MITSUBISHI ELECTRIC

CC-Link IE TSN Communication Software for Windows Programming Manual

SAFETY PRECAUTIONS

(Read these precautions before using this product.)

Before using this product, please read this manual and the relevant manuals carefully and pay full attention to safety to handle the product correctly.

Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

CONDITIONS OF USE FOR THE PRODUCT

(1) This software shall be used under the following conditions;

    i) that any failure occurred in this software, if any, shall not lead to any serious accident.

    ii) that the backup and/or fail-safe functions are systematically performed outside the devices in the cases of any failure occurred in this software.

(2) Mitsubishi Electric assumes no responsibility and liability (including but not limited to, default liability, defect liability, quality assurance responsibility, tort liability, product liability) for the quality, performance, and safety of both this software and products using this software.

(3) Mitsubishi Electric shall have no responsibility or liability for any problems involving this software and system trouble caused by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

INTRODUCTION

Thank you for purchasing CC-Link IE TSN Communication Software for Windows.

This manual describes the programming procedures and method specifications of CC-Link IE TSN Communication Library.

Before using this product, please read this manual and the relevant manuals carefully, and develop familiarity with the functions and performance of CC-Link IE TSN Communication Software for Windows to handle correctly.

Please make sure that the end users read this manual.

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RELEVANT MANUALS

Manual name [manual number]	Description	Available form
CC-Link IE TSN Communication Software for Windows Programming Manual [SH-082273ENG](this manual)	Programming, accessible devices, accessible range, class, methods, and error codes of CC-Link IE TSN Communication Library	e-Manual PDF

Point

e-Manual refers to the Mitsubishi Electric FA electronic book manuals that can be browsed using a dedicated tool.

e-Manual has the following features:

• Required information can be cross-searched in multiple manuals.

• Other manuals can be accessed from the links in the manual.

• Hardware specifications of each part can be found from the product figures.

• Pages that users often browse can be bookmarked.

• Sample programs can be copied to an engineering tool.

TERMS

Unless otherwise specified, this manual uses the following terms.

Term	Description
Authentication Class	A group of devices and switching hubs compatible with CC-Link IE TSN, classified according to the functions and performance by the CC-Link Partner Association. For authentication Class, refer to the CC-Link IE TSN Installation Manual (BAP-C3007ENG-001) published by the CC-Link Partner Association.
Buffering area	An area where link device data, which is received by CC-Link IE TSN Communication Service, is buffered (accumulated).
CC-Link IE TSN Communication Service	A Windows® service that communicates (transmits/receives) with CC-Link IE TSN devices and provides communication-related functions.
Link device	A device (RX, RY, RWr, RWw, LB, or LW) in a module on CC-Link IE TSN and CC-Link IE TSN Communication Service.
Link device data	Data of link devices received by CC-Link IE TSN Communication Service.
Local station	A station that performs cyclic transmission and transient transmission with the master station and other local stations.
Master station	A station that controls the entire network. This station can perform cyclic transmission and transient transmission with all stations. Only one master station can be used in a network.
Multicast mode	A communication mode used to send cyclic data to multiple stations.
Remote station	A station that exchanges I/O signals (bit data) and I/O data (word data) with another station by cyclic transmission. This station can also perform transient transmission.
Slave station	A station other than a master station: a local station, a remote station.
Snapshot data storage area	An area where link device data, which is received by CC-Link IE TSN Communication Service, is stored.

GENERIC TERMS AND ABBREVIATIONS

Unless otherwise specified, this manual uses the following generic terms and abbreviations.

Term	Description
LB	An abbreviation for a link relay of a link device. Bit data sent from each station of the network.
LW	An abbreviation for a link register of a link device. Word data sent from each station of the network.
RWr	An abbreviation for a remote register of a link device. This refers to word data input from a slave station to the master station.
RWw	An abbreviation for a remote register of a link device. This refers to word data output from the master station to a slave station.
RX	An abbreviation for remote input of a link device. This refers to bit data input from a slave station to the master station.
RY	An abbreviation for remote output of a link device. This refers to bit data output from the master station to a slave station.
SB	An abbreviation for a link special relay. Bit data that indicates the operating status and data link status of a module on CC-Link IE.
SW	An abbreviation for a link special register. Word data that indicates the operating status and data link status of a module on CC-Link IE.

1 OVERVIEW

CC-Link IE TSN Communication Software programs are developed by using CC-Link IE TSN Communication Library.

CC-Link IE TSN Communication Library

This is a library used to access link device data which is received from CC-Link IE TSN.

By using this library, programs to access devices can be created easily.

MEMO

2 DEVELOPMENT ENVIRONMENT

This chapter explains the environment for program development.

2.1 Tool

Use either of the following development tools to develop programs.
- Microsoft® Visual Studio® 2019 (Enterprise, Professional)
- Microsoft Visual Studio 2017 (Enterprise, Professional)

2.2 Language

CC-Link IE TSN Communication Software programs can be developed by using C#.

MEMO

3 PROGRAMMING

This chapter explains programming-related specifications to develop user applications.

> **Point**
>
> Only the essential procedures for developing programs of CC-Link IE TSN Communication Software are explained. For general development procedures of Visual Studio, refer to manuals corresponding to the Microsoft Corporation product or consult Microsoft Corporation.

