Technical Information

FCN-RTU Technical Guide

TI 34P02A14-01E

YOKOGAWA
Yokogawa Electric Corporation

TI 34P02A14-01E

2nd Edition Jun. 6, 2018 (YK)

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Introduction

■ About this manual

STARDOM control system provides

- High reliability
- Simple, high-quality engineering
- An open system that can be connected easily to other systems
- Reassuring support for long-term operation

This manual describes in detail the FCN-RTU functions in the STARDOM control system.

IMPORTANT

Notation in this document:

- The term “FCN” refers to the module consisting type autonomous controllers.
- The term “FCN-500” refers to the autonomous controllers with NFCP501/NFCP502 CPU module.
- The term “FCN-100” refers to the autonomous controllers with NFCP100 CPU module.
- The term “FCN-RTU” refers to the low power autonomous controllers with NFCP050 CPU module.
- The term “FCJ” refers to the all-in-one type autonomous controllers.

■ Contents of this manual

The contents of this manual are based on the style of hardware and the specifications of software release at the time of this publication.

A function may be limited by the combination of an operating hardware and software. Please check it on the following homepage.

“YOKOGAWA Partner Portal” site: https://partner.yokogawa.com/global/

-> [Products Support Information] - [Process PLC/RTU for SCADA] - [System Requirements] - [System Requirements (OS, CPU, Web Browser) for each revision]

- DownLoad Lists of System Requirement (OS, CPU, Web Browser) for each revison. -> Autonomous Controllers FCN/FCJ
- FCN/FCJ Software Windows10 Pro Release Information

■ Intended readers of this manual

This manual has been prepared for individuals who conduct engineering and estimates regarding FCN-RTU system as an estimate guide for the model choice.

Documentation Conventions

■ Symbol Marks

Throughout this Technical Information, you will find several different types of symbols are used to identify different sections of text. This section describes these icons.

WARNING

Indicates precautions to avoid a danger that may lead to death or severe injury.

CAUTION

Indicates precautions to avoid a danger that may lead to minor or moderate injury or property damage.

IMPORTANT

Identifies important information required to understand operations or functions.

TIP

Identifies additional information.

SEE ALSO

Identifies a source to be referred to.

Clicking a reference displayed in green can call up its source, while clicking a reference displayed in black cannot.

■ Drawing Conventions

Some drawings in this manual may be partially emphasized, simplified or omitted for the convenience of description.

Some screen images depicted in this manual may have different display positions or character types (e.g., uppercase/lowercase letters) compared to the actual screen displays, but only within a range that will not lead to misunderstanding of the function and operation monitoring.

Copyrights and Trademarks

■ Copyrights

■ Trademarks and Licensed Software

- STARDOM is a trademark of Yokogawa Electric Corporation.
- CENTUM and Vnet/IP are registered trademarks of YOKOGAWA.
- Microsoft and Windows are registered trademarks of Microsoft Corporation in the United States and other countries.
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STARDOM (FCN-RTU)

■ Software Licenses

Model	Title
NT751FJ	Logic Designer License
NT752AJ	FCN/FCJ Simulator License
NT781AJ	FCN/FCJ OPC Server for Windows
SSS6700	Device Management Tool for Foundation fieldbus

■ Hardware (Basic module)

Model	Title
NFBU200	Base module (long)
NFBU050	Base module (short)
NFPW444	Power Supply Module
NFPW426	Power Supply Module
NFCP050	CPU module for FCN-RTU

■ I/O Modules for FCN

Model	Title
NFAI135	Analog Input Module (4 to 20 mA, 8-channel, Isolated channels)
NFAP135	Pulse Input Module (8-channel, Pulse Count, 0 to 10 kHz, Isolated channels)
NFAI141	Analog Input Module (4 to 20 mA, 16-channel, Non-Isolated)
NFAV141	Analog Input Module (1 to 5 V, 16-channel, Non-Isolated)
NFAT141	TC/mV Input Module (16-channel, Isolated)
NFAI143	Analog Input Module (4 to 20 mA, 16-channel, Isolated)
NFAV144	Analog Input Module (-10 to +10 V, 16-channel, Isolated)
NFAR181	RTD Input Module (12-channel, Isolated)
NFAI835	Analog I/O Module (4 to 20 mA, 4-channel input/4-channel output, Isolated channels)
NFAI841	Analog I/O Module (4 to 20 mA input, 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)
NFAB841	Analog I/O Module (1 to 5 V input, 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)
NFAI543	Analog Output Module (4 to 20 mA, 16-channel, Isolated)
NFDV151	Digital Input Module (32-channel, 24 V DC, Isolated)
NFDV551	Digital Output Module (32-channel, 24 V DC, Isolated)
NFDR541	Relay Output Module (16-channel, 24 V DC, Isolated)

■ Communication Modules for FCN

Model	Title
NFLF111	Foundation fieldbus Communication Module
NFLC121	CANopen Communication Module (1-port, 10 kbps to 1 Mbps)
NFLP121	PROFIBUS-DP Communication Module (1-port, 9.6 kbps to 12 Mbps)

FCN-RTU Technical Guide

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Revision Information i

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1. Autonomous Controller FCN-RTU Features

FCN-RTU is a controller consisting of CPU, I/O, and other modules as necessary. It supports a variety of I/O modules with excellent scalability. And, FCN-RTU offers reliable controls for geographically distributed applications requiring low power consumption under harsh conditions.

FCN-RTU

Figure Autonomous Controller FCN-RTU

- **Low Power Consumption (with short basemodule)**
  - FCN-RTU consumes low power to be ideal for solar powered installations.
  - I/O points and communication ports adequate for typical general gas/oil wellhead control are equipped on CPU module to reduce total power consumption.

- **High Reliability**
  - FCN-RTU thrives in wide temperature range and in high altitude.
  - RAS features (CPU self diagnostics, temperature monitoring, I/O diagnostics, and more)
  - Low heat dissipation, eliminating the need for a cooling fan

- **Control Capability**
  - Applicable to a variety of processes, from sequence control processes to analog control processes.
  - Controller can be connected to SCADA system using serial connections using TCP/IP over PPP or SLIP.
  - By installing FCN/FCJ OPC server for Windows on PC, controller data can be accessed from an OPC (OLE for Process Control) client.

- **Autonomous Capability**
  - Autonomous functions required for geographically distributed applications are embedded in controllers.
  - Duolet-enabled — enables users to implement various applications, including displaying images on a Web browser, saving data files, transferring files using the FTP protocol and public network connection using the PPP protocol. Duolet application is a Java language application to run on Duolet function.
  - InfoWell packages make easy use of autonomous functions such as web browsers and logging without programming.

- **Engineering Efficiency**
  - Five IEC 61131-3 programming languages enables engineers to choose the proper language according to their applications.
  - Control logic can be encapsulated into software parts to improve reusability and quality of applications.
  - Application Portfolios packed with Yokogawa's application expertise enable easy implementation of advanced functions, including control-loop instrument blocks and communication with PLCs.

- **Easy Maintenance**
  - Online download function allows a control application to be modified during system operation.
  - All I/O modules (except CPU embedded I/Os) are hot-swappable.

■ Autonomous Controller FCN-RTU Architecture

The differences between the internal architecture of PLC and the internal architecture of FCN-RTU are shown in the figure below. FCN-RTU uses a 32 bit RISC Processor, and is characterized by the parallel execution of control program and information processing program. These programs are executed on the operating system in real time. In addition, a high-speed internal bus (SB bus) is used for connection with the I/O module providing highly reliable, high-speed performance. Further, connection with SCADA and other controllers can be made easily through the network connection function in the CPU.

By concentrating the network function, information processing function, and control function in a single as show in the figure below, FCN-RTU provides not only control functions as a mere PLC, but also information transmission functions and information processing functions in an integrated form.

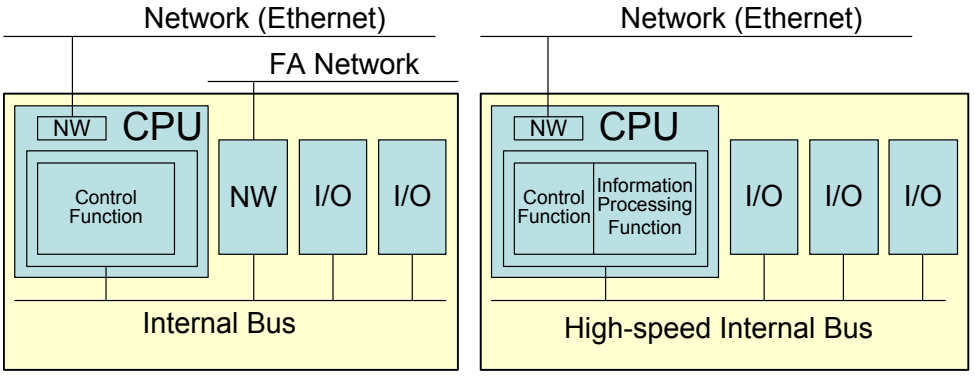


Figure Generic PLC Architecture and FCN-RTU Architecture

2. FCN-RTU Function Overview

2.1 FCN-RTU Control Functions

FCN-RTU control functions can be created freely using the functions, function blocks, stipulated in IEC 61131-3, and application portfolios. High-level control functions can be created easily and with high quality by using application portfolios.

■ Functions and Function Blocks

The following functions and function blocks are available.

- Type Conversion Functions
- Numerical Functions
- Arithmetic Functions
- Bitwise Boolean Functions
- Bit-string Functions
- Selection Functions
- Comparison Functions
- Character String Functions
- Bistable Function Blocks
- Edge Detection Function Blocks
- Counter Function Blocks
- Timer Function Blocks
- Bit Manipulation Functions
- FCN/FCJ Basic Function Blocks
- Inter-FCN/FCJ Communication Function Blocks
- FA-M3 Emulation (Serial Communication) Function Blocks
- Communication Utility Function Blocks
- Ethernet Communication Function Blocks
- Serial Communication Function Blocks

SEE ALSO

For details on Functions and Function Blocks, refer to 4.1.3, “FUs and FBs of Logic Designer."

■ PAS Portfolio

The following high-performance parts are available as a PAS portfolio to achieve process control.

- Input/Output Data Processing POU
- Regulatory Control POU
- Arithmetic Calculation POU
- Sequence POU
- FF-H1 (fieldbus) POU
- Utility POU

SEE ALSO

For more information about the PAS Portfolio, refer to “NPAS POU - Overview” (IM 34P02P25-01E).

■ Other Portfolio

High-performance portfolios are also available for communication with each type of device and for specific applications.

● Communication Portfolios

Libraries of parts for communicating with PLCs such as Yokogawa FA-M3, Mitsubishi MELSEC controllers, Modbus support device and DNP3 support device

SEE ALSO

- For more information about the FA-M3 Communication Portfolio, MELSEC-A Communication Portfolio, and Modbus Communication Portfolio, refer to “Application Portfolios (FCN-500/FCN-RTU)” (GS 34P02P20-02E).
- For more information about the DNP3 Communication Portfolio, refer to “DNP3 Communication Portfolio (FCN-500/FCN-RTU)” (GS 34P02P22-02E).

● Application-specific Portfolios

Libraries of parts for gas and liquid flow calculation

SEE ALSO

- For more information about the Gas Flow Calculation Portfolio, refer to “Gas Flow Calculation Portfolio (FCN-RTU)” (GS 34P02P31-02E).
- For more information about the Liquid Flow Calculation Portfolio, refer to “Liquid Flow Calculation Portfolio” (GS 34P02P33-01E).

2.2 Devices that can be connected to FCN-RTU

FCN-RTU can be easily connected to the types of device shown in the following table, making it possible to construct a wide variety of systems.

- **VDS**
- **OPC Server**
- **FCN/FCJ**
- **Various PLC, Modbus Support Device**
- **Display Unit**
- **Various Field Devices**

Table Devices that can be connected to FCN-RTU

Types	Devices	Interfaces	Communication Portfolio or Option Packages
Autonomous Controller	Yokogawa FCN/FCJ	Ethernet	Standard
SCADA	Yokogawa VDS	Ethernet	Standard
	FAST/TOOLS	Ethernet	Standard
	OPC support device	Ethernet	FCN/FCJ OPC Server for Windows
DCS	Yokogawa CENTUM VP (via UGS/UGS2)	Ethernet	Standard
	Yokogawa CENTUM VP (via SIOS)	Ethernet	FCN/FCJ OPC Server for Windows
	Yokogawa CENTUM VP (via FCS)	Modbus (RS-232-C, RS-422/RS-485, Ethernet)	Modbus Communication Portfolio
PLC	Yokogawa FA-M3	Ethernet, RS-232-C, RS-422/RS-485	FA-M3 Communication Portfolio
	Mitsubishi Electric MELSEC series	Ethernet	MELESEC-A Communication Portfolio
Temperature Controller	Yokogawa UTAdvanced series	Ethernet, RS-422/RS-485	Modbus Communication Portfolio
Field Device	FOUNDATION fieldbus H1 Device	FOUNDATION fieldbus H1	PAS Portfolio
	HART Support Device	HART	PAS Portfolio
	CANopen support device	CANopen	Standard
	PROFIBUS-DP support device	PROFIBUS-DP	Standard
Display Unit	Digital Co. • GP4000 series Hakko Electronics Co., Ltd. • V8 Series	Modbus (RS-232-C, RS-422/RS-485, Ethernet)	Modbus Communication Portfolio
Others	Modbus Support Device	Modbus (RS-232-C, RS-422/RS-485, Ethernet)	Modbus Communication Portfolio
	DNP3 Support Device	DNP3 (RS-232-C, RS-422/RS-485, Ethernet)	DNP3 Communication Portfolio

2.2.1 Connection to FAST/TOOLS

The FCN-RTU can connect, as standard, to FAST/TOOLS (Flexible Advanced System Techniques TOOLS), which is another component comprising STARDOM. In addition, each type of data of FCN-RTU can be easily accessed by FAST/TOOLS with objects & items.

SEE ALSO

For more information about the FAST/TOOLS, refer to “FAST/TOOLS Technical Product Description” (TI 50A01A20-01EN).

- **Integrating FAST/TOOLS into STARDOM**

FAST/TOOLS realizes HMI that integrates STARDOM and FCN/FCJ. It provides the tuning window of NPAS POU and the instrumental faceplate that FCN/FCJ has by default. After engineering FCN/FCJ, the FCN/FCJ tags can be retrieved with the FAST/TOOLS import function of FAST/TOOLS.

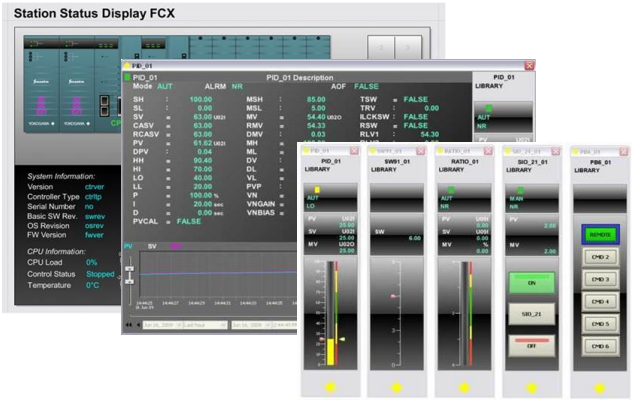


Figure HMI Example

- **Limitations in Number**

FAST/TOOLS is connected to FCN-RTUs via the control network (Ethernet). Each limitation in number is shown below.

- Up to a total of 10,000 controllers and devices including FCN-RTUs can be connected per FAST/TOOLS.
- FCN-RTUs on each control network can link with up to 4 units of VDS system, FCN/FCJ OPC server and FAST/TOOLS in total.

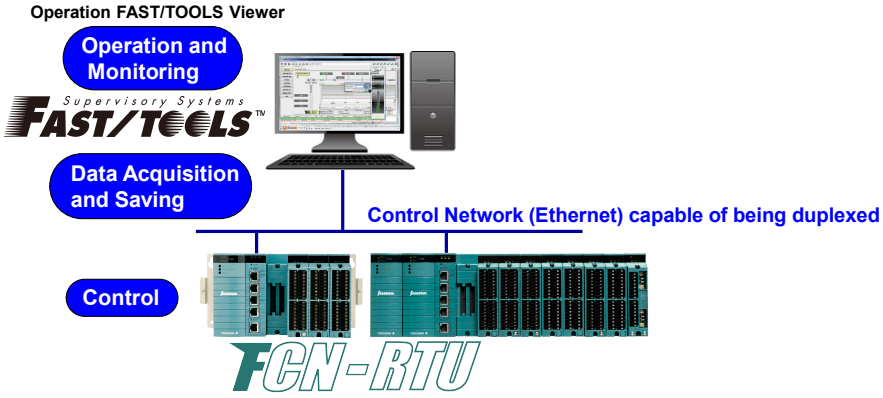


Figure Connection of FCN-RTU and FAST/TOOLS

2.2.2 Connection to VDS

The FCN-RTU can connect, as standard, to VDS (Versatile Data Server Software), which is another component comprising STARDOM. In addition, each type of data of FCN-RTU can be easily accessed by VDS with such as specialized tags.

SEE ALSO

For more information about the VDS, refer to “VDS Technical Guide” (TI 34P02A12-01E).

• Limitations in Number

VDS is connected to FCN-RTUs via the control network (Ethernet). Each limitation in number is shown below.

- Up to a total of 32 controllers and devices including FCN-RTUs can be connected per VDS.
- FCN-RTUs on each control network can link with up to 4 units of VDS systems (, FCN/FCJ OPC servers and FAST/TOOLS in total).

• Simple Data Access

If variables are defined to be referenced externally, the monitor tag (control object) on the VDS can be created automatically. In addition, the specialized control objects shown in the following table are available for accessing each type of data of FCN-RTU.

Table FCN-RTU Access Control Objects

Objects	Function
RAS objects	Objects for displaying RAS information of FCN-RTU on VDS
Message objects	Objects for monitoring, in a regular cycle, alarms generated by FCN-RTU
PAS POU objects	Objects for acquiring each type of PAS portfolio data

SEE ALSO

For more information about the PAS Portfolios, refer to 4.1.4, “Application Portfolios (APPF).”

