



IF Module for LSM Controller <EtherCAT>

LSM-EC-A



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. 99MBC165A1

Date of publication: June 1, 2025 (1)



■ Product names and model numbers covered in this document

Product name	Model number
IF Module for LSM Controller <EtherCAT>	LSM-EC-A

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- 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.
- Read this document thoroughly before operating the product. In particular, be sure to fully understand "Safety Precautions" and "Precautions for Use".
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Conventions and Wording Used in This Document

■ Safety reminder conventions and wording warning against potential hazards

 DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury .
 WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury .
 CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury .
NOTICE	Indicates a situation which, if not avoided, may result in property damage .
	Electricity Alerts the user to a specific hazardous situation that means "Caution, risk of electric shock".
	Hot surface Alerts the user to a specific hazardous situation that means "Caution, risk of burns due to high temperature".
	Flammable material Alerts the user to a specific hazardous situation that means "Caution, risk of igniting gas".
	Sharp element Alerts the user to a specific hazardous situation that means "Caution, risk of injury".
	Crushing of hands Alerts the user to a specific hazardous situation that means "Caution, risk of hand pinching".
	Optical radiation Alerts the user to a specific hazardous situation that means "Caution, risk of high-intensity light".

■ Conventions 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 reference location

Tips

Indicates further information and details relevant for the operating methods and procedures that are explained in that section.



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

Example: For details about XX, see  "1.2 Features of This Product" on page 1 in "1 Introduction".

Safety Precautions

Read these "Safety Precautions" thoroughly before operating the product to use it properly. These safety precautions include such information as to prevent injury to the operator and other persons, damage to property and product defects. Be sure to observe these precautions carefully.

■ Precautions for this product

CAUTION

 To prevent electric shocks, strictly observe the following.
Failure to observe these precautions could result in electric shocks or burns, or in some cases death.

- | | |
|---|--|
|  | <ul style="list-style-type: none">• When mounting external devices or optional accessories, turn off the power to the device.• Ensure that the product is properly grounded.• Halt the system in case of a malfunction. |
|  | <ul style="list-style-type: none">• Do not disassemble this product or remove its cover.
There is a risk of electric shock or burns, and in some cases, death or serious injury. In addition, there is a risk of accidents due to intrusion of material such as metal powder.• Do not touch the connection terminals with your hands or objects in order to prevent electric shocks due to connection faults. |

NOTICE

- | | |
|---|---|
|  | Securely connect the connectors of the connecting cables for noise isolation. |
|---|---|

Tips

Even if an error is displayed while measuring, it does not necessarily indicate a malfunction. See  "6 Troubleshooting" on page 39 to check the cause and solution.

Precautions for Use

■ Use and handling of the product

- Use this product only by connecting to measuring instruments which supports this product.



Do not use this product for measuring instruments which does not support this product.
For measuring instruments supported by this product, see  "1.3 LSM System Diagram" on page 2.

- This product is for industrial usage.



Do not use this product for purposes other than for industrial usage.

- This product is a precision instrument.



- Do not subject the product to drastic shocks such as dropping it, or exert excessive force upon it.
- Do not disassemble or modify the product.

If the product is used beyond the conditions indicated in the specifications ( "7 Specifications" on page 41), be aware that the functions and performance cannot be guaranteed.

■ Environment for placement

This product is a precision electronic instrument and is designed for indoor use. To obtain the highest accuracy, take into account the following conditions when installing the product. Mitutoyo assumes no responsibility for accidents or failures that result from disregarding the following items.

	Use the product in the following places. • Where there is minimal dust and grit Dust or grit in the usage area will adversely affect the mechanical and electronic components inside the product. • Where there are minimal vibrations If the product is going to be used in places where there are lots of vibrations, problems will be generated in the precision components being used, which will cause measuring performance to be impaired. If use in a place with vibrations is inevitable, take measures to reduce vibrations, such as laying an anti-vibration rubber mat under the product. • Where the ambient temperature is from 0 °C through 50 °C • Where the humidity is from 20 % RH through 85 % RH (without condensation) • Where the altitude is 2000 m or lower If the product is used in places where the altitude exceeds 2000 m, it will cause measuring performance to be impaired.
	Do not use or store the product in the following places where the temperature and humidity drastically fluctuate, because the product's functions and measurement results will be adversely affected and it will cause malfunction. • Where exposed to direct sunlight If installing this product in a place exposed to direct sunlight, such as near a window, is inevitable, take measures to shade the product from the sun, such as using a curtain. • Where extremely hot or cold • Where there are risks of getting wet

Tips

This product does not conform to the International Protection standard (IP standard). Sensors (LSM-02-A and LSM-30-A) are IP67 rated.

■ Maintenance

For information on the care of this product, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).

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.

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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 exported). 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	汞	镉	六价铬	多溴联苯	多溴二苯醚
	(Pb)	(Hg)	(Cd)	(Cr(VI))	(PBB)	(PBDE)
本体	○	○	○	○	○	○
电气设备部分	×	○	○	○	○	○
配件	○	○	○	○	○	○

部件名称	有害物质			
	邻苯二甲酸二正丁酯	邻苯二甲酸二异丁酯	邻苯二甲酸丁基苄酯	邻苯二甲酸二(2-乙基己)酯
	(DBP)	(DIBP)	(BBP)	(DEHP)
本体	○	○	○	○
电气设备部分	○	○	○	○
配件	○	○	○	○

本表格依据 SJ/T 11364 的规定编制。

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

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



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另外,此期限不同于质量/功能的保证期限。

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 Mitutoyo sales representative (☞ "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.

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About This Document

■ Positioning of this document, document map

This describes the positioning of this document and its relationship with other installments.

Laser Scan Micrometer <Controller> User's Manual	Describes use of LSMPAK to set up and operate the controller of the Laser Scan Micrometer.
Laser Scan Micrometer <Sensor> User's Manual	Describes the sensor of the Laser Scan Micrometer, including how to connect it to the controller and its specifications.
IF Module for LSM Controller <EtherCAT> User's Manual (This document)	Describes the IF Module for LSM Controller <EtherCAT> which is attached to the controller of the Laser Scan Micrometer, including its attachment to the controller and specifications.

■ Intended readers and purpose of this document

● Intended readers

This document is intended for operators and administrators of the Laser Scan Micrometer.

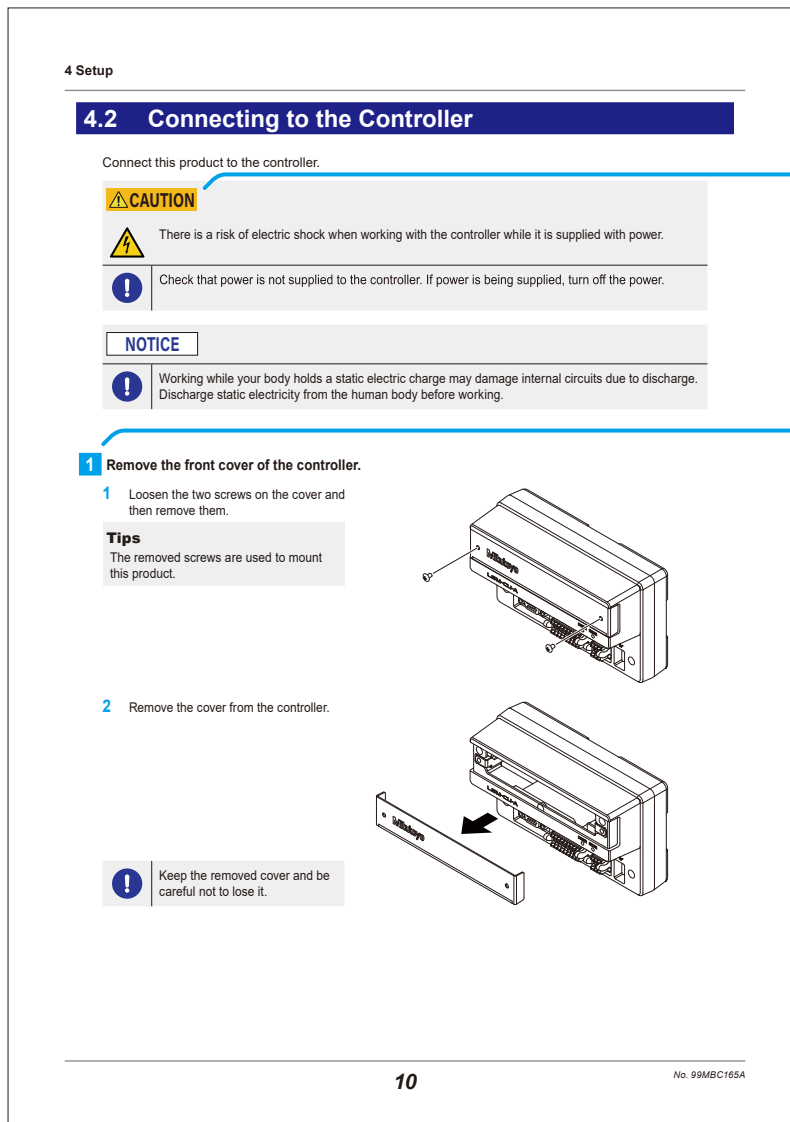
The readers are assumed to have been familiar with basic operations on a PC and Windows.

They are also assumed to be able to understand individual instructions by reading the described drawings.

● Purpose

The purpose of this document is to help you to understand the functional overview of the product, the functions of each part, the non-contact type sensor using a laser beam, operation procedures, and maintenance details.

■ How to read this document



Indicates safety information.

Indicates an operating procedure to be performed or its outline.

■ Brackets, quotation marks and numbers (1, 1)

The meanings of brackets, quotation marks and numbers to be used in this document are as follows.

(): Round brackets	Represent a paraphrase of an immediately preceding phrase or a supplementary explanation.
" ": Double quotation marks	Represent a highlighted phrase. They also indicate an index where information to be referenced is described.
[]: Square brackets	Represent a menu name on the screen, screen name, dialog name, button, display item, tab name, or key on the keyboard. They also indicate an item to be purposely entered or selected by the customer.
1, 2, 3 ... 1, 2, 3...	Indicates the order and the contents of tasks. (1 : indicates main tasks, 1 : indicates detailed tasks)

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1 Introduction

This product is an IF module that enables data communication using EtherCAT.

1.1 About EtherCAT

EtherCAT is an Ethernet-based open industrial network system developed by Beckhoff Automation GmbH, Germany. Use of "on-the-fly" processing enables high-speed and highly efficient communication and supports synchronous control of devices by taking transmission delay time into consideration.

Because it uses standard Ethernet technology as its physical layer, it also allows use of ordinary Ethernet cables.

A device such as a PLC that sends EtherCAT frames, is called an "EtherCAT master", and a device that processes EtherCAT frames on the fly is called an "EtherCAT slave".

1.2 Features of This Product

This product connects to the LSM controller and is used together with the LSM controller and sensors connected to the controller to form an LSM system.

This product communicates with an EtherCAT master device (PLC, etc.) as an EtherCAT slave.

With cyclic communication, data such as the control status of the controller and the sensor that is connected to the controller as well as the current position of the workpiece can be output to the EtherCAT master (PLC, etc.).

