



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.

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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 a Mitutoyo sales office or your dealer.
- 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 March 2019.
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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 EU EMC Directive. Note that in environments where electromagnetic interference exceeds EMC requirements defined in this directive, appropriate countermeasures are required to assure product performance.

EMC Directive EN61326-1

Immunity test requirement: Clause 6.2 Table 2

Emission limit: Class B

For the EU Directive

Authorized representative and importer in the EU:
Mitutoyo Europe GmbH
Borsigstrasse 8-10, 41469 Neuss, Germany

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 EU Member Countries

When you intend exporting of this product to any of the EU member countries, it 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 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 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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电子电气产品只要按照安全及使用说明内容, 正常使用情况下, 从生产月期算起, 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。

产品正常使用后, 要废弃在环保使用年限内或者刚到年限的产品时, 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

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 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.

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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.

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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

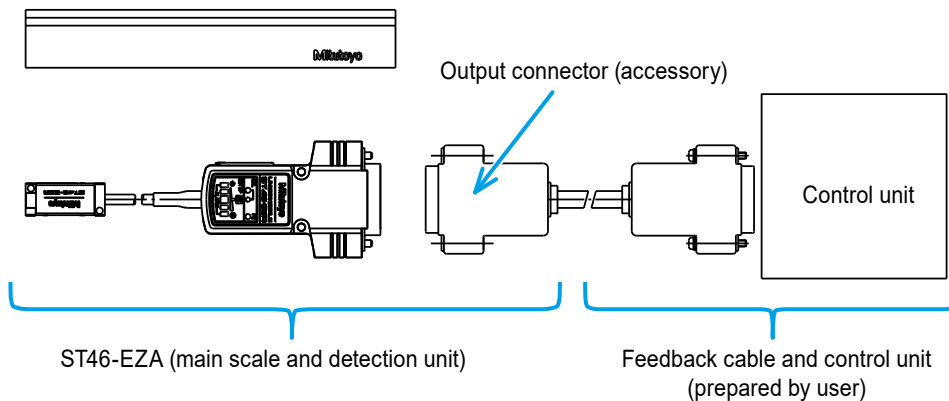
The optical separate type linear scale detects changes in the amount of light using light emitting elements and light receiving elements based on the glass scale grids and outputs the amount of changes.

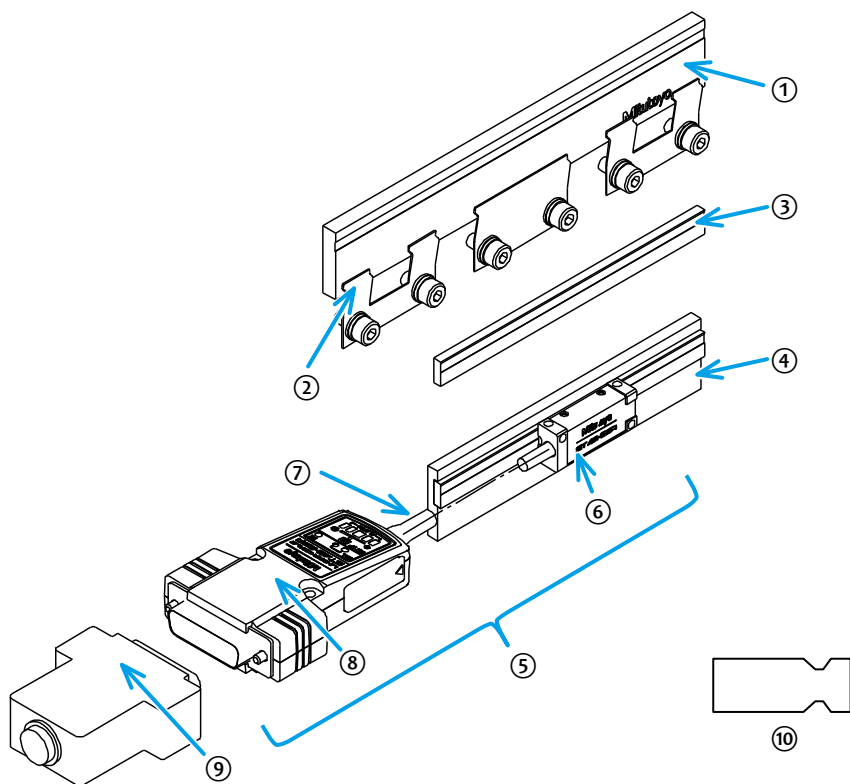
This can precisely measure moving amounts of various instruments including an aligner, wire bonding, and stage for semiconductor manufacturing.

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

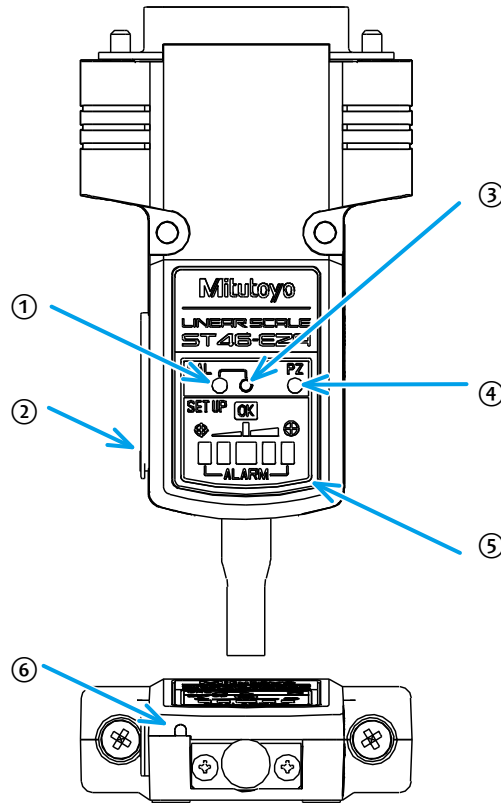
The system configuration and the name of each part are shown below.





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: \varnothing 1.5)
④	PZ light
⑤	Setup indicator
⑥	Setup button B (switch through hole: \varnothing 1.5)

Tips

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

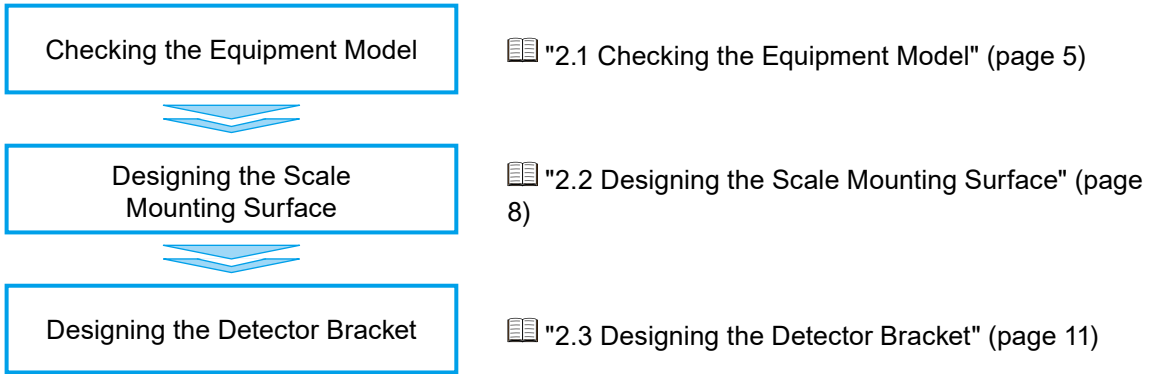
State	Light color	Solid/flashing
Normal operation or power-off	None	Off
Mounting position adjustment mode/error occurrence	Red	Flashing (2-second intervals)
Auto-tuning mode	Red	Flashing (0.5-second intervals)
Auto-tuning in progress	Red	On

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

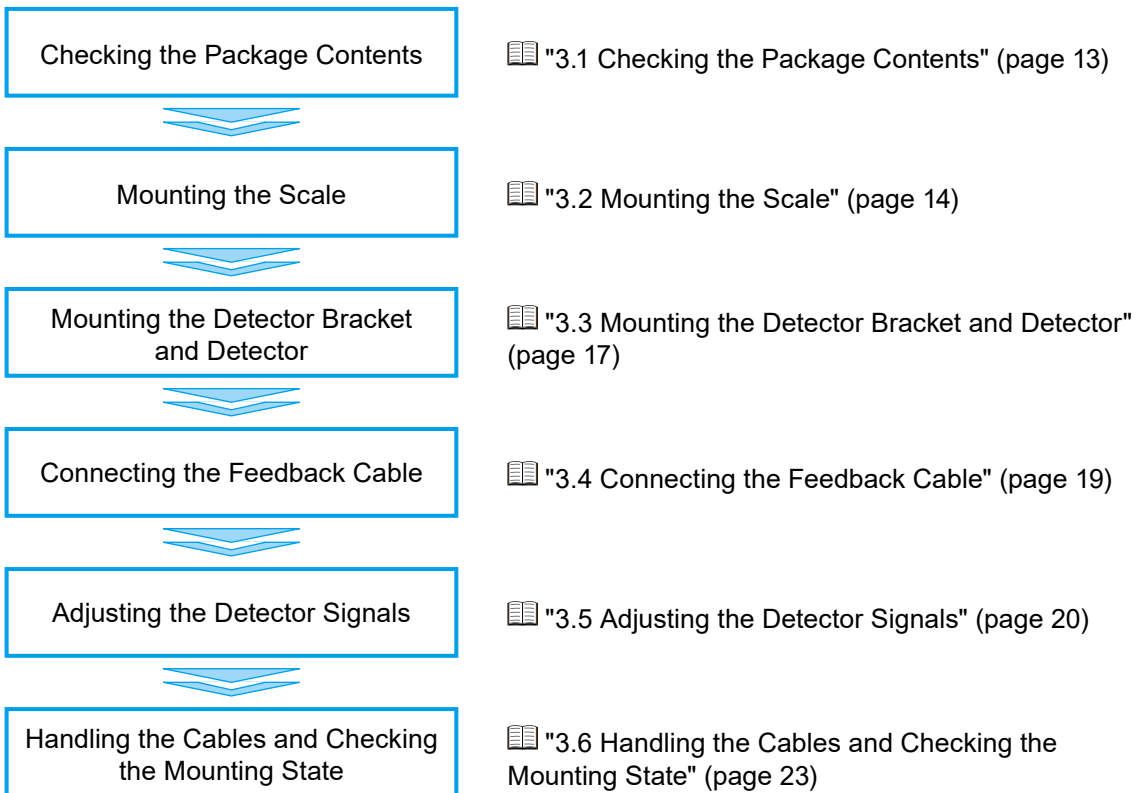
1.3 The Flow of Main Tasks

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

■ Preliminary preparation



■ Mounting onto the machine main unit



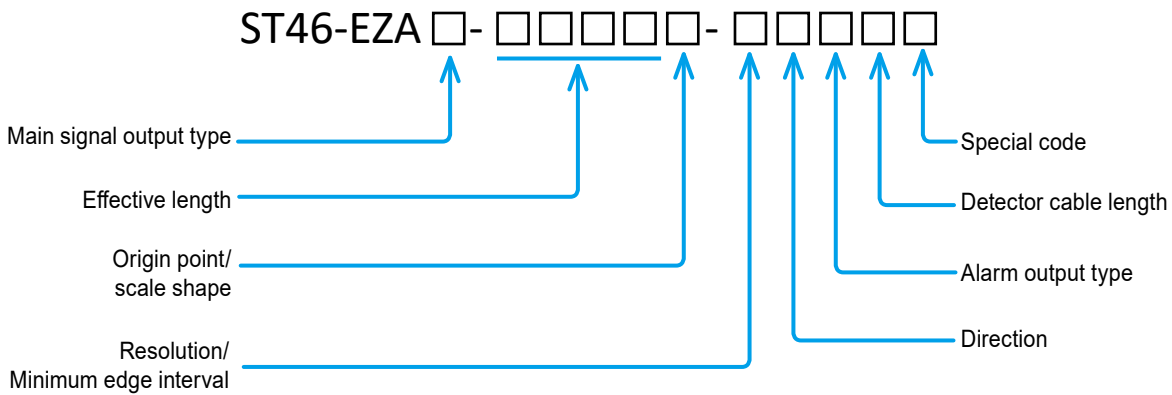
2 Setup for Mounting

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

2 Setup for Mounting

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)

