considering changes in temperature. If you have no choice but to use an aluminum material, install the unit in an environment with the standard temperature that does not change a lot (20 °C ± 3 °C recommended).

## 2.4 Designing the Detector Bracket



Design the Detector bracket according to "4.4 Dimensional Drawings". The dimensions must allow positioning adjustment in the side and gap directions of the Detector. It is recommended that the Detector fixing screw hole should be a long hole that makes it easier to adjust in the side or gap direction of the Detector.



### Tips

- Design the Detector bracket so that the scale base can be grounded as GND to frame ground through the installation part material at installation.
- Determine the bracket thickness by taking the Detector installation screw depth (side: 5 mm, top: 3 mm) into account. Please note that insufficient thickness may lower the Detector rigidity, decreasing the servo rigidity, accordingly.

**MEMO**

# 3 Installation onto the Machine Main Unit

This chapter describes the procedures, methods, and precautions required when installing this product onto the machine main unit.

## 3.1 Checking the Package Contents

Before starting installation, make sure that the product package contains all of the following items.

If the specifications of your scale are not as specified or you have any questions, contact your dealer or the nearest Mitutoyo office/service center.

Name	Quantity	Note
Scale base	1	Check the effective measurement length.
Detector	1 *1	Check the model number.
Installation spacer	1	t=0.4 mm
Serial No. tag	1	Make sure that the scale base and the Detector have the same number.
User's Manual	1	This manual
Inspection certificate	1	
Warranty card	1	

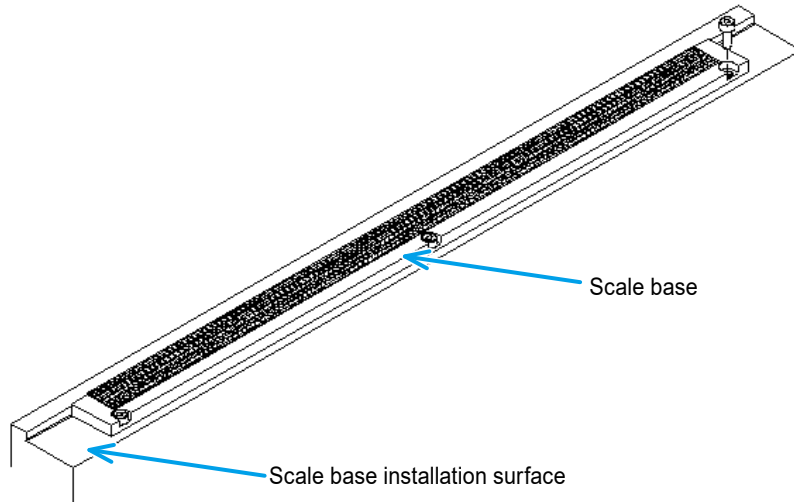
\*1: For the multi-head specification (custom specification of two or more Detectors), the number of Detectors is different.

## 3.2 Installing the Scale Base



- Before installing the scale base, clean the scale base installation surface and scale base backside with alcohol.
- Do not remove the protection tape on the scale base surface.

1 Place the scale base along the scale base installation surface and tighten the screws.



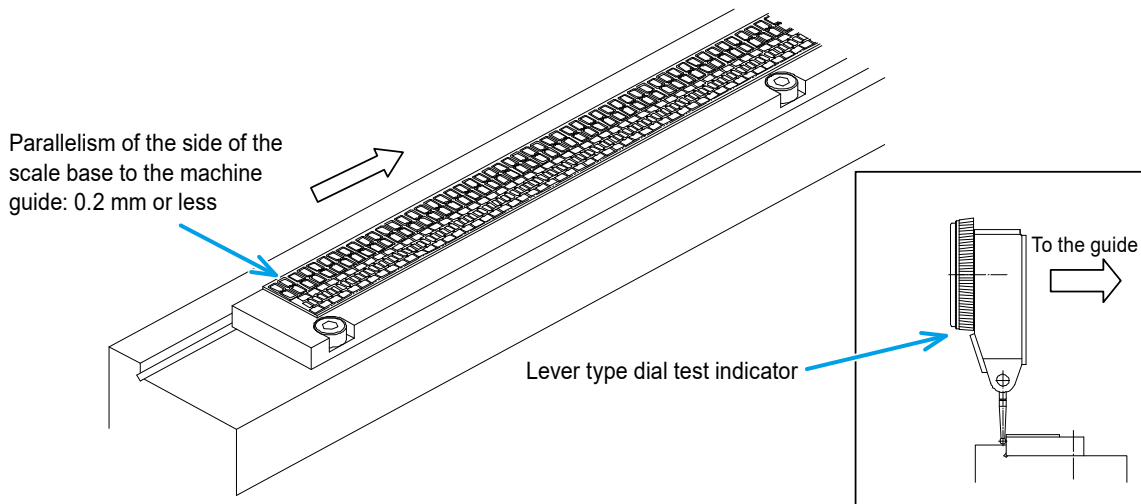
### Tips

Screw to use: M4 x 0.7, 6 mm or more

Tightening torque: 3 N•m–4 N•m

### 3.2.1 Checking after the Scale Base Installation

After installing the scale base, use a lever type dial test indicator to make sure that the parallelism of the scale base side to the machine guide is 0.2 mm or less.





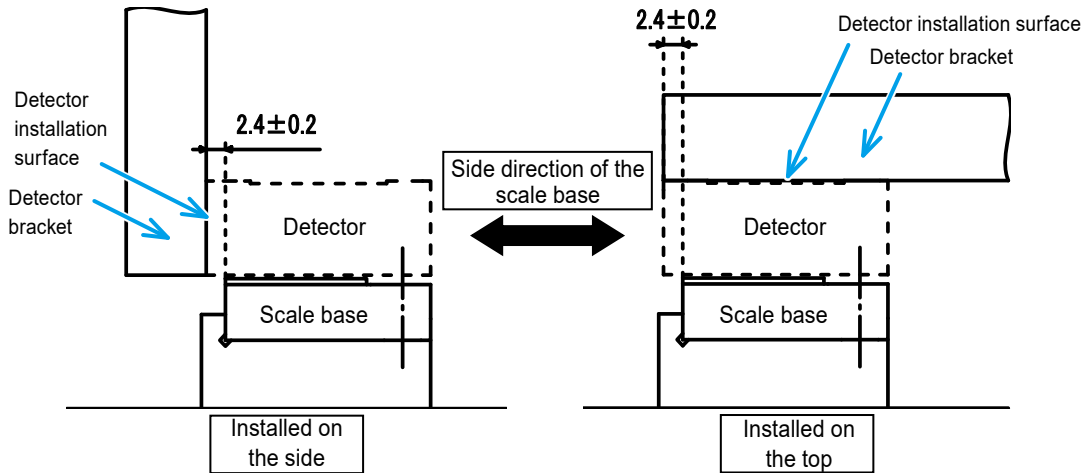
# 3.3 Installing the Detector Bracket and the Detector

## 3.3.1 Installing the Detector Bracket

1 Install the Detector bracket.



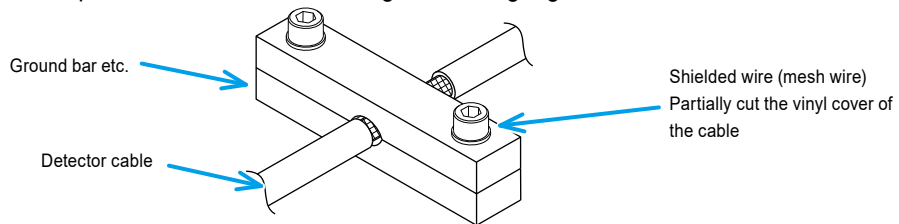
Install the Detector bracket so that there is a predetermined distance between the bracket and the side of the Detector.



## 3.3.2 Installing the Detector



The Detector must be installed so that it can be used with the machine main unit, including the bracket to be installed, electrically connected to ground. Without grounding, the unit may be affected by external noise. If it is difficult to ground due to the bracket material, securely connect the shielded part of the Detector cable to ground using a ground bar.



Example: Ground bar usage drawing

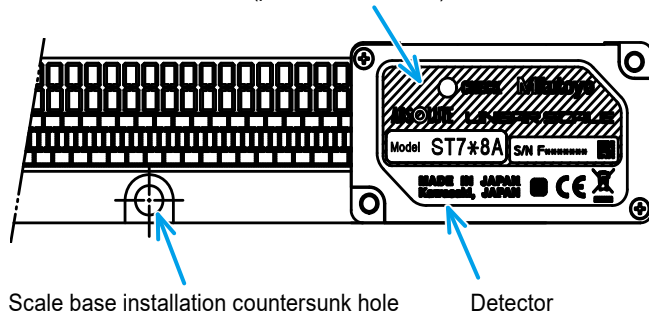
### 3 Installation onto the Machine Main Unit

- 1 Install the Detector on the Detector bracket by loosely tightening the screws (temporary fixing).

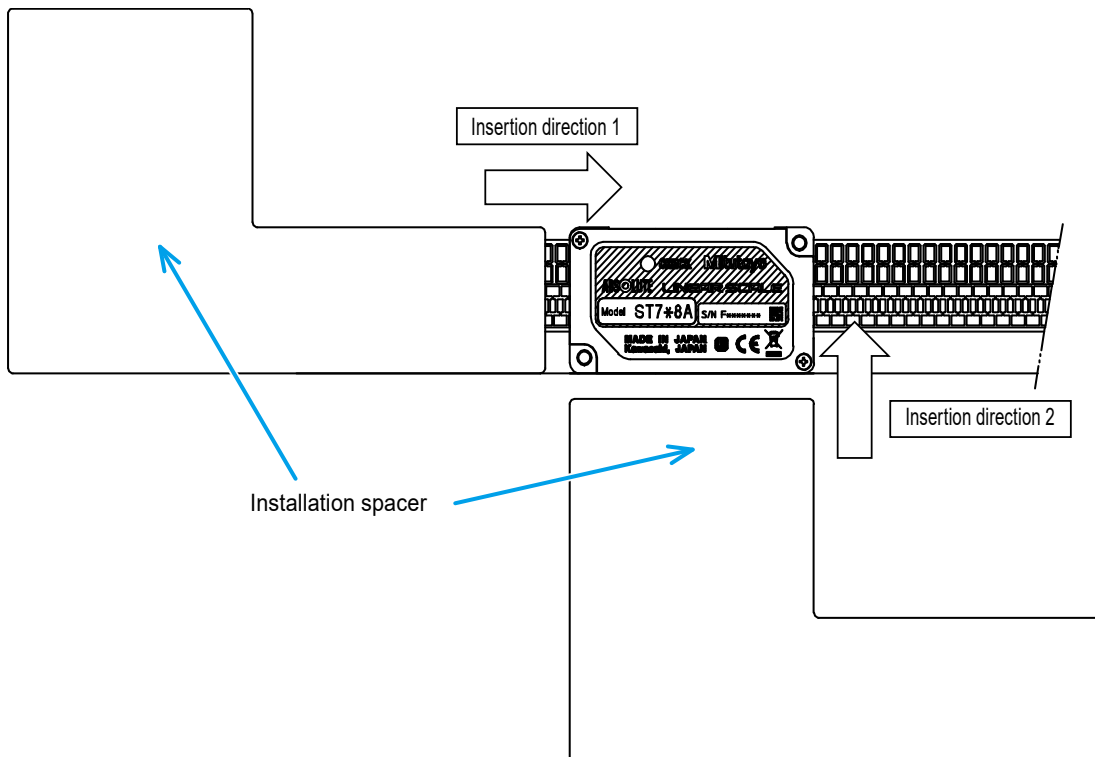
#### Tips

If you do not know the installation direction of the Detector, check it in the figure below.

Orientation of the sticker on the Detector  
(placed on the front)



- 2 Insert the supplied installation spacer (t = 0.4 mm) in between the detection surface of the Detector and the pitch surface of the scale base.



- 3 Fix the Detector by tightening the screws.

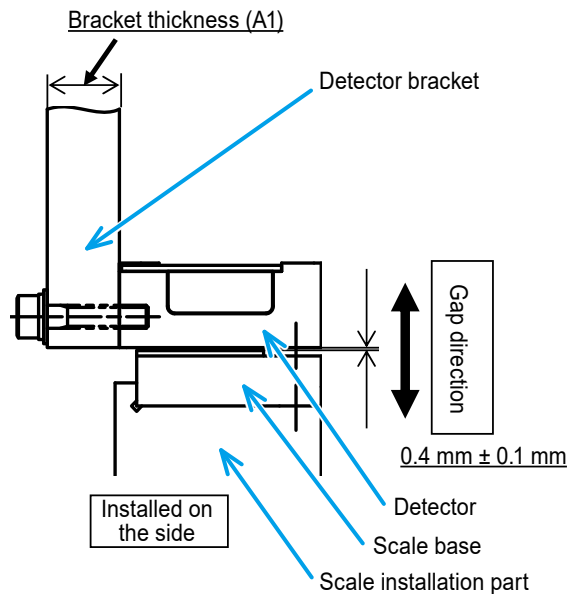
#### NOTICE

During positioning with the installation spacer, if the Detector is fixed, being pushed hard against the scale, the installation spacer may not be pulled out. In such a case, if you try to pull them out forcibly, the pitch surface of the scale base or the detection surface of the Detector may be damaged.

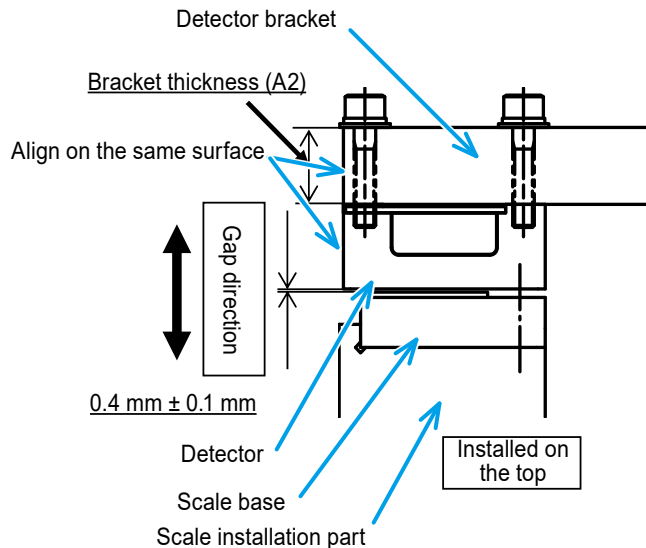
### 3 Installation onto the Machine Main Unit



- When you install the Detector bracket on the side of the Detector, please note the following:  
Screw to use: M3 x 0.5, Length = L mm ( $L = A1 + 3 \text{ mm} - 5 \text{ mm}$ )  
Tightening torque: 3 N•m–3.5 N•m



- When you install the Detector bracket on the top of the Detector, please note the following:  
Screw to use: M3 x 0.5, Length = L mm ( $L = A2 + 2 \text{ mm} - 3 \text{ mm}$ )  
Tightening torque: 3 N•m–3.5 N•m



- When you install the Detector bracket on the top of the Detector, it is recommended to adjust the gap using the following procedure:
  - 1 Install the Detector on the Detector bracket.
  - 2 In this state, align the end faces.
  - 3 Adjust the gap including the Detector bracket.

**4** Pull out the installation spacer.

# 3.4 Connecting the Cables

After installing the Detector, connect and fix the cables.



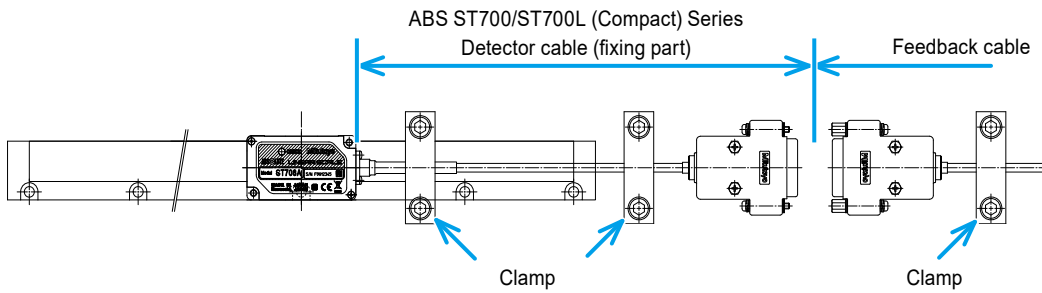
A feedback cable must be prepared by yourself. Find a cable appropriate for your model according to "4.2 Pin Assignment" (page 21).

**1** Perform wiring paying attention to the twisting or bends of the cables.



Note that the Detector cable and feedback cable may malfunction if bundled with other cables that may cause electrical noise, or if they are located near a switching relay dealing with a large current.

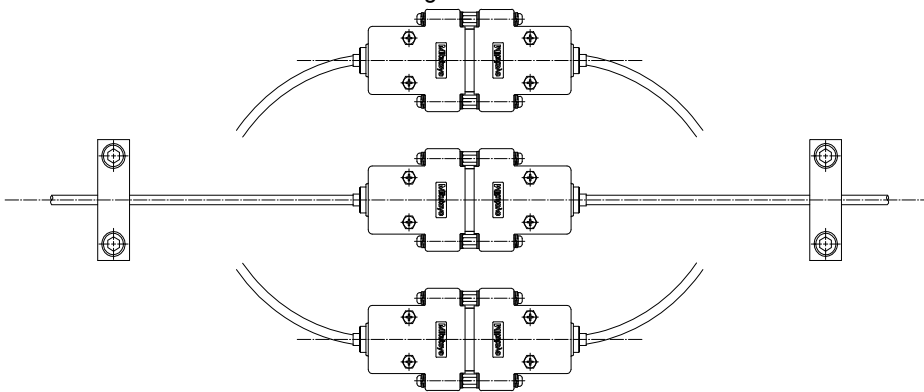
**2** Use cable clamps or other fasteners to secure the cables.



### Tips

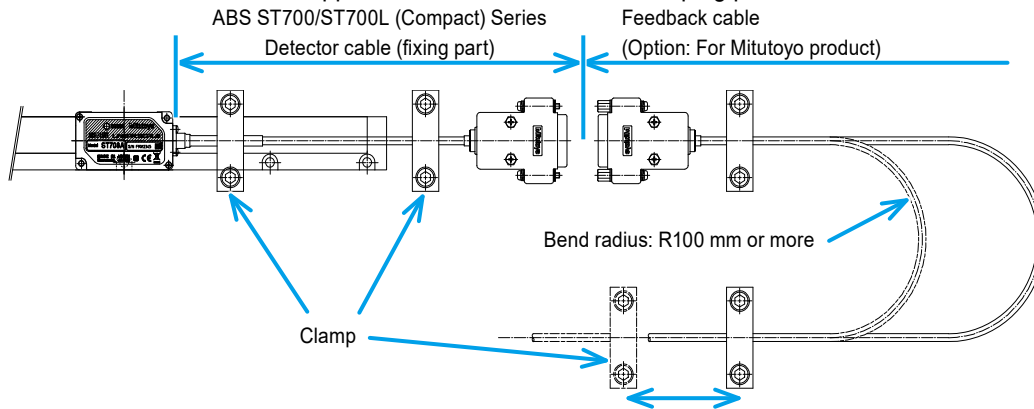
Note the following:

- Consider the shake due to vibration given to connectors.

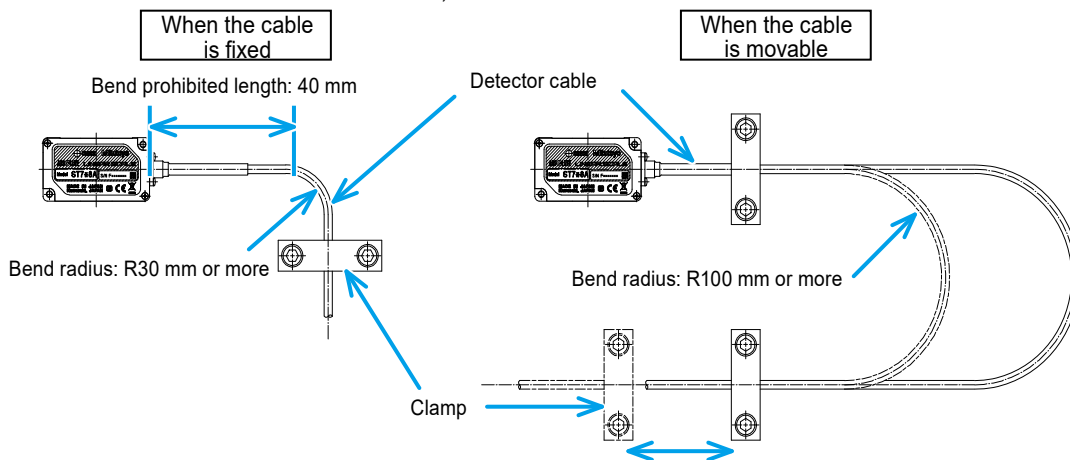


### 3 Installation onto the Machine Main Unit

- If the cables are going to be repeatedly bent, the feedback cable, not the output cable, should be movable. Please also avoid stress applied to near the root of the clamping part.



- If the Detector cable needs to be bent, secure the bend radius as shown below:




- It is recommended to attach the accessory Serial No. tag to a cable near the servo amplifier input connector so that the serial number of the linear scale can be easily checked.

**MEMO**

# 4 Specification

This chapter describes the specifications of this product.

## 4.1 Specifications

Item	Specification	
Detection method	Electromagnetic induction absolute position detection method	
Scale type	Separate type scale	
Resolution	0.1 $\mu\text{m}$	
Effective length (accuracy guaranteed range)	ABS ST700 (Compact) Series (effective measurement length: 3 m or less) 100/200/300/400/500/600/700/800/900/1000/1100/1200/ 1300/1400/1500/1600/1700/1800/1900/2000/2100/2200/ 2300/2400/2500/2600/2700/2800/2900/3000 mm ABS ST700L (Compact) Series (effective measurement length: 3.2m–6 m) 3200/3400/3600/3800/4000/4200/4400/4600/4800/5000/ 5200/5400/5600/5800/6000 mm	
Maximum travel length	Effective measurement length +10 mm (Refer to  "4.4 Dimensional Drawings" (page 26).)	
Indication precision (at 20 °C)	5 + (5L <sub>0</sub> /1000) $\mu\text{m}$ , L <sub>0</sub> : Effective measurement length (mm)	
Maximum feedrate	5 m/s	
Maximum feed acceleration	50 m/s <sup>2</sup>	
Coefficient of linear expansion	(12.0 $\pm$ 1.5) $\times 10^{-6}/^{\circ}\text{C}$ (when the material of the installation part is equivalent to iron)	
Usage condition	(Effective measurement length: 3m or less) Temperature: 0 °C–50 °C Humidity: 20 %–80 % RH (non condensation)	(Effective measurement length: 3.2–6m) Temperature: 0 °C–50 °C Humidity: 20 %–70 % RH (non condensation)
Storage condition	(Effective measurement length: 3m or less) Temperature: -20 °C–70 °C Humidity: 20 %–80 % RH (non condensation)	(Effective measurement length: 3.2–6m) Temperature: -20 °C–60 °C Humidity: 20 %–70 % RH (non condensation)
Power supply voltage	5 V $\pm$ 10 % (ripple and spike noise components must be 100 mV or less)	
Maximum current consumption	270 mA	
Vibration resistance (55 Hz–2000 Hz)	300 m/s <sup>2</sup>	
Shock resistance (1/2 sin, 11 ms)	500 m/s <sup>2</sup>	

## 4 Specification

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<b>Item</b>	<b>Specification</b>
Interface	Mitutoyo ENSIS® high-speed serial interface
	Mitsubishi Electric Corporation Specifications MELSERVO high-speed serial interface
	Mitsubishi Electric Corporation Specifications CNC Series high-speed serial interface
	Panasonic Corporation MINAS high-speed serial interface
	Yaskawa Electric Corporation Specifications $\Sigma$ Series high-speed serial interface
	FANUC Corporation Specifications high-speed serial interface
Detector cable	Length/Diameter: 1 m/ $\varnothing$ 3.8 mm
Maximum cable length	29 m (including Detector cable)
EMC standard	Compliant with CE marking
CE marking	EMC Directive: EN 61326-1 Immunity test requirement: Clause 6.2 Table 2 Emission limit: Class B RoHS Directive: EN IEC 63000

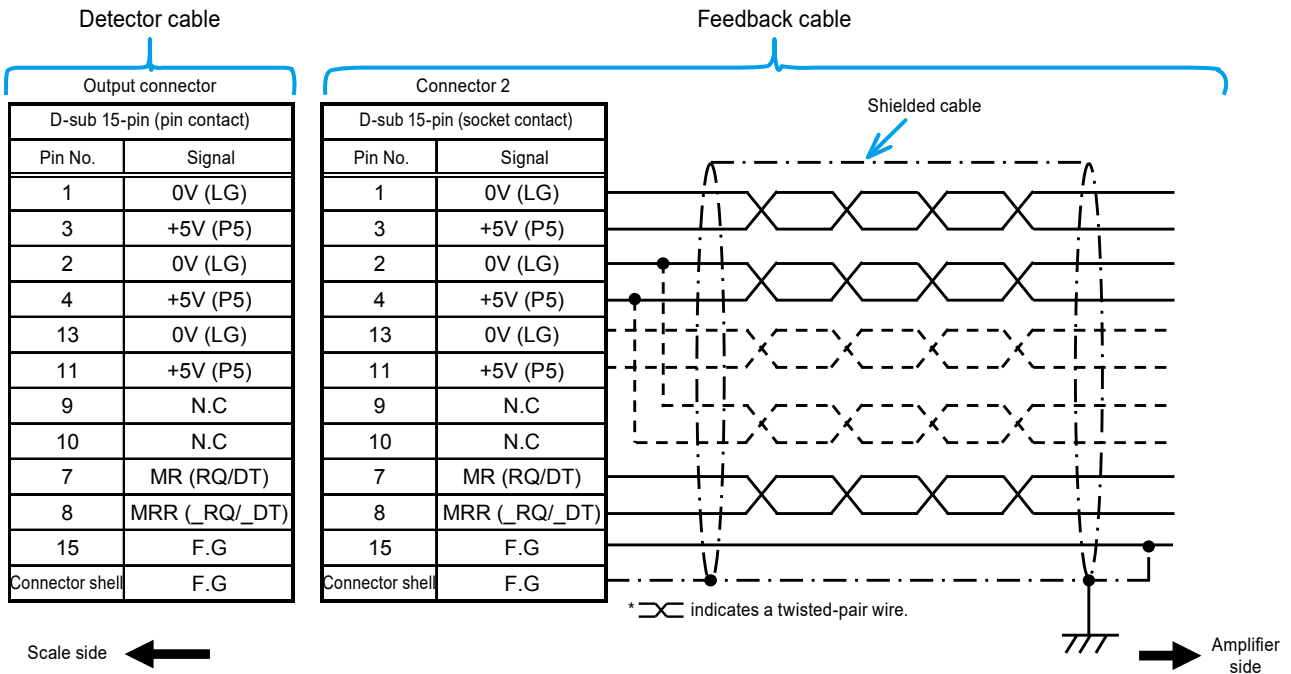


# 4.2 Pin Assignment



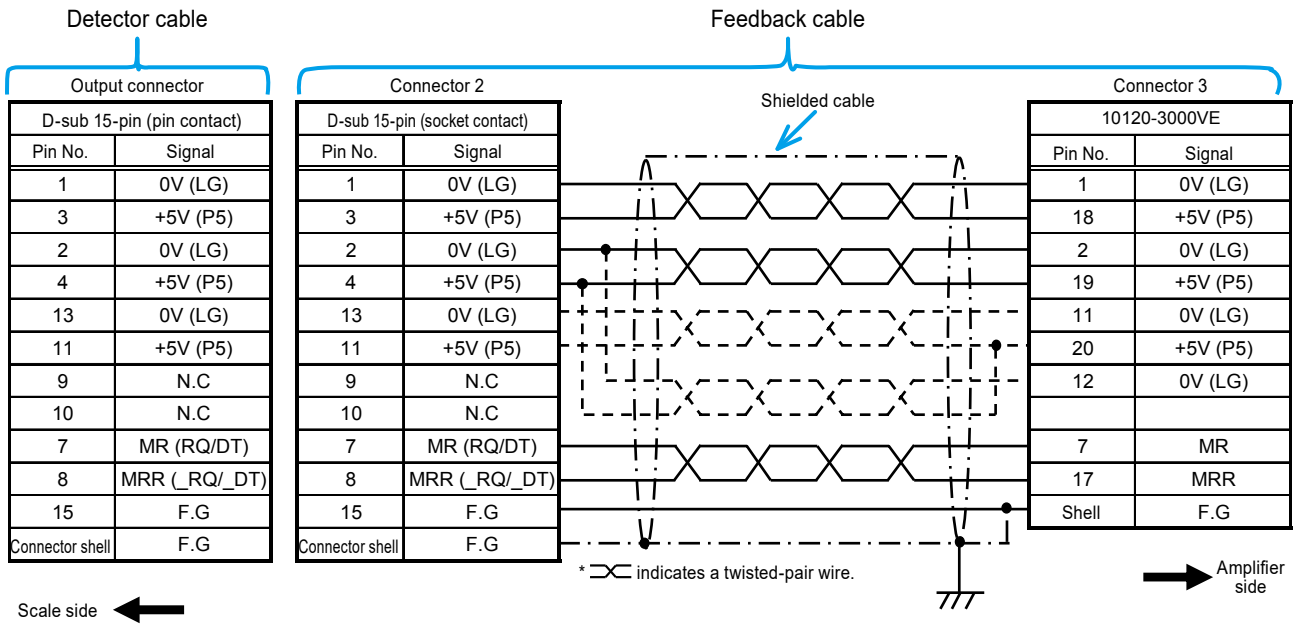
- In an environment subject to electromagnetic noise, it is recommended to perform the following for higher noise immunity:
  - Partially remove the sheath of the feedback cable near the servo amplifier and connect the shielded wire to the ground bar.
  - Solder the lead wire to the shield on the servo amplifier connector (connector 3) and connect it to the frame ground of the amplifier enclosure.
- To set a longer cable length, it is recommended to connect the wires shown by the dotted line (+5 V, 0 V) in the figures in this section.

## 4.2.1 ABS ST708A, ST708AL

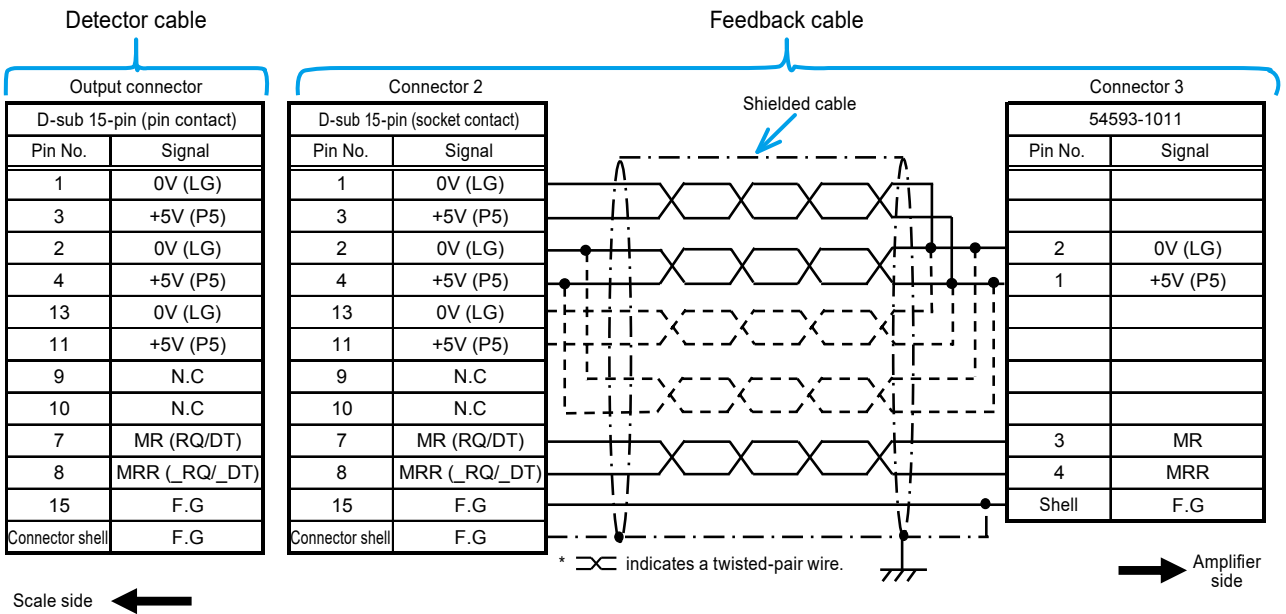


4 Specification

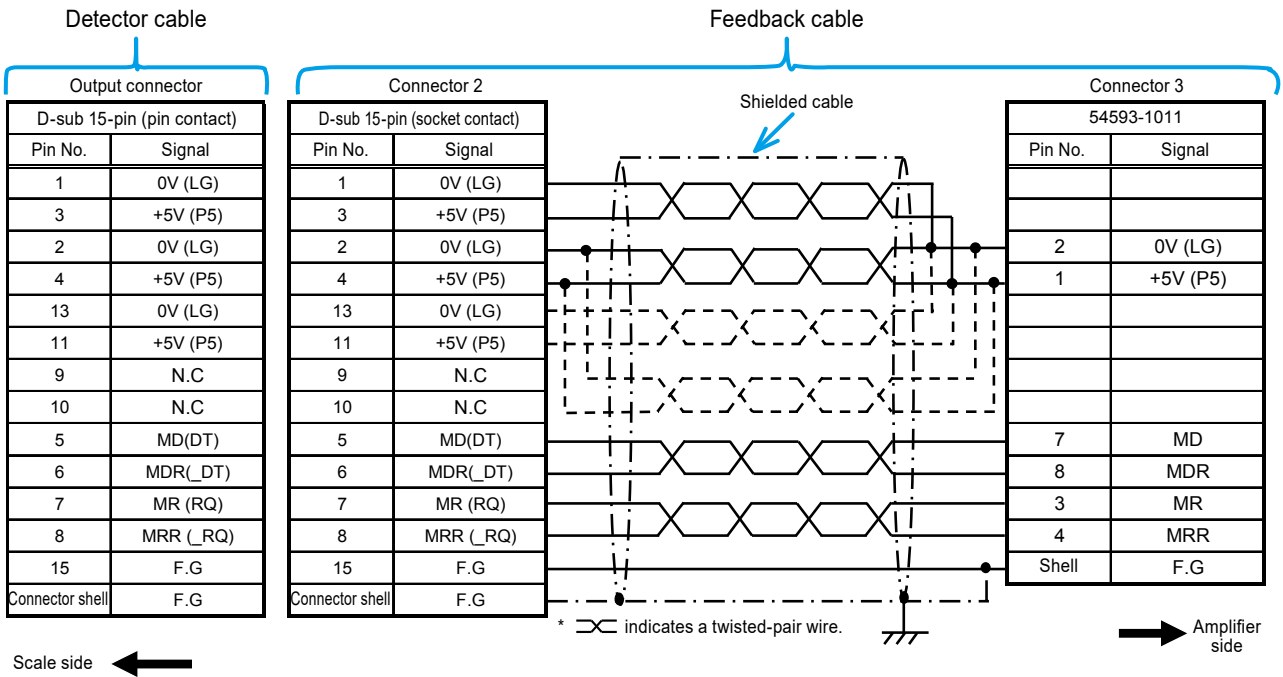
4.2.2 ABS ST748A, ST748AL Mitsubishi Electric Corporation Specifications MELSERVO MR-J2



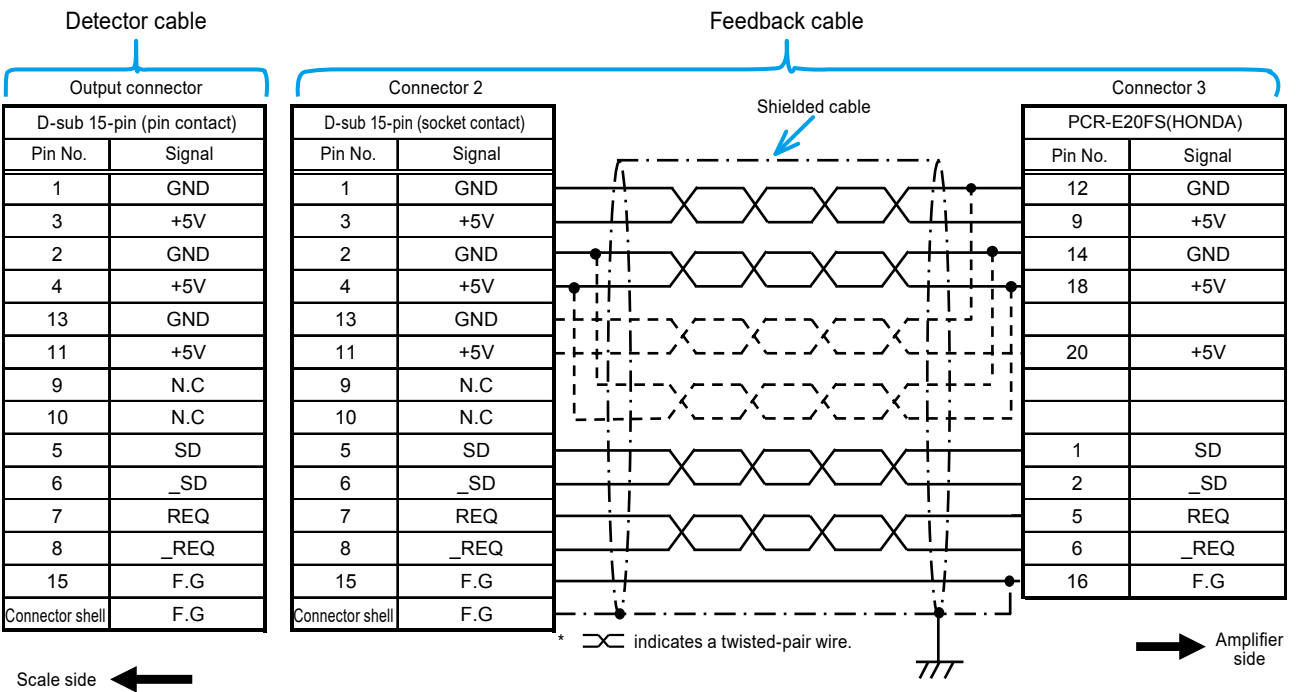
4.2.3 ABS ST748A, ST748AL Mitsubishi Electric Corporation Specifications MELSERVO MR-J3/MR-J4



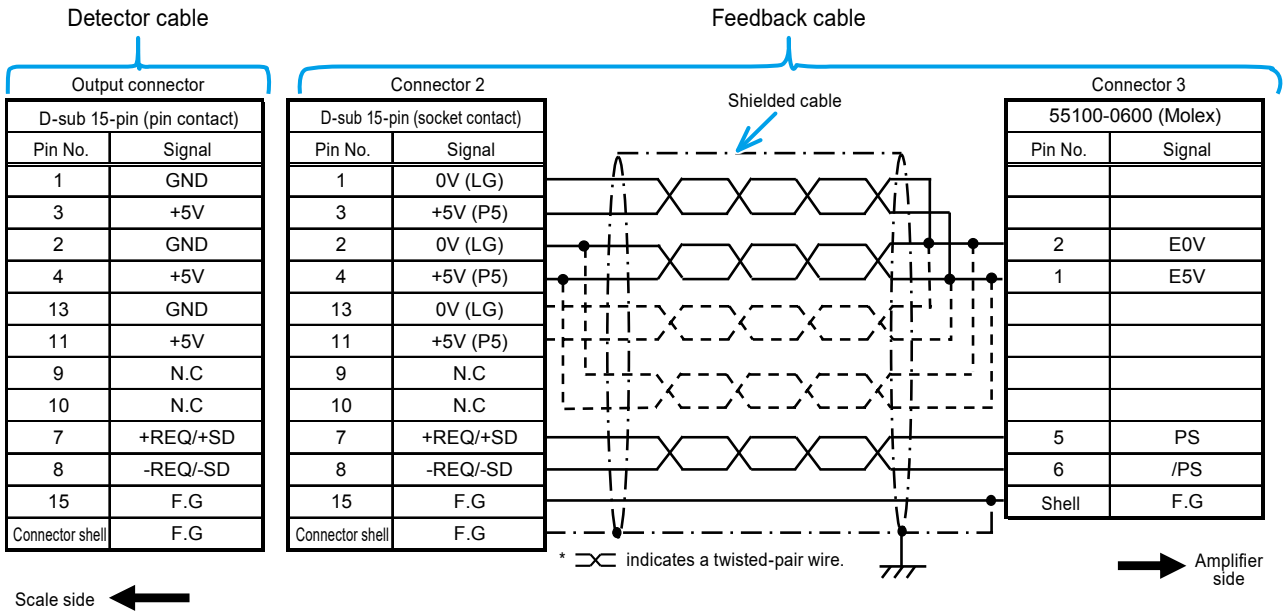
### 4.2.4 ABS ST748, ST748L Mitsubishi Electric Corporation Specifications CNC Series DS-D, MDS-DH, MDS-Dn



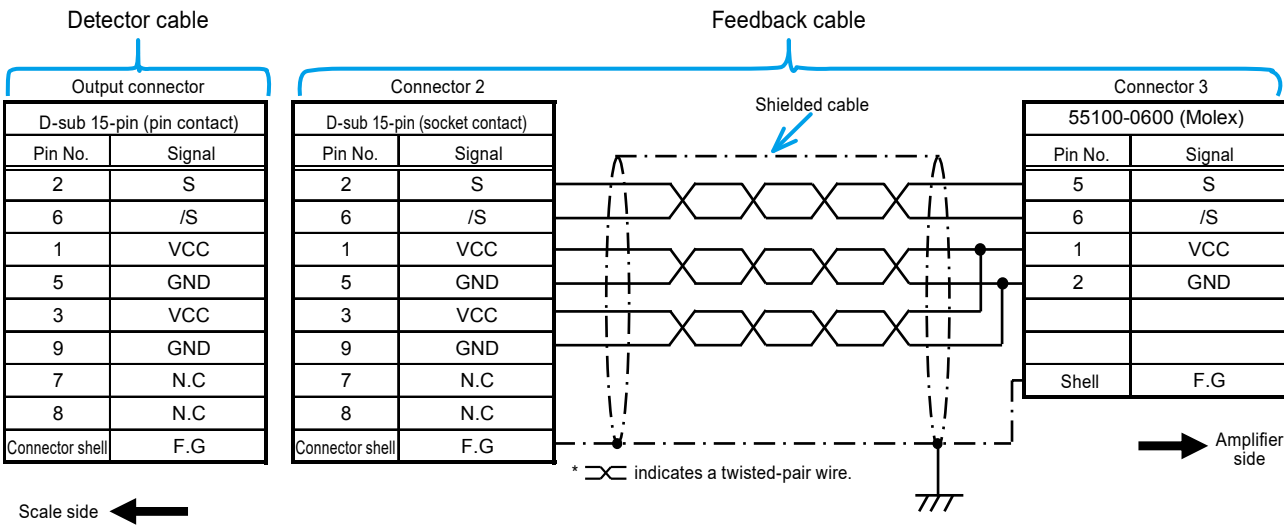
### 4.2.5 ABS ST758, ST758L FANUC Corporation



### 4.2.6 ABS ST778A, ST778AL Panasonic Corporation



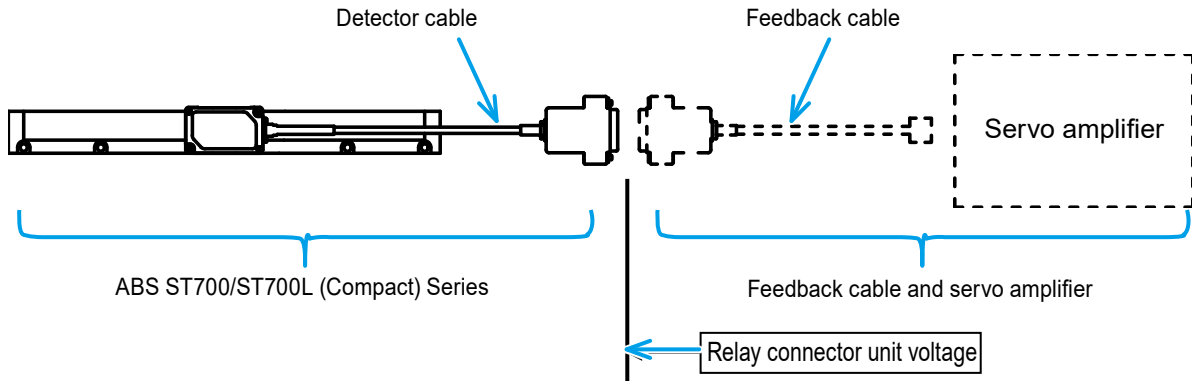
### 4.2.7 ABS ST788A, ST788AL Yaskawa Electric Corporation



# 4.3 Calculation of Feedback Cable Length

When making a feedback cable, refer to the following calculation method of maximum cable length.

## ■ Configuration



## ■ Condition: When the Detector cable length is 1 m

Name	Specifications and symbols	Unit
Maximum cable length	L	m
Wire resistance of used wire material	a	Ω/m
Number of pairs used for power supply line	b	wires
Supply voltage (minimum value) from the servo amplifier	4.95 *1	V
Current consumption value	0.27	A
Relay connector unit voltage (minimum value)	4.57 *2	V

\*1 This is standard supply voltage on the servo amplifier.

\*2 When the Detector cable length is longer than the default 1 m, a voltage drop of 0.07 V per 1 m occurs. Consider the voltage drop in the Detector cable.

## ■ Calculation formula

Allowable voltage drop  $\geq$  (Current consumption x wire material resistance x 2 x max cable length) ÷ Number of pairs used for power supply line (1)

Applying the conditions in the above table to formula (1) gives the following result.

$$(4.95 - 4.57) [V] \geq (0.27 [A] \times a [\Omega/m] \times 2 \times L [m]) \div b [wires] \quad (2)$$

Modify formula (2) above to the following one.

$$L [m] \leq \frac{b (4.95 - 4.57)}{0.54 a} \quad (3)$$

Produce the feedback cable of the max cable length (L[m]), wire resistance of used wire material (a[Ω/m]) and number of pairs used for power supply line (b[wires]) satisfying formula (3) above.



## Dimension table


Dimension table (common to ABS ST700 (Compact) Series: effective measurement length of 3 m or less)

Code No. (*1, *2)	Model number (*1, *3)	Effective measure- ment length (mm)	Maxi- mum travel length (mm)	L1 (mm)	L2 (mm)	L3 (mm)	n	L4 (mm)	Z
579-301*□8	ABS ST7◇8(A)-100A-*	100	110	180	90	80	2		3
579-302*□8	ABS ST7◇8(A)-200A-*	200	210	280	140	130			
579-303*□8	ABS ST7◇8(A)-300A-*	300	310	380	190	180			
579-304*□8	ABS ST7◇8(A)-400A-*	400	410	480	240	230			
579-305*□8	ABS ST7◇8(A)-500A-*	500	510	580	290	200	2	80	5
579-306*□8	ABS ST7◇8(A)-600A-*	600	610	680	340			130	
579-307*□8	ABS ST7◇8(A)-700A-*	700	710	780	390			180	
579-308*□8	ABS ST7◇8(A)-800A-*	800	810	880	440			230	
579-309*□8	ABS ST7◇8(A)-900A-*	900	910	980	490	200	4	80	7
579-310*□8	ABS ST7◇8(A)-1000A-*	1000	1010	1080	540			130	
579-311*□8	ABS ST7◇8(A)-1100A-*	1100	1110	1180	590			180	
579-312*□8	ABS ST7◇8(A)-1200A-*	1200	1210	1280	640			230	
579-313*□8	ABS ST7◇8(A)-1300A-*	1300	1310	1380	690	200	6	80	9
579-314*□8	ABS ST7◇8(A)-1400A-*	1400	1410	1480	740			130	
579-315*□8	ABS ST7◇8(A)-1500A-*	1500	1510	1580	790			180	
579-316*□8	ABS ST7◇8(A)-1600A-*	1600	1610	1680	840			230	
579-317*□8	ABS ST7◇8(A)-1700A-*	1700	1710	1780	890	200	8	80	11
579-318*□8	ABS ST7◇8(A)-1800A-*	1800	1810	1880	940			130	
579-319*□8	ABS ST7◇8(A)-1900A-*	1900	1910	1980	990			180	
579-320*□8	ABS ST7◇8(A)-2000A-*	2000	2010	2080	1040			230	
579-321*□8	ABS ST7◇8(A)-2100A-*	2100	2110	2180	1090	200	10	80	13
579-322*□8	ABS ST7◇8(A)-2200A-*	2200	2210	2280	1140			130	
579-323*□8	ABS ST7◇8(A)-2300A-*	2300	2310	2380	1190			180	
579-324*□8	ABS ST7◇8(A)-2400A-*	2400	2410	2480	1240			230	
579-325*□8	ABS ST7◇8(A)-2500A-*	2500	2510	2580	1290	200	12	80	15
579-326*□8	ABS ST7◇8(A)-2600A-*	2600	2610	2680	1340			130	
579-327*□8	ABS ST7◇8(A)-2700A-*	2700	2710	2780	1390			180	
579-328*□8	ABS ST7◇8(A)-2800A-*	2800	2810	2880	1440			230	
579-329*□8	ABS ST7◇8(A)-2900A-*	2900	2910	2980	1490	200	14	80	17
579-330*□8	ABS ST7◇8(A)-3000A-*	3000	3010	3080	1540			130	

\*1: \* (asterisk) in the code No. and model number indicates the Detector cable outlet direction.  
R: Right (Standard), D: Down (Selectable), L: Left (Selectable), U: Up (Selectable)

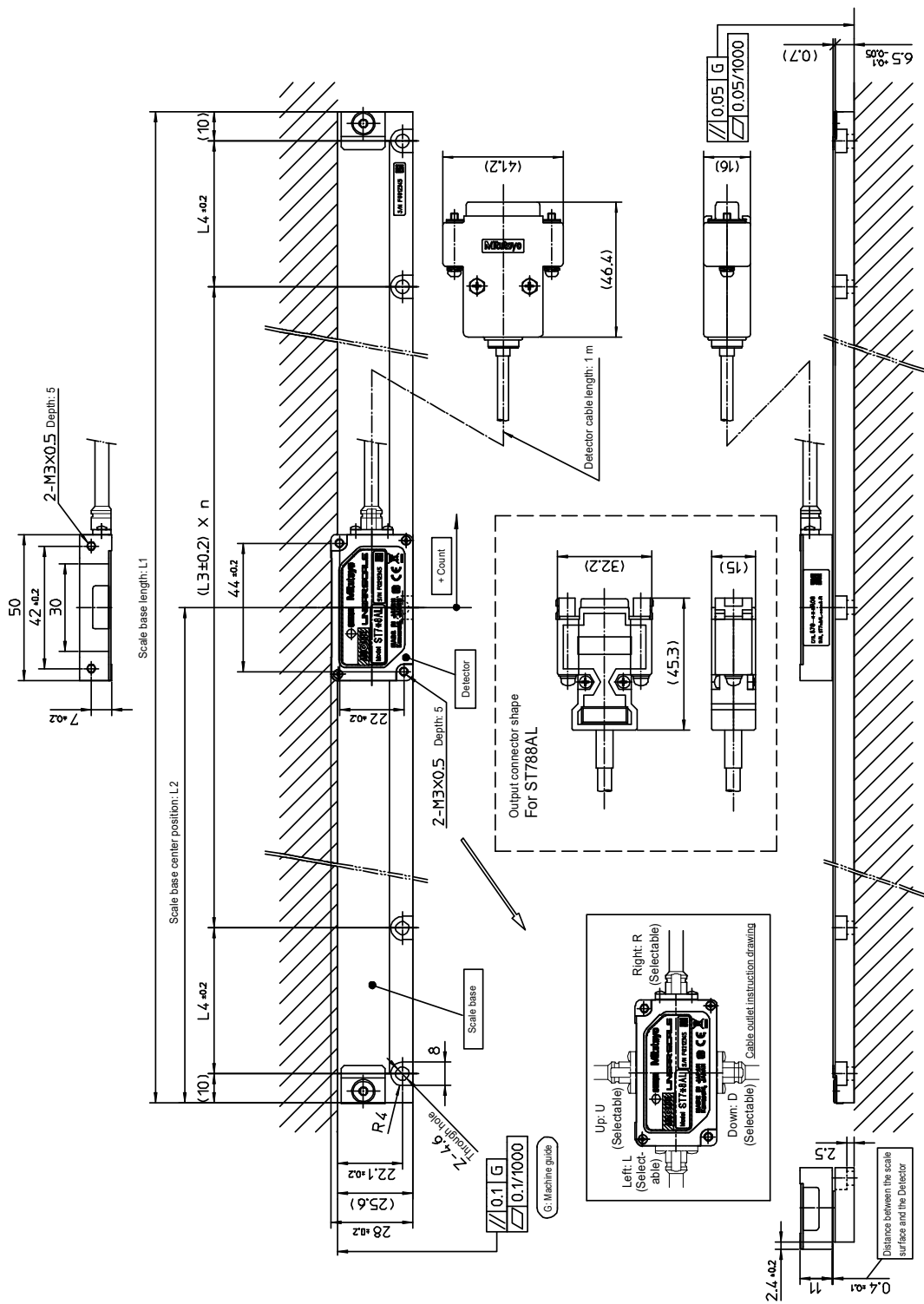
\*2: □ in the code No. indicates the following:

- 0: Mitutoyo Corporation ENSIS®
- 3: Mitsubishi Electric Corporation CNC Series
- 4: Mitsubishi Electric Corporation MELSERVO
- 5: FANUC Corporation
- 7: Panasonic Corporation
- 8: Yaskawa Electric Corporation

\*3: ◇ in the model number indicates the interface specifications: For details, refer to  "2.1 Checking the Equipment Model" (page 5).

### 4.4.2 ABS ST700L (Compact) Series

#### Dimensional drawing





■ Dimension table


Dimension table (common to ABS ST700L (Compact) Series: effective measurement length of 3.2 m–6 m)

Code No. (*1, *2)	Model number (*1, *3)	Effective measurement length (mm)	Maximum travel length (mm)	L1 (mm)	L2 (mm)	L3 (mm)	n	L4 (mm)	Z
579-331*□8	ABS ST7◇8(A)L-3200A-*	3200	3210	3280	1640	200	14	230	17
579-332*□8	ABS ST7◇8(A)L-3400A-*	3400	3410	3480	1740		16	130	19
579-333*□8	ABS ST7◇8(A)L-3600A-*	3600	3610	3680	1840			230	
579-334*□8	ABS ST7◇8(A)L-3800A-*	3800	3810	3880	1940		18	130	21
579-335*□8	ABS ST7◇8(A)L-4000A-*	4000	4010	4080	2040			230	
579-336*□8	ABS ST7◇8(A)L-4200A-*	4200	4210	4280	2140		20	130	23
579-337*□8	ABS ST7◇8(A)L-4400A-*	4400	4410	4480	2240			230	
579-338*□8	ABS ST7◇8(A)L-4600A-*	4600	4610	4680	2340		22	130	25
579-339*□8	ABS ST7◇8(A)L-4800A-*	4800	4810	4880	2440			230	
579-340*□8	ABS ST7◇8(A)L-5000A-*	5000	5010	5080	2540		24	130	27
579-341*□8	ABS ST7◇8(A)L-5200A-*	5200	5210	5280	2640			230	
579-342*□8	ABS ST7◇8(A)L-5400A-*	5400	5410	5480	2740		26	130	29
579-343*□8	ABS ST7◇8(A)L-5600A-*	5600	5610	5680	2840			230	
579-344*□8	ABS ST7◇8(A)L-5800A-*	5800	5810	5880	2940		28	130	31
579-345*□8	ABS ST7◇8(A)L-6000A-*	6000	6010	6080	3040			230	

\*1: \* (asterisk) in the code No. and model number indicates the Detector cable outlet direction.  
R: Right (Standard), D: Down (Selectable), L: Left (Selectable), U: Up (Selectable)

\*2: □ in the code No. indicates the following:

- 0: Mitutoyo Corporation ENSIS®
- 3: Mitsubishi Electric Corporation CNC Series
- 4: Mitsubishi Electric Corporation MELSERVO
- 5: FANUC Corporation
- 7: Panasonic Corporation
- 8: Yaskawa Electric Corporation

\*3: ◇ in the model number indicates the interface specifications: For details, refer to  "2.1 Checking the Equipment Model" (page 5).

**MEMO**

# 5 Troubleshooting

This chapter describes the Alarm Detection function inside the Detector and the alarm codes for each company interface.

## 5.1 Alarm Function

The ABS ST700/ST700L (Compact) Series is equipped with the Alarm Detection function inside the Detector.

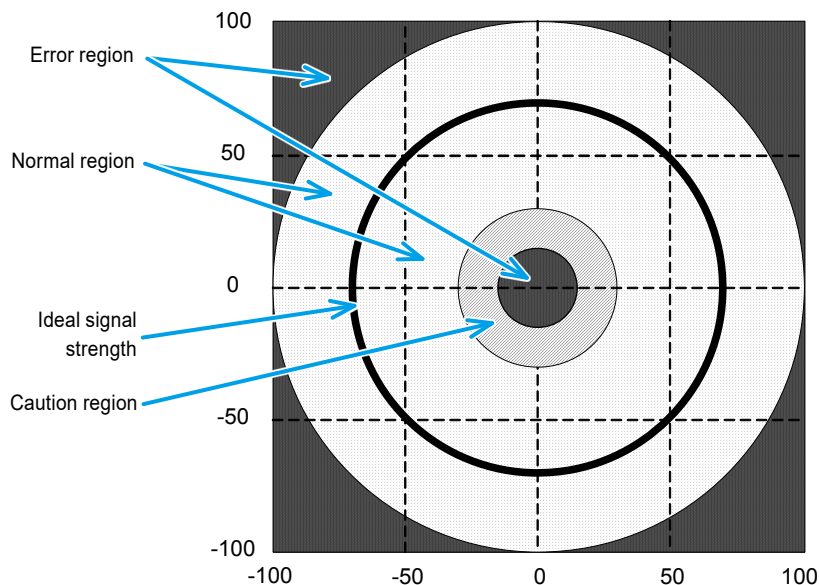
### 5.1.1 Alarm Detections

Alarms detected with the Alarm Detection function can be categorized into the following two groups: Caution and Error.

- **Caution:** Indicates low-level signal strength or the temperature error inside the Detector, detected by the sensor. In those cases, once troubleshoot the causes, the normal state can be restored.
- **Error:** Indicates a signal strength error or absolute value detection error, etc., detected by the sensor. Once these errors occur, the error detection state will be maintained until they are reset, or the power is re-supplied.

Alarm detection type		Description
Caution	Temperature error	This alarm is output when the temperature inside the Detector rises above 65 °C and returns to the normal state when it drops below 60 °C.
	Signal strength	This alarm is output when the signal strength drops below 30 % and returns to the normal state when it rises above 30 %.
Error	Signal strength	This alarm is output when the signal strength drops below 15 % or reaches 100 %.
	Transducer	This alarm is output when an abnormality is found in the internal signal balance.
	Absolute value detection	This alarm is output when an abnormality is found in the absolute value data.
	Hardware	This alarm is output when an abnormality is found in the internal hardware.
	Initialization	This alarm is output when system initialization is not successfully completed at power-on.
	Overspeed	This alarm is output when the maximum feedrate (5 m/s) is exceeded.

The intensity of the signal strength is expressed based on the three regions as shown in the figure below. The LED shows the intensity so that you can easily check the signal strength. The intensity of the signal strength must be within the normal region. If it is in the caution or error region, an alarm is output.



### 5.1.2 LED Display on the Detector

When an alarm occurs, the LED on the Detector lights up (or flashes). You can tell the details of the alarm by the LED display as shown below.

LED status	Alarm type			Description
	Caution	Error	OK	
Solid red -> OFF	-	-	✓	Power-on LED The LED lights up for about two seconds at power-on, indicating that the power is turned on.
Solid red	✓	✓	-	When both a caution and an error occur, the LED lights up in red. Then, once the cause of the caution is removed, the color turns yellow.
Solid yellow	-	✓	-	When an error occurs, the LED lights up in yellow. This status is maintained until a command is issued from the servo amplifier or the Detector is turned off.
Flashing yellow	✓	-	-	When a caution occurs, the LED flashes in yellow. Once the cause of the caution is removed, the LED is turned off.

**Tips**

When an alarm occurs during operation, check the details in "5.2 Alarm Codes" and contact the servo amplifier manufacturer or the nearest Mitutoyo sales office/service center.

## 5.2 Alarm Codes

### 5.2.1 ABS ST748A, ST748AL

The table below shows the relationship between the ABS ST748A/ST748AL alarm and the alarm code displayed on the servo amplifier made by Mitsubishi Electric Corporation.

Servo amplifier Alarm code	LED status	Description	Cause	Major solution
AL2A	Solid red/solid yellow	<b>Scale error occurred</b> <ul style="list-style-type: none"> <li>• Signal strength error</li> <li>• Transducer error</li> <li>• ABS detection error</li> <li>• Hardware error</li> <li>• Initialization error</li> <li>• Overspeed</li> </ul>	The Detector detected an error.	<ul style="list-style-type: none"> <li>• Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>• Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>
AL28	Flashing yellow	<b>Scale alarm occurred</b> <ul style="list-style-type: none"> <li>• Thermal alarm</li> <li>• Signal strength alarm</li> </ul>	The Detector detected a caution. The position data is correct; however, it is necessary to check the fixing state and the operating condition.	<ul style="list-style-type: none"> <li>• The surrounding temperature of the Detector may be above 60 °C. If so, review the operation conditions (speed, acceleration).</li> <li>• Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>• Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>

Servo amplifier Alarm code	LED status	Description	Cause	Major solution
AL16	-	<b>Communication error occurred</b> (during servo amplifier initialization) <ul style="list-style-type: none"> <li>An error was received consecutively three times on the servo amplifier side (including no response).</li> </ul>	A communication error between the ABS ST748A/ST748AL and the servo amplifier occurred (communication impossible from the time of turning on the servo amplifier).	<ul style="list-style-type: none"> <li>Check the connections of cables and connectors.</li> <li>Check the routing of the cable (influence of noise such as large current cable).</li> <li>At power-on, check the LED on the ABS ST748A/ST748AL to see if the power is supplied.</li> </ul>
AL20	-	<b>Communication error occurred</b> (during servo amplifier control) <ul style="list-style-type: none"> <li>An error was received consecutively three times on the servo amplifier side (including no response).</li> </ul>	A communication error between the ABS ST748A/ST748AL and the servo amplifier occurred (occurred while controlling by the servo amplifier).	<ul style="list-style-type: none"> <li>Check the connections of cables and connectors.</li> <li>Check the routing of the cable (influence of noise such as large current cable).</li> </ul>

### 5.2.2 ABS ST758, ST758L

The table below shows the relationship between the ABS ST758/ST758L alarm and the alarm code displayed on the servo amplifier made by FANUC Corporation.

Note that the alarm codes of NC devices differ between when using the scale with fully closed control and when using with a linear motor.

Servo amplifier Alarm code	LED status	Description	Cause	Major solution
380 (during fully closed connection) LED error	Solid red/solid yellow	<b>Scale error occurred</b> <ul style="list-style-type: none"> <li>Hardware error</li> </ul>	The Detector detected an error.	Turn on the power again. If an error is found again, the Detector needs to be replaced.
365 (during linear motor) LED error				

## 5 Troubleshooting

Servo amplifier Alarm code	LED status	Description	Cause	Major solution
381 (during fully closed connection) Phase error  361 (during linear motor) Phase error	Solid red/solid yellow	<b>Scale error occurred</b> <ul style="list-style-type: none"> <li>Initialization error</li> <li>Absolute error</li> <li>Transducer error</li> <li>Overspeed</li> <li>Signal strength error</li> <li>Signal strength warning</li> </ul>	The Detector detected an error.	<ul style="list-style-type: none"> <li>Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>
385 (during fully closed connection) Serial data error  368 (during linear motor) Serial data error	-	<b>Communication error occurred</b> <ul style="list-style-type: none"> <li>No response</li> </ul>	An error occurred in which data from the scale could not be received due to communication between the ABS ST758/ST758L and the NC device (no response).	<ul style="list-style-type: none"> <li>Check the connections of cables and connectors.</li> <li>Check the routing of the cable (influence of noise such as large current cable).</li> </ul>
386 (during fully closed connection) Data transfer error  369 (during linear motor) Data transfer error	-	<b>Communication error occurred</b> <ul style="list-style-type: none"> <li>Communication error</li> </ul>	A CRC error and a stop bit error occurred in the serial data from the scale in communication between the ABS ST758/ST758L and the NC device (communication error).	Check the routing of the cable (influence of noise such as large current cable).
447 (during fully closed connection) Hardware disconnection alarm  446 (during linear motor) Hardware disconnection alarm	-	<b>Communication error occurred</b> <ul style="list-style-type: none"> <li>Cable disconnection</li> </ul>	An error caused by cable disconnection occurred in communication between the ABS ST758/ST758L and the NC device.	Check the connections of cables and connectors.

### 5.2.3 ABS ST778A, ST778AL

The table below shows the relationship between the ABS ST778A/ST778AL alarm and the alarm code displayed on the servo amplifier (MINAS A6 Series) made by Panasonic Corporation.

#### Tips

The alarm codes in this section indicate ones that occur on a servo amplifier that is a fully closed system.

Servo amplifier Alarm code	LED status	Description	Cause	Major solution
Err51.0	Solid yellow	<b>Scale error occurred</b> • Overspeed	The Detector detected an overspeed error.	<ul style="list-style-type: none"> <li>Review the operation condition (specified speed).</li> </ul>
Err51.1	Solid red/solid yellow	<b>Scale error occurred</b> • Initialization error	The Detector detected an error during initialization.	<ul style="list-style-type: none"> <li>Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>
Err51.2	Solid red/solid yellow	<b>Scale error occurred</b> • Hardware error	The Detector detected an error.	Turn on the power again. If an error is found again, the Detector needs to be replaced.
Err51.3	Solid red/solid yellow	<b>Scale error occurred</b> • Absolute error	The Detector detected an error.	<ul style="list-style-type: none"> <li>Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>



## 5 Troubleshooting

Servo amplifier Alarm code	LED status	Description	Cause	Major solution
Err51.4	Solid red/solid yellow	<b>Scale error occurred</b> <ul style="list-style-type: none"> <li>• Transducer error</li> </ul>	The Detector detected an error.	<ul style="list-style-type: none"> <li>• Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>• Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>
Err51.5	Flashing yellow	<b>Scale alarm occurred</b> <ul style="list-style-type: none"> <li>• Signal strength error</li> </ul>	The Detector detected a caution. The position data is correct; however, it is necessary to check the fixing state and the operating condition.	<ul style="list-style-type: none"> <li>• Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>• Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>
Err50.0 Err50.1	-	<b>Communication error occurred</b>	A communication error between the ABS ST778A/ST778AL and the servo amplifier occurred.	<ul style="list-style-type: none"> <li>• Check the connections of cables and connectors.</li> <li>• Check the routing of the cable (influence of noise such as large current cable).</li> </ul>

## 5.2.4 ABS ST788A, ST788AL

The table below shows the relationship between the ABS ST788A/ST788AL alarm and the alarm code displayed on the servo amplifier ( $\Sigma$  Series) made by Yaskawa Electric Corporation.

Note that the alarm codes of NC devices differ between when using the scale with fully closed control and when using with a linear motor.

Servo amplifier Alarm code	LED status	Description	Cause	Major solution
A.8A3 <sup>*1</sup> A.84U <sup>*2</sup>	Solid red/solid yellow	<b>Scale error occurred</b> <ul style="list-style-type: none"> <li>• Signal strength error</li> <li>• Transducer error</li> <li>• Absolute value detection error</li> <li>• Initialization error</li> </ul>	The Detector detected an error.	<ul style="list-style-type: none"> <li>• Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>• Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>
A.8A5 <sup>*1</sup> A.85U <sup>*2</sup>	Solid yellow	<b>Scale error occurred</b> <ul style="list-style-type: none"> <li>• Overspeed</li> </ul>	The Detector detected an overspeed error.	Review the operation condition (specified speed).
A.8A6 <sup>*1</sup> A.860 <sup>*2</sup>	Flashing yellow	<b>Scale alarm occurred</b> <ul style="list-style-type: none"> <li>• Thermal alarm</li> <li>• Signal strength alarm</li> </ul>	The Detector detected a caution. The position data is correct; however, it is necessary to check the fixing state and the operating condition.	<ul style="list-style-type: none"> <li>• The surrounding temperature of the Detector may be above 60 °C. If so, review the operation conditions (speed, acceleration).</li> <li>• Use Signal Monitor of the Signal Adjustment Program to check the positional relationship between the Detector and the scale.</li> <li>• Use Calibration Start of the Signal Adjustment Program to perform signal adjustment as necessary.</li> </ul>

\*1 When using the scale with fully closed control

\*2 When using the scale with a linear motor

## 5 Troubleshooting

Servo amplifier Alarm code	LED status	Description	Cause	Major solution
A.8A1 *1 A.891 *2	Solid red/solid yellow	<b>Scale error occurred</b> • Hardware error	The Detector detected an error.	The Detector needs to be replaced.
A.CF1 *1 C90 *2	-	<b>Communication error occurred</b> (during servo amplifier control)	A communication error between the ABS ST788A/ST788AL and the servo amplifier occurred (occurred while controlling by the servo amplifier).	<ul style="list-style-type: none"> <li>• Check the connections of cables and connectors.</li> <li>• Check the routing of the cable (influence of noise such as large current cable).</li> </ul>

\*1 When using the scale with fully closed control

\*2 When using the scale with a linear motor

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\*As of October 2020

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## Revision Record

<b>Date of publication</b>	<b>Revision status</b>	<b>Details of revision</b>
November 1, 2018	Revised first edition	Completely revised and issued
February 1, 2020	Revised second edition	Correspond to product specification changes
January 1, 2021	Revised third edition	Revision due to changes of the harmonized European standards, etc.

# Mitutoyo Corporation

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