OMRON

CX-Compolet

Application Design Guide for CIP Communications

WS02-CPLC1
WS02-CPLC2

Technology Introduction Guide

V240-E1-02

Introduction

Thank you for using CX-Compolet. CX-Compolet Application Design Guide for CIP Communications (hereinafter referred to as this guide) uses CX-Compolet to describe the design procedures and troubleshooting of user applications using CIP communication. Read the manual of the device to be connected in conjunction with this guide.

A sample code is provided for the specific implementation of the guide described in the chapters of this guide. Use the sample code which is included with the installation CD of CX-Compolet Ver. 1.75 or higher.

Intended Audience

This guide is intended for the following personnel,

who must also have knowledge of electrical systems (electrical engineers or the equivalent).

- Personnel in charge of introducing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and maintaining FA systems.
- Personnel in charge of managing FA systems and facilities.

Applicable Products

This guide covers the following products.

- CX-Compolet
  - WS02-CPLC1
  - WS02-CPLC2

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Contents

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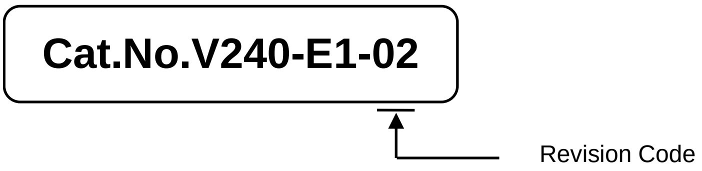
Precautions for Safe Use

Refer to the following manuals for precautions for safe use.

- *Conditions of Use in CX-Compolet Installation Guide and CX-Compolet (with SYSMAC Gateway Runtime) Installation Guide.*

Revision History

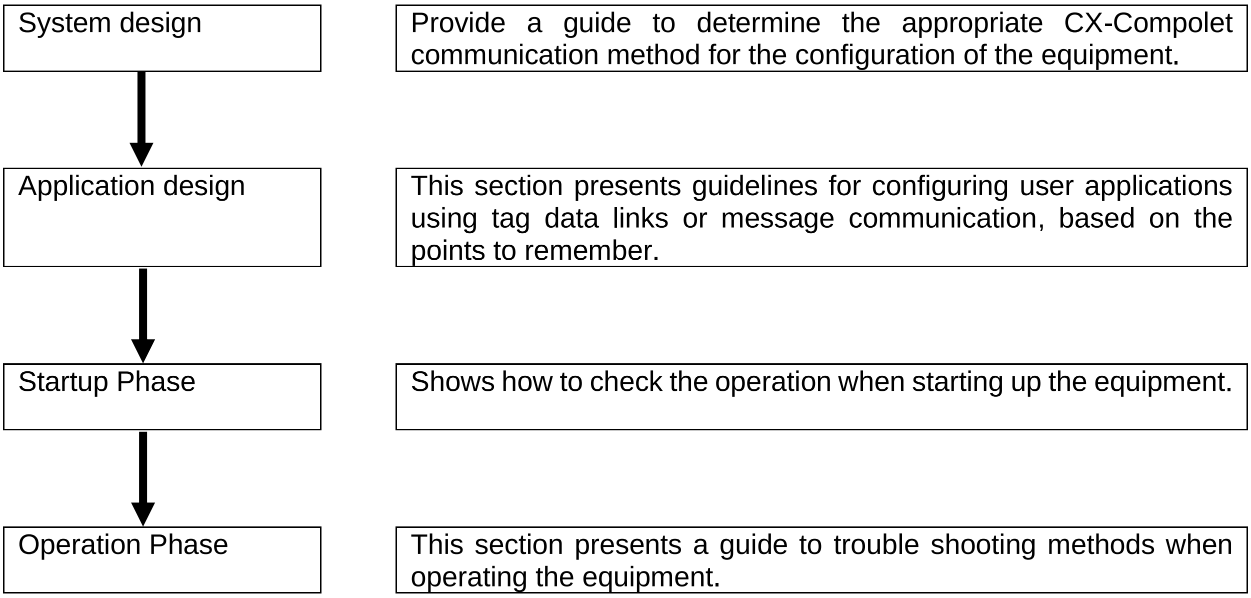
A manual revision code appears as a suffix to the document number on the front and back covers of the manual.



Revision code	Date	Revised content
01	February 2020	Original production
02	May 2021	Added upgraded information of CX-Compolet/SYSMAC Gateway Ver.1.80

1. Introduction

This guide provides a guide for facilitating the development of new designs for CX-Compolet devices.



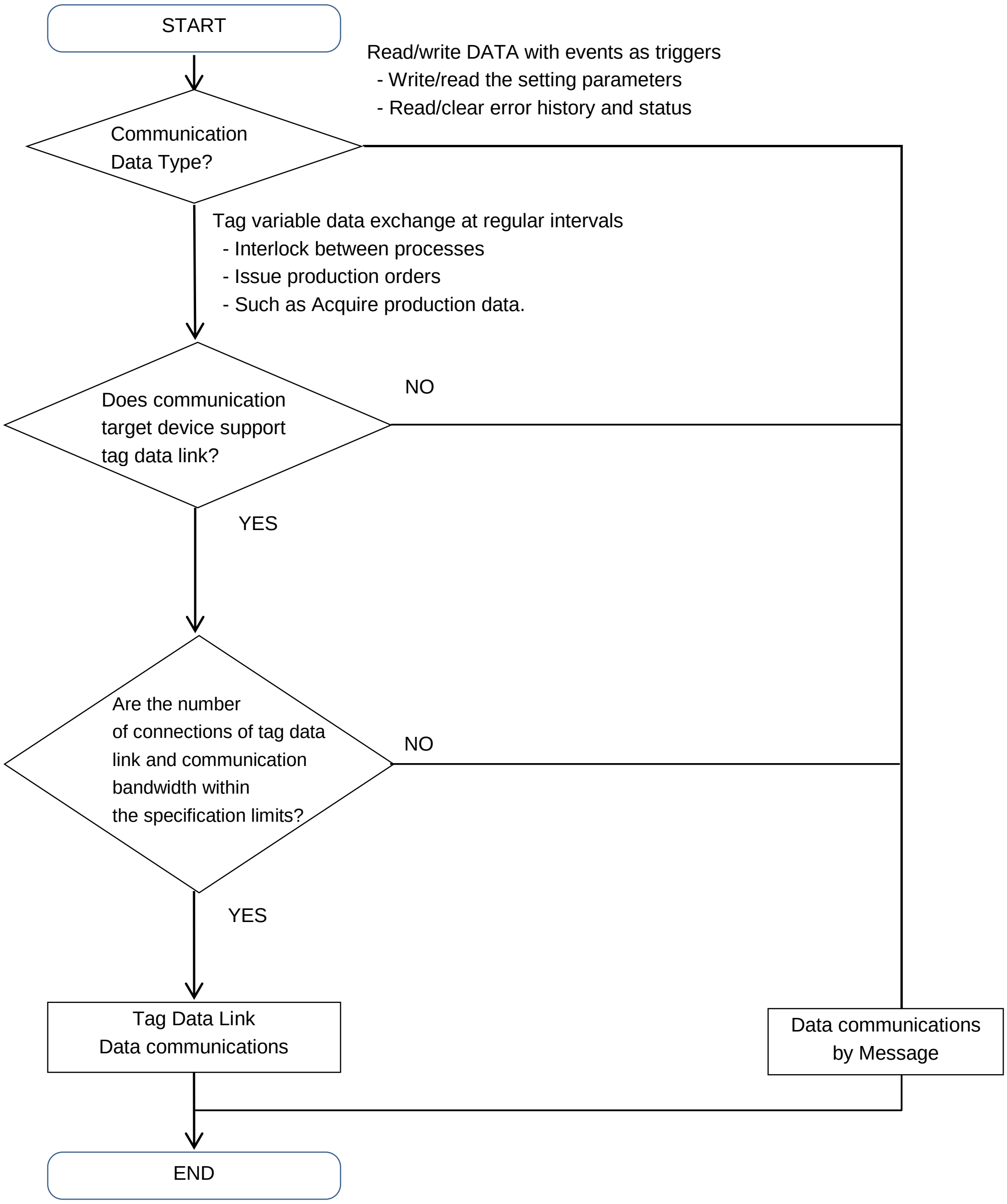
System design	Provide a guide to determine the appropriate CX-Compolet communication method for the configuration of the equipment.
Application design	This section presents guidelines for configuring user applications using tag data links or message communication, based on the points to remember.
Startup Phase	Shows how to check the operation when starting up the equipment.
Operation Phase	This section presents a guide to trouble shooting methods when operating the equipment.

2. System Design

The system design describes the selection of the optimum communication method (tag data link or message communication) for the target device and the limitations of each communication method.

2.1. Communication Method Selection Flow

Select the communication method (tag data link, message communication). Determine the communication method according to the flow chart below.


START
Read/write DATA with events as triggers
- Write/read the setting parameters
- Read/clear error history and status
Communication Data Type?
Tag variable data exchange at regular intervals
- Interlock between processes
- Issue production orders
- Such as Acquire production data.
Does communication target device support tag data link?
NO
YES
Are the number of connections of tag data link and communication bandwidth within the specification limits?
NO
YES
Tag Data Link Data communications
Data communications by Message
END

- The use of a tag data link is recommended if communication response performance or periodicity is emphasized, when developing an application to monitor the equipment (line) or to give instructions to the equipment. The tag data link must keep the used communication bandwidth (PPS) within the

specified range. Refer to the user’s manual of the unit and set the settings properly.
NJ/NX-series CPU Unit Built-in EtherNet/IP™ Port (Cat. No. W506)

Point

- When constructing the instruction system with the tag data link, design with consideration of the handshake(5.1.3.3 Application handshakes in user applications) in the application.

- Even if the system is mainly data reading/writing triggered by an event, when the data capacity is large or the event occurs frequently, the communication load and the load on the SYSMAC Gateway may increase. In addition, the expected response speed may not be satisfied. Therefore, we recommend designing for the restriction on the use of message communication, using the tag data link function as the basis.

2.2. Checking Specifications of Each Communication Method

In this chapter, the requirements for applications should be designed to be implemented within the specifications of each communication method described below.

2.2.1. Checking TCP/UDP port to use

SYSMAC Gateway uses the TCP/UDP port numbers shown in the following table. Do not set the same port number for other applications.

Function	Protocol	Port number	Remarks
Tag data link	UDP	2222	Fixed value and unchangeable
Message communication	TCP	44818	

2.2.2. Checking tag data link specifications

2.2.2.1. Checking number of connections

Check that the maximum value of the following items of the tag data link is not exceeded.

Item	Specifications
Number of connections	Up to 1536 (same when multiple ports are used)
Number of registrable tag sets	1536 (1 connection = 1 tag set)
Number of registrable tags	1536
Number of tags per connection (= 1 tag set)	Up to 8 (7 tags when the tag set includes the Controller status)

2.2.2.2. Checking the data size of the connection

Make sure that the data size does not exceed the maximum values of the following items.

Item	Specifications
Maximum link data size per node	2217984 bytes
Maximum data size per connection	1444 bytes[*1]
Maximum size of 1 tag set	722 words (The Controller status uses 1 word when the tag set includes the Controller status.)

*1: To use a data size of 505 bytes or larger, the system must support a large forward open (an optional CIP specification). The CS, CJ, NJ, NX, and NY-series Units support a large forward open, but before connecting to nodes of other companies, confirm that the devices also support it.

2.2.2.3. Checking the data exchange interval

Check the data exchange interval and the communication bandwidth.

Item	Specifications
Packet interval	1 to 10,000 ms*1 (The packet interval can be set separately for each connection in 1-ms increments)
Allowed communications bandwidth	40000 pps*2 (The heartbeat is included.)

*1: It can be set from 1ms at the shortest, but if the packet interval is short, the timeout is likely to occur depending on the OS state. Normally, use it at least 50 ms.

*2: The pps means "packets per second", and indicates the number of packets that can be processed per second.

Point

Communication time variations increase as the data length increases or the number of connections increases according to the setting of tag data link. Also, communication time variations occur depending on the type of network card, CPU load, and network load. The extent to which communication performance is achieved is depending on the usage environment. Be sure to measure the performance in the actual environment. Set such as the packet interval, time-out monitoring time to an appropriate value afterward.

2.2.3. Checking message communication specifications

2.2.3.1. Checking number of connections

Ensure that the total number of connections does not exceed the maximum.

Item	Specifications
Number of connections	Client: Maximum connections in total of UCMM and Class 3 = 128 Server: No restriction (depends on the computer memory)

2.2.3.2. Checking data size of connection

Ensure that the data size of the connection does not exceed the maximum.

Item	Specifications
Data sizes	Up to 1988 bytes*1 (Class 3)/496 bytes*1 (UCMM)

*1 These values are the maximum values. The values depend on the data type, variable name, path information, and other factors according to whether connections are used, R/W direction and the like.

2.2.3.3. Checking number of transactions that SYSMAC Gateway can accept simultaneously

Ensure that the number of processes in the user application does not exceed the maximum value.

Item	Specifications
Number of Open Connection Tasks	Up to 32
Number of Close Connection Tasks	Up to 64
Number of Send Message Tasks	Up to 64

2.3. Checking Compolet Type

Compolet is a Windows software component that facilitates communication between computers and PLCs. There are two types of Compolet, which are incorporated into the user application according to the purpose.

・ SYSMAC Compolet that facilitates PLC data read/write or PLC operations

・ SYSMAC Gateway Compolet that retrieves the data for the SYSMAC Gateway installed on the computer

Name		Overview
SYSMAC Compolet		Software components that provide the function to simplify PLC manipulation from a computer
	CJ2Compolet	Compolet for CIP communication with SYSMAC CJ Series CJ2 CPU unit
	NJCompolet	Compolet for CIP communication with the NJ Series CPU unit
	NXCompolet	Compolet for CIP communication with the NX Series CPU unit
	NYCompolet	Compolet for CIP communication with the NY Series IPC machine controller
	CommonCompolet	This component performs CIP communications with the controllers that complies with the ODVA specification data types and supporting industrial standard tag read-write service (service ID:0x4C, 0x4D)
	DataAccessCompolet	Compolet that provides a common IF encompassing the SYSMAC Compolet type above
SYSMAC Gateway Compolet		A software component of a computer that provides application software with operations to acquire and control the data and status of the SYSMAC Gateway itself, which operates virtually as a controller on the computer.
	VariableCompolet	Compolet to read and write the value of the variable registered in the SYSMAC Gateway
	CIPPortCompolet	Compolet to open/close the SYSMAC Gateway network port
	DatalinkCompolet	Compolet to get the tag data link settings and acquire the status
	SgwServiceCompolet	Compolet to retrieve the status of the SYSMAC Gateway and operate the function

Point

When you use CJ2Compolet/ NJCompolet/ NXCompolet/ NYCompolet/ DataAccessCompolet (Omron's PLCs are specified), ReadVariableMultiple and ReadRawDataMultiple methods can retrieve multiple variables with a single command. (For CommonCompolet/DataAccessCompolet (CipCommon is specified), Compolet reads variable one by one.)

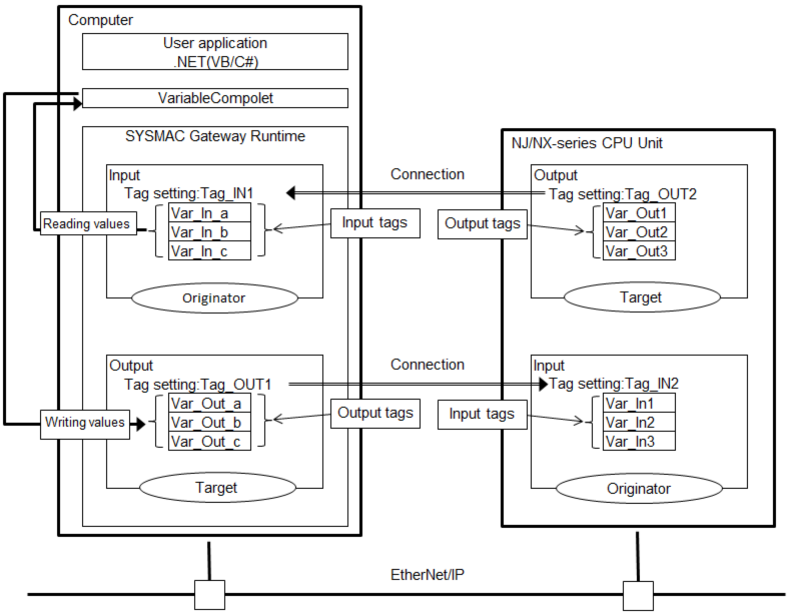
3. Application Design

This chapter describes the characteristics and usage of tag data links and message communication.

3.1. Using Tag Data Link

Tag data links can be cyclically exchanged data between SYSMAC Gateway and PLCs or between SYSMAC Gateway and SYSMAC Gateway, respectively, on the EtherNet/IP network.

In a user application, VariableCompolet retrieves the values of the variables reflected on the SYSMAC Gateway via the tag data link function.



Point

If periodicity is considered important for data exchange of the device, the tag data link should be used preferentially.

Design the user application in the following steps.

1. Create a Compolet instance

   Create a VariableCompolet instance to connect to the SYSMAC Gateway on the computer.

2. Enable the VariableCompolet component

   Maintain the active state of the component (Active property) until the user application is closed. Disables the component (the Active property is disabled) and disposes the VariableCompolet instance when closing the application.

3. Reading and Writing Variables Registered in the SYSMAC Gateway

- When communication is high-load, trouble such as timeout is likely to occur. For this reason, set the interval between several tens of ms and several hundred ms of sleep processing during read and write processing. The sleep interval is determined according to the system responsiveness.
- If you use a single Compolet instance from multiple threads, you need to perform exclusive access control to the instance.

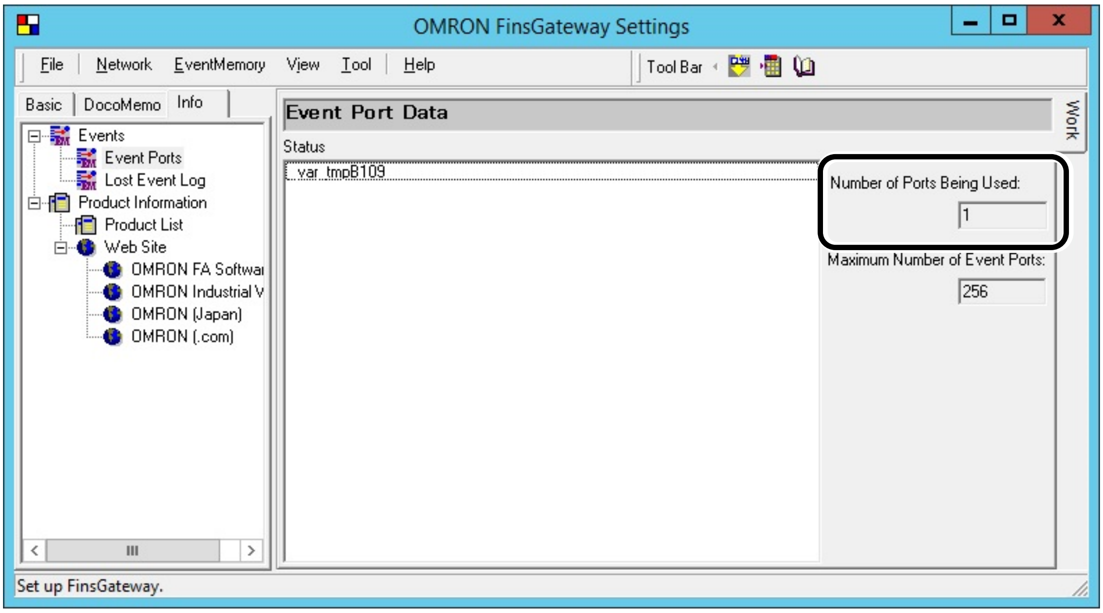
3.1.1. Creation of Compolet instance

3.1.1.1. Creation of one VariableCompolet

Create one VariableCompolet instance for one user application.