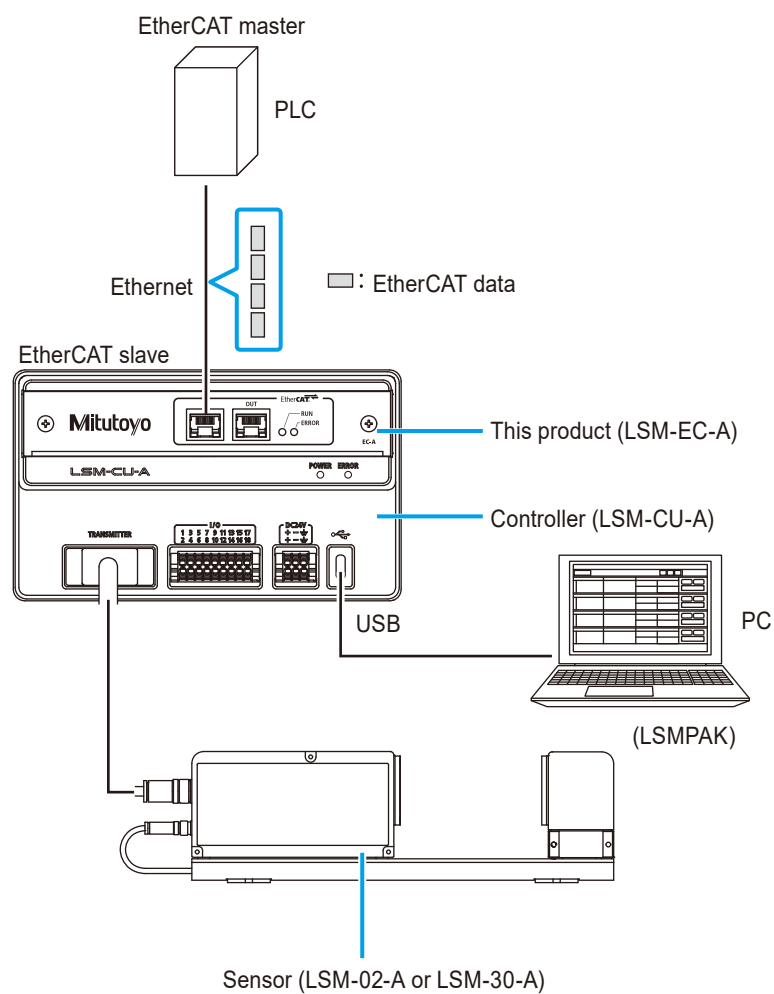
For details on communication, see  "5.1.1 EtherCAT Communication" on page 15.

For details about the controller, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).

For details about the sensor, see  "Laser Scan Micrometer <Sensor> User's Manual" (separate document).

1.3 LSM System Diagram

The following is an example of a system configuration with this product connected with the controller.



1 Introduction

Devices required for system configuration

Device name	Remarks
This product	This product is an optional accessory for controller LSM-CU-A. It is used in combination with the controller. This product enables EtherCAT communication. For details, see  "7.3 Measurement Configurations Usable with This Product" on page 42.
Controller	The controller LSM-CU-A controls the laser scan micrometer. For details about the controller, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).
Sensor	This is the sensor unit of the laser scan micrometer. LSM-02-A (0.005 mm to 2 mm) or LSM-30-A (0.3 mm to 30 mm) can be used. For details, see  "Laser Scan Micrometer <Sensor> User's Manual" (separate document).
LSMPAK (PC)	This is software used for controlling the controller. It is installed for use on a personal computer. The personal computer on which LSMPAK is installed is connected to the controller through a USB connection.
EtherCAT master (PLC, PC, etc.)	A device that communicates with this product as a slave device in EtherCAT communication. Typical EtherCAT masters include devices such as PLCs.

MEMO

2 Unpacking and Checking

After removing the product from its packaging, check that there are no missing parts or damage. This product has been thoroughly inspected before shipment from the factory, and its normal performance is guaranteed.

First, remove the product from its packaging and check the following.

- No missing parts (including the product and all accessories)
- No damage was sustained during transit

We take all possible measures to ensure the quality of our products, but in the unlikely event that you discover a missing or damaged product, please contact your nearest Mitutoyo sales office.

2

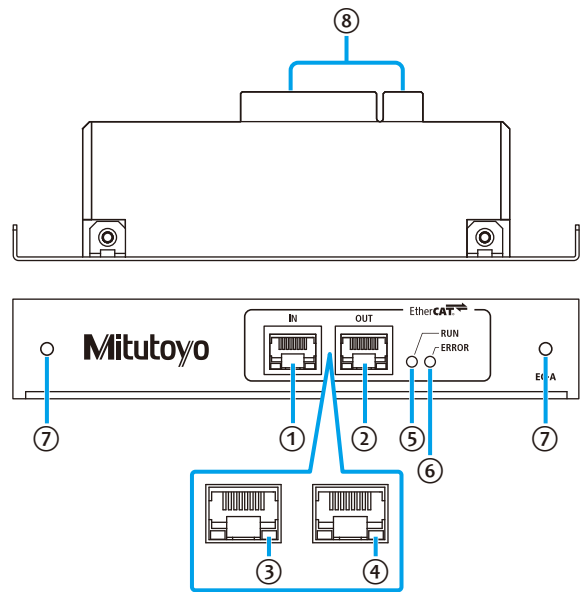
■ This product and included accessories

Part No.	Name	Quantity
02AGQ380	IF Module for LSM Controller <EtherCAT> (this product)	1
99MBC166B	Quick Start Manual	1
02NGA064	CD-ROM	1
02NGA075	LSM-EC-A device file	—
99MBC165J/A	User's Manual (PDF) (this document)	—
WA100	General product warranty (small)	1

MEMO

3 Part Names and Functions

This chapter describes the name and function of each part of this product.



No.	Name	Function	Reference
①	RJ-45 connector (port IN)	These are Ethernet ports. Connect to them with communication cables (Ethernet cables). Indicates the status of communications.	5.2.1
②	RJ-45 connector (port OUT)		
③	Link/activity LED (port IN)		
④	Link/activity LED (port OUT)		
⑤	RUN indicator	Indicates the network status of this product.	4.2
⑥	ERROR indicator	Indicates the error status of this product.	
⑦	Mounting hole	Used for mounting the controller.	
⑧	Edge connector	Insert into the socket of the controller.	

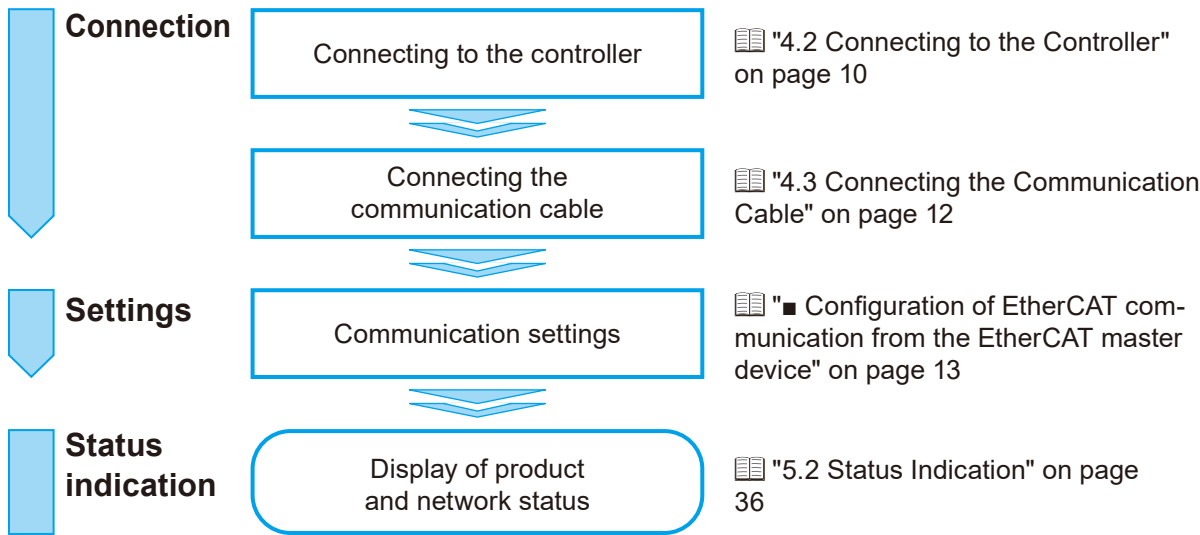
MEMO

4 Setup

Use the following procedure to connect this product and the system devices and configure the settings.

4.1 Work Flow

This section describes the work flow.



4.2 Connecting to the Controller

Connect this product to the controller.

CAUTION



There is a risk of electric shock when working with the controller while it is supplied with power.



Check that power is not supplied to the controller. If power is being supplied, turn off the power.

NOTICE



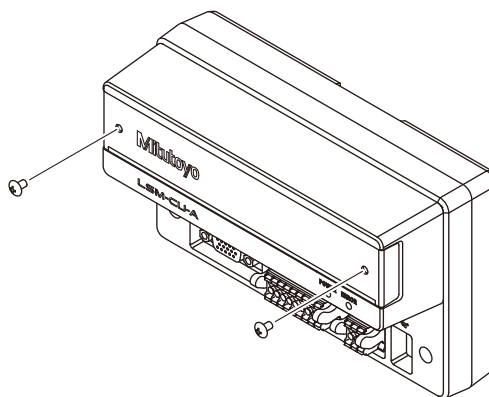
Working while your body holds a static electric charge may damage internal circuits due to discharge. Discharge static electricity from the human body before working.

1 Remove the front cover of the controller.

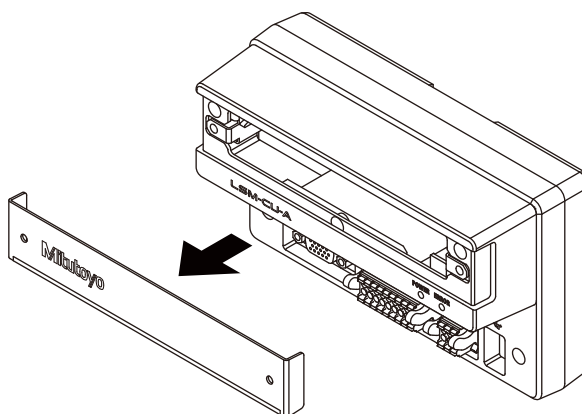
- 1 Loosen the two screws on the cover and then remove them.

Tips

The removed screws are used to mount this product.



2 Remove the cover from the controller.



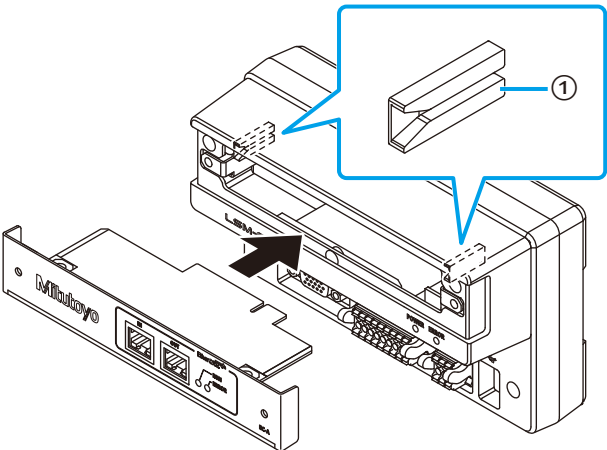
Keep the removed cover and be careful not to lose it.

2 Mount this product on the controller.

- 1** Insert this product along the guides on either side of the controller.

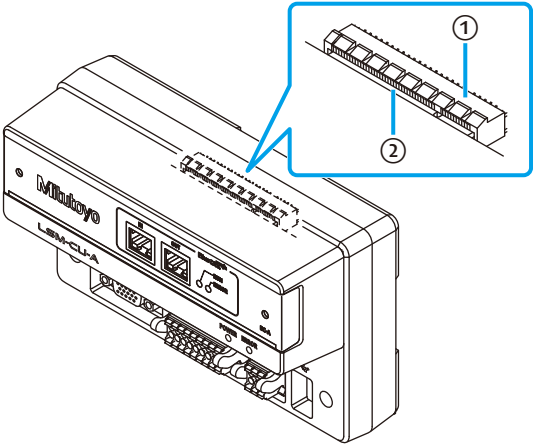
NOTICE

Insert straight into the controller.
If inserted obliquely, mounting parts such as connectors on the board may come into contact with each other, which may cause damage.



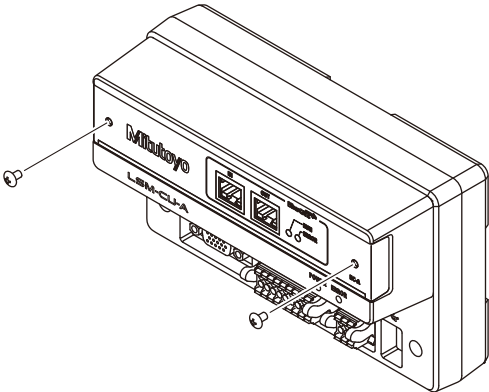
No.	Name
①	Guide

- 2** Insert the edge connector of this product into the socket of the controller.



No.	Name
①	Socket
②	Edge connector

- 3** Fasten with the two screws removed in step **1**.



4.3 Connecting the Communication Cable

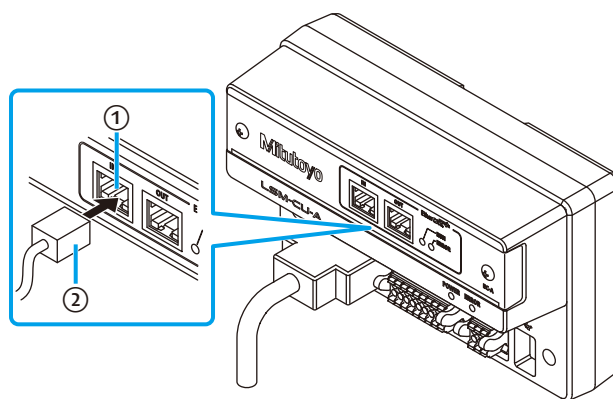
Connect the communication cable to this product.

4.3.1 How to Connect the Communication Cable

Tips

- Use an STP cable of Cat.5e or higher for the communication cable.
- This product is compatible with Auto MDI-X, which automatically detects whether the cable type is straight or cross for communication.
- This product does not support optical communication or single-pair Ethernet.
- Make sure that communication cable length does not exceed 30 m.

1 Connect the communication cable to the RJ-45 connector (port IN) of this product.



No.	Name
①	RJ-45 connector
②	Communication cable

2 Connect the other end of the communication cable to the RJ-45 connector on the network side.

Tips

- Depending on the PLC, the following connection operations may not result in normal EtherCAT communication and may require a reset operation on the PLC side.
When building your network, refer to your PLC manual.
 - Connection of the PLC to the RJ-45 connector (port OUT) of this product
 - Connection of devices that do not support EtherCAT communication
 - Connection or disconnection of the communication cable while the PLC is in the RUN state
- To add an additional EtherCAT slave, connect a communication cable to the RJ-45 connector (port OUT) of this product.

4.4 Device Settings

This section describes the settings for network communication between this product and the EtherCAT master device.

No IP address setting is required for EtherCAT communication.

■ Configuration of EtherCAT communication from the EtherCAT master device

The settings required for EtherCAT communication with this product are made using the engineering tool of the EtherCAT master device. For information on how to operate the engineering tool, see the EtherCAT master device manual.

The general setup process to be performed on the EtherCAT master device is as follows.

● Registering the device profile

Register the device profile of this product to the EtherCAT master device.

Use this product's ESI (EtherCAT Slave Information) file to register device profiles.

Use the ESI file stored on the included CD-ROM or download it from the Mitutoyo web site.

● Setting the connection

Set the connection type (point-to-point/multicast), send and receive data size, transmission interval, etc.

● Assigning device input/output data

Assign the data area to be sent/received by this product in the program variables using the engineering tool, etc.

MEMO

5 Communication Function

This chapter describes the device settings and communication function of this product.

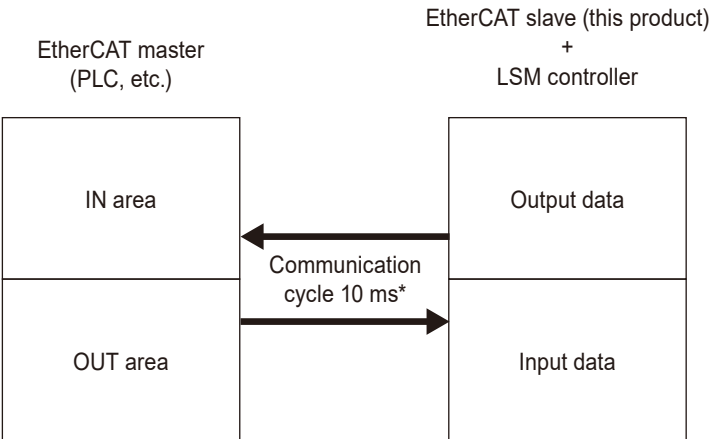
5.1 Communication Specification

5.1.1 EtherCAT Communication

Communication between the EtherCAT master device and this product is performed via EtherCAT. This section provides an overview of EtherCAT communication and details of the data used for communication.

■ Overview

The EtherCAT master device and this product conduct cyclic data communication at a fixed cycle, and input and output data are exchanged according to the communication cycle. The communication cycle of this product can be set to a value of 2 ms or greater.

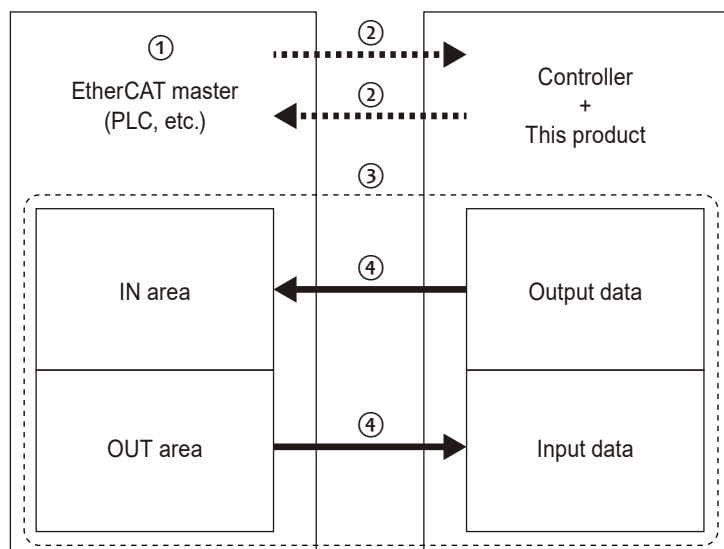


* The communication cycle can be set on an individual basis.

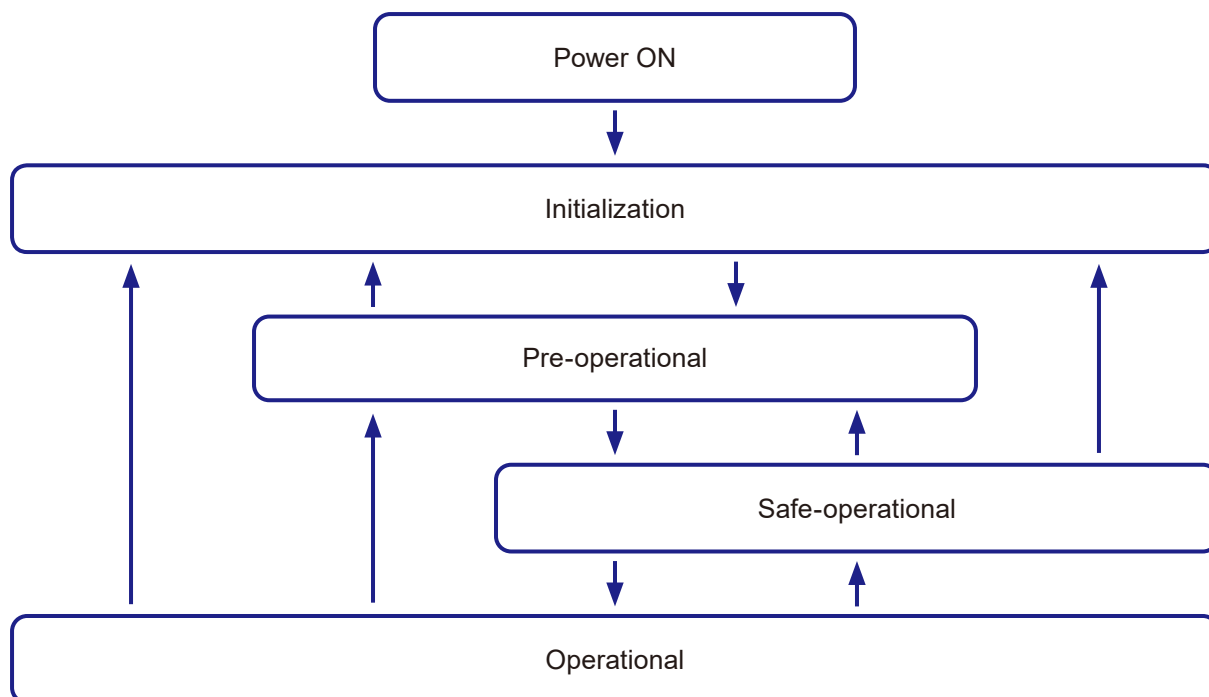
Communication must be established between the EtherCAT master and the EtherCAT slave in order for data communication to take place.

The following shows the sequence for starting data transmission.

- ① The EtherCAT master sends a connection request.
- ② Initial communication is conducted to make the connection.
- ③ Connection is established (data communication becomes possible).
- ④ Data is sent.



During the initial communication, the state of the EtherCAT slave sequentially changes according to the requests from the EtherCAT master as follows. The state of the EtherCAT slave may also change due to a connection termination request from the EtherCAT master or an error.



EtherCAT slave status	Mailbox communication (SDO communication)	Cyclic communication (PDO communication)	Description
Initialization	-	-	Communication initializing.
Pre-operational	✓	-	Mailbox communication is possible.
Safe-operational	✓	✓ (IN area only)	In addition to mailbox communication, cyclic communication to the IN area is possible for output data only.
Operational	✓	✓	Normal communication status (a connection is established to the EtherCAT master and data communication is possible).

■ Details of data

● This product → Output data to EtherCAT master

This product has two output data structures: Basic (28-byte) and Advanced (180-byte).

The Basic structure allows acquisition of data for one measurement from an EtherCAT master such as a PLC during one cyclic communication cycle while the Advanced structure allows acquisition of data for 20 measurements.

Two PDO mapping objects are defined in the ESI file for this product: Input Data (Index No. = 0x1A00, 28-byte) and Input Additional Data (Index No. = 0x1A01, 152-byte). The Basic and Advanced objects are switched by changing the assignment of the PDO assignment object (Index No. = 0x1C13).

When using the Basic structure, assign only input data to the PDO assignment object.

When using the Advanced structure, assign both input data and input additional data to the PDO assignment object.