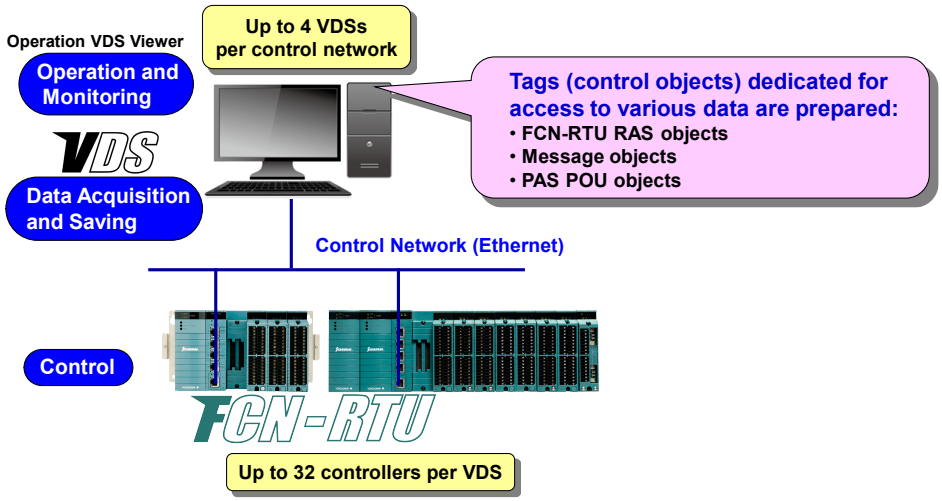


Figure Connection of FCN-RTU and VDS

2.2.3 Connection to SCADA with OPC Server

The optional FCN/FCJ OPC Server for Windows package enables applications written in Microsoft Visual Basic (VB), Visual Basic for Applications (VBA), or Visual C++ as well as commercial-off-the-shelf SCADA software supporting OPC DA 2.0, to access FCN-RTUs. This enables users to employ FCN-RTUs that offer many benefits while utilizing the resources of the existing HMIs.

● Specifications of FCN/FCJ OPC Server for Windows

The server is connected to FCN-RTU through a control network (Ethernet). The number which can be connected is as shown in the table below.

Table Specifications of FCN/FCJ OPC Server for Windows

Item		Specification
Connectable clients		Up to 100
Connectable FCNs and FCJs		Up to 100
Data access (DA)		Compliant with OPC Foundation's Data Access Custom Interface standard ver.2.05a.
	Group objects	Up to 1,000
	Item IDs	Up to 10,000 per group object; up to 100,000 in total
	Data update interval	1,000 to 3,600,000 milliseconds (1 second to 1 hour)
Message access (A&E)		Compliant with OPC Foundation's Alarms and Events Custom Interface standard ver.1.10. Message notification and filter (*1)
A&E	Event objects (*2)	1,000
Duplex network		Supported (*3).

*1: "Ack" and "area browse" are unsupported.

*2: Event subscription objects

*3: FCN-RTU can not used the duplexed network.

SEE ALSO

- For details of FCN/FCJ OPC Server for Windows, refer to "FCN/FCJ OPC Server for Windows" (GS 34P02Q61-01E).
- For details of the optional Duplexed Network Program for FCN/FCJ, refer to "Duplexed Network Program for FCN/FCJ OPC Server" (GS 34P02Q62-01E).

• System Requirements

Table System Requirements to Run FCN/FCJ OPC Server

Item	Specification	
Personal computer	PC/AT-compatible computer	
CPU	Windows 7 (32 bit)	1 GHz or higher 32 bit (x86) or 64 bit (x64) processor
	Windows 10 (64 bit) Windows 7 (64 bit) Windows Server 2008 R2 (64 bit)	2 GHz or higher 64 bit (x64) processor
RAM	2 GB or more	
Hard disk	20 GB or more free space is required.	
Ethernet adapter	A 10Base5, 10Base-T, or 100Base-TX adapter that is supported by the operating system specified at the bottom of this table is required.	
DVD-ROM drive	A DVD-ROM drive that is supported by the operating system specified at the bottom of this table is required for installation.	
OS	Windows 10 Enterprise 2016 LTSB (64 bit) Windows 10 IoT Enterprise 2016 LTSB (64 bit) Windows 7 Professional SP1 (32 bit/64 bit) Windows Server 2008 R2 Standard Edition SP1 (64 bit)	

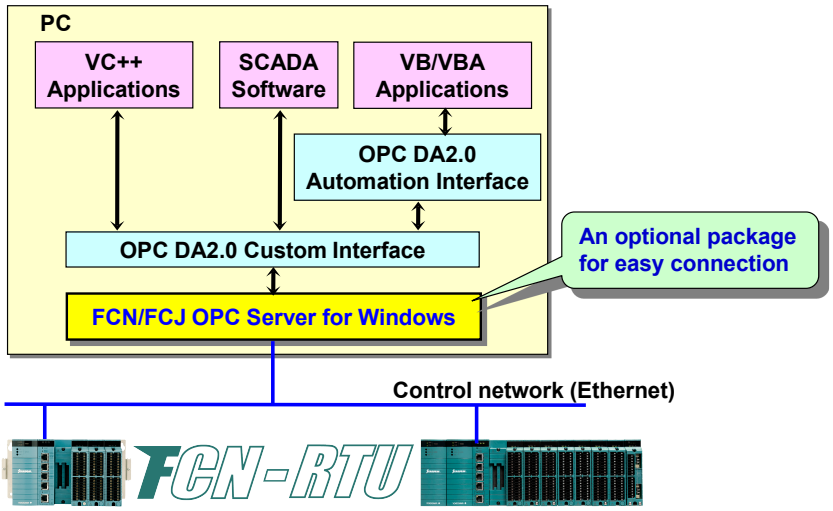


Figure Connection to SCADA and VB/VC++ Applications

2.2.4 Connection to CENTUM (Data Integration)

Data integration is the solution to connect FCN-RTU controllers to CENTUM FCS (Field Control Station) as a subsystem, and to handle FCN-RTU data in the same way as analog/digital I/O signals of CENTUM.
It allows FCN-RTUs to be connected to CENTUM in the same way as generic PLCs. Two types of connections are available:

- **Subsystem connection**
- **Connection using Generic Subsystem Gateway (GSGW)**

■ Subsystem Connection

In subsystem connection, an FCN-RTU is connected as a subsystem to an FCS of CENTUM. Two communications protocols are available:

- RTU mode (Communications duplex enable)
- Modbus/TCP

In either case, a communication module of the FCS is used to communicate with the FCN-RTU. Data of an FCN-RTU connected as a subsystem to an FCS are connected to I/O terminals of function blocks and accessed in the same way as analog/digital I/O signals of the FCS.

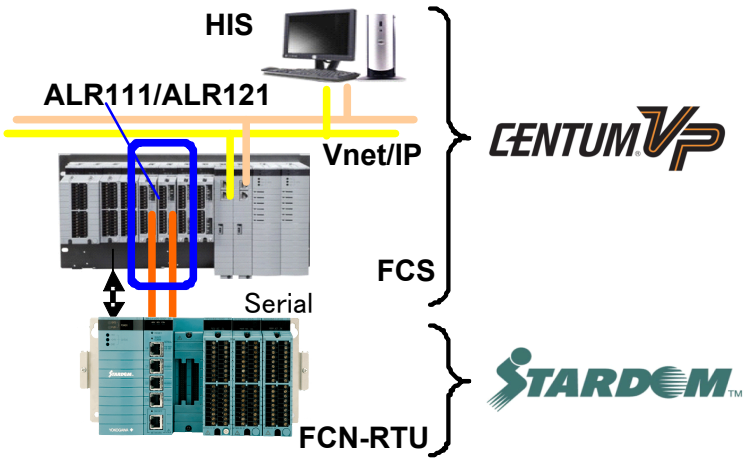


Figure An Example of RTU mode Connection

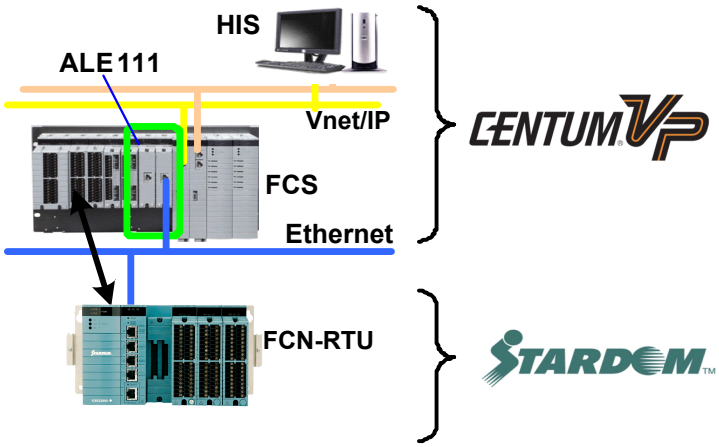


Figure An Example of Modbus/TCP Connection

Table Subsystem Connection

Communications Protocol	System	Connection Port [Documentation]	Optional Software Package [Documentation]	Remarks
RTU mode (Serial communications)	CENTUM VP	ALR111: RS-232-C ALR121: RS-422/RS-485 [GS 33J60G10-01EN]	Modbus Communication [GS 33J60G10-01EN]	Also supports communications redundancy
	FCN-RTU	NFCP050: RS-232 (3 ports) RS-422/RS-485 (1 port) [GS 34P02Q13-01E]	Modbus Communication [GS 34P02P20-02E]	
Modbus/TCP (Ethernet communications)	CENTUM VP	ALE111 [GS 33J60G11-01EN]	Modbus Communication [GS 33J60G11-01EN]	Also does not support communications redundancy
	FCN-RTU	Network port (100BASE-TX) [GS 34P02Q13-01E]	Modbus Communication [GS 34P02P20-02E]	

SEE ALSO

For more information about connection to CENTUM, refer to “Engineering Guide of CENTUM/STARDOM Integration" (TI 34P02K41-01E).

■ Connection Using Generic Subsystem Gateway (GSGW)

Generic Subsystem Gateway (GSGW) is a CENTUM station used for controlling and monitoring a subsystem.
Using a PC as a platform, a GSGW communicates with a subsystem (FCN-RTU) via a PC installed with OPC Server (FCN/FCJ OPC Server for Windows, abbreviated hereinafter as "FCN/FCJ OPC Server") according to the general-purpose OPC DA (OPC: OLE for Process Control) interface standard defined by the OPC Foundation.
Data of the subsystem (FCN-RTU) are allocated to I/O terminals of a GSGW function block, which can be controlled and monitored using HIS just like an FCS. GSGW is primarily designed for monitoring subsystem data, and does not have function blocks intended for control (e.g. PID block).

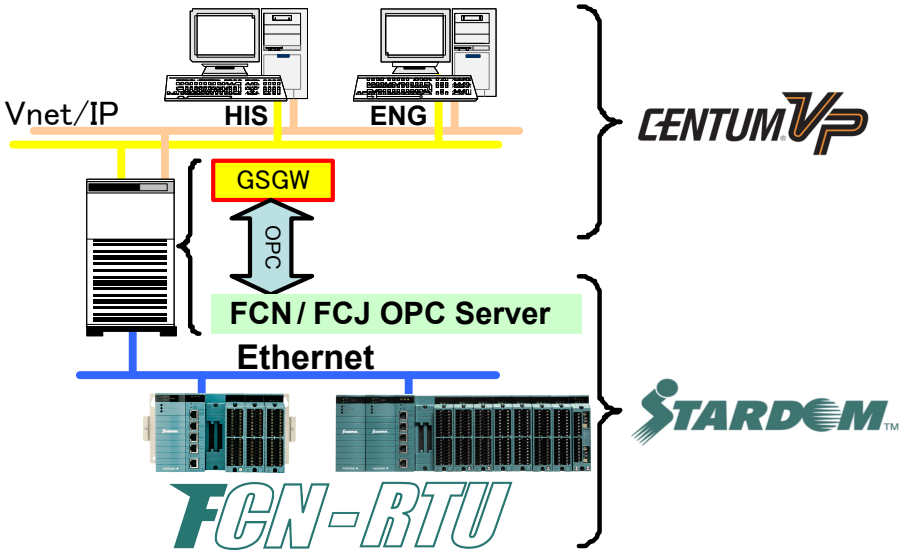


Figure An Example of GSGW Connection

Table Connection Using Generic Subsystem Gateway (GSGW)

Communications Protocol	System	Station/Connection Port [Documentation]		Optional Software [Documentation]	Remarks
OPC communications (Ethernet communications)	CENTUM VP	PC installed with GSGW [GS 33J20F10-01EN]		GSGW Generic Subsystem Gateway Package [GS 33J20F10-01EN]	Also supports communications redundancy.
	FCN-RTU			FCN/FCJ OPC Server for Windows [GS 34P02Q61-01E]	
			NFCP050:Ethernet [GS 34P02Q13-01E]		

2.2.5 Connection to CENTUM (Operation Integration)

In operation integration, UGS/UGS2 or SIOS is used to connect FCN-RTU controllers to a CENTUM system so that FCN-RTU function block data can be presented as one consolidated data on HIS. An FCN-RTU function block (instrument) mapped to UGS/UGS2 or SIOS can then be controlled and monitored with the same look and feel of a CENTUM function block. UGS/UGS2 enables management of alarms, generated by FCN-RTU, on HIS. SIOS hand-in-hand with the Consolidated Alarm Management Software for HIS (abbreviated hereinafter as "CAMS for HIS") enables consolidated management of all alarms, including alarms generated by FCN-RTU connected systems, on HIS.

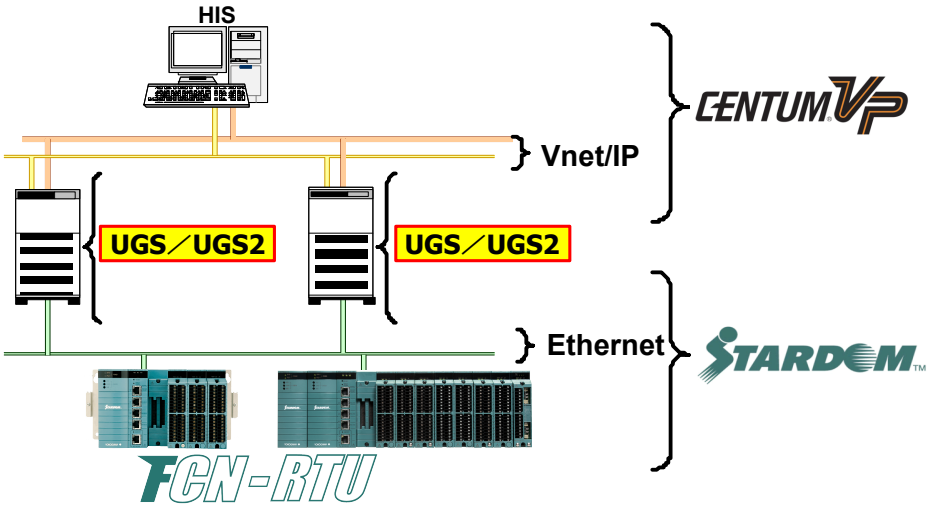


Figure An Example of FCN-RTUs Connected to CENTUM via UGS/UGS2

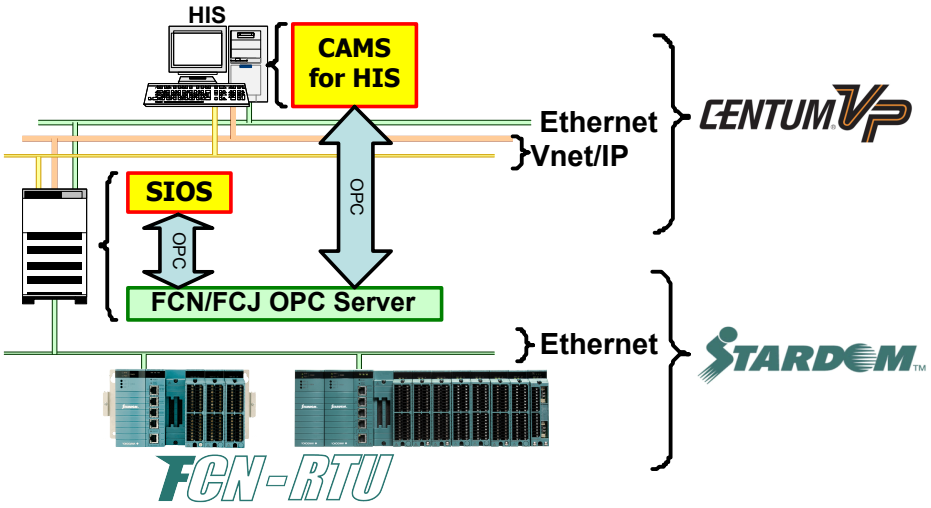


Figure An Example of FCN-RTUs Connected to CENTUM via SIOS

TIP

On CENTUM VP system, CAMS for HIS is included in Standard Operation and Monitoring Function (VP6H1100).

Table Methods for Connecting UGS/UGS2

Communications Protocol	System	Station/Connection Port [Documentation]	Software [Documentation]	Remarks
Ethernet communications	CENTUM VP	Computer installed with UGS/UGS2 [GS 33J20C10-01EN] [GS 33J20C20-01EN]	Unified Gateway Station (UGS/UGS2) Standard Function [GS 33J20C10-01EN] [GS 33J20C20-01EN]	Also supports communications redundancy except FCN-RTU.
	FCN-RTU	NFCP050:Ethernet [GS 34P02Q13-01E]	-	

Table Methods for Connecting SIOS and CAMS for HIS

Communications Protocol	System	Station/Connection Port [Documentation]	Software [Documentation]	Remarks
OPC communications (Ethernet communications)	CENTUM VP	Computer installed with SIOS [GS 33J20D10-01EN]	System Integration OPC Client Package [GS 33J05D10-01EN]	Also supports communications redundancy.
		HIS installed with CAMS for HIS [GS 33J05D10-01EN]	Standard Operation and Monitoring Function [GS 33J05D10-01EN]	
	FCN-RTU	NFCP050:Ethernet [GS 34P02Q13-01E]	FCN/FCJ OPC Server for Windows [GS 34P02Q61-01E]	

TIP

- UGS/UGS2 is recommended to use for operation integration of CENTUM VP R5.01 or later.
- For details of each functions CENTUM VP, refer to the IM come with the product if necessary.

SEE ALSO

For more information about connection to CENTUM, refer to “Engineering Guide of CENTUM/STARDOM Integration" (TI 34P02K41-01E).