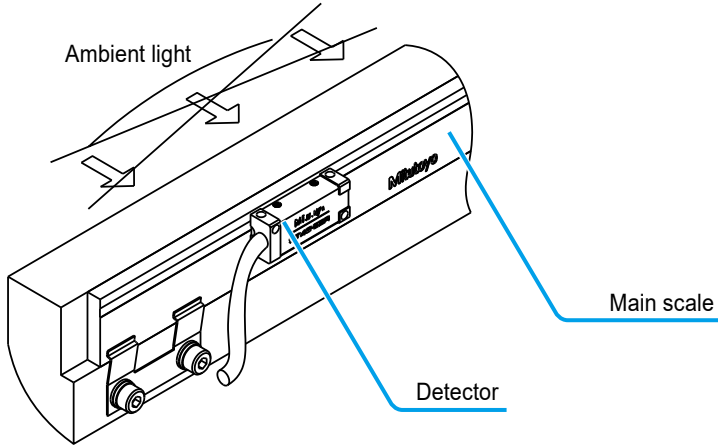
■ Special code

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.

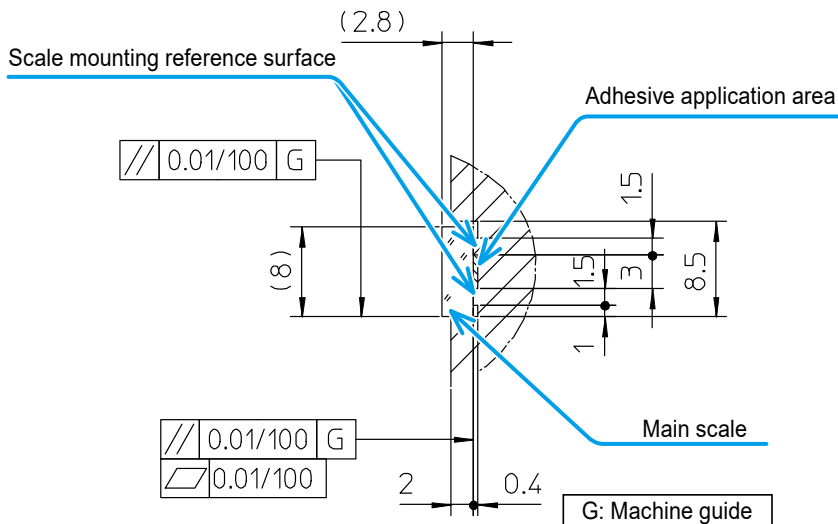


2.2.1 Mounting of the Scale with the Effective Length of 10 mm–80 mm (without Aluminum Base)

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

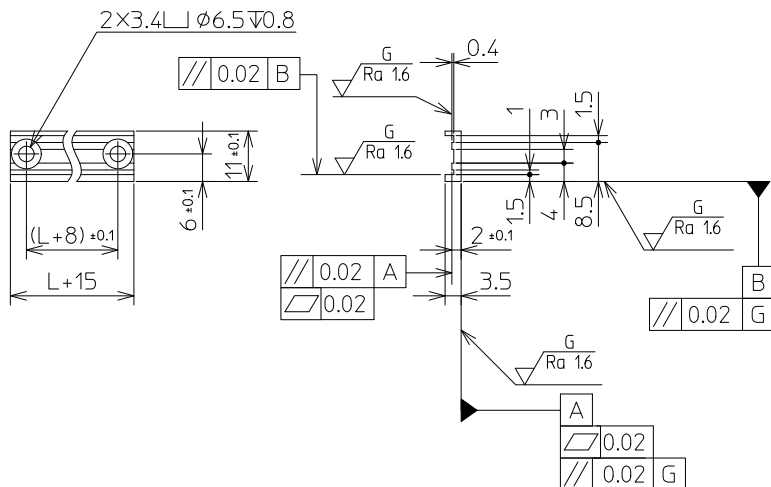


Design the main scale mounting area as shown in the figure below according to ["4.7.1 Effective Length of 10 mm–80 mm \(without Aluminum Base\)"](#) (page 34).



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.

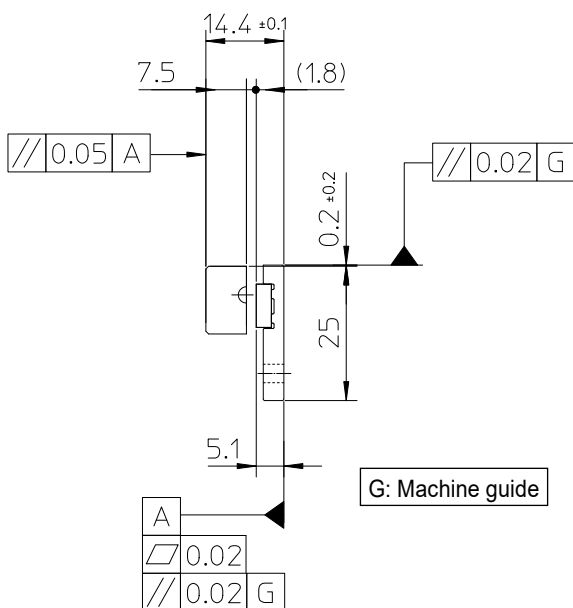


2.2.2 Mounting of the Scale with the Effective Length of 10 mm–80 mm (with Aluminum Base)

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).

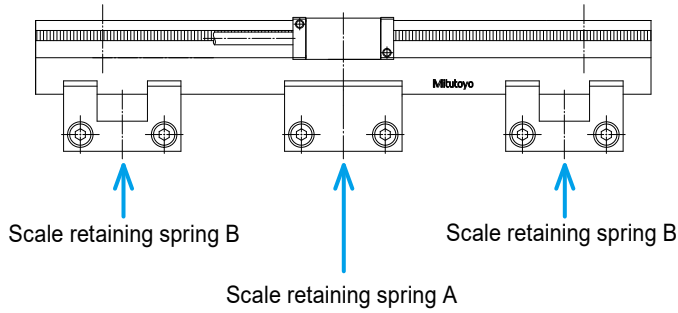


2.2.3 Mounting of the Scale with the Effective Length of 100 mm–3000 mm

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



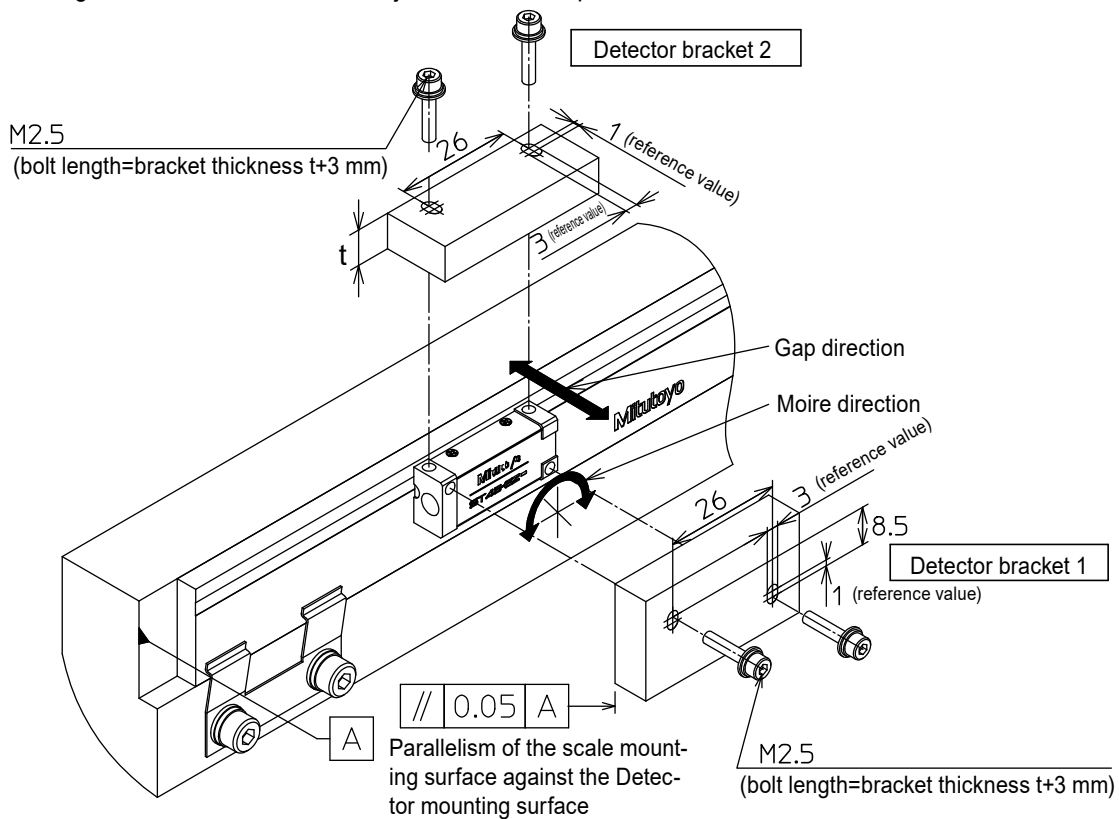
Secure a working space for tightening the bolts for scale retaining spring A and scale retaining spring B according to  "4.7.3 Effective Length of 100 mm–3000 mm" (page 38).



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 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 your dealer or the nearest Mitutoyo sales office/service center.