Tips

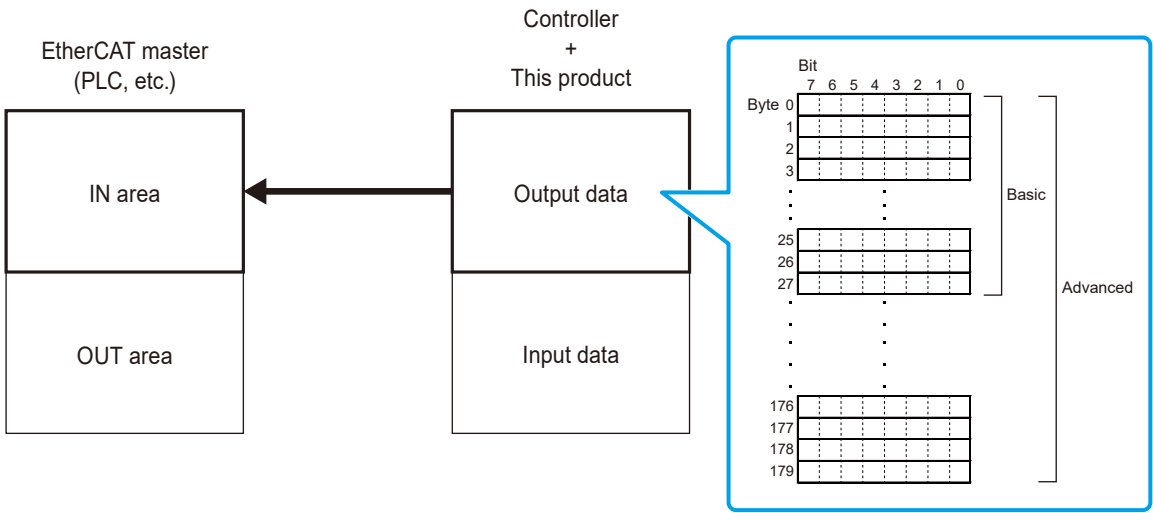
If the communication cycle between this product and the EtherCAT master is longer than the cycle for exchanging measurement data between the LSM controller and the product, measurement data may be lost on the EtherCAT master side.

The cycle of measurement data exchange between the LSM controller and this product depends on the number of averaging setting of the LSM controller.

Select Basic or Advanced and set the communication cycle between this product and the EtherCAT master according to the number of averaging setting of the LSM controller and the EtherCAT master's capability.

You can switch between Basic and Advanced and set the communication cycle between this product and the EtherCAT master using the EtherCAT master's configuration software. For details, see the EtherCAT master device manual.

5 Communication Function



Field type	TYPE	Byte	Bit	Description	Name	Current position display execution	Measurement execution
Status bit 1*	BYTE	0	7	N/A	N/A	Error record: 4 bytes	Error status record: 4 bytes
			6	N/A	N/A		
			5	Automatic workpiece detection	AUTO_DET		
			4	N/A	N/A		
			3	N/A	N/A		
			2	N/A	N/A		
			1	Two items measurement	SUB		
			0	Measuring	MEAS		
		1	7	N/A	N/A		
			6	N/A	N/A		
			5	N/A	N/A		
			4	N/A	N/A		
			3	N/A	N/A		
			2	Calibrating	CAL_OK		
			1	Offset state	OFST_NOW		
			0	Preset state	PRST_NOW		
		2	7:0	N/A	N/A		
		3	7:0	N/A	N/A		

5 Communication Function

Field type	TYPE	Byte	Bit	Description	Name	Current position display execution	Measurement execution
Status bit 2 ^{*1}	BYTE	4	7	N/A	N/A	✓ Status record: 4 bytes	✓ Status record: 4 bytes
			6	Calibration error	CAL_ER		
			5	Statistics buffer overflow	STAT_OVF		
			4	Overflow data	OVR_DATA		
			3	Waste removal (overflow)	RMV_DUST_OVR		
			2	Waste removal	RMV_DUST		
			1	Outlier elimination□(all)	ABNML_DATA_OUT_ALL		
			0	Outlier elimination	ABNML_DATA_OUT		
		5	7	N/A	N/A		
			6	N/A	N/A		
			5	Edge error	EDGER		
			4	Edge not detected	NOEDG		
			3	No measurement sampling	NO_SCAN_SIG		
			2	Measurement interruption from outside	EXT_MEAS_STP		
			1	Ring buffer overflow	RING_OVF		
			0	No workpiece	NO_WORK_PCS		
		6	7	Dirt detection	DIRT_ER		
			6	N/A	N/A		
			5	Watchdog error	WDTO_ER		
			4	LD overcurrent	LD_OC_ER		
			3	Amount of light memorize error	LIT_INT_ER		
			2	FPGA config. error	FPGA_ER		
			1	Measurement unit EEPROM load error	MEPRM_ER		
			0	EEPROM load error	EPRM_ER		
		7	7	Total error	TOTAL_ER		
			6	Invalid setting	STCFT		
			5	N/A	N/A		
			4	N/A	N/A		
			3	N/A	N/A		
			2	N/A	N/A		
			1	N/A	N/A		
			0	Power supply error	PWR_ER		
Not used	N/A	8	7:0	N/A	N/A	N/A	N/A
		9	7:0	N/A	N/A	N/A	N/A
I/O bit	BYTE	10	7	LSM processing in progress	BUSY	-	✓
			6	N/A	N/A	N/A	N/A
			5	N/A	N/A	N/A	N/A
			4	N/A	N/A	N/A	N/A
			3	Next data available	NEXT	-	✓
			2	N/A	N/A	N/A	N/A
			1	Valid measurement data available	MDVLD	-	✓
			0	Valid display data available	DDVLD	✓	-
		11	7	N/A	N/A	N/A	N/A
			6	GO/NG judgment	LT7	-	✓
			5		LT6	-	✓
			4		LT5	-	✓
			3		LT4	-	✓
			2		LT3	-	✓
			1		LT2	-	✓
			0		LT1	-	✓

5 Communication Function

Field type	TYPE	Byte	Bit	Description	Name	Current position display execution	Measurement execution
I/O bit (echo back)	BYTE	12	7	Reboot request	RBTRQ		
			6	N/A	N/A	N/A	N/A
			5	N/A	N/A	N/A	N/A
			4	N/A	N/A	N/A	N/A
			3	Stream measurement	STRM		
			2	Single measurement	SNGL		
			1	Measurement start	RUN		
			0	Current value display	DPVAL		
		13	7	Endian switching	ENDN		
			6	N/A	N/A	N/A	N/A
			5	N/A	N/A	N/A	N/A
			4	Parameter setting change request	CHGPRM		
			3	Error clear request	CLRRQ		
			2	Preset request	PSTRQ		
			1	Data reception OK	RCVOK		
			0	Measured data request	DREQ		
Device control bit (echo back)	BYTE	14	7:0	Parameter set number	PRM[7:0]		
		15	7	N/A	N/A	N/A	N/A
			6	N/A	N/A	N/A	N/A
			5	N/A	N/A	N/A	N/A
			4	N/A	N/A	N/A	N/A
			3	N/A	N/A	N/A	N/A
			2	N/A	N/A	N/A	N/A
			1	N/A	N/A	N/A	N/A
			0	GO/NG judgment ON	TOLON		
Number of valid data bits*2	INT	16	7:0	Valid data quantity	NODT[15:0] (Big endian)	✓	✓
		17	7:0				
Sequential number bits*2	UINT	18	7:0	Sequential number	SEQNO[15:0] (Big endian)		
		19	7:0				
Data bits (data ①)*2	FLOAT	20	7:0	Data	DATA01[31:0] (Big endian)	✓ Internal value ①: 4 bytes	✓ Measured value ①: 4 bytes
		21	7:0				
		22	7:0				
		23	7:0				
Data bits (data ①)*2	INT	24	7:0	GO/NG judgment information	TOL01[15:0] (Big endian)	-	✓ GO/NG judgment result①: 2 bytes
		25	7:0				
Data bits (data ①)*2	INT	26	7:0	Status information	STS01[15:0] (Big endian)	-	✓ Data status①: 2 bytes
		27	7:0				
:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:
Data bits (data ②)*2	FLOAT	172	7:0	Data	DATA20[31:0] (Big endian)	✓ Internal value ②: 4 bytes	✓ Measured value ②: 4 bytes
		173	7:0				
		174	7:0				
		175	7:0				
Data bits (data ②)*2	INT	176	7:0	GO/NG judgment information	TOL20[15:0] (Big endian)	-	✓ GO/NG judgment result②: 2 bytes
		177	7:0				
Data bits (data ②)*2	INT	178	7:0	Status information	STS20[15:0] (Big endian)	-	✓ Data status②: 2 bytes
		179	7:0				

*1 To update the status, perform a measurement (RUN) or display current value (DPVAL) before referring to the status. Status information is not updated unless measurement (RUN) or current value display (DPVAL) is performed.

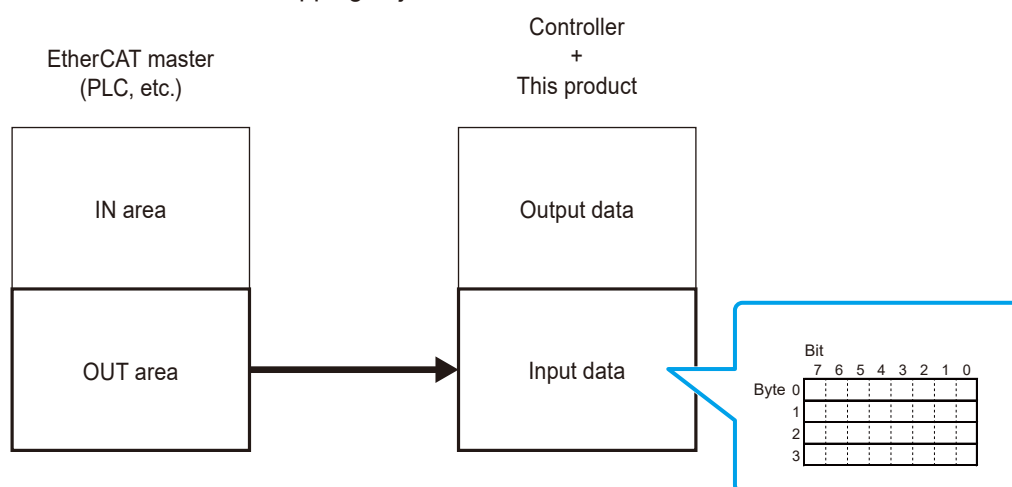
*2 Endian specification is available.

5 Communication Function

● EtherCAT master → Input data to this product

4-byte data (bytes 0 to 3) is received.

The Index No. of the PDO assignment object defined in the ESI file for this product is 0x1C12, and the Index No. of the PDO mapping object is 0x1600.



Field type	TYPE	Byte	Bit	Description	Name	Current position display execution	Measurement execution
I/O bit	BYTE	0	7	Reboot request	RBTRQ	✓	✓
			6	N/A	N/A	N/A	N/A
			5	N/A	N/A	N/A	N/A
			4	N/A	N/A	N/A	N/A
			3	Stream measurement	STRM		
			2	Single measurement	SNGL	-	✓
			1	Measurement start	RUN	-	✓
			0	Current value display	DPVAL	✓	-
I/O bit	BYTE	1	7	Endian switching	EDEN	N/A	N/A
			6	N/A	N/A	N/A	N/A
			5	N/A	N/A	N/A	N/A
			4	Parameter setting change request	CHGPRM		
			3	Error clear request	CLRRQ	✓	✓
			2	Preset request	PSTRQ	✓	✓
			1	Data reception OK	RCVOK	✓	✓
			0	Measured data request	DREQ	✓	✓
Device control bit	BYTE	2	7:0	Parameter number	PRM[7:0]		
Device control bit	BYTE	3	7:1	N/A	N/A	N/A	N/A
			0	GO/NG judgment ON	TOLON	✓	✓

● Functions of definition bits

This product → EtherCAT master

Field name	Size	Description
AUTO_DET	1 bit	Auto Detect Automatic workpiece detection 1: ON 0: OFF
BUSY	1 bit	Busy Access under way between IF module and LSM controller 1: Access in progress 0: No access
CAL_ER	1 bit	Calibration Error Calibration error 1: Error occurred 0: Normal
CAL_OK	1 bit	Calibration Calibration status display 1: Calibration OK 0: Not calibrated
DAT01	4 bytes	Data storage area Measured value ① to ⑳ or indicated value ① to ㉔.
DAT02	4 bytes	
DAT03	4 bytes	
DAT04	4 bytes	
DAT05	4 bytes	
DAT06	4 bytes	
DAT07	4 bytes	
DAT08	4 bytes	
DAT09	4 bytes	
DAT10	4 bytes	
DAT11	4 bytes	
DAT12	4 bytes	
DAT13	4 bytes	
DAT14	4 bytes	
DAT15	4 bytes	
DAT16	4 bytes	
DAT17	4 bytes	
DAT18	4 bytes	
DAT19	4 bytes	
DAT20	4 bytes	
DDVLD	1 bit	Valid Display Value Display data availability indication 1: Display data available 0: Display data not available
DIRT_ER	1 bit	Dirt Error Sensor unit protective glass stain error

5 Communication Function

Field name	Size	Description
EDGER	1 bit	Edge Error Edge error (Occurs when, for example, an odd number of boundaries is detected on the measurement target.) 1: Error occurred 0: Normal
EPRM_ER	1 bit	EEPROM Error EEPROM load error 1: Error occurred 0: Normal
FPGA_ER	1 bit	FPGA Error FPGA configuration error 1: Error occurred 0: Normal
LDOC	1 bit	LD Overcurrent Error Measurement unit laser diode overcurrent error 1: Overcurrent detected 0: Normal
LIT_INT_ER	1 bit	Light Intensity Error Measurement unit laser diode brightness reduction error
LT1	1 bit	Limit1 to Limit7 GO/NG judgment LT1 to LT7 * Corresponds to R1 to R7 of the Multi-Limit Selection function.
LT2	1 bit	
LT3	1 bit	
LT4	1 bit	
LT5	1 bit	
LT6	1 bit	
LT7	1 bit	
MDVLD	1 bit	Valid Measurement Data Measurement data availability indication 1: Measurement data available 0: Measurement data not available
MEAS	1 bit	Measuring Measuring 1: Measuring 0: Idle
MEPRM_ER	1 bit	Sensor EEPROM Error Measurement unit EEPROM load error 1: Error occurred 0: Normal
NEXT	1 bit	Next Data Next data availability indication 1: Next data available 0: Next data not available
NODT	2 bytes	Number of Valid Data Measurement data quantity indication

5 Communication Function

Field name	Size	Description
NOEDG	1 bit	No Edge Edge not detected error (Unable to properly detect boundary on the measurement target.) 1: Error occurred 0: Normal
OFT_NOW	1 bit	Offset Offset state indication 1: Offset set 0: No offset
PRM[0:7]	8 bit	Parameter Number Echo Measurement parameter set number display (0x0 to 0xff) * Up to 20 parameter sets can be stored.
PST_NOW	1 bit	Preset Preset state indication 1: Preset set 0: No preset
SEQNO	2 bytes	Sequence Number Sequence number assigned to the measurement data. * This is a sequential number from 0 through 65535 that is incremented each time the IF module acquires data from the LSM controller. Numbering returns to 0 upon reaching 65535.
STCFT	1 bit	State Conflict Error Setting mismatch 1: Mismatch error 0: Normal * Raised upon incorrect bit operation.
STS01	2 bytes	STATUS ① to ㉑ 0x0001: Outlier elimination 0x0002: Outlier elimination 0x0004: Dirt removal process applied 0x0008: Dirt removal process applied 0x0010: Overflow data 0x0020: Statistics buffer overflow 0x0040: Calibration error 0x0080: Outlier elimination CNT warning 0x0100: ERR-0 No workpiece 0x0200: Measurement ring buffer overflow 0x0800: ERR-8 No measurement sampling 0x1000: Edge not detected error (upon scan interrupt)
STS02	2 bytes	
STS03	2 bytes	
STS04	2 bytes	
STS05	2 bytes	
STS06	2 bytes	
STS07	2 bytes	
STS08	2 bytes	
STS09	2 bytes	
STS10	2 bytes	
STS11	2 bytes	
STS12	2 bytes	
STS13	2 bytes	
STS14	2 bytes	
STS15	2 bytes	
STS16	2 bytes	
STS17	2 bytes	
STS18	2 bytes	
STS19	2 bytes	
STS20	2 bytes	

Field name	Size	Description
TOL01	2 bytes	GO/NG judgment ① to ⑳ 1: Lower threshold exceeded (-NG) 2: Within limits (GO) 4: Upper threshold exceeded (+NG) * Threshold values are set from the LSM controller. For details about the controller, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).
TOL02	2 bytes	
TOL03	2 bytes	
TOL04	2 bytes	
TOL05	2 bytes	
TOL06	2 bytes	
TOL07	2 bytes	
TOL08	2 bytes	
TOL09	2 bytes	
TOL10	2 bytes	
TOL11	2 bytes	
TOL12	2 bytes	
TOL13	2 bytes	
TOL14	2 bytes	
TOL15	2 bytes	
TOL16	2 bytes	
TOL17	2 bytes	
TOL18	2 bytes	
TOL19	2 bytes	
TOL20	2 bytes	
TOTAL_ER	1 bit	Total Error Error status indication (determined from R-IN) 1: Error occurred 0: No error * All error causes are ORed for display.
WDTO	1 bit	Watchdog Error Watchdog timeout error 1: WDT timeout occurred 0: Error did not occur

EtherCAT master → this product

Field name	Size	Description
CHGPRM	1 bit	Change Parameter Parameter setting change 1: Change request 0: No change request * Changed on transition from 0 → 1.
CLRRQ	1 bit	Clear Request Error status clear request 1: Clear request 0: No clear request * Cleared on transition from 0 → 1.
DPVAL	1 bit	Display Value Display value acquisition start 1: Start display value acquisition 0: Stop display value acquisition

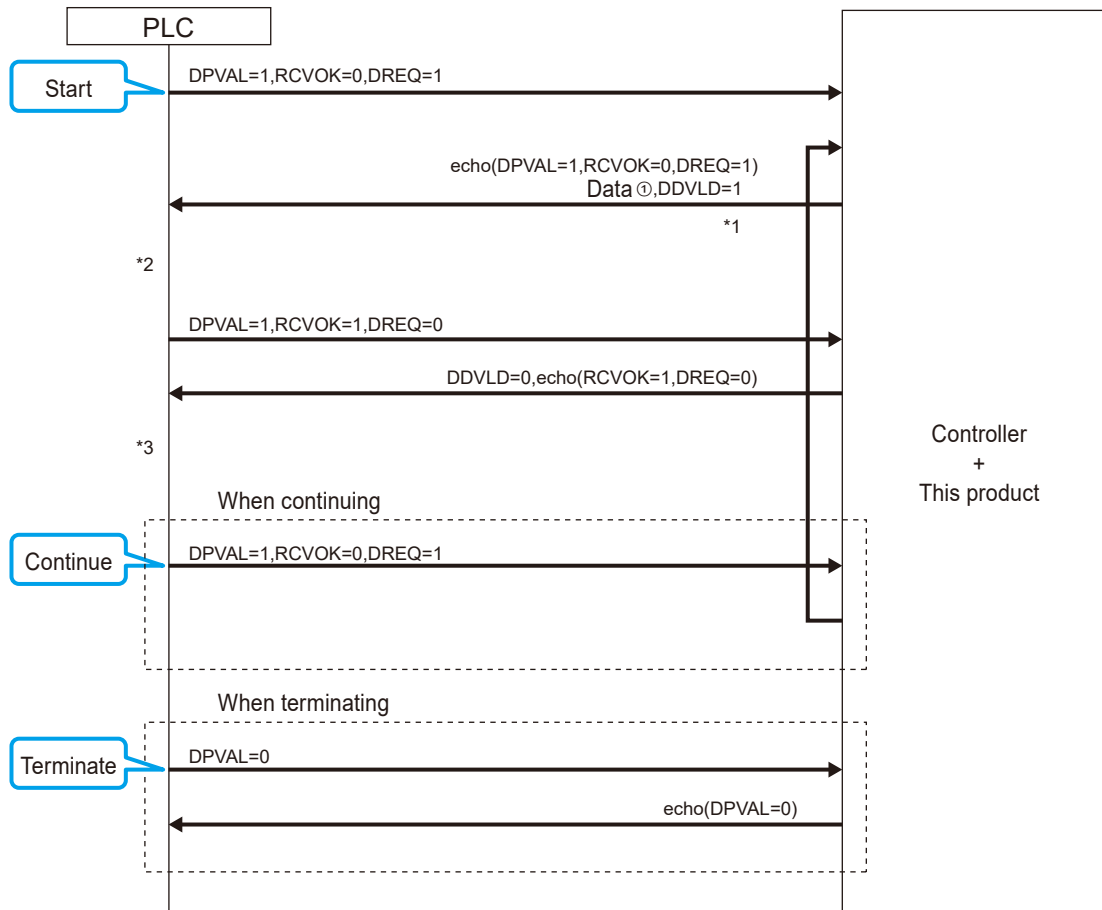
5 Communication Function

Field name	Size	Description
DREQ	1 bit	Data Request Measured/displayed value data request 1: Data request 0: No data request
ENDN	1 bit	Endian Swap Endian selection 1: Big endian 0: Little endian
PRM[0:7]	8 bit	Parameter Number Specify parameter set numbers 0 to 19 (0x00 to 0xff)
PSTRQ	1 bit	Preset Request Preset request 1: Preset request 0: No preset request * Set on transition from 0 → 1.
RBTRQ	1 bit	Reboot Request Device reset request 1: Reset request 0: No reset request * Reset on transition from 0 → 1.
RCVOK	1 bit	Receive OK Measurement data reception complete
RUN	1 bit	Run Measurement start/stop 1: Measurement start 0: Measurement stop
SNGL	1 bit	Single Measurement Single measurement specification 1: Single measurement 0: Continuous-run measurement
STRM	1 bit	Stream Measurement Measurement data streaming acquisition 1: Streaming acquisition 0: Normal acquisition
TOLON	1 bit	Tolerance On GO/NG judgment ON/OFF 1: GO/NG judgment ON 0: GO/NG judgment OFF

■ Communication method

This section describes the procedure for communication from an EtherCAT master (PLC, etc.) to the EtherCAT slave (this product).

● Idle value display



*1 Response (output data to IN area of the EtherCAT master (PLC, etc.))

- Idle value ①: Bytes 20 to 23 data ①
- Status record: Bytes 4 to 7
- Error record: Bytes 0 to 3
- Valid data quantity: Bytes 16 to 17 (valid data quantity=1)

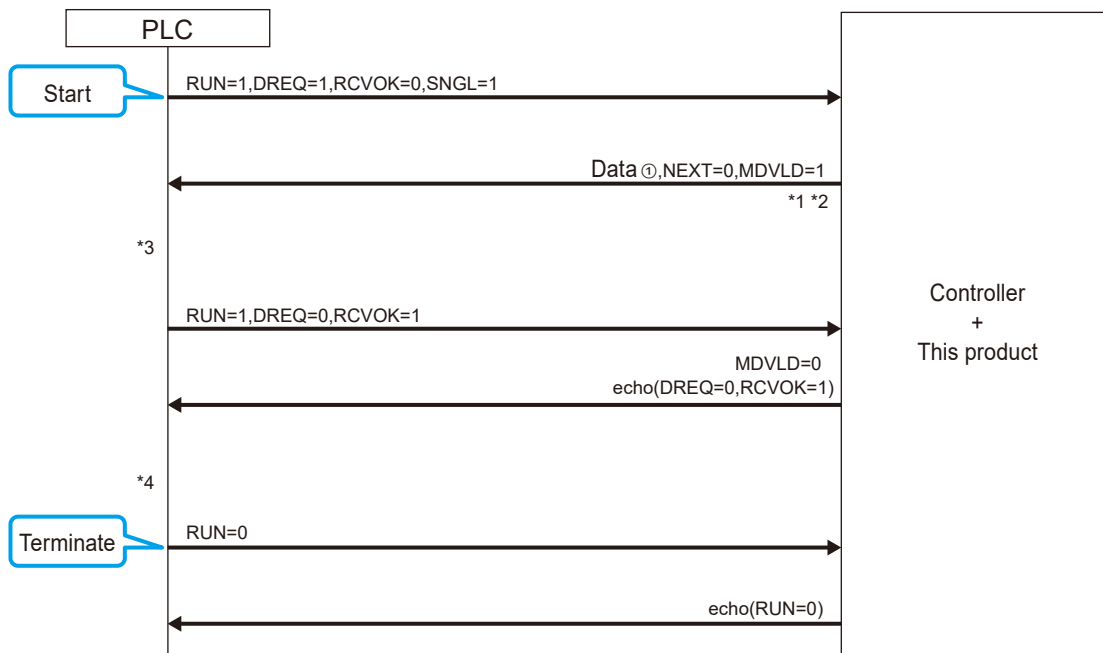
*2 Processing on PLC side

- Checks that DDVLD=1 was set.
- Reads the valid data quantity to check the data count.
- Reads in the number of pieces of data from data areas ① through ⑳ as written in the valid data quantity.
- Sets the data reception OK flag.
RCVOK=1
DREQ=0

*3 Processing on PLC side

After confirming DDVLD=0, sets RCVOK=0.

● Single measurement execution



*1 For single measurement: NEXT=0

*2 Response (output data to IN area of the EtherCAT master (PLC, etc.))

- Status record: Bytes 4 to 7
 - Error record: Bytes 0 to 3
 - Valid data quantity: Bytes 16 to 17
 - Measured value ①: Bytes 20 to 23
 - GO/NG judgment result of measured value ①: Bytes 24 to 25
 - Data status of measured value ①: Bytes 26 to 27
- (When two items measurement is performed, the acquired two items of data are stored in the data ① and ⑪ areas, respectively.)

For details about two items measurement, see "Laser Scan Micrometer <Controller> User's Manual" (separate document).

*3 Processing on PLC side

- Checks that MDVLD=1 was set.
 - Reads the valid data quantity to check the data count.
 - Reads in the number of pieces of data from data areas ① through ⑳ as written in the valid data quantity.
- (When two items measurement is performed, the acquired two items of data are stored in the data ① to ⑩ and ⑪ to ⑳ areas, respectively.)

For details about two items measurement, see "Laser Scan Micrometer <Controller> User's Manual" (separate document).

- Sets the data reception OK flag.
RCVOK=1
DREQ=0

*4 Processing on PLC side

After confirming MDVLD=0, sets RCVOK=0.

NOTICE

Zero run measurement is not supported.

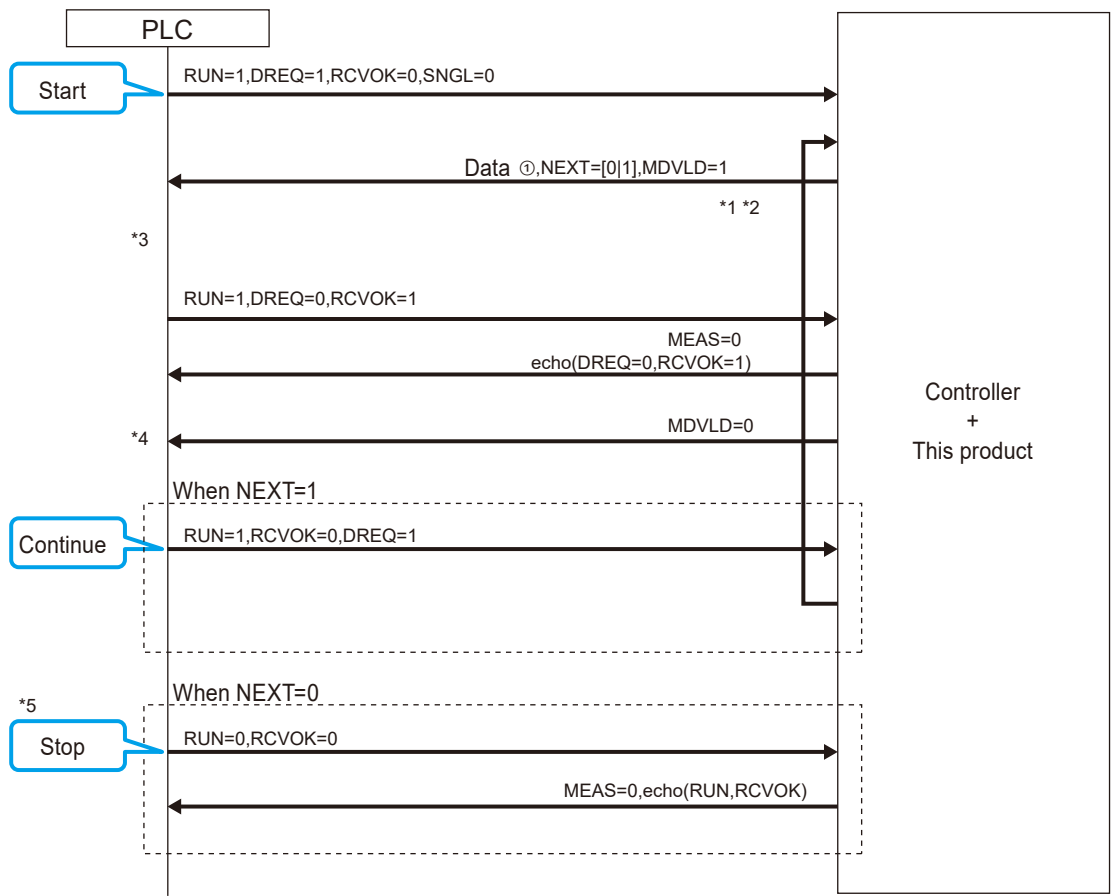
● Continuous measurement execution

Data can be acquired either by normal acquisition or streaming acquisition.
Streaming acquisition allows measurement data acquisition at shorter intervals than normal acquisition.
Use of streaming acquisition is recommended if the number of averaging is set to less than 4 times by the LSM controller.
For details about the number of averaging, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).

IMPORTANT

Communication handshaking between the PLC and LSM is omitted during streaming acquisition, so data is not assured. If you want to detect missing data, create a PLC program to check using sequence numbers.

With normal acquisition



*1 If the valid data quantity is not -1: NEXT=1

- Status record: Bytes 4 to 7
- Error record: Bytes 0 to 3
- Valid data quantity: Bytes 16 to 17
- Measured value ①: Bytes 20 to 23
- GO/NG judgment result of measured value ①: Bytes 24 to 25
- Data status of measured value ①: Bytes 26 to 27

(When two items measurement is performed, the acquired two items of data are stored in the data ① and ⑪ areas, respectively.)

processing on PLC side

- Checks that MDVLD=1 was set.
- Reads the valid data quantity to check the data count.
- Reads in the number of pieces of data from data areas ① through ⑳ as written in the valid data quantity.
(When two items measurement is performed, the acquired two items of data are stored in the data ① to ⑩ and ⑪ to ⑳ areas, respectively.)

Sets the data reception OK flag.
RCVOK=1
DREQ=0

After confirming MDVLD=0, sets RCVOK=0.

It may take a while to stop the measurement depending on the number of samples and the number of averages set.

```

sequenceDiagram
    participant PLC
    participant Controller as Controller + This product

    Note over PLC: Start
    PLC->>Controller: RUN=1,DREQ=1,STRM=1
    Controller-->>PLC: echo(RUN=1,DREQ=1,STRM=1)
    PLC->>Controller: Data ①~②⑩
    Controller-->>PLC: *1
    Note over PLC: *2
    PLC->>Controller: Data ①~②⑩
    Controller-->>PLC: *1
    PLC->>Controller: Data ①~②⑩
    Controller-->>PLC: *1
    Note over PLC: .
    Note over PLC: .
    Note over PLC: .
    Note over PLC: *3
    Note over PLC: Stop
    PLC->>Controller: RUN=0,DREQ=0,STRM=0
    Controller-->>PLC: echo(RUN=0,DREQ=0,STRM=0)
  
```

5 Communication Function

*1 Response (output data to IN area of the EtherCAT master (PLC, etc.))

- Status record: Bytes 4 to 7
 - Error record: Bytes 0 to 3
 - Valid data quantity: Bytes 16 to 17
 - Measured value ①: Bytes 20 to 23
 - GO/NG judgment result of measured value ①: Bytes 24 to 25
 - Data status of measured value ①: Bytes 26 to 27
- (When two items measurement is performed, the acquired two items of data are stored in the data ① and ⑪ areas, respectively.)

For details about two items measurement, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).

*2 Processing on PLC side

Data is acquired by repeating the following steps.

Data is updated at the specified communication cycle, and SEQNO is incremented at each update.

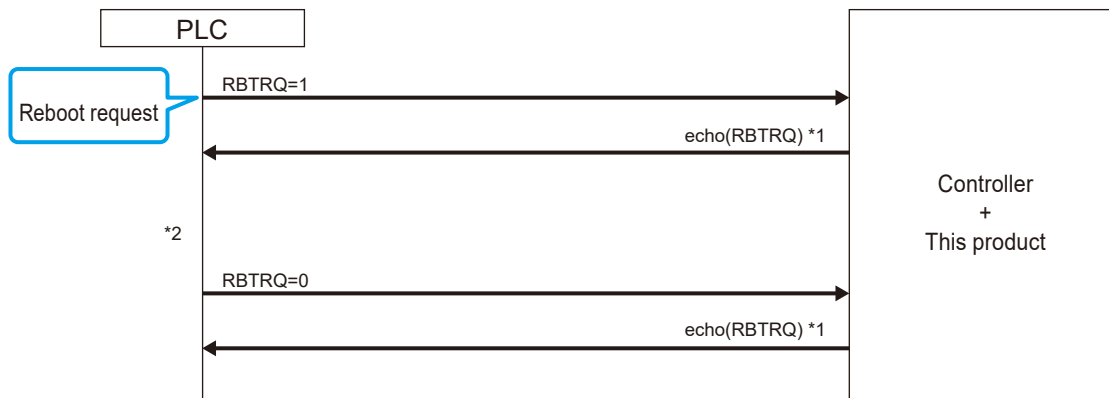
- Check the sequence number (SEQNO) of the data.
 - Reads the valid data quantity to check the data count.
 - Reads in the number of pieces of data from data areas ① through ⑳ as written in the valid data quantity.
- (When two items measurement is performed, the acquired two items of data are stored in the data ① to ⑩ and ⑪ to ㉑ areas, respectively.)