2.2.6 Connection to Various Controllers

The FCN-RTU can communicate each other directly without relying on a PC. In addition, optional software packages are available to link up other series of controllers such as Yokogawa FA-M3 controllers, Mitsubishi MELSEC controllers, Omron SYSMAC controllers, Modbus support device and DNP3 support device.
FCN-RTU can communicate via the Ethernet with up to 15 FCN/FCJ controllers and with up to 32 other (not FCN/FCJ) controllers.

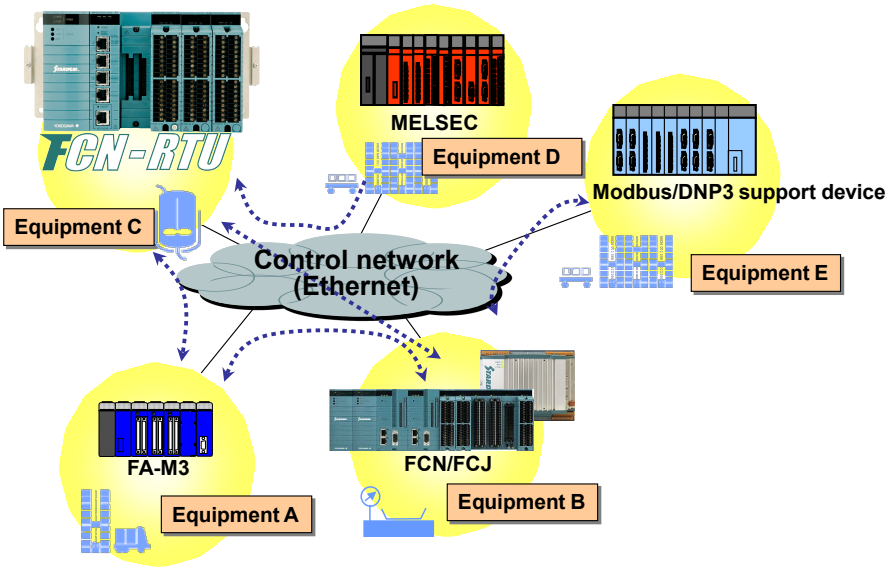


Figure Connection of FCN/FCJ and Controllers

2.2.7 Connection to Display Unit

The FCN-RTU can connect to a display unit by using the FA-M3 emulation or the Modbus communication function.

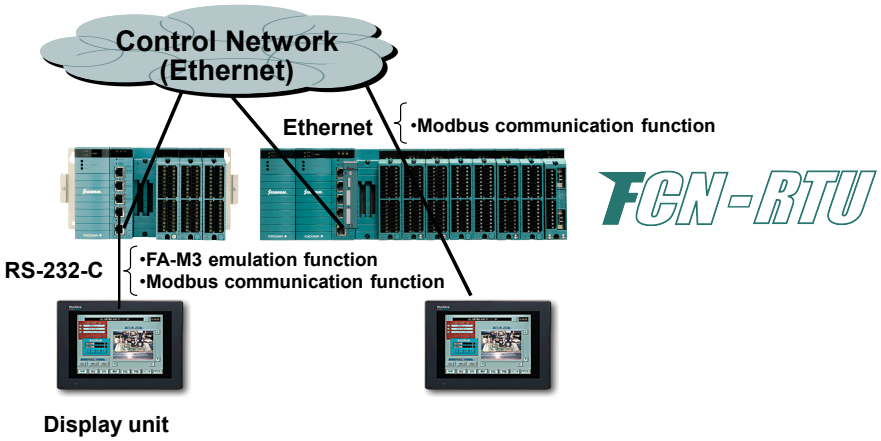


Figure Connection to Display Unit

2.2.8 Connection to Field Devices

The FCN-RTU can realize variety of applications by the connectivity for many types of field devices. The FCN-RTU support FOUNDATION fieldbus, HART Communication, CANopen Communication and PROFIBUS-DP Communication for network distribution at the field level.

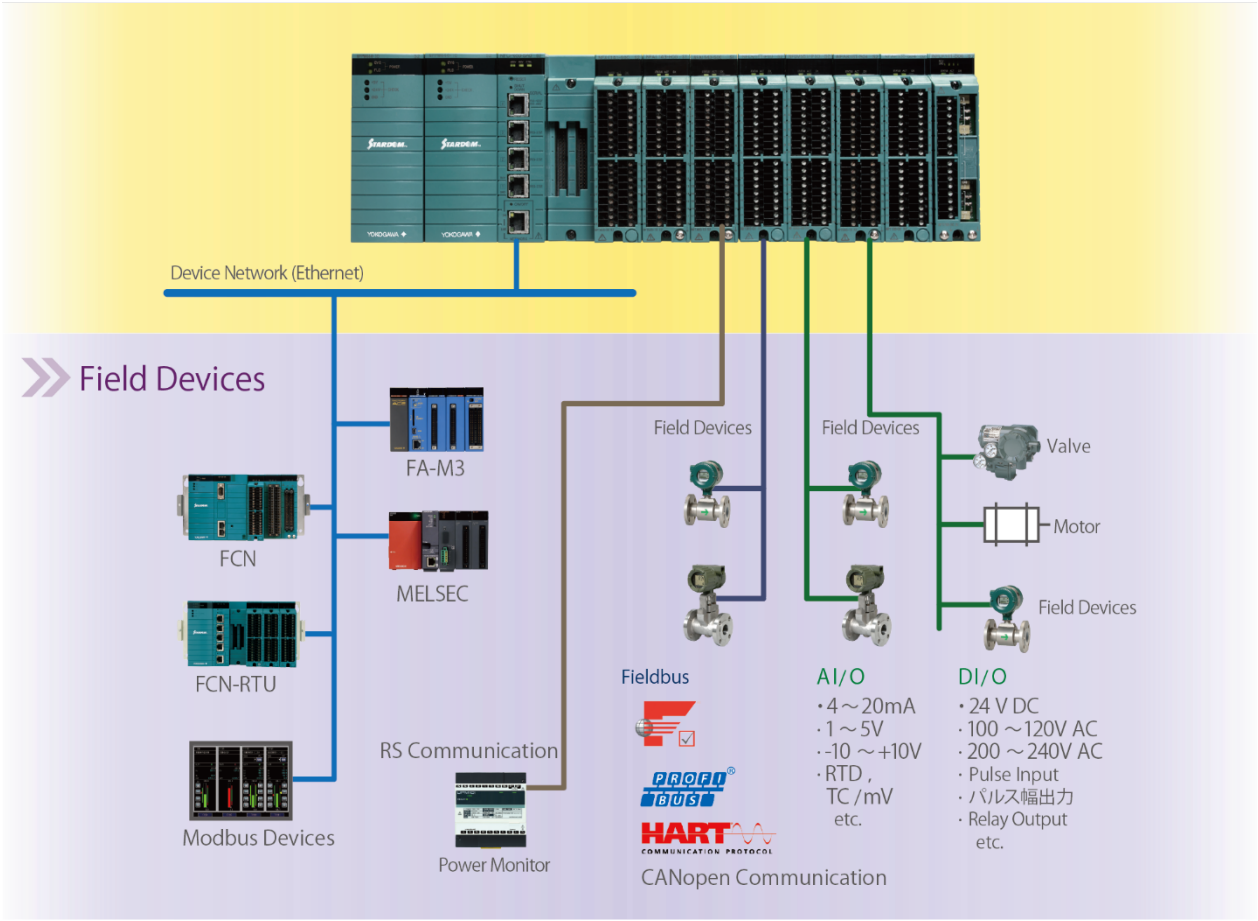


Figure Connection to Field Devices

2.3 FCN-RTU Information Transmission Functions

FCN-RTU provides the following functions to transmit information autonomously.
Part of this information transmission function makes it possible to achieve a Web server function, logging function or e-mail transmission function without programming, through using the information transmission package "InfoWell."

Table FCN-RTU Information Transmission Functions

Function	Description	Program Development Environment	
		InfoWell (*1)	Duolet (*2)
Web Server Function	FCN-RTU acts as a Web server to transmit data to PC Web browsers on the network.	Yes	Yes
Logging Function	FCN-RTU saves data of the control application in log files.	Yes	Yes
E-mail Transmission Function	FCN-RTU sends e-mail to portable terminals, etc., regarding alarms and other important information.	Yes	Yes
E-mail Reception Function	FCN-RTU responds with device diagnostic results, etc., in accordance with diagnosis request e-mail it has received.	No	Yes
FTP Function	FCN-RTU transfers data files between external systems.	No	Yes
PPP Connection Function	FCN-RTU enables IP (Internal Protocol) communications between external systems.	No	Yes
Time Synchronization Function (client)	FCN-RTU synchronizes time with an SNTP server. (*3)	-	-

*1: This function can be achieved using the information transmission package "InfoWell."

*2: This function can be achieved by creating a Duolet application.

*3: Standard function of FCN-RTU.

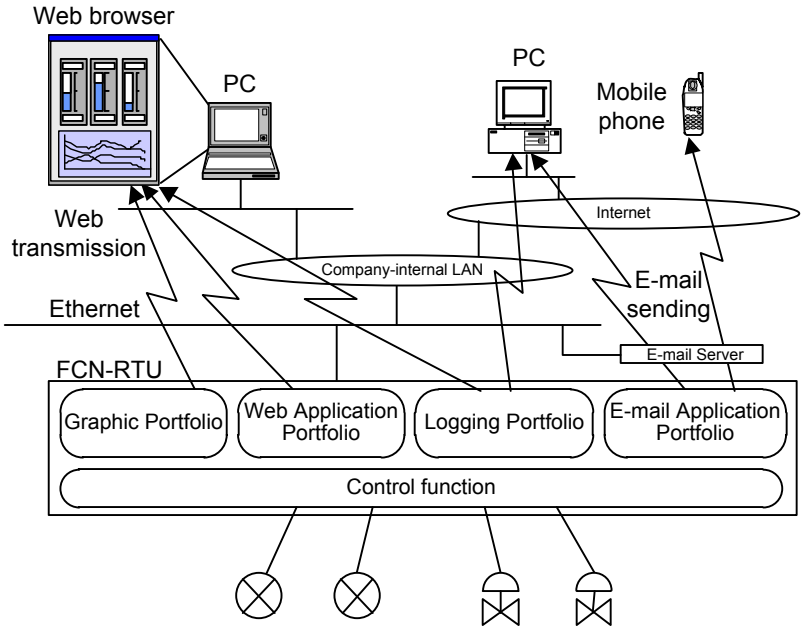
SEE ALSO

- For more information about the InfoWell, refer to 2.3.1, "InfoWell."
- For more information to create the Duolet Application, refer to 2.3.2, "Duolet Application."
- For more information about the time synchronization function, refer to 2.3.3, "Time Synchronization Function."

2.3.1 InfoWell

InfoWell operates on an FCN-RTU controller to provide information transmission functions on the Web or via e-mail using a stand-alone FCN-RTU with no SCADA software. InfoWell allows monitoring and operation in a stand-alone FCN-RTU of equipment for which constant monitoring by SCADA software is not necessary. InfoWell is comprised of the following portfolios:

- **Graphic Portfolio**
  An application portfolio which enables Web server on FCN-RTU to display a graphic screen and data to a Web browser on a PC in the network.
- **Web Application Portfolio**
  An application portfolio which enables Web server on FCN-RTU to transmit data to a Web browser on a PC in the network.
- **E-mail Application Portfolio (*1)**
  An application portfolio which enables FCN-RTU controller to send an e-mail automatically when any message or alarm occurs in the FCN-RTU controller.
- **Logging Portfolio**
  An application portfolio which enables FCN-RTU controller to save data of the control application in log files, and enables Web server on FCN-RTU to display the contents of the log file to a Web browser on a PC in the network.



*1: For sending e-mail, an e-mail server is needed. Not only e-mail servers in the intranet but also external e-mail servers, such as internet providers can be used. When external e-mail servers are used, the firewall needs to be configured that e-mails can be sent to external e-mail servers.

Figure InfoWell function overview diagram (example of using an e-mail server on the intranet)

● Features

- By using these portfolios, an information transmission function is added to FCN-RTU.
- Graphic portfolio enables users to monitor equipments intuitively, by displaying the controlled/monitored data of FCN-RTU as numerical values, bar displays and so on over an image, such as a photograph of equipment and a loop diagram.
- By using Graphic portfolio and/or Web Application Portfolio, FCN-RTU serves as a Web server and equipment monitoring and operation becomes possible from all PCs on the network.
- By using E-mail Application Portfolio, e-mail can be sent to the PCs in the OA area and to mobile phones, so that messages and data from the equipment can be received anytime and anywhere.
- The combination of Graphic portfolio, Web Application Portfolio and E-mail Application Portfolio enables the operation style that FCN-RTU usually operates the equipment without attention, and if trouble happen, operators start operation with Web browser by e-mail notification from FCN-RTU.
- The settings for Web Application Portfolio and E-mail Application Portfolio can be made easily from a Web browser. No special knowledge of programming is required, and setting can be done easily by anyone.
- Logging Portfolio enables users to implement a highly reliable logging function that is indispensable for managing the utilities and equipment at low cost without using a PC.

SEE ALSO

For more information about the InfoWell, refer to “InfoWell (FCN-RTU)” (GS 34P02P51-02E).

● Differences between Graphic Portfolio and Web Application Portfolio

There are differences between Graphic Portfolio and Web Application Portfolio.

Table Differences between Graphic Portfolio and Web Application Portfolio

Function	Graphic Portfolio	Web Application Portfolio
Screen	Graphical screens can be created and transmitted easily.	Data referencing/setting can be done. Trend and error history can be displayed.
Development Environment	PC (specialized tool)	FCN-RTU (via a Web browser)

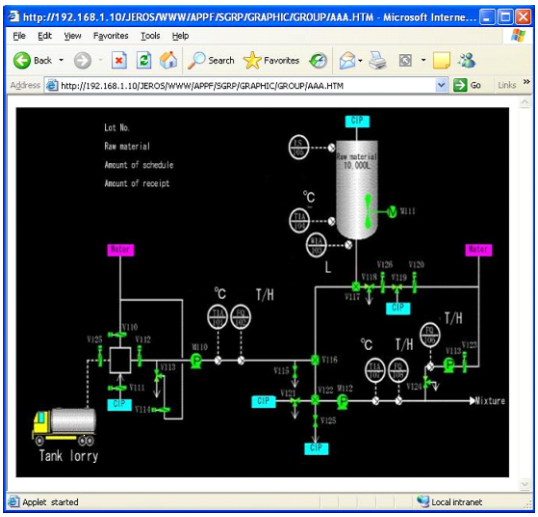
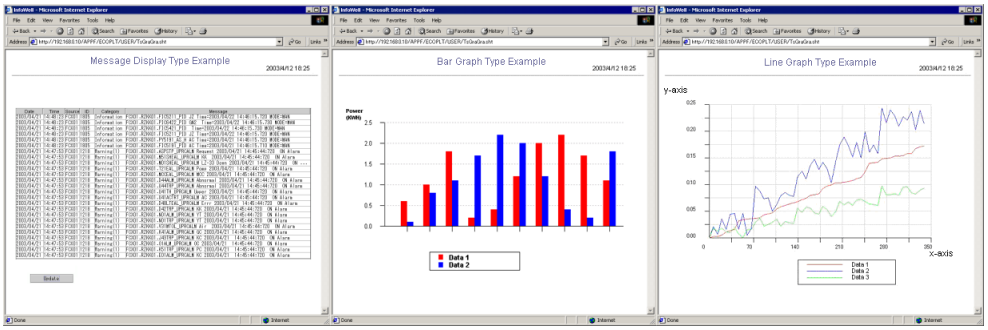


Figure Web page images of Graphic Portfolio (InfoWell)



Message display　　Bar graph display　　Line-segment graph display

Figure Web page images of Web Application Portfolio (InfoWell)

■ Graphic Portfolio

Graphic Portfolio (InfoWell) allows a graphic to be displayed in a Web browser. You can place and display graphic parts over a background image in a graphic. The background image can be an image file in bitmap (BMP), JPEG format, GIF format and PNG format. The display of a graphic part can be made to change with FCN-RTU data (variable values of control programs).

● Graphic Parts

The following graphic parts are available for display on a graphic.

Table List of Graphic Parts

Graphic Part	Main Function
DATA part	Displays a data as a numerical value.
TEXT part	Displays a text string, which changes with a data value
IMAGE part	Displays an image, which changes with a data value
BAR part	Displays a bar whose length changes with a data value
LABEL/LINK part	Displays a label and optionally displays a link as a pushbutton.

- DATA part
  A DATA part displays data as a numerical value. The background color or font color can also be made to change with a data value.

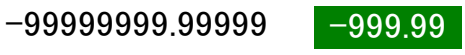


Figure Example of a DATA Part

- TEXT part
  A TEXT part displays text, which changes with a data value (0 to 7 or TRUE/FALSE). The font color or background color can also be made to change with a data value.

Figure Example of a TEXT Part

- IMAGE part
  An IMAGE part switches between the display of different images according to a data value (0 to 7, or TRUE/FALSE). The image can also be rotated or flipped.

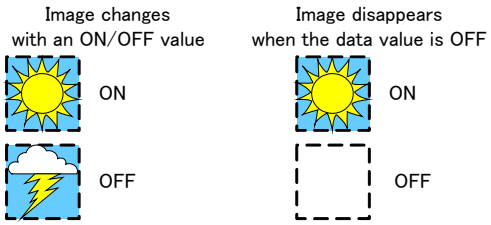


Figure Examples of IMAGE Parts

- BAR part
  A BAR part displays a bar graph whose length changes with a data value. The color of the bar can also be made to change.

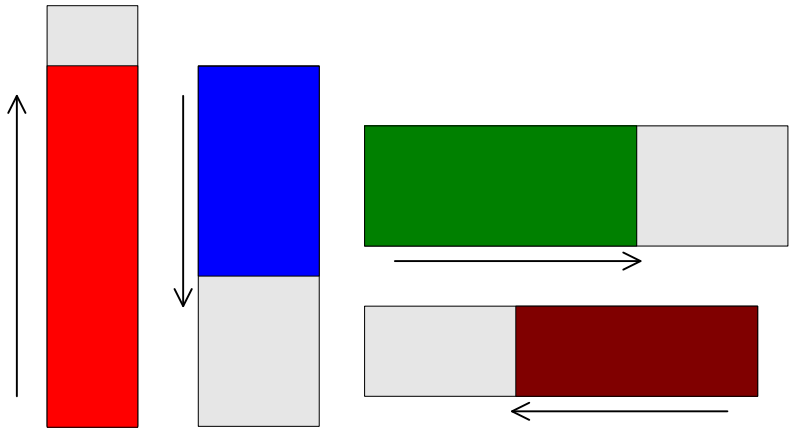


Figure Examples of BAR Parts

- LABEL/LINK part
  A LABEL/LINK part can be used to either display a label or a pushbutton that links to another graphic or URL.