3.1 Programming Creating Procedure

This section shows the procedure for creating programs by using CC-Link IE TSN Communication Library.

1. Install development tools (development environment for Windows).

2. Create a program project.

3. Set an environment for using CC-Link IE TSN Communication Library.

☞ Page 11 Registering a library file

4. Create a program.

☞ Page 12 Program processing order

Registering a library file

The following explains the procedure for registering a library file to a development tool.

Visual Studio 2019

The following explains the procedure for using Visual Studio 2019.

1. Select "Solution Explorer" ⇨ "(project name)" ⇨ "References," then right-click it and select [Add Reference] from the shortcut menu.

2. Select "Browse" and click the [Browse] button.

3. Select a library file (.dll) and click the [Add] button.

A library file is stored in the installation destination folder of CC-Link IE TSN Communication Software.

File	Folder
CCIETSNCommunication.dll	(An installation destination folder)\library\lib\x86
CCIETSNCommunication64.dll	(An installation destination folder)\library\lib\x64

To develop a user application (64 bit), select 'CCIETSNCommunication64.dll.'

4. Check that the selected file is added, and click the [OK] button.

5. Check that the library file is added in "Browse."

Visual Studio 2017

The following explains the procedure for using Visual Studio 2017.

1. Select "Solution Explorer" ⇨ "(project name)" ⇨ "References," then right-click it and select [Add Reference] from the shortcut menu.

2. Select "Browse" and click the [Browse] button.

3. Select a library file (.dll) and click the [Add] button.

A library file is stored in the installation destination folder of CC-Link IE TSN Communication Software.

Library	Storage destination folder
CCIETSNCommunication.dll	(An installation destination folder)\library\lib\x86
CCIETSNCommunication64.dll	(An installation destination folder)\library\lib\x64

To develop a user application (64 bit), select 'CCIETSNCommunication64.dll.'

4. Check that the selected file is added, and click the [OK] button.

5. Check that the library file is added in "Browse."

Access to a library

To access a library member, specify the following namespace.

Library	Namespace
CCIETSNCommunication.dll	MitsubishiElectric.CCIETSN.Library
CCIETSNCommunication64.dll	

Program processing order

The following explains the processing order of a program.

1. Open a communication line. (Open)

2. Access a device by using each class and method.

They continue to access the target device until the program ends.

To end the program, proceed to the next procedure.

3. Close the communication line. (Close)

Precautions

When the communication line is closed, make sure that the Close method is completed properly. (☞ Page 13 Precautions when Programming)

3.2 Precautions when Programming

Note the following points when programming.
- Open and close a communication line only once at the beginning and end of a program respectively. Repeating the processing for each communication causes deterioration of communication performance.
- The execution speed and the execution interval of CC-Link IE TSN Communication Library may be extended temporarily by Windows processes or other applications.
- Do not forcibly terminate a user application in which CC-Link IE TSN Communication Library is currently running. Otherwise, the following symptom may occur. In addition, unexpected behavior other than the following symptom may also occur.

| Symptom	Corrective action
Snapshot data access error (-118) occurs after CC-Link IE TSN Communication Service and CC IE TSN Communication Software Utility freeze and no response returned from CC-Link IE TSN Communication Library for a certain period of time.	Execute the Close method first, and then restart CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility. After CC-Link IE TSN Communication Software is restarted, execute the user application again.

- CC-Link IE TSN Communication Library cannot be used from Windows Service applications. Use CC-Link IE TSN Communication Library with user applications.
- When CC-Link IE TSN Communication Service stops and restarts for writing parameters etc., an error will occur in a user application in which a communication line has already been opened. Close the communication line once, and then open it again.
- When executing the Close method while the other methods are running in the other threads, a close error (-218) will be returned. Execute the Close method again after the methods are completed.
- To discard an instance of the CCIETSNCommunication class, discard it after confirming that the Close method is completed properly. Discarding an instance while the method is running may cause an application error.

MEMO

4 ACCESSIBLE RANGE AND DEVICES

This chapter explains accessible range and devices.

4.1 Accessible Range

CC-Link IE TSN Communication Software can only access own station (devices managed by CC-Link IE TSN Communication Service) within the connected network.
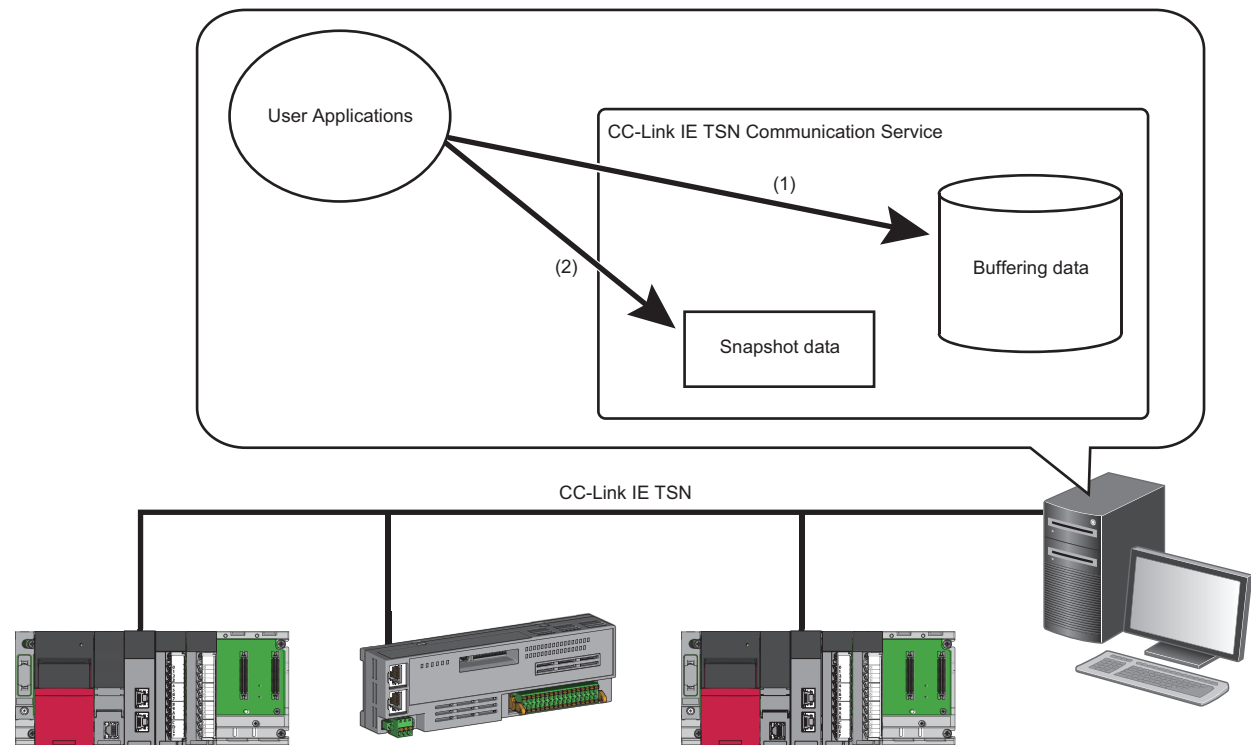
(1) Access to link device data in the buffering area (reading buffering data)

(2) Access to link device data in the snapshot data storage area (reading snapshot data)

4.2 Accessible Devices

This section shows accessible devices of own station by using CC-Link IE TSN Communication Software.

Device name (Device)	Device type		Device name specification
	Code specification		
	Decimal	Hexadecimal	
Remote input (RX)	1	1H	Dev.X
Remote output (RY)	2	2H	Dev.Y
Link relay (LB)	23	17H	Dev.B
Link register (LW)	24	18H	Dev.W
Remote register for transmission (RWw)	36	24H	Dev.Ww
Remote register for reception (RWr)	37	25H	Dev.Wr
Link special relay (SB)	5	5H	Dev.SM
Link special register (SW)	14	EH	Dev.SD

4.3 Considerations for Accessing Devices

This section shows the considerations for accessing devices.

Accessing link devices (RX, RY, RWw, RWr, LB, and LW) of own station

An interlock may be required depending on the status of CC-Link IE TSN Communication Service in own station.

Data becomes valid (link device values are updated) only when the following condition is satisfied.

 • 'Service connection status' (SW1025) is 'Collecting' (1H)

When 'Service connection status' (SW1025) is other than 'Collecting' (1H), link device values will be '0' or the last stored values.

For details on link special registers (SW), refer to the following:

📖CC-Link IE TSN Communication Software for Windows User's Manual

Accessing link devices (SB and SW) of own station

When 'Service connection status' (SW1025) is 'Preparing for connection' (0H), link device values, except for some devices, will be '0.'

For details on link special registers (SW), refer to the following:

📖CC-Link IE TSN Communication Software for Windows User's Manual

5 CLASS, STRUCTURE, AND METHOD

This chapter explains a class, structures, and methods of CC-Link IE TSN Communication Library.

5.1 Common Specifications

This section explains common specifications for CC-Link IE TSN Communication Library, such as the definition of arguments.

Channel number

The following shows the available channel numbers.

Channel No.	Channel name
201	CC-Link IE TSN
202	

Set a channel number and network adapter to use for communication by using CC IE TSN Communication Software Utility.

For details on the settings, refer to the following:

📖CC-Link IE TSN Communication Software for Windows User's Manual

Precautions

An error occurs when specifying a channel number other than 201 and 202.

Specifying device types

Specify a device type by specifying the code or device name.

For details on device types, refer to the following:

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5.2 CCIETSNCommunication Class

This is a class for managing a communication line of CC-Link IE TSN Communication Library and devices, as well as for accessing devices.

Format

class CCIETSNCommunication

Constructor

Format	Description	Reference
CCIETSNCommunication()	To initialize the new instance of the CCIETSNCommunication class.	☞ Page 18 CCIETSNCommunication()

Constructor

CCIETSNCommunication()

This initializes the new instance of the CCIETSNCommunication class.

■ Format
public CCIETSNCommunication()

■ Argument
None

■ Property
None

■ Method

Name	Description	Reference
Open	To open a communication line (channel).	☞ Page 20 Open
Close	To close a communication line (channel).	☞ Page 21 Close
ReadDeviceBlock	To read devices in a batch.	☞ Page 22 ReadDeviceBlock
ReadDeviceRandom	To read devices randomly.	☞ Page 23 ReadDeviceRandom
ReadDevice	To read one point of device.	☞ Page 25 ReadDevice
StartDataAssurance	To start snapshot data assurance.	☞ Page 26 StartDataAssurance
EndDataAssurance	To end snapshot data assurance.	☞ Page 27 EndDataAssurance
SetBufferingDataRecipe	To set the conditions for buffering data collection.	☞ Page 28 SetBufferingDataRecipe
StartBuffering	To start buffering.	☞ Page 31 StartBuffering
StopBuffering	To stop buffering.	☞ Page 32 StopBuffering
ReadBufferingData	To acquire buffering data.	☞ Page 33 ReadBufferingData
WaitBufferingDataEvent	To wait for data to be accumulated for the specified number of records.	☞ Page 35 WaitBufferingDataEvent

5.3 DevBlock Structure

This is a structure for setting device information (device type, start device number, and the number of device points).

Format

struct DevBlock

Field

Data type	Variable name	Name
int	devType	Device type
int	devNo	Start device number
int	devPoints	Number of device points

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5.4 Method Details

Open

This method opens a communication line (channel).

Format

short Open(short chan);

Argument

Argument	Name	Description	IN/OUT
chan	Channel number	Specify a channel number. ☞ Page 17 Channel number	IN

Description

- Only one communication line can be opened for one class. An error will occur if a communication line has already been opened.

  To open multiple channels, prepare multiple classes and open each one for respective channel numbers.
- Maximum four communication lines can be opened simultaneously for one channel number. An error will occur if four communication lines have already been opened.

  The maximum number of communication lines which can be opened includes the number of activated device monitors. If some device monitors have already been opened, the lesser number of communication lines can be opened.
- An error occurs if CC-Link IE TSN Communication Service is not activated.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 21 Close

Close

This method closes a communication line (channel).

Format

short Close();

Argument

None

Description

- When using multiple communication lines, the Close method must be performed for each communication line.
- An error occurs when executing this method while the other methods are running in the other threads.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open

ReadDeviceBlock

This method reads devices in a batch.

Format

int ReadDeviceBlock(int devType, int devNo, ref int readByteSize, out short[] readData);

Argument

Argument	Name	Description	IN/OUT
devType	Device type	Specify the type of device to be read in a batch. ☞ Page 17 Specifying device types	IN
devNo	Start device number	Specify the start device number of a device to be read in a batch. • Specify the start device number with a multiple of 8 for the access to a bit device.	IN
readByteSize	Read data size	Specify the read data size in byte units. • When the specified read byte size exceeds the device range (-5: size error), a readable size is returned to the read data size (readByteSize).	IN/OUT
readData	Read data storage destination	Specify the data to be read in single-precision integer array.	OUT

Description

This method reads devices in a batch.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open

☞ Page 21 Close

ReadDeviceRandom

This method reads devices randomly.

Format

int ReadDeviceRandom(ref CCIETSNCommunication.DevBlock[] devList, out short[] buf, int bufByteSize);

Argument

Argument	Name	Description	IN/OUT
devList	Randomly-specified device	Specify the device type, the start device number, and the number of points of each device to be read. ☞ Page 23 How to specify the randomly-specified devices (devList)	IN
buf	Read data storage destination	Store the read data to the array variable of buf[0] or later.	OUT
bufByteSize	Read data storage destination size	Specify the read data size in byte units.	IN

Description

This method takes longer processing time than the ReadDeviceBlock method. To shorten the processing time, consider using the ReadDeviceBlock method.

■ How to specify the randomly-specified devices (devList)

The following table shows how to specify the randomly-specified devices (devList).

Up to 32767 blocks can be specified.

devList	Description	
devList[0].devType	Device type	Specify the device of block 1.
devList[0].devNo	Start device number	
devList[0].devPoints	Points	
devList[1].devType	Device type	Specify the device of block 2.
devList[1].devNo	Start device number	
devList[1].devPoints	Points	
⋮	⋮	
devList[n-1].devType	Device type	Specify the device of block n.
devList[n-1].devNo	Start device number	
devList[n-1].devPoints	Points	

When reading values from multiple devices

The following tables show an example when reading the values from devices.

Block	Device	Value
Block 1	RX100 to RX10F	All bits are OFF.
Block 2	RWw10 to RWw13	RWw10=10, RWw11=200, RWw12=300, RWw13=400
Block 3	LB0 to LB9	All bits are ON.

• Randomly-specified devices (devList)

devList	Description	
devList[0].devType	Dev.X	Block 1
devList[0].devNo	100	• Specify the start device (RX100).
devList[0].devPoints	16	• Specify 16 points (RX100 to RX10F).
devList[1].devType	Dev.Ww	Block 2
devList[1].devNo	10	• Specify the start device (RWw10).
devList[1].devPoints	4	• Specify four points (RWw10 to RWw13).
devList[2].devType	Dev.B	Block 3
devList[2].devNo	0	• Specify the start device (LB0).
devList[2].devPoints	10	• Specify 10 points (LB0 to LB9).

• Read data storage destination (buf)

buf	Description	
buf[0]	0	All bits from RX100 to RX10F are OFF. (Bit information for 16 points can be stored.)
buf[1]	10	Current value of RWw10
buf[2]	200	Current value of RWw11
buf[3]	300	Current value of RWw12
buf[4]	400	Current value of RWw13
buf[5]	3FFH	All bits from LB0 to LB9 are ON.

• Read data storage destination size (bufByteSize)

(buf[0] to buf[5]=6) $\times$ 2 = 12 bytes

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

ReadDevice

This method reads one point of device.

Format

int ReadDevice(int devType, int devNo, out short readData);

Argument

Argument	Name	Description	IN/OUT
devType	Device type	Specify the type of device to be read for one point. ☞ Page 17 Specifying device types	IN
devNo	Specified device number	Specify the device number of a device to be read for one point.	IN
readData	Read data storage destination	Specify a read data storage destination.	OUT

Description

This method reads one point of device in the unit of points.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open

☞ Page 21 Close

StartDataAssurance

This method starts the snapshot data assurance.

Format

short StartDataAssurance();

Argument

None

Description

- This method starts data assurance for reading snapshot data.
- Execute the EndDataAssurance method to end data assurance.
- An error occurs if CC-Link IE TSN Communication Service is not activated.
- An error occurs when executing this method during data assurance.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open
☞ Page 21 Close
☞ Page 27 EndDataAssurance

EndDataAssurance

This method ends snapshot data assurance.

Format

short EndDataAssurance();

Argument

None

Description

- This method ends data assurance for reading snapshot data.
- Execute the StartDataAssurance method to start data assurance.
- An error occurs if CC-Link IE TSN Communication Service is not activated.
- By executing this method, the data in the snapshot data storage area is updated.
- An error occurs when executing this method before data assurance is started.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open
☞ Page 21 Close
☞ Page 26 StartDataAssurance

SetBufferingDataRecipe

This method configures buffering data collection settings of buffering function.

Format

short SetBufferingDataRecipe(ref CCIETSNCommunication.DevBlock[] bufferingDevList, ushort bufferingInterval, uint recordNum, out uint recordByteSize);

Argument

Argument	Name	Description	IN/OUT
bufferingDevList	Buffering target data list	Specify a device type, start device number, and the number of collection points of a device to be collected. ☞ Page 28 bufferingDevList	IN
bufferingInterval	Buffering interval	Specify a buffering interval. • 0: Collecting data for each cyclic cycle • 1 to 65535: Collecting data for specified time (ms)	IN
recordNum	Number of retainable records	Specify the size of the buffering data storage area (the number of retainable records) where devices to be collected are stored. ☞ Page 29 recordNum	IN
recordByteSize	Record size storage destination	Specify the storage destination of one record size, which is calculated from the buffering target data list (bufferingDevList), in byte unit. ☞ Page 29 recordByteSize	OUT

Description

- This method configures buffering data collection settings of buffering function with specified conditions.
- When executing this method for multiple times, the setting that is executed last will be enabled.
- Execute the StopBuffering method to end buffering.
- The collection setting is only applied at normal completion of this method.
- An error occurs if CC-Link IE TSN Communication Service is not activated.
- This method is only for configuring collection settings of buffering function, and therefore does not start collection. To start buffering, run the StartBuffering method.

■ bufferingDevList

- Specify the setting information of data stored in the buffering area.
- Make sure that the total number of collection points in each block number does not exceed the total of the maximum number of points in each device. An error occurs if a value exceeding the maximum number of points is specified.
- Specify the device type corresponding to the device to be collected. (☞ Page 17 Specifying device types)
- Specify '1' or more for the number of collection points. An error occurs if '0' is specified.

How to specify the buffering target data list (bufferingDevList)

The following table shows how to specify the buffering target data list (bufferingDevList).

Up to 114688 blocks can be specified.

bufferingDevList	Description	
bufferingDevList[0].devType	Device type	Specify the device of block 1.
bufferingDevList[0].devNo	Start device number	
bufferingDevList[0].devPoints	Collection points	
bufferingDevList[1].devType	Device type	Specify the device of block 2.
bufferingDevList[1].devNo	Start device number	
bufferingDevList[1].devPoints	Collection points	
⋮	⋮	
bufferingDevList[n-1].devType	Device type	Specify the device of block n.
bufferingDevList[n-1].devNo	Start device number	
bufferingDevList[n-1].devPoints	Collection points	

■ recordNum

- Specify the number of retainable records.
- Specify the number of retainable records according to the following standard:

  recordNum=(the interval for calling ReadBufferingData (100 ms or more) $\times$ 2)/communication cycle (ms)
- Specify '1' or more for the number of retainable records. An error occurs if '0' is specified.

Ex.

Collecting data at the communication cycle interval of 1 ms and acquiring data (executing the ReadBufferingData method) at 200 ms interval

(200ms$\times$2)/1ms=400

■ recordByteSize

- A value for the size of one record is stored in the storage destination specified in 'Record size storage destination (recordByteSize).'
- The size of one record is the total record size value for each block that is calculated from the number of collection points of a block. The calculation method for the record size varies depending on device types. The calculation method for each device is shown as below:

Device type		Calculation method
Word device		Number of collection points $\times$ 2 bytes
Bit device	The number of collection points can be divided by 16	(Number of collection points/16) $\times$ 2 bytes[1]
	Number of collection points cannot be divided by 16	((Number of collection points/16) +1) $\times$ 2 bytes[1]

*1   A value calculated by '(Number of collection points/16)' can be rounded down after the decimal point.

- If the size which is calculated by 'The size of one record $\times$ the number of retainable records (recordNum)' exceeds 320 MB, an error occurs and the value will not be stored.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open

☞ Page 21 Close

☞ Page 32 StopBuffering

StartBuffering

This method starts buffering.

Format

short StartBuffering();

Argument

None

Description

- This method starts buffering.
- This method runs according to the buffering data collection settings configured by the SetBufferingDataRecipe method.
- An error occurs if CC-Link IE TSN Communication Service is not activated.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open

☞ Page 21 Close

☞ Page 28 SetBufferingDataRecipe

☞ Page 32 StopBuffering

StopBuffering

This method stops buffering.

Format

short StopBuffering();

Argument

None

Description

- This method stops buffering.
- To start buffering again, run the StartBuffering method.
- An error occurs if CC-Link IE TSN Communication Service is not activated.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open
☞ Page 21 Close
☞ Page 31 StartBuffering

ReadBufferingData

This method acquires buffering data.

Format

short ReadBufferingData(out short[] buf, uint bufByteSize, out uint recordNum);

Argument

Argument	Name	Description	IN/OUT
buf	Acquired data storage destination	Specify the storage destination (address) of acquired data. ☞ Page 33 buf	OUT
bufByteSize	Acquired data storage destination size	Specify the acquired data storage destination size in byte unit. ☞ Page 33 bufByteSize	IN
recordNum	Storage destination for the number of read records[1]	Specify the storage destination for the number of read records. ☞ Page 33 recordNum	OUT

*1   A record refers to data for one cyclic transmission cycle.

Description

- This method acquires link device data which is collected by reading buffering data for multiple cycles.
- An error occurs if CC-Link IE TSN Communication Service is not activated.
- When changing parameters of a master station during buffering, CC-Link IE TSN Communication Service stops data collection.
- An error occurs if data is not stored in the buffering area when buffering is canceled.

■ buf

- Acquired data is stored according to the settings configured by the SetBufferingDataRecipe method.
- Data is stored in the storage destination, which is specified by 'Acquired data storage destination (buf),' as shown below.

buf	Description	
buf[0]	Data (start)	Record 1
⋮	⋮	Data is stored in the order set by the SetBufferingDataRecipe method. The number of stored points varies depending on device types.
buf[(n-1)]	Data (end)	• Bit device: 16 points each (The bit will be '0' for the remainder when the specified number of points in a block is divided by 16.) • Word device: One point each
⋮	⋮	
buf[(n)(m-1)]	Data (start)	Record m
⋮	⋮	
buf[n(m-1)+n]	Data (end)	

For storage examples, refer to the 'When reading values from multiple devices' in the section of the ReadDeviceRandom method.

☞ Page 23 ReadDeviceRandom

■ bufByteSize

- Specify the size of the storage destination buffer (buf) which acquires device data which is collected for multiple cycles.
- Data is stored in 'Acquired data storage destination (buf)' from the oldest records until 'Acquired data storage destination size (bufByteSize)' is completely filled. When a value specified for 'Acquired data storage destination size (bufByteSize)' cannot be divided by the data size required for one record, data will be stored to the to 'Acquired data storage destination (buf)' until reaching to a value specified in 'Acquired data storage destination size (bufByteSize).'
- When specifying '0' for this argument, the number of read records remains '0' and the ReadBufferingData method will be completed normally. However, an error will occur when specifying a value, which is less than the required data size for one record, is specified.

■ recordNum

Store the number of records of data which is stored in the 'Acquired data storage destination (buf)' to the 'Storage destination for the number of read records (recordNum).'

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

☞ Page 20 Open

☞ Page 21 Close

☞ Page 31 StartBuffering

WaitBufferingDataEvent

This method waits for data for the specified number of records to be accumulated.

Format

short WaitBufferingDataEvent(ushort waitRecordNum, uint eventTimeout);

Argument

Argument	Name	Description	IN/OUT
waitRecordNum	Number of wait records	Specify the number of wait records.	IN
eventTimeout	Timeout value	Specify the timeout value. • 0 to FFFFFFFEH: Specified timeout value (ms) • FFFFFFFFH: Waiting infinitely	IN

Description

- This method waits for link device data, which is collected by reading buffering data, to be stored for the specified number of records.
- If data in the temporary area has already exceeded the specified number of records at the time when this method is called, this method returns immediately.
- An error occurs if buffering is stopped or canceled.
- An error occurs if CC-Link IE TSN Communication Service is not activated.

Return value

Return value	Description
0(0000H)	Normal
Other than 0	Error For details on the error, refer to the following: ☞ Page 36 Error Code

Relevant function

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APPENDIX

Appendix 1 Error Code

This section shows error codes generated by CC-Link IE TSN Communication Library and the corrective actions.

If an error whose error code is not described in the following table occurs, please contact your local Mitsubishi Electric sales office or representative.

Error code		Error description	Corrective action
Decimal	**Hexadecimal**		
66	42H	■Already opened error The class, in which the Open method is executed, has already been opened.	• Execute the Close method first, and then the Open method again. • Execute the Open method again using the other classes.
77	4DH	■Memory reservation error/resource memory shortage error A memory is insufficient.	• The memory may be insufficient. Close other running applications. • End the program and restart the personal computer. • The specified write data, read byte size, and the number of blocks are too large. Check the specified value.
-1	FFFFFFFFH	■Not opened error A method is executed without executing the Open method.	Execute the Open method first, and then the other methods.
-2	FFFFFFFEH	■Start device number error The start device number does not exist.	• Check the start device number. • Change the start device number to an existing device number. • To specify a bit device, specify a start device number with a multiple of 8.
-3	FFFFFFFDH	■Device type error The specified device type does not exist.	Specify an accessible device type.
-5	FFFFFFFBH	■Size error • The device size is out of the range. • 'NULL' is specified for a read byte size. • When specifying a word device, an odd byte is specified for read byte size.	• Check the read byte size and the number of points of device blocks. Make sure that the sum of start device number and read byte size, or the number of points of device block is an existing device number. • Set a value greater than '0' for the size and the number of points of device block. • Specify a value other than NULL for the read byte size. • Specify an even-number byte for a word device.
-6	FFFFFFFAH	■Number of blocks error The number of blocks specified for ReadDeviceRandom is out of the range.	Check the number of blocks of the randomly-specified device. • Specify a value for the number of blocks of the randomly-specified device within the range of 1 to 32767. • Specify a randomly-specified device other than NULL.
-8	FFFFFFF8H	■Channel number error The channel number is out of the range.	The channel number specified by the Open method is invalid. Check the channel number.
-81	FFFFFFAFH	■Time-out error Failed to communicate with CC-Link IE TSN Communication Service.	Try the communication again after a while. If the same error occurs, check the running status of CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility, and restart the service. After the restart, execute again from the Open method.
-90	FFFFFFA6H	■System error	• End the program and restart the personal computer. • Install it again. • Please contact your local Mitsubishi Electric sales office or representative.
-91	FFFFFFA5H	■System error	• Try again after executing the Close method first, and then the Open method. If the same error occurs, check the running status of CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility, and restart the service. After the restart, execute again from the Open method. • End the program and restart the personal computer.
-92 to -93	FFFFFFA4H to FFFFFFA3H	■Service operation error Failed to communicate with CC-Link IE TSN Communication Service.	
-94	FFFFFFA2H	■Number of Open error The Open method is executed multiple times for the same channel.	Review the system to ensure the number of communication lines connected to the same channel is four or less.

Error code		Error description	Corrective action
Decimal	Hexadecimal		
-99	FFFFFF9DH	■Buffering data collection setting unconfigured error Buffering is started without buffering data collection settings being configured.	Configure the buffering data collection settings first, and then try again.
-100	FFFFFF9CH	■Snapshot data access error Snapshot data, which cannot be referred to, is accessed.	• Try again after executing the Close method first, and then the Open method. If the same error occurs, check the running status of CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility, and restart the service. After the restart, execute again from the Open method. • End the program and restart the personal computer.
-101	FFFFFF9BH	■Data assurance function execution error Snapshot data assurance function is executed again while the function is in progress.	Check that snapshot data assurance function is not activated in two instances by the user program.
-102	FFFFFF9AH	■Snapshot data unregistered error Snapshot data is accessed without data being collected.	Check the network status of the master station, and try again after making the status available to collect data.
-103	FFFFFF99H	■System error	• Try again after executing the Close method first, and then the Open method. If the same error occurs, check the running status of CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility, and restart the service. After the restart, execute again from the Open method. • End the program and restart the personal computer.
-105	FFFFFF97H	■Buffering stop error A method is executed in the state where buffering data collection is canceled.	Stop buffering data collection, and then try again.
-106	FFFFFF96H	■Buffering data collection setting unregistered error Buffering data is read or the WaitBufferingDataEvent method is executed without buffering data collection settings being configured.	Configure the buffering data collection settings first, and then try again.
-107	FFFFFF95H	■System error	• Try again after executing the Close method first, and then the Open method. If the same error occurs, check the running status of CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility, and restart the service. After the restart, execute again from the Open method. • End the program and restart the personal computer. • Please contact your local Mitsubishi Electric sales office or representative.
-108	FFFFFF94H	■Buffering not executed error Buffering is not started.	Start the buffering and try again.
-109	FFFFFF93H	■Buffering executing error • Buffering data collection settings are configured while buffering is in progress. • Buffering is restarted again while buffering is in progress.	Stop the buffering, and then try again.
-110 to -111	FFFFFF92H to FFFFFF91H	■Memory error	• The memory may be insufficient. Close other running applications. • End the program and restart the personal computer.
-112 to -113	FFFFFF90H to FFFFFF8FH	■System error	• Try again after executing the Close method first, and then the Open method. If the same error occurs, check the running status of CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility, and restart the service. After the restart, execute again from the Open method. • End the program and restart the personal computer.
-116	FFFFFF8CH	■System error	• Try again after executing the Close method first, and then the Open method. If the same error occurs, check the running status of CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility, and restart the service. After the restart, execute again from the Open method. • End the program and restart the personal computer.

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Error code		Error description	Corrective action
Decimal	Hexadecimal		
-118	FFFFFF8AH	■Snapshot data access error Snapshot data cannot be accessed due to forced termination of the program or other reasons.	• Execute the Close method first, and then restart CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility. After the restart, execute again from the Open method. • End the program and restart the personal computer.
-132	FFFFFF7CH	■Acquired data storage destination size specification error A value smaller than the size of one record is specified for the acquired data storage destination size to acquire buffering data.	Specify a value equal to or greater than the size of one record.
-133	FFFFFF7BH	■Buffering wait status error The WaitBufferingDataEvent method is executed again while waiting for buffering data to be accumulated.	Execute the WaitBufferingDataEvent method after the buffering data is accumulated.
-134	FFFFFF7AH	■Number of wait records specification error A value greater than the set number of retainable records is specified for the number of wait records.	Specify a value equal to or less than the set number of retainable records.
-135	FFFFFF79H	■System error	• Try again after executing the Close method first, and then the Open method. If the same error occurs, check the running status of CC-Link IE TSN Communication Service in CC IE TSN Communication Software Utility, and restart the service. After the restart, execute again from the Open method. • End the program and restart the personal computer.
-136	FFFFFF78H	■Channel unused configuration error The Open method is executed for a channel number to which "Not Use" is set.	• Review the channel number to be specified when running the Open method. • Specify the channel number to which "Use" is set.
-137	FFFFFF77H	■Buffering accumulation waiting timeout error Specified timeout time elapsed before the specified number of records is accumulated.	Review the timeout time, and execute the WaitBufferingDataEvent method again.
-201	FFFFFF37H	■Number of retainable records error The number of retainable records is out of the setting range.	• Check the number of retainable records. • Set a value other than '0' for the number of retainable records.
-205	FFFFFF33H	■Record storage destination error The storage destination of the number of written records is incorrect.	Check the address of the storage destination.
-207	FFFFFF31H	■Number of blocks error The number of blocks of the buffering target data list is out of the setting range.	• Check the number of blocks of the buffering target data list. • Specify the number of blocks of the buffering target data list within the range of 1 to 114688. • Specify a value other than NULL for the buffering target data list.
-208	FFFFFF30H	■Number of collection points error The number of collection points of the buffering target data list is out of the setting range.	• Check the number of collection points of the buffering target data list. • Set a value greater than '0' for the number of collection points of the buffering target data list.
-209	FFFFFF2FH	■Start device number error The start device number of the buffering target data list does not exist.	• Check the start device number of the buffering target data list. • Change the start device number of the buffering target data list to an existing device number.
-210	FFFFFF2EH	■Size error • The number of collection points of buffering target data list is out of the setting range. • The sum of the start device number and the number of collection points for each block in the buffering target data list is not an existing device number.	• Check the number of collection points of the buffering target data list. • Check that the sum of the start device number and the number of collection points in the buffering target data. • Change these device numbers to the existing numbers.
-211	FFFFFF2DH	■Device type error The device type of buffering target data list is incorrect.	• Check the device type of the buffering target data list. • Change the device type of the buffering target data list to the one which is accessible to own station.
-214	FFFFFF2AH	■Memory error	• Reduce the number of collection points of buffering target data list. • The memory may be insufficient. Close other running applications. • End the program and restart the personal computer.

Error code		Error description	Corrective action
Decimal	Hexadecimal		
-218	FFFFFF26H	■Close error The Close method is executed while the other methods are in progress.	Execute the Close method after the execution of the methods are completed.
-220	FFFFFF24H	■Buffering area exceeded error The total size of specified collected data and the number of retainable records exceeds 320 MB.	• Reduce the number of points of collected data. • Reduce the number of retainable records.
-224	FFFFFF20H	■Data assurance function not executed error Snapshot data assurance is ended without being executed.	Try again after executing snapshot data assurance.

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METHOD INDEX

MEMO

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Description
October 2020	SH(NA)-082273ENG-A	First edition

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WARRANTY

Please confirm the following product warranty details before using this product.

1. **Gratis Warranty Term and Gratis Warranty Range**

   If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.

   However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

   [Gratis Warranty Term]

   The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place. Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

   [Gratis Warranty Range]

   (1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.

   (2) Even within the gratis warranty term, repairs shall be charged for in the following cases.

      1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
      2. Failure caused by unapproved modifications, etc., to the product by the user.
      3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
      4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
      5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
      6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
      7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

2. **Onerous repair term after discontinuation of production**

   (1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.

   (2) Product supply (including repair parts) is not available after production is discontinued.

3. **Overseas service**

   Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

4. **Exclusion of loss in opportunity and secondary loss from warranty liability**

   Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

   (1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
   (2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
   (3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
   (4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. **Changes in product specifications**

   The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

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