For details about two items measurement, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).

*3 Response

It may take a while to stop the measurement depending on the number of samples and the number of averages set.

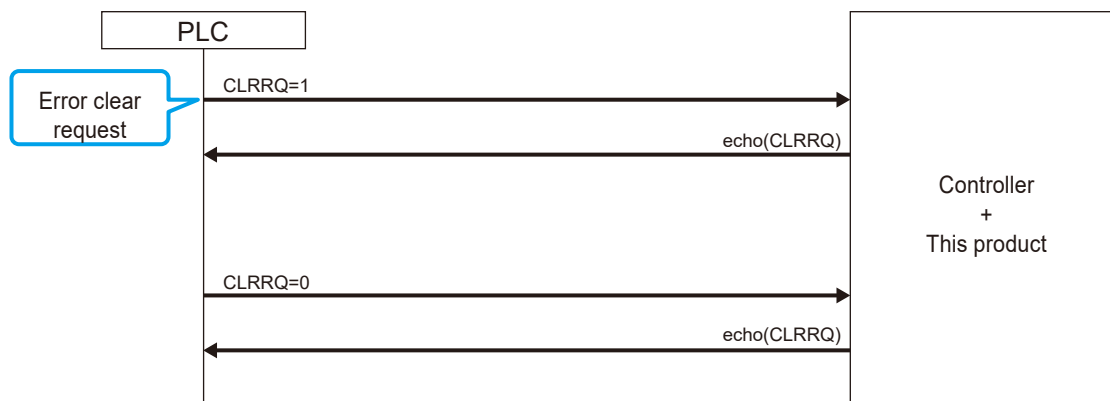
● Reboot request



*1 Depending on the timing, this response may not be received by PLC. This is because when RBTRQ is issued, the device enters reboot operation and echo(RBTRQ) becomes 0.

*2 The RBTRQ bit should be held for at least one cycle of cyclic communication.

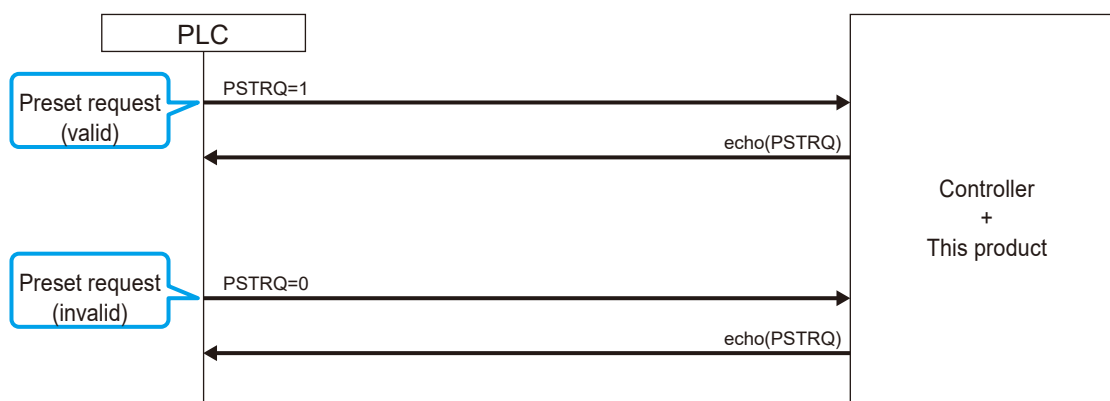
● Error clear request



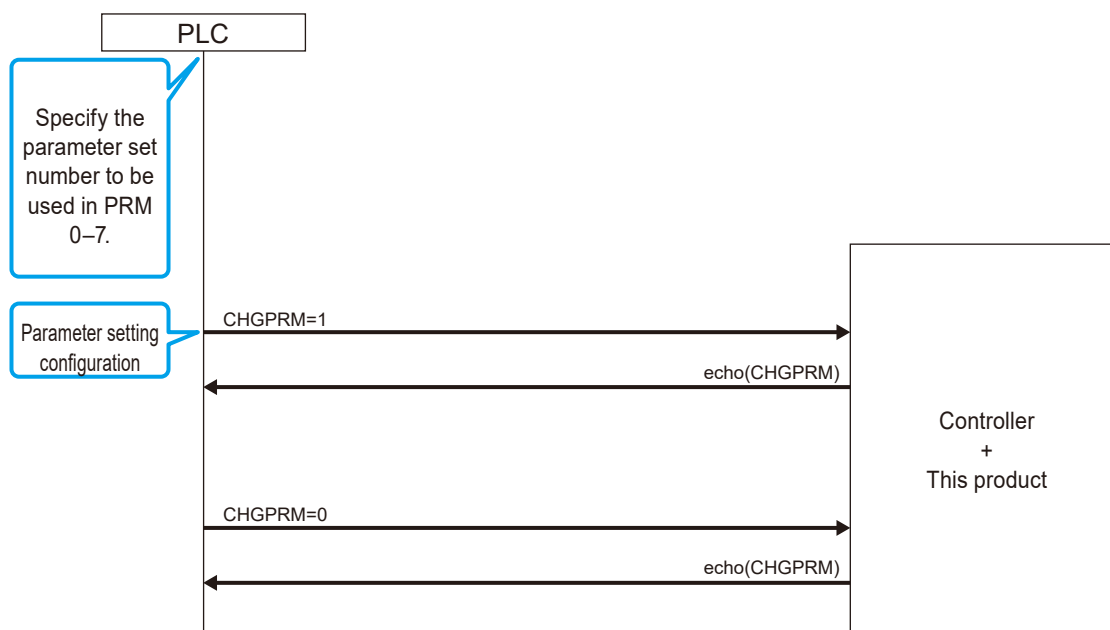
Tips

To update the error status after assertion of CLRRQ, set DPVAL ON and update the current value display.

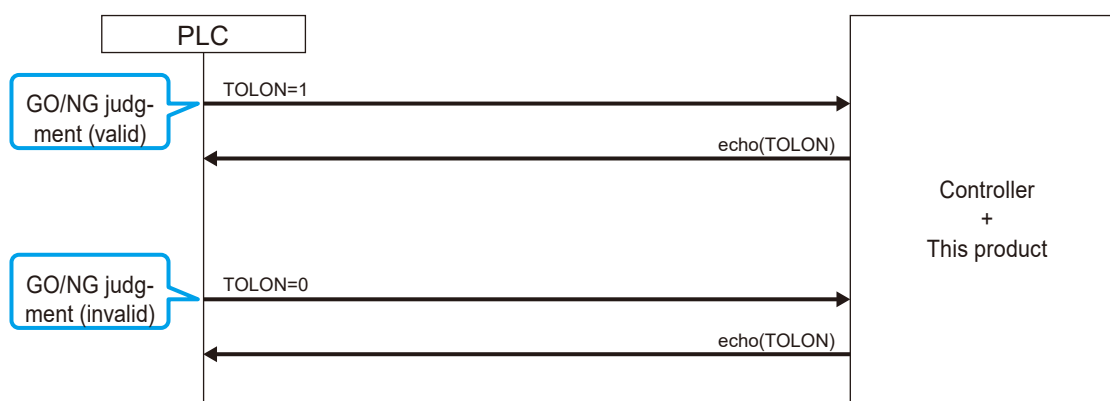
● Preset request



● Parameter setting configuration

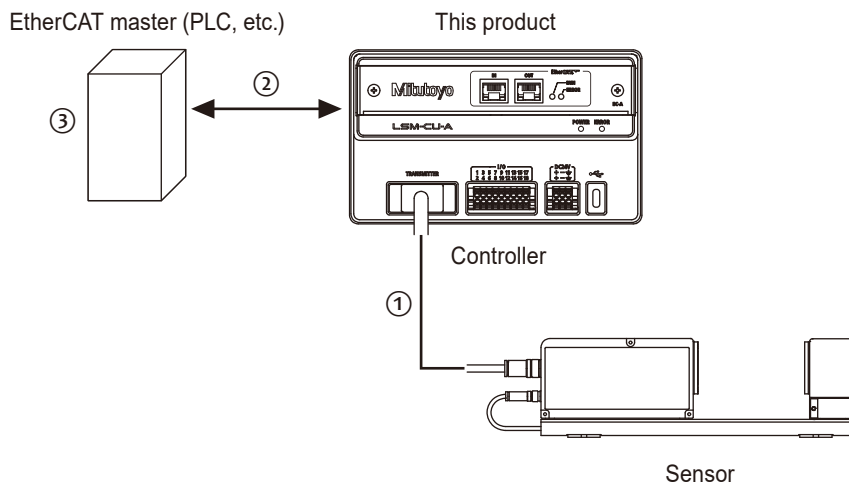


● GO/NG judgment setting



5.1.2 Duration of Data Processing

Time required from measurement execution to data processing by the EtherCAT master (PLC, etc.) is shown below.



Maximum data processing time = ① + ② + ③

- ① Response time of the controller
- ② Transmission interval
- ③ Scanning time of the EtherCAT master (PLC, etc.)

- ① For details about response time of the controller, see "Laser Scan Micrometer <Controller> User's Manual" (separate document).
- ② The communication cycle is set by the configuration software on the EtherCAT master side. The minimum value that can be set is 2 ms.
- ③ Program scan times of the EtherCAT master vary according to device processing capacity and program size. Check specifications of the device used and program execution time.

Tips

If the EtherCAT master's scan time is shorter than the communication cycle, data may not be acquired correctly.

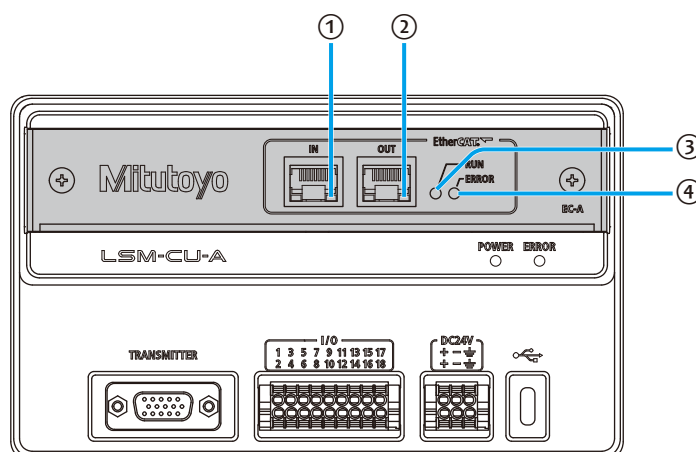
5.2 Status Indication

The status of the controller and network can be checked with the LEDs on this product or with LSMPAK.

For details about LSMPAK, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).

5.2.1 LED Indicators on This Product

The LED indications of this product change according to the status of the controller and network.

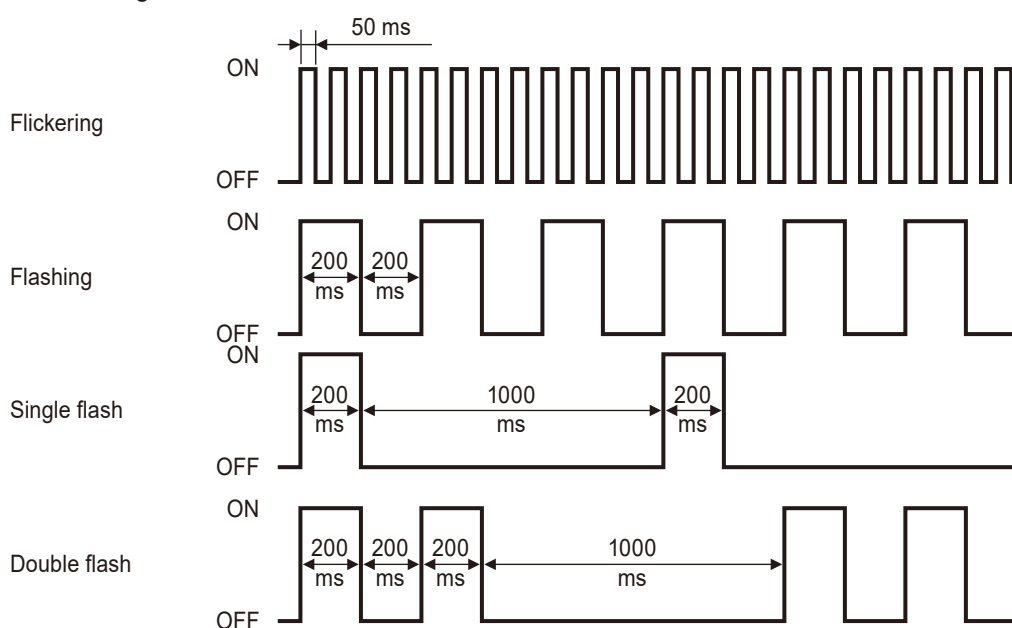


No.	Name	Applica- tion	Indicator color		Description
①	Link/activity LED (port IN)	Ethernet	Off		No data is being sent or received.
			Flashing green		Data is being sent/received.
②	Link/activity LED (port OUT)	Ethernet	Off		No data is being sent or received.
			Flashing green		Data is being sent/received.
③	RUN indicator*	EtherCAT	Off		Power is not being supplied to this product or EtherCAT communication is undergoing initialization.
			Flashing green		This product is in the pre-operational state.
			Single green flash		This product is in the safe-operational state.
			Steady green		This product is in the operational state (connection is established with the EtherCAT master).

No.	Name	Applica- tion	Indicator color		Description
④	ERROR indicator	EtherCAT	Off		Power is not being supplied to the product or there is nothing wrong with the product.
			Flashing red		Incorrect communication settings were received from EtherCAT master. Check the settings on the EtherCAT master side.
			Flickering red		An SII EEPROM access error occurred. Replacement of this product may be required.
			Single red flash		A synchronization error or communication data error occurred. Check the settings on the EtherCAT master side. Example: The EtherCAT master does not supply a synchronization signal with the DC synchronization configuration.
			Double red flash		EtherCAT communication timed out. Example: The Ethernet cable was disconnected during EtherCAT communication.
			Steady red		Unrecoverable error occurred in this product. Replacement of this product may be required.

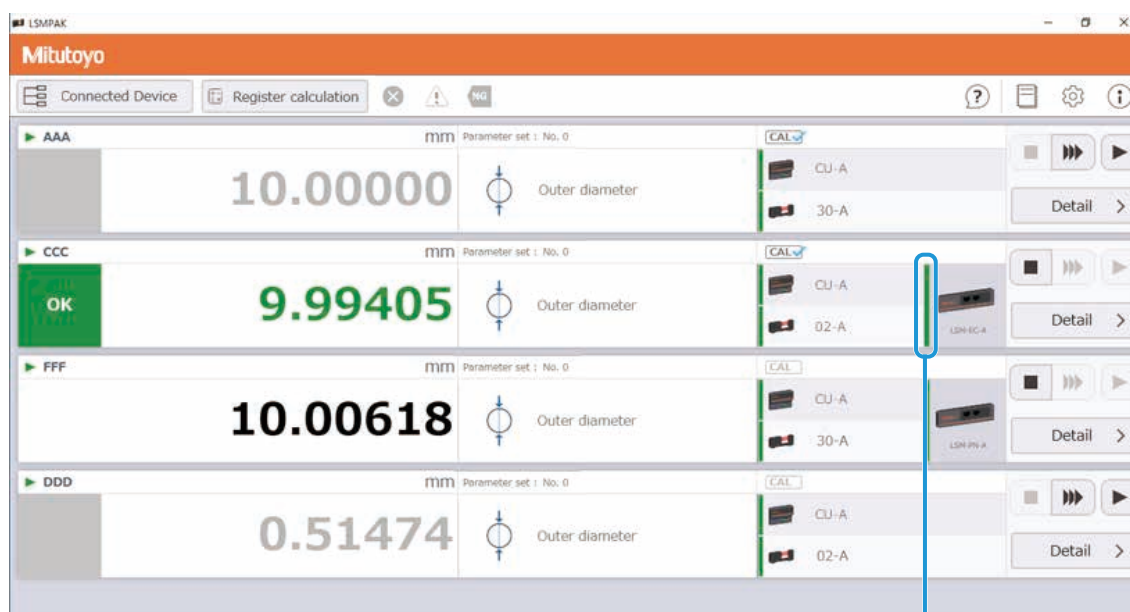
* For details on communication states of this product, see  "■ Overview" on page 15.

* The timings at which the RUN and ERROR indicators flash are as indicated below.



5.2.2 LSMPAK Screen

When this product is operating normally, the status LED lights green. (Red: Error occurred, Gray: Not working)



Status light

6 Troubleshooting

If you cannot access the network, check the LED indicators.

For details about the LED indicators, see  "5.2.1 LED Indicators on This Product" on page 36

For details about LSMPAK error messages, see  "Laser Scan Micrometer <Controller> User's Manual" (separate document).

Problem	Cause	Solution
Power does not go on.	This product is not properly inserted into the socket of LSM-CU-A.	Insert this product correctly into the LSM-CU-A.  "4.2 Connecting to the Controller" on page 10
Communication not working.	The cable is not properly connected.	Check cable connections and verify that the link/activity LED is lit.
	The connected device is not turned on.	Make sure the connected device is turned on and that the link/activity LED is lit.
	Incorrect communication settings on current device or connected device.	Check the LED indicators on the device and make communication settings required to obtain a normal lighting pattern. For details on LED lighting patterns, see  "5.2.1 LED Indicators on This Product" on page 36. For communication settings for the connected device, see the manual or other document related to that device.
Operation of this product is unstable. • Correct measurement values cannot be obtained. • Communication errors occur. • This product re-starts.	This product is receiving electromagnetic interference that exceeds the requirements of the EMC Directive and the UK Electromagnetic Compatibility Regulations.	Eliminate the electromagnetic interference. This product resumes normal operation after the electromagnetic interference is eliminated.
Operation of other devices is unstable. This product is causing loss of specified functionality of other devices.	This product is being used in other than the intended operating environment. This product generates electromagnetic emissions in an industrial environment. This product is not intended for use outside of an industrial environment, and its use in residential areas or other environments may cause electromagnetic interference with other devices.	Implement countermeasures to prevent electromagnetic interference with other devices.

MEMO

7.1 Basic Specifications

7.2 Ethernet Communication Specifications

Item	Specification
Communication port	RJ45×2
Transmission speed	100 Mbps, full duplex
Cable used	STP communication cables of type Cat.5e or higher

7.3 Measurement Configurations Usable with This Product

Using this device, multiple LSM controllers can be connected to a network.

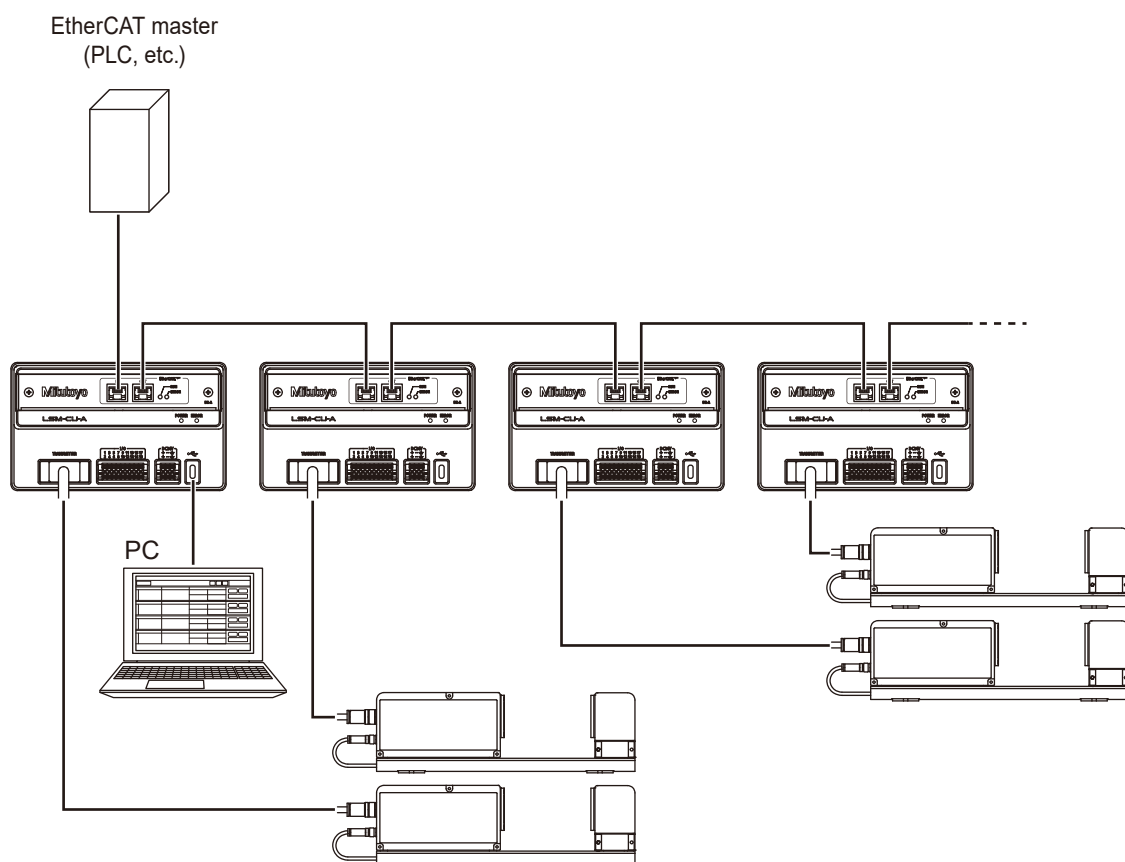
Typical connection of multiple LSM controllers is shown below.

Networked LSM controllers can be managed from a PC using LSMPAK.

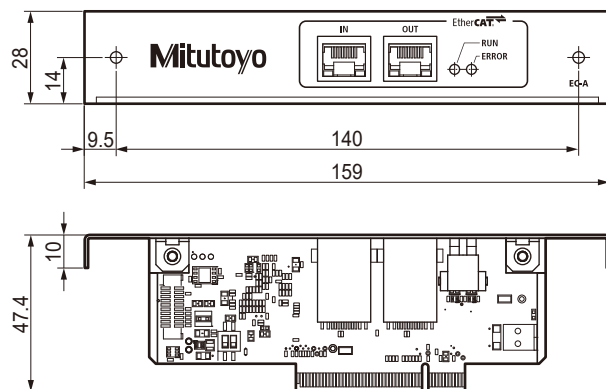
The maximum number of LSM controllers that can be managed using LSMPAK is eight.

Tips

Use port IN for connection from upstream (the PLC side) and port OUT for connection to the downstream LSM.



7.4 External Dimensions Drawing



Unit: mm

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*As of May 2025

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