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

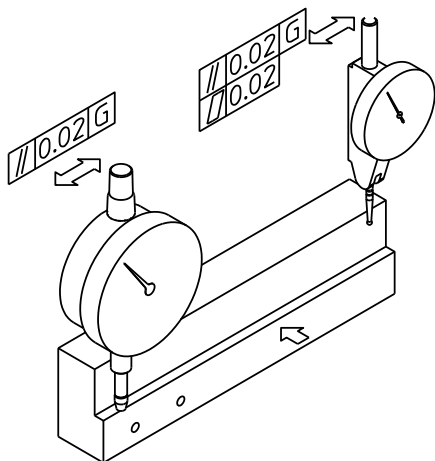
- Conduct temperature leveling thoroughly for both the main scale and mounting parts before fixing them. The accuracy of this product is guaranteed at 20 °C. The recommended temperature leveling is about 8 hours or longer at 20 °C for both the main scale and parts for mounting the scale. Perform mounting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

3 Mounting onto the Machine Main Unit

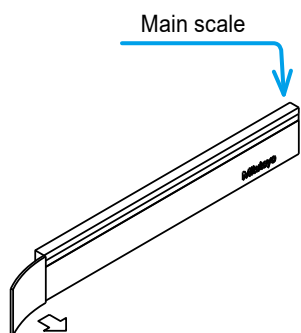
- 1 Use a lever-type dial indicator or electric micrometer to make sure that the scale mounting surface is prepared as shown below.



- 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.



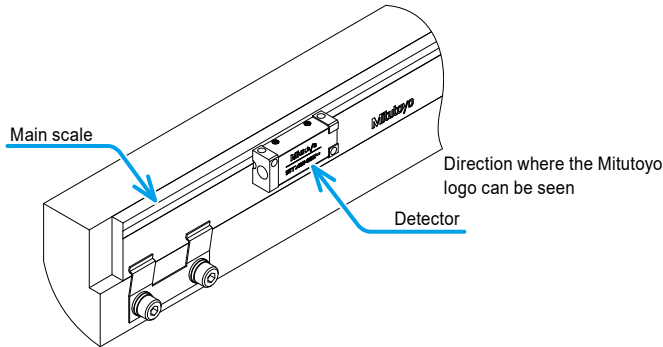
Peel the scale protection tape.

3 Mounting onto the Machine Main Unit

3 Mount the main scale.



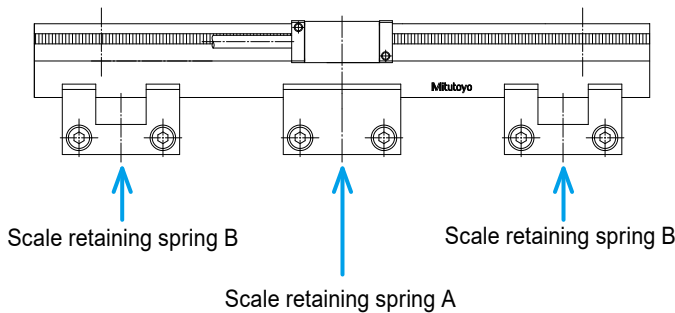
- Mount the main scale so that the Detector is placed on the grid surface (surface where rainbow colors appear when light is applied diagonally).
- For a scale with the Mitutoyo logo attached, the correct mounting direction is where the logo can be appropriately viewed from the Detector side.



- 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.

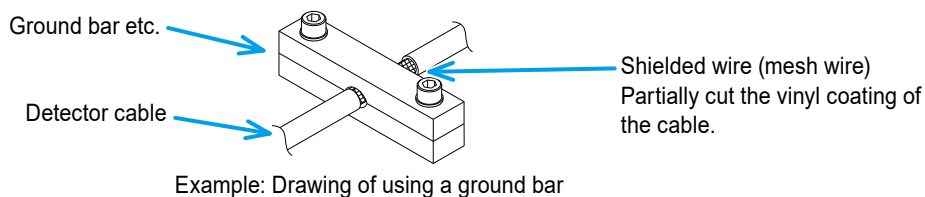
3.3 Mounting the Detector Bracket and Detector

NOTICE

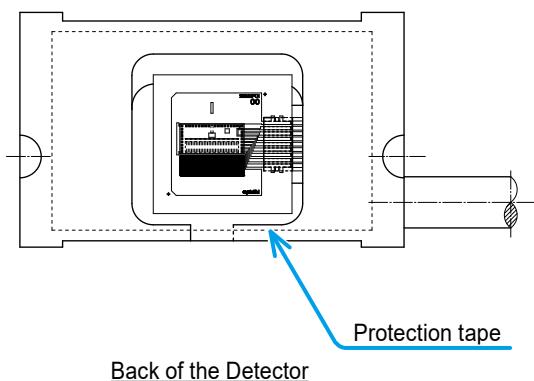
Do not directly touch the connector shell pins during mounting. Otherwise, electronic parts may be damaged by static electricity. Be sure to take measures to prevent static electricity for mounting.



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.



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

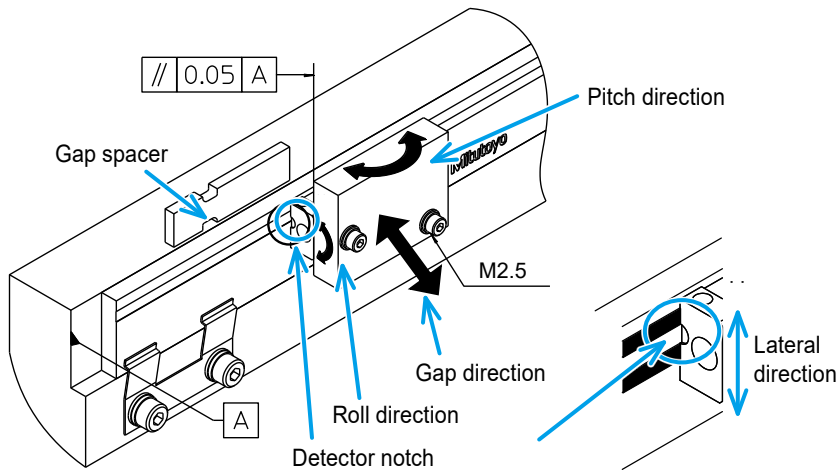


3 Mounting onto the Machine Main Unit

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 $0.4 \text{ N}\cdot\text{m} - 0.6 \text{ N}\cdot\text{m}$.
- 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.

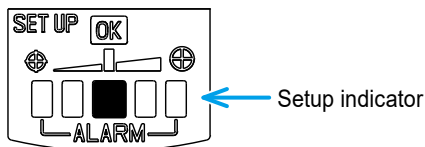
» The connector shell light turns on or flashes.



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.

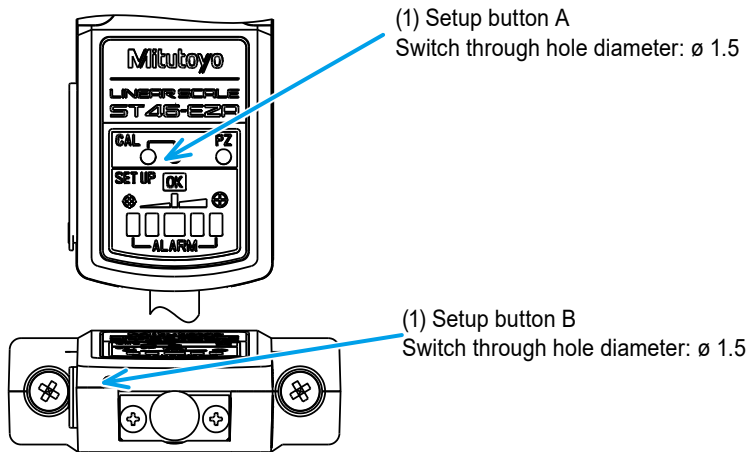


3.5 Adjusting the Detector Signals

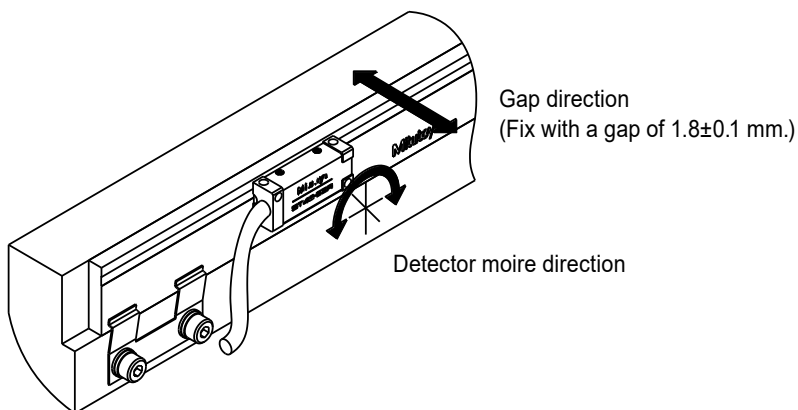
After mounting the main scale and Detector and connecting the feedback cable, adjust the signals using the connector shell.

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

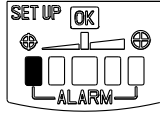




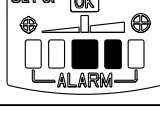
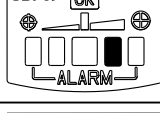
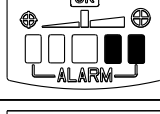

» The CAL light flashes in red (at intervals of 2 seconds) and enters the mode to adjust the Detector mounting position.



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



3 Mounting onto the Machine Main Unit

	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.

3 Mounting onto the Machine Main Unit



- 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

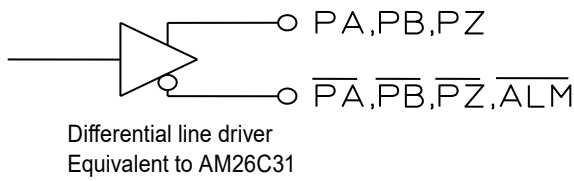
Item	Specification
Detection method	Optical reflection type linear encode
Main scale grid pitch	20 μm
Output signal type	Type B: Two-phase square wave, origin signal pulse, external reset input Type C: Two-phase square wave, origin signal pulse, two-phase sine wave
Effective length	10 mm–3000 mm
Indication accuracy (20 °C)	Effective length of 10 mm–300 mm: $\pm 1 \mu\text{m}$ Effective length of 350 mm–500 mm: $\pm 2 \mu\text{m}$ Effective length of 600 mm–1000 mm: $\pm 3 \mu\text{m}$ Effective length of 1100 mm–3000 mm: $\pm 3 \mu\text{m/m}$
Coefficient of linear expansion	$\approx 8 \times 10^{-6}/\text{K}$
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 $\pm 5 \%$
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

4.2 Output Circuits and Signal Waveforms

4.2.1 Main Signal Type: Type B, Type C

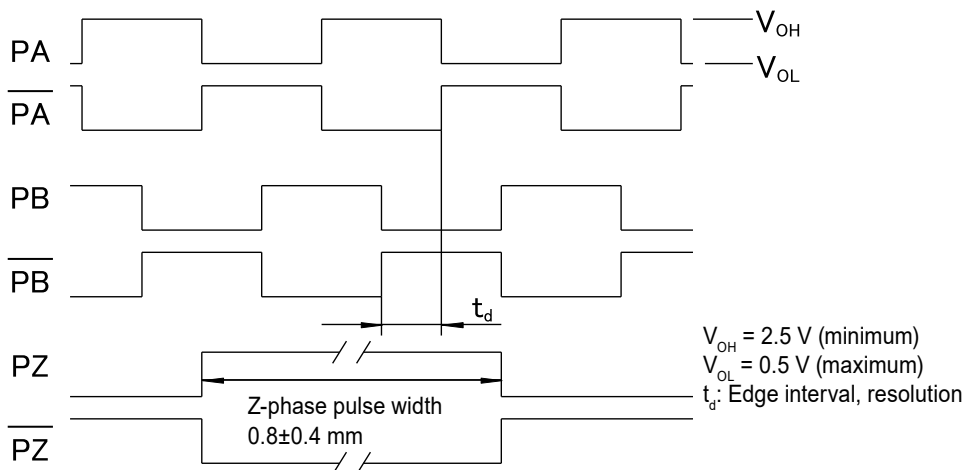
Output circuit

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.