Figure Example of a LABEL/LINK Part

● Data Display Function

Data is displayed in the Web browser according to the following procedures.

1. A user specifies the URL of the FCN-RTU in a Web browser running on a PC.
2. The Web browser uploads graphic information (background image, graphic parts, etc.) coded in HTML format from the FCN-RTU.
3. The background image is displayed in the Web browser window.
4. The graphic parts in the Web browser window requests data from the FCN-RTU.
5. The data transfer function of the FCN-RTU reads the data from the control application, and sends the data to the Web browser.
6. The Web browser updates the information of the graphic parts according to the sent data.

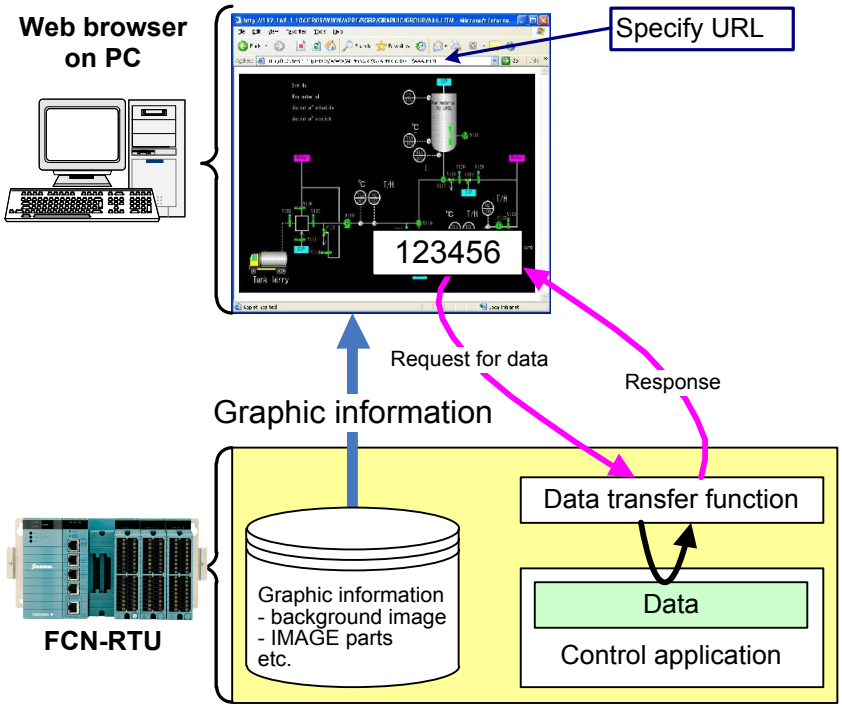


Figure Operation of the Data Display Function

TIP

- Graphic parts which access FCN-RTU data include DATA parts, TEXT parts, IMAGE parts and BAR parts. LABEL/LINK parts do not access FCN-RTU data.
- Data from up to ten FCN-RTUs can be displayed on one graphic.
- Each FCN-RTU can display its data on a maximum of 10 graphics concurrently.

■ Web Application Portfolio

Web Application Portfolio has three types of Web page display that offers with their individual special features.

Table Display types

Display types	Explanation
Table display type	Data display in a table Data display and setting are possible.
Graphical display type	Data are displayed graphically by graphics etc. Periodic data updating is possible.
Real-time update type	Data are updated and displayed in real-time.

Table Web pages

Display types	Web pages	Explanation
Table display type	Table display	Multiple data are displayed in one table.
Graphical display type	Bar graph display	Array data are displayed as a bar graph.
	Line-segment graph display	Array data are displayed as a line-segment graph.
	Message display	FCN-RTU system messages and application messages are displayed in time-series order.
Real-time update type	Numeric-value display	Real-time display of data as numeric-values.
	Bar display	Real-time display of data as bars.
	Trend display	Display of the time-series change of data as a trend.

With this portfolio, display type can be selected as needed.

● Table display type

This type displays tables by HTML.

This type permits display and setting of data.

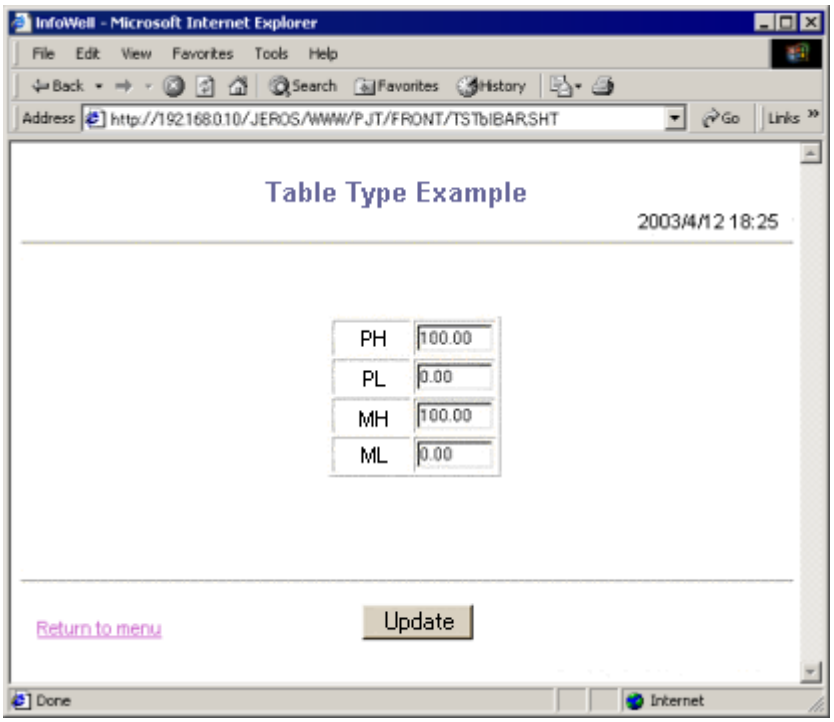


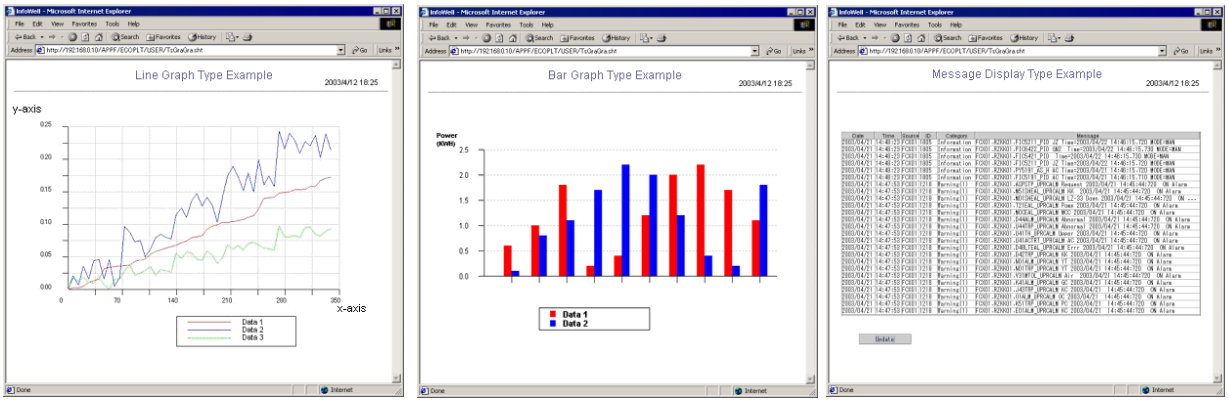
Figure Web Page images of table display type

- **Graphical display type**

  With this type, data are displayed with a program, Java applet, running on a Web browser.

  With this type, data are updated periodically. Periodic updating for message display is not possible.

  The data update method used with this type is the PULL type, where the Java applet periodically requests data from FCN-RTU.



Line-segment graph display　　Bar graph display　　Message display

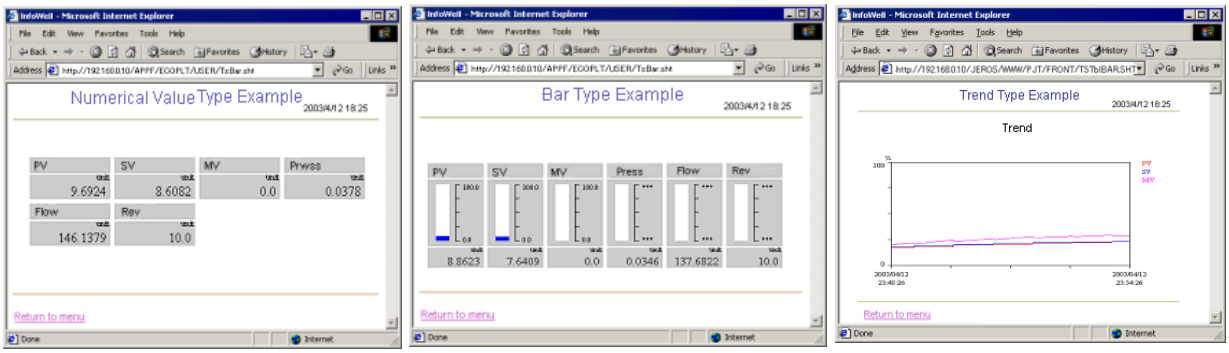
Figure Web page images of graphical type

- **Real-time update type**

  The real-time update type displays data with a program, Java applet, running on a Web browser.

  With this type, data are updated in real-time.

  The data update method used with this type is the PUSH type. The program for data acquisition on FCN-RTU periodically acquires data, and periodically sends data to the Java applet on the Web browser.



Numeric-value display　　Bar display　　Trend display

Figure Web page images of real-time update type

■ E-mail Application Portfolio

E-mail Application Portfolio offers a function for automatic sending of e-mail when an event occurs in FCN-RTU.
The following two types of e-mail sending are provided for E-mail Application Portfolio.

● Alarm sending

Alarm sending sends an e-mail when the data of the control applications exceed the high or low limit. Aside from the alarm detection done by the control applications, data acquisition and alarm detection are done independently on E-mail Application Portfolio side.

The body of the e-mail can be set individually for each control application data. This makes it possible to use alarm detection as the trigger to send e-mail with free text.

```
FCX1 192.168.1.1
2003/02/08 0:00:00
The temperature in the tank is HIGH_ALARM status. The present
value is 120°C.
Switch 1 is in BOOL_ALARM status. The present value is true.
                -
                -
                -
```

Figure Example of the alarm sending e-mail body

● Message sending

Message sending sends an e-mail when system messages of FCN-RTU or application messages of the control applications occur.

```
FCX1 192.168.1.1
2003/02/08 0:00:00
Type = application alarm Occur, Application alarm recover
Instance Name = Task1.Loop1
Key Word = HH,LL
2003/02/27 20:19:10 alarm
message.application.Task1.Loop1.2206.HH alarm(PV=88%)
                -
                -
                -
```

Figure Example of the message sending e-mail body

■ Logging Portfolio

Logging Portfolio provides a logging function that is indispensable for managing the utilities and equipment. It collects data from the control application in an FCN-RTU in various forms ideal for use by the system, and saves it in a log file (in CSV format). This log file can be viewed in various forms (trend view, table format view, etc.) from the Web browser via a network. The log file can also be sent by e-mail. Use of software for a PC that is included in the package allows for the acquisition of log files periodically from the PC via a network for further use.

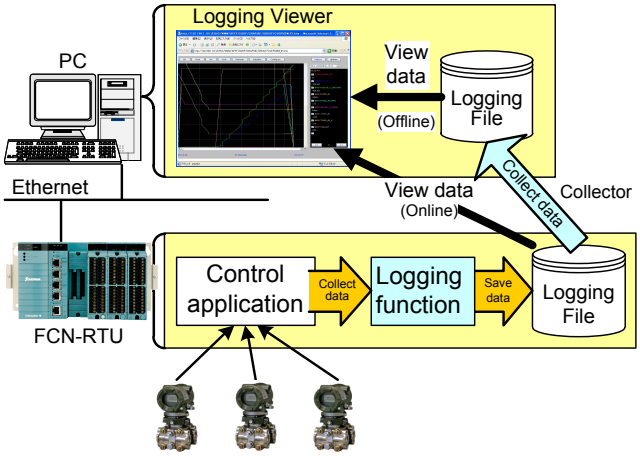


Figure Logging Function

● Logging Function

- Data Logging

Table Data Logging

Logging type		Periodic data collection		Closing timing	Simple report (*6)
		High speed (*1)	Low speed		
Hourly logging		1 to 60 seconds (*2) (*3)	1 to 60 minutes (*4)	Every hour	Daily, monthly, yearly report
Daily logging		-	1 to 60 minutes (*4)	Every day	Monthly, yearly report
Batch logging		1 to 60 seconds (*2) (*3)	1 to 60 minutes (*4)	Batch start/stop switch	-
Snapshot logging	Continuous	-	Trigger (*5)	Every hour or every day	Daily, monthly, yearly report
	Triggered			Closing trigger	-

*1: FCN-RTU does not support this high-speed data-collecting.

*2: Any of the fixed values (1, 2, 5, 10, 15, 30, and 60 seconds) can be set.

*3: To collect data, a program organization unit (POU) for logging is required when programming a control application.

*4: Any of the fixed values (1, 2, 5, 10, 15, 30, and 60 minutes) can be set.

*5: Periodic cycle longer than 1 minute for the data collection trigger interval is recommended.

*6: A simple report, including daily, monthly and yearly report, is a CSV format file consisting of closing values (maximum, minimum, average and total).

- SOE (Sequence of Events) Logging
  This function collects data at high speed before and after the detection of event such as failure and saves data in a file. Simple reports cannot be created.
- Message Logging
  This function saves FCN-RTU messages in a continuous (one-minute) period in the file. The messages can also be filtered by the message number.

● Logging File Collection Function

Logging files on FCN-RTU are periodically collected on PC using logging file collection function. Collection can also be performed manually whenever necessary.

The following methods are prepared for the logging file collection function. Select one of them for the intended purpose.

- Logging File Collector
  It runs in the task tray while PC is logged on.
- Logging File Collection Service
  It runs as a PC service even if PC is not logged on.

● Logging File View Function

- Logging File View Function
  Data collected by the logging function can be viewed in Logging Viewer on the Web browser (online view).
  Logging files not only in the FCN-RTU but also those collected on the PC can be simply viewed using Logging Viewer (offline view).
  Trend View and Table Format View are available in Logging Viewer.
- Message View Function
  FCN-RTU message logs that were collected can also be viewed in Logging Viewer in the same manner as viewing data.

● Logging File Transmission (E-mail) Function (*1)

This function allows for transmitting logging files as attachments by e-mail.

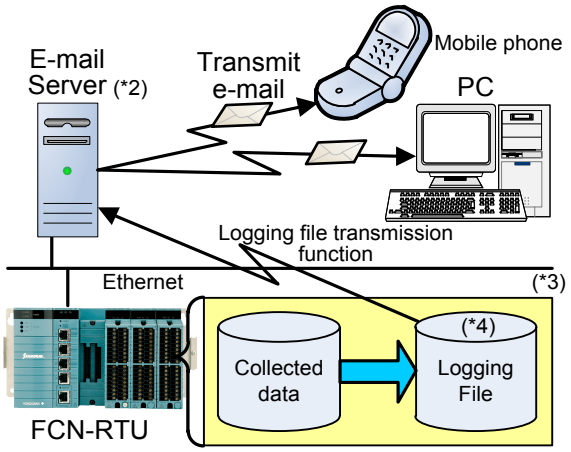


Figure Logging File Transmission (E-mail) Function (example of using an e-mail server on the intranet)

*1: Not supported by FCN-RTU (NFCP050) style S1.

*2: For sending e-mails, an e-mail server is needed. Not only e-mail servers in the intranet but also external e-mail servers, such as internet providers can be used. When external e-mail servers are used, the firewall needs to be configured that e-mails can be sent to external e-mail servers.

*3: Use E-mail Application Portfolio (InfoWell) to transmit FCN-RTU messages and alarms by e-mail. The Logging File Transmission (E-mail) Function and E-mail Application Portfolio (InfoWell) can be applied simultaneously.

*4: The logging files that can be transmitted are simple reports (daily report, monthly report, and yearly report), batch logging, snapshot logging and SOE logging.

2.3.2 Duolet Application

The following functions can be created freely by creating a Duolet application.

- **WWW Server Function**
- **Logging Function**
- **E-mail Transmission/Reception Function**
- **FTP Function**

IMPORTANT

The desired information transmission function can be created by creating a Duolet application.

However, using the information transmission package “InfoWell” makes it possible to create information transmission functions easily without programming.

SEE ALSO

For more information about the Duolet Application Development, refer to 4.1.5, “FCN-RTU Duolet Application Development.”

■ WWW Server Function

Each FCN-RTU can act as a WWW server to allow a Web browser running on a PC to be used as a human machine interface such as for monitoring the data acquired by the FCN-RTUs.

- HTML files and Java applets in an FCN-RTU can be downloaded to a Web browser that accesses the FCN-RTU, to allow monitoring of acquired data and operations. No special software is needed on a client computer running a Web browser.
- Can be accessed not only via an intranet but also via the Internet (appropriate firewall and relevant settings must be made).
- Ensures security to protect the system from unauthorized access (appropriate user account settings must be made).

TIP

- Access control can be set and performed for each folder containing HTML files inside each FCN-RTU.
- All users must enter a user name and password to access HTML files.