Point

Confirm that the instance is generated correctly by FinsGateway Setting. Confirm that Number of Ports Being Used for FinsGateway setting is increased by one when the user application is started.



var_tmpB109

Number of Ports Being Used: 1

Maximum Number of Event Ports: 256

Set up FinsGateway.

3.1.2. Validation of VariableCompolet

3.1.2.1. Remain VariableCompolet valid until user application is terminated

The Active property of the VariableCompolet is enabled until the user application is terminated and remains enabled until the user application is terminated. Disables the Active property of the VariableCompolet at the end of the user application and disposes of the VariableCompolet instance (Dispose).

Point

VariableCompolet is enabled or disabled only once for the start and end of a user application. Enable/disable checks that the number of event ports does not increase or decrease, except at the start and end of the user application. (See *3.1.1 Creation of Compolet Instance*)

3.1.3. Reading and writing variable values registered in SYSMAC Gateway

3.1.3.1. Setting of Read/Write processing interval

Set the interval between several tens ms and several hundred ms of sleep processing during read and write processing. The sleep interval is changed according to the system responsiveness.

3.1.3.2. Reading and writing variables from multiple threads

When you read and write variables from multiple threads using a single Compolet instance, you need to perform the exclusive control in your applications.

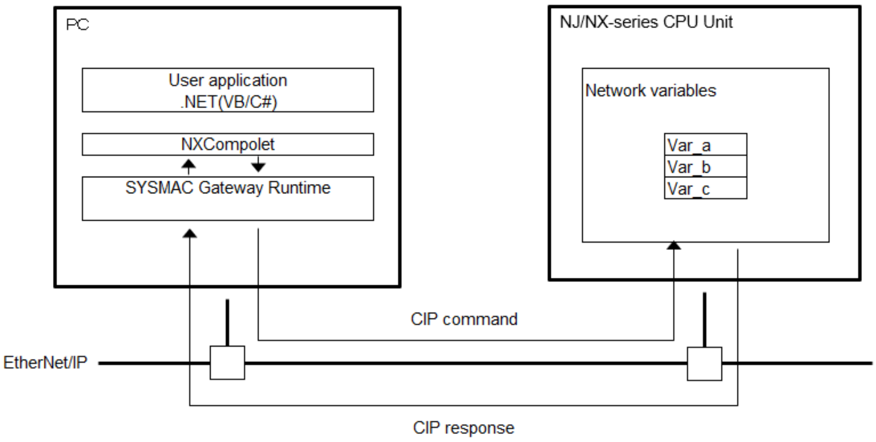
Point

Instance members that are not public static (Visual Basic: Shared) of Compolet are not thread-safe.

3.2. Using Message Communications

For devices on an EtherNet/IP network, CIP communication (issuing CIP commands and receiving responses) can be performed by executing any Compolet on a user application.

CIP communication is performed using the Compolet (2.3. Checking Compolet Type) corresponding to the device to be communicated. The figure below shows an example when communicating with the NX-series CPU Unit.



Point

Message communication differs from tag data links in that only tag variables can be used to read and write memory of a device.

Message communication is suitable for use in event-type communication such as reading errors. The use of tag data link is recommended if data exchange is in regular intervals.

The following steps are used to design.

1. Create Compolet instances.

   Remember to assign a Compolet Instance to a Node.

2. Set timeout monitoring period.

   Set the timeout monitoring period (ReceiveTimeLimit property) to 2 seconds or longer.

3. Open a connection.

   Keep the connection open until the application finished. When closing the application, also close the connection, and dispose the Compolet instances.

   Point

   - If you want to open connections simultaneously from multiple threads (Set Active property Enabled), you need to perform the exclusive control to open connections in your applications.

4. Perform message communication.

   - Set several tens ms and several hundred ms of sleep processing during communications and set the interval for each message communication.

   - Add an appropriate CIP communication every 5 seconds if you set 10 seconds or more intervals. SYSMAC Gateway implements a standard specification for CIP communication that disconnects connection when there is no communication with a target for 10 seconds. To prevent unintended disconnection, appropriate CIP communication must be performed within 10 seconds.

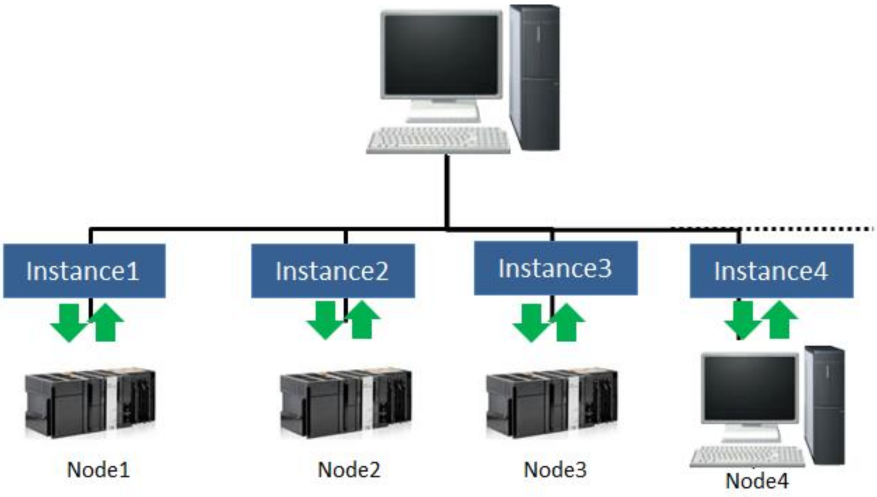
Point

- When communicating by a single Compolet instance from multiple threads, you need to perform the exclusive control in your applications.

3.2.1. Creation of Compolet instance

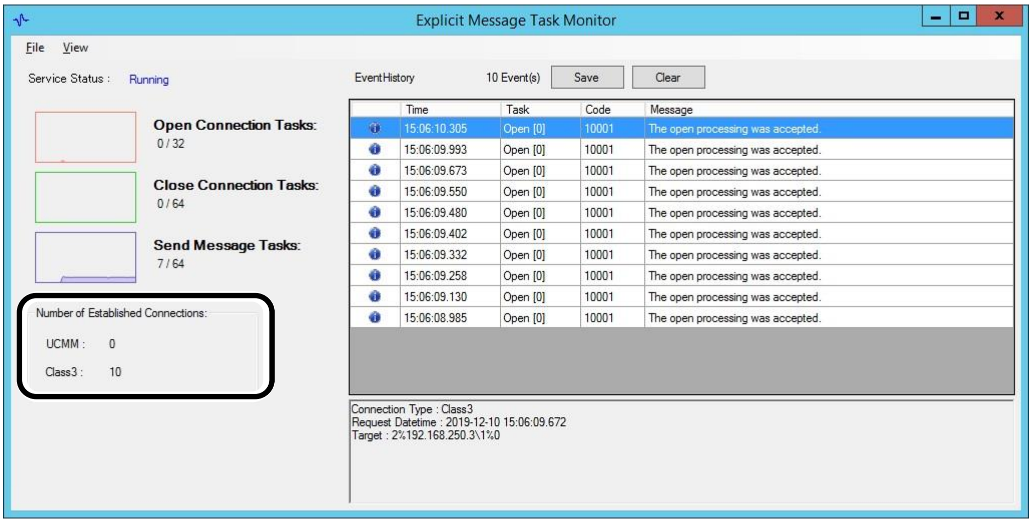
3.2.1.1. When creating Compolet instances, remember to assign a Compolet Instance to a PLC Node.

Each Compolet should correspond to each Node (Controller or SYSMAC Gateway installed in computer). Assigning one instance to one node prevents simultaneous access from multiple Compolet instances.



Point

The Explicit Message Task Monitor on the SYSMAC Gateway allows you to check Number of Established Connections. Confirm that the number of nodes to be connected is the same as the number of connections displayed. If there is an inconsistency, extra connections may be left.



Service Status : Running

Open Connection Tasks: 0 / 32

Close Connection Tasks: 0 / 64

Send Message Tasks: 7 / 64

Number of Established Connections:

UCMM : 0

Class3 : 10

EventHistory 10 Event(s)

	Time	Task	Code	Message
🛈	15:06:10.305	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.993	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.673	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.550	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.480	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.402	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.332	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.258	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.130	Open [0]	10001	The open processing was accepted.
🛈	15:06:08.985	Open [0]	10001	The open processing was accepted.

```
Connection Type : Class3
Request Datetime : 2019-12-10 15:06:09.672
Target : 2%192.168.250.3\1%0
```

3.2.2. Setting timeout monitoring period

3.2.2.1. Set timeout monitoring period (ReceiveTimeLimit Property) to 2 Seconds or Longer.

When multiple Compolet instances are used in user applications that handle multiple nodes, there is a risk that the response received by Compolet will be delayed due to the increased communication load. In order to reduce this risk, ensure to set long timeout monitoring period.

Point

- Like the SYSMAC Gateway, the timeout monitoring period is set to 2 seconds or longer, which is the default Response Monitor Time of Sysmac Studio, which is the software for communicating with the controller.
- In the source code of the user application, check the timeout monitoring period set in the ReceiveTimeLimit property of the Compolet.
- The MaxExecuteTimeSpan property of Compolet can be used to acquire the maximum communication time. When timeout occurs during operation, the timeout monitoring period is set based on the maximum communication time acquired.