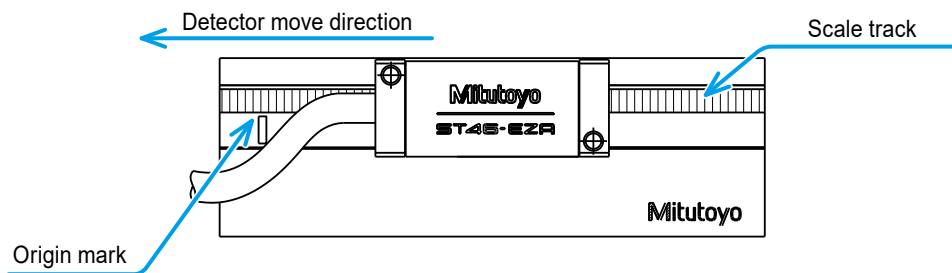
Signal waveform

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.

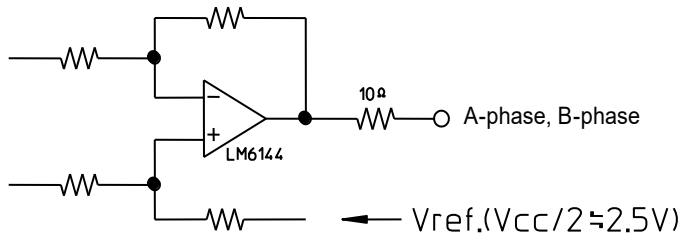


4.2.2 Main Signal Type: Type C

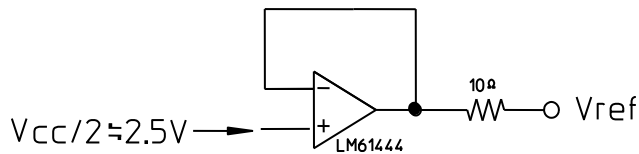
Output circuit

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

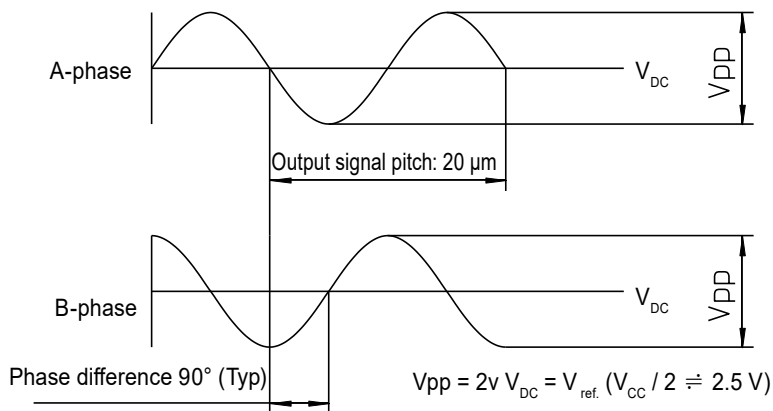


Reference signal (Vref) output circuit



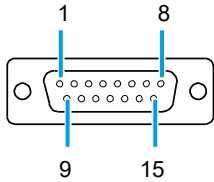
Signal waveform

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

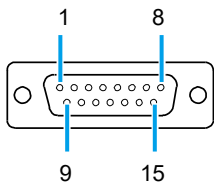


Pin No.	Signal name	Pin No.	Signal name
1, 2	0V (GND)	9	ALM (alarm)
3, 4	+5 V (Vcc)	10	PA (main signal pulse_positive phase)
5	Reset input AL (anode)	11	\overline{PA} (main signal pulse_reverse phase)
6	Reset input AL (cathode)	12	PB (main signal pulse_positive phase)
7	N.C.	13	\overline{PB} (main signal pulse_reverse phase)
8	PZ (origin signal pulse_positive phase)	14	\overline{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	ALM (alarm)
3, 4	+5 V (Vcc)	10	PA (main signal pulse_positive phase)
5	A-phase (sine wave)	11	\overline{PA} (main signal pulse_reverse phase)
6	B-phase (sine wave)	12	PB (main signal pulse_positive phase)
7	Vref ($\doteq Vcc/2$)	13	\overline{PB} (main signal pulse_reverse phase)
8	PZ (origin signal pulse_positive phase)	14	\overline{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.

$$V_{sp} - (R_c \div 2) \times L \times 2 \times 0.25 \geq 4.75 \text{ V}$$

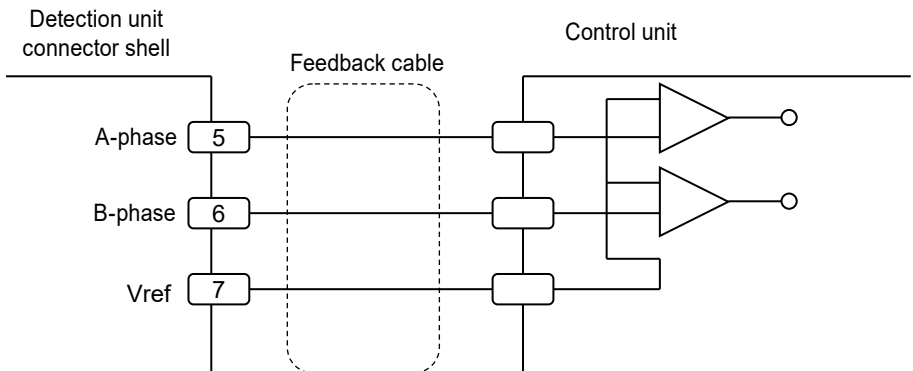
V_{sp} : Power voltage supplied from the control unit (Volts)

R_c : Cable power, ground wire impedance (Ω/m)

L: Cable length (m)

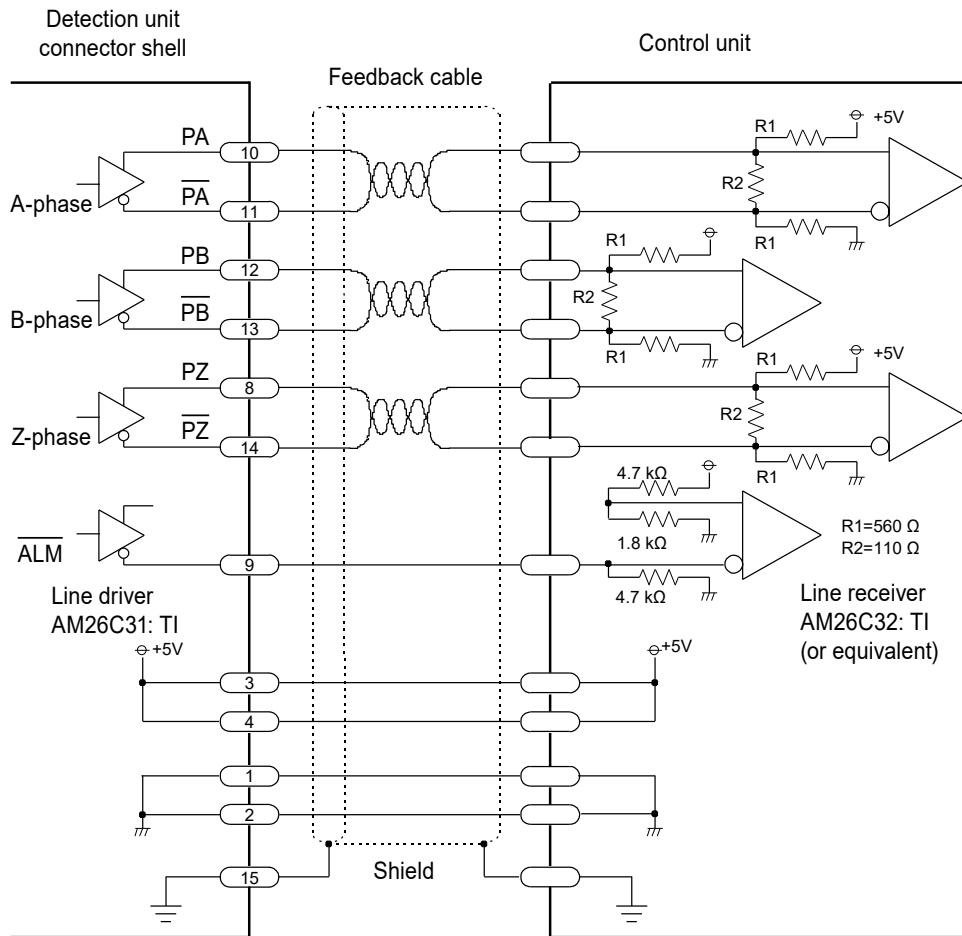
0.25: Maximum current consumption of the scale unit (A)

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



4 Specifications

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.

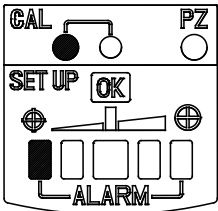
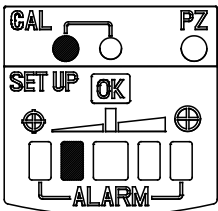
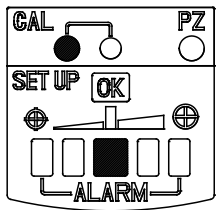
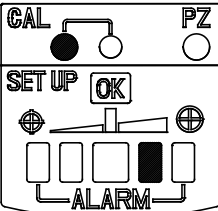
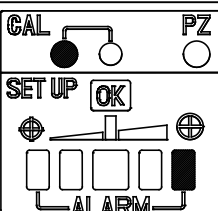
4.5 Alarm Function

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

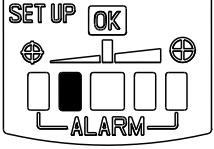
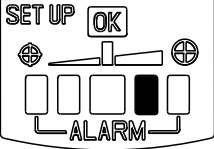
When multiple errors occur, all the corresponding lights on the setup indicator turn on.

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	<ul style="list-style-type: none"> - 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.

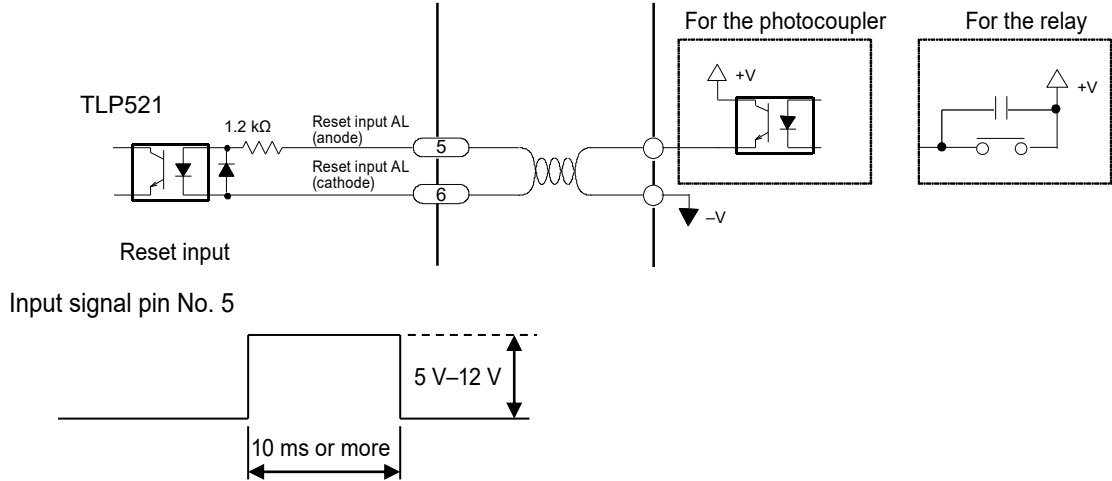
■ Alarm reset signal

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

4 Specifications



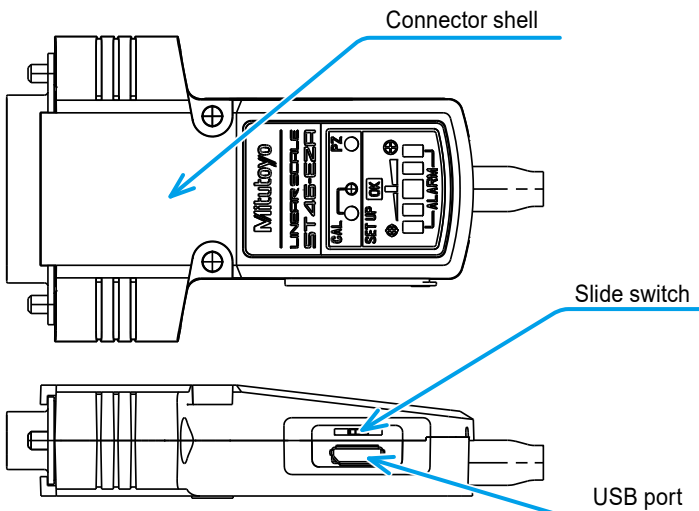
- The alarm can be reset by the alarm reset signal only when the main signal output type is B (two-phase square wave + external reset input).
- Connect the alarm reset input circuit so that the current is 3 mA–10 mA.
- Since the product is equipped with a resistor (1.2 kΩ) inside, applying 5 V–12 V between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



- 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.

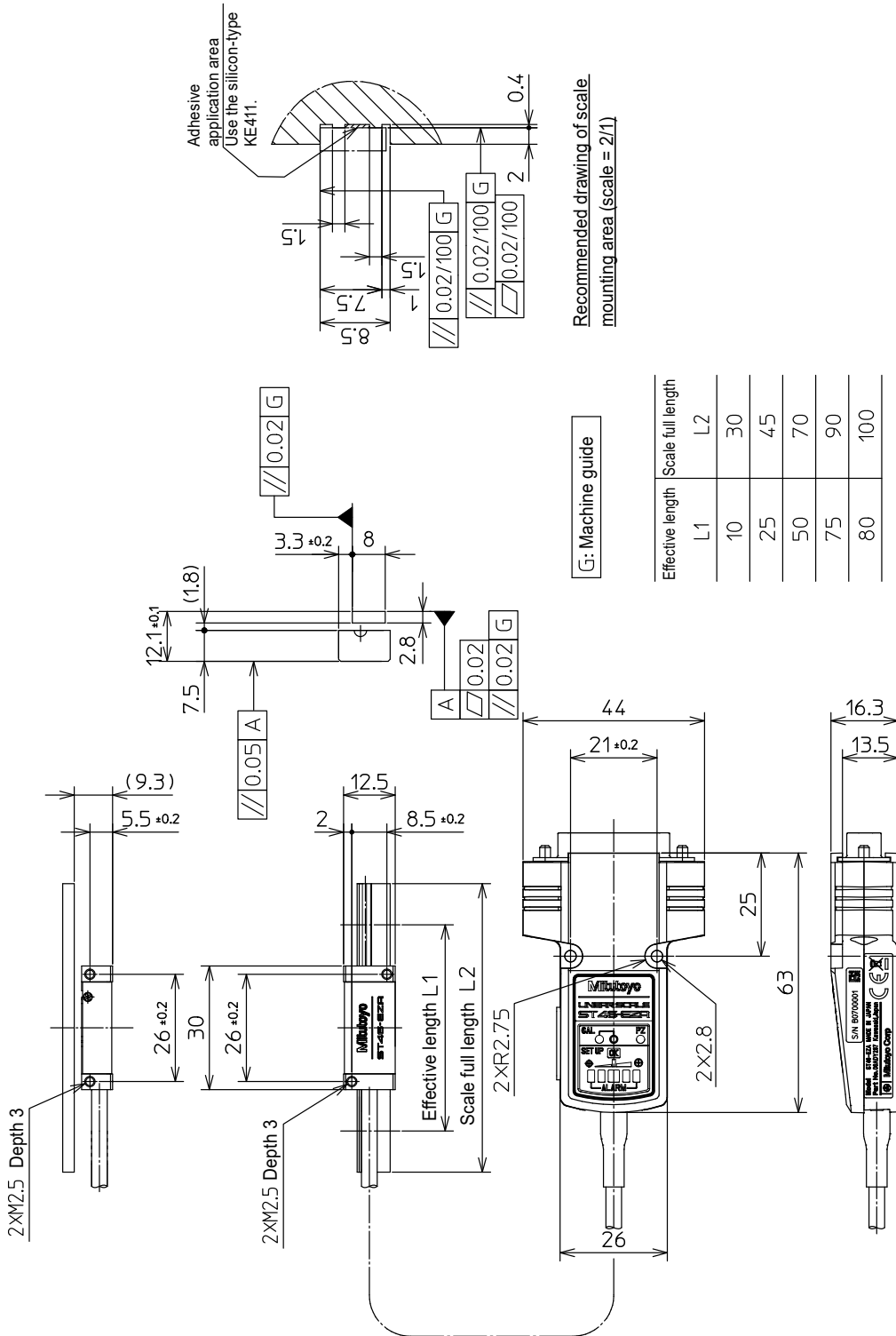


	Switch state	Direction
Positive		Sine wave and phase
Reverse		Sine wave and anti-phase

4.7 External View and Dimensional Drawings

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

■ Dimensional drawings



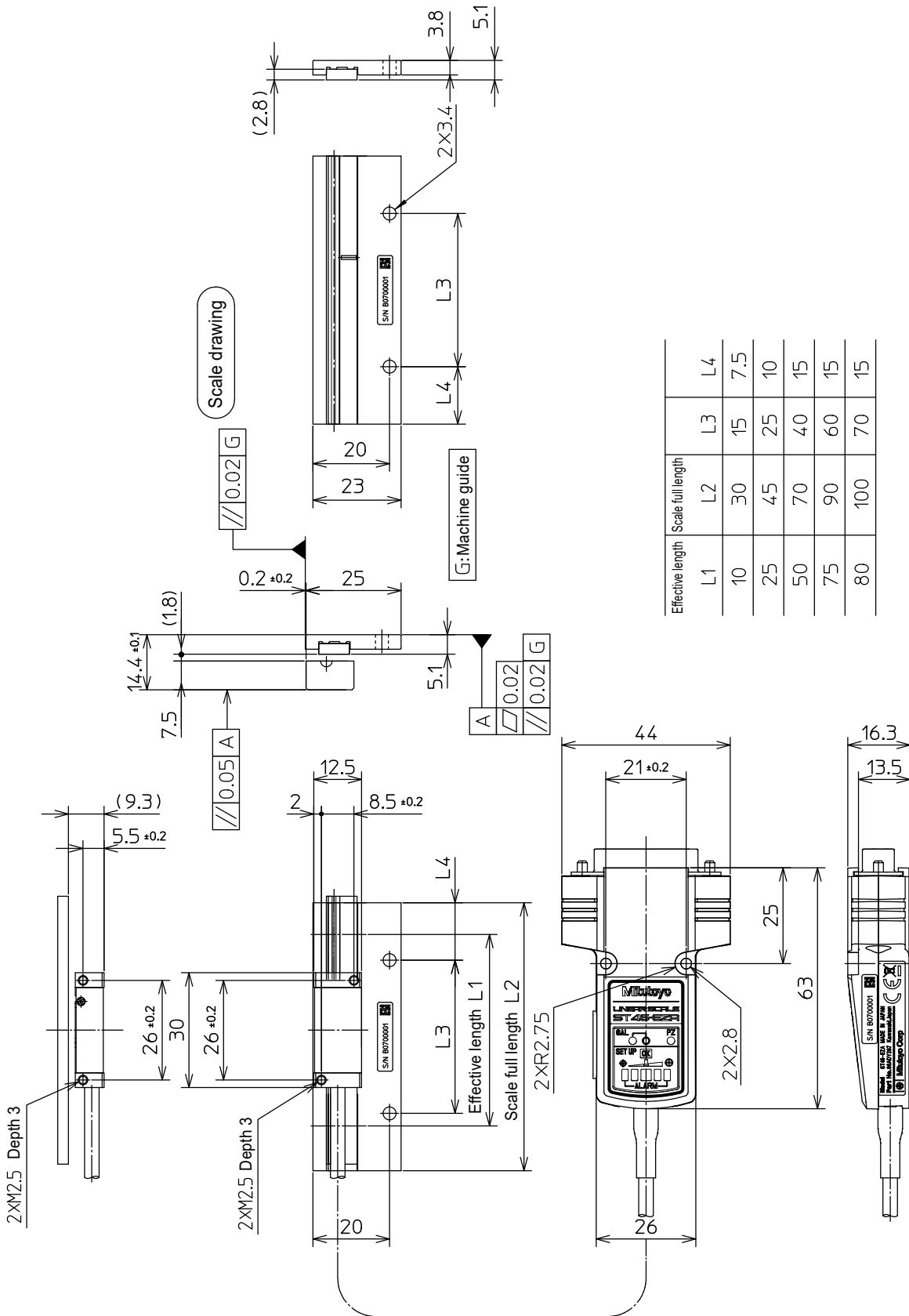
Effective length	Scale full length
L1	L2
10	30
25	45
50	70
75	90
80	100

■ 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



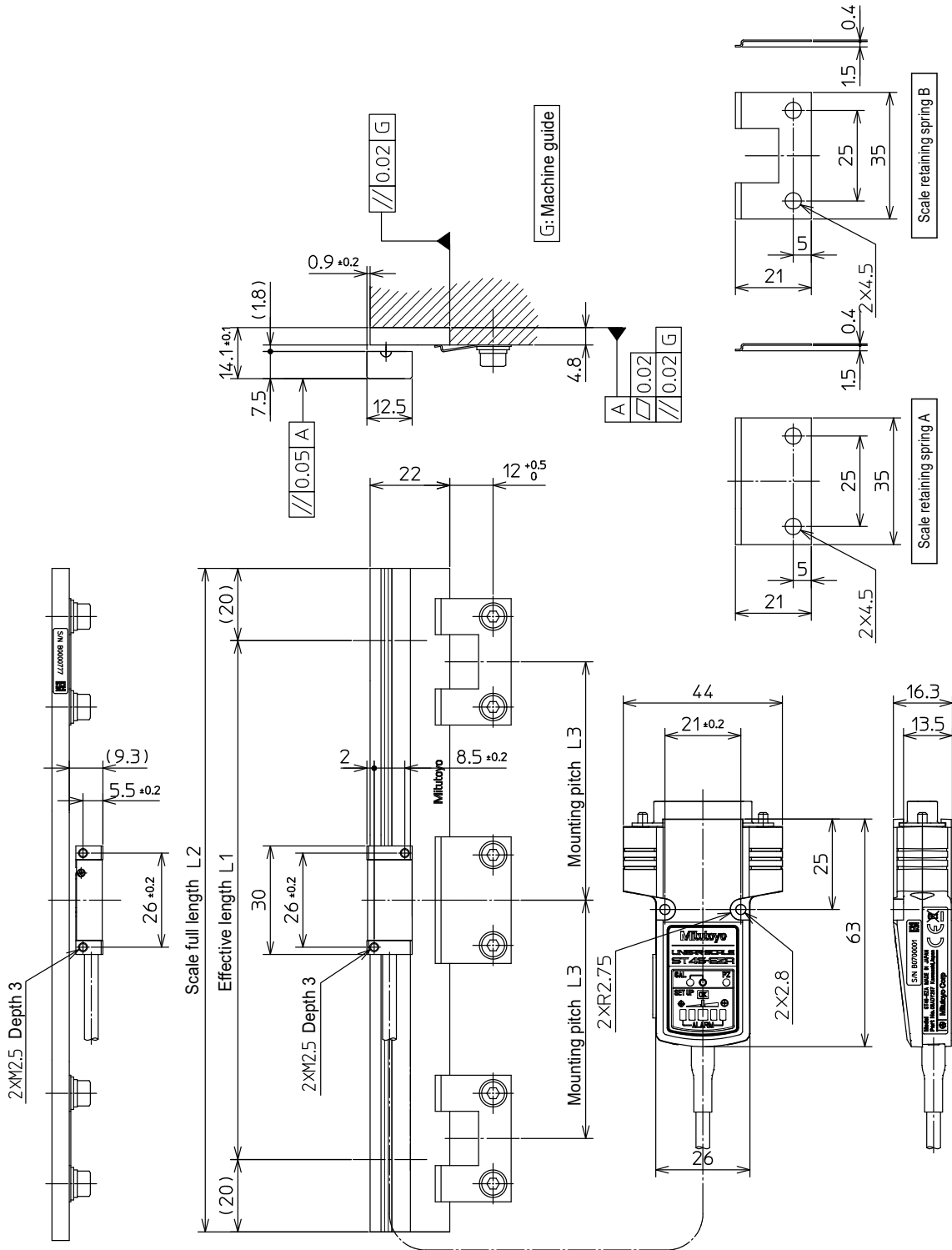
4 Specifications

■ 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:

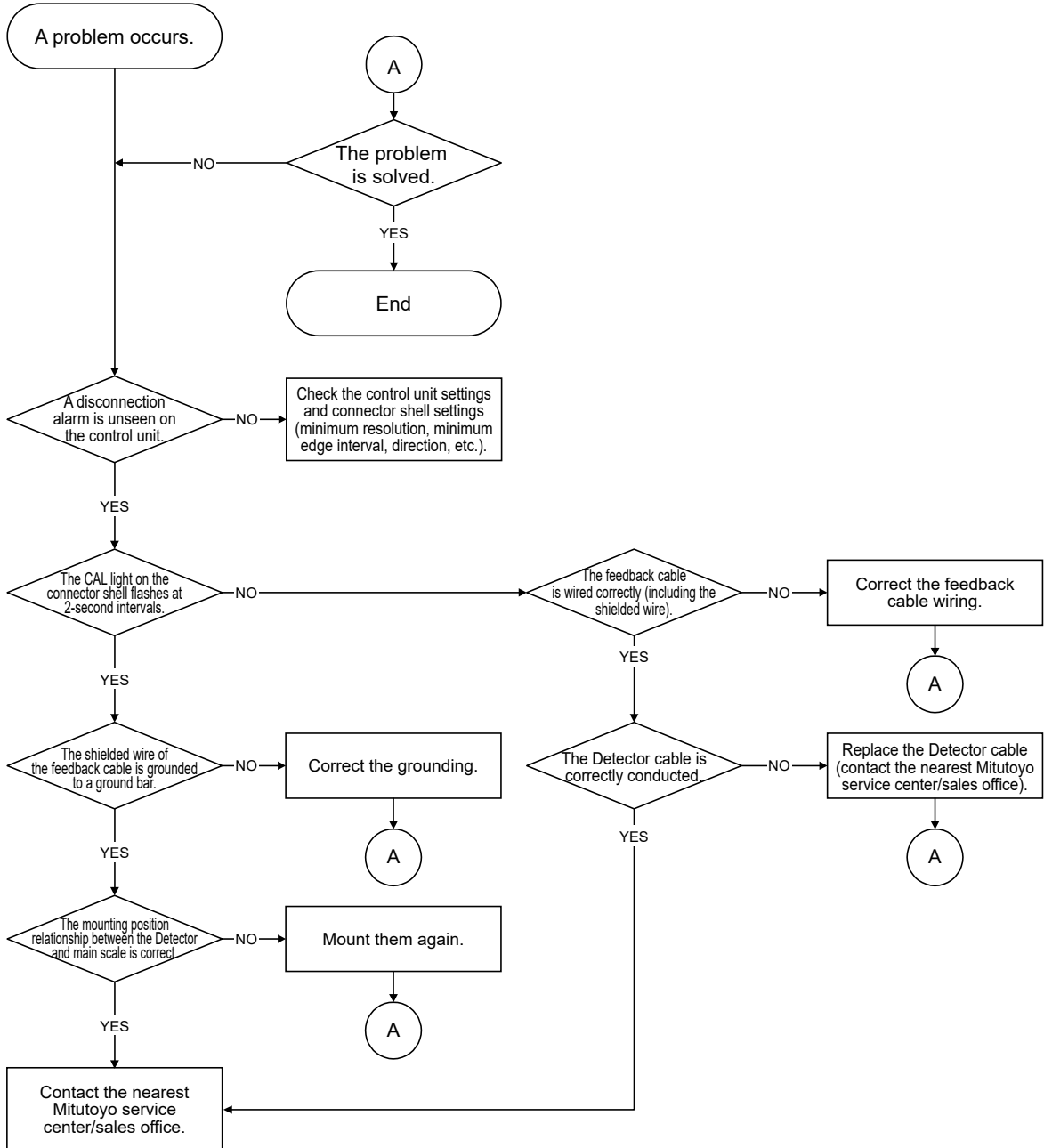
B: Two-phase square wave + external reset input

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

MEMO

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.



MEMO

SERVICE NETWORK

*As of January 2019

Europe

Mitutoyo Europe GmbH

Borsigstrasse 8-10, 41469 Neuss, GERMANY
TEL: 49 (0)2137 102-0 FAX: 49 (0)2137 102-351

Mitutoyo CTL Germany GmbH

Von-Gunzert-Strasse 17, 78727 Oberndorf, GERMANY
TEL: 49 (0)7423 8776-0 FAX: 49 (0)7423 8776-99

KOMEG Industrielle Messtechnik GmbH

Zum Wasserwerk 3, 66333 Völklingen, GERMANY
TEL: 49 (0)6898 91110 FAX: 49 (0)6898 911100

Germany

Mitutoyo Deutschland GmbH

Borsigstrasse 8-10, 41469 Neuss, GERMANY
TEL: 49 (0)2137 102-0 FAX: 49 (0)2137 86 85

M3 Solution Center Hamburg

Tempowerkring 9-im HIT-Technologiepark 21079
Hamburg, GERMANY
TEL: 49 (0)40 791894-0 FAX: 49 (0)40 791894-50

M3 Solution Center Berlin

Carl-Scheele-Straße 16, 12489 Berlin, GERMANY
TEL:49(0)30 2611 267

M3 Solution Center Eisenach

Heinrich-Ehrhardt-Platz 1, 99817 Eisenach,GERMANY
TEL: 49 (0)3691 88909-0 FAX: 49 (0)3691 88909-9

M3 Solution Center Ingolstadt

Marie-Curie-Strasse 1a, 85055 Ingolstadt, GERMANY
TEL: 49 (0)841 954920 FAX: 49 (0)841 9549250

M3 Solution Center Leonberg

Steinbeisstrasse 2, 71229 Leonberg, GERMANY
TEL: 49 (0)7152 6080-0 FAX: 49 (0)7152 608060

Mitutoyo-Messgeräte Leonberg GmbH

Heidenheimer Strasse 14, 71229 Leonberg, GERMANY
TEL: 49 (0)7152 9237-0 FAX: 49 (0)7152 9237-29

U.K.

Mitutoyo (UK) Ltd.

Joule Road, West Point Business Park,
Andover, Hampshire SP10 3UX, UNITED KINGDOM
TEL: 44 (0)1264 353 123 FAX: 44 (0)1264 354883

M3 Solution Center Coventry

Unit6, Banner Park, Wickmans Drive, Coventry,
Warwickshire CV4 9XA, UNITED KINGDOM
TEL: 44 (0)2476 426300 FAX: 44 (0)2476 426339

M3 Solution Center Halifax

Lowfields Business Park, Navigation Close, Elland,
West Yorkshire HX5 9HB, UNITED KINGDOM
TEL: 44 (0)1422 375566 FAX: 44 (0)1422 328025

M3 Solution Center East Kilbride

The Baird Building, Rankine Avenue, Scottish
Enterprise Technology Park, East Killbride G75
0QF, UNITED KINGDOM
TEL: 44 (0)1355 581170 FAX: 44 (0)1355 581171

France

Mitutoyo France

Paris Nord 2-123 rue de la Belle Etoile, BP 59267
ROISSY EN FRANCE 95957 ROISSY CDG
CEDEX, FRANCE
TEL: 33 (0)149 38 35 00

M3 Solution Center LYON

Parc Mail 523, cours du 3éme millénaire, 69791
Saint-Priest, FRANCE
TEL: 33 (0)149 38 35 70

M3 Solution Center STRASBOURG

Parc de la porte Sud, Rue du pont du péage,
67118 Geispolsheim, FRANCE
TEL: 33 (0)149 38 35 80

M3 Solution Center CLUSES

Espace Scionzier 480 Avenue des Lacs, 74950
Scionzier, FRANCE
TEL: 33 (0)1 49 38 35 90

M3 Solution Center TOULOUSE

Aeroparc Saint Martin Cellule B08 ZAC de Saint
Martin du Touch 12 rue de Caulet 31300
Toulouse, FRANCE
TEL: 33 (0)1 49 38 42 90

M3 Solution Center RENNES

ZAC Mivoie
Le Vallon
35230 Noyal-Châtillon sur Seiche, FRANCE
TEL: 33 (0)1 49 38 42 10

Italy

MITUTOYO ITALIANA S.r.l.

Corso Europa, 7 - 20020 Lainate (MI), ITALY
TEL: 39 02 935781 FAX: 39 02 9373290•93578255

M3 Solution Center BOLOGNA

Via dei Carpini1/A - 40011 Anzola Emilia (BO), ITALY
TEL: 39 02 93578215 FAX: 39 02 93578255

M3 Solution Center CHIETI

Contrada Santa Calcagna - 66020 Rocca S. Giovanni (CH), ITALY
TEL: 39 02 93578280 FAX: 39 02 93578255

M3 Solution Center PADOVA

Via G. Galilei 21/F - 35035 Mestrino (PD), ITALY
TEL: 39 02 93578268 FAX: 39 02 93578255

Belgium / Netherlands

Mitutoyo BeNeLux

Mitutoyo Belgium N.V.

Hogenakkerhoekstraat 8, 9150 Kruibeke, BELGIUM
TEL: 32 (0)3-2540444 FAX: 32(0)3-2540445

Mitutoyo Nederland B.V.

Wiltonstraat 25, 3905 KW Veenendaal,
THE NETHERLANDS
TEL: 31(0)318-534911

Sweden

Mitutoyo Scandinavia AB

Släntvägen 6, 194 61 Upplands Väsby, SWEDEN
TEL: 46 (0)8 594 109 50 FAX: 46 (0)8 590 924 10

M3 Solution Center Alingsås

Ängsvaktaregatan 3A, 441 38 Alingsås, SWEDEN
TEL: 46 (0)8 594 109 50 FAX:46 (0)322 63 31 62

M3 Solution Center Värnamo

Storgatsbacken 1, 331 30 Värnamo, SWEDEN
TEL: 46 (0)8 594 109 50 FAX: 46 (0)370 463 34

Switzerland

Mitutoyo (Schweiz) AG

Steinackerstrasse 35, 8902 Urdorf, SWITZERLAND
TEL: 41 (0)447361150 FAX: 41(0)447361151

Mitutoyo (Suisse) SA

Rue Galilée 4, 1400 Yverdon-les Bains, SWITZERLAND
TEL: 41 (0)244259422 FAX: 41 (0)447361151

Poland

Mitutoyo Polska Sp.z o.o.

Ul.Graniczna 8A, 54-610 Wroclaw, POLAND
TEL: 48 (0)71354 83 50 FAX: 48 (0)71354 83 55

Czech Republic

Mitutoyo Česko s.r.o.

Dubská 1626, 415 01 Teplice, CZECH REPUBLIC
TEL: 420 417-514-011 FAX: 420 417-579-867

Mitutoyo Česko s.r.o. M3 Solution Center Ivančice

Ke Karlovu 62/10, 664 91 Ivančice, CZECH REPUBLIC
TEL: 420 417-514-011 FAX: 420 417-579-867

Mitutoyo Česko s.r.o. M3 Solution Center Ostrava Mošnov

Mošnov 314, 742 51 Mošnov, CZECH REPUBLIC
TEL: 420 417-514-050 FAX:420 417-579-867

Mitutoyo Česko s.r.o. Slovakia Branch

Hviezdoslavova 124, 017 01 Povážská
Bystrica, SLOVAKIA
TEL: 421 948-595-590

Hungary

Mitutoyo Hungária Kft.

Záhony utca 7, D-épület / fsz, 1031 Budapest, HUNGARY
TEL: 36 (0)1 2141447 FAX: 36 (0)1 2141448

Romania

Mitutoyo Romania SRL

1A Drumul Garii Odai Street, showroom, Ground
Floor, 075100 OTOPENI-ILFOV, ROMANIA
TEL: 40 (0)311012088 FAX: +40 (0)311012089

Showroom in Brasov

Strada Ionescu Crum Nr.1, Brasov Business
Park Turnul 1, Mezanin, 500446
Brasov-Judetul Brasov, ROMANIA
TEL/FAX: 40 (0)371020017

Russian Federation

Mitutoyo RUS LLC

13 Sharikopodshipnikovskaya, bld.2,
115088 Moscow, RUSSIAN FEDERATION
TEL: 7 495 7450 752

Finland

Mitutoyo Scandinavia AB Finnish Branch

Viherkiitäjä 2A, 33960, Pirkkala, FINLAND
TEL: 358 (0)40 355 8498

Austria

Mitutoyo Austria GmbH

Johann Roithner Straße 131 A-4050 Traun, AUSTRIA
TEL: 43 (0)7229 23850 FAX: 43 (0)7229 23850-90

Götzis Regional Showroom

Lasten Straße 48A 6840, AUSTRIA

Singapore

Mitutoyo Asia Pacific Pte. Ltd.

Head office / M3 Solution Center

24 Kallang Avenue, Mitutoyo Building,
SINGAPORE 339415

TEL:(65)62942211 FAX:(65)62996666

Malaysia

Mitutoyo (Malaysia) Sdn. Bhd.

Kuala Lumpur Head Office / M3 Solution Center

Mah Sing Integrated Industrial Park, 4, Jalan Utarid U5/14,
Section U5, 40150 Shah Alam, Selangor, MALAYSIA

TEL:(60)3-78459318 FAX:(60)3-78459346

Penang Branch office / M3 Solution Center

No.30, Persiaran Mahsuri 1/2, Sunway Tunas,
11900 Bayan Lepas, Penang, MALAYSIA

TEL:(60)4-6411998 FAX:(60)4-6412998

Johor Branch office / M3 Solution Center

No. 70, Jalan Molek 1/28, Taman Molek, 81100
Johor Bahru, Johor, MALAYSIA

TEL:(60)7-3521626 FAX:(60)7-3521628

Thailand

Mitutoyo(Thailand)Co., Ltd.

Bangkok Head Office / M3 Solution Center

76/3-5, Chaengwattana Road, Kwaeng Anusaowaree,
Khet Bangkaen, Bangkok 10220, THAILAND

TEL:(66)2-080-3500 FAX:(66)2-521-6136

Chonburi Branch / M3 Solution Center

7/1, Moo 3, Tambon Bowin, Amphur Sriracha,
Chonburi 20230, THAILAND

TEL:(66)2-080-3563 FAX:(66)3-834-5788

Amata Nakorn Branch / M3 Solution Center

700/199, Moo 1, Tambon Bankao, Amphur Phan-
thong, Chonburi 20160, THAILAND

TEL:(66)2-080-3565 FAX:(66)3-846-8978

Indonesia

PT. Mitutoyo Indonesia

Head Office / M3 Solution Center

Jalan Sriwijaya No.26 Desa cibatu Kec. Cikarang
Selatan Kab. Bekasi 17530, INDONESIA

TEL: (62)21-2962 8600 FAX: (62)21-2962 8604

Vietnam

Mitutoyo Vietnam Co., Ltd

Hanoi Head Office / M3 Solution Center

No. 07-TT4, My Dinh - Me Tri Urban Zone, My Dinh 1
Ward, Nam Tu Liem District, Hanoi, VIETNAM

TEL:(84)24-3768-8963 FAX:(84)24-3768-8960

Ho Chi Minh City Branch Office / M3 Solution Center

123 Dien Bien Phu Street,Ward 15,Binh Thanh
District, Ho Chi Minh City, VIETNAM

TEL:(84)28-3840-3489 FAX:(84)28-3840-3498

Mitutoyo Philippines, Inc.

Head Office / M3 Solution Center

Unit 2103, Bldg 2 GMV Building 2, 107 North Main Avenue,
Laguna Technopark, Binan, Laguna 4024, Philippines

TEL:(63)49 544 0272 FAX:(63)49 544 0272

India

Mitutoyo South Asia Pvt. Ltd.

Head Office / M3 Solution Center

C-122, Okhla Industrial Area, Phase-I,
New Delhi-110 020, INDIA

TEL:91(11)2637-2090 FAX:91(11)2637-2636

MSA Gurgaon technical center

Plot No. 65, Phase-IV, Udyog Vihar, Gurgaon – 122016

TEL : 91 (0124) – 2340294

Mumbai Region Head office

303, Sentinel Hiranandani Business Park Powai,
Mumbai-400 076, INDIA

TEL:91(22)2570-0684, 837, 839 FAX:91(22)2570-0685

Pune Office / M3 Solution Center

G2/G3, Pride Kumar Senate, F.P. No. 402 Off.
Senapati Bapat Road, Pune-411 016, INDIA

TEL:91(20)6603-3643, 45, 46 FAX:91(20)6603-3644

Bengaluru Region Head office / M3 Solution Center

No. 5, 100 Ft. Road, 17th Main, Koramangala,
4th Block, Bengaluru-560 034, INDIA

TEL:91(80)2563-0946, 47, 48 FAX:91(80)2563-0949

Chennai Office / M3 Solution Center

No. 624, Anna Salai Teynampet, Chennai-600 018, INDIA

TEL:91(44)2432-8823, 24, 27, 28

FAX:91(44)2432-8825

Kolkata Office

Unit No. 1208,Om Tower, 32,J.L..Nehru Road,
Kolkata-700 071, INDIA

Tel: 91 33-22267088/40060635 Fax: (91) 33-22266817

Ahmedabad Office/M3 Solution Center (Ahmedabad)

A-104 & A-105, First Floor, Solitaire Corporate
Park, Near Divya Bhaskar Press, S.G. Road,
Ahmedabad - 380 015, INDIA

TEL: (91) 079 - 29704902/903

Coimbatore Office (Coimbatore)

Regus, Srivari Srimath, 3rd Floor, Door No:1045,
Avinashi Road, Coimbatore - 641 018,INDIA

TEL: (91) 9345005663

Taiwan

Mitutoyo Taiwan Co., Ltd. / M3 Solution Center Taipei
4F., No.71, Zhouzi St., Neihu Dist., Taipei City 114,
TAIWAN (R.O.C.)
TEL:886(2)5573-5900 FAX:886(2)8752-3267

Taichung Branch / M3 Solution Center Taichung
1F., No.758, Zhongming S. Rd., South Dist.,
Taichung City 402, TAIWAN(R.O.C.)
TEL:886(4)2262-9188 FAX:886(4) 2262-9166

Kaohsiung Branch / M3 Solution Center Kaohsiung
1F., No.31-1, Haibian Rd., Lingya Dist.,
Kaohsiung City 802, TAIWAN (R.O.C.)
TEL:886(7)334-6168 FAX:886(7)334-6160

South Korea

Mitutoyo Korea Corporation
Head Office / M3 Solution Center
(Sanbon-Dong, Geumjeong High View Build.), 6F, 153-8,
Ls-Ro, Gunpo-Si, Gyeonggi-Do, 15808 KOREA
TEL:82(31)361-4200 FAX:82(31)361-4202

Busan Office / M3 Solution Center
(3150-3, Daejeo 2-dong) 8,Yutongdanji 1-ro
49beon-gil, Gangseo-gu, Busan, 46721 KOREA
TEL:82(51)718-2140 FAX:82(51)324-0104

Daegu Office / M3 Solution Center
(Galsan-dong, Daegu Business Center), 301-Ho, 217,
Seongseogongdan-ro, Dalseo-gu, Daegu 42704 KOREA
TEL:82(53)593-5602 FAX:82(53)593-5603

China

Mitutoyo Measuring Instruments (Shanghai) Co., Ltd.
12F, Nextage Business Center, No.1111
Pudong South Road, Pudong New District,
Shanghai 200120, CHINA
TEL:86(21)5836-0718 FAX:86(21)5836-0717

Suzhou Office / M3 Solution Center (Suzhou)
No. 46 Baiyu Road, Suzhou 215021, CHINA
TEL:86(512)6522-1790 FAX:86(512)6251-3420

Wuhan Office
Room 1701, Wuhan Wanda Center, No. 96,
Linjiang Road, Wuchang District, Wuhan
Hubei 430060, CHINA
TEL:86(27)8544-8631 FAX:86(27)8544-6227

Chengdu Office
1-701, New Angle Plaza, 668# Jindong Road,
Jinjiang District, Chengdu, Sichuan 610066, CHINA
TEL:86(28)8671-8936 FAX:86(28)8671-9086

Hangzhou Office

Room 804, Eastern International Business Center
Building 1, No.600 Jinsha Road
Hangzhou Economic and Technological
Development Zone, 310018, CHINA
TEL: 86(571)8288-0319 FAX: 86(571)8288-0320

Tianjin Office / M3 Solution Center Tianjin
Room D 12/F, TEDA Building, No.256 Jie-fang
Nan Road Hexi District, Tianjin 300042, CHINA
TEL:86(22)5888-1700 FAX:86(22)5888-1701

Changchun Office
Room 815, 8F, Building A1, Upper East
International No.3000 Dongsheng Street,
Erdao District, Changchun, Jilin, 130031, CHINA
TEL:86(431)8192-6998 FAX:86(431)8192-6998

Chongqing Office
Room 1312, Building 3, Zhongyu Plaza, No.86,
Hongjin Avenue, Longxi Street, Yubei District,
Chongqing, 400000, CHINA
TEL:86(23)6595-9950 FAX:86(23)6595-9950

Qingdao Office
Room 638, 6F, No.192 Zhengyang Road, Chengyang
District, Qingdao, Shandong, 266109, CHINA
TEL:86(532)8096-1936 FAX:86(532)8096-1937

Xi'an Office
Room 805, Xi'an International Trade Center, No.
196 Xiaozhai East Road, Xi'an, 710061, CHINA
TEL:86(29)8538-1380 FAX:86(29)8538-1381

Dalian Office / M3 Solution Center Dalian
Room 1008, Grand Central IFC, No.128 Jin ma Road,
Economic Development Zone, Dalian 116600, CHINA
TEL:86(411)8718 1212 FAX:86(411)8754-7587

Zhengzhou Office
Room1801,18/F,Unit1,Building No.23, Shangwu Inner
Ring Road, Zhengdong New District, Zhengzhou City,
Henan Province, 450018, CHINA
TEL:86(371)6097-6436 FAX:86(371)6097-6981

Mitutoyo Leepport Metrology (Hong Kong) Limited
Room 818, 8/F, Vanta Industrial Centre, No.21-33, Tai
Lin Pai Road, Kwai Chung, NT, Hong Kong
TEL:86(852)2992-2088 FAX:86(852)2670-2488

Mitutoyo Leepport Metrology (Dongguan) Limited / M3 Solution Center Dongguan
No.26, Guan Chang Road, Chong Tou Zone,
Chang An Town, Dong Guan, 523855 CHINA
TEL:86(769)8541 7715 FAX:86(769)-8541 7745

Mitutoyo Leepport Metrology (Dongguan) Limited – Fuzhou office

Room 2104, City Commercial Centre, No.129 Wu Yi Road N., Fuzhou City, Fujian Province, CHINA
TEL 86 591 8761 8095 FAX 86 591 8761 8096

Mitutoyo Leepport Metrology (Dongguan) Limited –Changsha office

Room 2207, Shiner International Plaza, No. 88, Kaiyuan Middle Road, Changsha City, Hunan, China
TEL 86 731 8401 9276 FAX 86 731 8401 9376

Mitutoyo Measuring Instruments (Suzhou) Co., Ltd.

No. 46 Baiyu Road, Suzhou 215021, CHINA
TEL:86(512)6252-2660 FAX:86(512)6252-2580

U.S.A.

Mitutoyo America Corporation

965 Corporate Boulevard, Aurora, IL 60502, U.S.A.
TEL:1-(630)820-9666 Toll Free No. 1-(888)648-8869
FAX:1-(630)978-3501

M3 Solution Center-Illinois

965 Corporate Boulevard, Aurora, IL 60502, U.S.A.
TEL:1-(888)648-8869 FAX:1-(630)978-3501

M3 Solution Center-Ohio

6220 Hi-Tek Court, Mason, OH 45040, U.S.A.
TEL:1-(888)648-8869 FAX:1-(513)754-0718

M3 Solution Center-Michigan

46850 Magellan Drive, Suite 100, Novi, MI 48377, U.S.A.
TEL:1-(888)648-8869 FAX: 1-(248)926-0928

M3 Solution Center-California

16925 E. Gale Avenue, City of Industry, CA 91745, U.S.A.
TEL:1-(888)648-8869 FAX:1-(626)369-3352

M3 Solution Center-North Carolina

11515 Vanstory Drive, Suite 140, Huntersville, NC 28078, U.S.A.
TEL:1-(888)648-8869 FAX:1-(704)875-9273

M3 Solution Center-Alabama

2100 Riverchase Center, Suite 106, Hoover, AL 35244, U.S.A.
TEL:1-(888)648-8869 FAX:1-(205)988-3423

M3 Solution Center-Washington

1000 SW 34th Street Suite G, Renton, WA 98057 U.S.A.
TEL:1-(888)648-8869

M3 Solution Center-Texas

4560 Kendrick Plaza Drive, Suite 120, Houston, TX 77032, U.S.A.
TEL:1-(888)648-8869 FAX:1-(281)227-0937

M3 Solution Center-Massachusetts

753 Forest Street, Suite 110, Marlborough, MA 01752, U.S.A.
TEL:1-(888)648-8869 FAX:1-(508)485-0782

Mitutoyo America Corporation Calibration Lab

965 Corporate Boulevard, Aurora, IL 60502, U.S.A.
TEL:1-(888)648-8869 FAX:1-(630)978-6477

Micro Encoder, Inc.

11533 NE 118th Street, Kirkland, WA 98034-7111, U.S.A.
TEL:1-(425)821-3906 FAX:1-(425)821-3228

Micro Encoder Los Angeles, Inc.

16925 E. Gale Avenue, City of Industry, CA 91745-1806 U.S.A.
TEL: 1-626-961-9661 FAX:1-626-333-8019

Canada

Mitutoyo Canada Inc.

2121 Meadowvale Blvd., Mississauga, Ont. L5N 5N1., CANADA
TEL:1-(905)821-1261 FAX:1-(905)821-4968

Montreal Office

7075 Place Robert-Joncas Suite 129, Montreal, Quebec H4M 2Z2, CANADA
TEL:1-(514)337-5994 FAX:1-(514)337-4498

Brazil

Mitutoyo Sul Americana Ltda.

Head office / M3 Solution Center / Factory
Rodovia Índio Tibiriça 1555, Bairro Raffo, CEP 08655-000 Suzano – SP, Brasil
TEL:55 (11)5643-0040

Argentina

Mitutoyo Sul Americana Ltda.

Argentina Branch / M3 Solution Center
Av. B. Mitre 891/899 – C.P. (B1603CQI)
Vicente López –Pcia. Buenos Aires – Argentina
TEL:54(11)4730-1433 FAX:54(11)4730-1411

Sucursal Cordoba / M3 Solution Center

Av. Amadeo Sabattini, 1296, esq. Madrid B° Crisol Sur – CP 5000, Cordoba, ARGENTINA
TEL/FAX:54 (351) 456-6251

Mexico

Mitutoyo Mexicana, S.A. de C.V.

Prolongación Industria Eléctrica No. 15 Parque Industrial Naucalpan

Naucalpan de Juárez, Estado de México C.P. 53370, MÉXICO

TEL: 52 (01-55) 5312-5612

Monterrey Office / M3 Solution Center Monterrey

Blv. Interamericana No. 103, Parque Industrial FINSA, C.P. 66636 Apodaca, N.L., MÉXICO

TEL: 52(01-81) 8398-8227/8228/8242/8244

FAX: 52(01-81) 8398-8226

Tijuana Office / M3 Solution Center Tijuana

Calle José María Velazco 10501-C, Col. Cd. Industrial Nueva Tijuana, C.P. 22500 Tijuana, B.C., MÉXICO

TEL: 52 (01-664) 647-5024

Querétaro Office / M3 Solution Center Querétaro

Av. Cerro Blanco No.500-1, Colonia Centro Sur, Querétaro, Querétaro, C.P. 76090, MÉXICO

TEL: 52 (01-442) 340-8018, 340-8019 and 340-8020

FAX: 52 (01-442) 340-8017

Mitutoyo Mexicana, S.A. de C.V. Querétaro Calibration Laboratory

Av. Cerro Blanco 500 30 Centro Sur, Querétaro, Querétaro, C.P. 76090, MÉXICO

TEL: 52 (01-442) 340-8018, 340-8019 and 340-8020

FAX: 52 (01-442) 340-8017

Aguascalientes Office / M3 Solution Center

Av. Aguascalientes No. 622, Local 15 Centro Comercial El Cilindro Fracc. Pulgas Pandas Norte, C.P. 20138, Aguascalientes, Ags. MÉXICO

TEL: 52 (01-449) 174-4140 and 174-4143

Irapuato Office / M3 Solution Center

Boulevard a Villas de Irapuato No. 1460 L.1 Col. Ejido Irapuato C.P. 36643

Irapuato, Gto., MÉXICO

TEL: 52 (01-462) 144-1200 and 144-1400

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Mitutoyo Corporation

20-1, Sakado 1-Chome, Takatsu-ku, Kawasaki-shi, Kanagawa 213-8533, Japan
Tel: +81 (0)44 813-8230 Fax: +81 (0)44 813-8231
Home page: <http://www.mitutoyo.co.jp/global.html>

For the EU Directive, Authorized representative and importer in the EU:
Mitutoyo Europe GmbH
Borsigstrasse 8-10, 41469 Neuss, Germany

Printed in Japan

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