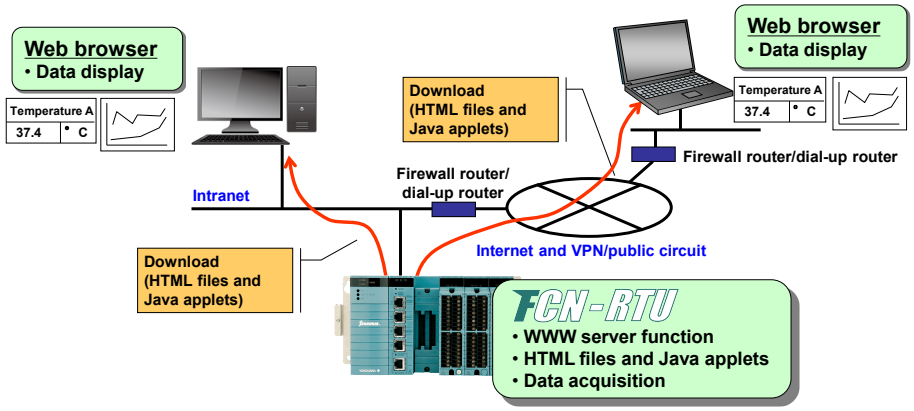


Figure WWW Server Function for FCN-RTU

■ Logging Function

It collects data from the control application in an FCN-RTU, and saves it in a logging file.
This logging file can be viewed by Web server function, can be sent by e-mail function and can be transmitted by FTP function.

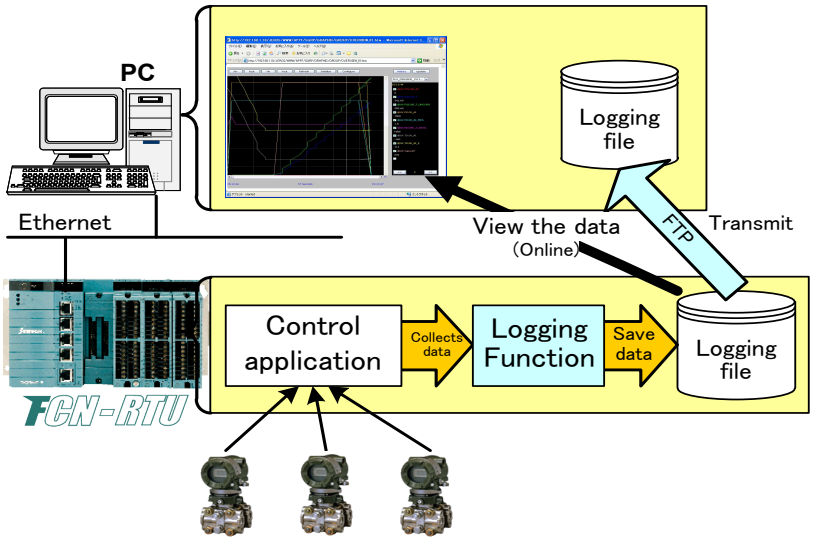


Figure Logging Function for FCN-RTU

■ E-mail Transmission/Reception Function

The FCN-RTU simplify operation that previously relied on HMI software. Individual FCN-RTUs can autonomously transmit critical information such as alarms to portable terminals by e-mail, and return an equipment diagnostics result in reply to a diagnostics request. This allows the site statuses to be identified from anywhere, thus simplifying operation.

- Individual FCN-RTUs can transmit e-mail upon occurrence of an abnormality without involvement of HMI software or any person.
- FCN-RTU can carry out processes in accordance with e-mail received from the operator.
- If the mail server is an Internet mail server, PCs as well as cellular phones (such as increasingly popular i-mode phones) can receive e-mail from FCN-RTUs.
- Using E-mail Application Portfolio (InfoWell) makes programming unnecessary. Data can be displayed easily by setting from a Web browser.

TIP

- The SMTP and POP3 protocols are used for mail transmission and reception, respectively.
- An application incorporating the necessary logic including equipment diagnostics and equipment status acquisition logic, however, must be developed.

SEE ALSO

For more information about the E-mail Application Portfolio (InfoWell), refer to 2.3.1, “InfoWell.”

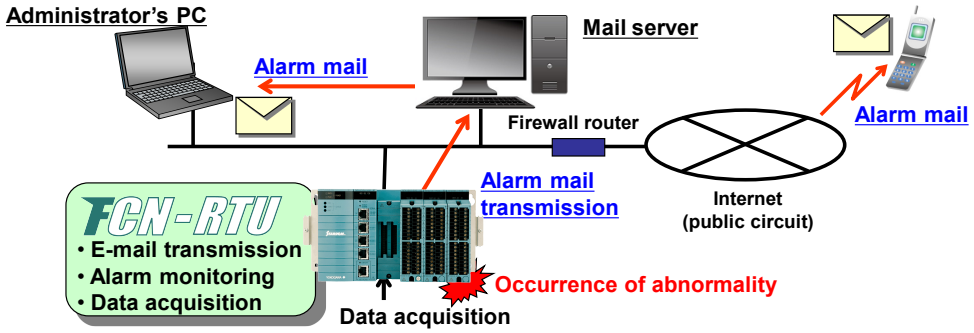


Figure E-mail Transmission Function for FCN-RTU

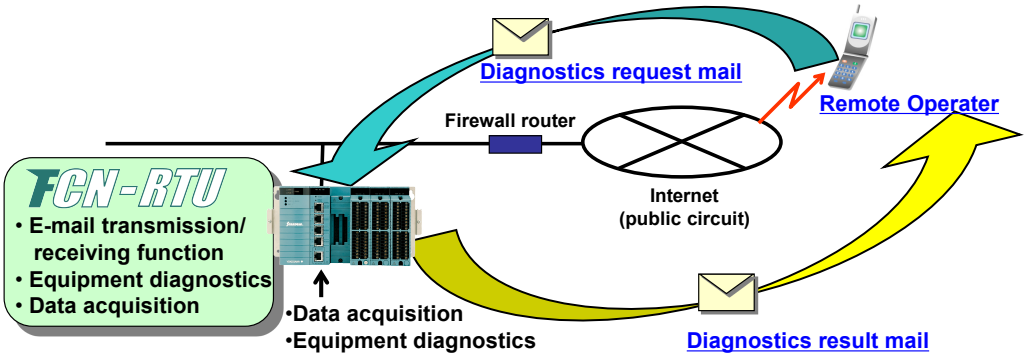


Figure E-mail Transmission/Reception Function for FCN-RTU

■ FTP Function

Data files can be transferred to/from an external system.

- Using the FTP client function, each of the FCN-RTUs can transfer data files to a desired FTP server. This allows bulk data files acquired in each controller to be transferred to an FTP server periodically as well as critical data to be transferred when an alarm occurs.
- Using the FTP server function, each of the FCN-RTUs can download data files from an external FTP client.

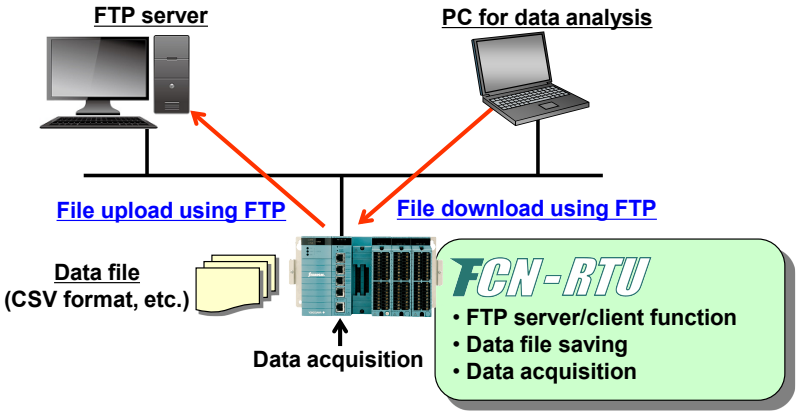


Figure FTP Communication Function for FCN-RTU

■ PPP (Point to Point Protocol) Connection Function

The PPP (Point to Point Protocol) connection function of FCN-RTU enables IP (Internal Protocol) communications between an FCN-RTU and an FCN/FCJ or between an FCJ-RTU and a PC over a public line or an internal line.

SEE ALSO

For more information about the PPP Connection Function, refer to “STARDOM FCN/FCJ PPP Connection Function User Guide (TI 34P02Q51-01E).”

- FCN-RTU connecting as client

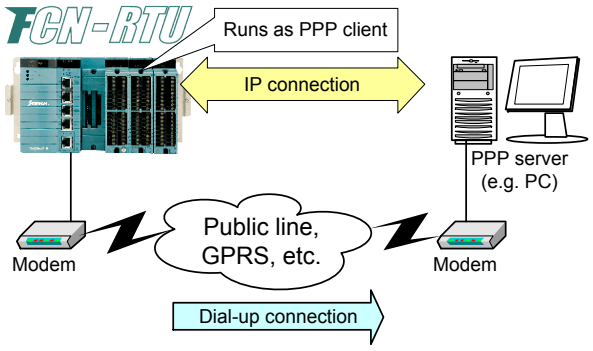


Figure FCN-RTU Connecting as Client

- FCN-RTU connecting as server

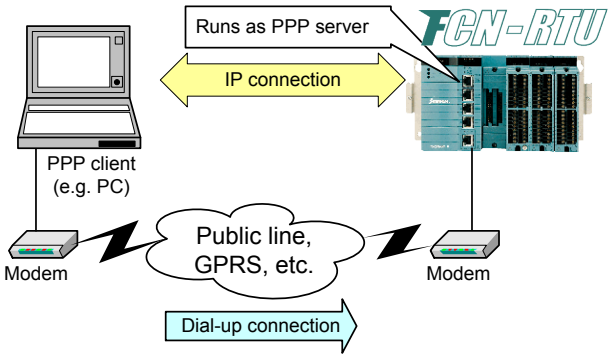


Figure FCN-RTU Connecting as Server

- Connecting FCN-RTU and FCN/FCJ

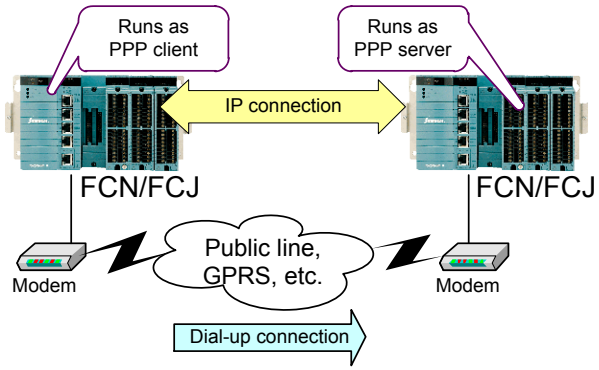


Figure Connecting FCN-RTU and FCN/FCJ

2.3.3 Time Synchronization Function

FCN-RTUs enable time synchronization among equipment supporting SNTP (Simple Network Time Protocol). An FCN-RTU can operate as an SNTP server or as an SNTP client.

■ Function Specifications

Table Time Synchronization Function

Item	Function
	Client Function
Communication Protocol	SNTP (Simple Network Time Protocol), UDP port: 123
License	Not required
Unicast Mode (*1)	✓
Broadcast Mode (*2)	✓
Number of Connections	4 servers
Accuracy of Time	±500 ms (*3)
Time Compensation Method	Acquisition of time from a server at intervals of 100 seconds (Unicast Mode) (*4)
Others	• Redundant networks can also be supported. • Redundant CPUs can also be supported.

*1: An SNTP client periodically interrogates an SNTP server for the time.

*2: An SNTP server periodically notifies an SNTP client of the time.

*3: The accuracy of time varies depending on how the time compensation method is configured.

*4: The following adjustments are to be performed depending on time differences. (The time differences below are default values. Time differences are configurable.)
500 ms or less: No adjustment
Less than 5 seconds: Smooth adjustments (The time is adjusted smoothly so that it does not skip.)
5 seconds or more: Immediate setting (The specified time is set immediately.)

SEE ALSO

For details of Time Synchronization Server Portfolio, refer to “Application Portfolios for FCN/FCJ (FCN-500/FCN-RTU)” (GS 34P02P20-02E).

● Time Synchronization Function (Broadcast Mode)

The time synchronization function (broadcast mode) allows the SNTP server to periodically notify all units in the same subnet of the current time.
Upon receiving the current time, SNTP clients perform time synchronization.

TIP

The broadcast mode has the following limitations:

- Time cannot be synchronized with units in different subnets.
- Since the round trip time (time required for server/client communications) cannot be taken into account, accuracy of time may deteriorate if a low-speed communication link is used or if communication load is high.
- It is not possible to install more than one server in the same subnet.

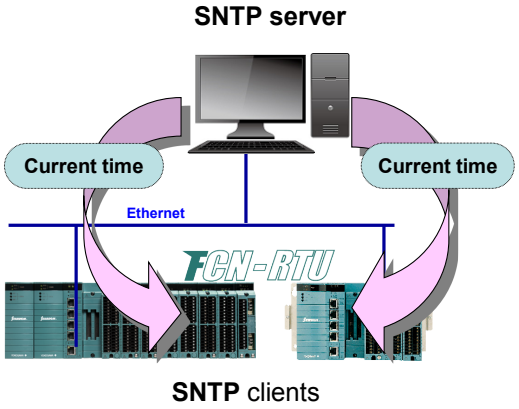


Figure Time Synchronization Function (Broadcast Mode)

- ## Time Synchronization Function (Unicast Mode)

The time synchronization function (unicast mode) allows an SNTP client to send a request for time to the SNTP server.
In response, the SNTP server notifies the SNTP client of the current time. Upon receiving the current time, the SNTP client performs time synchronization.

TIP

The unicast mode does not have the limitations that the broadcast mode has. In the unicast mode, therefore, the time synchronization function can provide better accuracy.

It is recommended that the unicast mode be used for time synchronization of FCN-RTUs.

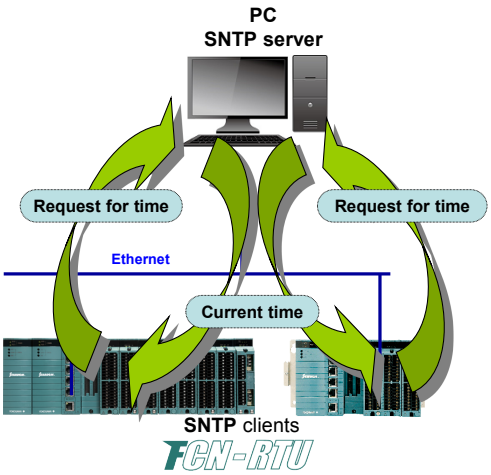


Figure Time Synchronization Function (Unicast Mode)

■ Time Adjustment Method

The time adjustment method of FCN-RTUs provides the following three patterns depending on time differences.

- No adjustment (if a time difference is 500 ms or less (*1))
- Smooth adjustment (if a time difference is 500 ms or more and less than 5 seconds (*1))
- Immediate adjustment (if a time difference is 5 seconds or more (*1))

*1: The above parameters for time differences are default values. These parameters are configurable.

● Smooth adjustment

The smooth adjustment allows intervals of a periodic timer to be adjusted by 0.5% for time adjustment.

If an SNTP client is delayed, time is advanced by bringing intervals of the periodic timer forward by 0.5%.

If the SNTP is faster, time is delayed by bringing intervals of the periodic timer backward by 0.5%.

If a parameter for time differences is a default value in smooth adjustment, time adjustment of 500 ms can be performed for 100 seconds.

● Immediate adjustment

If the difference between the time of the SNTP server and the time of an SNTP client is 5 seconds or more, the time of the SNTP client is designated as the time of the SNTP server.

Thus, the time of the SNTP client will not be continuous.

3. FCN-RTU Hardware

An FCN-RTU consists of the following modules:

- **Base module (This is the module to which other modules such as the power supply, CPU, and I/O modules are installed.)**
- **Power supply module (This is the module that supplies power to all other modules. One power supply module is required for each unit, two are required for dualredundant configuration.)**
- **CPU module (This is the module that has CPU functions with built-in I/Os.)**
- **I/O modules (This is the module that has I/O functions.)**

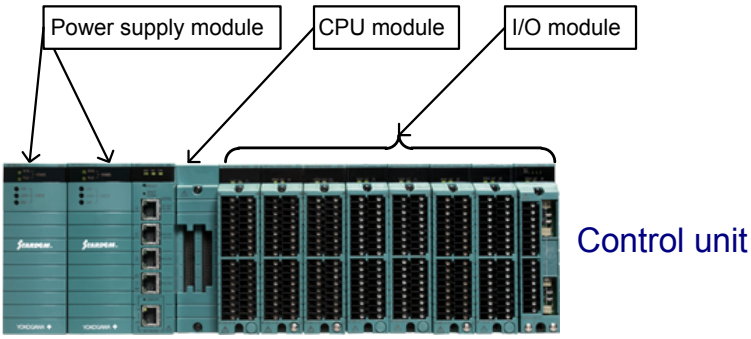


Figure Autonomous Controller FCN-RTU with NFBU200 Base Modules (long)

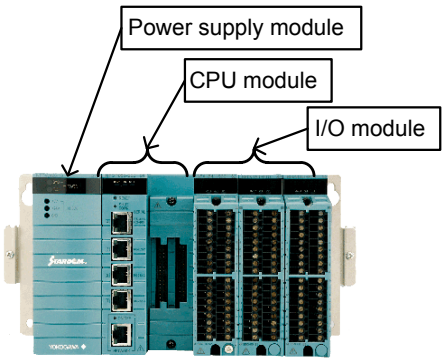


Figure Autonomous Controller FCN-RTU with NFBU050 Base Module (short)

IMPORTANT

An FCN-RTU modules are restricted to the compliant standards and the installation. For details, refer to "FCN-RTU Low Power Autonomous Controller Hardware" (GS 34P02Q13-01E).

● Limitations of Installation for Modules on NFBU200 Base Module (long)

NFBU200 Base module (long) has 2 power supply slots and 10 I/O slots.

- CPU module:
  A CPU module occupies 2 I/O slots No. 1–2.
- I/O modules:
  I/O modules occupy I/O slots No. 3–10.

TIP

When you install the following I/O modules, ensure that the required power volume does not exceed the rated power output of the power supply module.
For the amount of power supply that each I/O module requires (5 V DC and 24 V DC), refer to the applicable general specifications.

- The following modules need to be checked for current consumption from a 5 V DC system power supply
  NFDV551 and NFDR541
- The following modules need to be checked for current consumption from a 24 V DC analog field power supply
  NFAI841, NFAI143 and NFAI543

● Limitations of Installation for Modules on NFBU050 Base Module (short)

1 power supply module, 1 CPU module and up to 3 I/O modules are to be installed on NFBU050 base module. SB bus repeat module cannot be installed on NFBU050 base module.

- CPU module:
  A CPU module occupies I/O slots No. 1–2.
- I/O modules:
  I/O modules occupy I/O slots No. 3–5.

■ Examples of Configuration

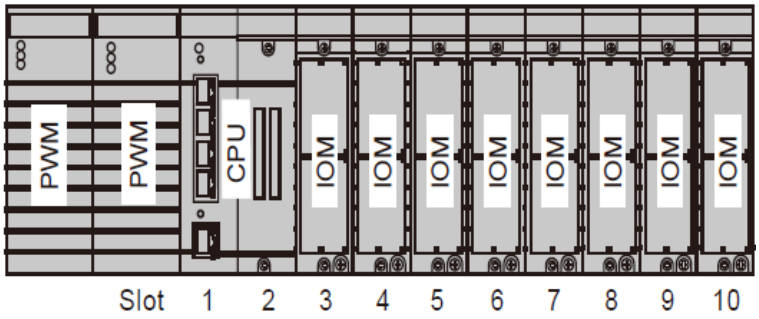


Figure NFBU200 Base module (long)

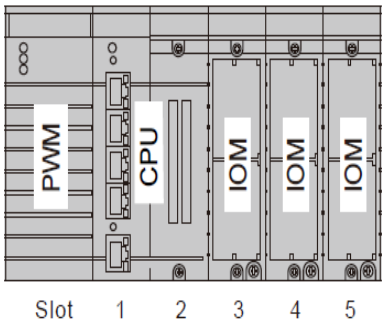


Figure NFBU050 Base module (short)

Table Description of Abbreviation in Figures shown above

Abbreviation	Description
PWM	Power supply module
CPU	CPU module
IOM	I/O module

3.1 NFBU200/NFBU050 Base module

This subsection describes the features of NFBU200 base module (long) and NFBU050 base module (short).

■ NFBU200 Base module (long)

The base module provides the following functions:

- **Standard equipment of the slots for duplex power supply module**
- **10 slots available for installation of function modules (One CPU module occupies two slots)**

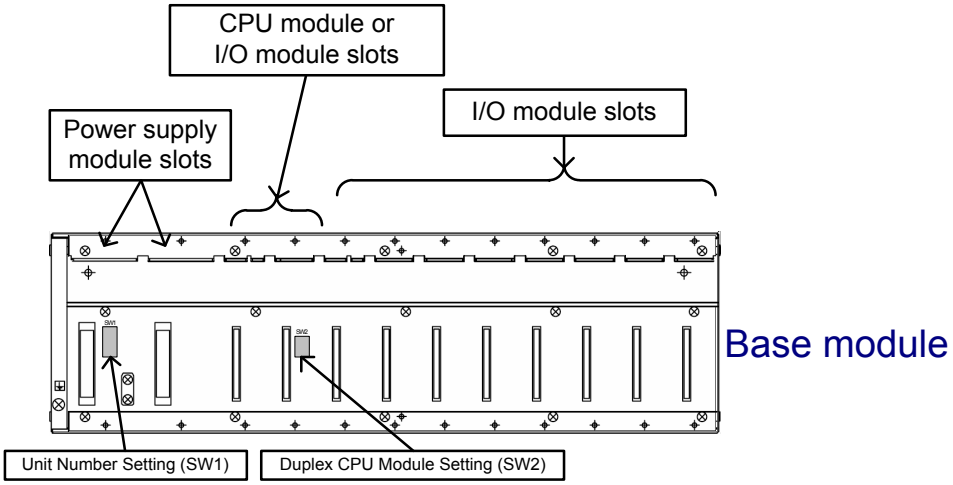


Figure NFBU200 Base module (long)

IMPORTANT

Always install dummy covers on all unused slots.

SEE ALSO

- For more information about the base module, refer to “FCN-RTU Low Power Autonomous Controller Hardware” (GS 34P02Q13-01E).
- For more information about the base module setting, refer to “■ NFBU200 Base module setting” in 4.2.1, “Hardware Setup.”

Table NFBU200 Base module (long)

Model	Description	Specification	Weight	Remarks
NFBU200-S0□	Base module (long) (19-inch rack-mounted)	• Slot configuration: 2 power supply module slots, 10 function module slots (CPU, I/O, SB) • Appropriated slot width: 1 CPU, 2 slots, 1 I/O module, 1 slot, • Maximum power consumption (Self-consumption: 0.4 A (5 V))	1.9 kg	CPU single/ duplex and control unit/expansion unit can be switched with a setting.
NFBU200-S1□	Base module (long) (DIN rail-mounted)		1.0 kg	

■ NFBU050 Base module (short)

The base module provides the following functions:

- **Standard equipment of the slot for single power supply module**
- **Single SB bus**
- **5 I/O slots available for 1 CPU module (slot No. 1-2) and 3 I/O modules (slot No. 3, slot No.4 and slot No. 5)**

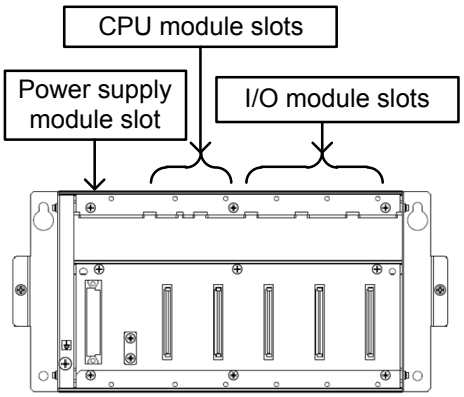


Figure NFBU050 Base module (short)

IMPORTANT

Always install dummy covers on all unused slots.

SEE ALSO

For more information about the base module, refer to “FCN-RTU Low Power Autonomous Controller Hardware” (GS 34P02Q13-01E).

Table NFBU050 Base module (short)

Model	Description	Specification	Weight	Remarks
NFBU050-S1□	Base module (short) (DIN rail-mounted)	• Slot configuration: 1 power supply module slot, 5 function module slots (CPU, I/O) • Appropriated slot width: 1 CPU, 2 slots, 1 I/O module, 1 slot, • Maximum power consumption (Self-consumption: 0.025 A (5 V))	0.6 kg	

3.2 Power Supply Module

The power supply module supplies stable power to CPU module and I/O modules on each base module.
It may be used for a duplexed configuration on each base module (long).
It is equipped with an input terminal for analog field power (24 V DC) and power is supplied through the base module to each I/O module via this terminal. As for digital output modules, some I/O modules require this type of field power (24 V DC). In this case, power must be supplied to each I/O module terminal.
The power supply modules are hot-swappable.

SEE ALSO

- For details of each I/O module terminal, refer to the specification of the I/O module.
- For more information about the power supply module, refer to “FCN-RTU Low Power Autonomous Controller Hardware” (GS 34P02Q13-01E).

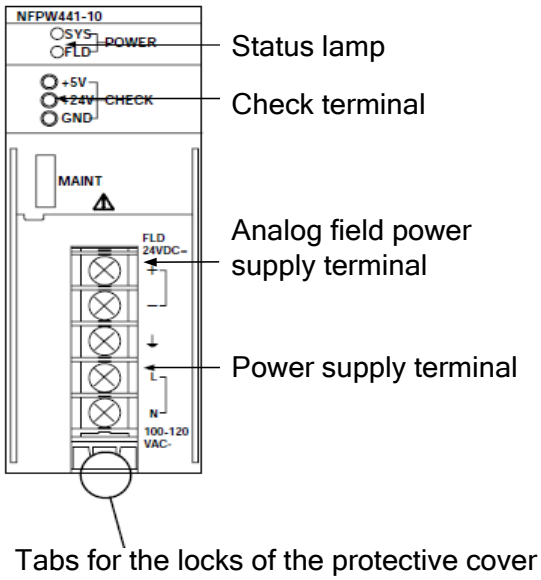


Figure External View for Power Supply Module

■ Behavior of Duplexed Power Supply Modules

The power is fed to each of the CPU and I/O modules through diodes aligned opposite to each other.

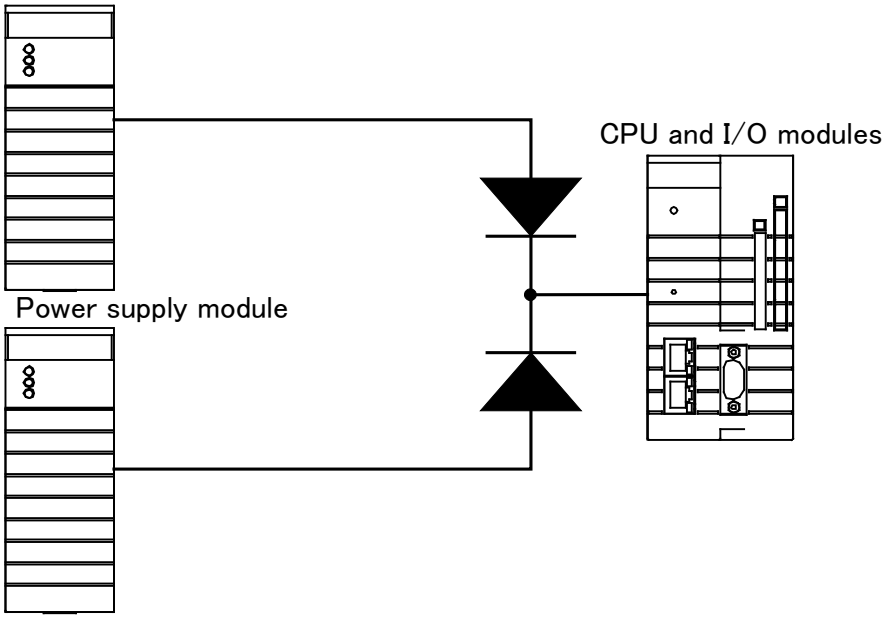


Figure Power Feed from Duplexed Power Supply Modules

■ Power Supply Module

Table Power Supply Module

Model	Description	Specification	Remarks
NFPW444	Power supply module (24 V DC input)	• Duplex configuration: Possible • Hot-Swap: Possible (when installed on NFBU200 base module long) • Rated output: +5.1 V DC, 7.8 A • Analog field power supply: Input: 24 V DC ±10%, 4 A, Duplexed (matching-diode) • LED Indicator: SYS-POWER: Lights when the 5 V system power output is on. FLD-POWER: Lights when the 24 V field power supply is on. • Checking terminals: +5 V, +24 V • Weight: 0.6 kg	- Power supply single/ duplex shared (Can be made duplex by installing two on the NFBU200 base module long.)
NFPW426	Power supply module (12 V DC input or 24 V DC input)	• Duplex configuration: Not available • Hot-Swap: Not available • Rated output: +5.1 V DC (2.4 A) • Analog field power supply: Input: 24 V DC ±10%, 0.54 A, • LED Indicator: SYS-POWER: Lights when the 5 V system power output is on. FLD-POWER: Lights when the 24 V field power supply is on. • Checking terminals: +5 V, +24 V • Weight: 0.61 kg	- Power supply single only

SEE ALSO

For more information about the insensitive momentary power-failure time of power supply module, refer to 7.2.1, “Insensitive Momentary Power-failure Time.”

3.3 CPU Module (NFCP050)

One CPU module is mounted in each control unit configuration. The CPU module runs a real-time operating system, supports programming languages compliant with the IEC 61131-3 global standard, and serves as a Java virtual machine.
The CPU module has the following features.

- **CPU Module Features**
  - ECC (Error Correcting Code) memory
  - Fan less design
  - A full feature of RAS functions (CPU self-diagnosis, temperature monitoring, I/O diagnosis, etc.)

■ External View

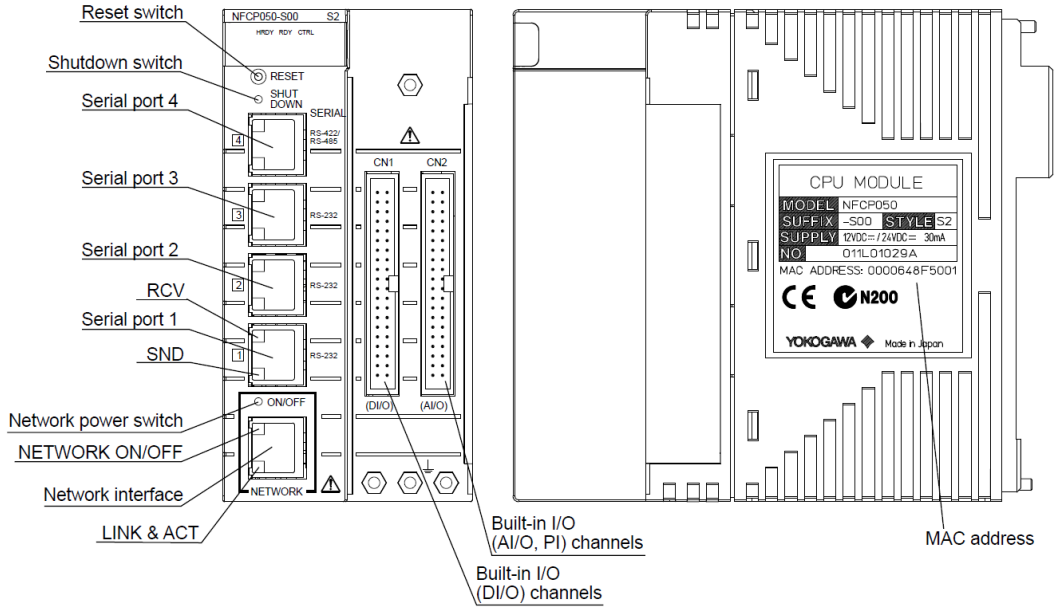


Figure CPU Module for FCN-RTU

■ CPU Module for FCN-RTU

Table CPU Module for FCN-RTU

Item		Specification	
Model		NFCP050-S1□	
Processor		SH-4A (SH7730) 256 MHz	
Memory	Main	128 MByte with ECC (*4)	
	Static RAM	1 MByte with ECC, backed up by battery (*5)	
System		128 MByte on-board flash memory (*6)	
Serial Port (*1)		3 RS-232 ports (SERIAL: 1, 2, 3), non-isolated, RJ45 modular jacks (*7) 1 RS-422/RS-485 port (SERIAL: 4), non-isolated, RJ45 modular jack	
	Communication method	RS-232: Full/Half duplex (software settings) RS-422/RS-485: Full/Half duplex (DIP switch settings)	
	Synchronisation	Asynchronous	
	Baud rate	SERIAL: 1, 4	1.2, 2.4, 4.8, 9.6, 14.4, 19.2, 28.8, 38.4, 57.6, or 115.2 kbps
		SERIAL: 2, 3	1.2, 2.4, 4.8, 9.6, 14.4, 19.2, 28.8, or 38.4 kbps
	Terminating resistance	RS-422/RS-485: 120 Ω built-in, ON/OFF (DIP switch settings)	
Network interface		NETWORK	1 Ethernet port: 100/10 Mbps, 100BASE-TX, RJ45 modular jack, with Network power switch (ON/OFF)
Built-in I/O (*2)		16 DI channels, 8 DO channels, 12 AI channels (1-5 V), 2 AO channels (4-20 mA, required for external power supply), 2 PI channels, 1 AI channel (0-32 V)	
I/O interface		SB bus (single)	
RAS features		Watchdog timer, test-mode, temperature monitor, etc.	
Battery (*3)		2700 mAH lithium battery	
Display		3 LEDs for CPU status indication, 2 LEDs for LAN status indication 2 LEDs for each Serial port status indication	
Switches		Reset, shutdown, ON/OFF (network)	
Power supply	Supply voltage	5 V DC ±5%	
	Power consumption	1.16 to 2.30 W	
Duplex configuration		Impossible	
Weight		0.57 kg	
Size	Dimensions (W x H x D)	65.8 x 130 x 142.5 mm	
	Occupying slots	2	

*1: For connecting to these serial ports, prepare specially made cables following the table shown below.

*2: MIL 40-pin x 2 (KMS40 cable and TAS40 terminal block can be used)

*3: With battery exhaustion detecting function

*4: 128 MByte with ECC for S2 (Style 2) or later, 64 MByte without ECC for S1 (Style 1).

*5: 1 MByte with ECC for S2 (Style 2) or later, 1 MByte without ECC for S1 (Style 1).

*6: 128 MByte for S2 (Style 2) or later, 64 MByte for S1 (Style 1).

*7: By default factory setting, fow controls are disabled. Flow controls can be enabled by editing “COM Port Setting File” on “FCX Maintenance Menu.” For more information, refer to the Help of “FCX Maintenance Menu.”

IMPORTANT

Software licenses are bundled with CPU modules (NFCP050) for FCN-RTU, license can not be added on FCN-RTU later on.
For details of licenses on CPU module (NFCP050), refer to “FCN-RTU Low Power Autonomous Controller Functions” (GS 34P02Q02-01E).

SEE ALSO

For details of the CPU module, refer to “FCN-RTU Low Power Autonomous Controller Hardware” (GS 34P02Q13-01E).

Table Built-in Analog Inputs (1 to 5 V DC)

Item		Specification
Input points		12
Input signals		1 to 5 V differential, non-isolated Allowable common mode voltage range ±1 V DC
Maximum absolute input voltage range		±7.5 V
Input impedance	During power-on	1 MΩ or more
	During power-off	340 kΩ or more
Allowable signal source resistance		500 Ω or less
Accuracy		±0.3% of full scale
Maximum temperature drift		±0.01%/°C of full scale
A/D resolution		15 bits/1-5 V
Data refresh cycle		10 ms
Input step resopnse time		100 ms
Normal mode noise rejection ratio		37 dB or more (with power supply frequency at 50/60 Hz)

Table Built-in Analog Outputs (*1)

Item	Specification
Output points	2
Output signals	4 to 20 mA DC, non-isolated
Allowable load resistance	0 to 250 Ω (12 V), 0 to 750 Ω (24 V)
Accuracy	±0.5% of full scale
Temperature drift	±0.01%/°C
D/A resolution	13 bits/4-20 mA
Data refresh cycle	10 ms
Step resopnse time	100 ms
Output fallback (*2) (*3)	HOLD: Holds the current level when the fallback action is triggered SETV: Sets the output to the preset level when the fallback action is triggered.
Output ripple	50 mVp-p (250 Ω load)
Output open detection	Provided

*1: To use AO, connect a power supply (12 or 24 V) to Vin and Com terminals.

*2: The fallback detection time is 4 seconds.

*3: Fallback functions can be enabled in common. When enabling them, HOLD or SETV can be set for each channel.

Table Built-in Digital Inputs

Item	Specification
Input points	16, non-isolated
Rated input voltage	3.3 V DC, voltage-free contact
Input "on" voltage	1.2 V DC or less
Input "off" voltage	2.5 V DC or more
Source current	1 mA
Input resopnse time	25 ms
Function: Status inputs	On/off status detection Rise/fall

Table Built-in Digital Outputs

Item	Specification
Output points	8, non-isolated
Rated load voltage	12 V DC, 24 V DC
Maximum "on" voltage	2 V DC
Maximum output-off leak current	0.1 mA
Output type	Current sink
Maximum load	100 mA/point, 13.2 V 100 mA/point, 26.4 V
Output resopnse time	15 ms
Function: Status outputs	On/off status outputs
Output fallback (*1) (*2)	HOLD: Holds the current status when the fallback action is triggered. OFF: Resets all the output channels to off when the fallback action is triggered.

*1: The fallback detection time is 4 seconds.

*2: Fallback functions can be enabled in common. When enabling them, HOLD or OFF can be set in common.

Table Built-in Pulse Inputs

Item	Specification
Input points	2, non-isolated
Input signals	Voltage-free contact pulse, voltage pulse
Absolute maximum input voltage	26.4 V DC
Input frequency	0 to 10 kHz
Minimum input pulse width	40 µs
Inupt signal level	VH-VL (voltage swing): 3 V or greater where VH: 3 to 24 V VL: Ranges from -1 to 8 V Signal source resistance: 1 kΩ or less
Pull-up resistance	None
Data refresh cycle	10 ms
Filter function	Can select a filter that eliminates chattering (*1)

*1: The maximum input frequency is lower than specified when the filter for eliminating chattering is used.

Table Built-in Analog Input (0 to 32 V DC) (*1)

Item		Specification
Input points		1
Input signals		0 to 32 V differential, non-isolated Allowable common mode voltage range ±1 V DC
Maximum absolute input voltage range		±36 V
Input impedance	During power-on	1 MΩ or more
	During power-off	56 kΩ or more
Allowable signal source resistance		500 Ω or less
Accuracy		±100 mV, ±0.3% of full scale
Maximum temperature drift		±64 mV/10°C, ±0.02%/°C of full scale
A/D resolution		15 bits/0-32 V
Input step resopnse time		100 ms
Normal mode noise rejection ratio		25 dB or more (with power supply frequency at 50/60 Hz)

*1: The signal name is BAT +/-.

SEE ALSO

For details of CPU module, refer to “FCN-RTU Low Power Autonomous Controller Hardware” (GS 34P02Q13-01E).

■ Hardware Configuration of CPU Module

Inside the module, the CPU operates by accessing the memory, various I/O modules and the on-board flash memory.

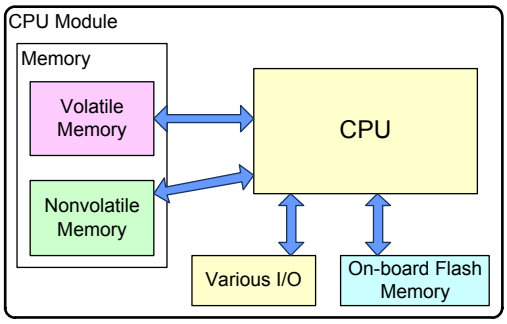


Figure Hardware Configuration Overview of CPU Module

● Volatile and Nonvolatile Memory

The CPU module has volatile and nonvolatile memory. The information stored in the volatile memory is cleared when the power is turned off. The nonvolatile memory retains the information using an internal battery.

● On-board Flash Memory

All information is stored in the on-board flash memory.

The stored information including:

- Real time OS/I/O driver
- Details of various settings
- Control application
- Control Engine
- Duolet application
- Java Virtual Machine

■ Terminals/LEDs/Switches

● Built-in RS-232 Serial Port Terminals

RS-232 communication cables for NFCP050 should be prepared by the user.

Table Pin Assignment of SERIAL Port (RS-232)

RJ45 Pin No.	RS-232 Signal Name	Conversion to D-sub Connector	
		D-sub 9pin Male (Straight Cable)	D-sub 9pin Female (Crossover Cable)
1	DCD (Data Carrier Detect)	1	1
2	DSR (Data Set Ready)	6	4
3	RXD (Received Data)	2	3
4	RTS (Request To Send)	7	8
5	TXD (Transmitted Data)	3	2
6	CTS (Clear To Send)	8	7
7	DTR (Data Terminal Ready)	4	6
8	GND (Common Ground)	5	5

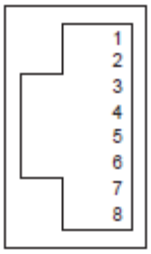


Figure Front View of RJ45 Connector (RS-232)

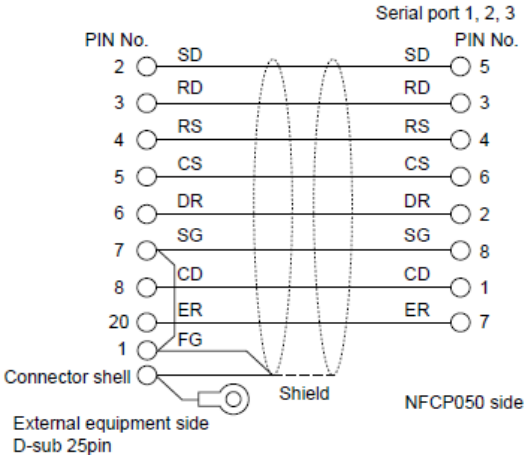


Figure Internal Connection of the RS-232 Communication Cable to NFCP050

● Built-in RS-422/RS-485 Serial Port Terminals

RS-422/RS-485 communication cables for NFCP050 should be prepared by the user.

Table Pin Assignment of SERIAL Port (RS-422/RS-485)

RJ45 Pin No.	Half Duplex (2-wire)	Full Duplex (4-wire)
1	DATA+	TX+
2	DATA-	TX-
3		RX+
4		
5		
6		RX-
7		
8	GND	GND

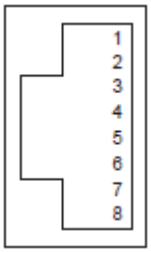
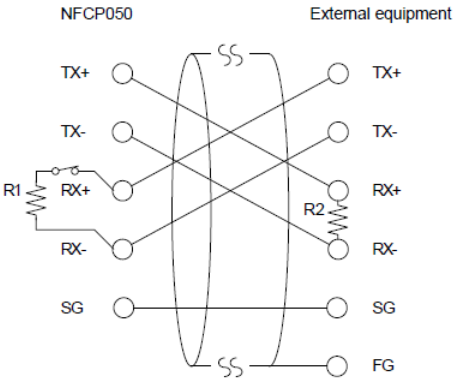
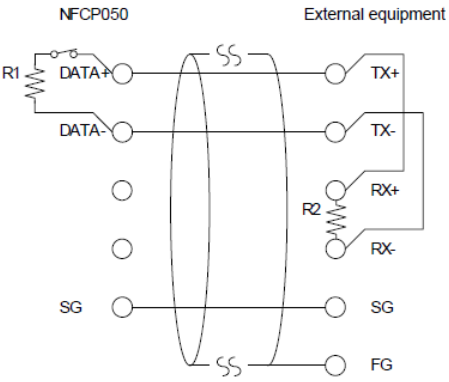


Figure Front View of RJ45 Connector (RS-422/RS-485)



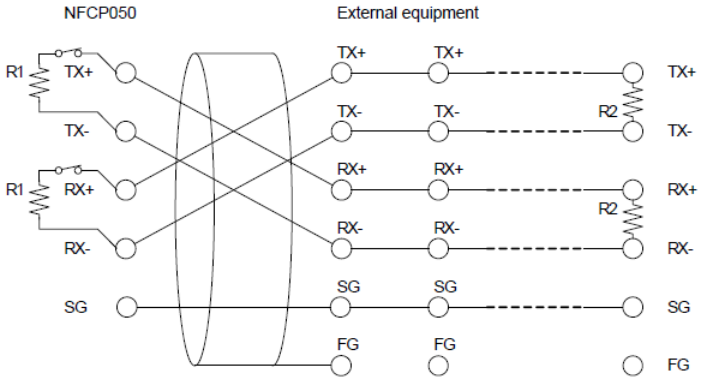
R1: Temination resistance of 120 ohm (NFCP050 built-in)
R2: According to the instruction on the external equipment side

Figure 1 to 1 Connection in 4-wire Type (RS-422/RS-485)



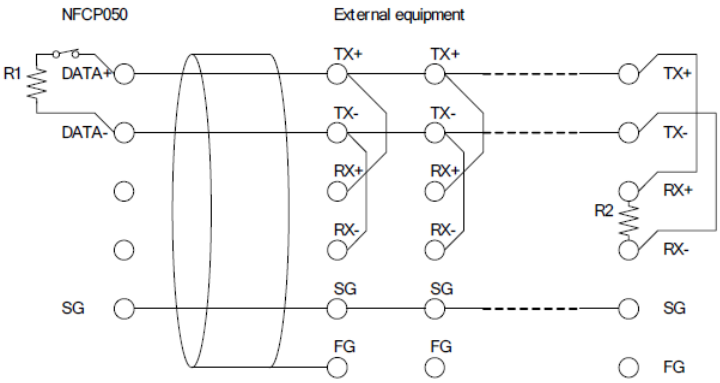
R1: Temination resistance of 120 ohm (NFCP050 built-in)
R2: According to the instruction on the external equipment side

Figure 1 to 1 Connection in 2-wire Type (RS-422/RS-485)



R1: Temination resistance of 120 ohm (NFCP050 built-in)
R2: According to the instruction on the external equipment side

Figure 1 to n Connection in 4-wire Type (RS-485)



R1: Temination resistance of 120 ohm (NFCP050 built-in)
R2: According to the instruction on the external equipment side

Figure 1 to n Connection in 2-wire Type (RS-485)

• Built-in I/O Terminals

CN1 (DI/O)

signal name	Pin No.		signal name
N.C.	40	39	N.C.
DI1	38	37	DO1
DI2	36	35	DO2
DI3	34	33	DO3
DI4	32	31	DO4
DI5	30	29	DO5
DI6	28	27	DO6
DI7	26	25	DO7
DI8	24	23	DO8
DI9	22	21	COM
DI10	20	19	COM
DI11	18	17	COM
DI12	16	15	COM
DI13	14	13	N.C.
DI14	12	11	N.C.
DI15	10	9	N.C.
DI16	8	7	N.C.
COM	6	5	N.C.
COM	4	3	N.C.
N.C.	2	1	N.C.

CN2 (AI/O, PI)

signal name	Pin No.		signal name
BAT+	40	39	BAT-
AI1+	38	37	AI1-
AI2+	36	35	AI2-
AI3+	34	33	AI3-
AI4+	32	31	AI4-
AI5+	30	29	AI5-
AI6+	28	27	AI6-
AI7+	26	25	AI7-
AI8+	24	23	AI8-
AI9+	22	21	AI9-
AI10+	20	19	AI10-
AI11+	18	17	AI11-
AI12+	16	15	AI12-
N.C.	14	13	N.C.
PI1+	12	11	PI1-
PI2+	10	9	PI2-
N.C.	8	7	N.C.
AO1+	6	5	AO1-
AO2+	4	3	AO2-
Vin	2	1	Com

Vin: Power supply (12 or 24 V) input terminal (+) for built-in AO
Com: Power supply (12 or 24 V) input terminal (-) for built-in AO

Figure Pin Assignment of Built-in I/O (MIL)

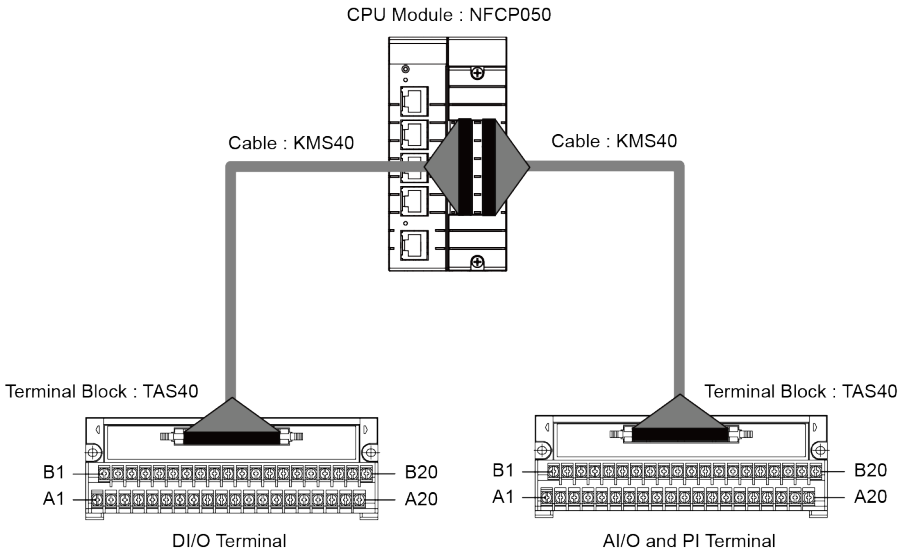
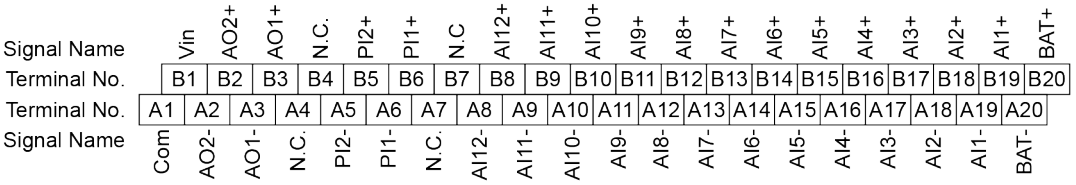


Figure Connection of NFCP050 buit-in I/O and Terminal block TAS40



Vin: Power Supply (12 or 24V) input terminal (+) for built-in AO
Com: Power Suppy (12 or 24V) input terminal (-) for built-in AO

Figure I/O Assignment of TAS40 for NFCP050 built-in AI/O and PI

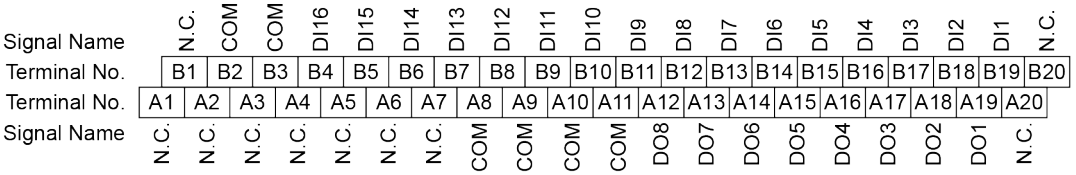


Figure I/O Assignment of TAS40 for NFCP050 built-in DI/O

● LEDs

Table Status Indicators

LED Indicator	Color	Description
HRDY	Green	Lights when the hardware is normal.
RDY	Green	Lights when the system is normal.
CTRL	Green	Lights when the control actions are carried out normally.

Table LAN status indicators (near RJ45 modular jacks)

LED Indicator	Color	Description
NETWORK ON/OFF	Green	Lights on in the normal communication mode. Lights off in the power down mode.
LINK & ACT	Green	Lights when the LINK has been established. Blinks when the transmission/reception is on.

Table SERIAL status indicators (near RJ45 modular jacks)

LED Indicator	Color	Description
Receive (RCV)	Green	Reception in progress
Send (SND)	Green	Transmission in progress

● RESET Switch

This switch is used to restart the CPU module.

● SHUT DOWN Switch

This switch is used to terminate the CPU module operation safely.

3.4 I/O Modules

An FCN-RTU supports the following versatile I/O modules.

SEE ALSO

For details, refer to the following GSs.

- Analog I/O Modules (GS 34P02Q31-01E)
- Digital I/O Modules (GS 34P02Q35-01E)
- Foundation fieldbus Communication Module (GS 34P02Q55-01E)
- Terminal Block (GS 34P02Q41-01E)
- MIL Connector Terminal Blocks, MIL Connector Cables (GS 34P02Q43-01E)

■ Analog I/O Modules

Table Analog I/O Modules for FCN-RTU (Non-Isolated)

Model	Function	Isolation	Terminal (*1)	MIL (*2)	Specifications	Remarks
NFAI141	Analog Input Module (4 to 20 mA, 16-channel)	Non-Isolated	✓	40	- Input accuracy: ± 0.1% of full scale - Data refresh cycle: 10 ms - Input step response time: 100 ms - Temperature drift: ± 0.01%/°C (Max)	(*3)
NFAV141	Analog Input Module (1 to 5 V, 16-channel, Non-Isolated)	Non-Isolated	✓	40	- Input accuracy: ± 0.1% of full scale - Data refresh cycle: 10 ms - Input step response time: 100 ms - Temperature drift: ± 0.01%/°C (Max)	—
NFAI841	Analog I/O Module (4 to 20 mA input, 4 to 20 mA output, 8-channel input/ 8-channel output)	Non-Isolated	✓	40	- Output fallback: Set for each channel - Input accuracy: ± 0.1% of full scale - Output accuracy: ± 0.3% of full scale - Data refresh cycle: 10 ms - Input step response time: 100 ms - Output step response time: 40 ms - Temperature drift: ± 0.01%/°C (Max)	(*3)
NFAB841	Analog I/O Module (1 to 5 V input, 4 to 20 mA output, 8-channel input/ 8-channel output)	Non-Isolated	✓	40	- Input: differential input (allowable common mode voltage ±1 V or less) - Output fallback: Set for each channel - Input accuracy: ± 0.1% of full scale - Output accuracy: ± 0.3% of full scale - Data refresh cycle: 10 ms - Input step response time: 100 ms - Output step response time: 40 ms - Temperature drift: ± 0.01%/°C (Max)	—

*1: ✓: Pressure clamp terminal can be connected.
(Some models of pressure clamp terminals incorporate a surge absorber.)
—: Pressure clamp terminal cannot be connected.

*2: 40: MIL connector of 40 pins can be connected.
—: MIL connector cannot be connected.

*3: Setting of 2-wire or 4-wire transmitter: For each channel by setting pin

- Common Specifications:
  - LED Indicator:
    - STATUS: Lights when the hardware is normal
    - ACT: Lights when input/output actions are carried out
  - Hot-Swap: Possible

Table Analog I/O Modules for FCN (Isolated)

Model	Function	Isolation	Terminal (*1)	MIL (*2)	Specifications	Remarks
NFAI143	Analog Input Module (4 to 20 mA, 16-channel)	Isolated	✓	40	- Withstanding voltage: 1500 V AC (Between input and system) - Input accuracy: ± 0.1% of full scale - Data refresh cycle: 10 ms - Input step response time: 100 ms - Temperature drift: ± 0.01%/°C (Max)	(*3)
NFAV144	Analog Input Module (-10 to +10 V, 16-channel)	Isolated	✓	40	- Switching input signals 1 to 5 V/-10 to +10 V (Set for channels all together) - Withstanding voltage: 1500 V AC (Between input and system) - Input accuracy: ± 0.1% of full scale - Data refresh cycle: 10 ms - Input step response time: 100 ms - Temperature drift: ± 0.01%/°C (Max)	(*4)
NFAI543	Analog Output Module (4 to 20 mA, 16-channel)	Isolated	✓	40	- Withstanding voltage: 1500 V AC (Between output and system) - Output fallback: Set for each channel - Output accuracy: ± 0.3% of full scale - Data refresh cycle: 10 ms - Output step response time: 100 ms - Temperature drift: ± 0.01%/°C (Max)	—
NFAT141	TC/mV Input Module (16-channel)	Isolated	✓	40 (*5)	- Switching input signals: TC/mV can be set individually for CH1 to CH16. - Burn-out: All channels can be set together. (detection time: 60 seconds) - Withstanding voltage: 1500 V AC (Between input and system) - Thermocouple inputs: ±0.03% of full scale (for -20 to 80 mV) - mV inputs: ±0.032% of full scale (for -100 to 150 mV) - Data refresh cycle: 1 sec - Thermocouple inputs: Max.±30 ppm/°C - mV inputs: Max.±32 ppm/°C	—
NFAR181	RTD Input Module (12-channel)	Isolated	✓	—	- Switching input signals: Set for each channel - Burn-out: All channels can be set together. (detection time: 60 seconds) - Withstanding voltage: 1500 V AC (Between input and system) - Input accuracy: ±0.03% of full scale (for 0 to 400 Ω) - Data refresh cycle: 1 sec - Thermocouple inputs: Max.±30 ppm/°C	—

*1: ✓: Pressure clamp terminal can be connected.
(Some models of pressure clamp terminals incorporate a surge absorber.)
—: Pressure clamp terminal cannot be connected.

*2: 40: MIL connector of 40 pins can be connected.
—: MIL connector cannot be connected.

*3: Setting of 2-wire or 4-wire transmitter: For each channel by setting pin

*4: Specifying “-10 V to +10 V” as an input signal enables you to set the input range by the resource configurator.

*5: Use a MIL connector cable for only mV input.

- Common Specifications:
  - LED Indicator:
    - STATUS: Lights when the hardware is normal
    - ACT: Lights when input/output actions are carried out
  - Hot-Swap: Possible

Table Analog I/O Modules for FCN (Isolated channels)

Model	Function	Isolation	Terminal (*1)	MIL (*2)	Specifications	Remarks
NFAI135	Analog Input Module (4 to 20 mA, 8-channel, Isolated channels)	Isolated channels	✓	40	- Withstanding voltage: 500 V AC (Between input and system) 500 V AC (Between channel) - Input accuracy: ± 0.1% of full scale - Data refresh cycle: 10 ms - Input step response time: 100 ms - Temperature drift: ± 0.01%/°C (Max)	(*3)
NFAI835	Analog I/O Module (4 to 20 mA, 4-channel input/4-channel output, Isolated channels)	Isolated channels	✓	40	- Withstanding voltage: 500 V AC (Between input/output and system) 500 V AC (Between channel) - Output fallback: Set for each channel - Input accuracy: ± 0.1% of full scale - Output accuracy: ± 0.3% of full scale - Data refresh cycle: 10 ms - Input step response time: 100 ms - Output step response time: 100 ms - Temperature drift: ± 0.01%/°C (Max)	(*3)
NFAP135	Pulse Input Module (8-channel, Pulse count, 0 to 10 kHz, Isolated channels)	Isolated channels	✓	40	- Withstanding voltage: 500 V AC (Between input and system) 500 V AC (Between channel) - Minimum input pulse width: 40 µs - Data refresh cycle: 2 ms - Input mode: Dry contact pulse(open-collector contact) Dry contact pulse (relay contact) Voltage pulse 2-wire transmitter current pulse 3-wire transmitter voltage pulse	(*4)

*1: ✓: Pressure clamp terminal can be connected.
(Some models of pressure clamp terminals incorporate a surge absorber.)
—: Pressure clamp terminal cannot be connected.

*2: 40: MIL connector of 40 pins can be connected.
—: MIL connector cannot be connected.

*3: Setting of 2-wire or 4-wire transmitter: For each channel by setting pin

*4: Specifying “-10 V to +10 V” as an input signal enables you to set the input range by the resource configurator.

- Common Specifications:
  - LED Indicator:
    - STATUS: Lights when the hardware is normal
    - ACT: Lights when input/output actions are carried out
  - Hot-Swap: Possible

■ Digital I/O Modules for FCN

Table Digital I/O Modules for FCN

Model	Function	Terminal (*1)	MIL (*2)	Specifications	Remarks
NFDV151	Digital Input Module (32-channel, 24 V DC, Isolated)	✓	50	- Function for detecting ON/OFF status, and counting the push button edge - Input response time: 8 ms or less (for status input) - Minimum ON detection time: 20 ms (for push button input) - Maximum ON/OFF cycle: 25 Hz (for push button input)	(*3)
NFDV551	Digital Output Module (32-channel, 24 V DC, Isolated)	✓	50	- Output fallback: Set for channels all together - Output response time: 3 ms or less (for status output)	(*4)
NFDR541	Relay Output Module (16-channel, 24 V DC, Isolated)	✓	—	- Rated applied voltage: 24 V DC - Output fallback: Set for channels all together - Output response time: 12 ms or less (for status output)	(*5)

*1: ✓: Pressure clamp terminal can be connected.
(Some models of pressure clamp terminals incorporate a surge absorber.)
—: Pressure clamp terminal cannot be connected.

*2: 50: MIL connector of 50 pins can be connected.
—: MIL connector cannot be connected.

*3: Common plus(+) or minus (-) side every 16-channel

*4: Common minus (-) side every 16-channel

*5: Common plus(+) or minus (-) side every 8-channel

- Common Specifications:
  - LED Indicator:
    - STATUS: Lights when the hardware is normal
    - ACT: Lights when input/output actions are carried out
  - Hot-Swap: Possible

■ Communication Modules for FCN

Table Serial Communication Modules for FCN

Model	Function	Specifications	Remarks
NFLF111	NFLF111 Foundation fieldbus communication module	- Communication port: 4 ports - Communication speed: 31.25 kbps	- Up to 8 duplexed pairs of NFLF111 per FCN - Pressure clamp terminal block for fieldbus connections (Model NFTF9S)
NFLC121	CANopen Communication Module	- Communication port: 1 port - Communication speed: 10 kbps to 1 Mbps	Wiring connection: D-sub 9-pin, male Inch screw (No.4-40UNC)
NFLP121	PROFIBUS-DP Communication Module	- Communication port: 1 port - Communication speed: 9.6 kbps to 12 Mbps	Wiring connection: D-sub 9-pin, female Inch screw (No.4-40UNC)

- Common Specifications:
  - LED Indicator:
    - STATUS: Lights when the hardware is normal
    - ACT: Lights when the module is running normally
  - Hot-Swap: Possible

■ The Operation of FCN-RTU CPU Module built-in I/Os and I/O Modules

This chapter describes the operation specifications of FCN-RTU CPU module built-in I/Os and I/O modules when system functions malfunction and the failures are recovered. See the table below.

Table Behavior for CPU Module Built-in I/Os and I/O Modules Fail

Error	CPU Module Built-in I/Os		I/O Modules (*1)	
	When Fails	When Recovered	When Fails	When Recovered
CPU Module	Output fallback operation	Recover operation from higher level errors	Output fallback operation	Recover operation from higher level errors
Control Unit Power Supply	–	Restart operation	–	Restart operation
SB Bus	Output fallback operation	Recover operation from higher level errors	Output fallback operation	Recover operation from higher level errors
CPU Module Built-in I/Os	–	Restart operation	Undetected	Continued Operation
I/O Modules	Undetected	Continued Operation	–	Restart operation

*1: The I/O module behavior is the same as the mentioned in the “I/O module in main nest” described in Table “I/O Module Operation when an I/O Module Malfunctions” of Section C4.1 “Overview.”

The behavior of FCN-RTU CPU module built-in I/O when failed and recovered are the same as the FCN extended I/O module, except for the reset switch and rebooting from the Maintenance homepage shown in the table below. For the output fallback behavior and other behaviors, refer to C3 “I/O Module Operation.”

Table Behavior for Each Operation when Performed

Operation	CPU Module Built-in I/Os		I/O Modules	
	Hardware normal	Hardware error (*1)	Hardware normal	Hardware error
RESET Switch	Restart operation		Continued Operation	
Rebooting from Maintenance Homepage	Output fallback operation	Restart operation	Output fallback operation	Continued Operation

*1: When FCN-RTU CPU module built-in I/O module fails, the operation status display LED RDY changes to the red flashing status.

3.5 Compliant Standards and Installation Requirements

SEE ALSO

For the installation procedures, implementation restrictions, and implementation precautions, refer to the “STARDOM FCN/FCJ Installation Guide” (TI 34P02Q91-01E).

3.5.1 Installation Requirements

Table Installation Requirements

Item	Specification	
Ambient temperature	Operation	-40 to +70 °C (*1)
	Transportation/storage	-40 to +85 °C
Ambient humidity	Operation	5 to 95 %RH (no condensation)
	Transportation/storage	5 to 95 %RH (no condensation)
Rate of change in temperature	Operation	Within ±10 °C/h
	Transportation/storage	Within ±20 °C/h
Dust		0.3 mg/m^3 or less
Protection class		IP20
Resistance to corrosive gases		ANSI/ISA S71.04 Class G2 (Standard) (ANSI/ISA S71.04 Class G3, option)
Resistance to vibration		0.15 mm P-P (5 to 58 Hz)
		1 G (58 to 150 Hz)
Resistance to shock		15 G, 11 ms (during power-off, for sine half-waves in XYZ-directions)
Altitude		3000 m or less (*1)
Noise	Electric field	3 V/m or less (26 MHz to 1 GHz)
	Magnetic field	30 A/m (AC) or less, 400 A/m (DC) or less
	Electrostatic discharge	4 kV or less contact discharge, 8 kV or less aerial discharge
Grounding		Apply the grounding system which is defined by the rules and standards of the country or the region.
Cooling		Natural air cooling

*1: It depends on additional I/O modules. Refer to 3.5.3, “List of FCN-RTU’s Modules and Descriptions” for details.

3.5.2 Compliant Standards

Table Compliant Standards

Item		Standards
Safety Standards (*1) (*8) (*11)	CSA	CAN/CSA-C22.2 No.61010-1 CAN/CSA-IEC 61010-2-201 CAN/CSA-C22.2 No.61010-2-030
	CE Marking Low Voltage Directive	EN 61010-1 EN 61010-2-201 EN 61010-2-030
	EAC Marking	CU TR 004
EMC Standards	CE Marking EMC Directive	EN 55011 Class A Group 1 (*9) EN 61000-6-2 (*1) (*2) (*3)
	RCM	EN 55011 Class A Group 1 (*9)
	KC Marking	Korea Electromagnetic Conformity Standard
	EAC Marking	CU TR 020
Standards for Hazardous Location Equipment (*4) (*5)	US (FM) Nonincendive (*1)	Class I Division 2, Groups A, B, C, D T4 Class 3600:2011 Class 3611:2004 Class 3810:2005
	ATEX Type “n” (*6) (*7)	⟨Ex⟩ II 3 G Ex nA IIC T4 Gc X (*10) EN 60079-0:2012 +A11:2013 EN 60079-15:2010
	Canada (CSA) Non-Incendive (*1)	Class I Division 2, Groups A, B, C, D T4 C22.2 No.213-M1987 CAN/CSA-C22.2 No. 61010-1-12 CAN/CSA-C22.2 No. 61010-2-030-12 CAN/CSA-IEC 61010-2-201:14
	IECEx Type “n” (*1)	Ex nA IIC T4 Gc IEC 60079-0:2011 IEC 60079-15:2010
Restriction of Hazardous Substances (*5)	RoHS Directive	EN 50581

*1: For the rack-mountable devices, DIN rail-mountable devices, and wall-mountable devices to meet the Safety Standards and EMC Standards, the devices must be installed in a lockable metal cabinet. The cabinet must conform to IEC/EN/CSA 61010-2-201 or provide degrees of protection IP3X or above and IK09 or above.

*2: For lightning surge immunity, a device such as a lightning arrester needs to be installed externally. Some module can select a pressure clamp terminal block with surge absorber. For details, refer to “Terminal Block” (GS 34P02Q41-01E).

*3: When using the NFCP050 or NFLP121, mount ferrite cores as shown below in order to meet the EMC standards.
• NFCP050 (CPU module): Mount two ferrite cores “A1193MN” to Ethernet cable of the NFCP050 side.
• NFLP121 (PROFIBUS-DP Communication module) : Mount one ferrite core “A1193MN” to PROFIBUS-DP cable of the NFLP121 side.

*4: Refer to TI 34P02Q91-01E for the products meeting NI.

*5: For modules conforming to each standards, refer to 3.5.3, “List of FCN-RTU’s Modules and Descriptions”.

*6: When FCN-RTU is used under the ATEX Type “n” environment, the Instruction Manual, “Explosion Protection of FCN/FCJ Products” (IM 34P02Q11-02E) is required for safer installation and wiring.

*7: To be compliant with these standards, the FCN-RTU hardware needs to be installed in a lockable metal cabinet of IP54 or higher protection rating.

*8: For ensuring the FCN-RTU hardware to satisfy the safety standards, the dedicated breakers in the power supply side must be installed and conform to the following specifications.
• [CSA] CSA C22.2 No.5 or UL 489
• [CE Marking] EN 60947-1 and EN 60947-3

*9: A Class A hardware device is designed for use in the industrial environment. Please use this device in the industrial environment only.

*10: Symbol ‘X’ denotes the specific condition of use. See “Explosion Protection of FCN/FCJ Products” (IM 34P02Q11-02E) for detail.

*11: To be compliant with these standards, the FCN’s cable which is drawn out from the metal, needs to be used the VW-1 class or more of flame-retardant cable.

In relation to the CE Marking, the manufacturer and the authorised representative for the Product in the EEA are indicated below:

- Manufacturer:
  Yokogawa Electric Corporation (2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan)
- Authorised representative in the EEA:
  Yokogawa Europe B.V. (Euroweg 2, 3825 HD Amersfoort, The Netherlands)

3.5.3 List of FCN-RTU's Modules and Descriptions

Table List of FCN-RTU's Modules and Descriptions (1/2)

Type	Model	Description	Temp. (-40to+70°C) Altitude (3000m)	Temp. (-20to+70°C) Altitude (2000m)	Explosion Protection: US (FM) NI (Nonincendive) / ATEX Type "n" / Canada (CSA) NI (Non-Incendive)	Explosion Protection: IECEx Type "n"	RoHS (*14)	HART Option
Base module	NFBU050	Base Module (short)	✓	✓	✓	✓	✓	(*1)
	NFBU200	Base Module (long)	N.A.	✓	✓	✓	✓	
Power supply module	NFPW426	Power Supply Module (12 V DC input, 24 V DC input)	✓	✓	✓	✓	✓	
	NFPW444	Power Supply Module (24 V DC input)	N.A.	✓ (*8)	✓	✓	✓	
CPU module	NFCP050	CPU Module for FCN-RTU	✓	✓	✓	✓	✓	
Analog I/O Modules (*2)	NFAI135	Analog Input Module (4 to 20 mA, 8-channel, Isolated channels)	N.A.	✓ (*9)	✓	N.A.	✓	✓
	NFAI141	Analog Input Module (4 to 20 mA, 16-channel, Non- Isolated)	N.A.	✓ (*9)	✓ (*3)	✓ (*3)	✓	✓ (*3)
	NFAI143	Analog Input Module (4 to 20 mA, 16-channel, Isolated)	N.A.	✓ (*9)	✓	✓	✓	✓
	NFAI543 (*11)	Analog Output Module (4 to 20 mA, 16-channel, Isolated)	N.A.	✓ (*10)	✓	✓	✓	✓
	NFAV141	Analog Input Module (1 to 5 V, 16-channel, Non-Isolated)	N.A.	N.A.	✓	N.A.	✓	N.A.
	NFAV144	Analog Input Module (1 to 5 V, 16-channel, Isolated)	N.A.	✓ (*5)	✓	N.A.	✓	N.A.
	NFAI841	Analog I/O Module (4 to 20 mA input, 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)	N.A.	✓ (*9) (*10)	✓ (*3)	✓ (*3)	✓	✓ (*3)
	NFAB841	Analog I/O Module (1 to 5 V input: differential input, 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)	N.A.	N.A.	✓	N.A.	✓	N.A.
	NFAT141	TC/mV Input Module (16-channel, Isolated)	N.A.	N.A.	✓	N.A.	✓	N.A.
	NFAR181	RTD Input Module (12-channel, Isolated)	✓ (*4) (*7)	✓ (*4) (*7)	✓	✓	✓	N.A.
	NFAI835	Analog I/O Module (4 to 20 mA, 4-channel input/4-channel output, Isolated channels)	N.A.	✓ (*9)(*10)	✓	✓	✓	✓
	NFAP135	Pulse Input Module (8-channel, Pulse count, 0 to 10 kHz, Isolated channels)	✓ (*4) (*7)	✓ (*4) (*7) (*9)	✓	N.A.	✓	N.A.
Digital I/O Modules (*2)	NFDV151	Digital Input Module (32-channel, 24 V DC, Isolated)	N.A.	✓	✓	✓	✓	N.A.
	NFDV551	Digital Output Module (32-channel, 24 V DC, