Mitutoyo

Separate Type Linear Scale

ST46-EZA

User's Manual

- Instructions for use -

Read this document thoroughly before operating the product. After reading, retain it close at hand for future reference.
This English language version of the document contains the original instructions.

No. 99MBE078B3
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Correspondence of product names and model numbers

Product name	Model number
Separate Type Linear Scale	ST46-EZA

Notice regarding this document

- Mitutoyo Corporation assumes no responsibilities for any damage to the product, caused by its use not conforming to the procedure described in this document.
- Upon loan or transfer of this product, be sure to attach this document to the product.
- In the event of loss or damage to this document, immediately contact the agent where you purchased the product or a Mitutoyo sales office.
- Before operation of the product, thoroughly read this document to comprehend its contents.
- Particularly, for full understanding of information, carefully read "Safety Precautions" and "Precautions for Use" at the outset of this document before using the product.
- The contents in this document are based on the information current as of July 2021.
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CONVENTIONS USED IN MANUALS

Conventions used in Mitutoyo's User's Manual are roughly divided into three types (safety reminders, prohibited and mandatory actions, and referential information and locations). Moreover, these conventions 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

DANGER	Indicates an immediately hazardous situation which, if not avoided, will result in serious injury or death.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor injury.
NOTICE	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 referential information such as that for when the operating methods and procedures which are printed in these sentences are to be applied to specific conditions.

Indicates referential locations if there is information that should be referred to in this document or an extraneous User's Manual.

E.g.: For details about XX, see "1.2 Name and Functions of Each Part" (page 2)

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

■ General safety precautions

● This product is a measuring instrument.

Do not use this product for any other purpose than measuring.

● This is an industrial product.

Do not use this product for any other purpose than industrial use.

● This product is a precision instrument.

Handle this product with extra care. Do not apply any strong impact or excessive force to the parts during use.

■ Required environment for installation

● Vibration

To mount this product onto the 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 main 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 scale main unit.

● Ambient temperature and humidity

This product should be operated in an environment where the temperature is 0 °C–40 °C and where the relative humidity is 20 %RH–80 %RH. Do not use this product in a place where sudden changes in temperature or humidity are observed.

Electromagnetic Compatibility (EMC)

This product complies with the EMC Directive and the UK Electromagnetic Compatibility Regulations; however, if this receives electromagnetic interference that exceeds these requirements, it will be out of warranty and require appropriate measures.

This product is an industrial product, and is not intended to be used in residential environment. If this product is used in residential environment, this product may cause electromagnetic interference with other instruments. In such a case, it is required to take appropriate measures for preventing such electromagnetic interference.

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 Export Trade Control Order or under Category 16 of Appended Table of Foreign Exchange Control Order, based on 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-providing of the technology (including Programs), you shall 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, List-Control Technology (including Programs) under Category 1 - 15 of Appended Table 1 of Export Trade Control Order or under Category 1 - 15 of 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-providing of the technology (including Programs), you shall observe the regulations of your country. Please contact Mitutoyo in advance.

Notes on Export to European Countries

When you intend exporting of this product to any of the European countries, it may be required to provide User's Manual(s) in English and Declaration of Conformity in English (in some cases, the official language of the country to be exproted). For detailed information, please contact Mitutoyo in advance.

Disposal of Products outside the European Countries

Please follow the official instruction in each community and country.

Disposal of Old Electrical & Electronic Equipment (Applicable in the 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), and this symbol indicates that this product shall not be treated as household waste.

To reduce the environmental impact and minimize the volume of landfills, please cooperate in reuse and recycle.

For how to dispose of the product, please contact the agent where you purchased the product or a 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。

环保使用期限标识是根据《电器电子产品有害物质限制使用管理办法》以及《电子电气产品有害物质限制使用标识要求(SJ/T11364–2014)》制定的,适用于中国境内销售的电子电气产品的标识。

电器电子产品只要按照安全及使用说明内容在正常使用情况下,从生产日期算起,在此期限内产品中含有的有毒有害物质不致发生外泄或突变,不致对环境造成严重污染或对其人身、财产造成严重损害。

产品使用后,要废弃在环保使用年限内或者刚到年限的产品,请根据国家标准采取适当的方法进行处置。

另外,此期限不同于质量/功能的保证期限。

Warranty

This product has been manufactured under strict quality management, but should it develop problems within one year of the date of purchase in normal use, repair shall be performed free of charge. Please contact the agent where you purchased the product or a Mitutoyo sales office (📖 "SERVICE NETWORK" on page App-1). This warranty, however, shall not affect any 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 fair wear and tear
- Failure or damage owing to inappropriate handling, maintenance or repair, or to unauthorized modification
- Failure or damage owing to transport, dropping, or relocation of the product 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 product is properly installed and operated in conformance with the instructions in this document 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.

Disclaimer

IN NO EVENT WILL MITUTOYO, ITS AFFILIATED AND RELATED COMPANIES AND SUPPLIERS BE LIABLE FOR ANY LOST REVENUE, PROFIT, OR DATA, OR FOR SPECIAL, DIRECT, INDIRECT, CONSEQUENTIAL, INCIDENTAL, OR PUNITIVE DAMAGES HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY ARISING OUT OF THE USE OF OR INABILITY TO USE THIS PRODUCT EVEN IF MITUTOYO OR ITS AFFILIATED AND RELATED COMPANIES AND/OR SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

If, notwithstanding the foregoing, Mitutoyo is found to be liable to you for any damage or loss which arises out of or is in any way connected with use of this product by you, in no event shall Mitutoyo's and/or its affiliated and related companies' and suppliers' liability to you, whether in contract, tort (including negligence), or otherwise, exceed the price paid by you for the product only.

The foregoing limitations shall apply even if the above-stated warranty fails of its essential purpose.

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About This Document

■ Positioning of this document in document map

In addition to this document, a manual for the software is available.

● For linear scale

ST46-EZA
Separate Type Linear Scale
User's Manual (This Document)

● For software

ST46-EZA
Separate Type Linear Scale
Application Program
User's Manual

■ Intended readers and purpose of this document

● Intended readers

This document is intended for beginners of ST46-EZA Separate Type Linear Scale.

Readers are assumed to be able to understand individual instructions by reading dimensional schematics.

● Purpose

This document is aimed at understanding a basic knowledge of ST46-EZA Separate Type Linear Scale.

Contents

1 Overview

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

1.1 Features

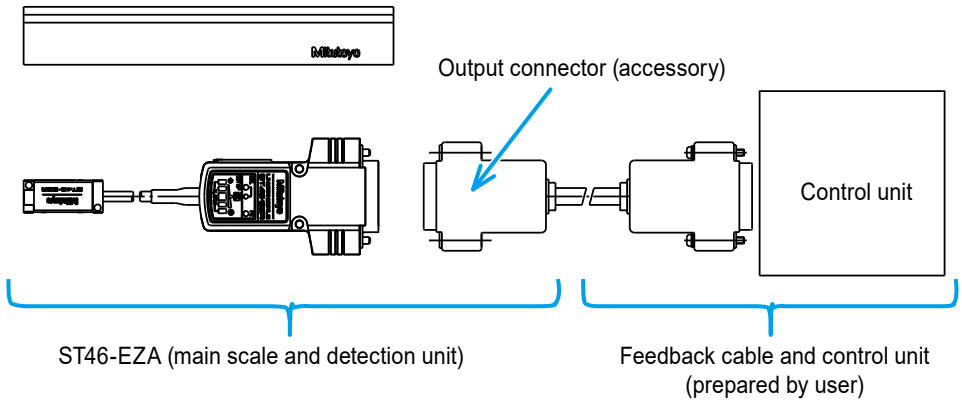
The optical separate type linear scale detects changes in the amount of light using light emitting elements and light receiving elements based on the glass scale grids and outputs the amount of changes.

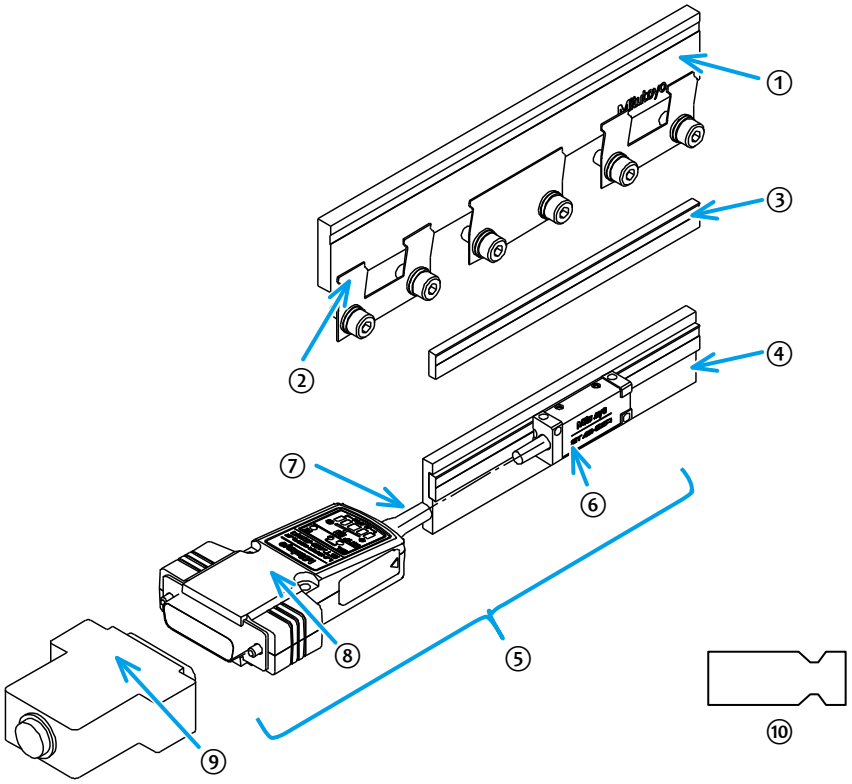
This can precisely measure moving amounts of various instruments including an aligner, wire bonding, and stage for semiconductor manufacturing.

This product is equipped with the Automatic Signal Adjustment function (EZA function), which is triggered by pushing the button. During the mounting of the Detector, you can check the signal strength by the setup indicator mounted on the connector shell, which eliminates adjustment using an oscilloscope. By connecting this product to the PC, you can check the signal strength and set the parameters on the dedicated application program. The I/F circuit built inside the connector shell also allows a space-saving design.

1.2 System Configuration and Name of Each Part

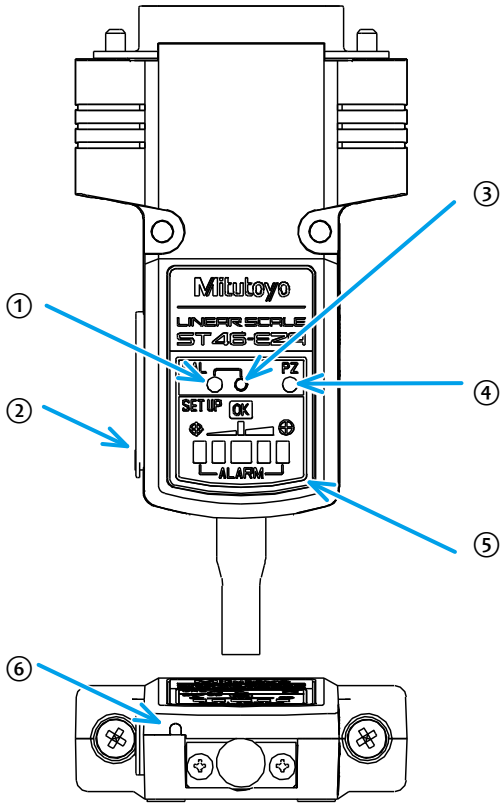
The system configuration and the name of each part are shown below.





No.	Name
①	Main scale (effective length: 100 mm–3000 mm)
②	Scale retaining spring
③	Main scale (effective length: 10 mm–80 mm (without aluminum base))
④	Main scale (effective length: 10 mm–80 mm (with aluminum base))
⑤	Detection unit
⑥	Detector
⑦	Detector cable
⑧	Connector shell
⑨	Output connector
⑩	Gap spacer

1.2.1 Name of Each Part of Connector Shell



No.	Name
①	CAL light
②	Direction switch/USB connector (PC connection)
③	Setup button A (switch through hole: ø 1.5)
④	PZ light
⑤	Setup indicator
⑥	Setup button B (switch through hole: ø 1.5)

Tips

- You can check the following states by the CAL light.

State	Light color	Solid/flashing
Normal operation or power-off	None	Off
Mounting position adjustment mode/error occurrence	Red	Flashing (2-second intervals)
Auto-tuning mode	Red	Flashing (0.5-second intervals)
Auto-tuning in progress	Red	On

- The PZ light turns on in green when the origin is detected.

1.3 The Flow of Main Tasks

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

■ Preliminary preparation

- Checking the Equipment Model — "2.1 Checking the Equipment Model" (page 5)
- Designing the Scale Mounting Surface — "2.2 Designing the Scale Mounting Surface" (page 8)
- Designing the Detector Bracket — "2.3 Designing the Detector Bracket" (page 11)

■ Mounting onto the machine main unit

- Checking the Package Contents — "3.1 Checking the Package Contents" (page 13)
- Mounting the Scale — "3.2 Mounting the Scale" (page 14)
- Mounting the Detector Bracket and Detector — "3.3 Mounting the Detector Bracket and Detector" (page 17)
- Connecting the Feedback Cable — "3.4 Connecting the Feedback Cable" (page 19)
- Adjusting the Detector Signals — "3.5 Adjusting the Detector Signals" (page 20)
- Handling the Cables and Checking the Mounting State — "3.6 Handling the Cables and Checking the Mounting State" (page 23)

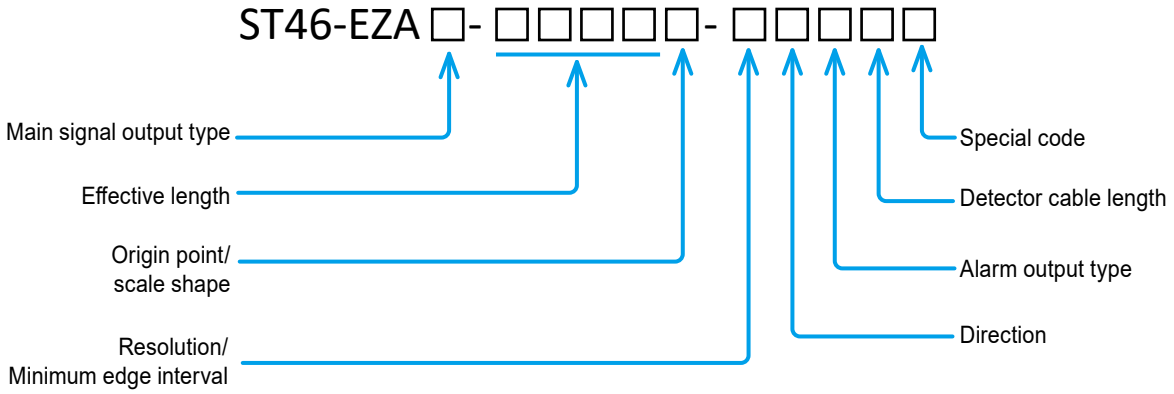
2 Setup for Mounting

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

2.1 Checking the Equipment Model

The ST46-EZA model number is determined based on the main signal output type, effective length, origin point/scale shape, resolution/minimum edge interval, direction, alarm output type, Detector cable length, and special code.

Make sure that your scale unit model satisfies desired specifications.



■ Main signal output type

Symbol	Description
B	Two-phase square wave + external reset input
C	Two-phase square wave + two-phase sine wave

■ Effective length

Symbol	Effective length (mm)	Symbol	Effective length (mm)
0010	10	0500	500
0025	25	0600	600
0050	50	0700	700
0075	75	0800	800
0080	80	0900	900
0100	100	1000	1000
0150	150	1100	1100
0200	200	1200	1200
0250	250	1300	1300
0300	300	1400	1400
0350	350	1500	1500
0400	400	1600	1600
0450	450	1700	1700

Symbol	Effective length (mm)	Symbol	Effective length (mm)
1800	1800	2500	2500
2000	2000	2600	2600
2200	2200	2800	2800
2400	2400	3000	3000

■ Origin point/scale shape

Symbol	Scale shape (effective length)	Origin point (effective length)
A	Glass scale: Thickness 4.8 mm x width 22 mm (100 mm–3000 mm)	50-mm pitch
B	Glass scale: Thickness 2.8 mm x width 8 mm (10 mm–80 mm)	Center point
C	Glass scale with aluminum base: Thickness 5.1 mm x width 23 mm (10 mm–80 mm)	Center point
Z	Special shape	Special point specification

■ Resolution/minimum edge interval

Symbol	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

■ Direction

Symbol	Description
1	Positive: PA-phase advance
2	Reverse: PB-phase advance

■ Alarm output type

Symbol	Description
S	Alarm signal
H	High impedance

■ Detector cable length

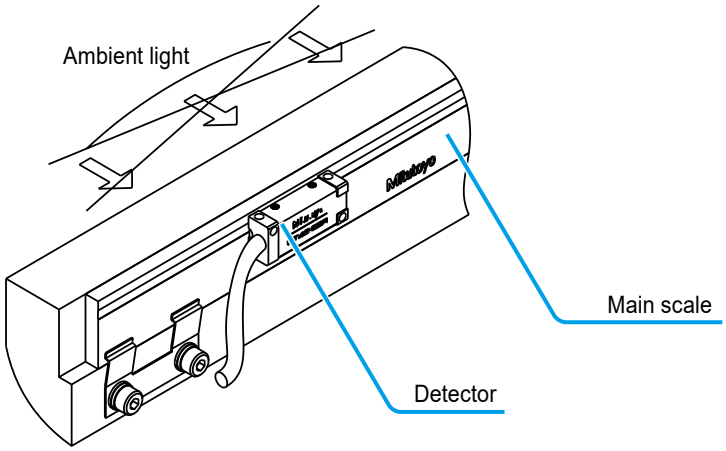
Symbol	Length
A	1 m (standard)
B	0.5 m
C	2 m
Z	Special length specification (maximum length: 2.5 m)

■ Special code

Symbol	Description
None	Standard selection specification
Z	Special specification

2.2 Designing the Scale Mounting Surface

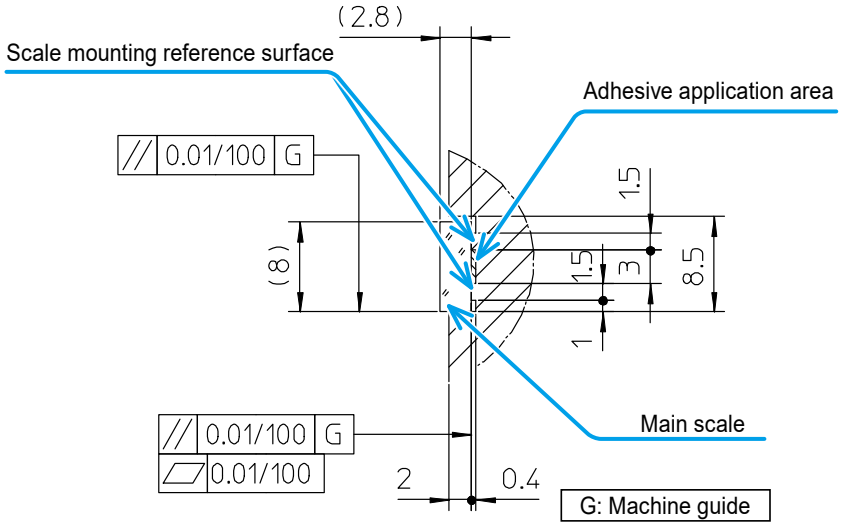
If ambient light enters the main scale from the back side, it causes a malfunction. Design the main scale mounting area to prevent ambient light as shown in the figure below.



2.2.1 Mounting of the Scale with the Effective Length of 10 mm–80 mm (without Aluminum Base)

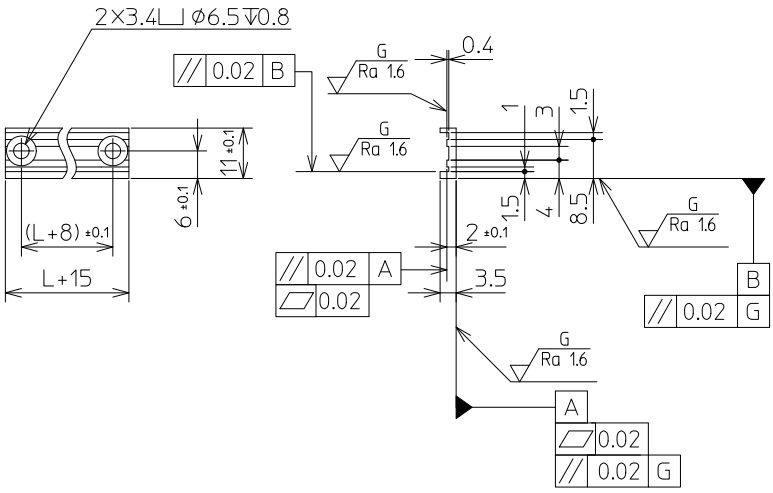
Mount the main scale with the effective length of 10 mm–80 mm (without aluminum base) by fixing it with adhesives.

Design the main scale mounting area as shown in the figure below according to "4.7.1 Effective Length of 10 mm–80 mm (without Aluminum Base)" (page 34).



Tips

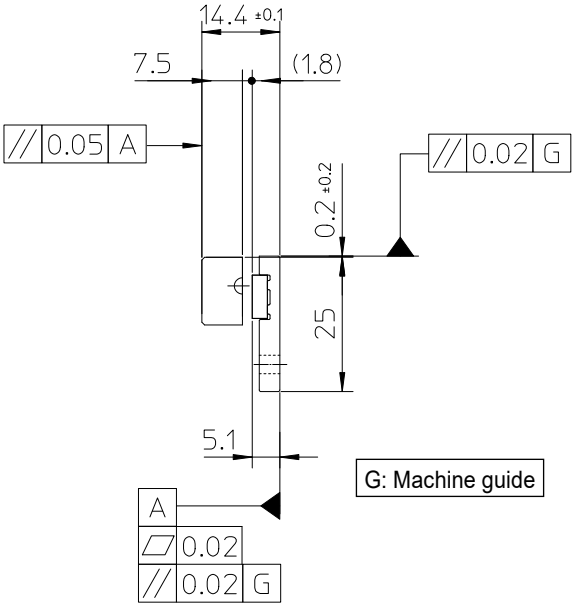
When you may need to remount the main scale with the effective length of 10 mm–80 mm (without aluminum base) for maintenance, attach the main scale to a scale bracket as shown in the figure below and fix it with bolts.



2.2.2 Mounting of the Scale with the Effective Length of 10 mm–80 mm (with Aluminum Base)

Mount the main scale with the effective length of 10 mm–80 mm (with aluminum base) by fixing it with bolts.

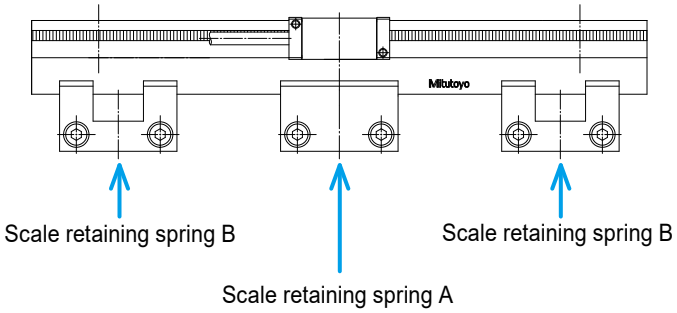
Design the main scale mounting area as shown in the figure below according to "4.7.2 Effective Length of 10 mm–80 mm (with Aluminum Base)" (page 36).



2.2.3 Mounting of the Scale with the Effective Length of 100 mm–3000 mm

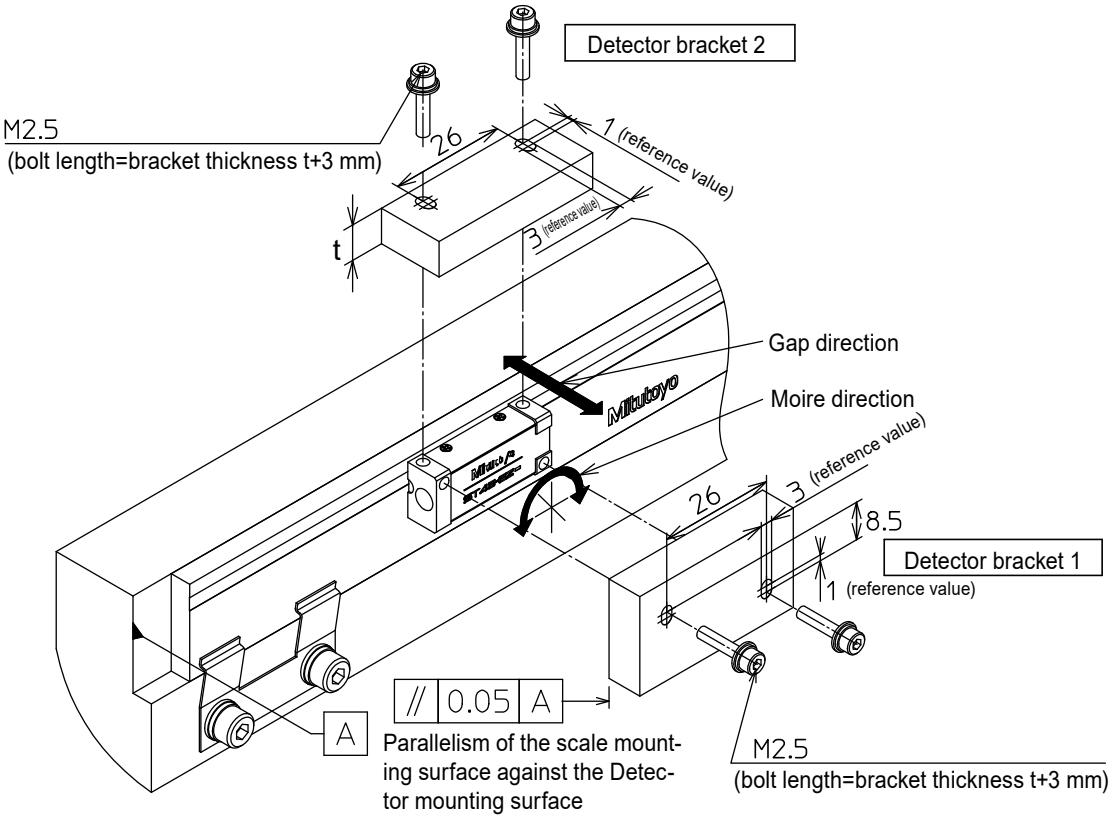
Mount the main scale with the effective length of 100 mm–3000 mm by fixing it with scale retaining spring.

Secure a working space for tightening the bolts for scale retaining spring A and scale retaining spring B according to "4.7.3 Effective Length of 100 mm–3000 mm" (page 38).



2.3 Designing the Detector Bracket

- Design the Detector bracket according to the figure below. Its shape must allow adjustment of the Detector position (moire/gap). It is recommended that the Detector fixing screw holes should be long holes to make it easier to adjust the Detector position.



- Design it so that the parallelism of the Detector mounting surface against the scale mounting surface is within 0.05 mm.
- The change in the gap direction within the maximum travel range of the machine unit must be 0.01 mm or less per 200 mm.

MEMO

3 Mounting onto the Machine Main Unit

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

3.1 Checking the Package Contents

Before mounting, make sure that the product package contains the following items.

If your scale does not satisfy the specified specifications or you have any questions or concerns about the product, please contact the agent where you purchased the product or a Mitutoyo sales office.

Name	Quantity	Note
Main scale	1	Check the specifications and effective length of the scale.
Detection unit	1	
Scale retaining spring		This accessory comes with the scale with the effective length of 100 mm–3000 mm. For details on the quantity, refer to "4.7.3 Effective Length of 100 mm–3000 mm" (page 38).
Output connector	1	
Gap spacer	1	
Serial number sticker	1	This accessory comes with the scale with the effective length of 10 mm–80 mm.
User's Manual	1	This document
Inspection certificate	1	
Warranty card	1	

- To mount the Detector, prepare the following parts.

Part name	Quantity
Hex socket head cap screw (M2.5 x (bracket thickness + 3 mm) or less)	2

- To mount the scale with the effective length of 10 mm–80 mm (with aluminum base), prepare the following parts.

Part name	Quantity
Hex socket head cap screw (M3 x (bottom hole depth +3.8 mm) or less)	2
Plain washer (nominal diameter 3)	2
Spring washer (nominal diameter 3)	2

- To mount the scale with the effective length of 100 mm–3000 mm, prepare the following parts.

Part name	Quantity
Hex socket head cap screw (M4 x bottom hole size or less)	Number of scale retaining spring x 2
Plain washer (nominal diameter 4)	Number of scale retaining spring x 2
Spring washer (nominal diameter 4)	Number of scale retaining spring x 2

3.2 Mounting the Scale

NOTICE

The main scale is made of glass. Be very careful that the scale is not damaged or scratched.

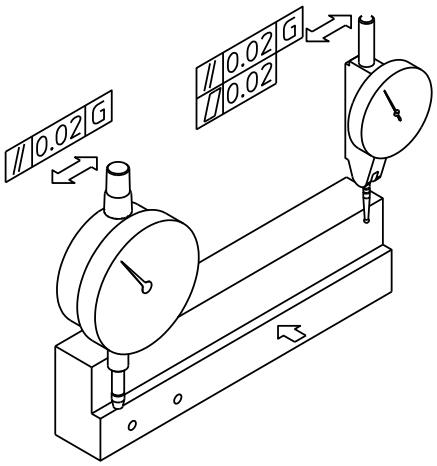
- If dirt and dust are attached to the main scale, it causes a malfunction or deteriorates the accuracy. Wipe off the dirt and dust with a soft cloth soaked in alcohol or cleaning paper. Similarly, clean the scale mounting surface of the machine unit thoroughly with alcohol.
- Use elastic adhesives to attach the main scale with the effective length of 10 mm–80 mm (without aluminum base). Shin-Etsu Silicones' KE441T is recommended.

Tips

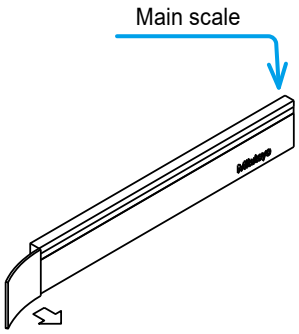
- Conduct temperature leveling thoroughly for both the main scale and mounting parts before fixing them. The accuracy of this product is guaranteed at 20 °C. The recommended temperature leveling is about 8 hours or longer at 20 °C for both the main scale and parts for mounting the scale. Perform mounting after temperature leveling.
- If the temperature environment is insufficient, including temperature leveling, the predetermined indication accuracy may not be achieved.

1 Use a lever-type dial indicator or electric micrometer to make sure that the scale mounting surface is prepared as shown below.

- Check the parallelism of the main scale mounting surface against the axis of motion of the machine unit.
- If the parallelism is insufficient, adjust the machine unit again.



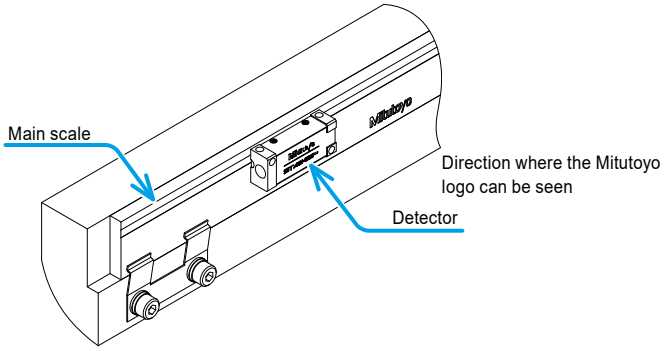
2 Peel the scale protection tape.



Peel the scale protection tape.

3 Mount the main scale.

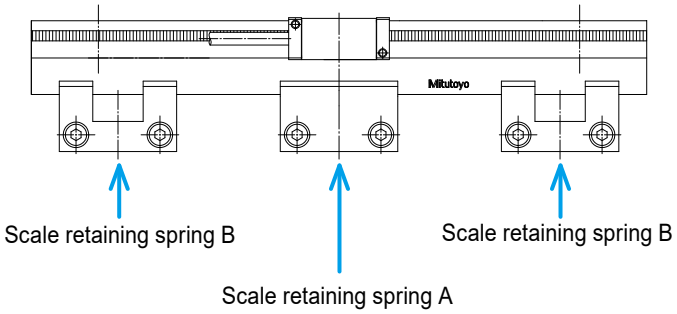
- Mount the main scale so that the Detector is placed on the grid surface (surface where rainbow colors appear when light is applied diagonally).
- For a scale with the Mitutoyo logo attached, the correct mounting direction is where the logo can be appropriately viewed from the Detector side.



- Put the serial number sticker near the location where the scale is mounted on the machine for the main scale with the effective length of 10 mm–80 mm.

■ Mounting using the scale retaining spring

1 Temporarily fix the center of the main scale with the scale retaining spring A.



2 Temporarily fix the main scale with the scale retaining spring B.

This must be performed in the order closer to the center of the main scale.

3 Conduct temperature leveling for 1 to 2 hours.

4 Fully tighten the bolts for scale retaining spring in the order from the center to both ends of the main scale.

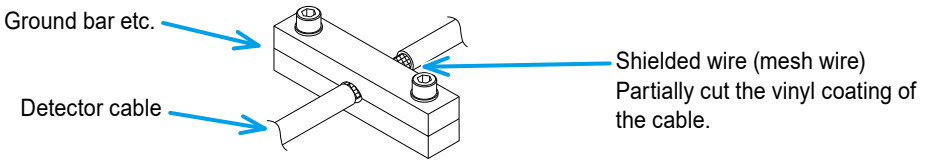
The recommended tightening torque for scale retaining spring bolts is 1.5 N•m.

3.3 Mounting the Detector Bracket and Detector

NOTICE

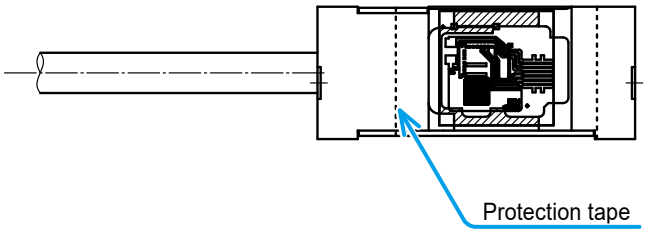
Do not directly touch the connector shell pins during mounting. Otherwise, electronic parts may be damaged by static electricity. Be sure to take measures to prevent static electricity for mounting.

To use the scale with the Detector mounted, the machine main unit, as well as the attachment bracket, must be electrically grounded. Failure to do so may cause the scale unit and the Detector to be affected by external noise. When it is difficult to ground due to the characteristics of the bracket material, make sure that the shielded part of the Detector cable is grounded using a ground bar.



Example: Drawing of using a ground bar

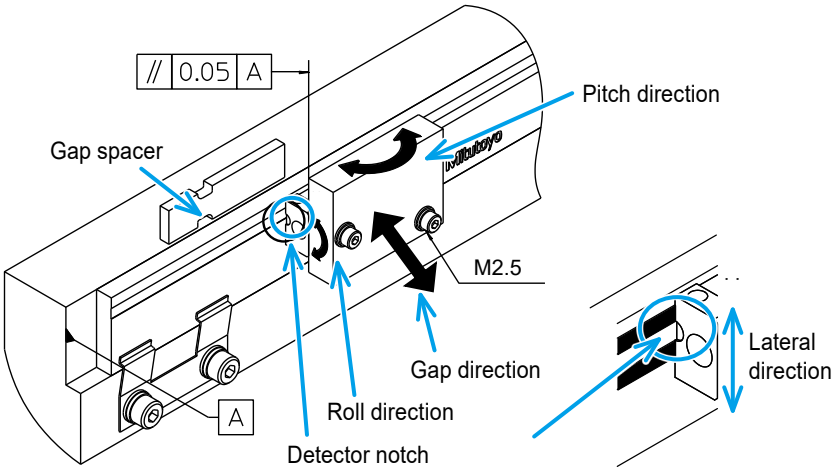
1 Peel the protection tape (blue) off the detecting surface of the Detector.



Back of the Detector

2 Attach the Detector to the Detector bracket.

- Use a gap spacer as shown in the figure below to adjust the distance (gap) between the Detector and main scale to 1.8±0.1 mm.



- The lateral direction of the Detector must be a position where the Detector notches (left and right) match the grids (translucent).

3 Check the parallelism of the Detector against the main scale with a lever-type dial indicator or electric micrometer.

The parallelism of the Detector against the main scale must be within 0.05 mm.

4 Fix the Detector.

- The recommended tightening torque for Detector fixing screws is 0.4 N•m–0.6 N•m.
- After fixing the Detector, use a gap spacer to make sure that the distance (gap) between the Detector and main scale is 1.8±0.1 mm.

3.4 Connecting the Feedback Cable

- Be sure to turn off the control unit before connecting the scale unit to the control unit with a feedback cable.
- A feedback cable must be prepared by the user. Find a cable that supports your model according to "4.4 Production of Feedback Cable" (page 29).

1 Connect the connector shell of the detection unit to the control unit with the feedback cable.

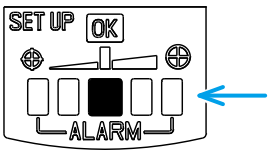
2 Turn on the control unit.

» The connector shell light turns on or flashes.

Ignore the connector shell light state and be sure to perform signal adjustment described in "3.5 Adjusting the Detector Signals" (page 20).

Tips

When the Detector mounting state is correct, if you turn on the control unit, the setup indicator center LED (blue) turns on.

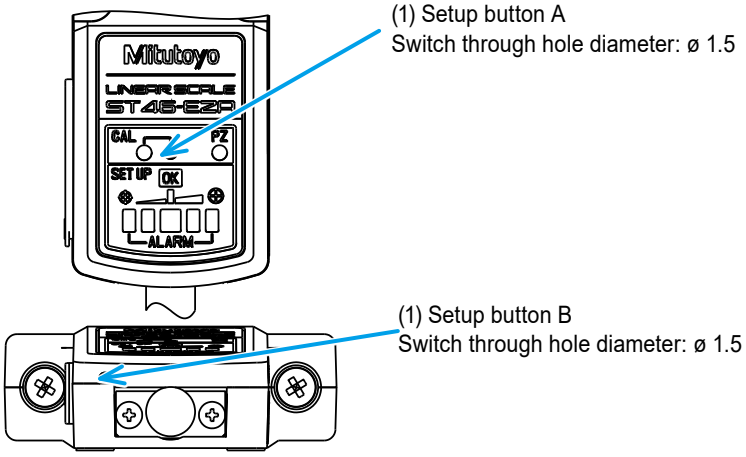


3.5 Adjusting the Detector Signals

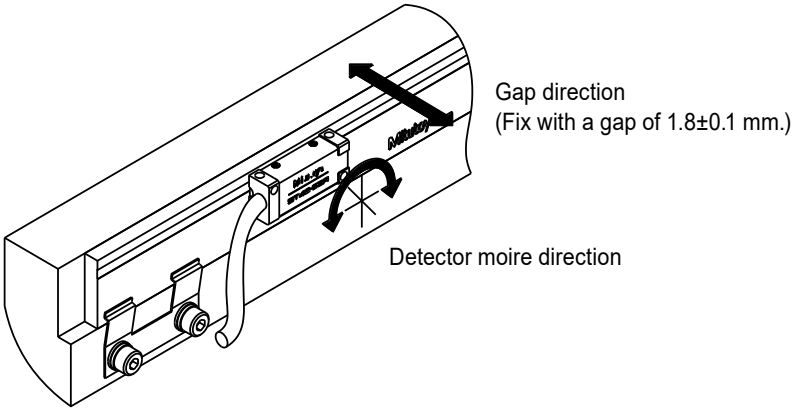
After mounting the main scale and Detector and connecting the feedback cable, adjust the signals using the connector shell.

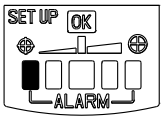
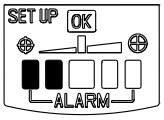
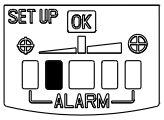
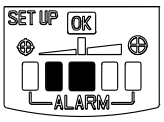
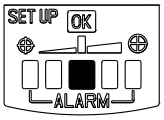
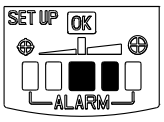
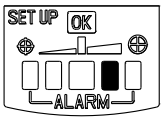
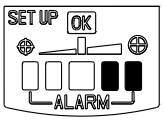
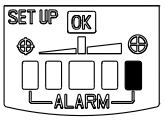
1 Press the setup button A or B on the connector shell with a thin stick of ø 1.0–ø 1.4 (hex wrench key nominal 1.3 (for hex socket head cap screw M2.5)).

» The CAL light flashes in red (at intervals of 2 seconds) and enters the mode to adjust the Detector mounting position.



2 Adjust the moire direction of the Detector so that the signal strength judgment results in "OK" on the setup indicator.



	Light indication	Color	Signal strength judgment
State 1		Red	NG
State 2		Left: Red Right: Yellow	NG
State 3		Yellow	NG
State 4		Left: Yellow Right: Blue	NG
State 5		Blue	OK
State 6		Left: Blue Right: Yellow	NG
State 7		Yellow	NG
State 8		Left: Yellow Right: Red	NG
State 9		Red	NG

Lower signal

Higher signal

Tips

When the setup indicator does not light up in blue, adjust the gap direction of the Detector.

3 Press the setup button A or B again.

» The CAL light changes from flashing red to solid red and enters the auto-tuning mode.

4 Move the Detector or main scale at a speed of 5 mm/s–50 mm/s by 15 mm or more in the measurement direction.

» The CAL light turns off, and auto-tuning is finished.

- Move the Detector or main scale in one specific direction. If it is moved in the reverse direction during auto-tuning, a CAL error occurs.
- In case of a CAL error, adjust the signals again from scratch. You do not need to turn off the power for signal adjustment.

5 Make sure that the signal strength judgment is "OK" on the setup indicator throughout the effective length.

Tips

If the scale travel distance is short, a CAL error may occur. If you need to use on a unit with the scale travel distance of 15 mm or less, contact the nearest Mitutoyo sales office.

3.6 Handling the Cables and Checking the Mounting State

3.6.1 Handling the Cables

After adjusting the signals, fix the feedback cable.

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

NOTICE

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

2 Fix the feedback cable with cable clamps.

Clamp the feedback cable to a nearby part that moves along with the Detector so that force is not applied to the Detector when the machine unit is running.

Be sure to fix the connector shell to the machine main unit with screws.

3.6.2 Checking the Mounting and Adjustment States

After fixing the feedback cable, check the mounting and adjustment states of the main scale and Detector again.

Tips

Perform this operation while making sure that the Detector does not make contact or interfere with any part of the machine unit or main scale.

1 Make sure that all the part screws and clamps are firmly tightened.

2 Turn off the control unit and turn it on again after 5 to 10 seconds.

Tips

Turning off the control unit resets the alarm that occurred during adjustment.

3 Make sure that the setup indicator on the connector shell lights up in blue throughout the travel range of the machine unit.

Tips

If the setup indicator lights up in red or yellow, check the main scale for any dirt or the moire/gap directions again.

3.6.3 Putting the Protection Cover

After checking the mounting and adjustment states of the main scale and Detector again, put the protection cover.

- Make sure that the protection cover does not make contact with any machine unit part or scale unit cable.
- Check the above for the entire travel range of the machine unit.

4 Specifications

4.1 List of Specifications

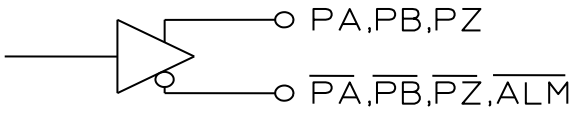
Item	Specification
Detection method	Optical reflection type linear encode
Main scale grid pitch	20 µm
Output signal type	Type B: Two-phase square wave, origin signal pulse, external reset input Type C: Two-phase square wave, origin signal pulse, two-phase sine wave
Effective length	10 mm–3000 mm
Indication accuracy (20 °C)	Effective length of 10 mm–300 mm: ±1 µm Effective length of 350 mm–500 mm: ±2 µm Effective length of 600 mm–1000 mm: ±3 µm Effective length of 1100 mm–3000 mm: ±3 µm/m
Coefficient of linear expansion	≈8×10^{-6}/K
Maximum response speed	2.6 m/s (at sine wave amplitude of -3 dB)
Scale origin	Available (50 mm pitch, center point for effective length of 10 mm–80 mm)
Power supply voltage	DC 5 V±5 %
Maximum current consumption	250 mA
Operating temperature range	0 °C–40 °C
Storage temperature range	-20 °C–60 °C
Operating/storage humidity range	20 %RH–80 %RH (non condensation)
Alarm Display function	A scale unit alarm is indicated with a LED on the connector shell
CE marking/UKCA marking	EMC Directive/Electromagnetic Compatibility Regulations: EN 61326-1 Immunity test requirement: Clause6.2 Table 2 Emission limit: Class B RoHS Directive/The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations: EN IEC 63000

4.2 Output Circuits and Signal Waveforms

4.2.1 Main Signal Type: Type B, Type C

■ Output circuit

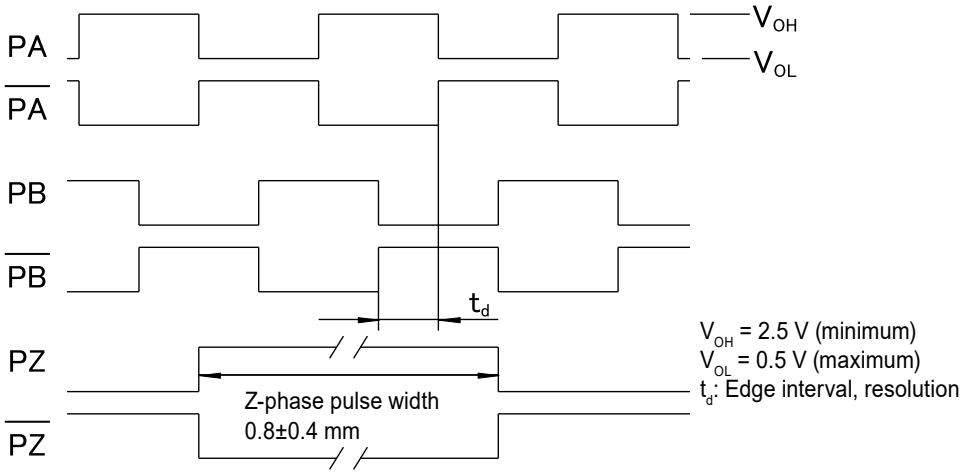
The output circuit of the square wave output signals (PA-phase, PB-phase), origin signal, and alarm signal is as shown in the figure below.



Differential line driver
Equivalent to AM26C31

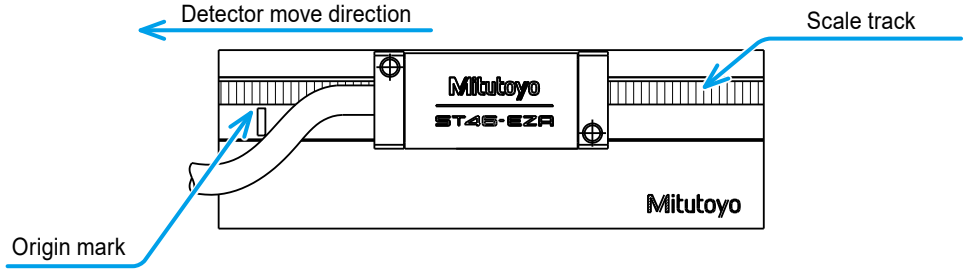
■ Signal waveform

The waveforms of the square wave output signals (PA-phase, PB-phase) and origin signal are as shown in the figure below.



Tips

The above figure shows waveforms when the Detector moves as follows with the direction switch on the connector shell set to "positive". The phase relationship (counting direction) between output PA and PB changes according to the direction switch state.

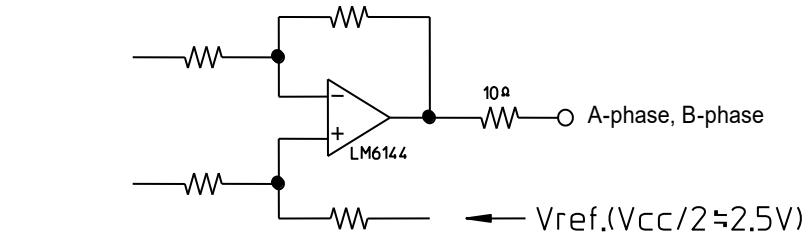


4.2.2 Main Signal Type: Type C

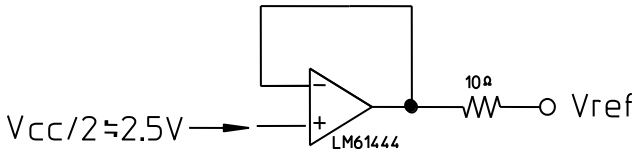
■ Output circuit

The output circuits of the sine wave output signals (A-phase, B-phase) and reference signal are as shown in the figure below.

A-phase/B-phase (sine wave) output circuit

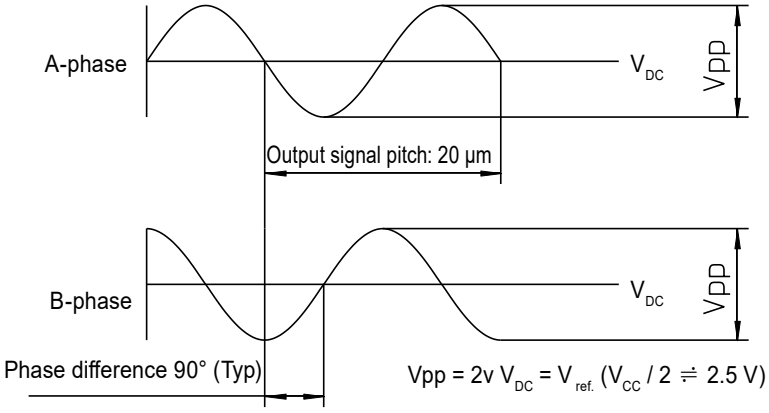


Reference signal (Vref) output circuit



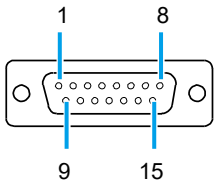
■ Signal waveform

The waveforms of the sine wave output signals (A-phase, B-phase) are as shown in the figure below.



4.3 Pin Assignment

4.3.1 Main Signal Type: Type B

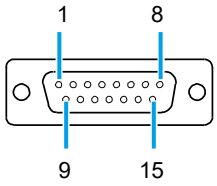


Pin No.	Signal name	Pin No.	Signal name
1, 2	0V (GND)	9	$\overline{\text{ALM}}$ (alarm)
3, 4	+5 V (Vcc)	10	PA (main signal pulse_positive phase)
5	Reset input AL (anode)	11	$\overline{\text{PA}}$ (main signal pulse_reverse phase)
6	Reset input AL (cathode)	12	PB (main signal pulse_positive phase)
7	N.C.	13	$\overline{\text{PB}}$ (main signal pulse_reverse phase)
8	PZ (origin signal pulse_ positive phase)	14	$\overline{\text{PZ}}$ (origin signal pulse_reverse phase)
		15	F.G

Tips

The applicable connector (accessory) is HDAB-15S.

4.3.2 Main Signal Type: Type C



Pin No.	Signal name	Pin No.	Signal name
1, 2	0 V (GND)	9	$\overline{\text{ALM}}$ (alarm)
3, 4	+5 V (Vcc)	10	PA (main signal pulse_positive phase)
5	A-phase (sine wave)	11	$\overline{\text{PA}}$ (main signal pulse_reverse phase)
6	B-phase (sine wave)	12	PB (main signal pulse_positive phase)
7	Vref (≒Vcc/2)	13	$\overline{\text{PB}}$ (main signal pulse_reverse phase)
8	PZ (origin signal pulse_ positive phase)	14	$\overline{\text{PZ}}$ (origin signal pulse_reverse phase)
		15	F.G

Tips

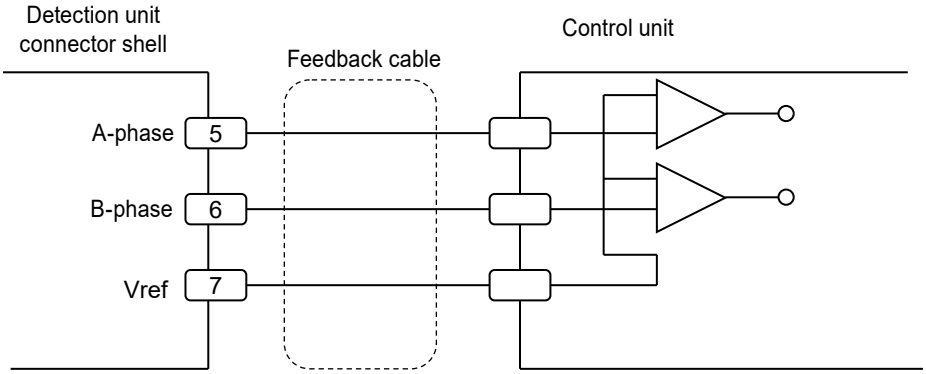
The applicable connector (accessory) is HDAB-15S.

4.4 Production of Feedback Cable

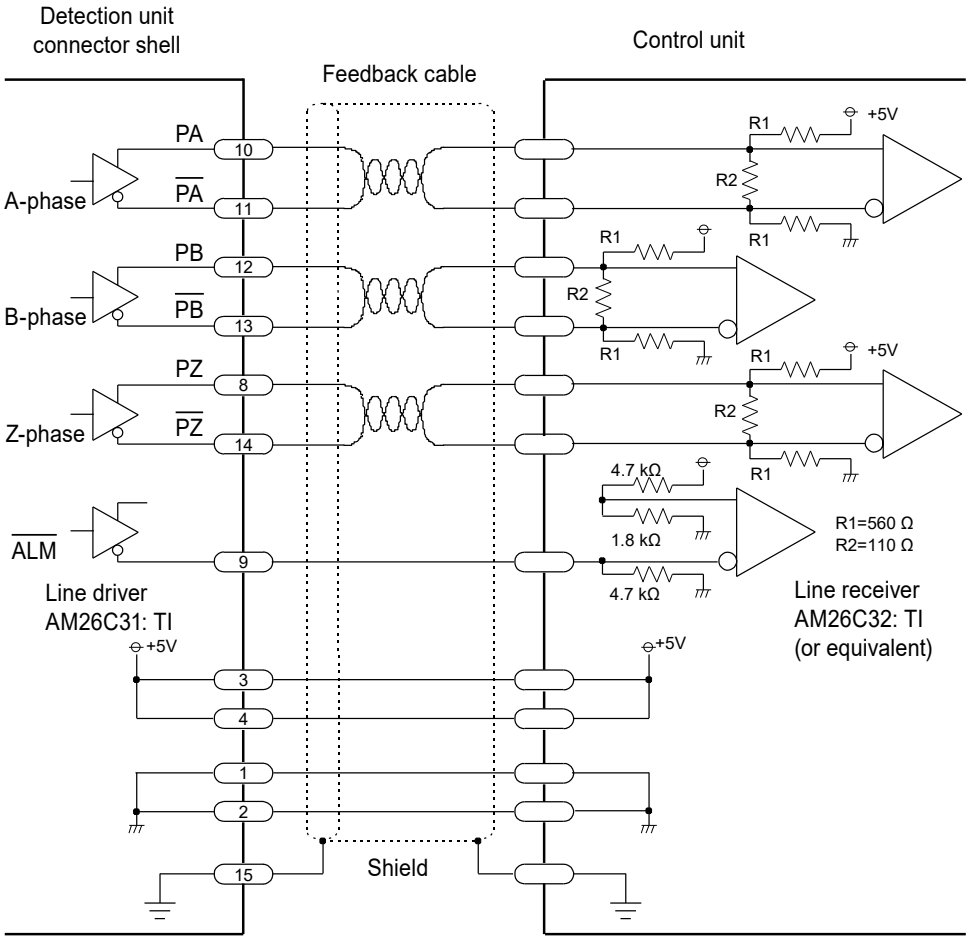
The following conditions must be met for the feedback cable:

- Use a mesh shielded cable.
- Clamp the shield (FG) to the metal case of the supplied connector. If it is difficult to clamp, connect it to pin No. 15.
- Set the cable impedance and length so that the power voltage is 4.75 V or more on the connector shell.
  V_{sp} - (R_c ÷ 2) x L x 2 x 0.25 $\geqq$ 4.75 V
  V_{sp}: Power voltage supplied from the control unit (Volts)
  R_c: Cable power, ground wire impedance (Ω/m)
  L: Cable length (m)
  0.25: Maximum current consumption of the scale unit (A)

To use the sine wave output signals, connect the output signal cable as shown in the figure below.



To use the square wave output signals, connect the output signal cable as shown in the figure below.



- When the control unit has the Disconnection Detection function for A-phase/B-phase (PA, $\overline{PA}$, PB, $\overline{PB}$), you do not need to connect the $\overline{ALM}$ output. In this case, use a scale unit with the alarm output type of H (high impedance) specification.
- If the control unit has no Disconnection Detection function or putting the A-phase/B-phase output in high impedance causes a problem for the system, connect the $\overline{ALM}$ output. In this case, use a scale unit with the alarm output type of S (alarm signal) specification.

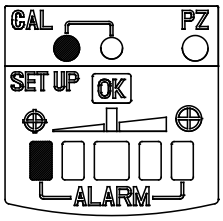
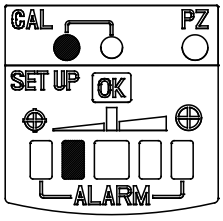
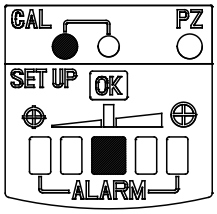
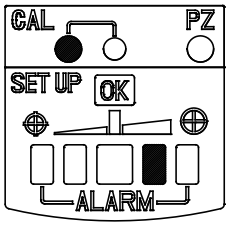
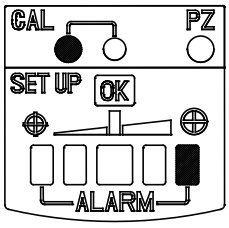
4.5 Alarm Function

4.5.1 Detection Details

When an alarm is detected, the CAL light on the connector shell turns on and off at intervals of 2 seconds. While the CAL light is lit, the setup indicator display light represents the error details as follows.

Tips

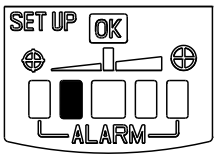
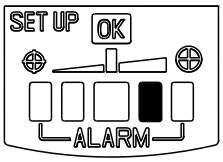
When multiple errors occur, all the corresponding lights on the setup indicator turn on.

Display	Error name	Cause
	Over range error*1	The waveform of the input sine wave signal is too large or too small.
	Over speed error	The travel speed exceeds the maximum response speed.
	Hardware error	Internal processing error (part failure, communication error)
	Calibration error	Error during signal adjustment
	LED current error	- LED deterioration - Sensor overcurrent - Insufficient adjustment of the Detector mounting position

*1 While the CAL light is not lit, the alarm details about over range are not shown.

Tips

- If the scale is within the error range when the waveform of the input sine wave signal is too large or too small, an over range error occurs.
- If the scale is within the caution range when the waveform of the input sine wave signal is too large or too small, no alarm occurs, but the accuracy of division is reduced.

	Light indication when the scale is within the caution range	Color
Caution range		Yellow
		

4.5.2 Resetting the Alarm

■ Turning on the power again

1 Eliminate the cause of the alarm.

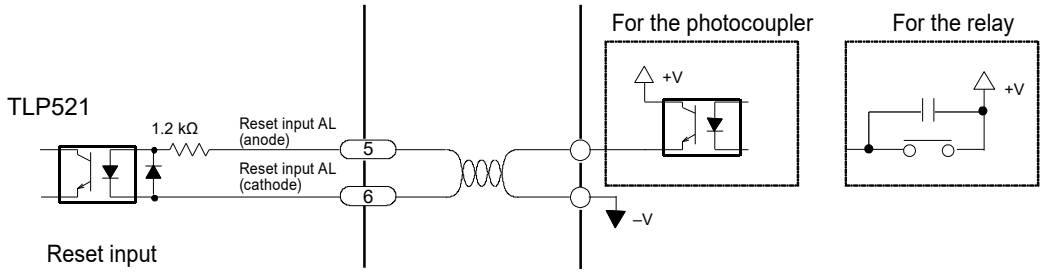
2 Turn off the control unit and turn it on again after 10 seconds or more.

■ Alarm reset signal

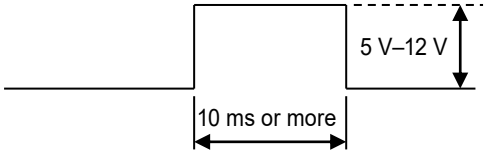
1 Eliminate the cause of the alarm.

2 Input the alarm reset signal (pulse width of 10 ms or more).

- The alarm can be reset by the alarm reset signal only when the main signal output type is B (two-phase square wave + external reset input).
- Connect the alarm reset input circuit so that the current is 3 mA–10 mA.
- Since the product is equipped with a resistor (1.2 kΩ) inside, applying 5 V–12 V between the reset input AL (anode) and reset input AL (cathode) resets the alarm.



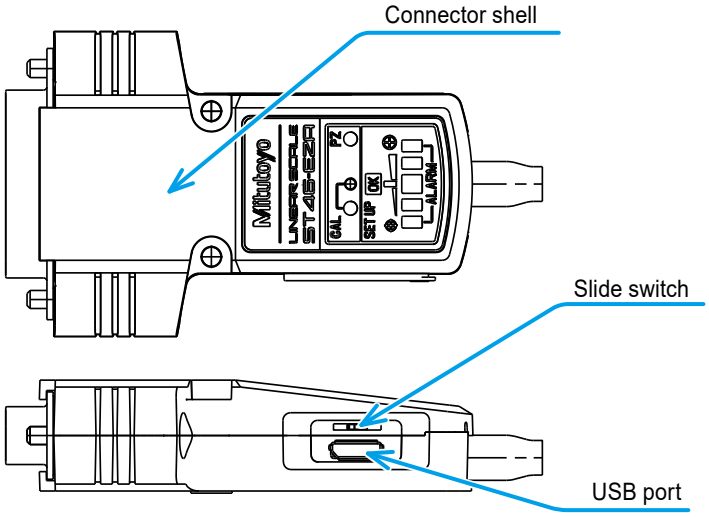
Input signal pin No. 5



- To apply 12 V or more, add a resistor externally.

4.6 Changing the Direction

1. Turn off the control unit.
2. Remove the rubber cap.
3. Change the position of the slide switch on the connector shell.

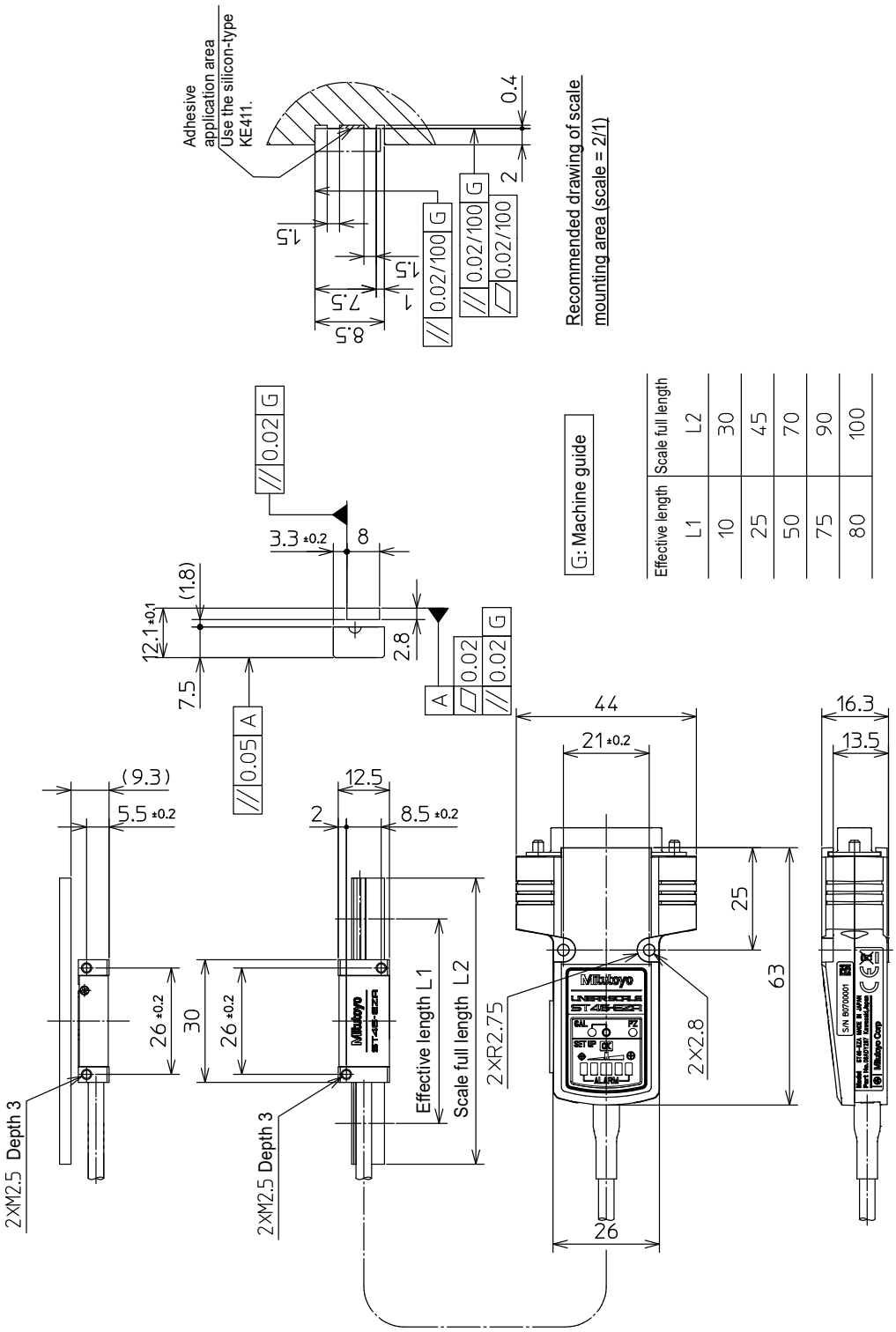


	Switch state	Direction
Positive		Sine wave and phase
Reverse		Sine wave and anti-phase

4.7 External View and Dimensional Drawings

4.7.1 Effective Length of 10 mm–80 mm (without Aluminum Base)

■ Dimensional drawings

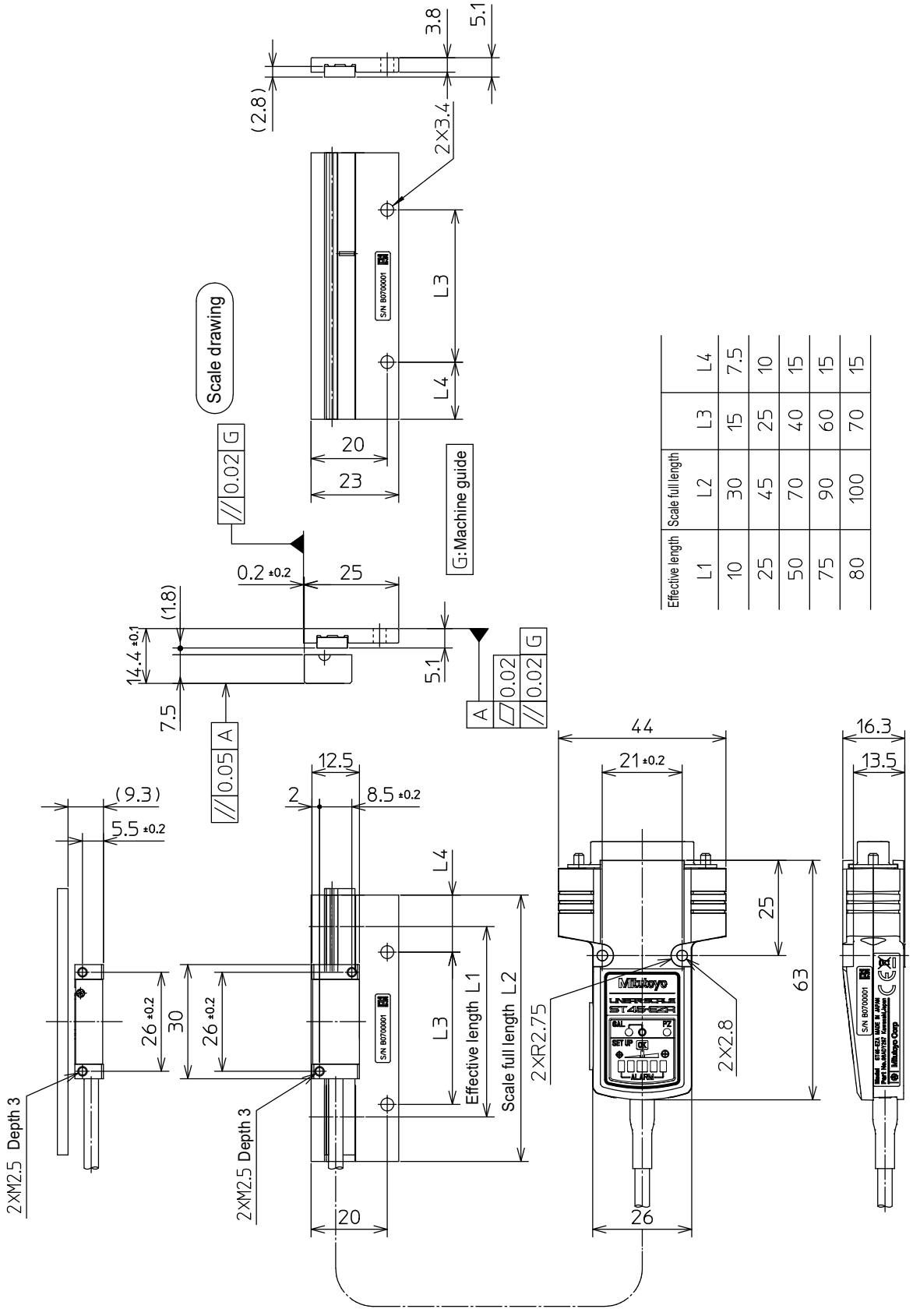


■ Dimensional drawings table

Code No.	Model number	Effective length L1 (mm)	Scale full length L2 (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

4.7.2 Effective Length of 10 mm–80 mm (with Aluminum Base)

■ Dimensional drawings



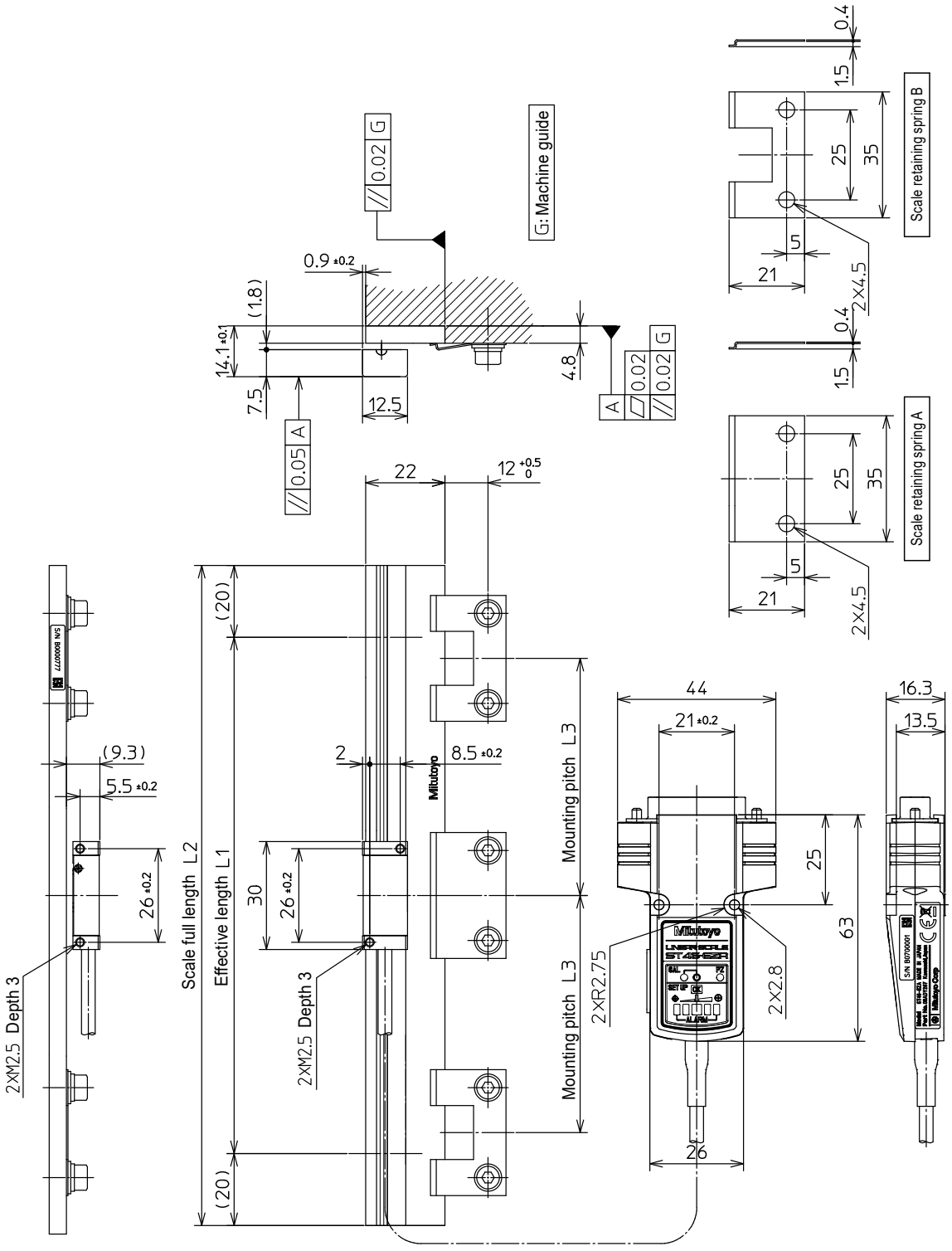
Effective length	Scale full length			
L1	L2	L3	L4
10	30	15	7.5
25	45	25	10
50	70	40	15
75	90	60	15
80	100	70	15

■ Dimensional drawings table

Code No.	Model number	Effective length L1 (mm)	Scale full length L2 (mm)	L3 (mm)	L4 (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

4.7.3 Effective Length of 100 mm–3000 mm

■ Dimensional drawings



■ Dimensional drawings table

Code No. (*1)	Model number (*2)	Effective length L1 (mm)	Scale full length L2 (mm)	Scale fixed pitch L3 (mm)	Scale retaining spring A (quantity)	Scale retaining spring B (quantity)
579-670-□1	ST46EZA◇-100A	100	140	50	1	2
579-671-□1	ST46EZA◇-150A	150	190	75	1	2
579-672-□1	ST46EZA◇-200A	200	240	100	1	2
579-673-□1	ST46EZA◇-250A	250	290	60	1	4
579-674-□1	ST46EZA◇-300A	300	340	75	1	4
579-675-□1	ST46EZA◇-350A	350	390	85	1	4
579-676-□1	ST46EZA◇-400A	400	440	100	1	4
579-677-□1	ST46EZA◇-450A	450	490	75	1	6
579-678-□1	ST46EZA◇-500A	500	540	80	1	6
579-679-□1	ST46EZA◇-600A	600	640	100	1	6
579-680-□1	ST46EZA◇-700A	700	740	85	1	8
579-681-□1	ST46EZA◇-800A	800	840	100	1	8
579-682-□1	ST46EZA◇-900A	900	940	90	1	10
579-683-□1	ST46EZA◇-1000A	1000	1040	100	1	10
579-684-□1	ST46EZA◇-1100A	1100	1140	90	1	12
579-685-□1	ST46EZA◇-1200A	1200	1240	100	1	12
579-686-□1	ST46EZA◇-1300A	1300	1340	130	1	10
579-687-□1	ST46EZA◇-1400A	1400	1440	100	1	14
579-688-□1	ST46EZA◇-1500A	1500	1540	125	1	12
579-689-□1	ST46EZA◇-1600A	1600	1640	100	1	16
579-690-□1	ST46EZA◇-1700A	1700	1740	120	1	14
579-691-□1	ST46EZA◇-1800A	1800	1840	100	1	18
579-692-□1	ST46EZA◇-2000A	2000	2040	100	1	20
579-693-□1	ST46EZA◇-2200A	2200	2240	100	1	22
579-694-□1	ST46EZA◇-2400A	2400	2440	100	1	24
579-695-□1	ST46EZA◇-2500A	2500	2540	95	1	26
579-696-□1	ST46EZA◇-2600A	2600	2640	100	1	26
579-697-□1	ST46EZA◇-2800A	2800	2840	100	1	28
579-698-□1	ST46EZA◇-3000A	3000	3040	100	1	30

*1: The □ mark in Code No. represents as follows:

1: Two-phase square wave + external reset input

2: Two-phase sine wave + two-phase square wave

*2: The ◇ mark in Model number represents as follows:

B: Two-phase square wave + external reset input

C: Two-phase sine wave + two-phase square wave

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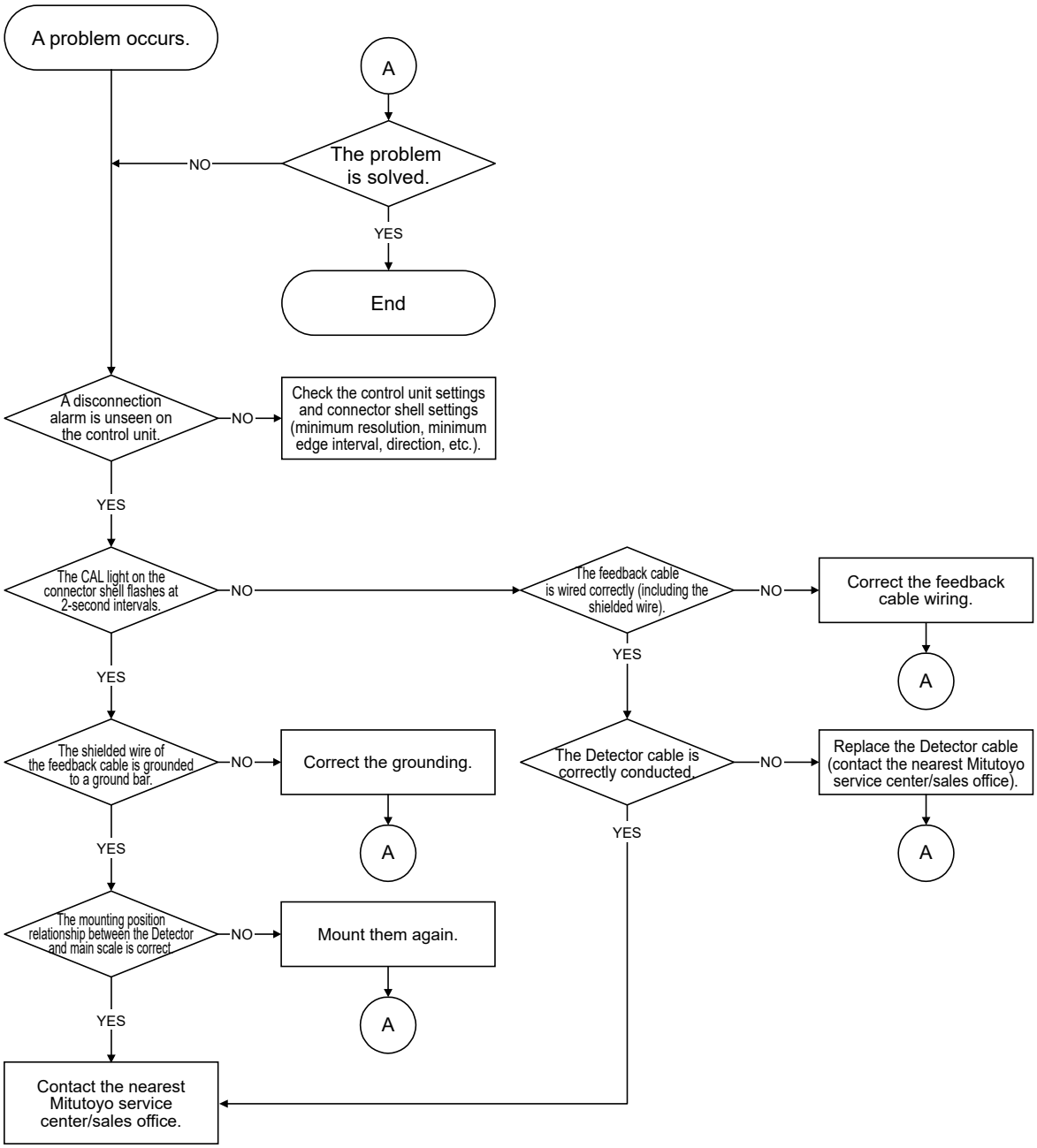
5 Troubleshooting

This chapter describes how to check for the reasons why problems occur when initially powering on, or for when alarms are generated during operation.



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