3.2.3. Opening connections

3.2.3.1. Keeping the connection open until the application finished.

Design the connection to remain open until the end of the user application. When closing the application, also close the connection, and dispose the Compolet instances.

Point

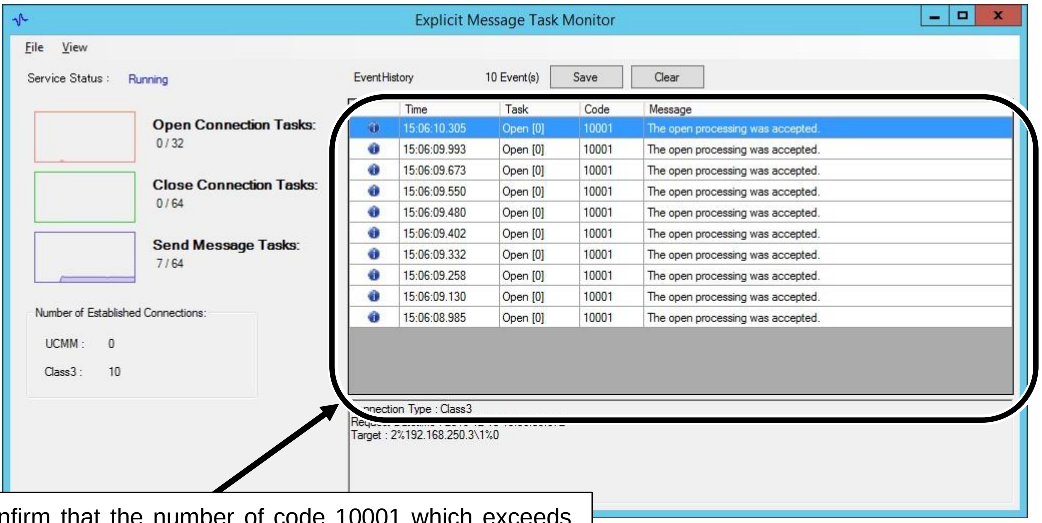
The connection is maintained by the communication of the opened connection.

If the communication is not performed, the connection is automatically disconnected.

Once the connection is opened, by maintaining it, to re-open unnecessary connections is suppressed. In addition, the processing load inside Compolet is reduced.

When SYSMAC Gateway is accepted an open connection request, an event (10001) of a request connection in the event history of the Explicit Message Task Monitor is recorded. When composed of multiple nodes, you can confirm the event for the number of nodes. When registered the number of events which exceeds that of nodes, check that of connections per node.

Code	Level	Message
10001	Information	The open processing was accepted.



Service Status : Running

EventHistory 10 Event(s)

Open Connection Tasks: 0 / 32

Close Connection Tasks: 0 / 64

Send Message Tasks: 7 / 64

Number of Established Connections:

UCMM : 0

Class3 : 10

	Time	Task	Code	Message
🛈	15:06:10.305	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.993	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.673	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.550	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.480	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.402	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.332	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.258	Open [0]	10001	The open processing was accepted.
🛈	15:06:09.130	Open [0]	10001	The open processing was accepted.
🛈	15:06:08.985	Open [0]	10001	The open processing was accepted.

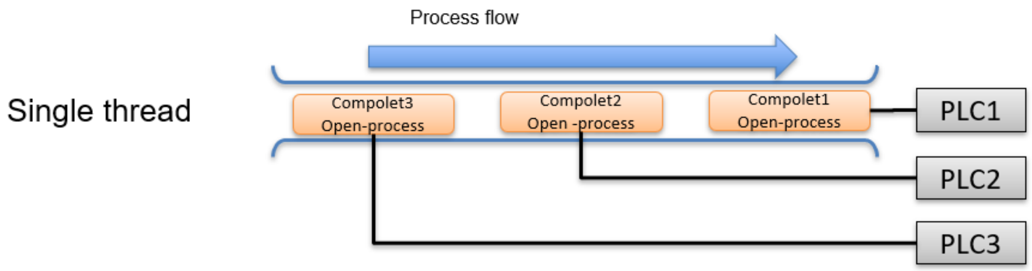
nnection Type : Class3

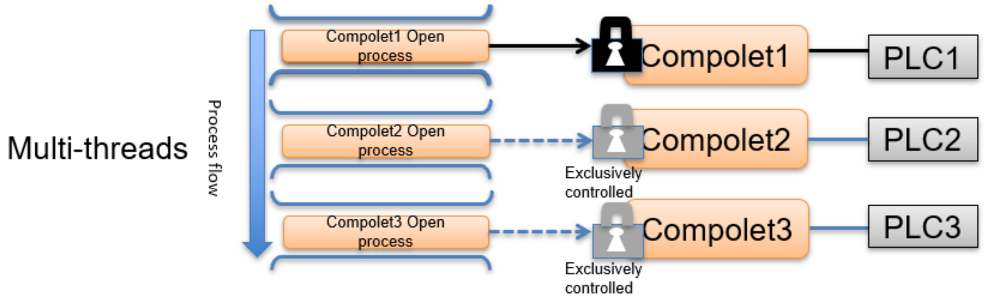
Target : 2%192.168.250.3\1%0

Confirm that the number of code 10001 which exceeds that of nodes are not displayed.

3.2.3.2. One by one opening connections for multiple nodes

Design the connections for a multiple node to open connections one by one when a user application opens connections for each node.



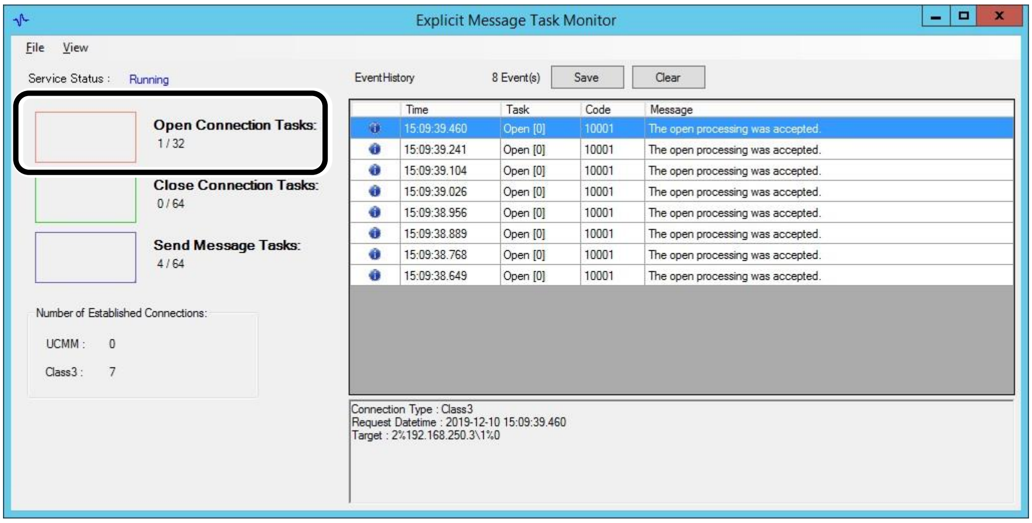


Point

Upon receipt of the opening request from Compolet, the SYSMAC Gateway performs the connection opening process. User application should be designed to avoid overlapping opening requests because SYSMAC Gateway performs only one connection opening process at a time.

After confirming the opening process is completed, perform the following connection opening process.

The Explicit Message Task Monitor enables you to check the current connection opening requests SYSMAC Gateway accepted. Confirm the number of open connection tasks, which represents the number of open connection requests, is not more than two.



Service Status : Running

Open Connection Tasks: 1 / 32

Close Connection Tasks: 0 / 64

Send Message Tasks: 4 / 64

Number of Established Connections:

UCMM : 0

Class3 : 7

EventHistory 8 Event(s)

Time	Task	Code	Message
15:09:39.460	Open [0]	10001	The open processing was accepted.
15:09:39.241	Open [0]	10001	The open processing was accepted.
15:09:39.104	Open [0]	10001	The open processing was accepted.
15:09:39.026	Open [0]	10001	The open processing was accepted.
15:09:38.956	Open [0]	10001	The open processing was accepted.
15:09:38.889	Open [0]	10001	The open processing was accepted.
15:09:38.768	Open [0]	10001	The open processing was accepted.
15:09:38.649	Open [0]	10001	The open processing was accepted.

```
Connection Type : Class3
Request Datetime : 2019-12-10 15:09:39.460
Target : 2%192.168.250.3\1%0
```

3.2.4. Performing message communications

3.2.4.1. Control exclusively for multiple simultaneous access to a single Compolet instance.

When accessing a single Compolet instance using multi-threaded, you need to perform the exclusive control in your applications.

Alternatively, design to perform an access to one Compolet instance from one thread only.

3.2.4.2. Setting of communication processing interval

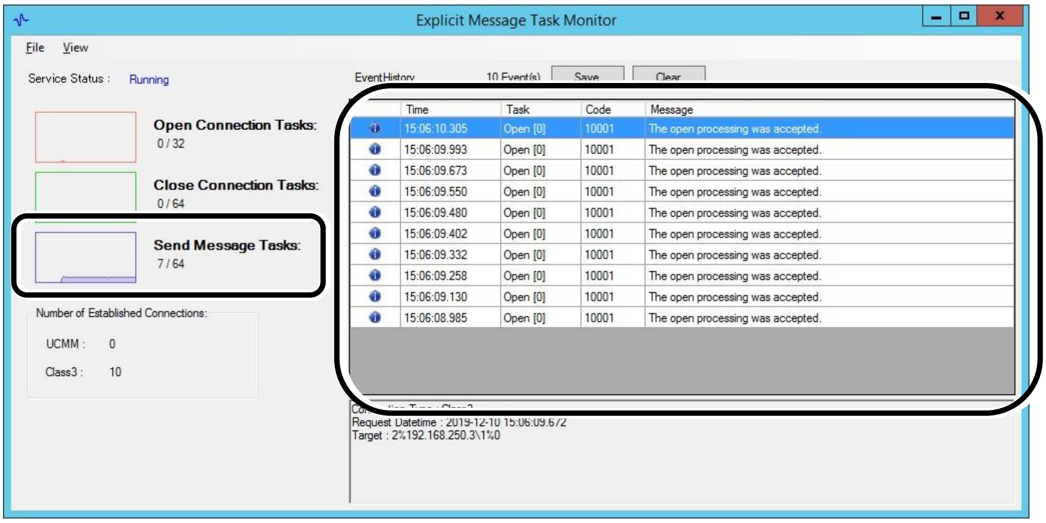
Set the interval for communication by putting tens to hundreds of milliseconds of sleep during communication.

Point

Check the communication load state on the Explicit Message Task Monitor and adjust the interval so that the reception timeout does not occur.

The number of send message tasks and the status of communication timeouts can be checked on the Explicit Message Task Monitor. If a communication timeout occurs or is likely to occur, the following events are recorded in the event history.

Code	Level	Message
10002	Information	No response was received within the receive timeout.
10003	Information	Receive timeout has almost occurred.



Service Status : Running

Open Connection Tasks: 0 / 32

Close Connection Tasks: 0 / 64

Send Message Tasks: 7 / 64

Number of Established Connections:

UCMM : 0

Class3 : 10

EventHistory 10 Event(s)

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ℹ	15:06:10.305	Open [0]	10001	The open processing was accepted.
ℹ	15:06:09.993	Open [0]	10001	The open processing was accepted.
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ℹ	15:06:09.550	Open [0]	10001	The open processing was accepted.
ℹ	15:06:09.480	Open [0]	10001	The open processing was accepted.
ℹ	15:06:09.402	Open [0]	10001	The open processing was accepted.
ℹ	15:06:09.332	Open [0]	10001	The open processing was accepted.
ℹ	15:06:09.258	Open [0]	10001	The open processing was accepted.
ℹ	15:06:09.130	Open [0]	10001	The open processing was accepted.
ℹ	15:06:08.985	Open [0]	10001	The open processing was accepted.

Connection Type : Class3
Request Datetime : 2019-12-10 15:06:09.672
Target : 2%192.168.250.3\1%0

3.2.4.3. Setting the communication processing interval of the connection open state in under 10 seconds

When the communication interval exceeds 10 seconds, the process of performing appropriate message communication should be added once every 5 seconds.

When an interval of more than 10 seconds is generated in the event of message communication in the connection open state, an appropriate message communication process should be added.

Additional Information

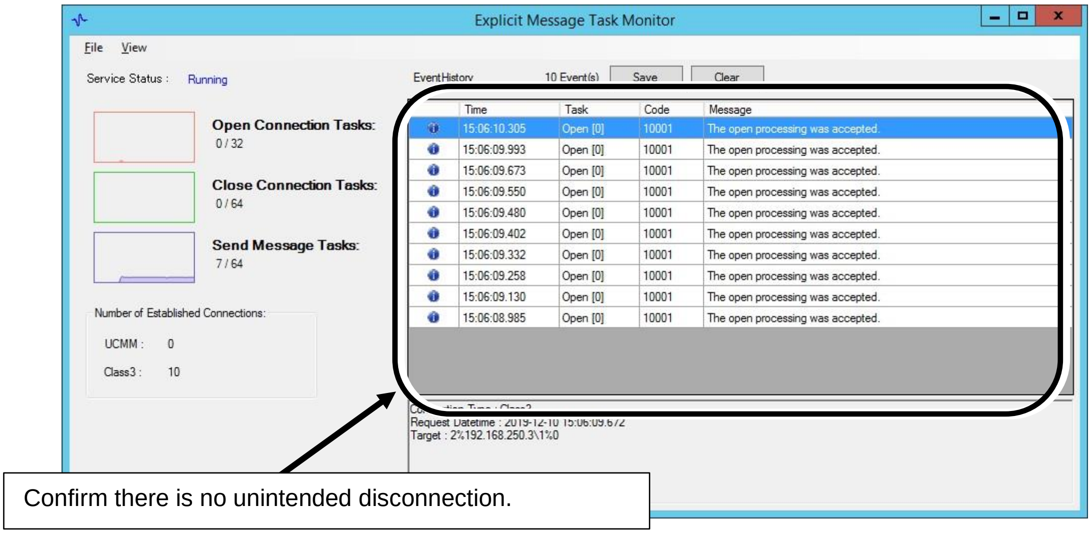
As a general specification of EtherNet/IP, when there is no communication for a certain period, the connection is automatically disconnected. According to this specification, SYSMAC Gateway disconnects the connection if the user application does not request transmission for more than 10 seconds.
When CIP communication is executed after the connection is disconnected, the Compolet automatically performs reconnection.

Point

When there is no communication for a certain period and the connection is closed, the following two events are recorded for each close in the event history on Explicit Message Task Monitor.

If the events are confirmed, check countermeasures of 3.2.4.3 Setting The Communication Processing Interval In The Connection Open State In Under 10 Seconds again.

Code	Level	Message
150	Warning	The connection for message communications was closed.
10001	Information	The open processing was accepted.



Service Status : Running

Open Connection Tasks: 0 / 32

Close Connection Tasks: 0 / 64

Send Message Tasks: 7 / 64

Number of Established Connections:

UCMM : 0

Class3 : 10

EventHistory 10 Event(s)

	Time	Task	Code	Message
●	15:06:10.305	Open [0]	10001	The open processing was accepted.
●	15:06:09.993	Open [0]	10001	The open processing was accepted.
●	15:06:09.673	Open [0]	10001	The open processing was accepted.
●	15:06:09.550	Open [0]	10001	The open processing was accepted.
●	15:06:09.480	Open [0]	10001	The open processing was accepted.
●	15:06:09.402	Open [0]	10001	The open processing was accepted.
●	15:06:09.332	Open [0]	10001	The open processing was accepted.
●	15:06:09.258	Open [0]	10001	The open processing was accepted.
●	15:06:09.130	Open [0]	10001	The open processing was accepted.
●	15:06:08.985	Open [0]	10001	The open processing was accepted.

```
Connection Type : Class3
Request Datetime : 2019-12-10 15:06:09.672
Target : 2%192.168.250.3\1%0
```

Confirm there is no unintended disconnection.

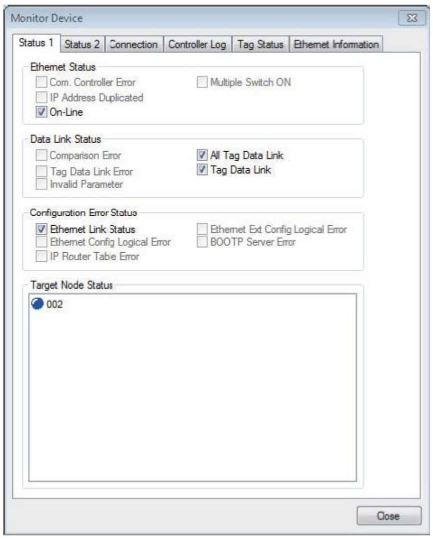
4. Startup Phase

This chapter describes the procedures and notes about tag data links and message communication during the system startup.

4.1. Using Tag Data Link

Monitor the communication status of the tag data link in the Network Configurator. Connect the Network Configurator online, select the device to be checked, right-click to display the pop-up menu, and select **Monitor**.

The **Monitor Device** Dialog Box will be displayed. Then, check as described in the next section.



Ethernet Status

- ☐ Com. Controller Error
- ☐ IP Address Duplicated
- ☑ On-Line
- ☐ Multiple Switch ON

Data Link Status

- ☐ Comparison Error
- ☐ Tag Data Link Error
- ☐ Invalid Parameter
- ☑ All Tag Data Link
- ☑ Tag Data Link

Configuration Error Status

- ☑ Ethernet Link Status
- ☐ Ethernet Config Logical Error
- ☐ IP Router Tabe Error
- ☐ Ethernet Ext Config Logical Error
- ☐ BOOTP Server Error

Target Node Status

● 002

Additional Information

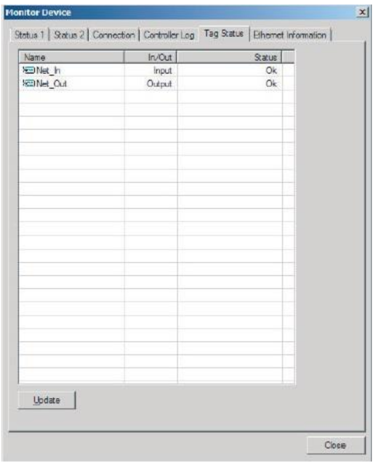
If a communications error occurs during monitoring, the dialog box will continue to show the last information that was collected.

To start monitoring again, close the Monitor Device Dialog Box, and then open the Monitor Device Dialog Box again.

4.1.1. Checking connection status

4.1.1.1. Checking tag status

Display Tag Status Tab Page and check the tag resolution status.



Name	In/Out	Status
Net_In	Input	Ok
Net_Out	Output	Ok

This tab page displays if the tag settings for each tag for tag data links are set so that data can be exchanged.

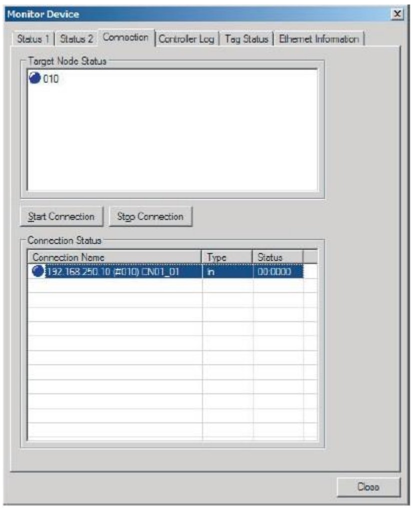
The following status is displayed depending on the status that is set.

Status	Description
Ok	Normal data exchange is possible.
Processing to solve	The variables with tags are being resolved. When the resolution is completed normally, a connection will be established, and the data exchange will start.
Size error	Different sizes are set for the network variables and the tag settings. A connection will not be established for a tag for which this error occurs.
Not exist	A network variable set in the specified tag setting does not exist. A connection will not be established for a tag for which this error occurs.
Refresh type error	(1) The Controller network variable cannot be written because of the Constant attribute. (2) The I/O direction that is set in the tag data link settings does not agree with the I/O direction of the network variable. A connection will not be established for a tag for which this error occurs.

If the status is not “Ok”, set the tag data link or the network variable correctly.

4.1.1.2. Checking connection status

Display Connection tab and check the Connection status.



Target Node Status

● 010

Connection Status

Connection Name	Type	Status
● 192.168.250.10 (#010) CN01_01	in	00:0000

Information about the target node that acts as the originator is displayed.

If all the tag data link connections with the node in the monitor are established and normal, this information is displayed in blue. However, if any connection is broken it is displayed in red. However, this information is displayed in gray if the connection of a node in the monitor is stopped.

In addition, in the Connection Status Area, the **Status** Column shows the current status of each connection that is set as the originator. This information can be used to identify the cause of tag data link errors.

Refer to one of the following manuals for details of connection status information.

NJ/NX-series CPU Unit Built-in EtherNet/IP Port User's Manual (Cat. No. W506)

NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC Built-in EtherNet/IP Port User's Manual (Cat. No. W563)

4.2. Using Message Communications

4.2.1. Checking communication load of Compolet/SYSMAC Gateway

The Explicit Message Task Monitor can monitor the communication load of the Compolet and SYSMAC Gateway.

More information about using the Explicit Message Task Monitor can be found in the SYSMAC Gateway Help. **SYSMAC Gateway Help - SYSMAC Gateway - Troubleshooting - How to use Explicit Message Task Monitor**

4.2.1.1. Checking number of internal processes in SYSMAC Gateway

Check the number of SYSMAC Gateway internal processes on the Explicit Message Task Monitor. The following three tasks can be checked.

- Open Connection Tasks

  Shows the number of connection requests received by the SYSMAC Gateway.

- Close Connection Tasks

  Shows the number of disconnect requests received by the SYSMAC Gateway.

- Send Message Tasks

  Shows the number of send messages that SYSMAC Gateway is processing at the same time.

Point

You can check the change in the number of processes using a graph. Confirm that the design does not exceed the upper limit of the number of processes.

Refer to 2.2.3.3. Checking number of transactions that SYSMAC Gateway can accept simultaneously.

4.2.1.2. Checking number of connections

Confirm each number of connections of UCMM and Class3 that the SYSMAC Gateway has established as clients. For the maximum number of connections, refer to 2.2.3.1. Checking number of connections.

Point

If the number of connections is increasing, refer to 3.2 Using Message Communications.

5. Operation Phase

This chapter describes the problems that may occur during operation of devices, possible causes, and troubleshooting.

5.1. Investigation Flow

This section describes the flow of investigations for detailed confirmation of phenomena and separation of causes of major problems that occur when operating devices.

In section 5.1.1 is described as following: common problems, assumed factors, and troubleshooting for tag data link/message communication.

From section 5.1.2 to 5.1.4 are described as following: the tag data link.

In section 5.1.5 is described as following: the message communication-specific items.

5.1.1. Communications which cannot be performed with the target device

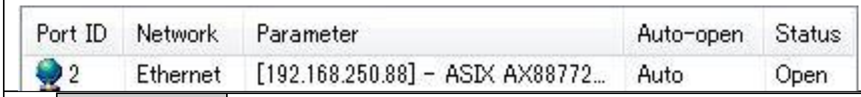
Use the following procedure to grasp the situation and identify the cause if communications cannot be performed with the target device.

1. Is the SYSMAC Gateway port open correctly?
2. Are the communications being performed in the Windows level?
3. Can SYSMAC Gateway perform the communications?

5.1.1.1. Checking open state of SYSMAC Gateway port

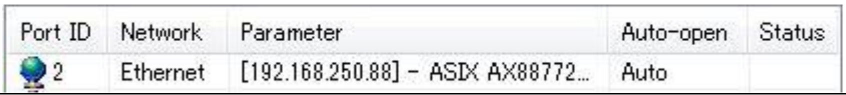
Check the condition of the applicable port on the SYSMAC Gateway Console.

1. Start the SYSMAC Gateway Console.
2. Check the parameter display area of the applicable port ID in the network port.



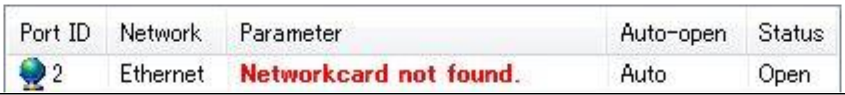
Port ID	Network	Parameter	Auto-open	Status
2	Ethernet	[192.168.250.88] - ASIX AX88772...	Auto	Open

Meaning	Normal
Description	・ The specified IP address is assigned correctly. ・ The port is correctly open with the status "Open”.
Action	When the communications cannot be performed even if the port is correctly open, refer to “5.1.1.2 Checking Windows communication status”.



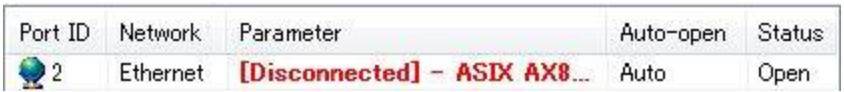
Port ID	Network	Parameter	Auto-open	Status
2	Ethernet	[192.168.250.88] - ASIX AX88772...	Auto	

Meaning	Service has not been started.
Description	･The specified IP address is assigned correctly. ・ The status is not displayed. The communication service may have not been started.
Action	Check if the SYSMAC Gateway service has been started.



Port ID	Network	Parameter	Auto-open	Status
2	Ethernet	Networkcard not found.	Auto	Open

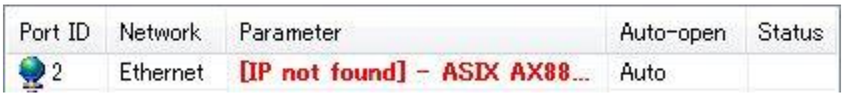
Meaning	Network card selection error
Description	The network card is not selected correctly.
Action	・ Check if the network card that you want to use is set in the network port property page. ・ Check if the specified network card is available.



Port ID	Network	Parameter	Auto-open	Status
2	Ethernet	[Disconnected] - ASIX AX8...	Auto	Open

Meaning	Cable disconnection error

Description	No IP address is allocated to the specified network card.
Action	・ Check if the IP address is allocated correctly. ・ Check if a normal response is returned from the connected device to the ping command.



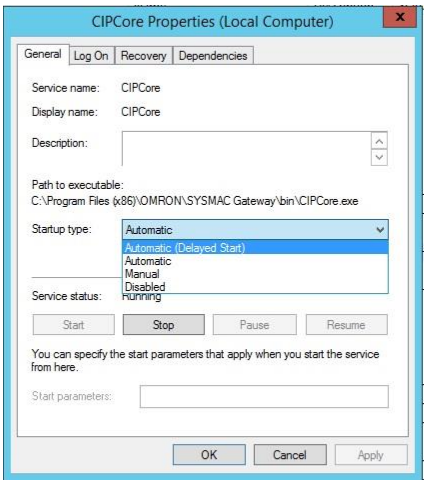
Port ID	Network	Parameter	Auto-open	Status
2	Ethernet	[IP not found] - ASIX AX88...	Auto	

Meaning	The IP address was changed.
Description	A different IP address from the one specified in the setting is allocated.
Action	・ Check if the IP address that you set has been changed. ・ Check if the network setting to use DHCP for getting the IP address is made.

Additional Information

If you set the *Automatically open port at startup* of the Ethernet Port Properties in SYSMAC Gateway Console, SYSMAC Gateway may perform the opening process before Windows recognizes the network card.

In order to execute the open process in the user application, set the Startup Type of CIPCore service the delay start, or disable Open port automatically at startup and then you perform open port process in your applications.



CIPCore Properties (Local Computer)

Service name: CIPCore

Display name: CIPCore

Description:

Path to executable:
C:\Program Files (x86)\OMRON\SYSMAC Gateway\bin\CIPCore.exe

Startup type: Automatic

Service status: Running

You can specify the start parameters that apply when you start the service from here.

Start parameters:

5.1.1.2. Checking Windows communication status

Check the following when the communications cannot be performed even if the port is open for SYSMAC Gateway.

1. Check if the communications can be performed with the connected device by using the ping command.

   1-1. Check if the connected device returns a response to the ping command in the Windows command prompt.

   1-2. When no response is returned to the ping command, check the network status and connected device as shown below.

   - Is the power supply to the connected device ON?
   - Is the correct IP address is set for the connected device?
   - Is the correct network address is set for the IP address of the connected device?
   - Are the problems solved by changing the connection cable, network card, and switching hub status?

2. Check for the firewall settings.

   2-1. Check if the CIPCore.exe, which is the execution file of SYSMAC Gateway in the firewall settings.

2-2. Register CIPCore.exe as an exception process of the firewall. (both for UDP and TCP)

Refer to the Firewall Settings in the Installation Guide for details.

5.1.1.3. Checking communication status of SYSMAC Gateway

After confirming the Windows communication status, use the message communication function of SYSMAC Gateway to check the communication.

1. Check if the tags of the connected device can be monitored by the tag monitoring function.

   Only the network variables can be monitored.

   For information about using the tag monitoring function, refer to the SYSMAC Gateway Help.

   SYSMAC Gateway Help - Tag Monitor

2. Confirm that communication can be performed correctly in the message communication test.

   Refer to SYSMAC Gateway Help on how to test the message communication.

   SYSMAC Gateway Help - SYSMAC Gateway - Troubleshooting - Message Communications Test

5.1.2. Tag data Link which cannot be established properly

Use the following procedure to grasp the situation and identify the cause if the tag data link has not been correctly established although the basic communications have been established with the target Controller.

1. Are the data link settings correct?
2. Haven't any problems been detected in the SYSMAC Gateway level?

5.1.2.1. Are the data link settings correct?

Check if the connection to SYSMAC Gateway has been established using Network Configurator or SYSMAC Gateway Troubleshooter.

1. If the connection for the tag data link has not been established, solve the problem based on the instructions displayed in the Troubleshooter.
   SYSMAC Gateway Help - SYSMAC Gateway - Troubleshooting - Troubleshoot
2. Also, check the following.

   2-1. Are the tag settings and data link settings correct?

   2-2. When the settings are changed in the Network Configurator, were the settings downloaded to all of the devices?

   2-3. For the data link settings between NJ/NX/NY-series Controller and SYSMAC Gateway, are the tags of the NJ/NX/NY-series Controller CJ2-compatible alignment?

   Refer to SYSMAC Gateway Help on how to exchange data with the NJ/NX/NY controller. **SYSMAC Gateway Help - SYSMAC Gateway - Using SYSMAC Gateway - Precautions - Data exchange with NJ/NX/NY Controllers**

   2-4. When multiple ports are used, make sure that the settings for all ports are correct.

   Refer to SYSMAC Gateway Help for instructions on extending Ethernet ports.

   SYSMAC Gateway Help - SYSMAC Gateway - Tag Data Link - Setting for Extending Ethernet Ports

5.1.2.2. Checking problems detected by SYSMAC Gateway

Check the Windows Event Viewer for problems detected by SYSMAC Gateway.

The Windows Event Log, which is recorded in the Windows Event Viewer, records the internal status changes and problems detected by the SYSMAC Gateway. You can detect problems by checking the Windows event log.

Refer to SYSMAC Gateway Help for the general information and check procedure of the windows event log.

SYSMAC Gateway Help - SYSMAC Gateway- Troubleshooting - Checking the Windows Event Log

5.1.3. Not applied data regardless of the established tag data link connection

Use the following procedure to grasp the situation and identify the cause if the data is not applied although the basic communications have been established with the target Controller and the tag data link connection has been also established.

1. Is the CIPCore excluded from the filtering target in the firewall settings?
2. Doesn't the network card filter the messages?
3. In the application program, is the handshake taken into account in the programming?

5.1.3.1. Checking firewall settings

Depending on the firewall settings, it may look as if the data is not applied although the tag data link is established. When receive data of tag data link is filtered by the firewall setting, the following symptoms appear.

- When monitoring a data link of which SYSMAC Gateway is the originator on Network Configurator, it looks as if the data is not updated although the connection is normally established.
- When monitoring using the Troubleshooter, it looks as if the connection is opened and closed in a 10-s cycle.
- When checking the event log, it looks as if a timeout occurs for the originator once every 10 s and the connection is re-opened.

1. Exclude CIPCore.exe from the filtering targets. Refer to the Firewall Settings of the installation guide for concrete setting procedures.
2. By changing or version-upgrading the antivirus software, the firewall settings may be initialized or filtering of the unintended data. Disable or uninstall the antivirus software to check for the impact of the antivirus software.

5.1.3.2. Checking network cards

Check whether the network card driver is up to date.

Depending on the parameter settings of the network card driver, the multicast data filtering function may work when the communications load is heavy.

1. Check the network card specifications and that the correct parameters are set.
2. If the parameter change does not resolve, apply the network card of the different vendor and check the state.

5.1.3.3. Application of handshakes in user applications

The tag data link periodically sends data at high speed. Even if a communications error occurs, the transmission is not retried. And the data for the next cycle is sent as the latest data.

1. When transmitting data with reliability, the communication handshake should be applied to the user application.

   "data with reliability" means that the data is reliably reached by flag processing between application and controller.

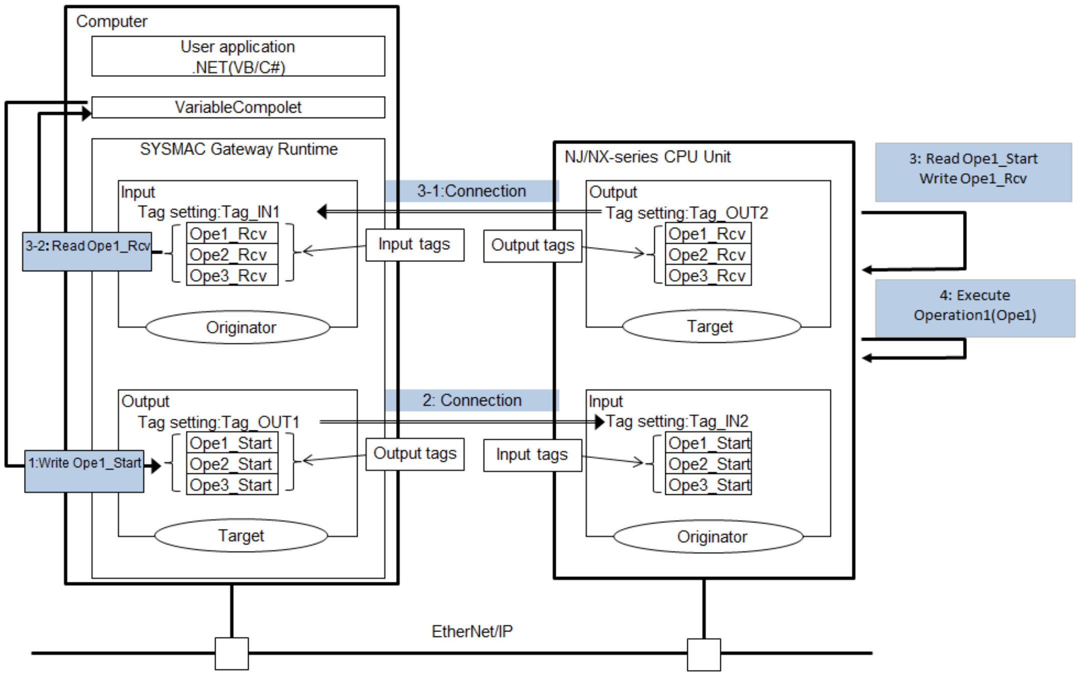


Image of the communication handshake

2. Check if the target data is not re-written from the application separately from updates in the tag data link.

5.1.4. Disconnection of tag data link

Use the following procedure to grasp the situation and identify the cause if the tag data link connection is closed although the basic communications have been established with the target Controller and the tag data link connection has been also established.

1. Confirmation of communication environment and computer environment
2. Confirmation of communication cycle
3. Confirmation of timeout monitoring period

5.1.4.1. Confirmation of communication environment and computer environment

The following communications environment factors may cause timeouts. Check the environment to see if the frequency of the phenomena is increased or reduced by changing the environmental factors.

- Message communications errors may be caused by a contact failure of a cable or by using a non-standard cable.
- Noise in the communications cable and target device may cause message communications errors.
- Check the performance, settings, and arrangement of the switches, routers, hubs, and other items.
  Depending on the performance and settings of switches, routers, hubs, and other items, the communications performance may be lowered, or the messages may be filtered. For example, if IGMP filter is set, multicast packets of the tag data link are not be received, and the timeout occurs.
- Changing the network card may improve the processing speed and reduce the timeouts.
  Depending on the driver software version of the network card or driver parameter settings, data capturing failures may occur.
- The computer may have some error such as disk error and memory error.
- Confirming the latest Windows operating system update
- If there are some patterns on the timing when the tag data link is disconnected, the phenomenon may occur by the influence of the function that is being executed at the time.
  For example:
  - The phenomenon occurs at a similar time in the morning. In this case, some processing may be executed periodically at the time in the computer.
  - The phenomenon occurs when a certain device or program is started.
- Check antivirus software
  The communications performance may be lowered, or the messages may be filtered by some function such as antivirus software that checks the receive messages.

5.1.4.2. Packet interval confirmation

If update data is not received within the monitoring time set to detect a timeout, the tag data link regards it as a timeout, delete a connection, and re-establish the connection.

The Windows OS is not a realtime OS. Therefore, SYSMAC Gateway may need to wait for a long time when heavy load is imposed on the OS processing.

- Confirm that the packet interval is set to 50 ms or more.
  Although the minimum data packet interval of the tag data link is 1 ms, timeouts may often occur depending on the OS status if the packet interval is short. Normally, set the interval to 50 ms or longer.

Point

Communication time variation increases as the data length increases or the number of connections increases according to the setting of tag data link. Also, communication time variations occur depending on the type of network card, CPU load, and network load. The extent to which communication performance is achieved is depending on the usage environment. Be sure to measure the performance in the actual environment. Set such as the packet interval, time-out monitoring time to an appropriate value afterward.

5.1.4.3. Checking timeout monitoring time

If a connection timeout occurs, verify that:

- Check if the problem is solved by extending the monitoring time to detect the timeout.

  The connection is closed and automatically re-opened when a timeout occurs. If this re-opening request is generated, closing and re-opening processing increase communication load of SYSMAC Gateway, and the timeout will occur more easily in a chain reaction.

Additional Information

The packet of tag data link may not have been sent within the time required for the application due to the high PLC load. Check the interval time between packets using the network protocol analyzer (such as Wireshark). If the timeout monitoring time cannot be increased, consider reducing the load on the PLC.

5.1.5. Error message communication

Use the following procedure to grasp the situation and identify the cause if a message communication is error with the target device.

1. Is it possible to send a message individually while the application is not running?
2. Is the exclusive control taken into account for multi-thread processing?
3. Isn't the application terminated or stopped by application errors during debugging?
4. Is the monitoring time to detect a timeout proper?

5.1.5.1. Is it possible to send a message individually while the application is not running?

Use the procedure for 5.1.1. Communications cannot be performed with the target device to check if a problem has occurred.
Check if the communications can be performed with the utility provided by SYSMAC Gateway.

1. Can the tags be monitored by on the tag monitoring on SYSMAC Gateway?
2. Can the communications be performed by the CIP communications test?
   - Select Communications Test from the control panel of SYSMAC Gateway Console.
   - Set the IP address of the target device to check for the CIP communications and click the Start button.
3. Check that the communications are performed by the sample program in use if you use CX-Compolet.
   - Select the sample program from [Omron] - [CX-Compolet] - [Samples] of the Windows menu and build and execute them.

5.1.5.2. Is the exclusive control taken into account for multi-thread processing?

The API and the CX-Compolet functions provided by SYSMAC Gateway SDK are not thread-safe. As described in 3.2.4.1 Control exclusively for multiple simultaneous access to a single Compolet instance, if you use them in the multi-thread environment, you need to perform the exclusive control in your applications.

5.1.5.3. Isn't the application terminated or stopped by application errors during debugging?

If the process is interrupted or stopped due to an application error during debugging of a user application, the memory area used by the SYSMAC Gateway may not be released and the communication process may be affected.

If the following conditions are found, the application using the SYSMAC Gateway and the service of the SYSMAC Gateway are all terminated, and then the communication status is checked by starting again.

- The program was aborted without exit processing after debugging.
- The application was terminated due to an error without exit processing during development of the application.

5.1.5.4. Is the monitoring time to detect a timeout proper?

Perform enough evaluation for the timeout monitoring detection time in your system and set the optimum time before starting operation of the device.

Set a time out period in the user application, refer to 3.2.2 Setting timeout monitoring period.

Additional Information

The response time depends on the number of relay stations.

The timeout monitoring time should be added approximately 5 seconds to each relay station.

6. Checking for Errors and Troubleshooting

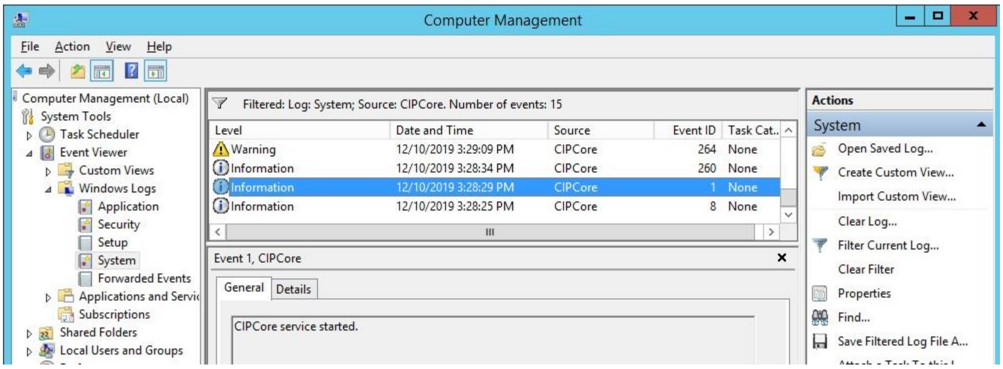
This chapter describes how to check for errors and specific troubleshooting.

6.1. Checking Methods of Error

6.1.1. Confirmation by Windows Event Viewer

Start the Windows Event Viewer and select **System**. The SYSMAC Gateway's communications service log entries are indicated with "CIPCore" as the source.

The following is an example of filtering with the event source "CIPCore”.



Filtered: Log: System; Source: CIPCore. Number of events: 15

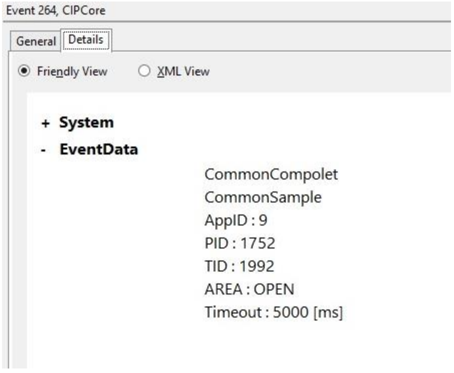
Level	Date and Time	Source	Event ID	Task Cat..
Warning	12/10/2019 3:29:09 PM	CIPCore	264	None
Information	12/10/2019 3:28:34 PM	CIPCore	260	None
Information	12/10/2019 3:28:29 PM	CIPCore	1	None
Information	12/10/2019 3:28:25 PM	CIPCore	8	None

Event 1, CIPCore

CIPCore service started.

In the Windows Event Viewer, you can view event details, by selecting **Details** tab in the window.

The following is an example of detailed data for event 264. From the AREA:OPEN record, it can be confirmed that the reception timeout occurred when the connection was opened.



Event 264, CIPCore

+ System
- EventData

CommonCompolet
CommonSample
AppID : 9
PID : 1752
TID : 1992
AREA : OPEN
Timeout : 5000 [ms]

Additional Information

You may find out the causes of the CIPCore errors by the following checks.

- Do application operations which are recorded in Application of Windows Event Viewer work properly?
- Are any network card errors recorded?

6.1.2. Confirmation by the monitor device function of the network configurator (only tag data link)

Connect the Network Configurator online, select the device to be checked, right-click to display the pop-up menu, and select **Monitor**.

6.2. Checking Details of the Windows Event Log and Troubleshooting

6.2.1. Error caused by message communication

Code	Message	Cause and troubleshooting
144	The open processing was not accepted.	Cause: Request for establishment processing exceeded the number of Open Connection Tasks that can be accepted. Troubleshooting: Check the number of Open Connection Tasks with the Explicit Message Task Monitor to avoid concentration of connections.
145	The send processing was not accepted.	Cause: Request for send processing exceeded the number of Send Message Tasks that can be accepted. Troubleshooting: Check the number of Send message tasks with the Explicit Message Task Monitor to avoid concentration of send processing.
146	The close processing was not accepted.	Cause: Request for close processing exceeded the number of Close Connection Tasks that can be accepted. Troubleshooting: Check the number of Close Connection Tasks with the Explicit Message Task Monitor to avoid concentration of close processing.
148	The processing was requested when the port was not open.	Cause: An attempt was made to communicate messages while the SYSMAC Gateway network port was not opened. The network port of the SYSMAC Gateway is set to the "Automatically open port at startup”. However, Windows was unable to recognize the LAN card and the port could not be opened when the communication service was started. Troubleshooting 1: Starting the SYSMAC Gateway Console and manually opening the network port. Troubleshooting 2: Opening the network port using CIPPortCompolet in a user application.
149	A timeout occurred when opening a connection for message communications.	Cause: When the SYSMAC Gateway accepts the opening of multiple connections, it performs the opening of connections one by one from the previously accepted connection request. Although the SYSMAC Gateway accepted multiple connection opening requests, there was a connection task that did not complete within the timeout monitoring period (5 seconds). Troubleshooting: When opening multiple connections in an application, design the application to perform the following connection opening process after the appropriate connection opening process is completed.
150	The connection for message communications was closed.	Cause: Sending message interval exceeds a certain time (10 seconds) at any connection. Troubleshooting: The connection is automatically and temporarily closed inside the Compolet and the open process is executed again. If this warning occurs in multiple connections, ID: 149 warning may occur. Execute any communication so that the sending interval is no longer than 10 seconds.
151	The available number of connections has been exceeded.	Cause: The number of connections reached the maximum number (128) of connections that can be established. Troubleshooting 1: Check the number of established

		connections using the Explicit Message Task Monitor to make sure whether the number of connections opened by the user application is too many or not. Troubleshooting 2: When the user application is closed, make sure that the Active property of the Compolet is false before closing.
264	Receive timeout has occurred.	Cause 1: Short timeout monitoring period Troubleshooting 1: Set timeout monitoring period to 2 seconds or longer.
		Cause 2: When the SYSMAC Gateway accepts the opening of multiple connections, it establishes the opening of connections one by one from the previously accepted connection request. Although the SYSMAC Gateway accepted multiple connection opening requests, there was a connection task that did not complete within the timeout monitoring period (5 seconds). Troubleshooting 2: When opening multiple connections in an application, design the application to perform the following connection opening process after the optional connection opening process is completed.
		Cause 3: Event ID150 occurs in multiple connections at the same time and a number of open processing are in concentration for a short period. Troubleshooting 3: Execute the troubleshooting for event ID 150, and refer to 3.2.4.3. Setting the communication processing interval of the connection open state in under 10 seconds.
		Cause 4: Heavy communication load of SYSMAC Gateway due to concentrated sending message requests. Troubleshooting 4: Increase the sending message interval so that sending message requests are not concentrated.

6.2.2. Error occurring in tag data link

Code	Message	Cause and troubleshooting
118	Timeout detected for the originator data link.	Cause 1: Cable disconnection or Turn off the power to the target or switch. Troubleshooting 1: Check the power and cabling conditions of on-path device including targets and switches.
		Cause 2: Packet loss on-path due to network communication load Troubleshooting 2: Increase the connection timeout value or the RPI. Or review the network environment and network devices.

6.3. Checking Events Occurring in SYSMAC Gateway

Check the event history on the Explicit Message Task Monitor to check the status.

In addition to Windows events described in 6.2 Checking details of the Windows Event Log and Troubleshooting, the following information is displayed.

Code	Message	Description
10001	The open processing was accepted.	Occurs when SYSMAC Gateway accepts a request for open connection from a client application.
10002	No response was received within the receive timeout.	Occurs when a response for message communication is received after the receive timeout specified by the client application has elapsed. Check receive timeout. Also, review the process so that requests for sending messages from the user application do not concentrate.
10003	Receive timeout has almost occurred.	Occurs when a response for message communication is received after 90% of the receive timeout specified by the client application has elapsed. Check receive timeout. Also, review the process so that requests for sending messages from the user application do not concentrate.

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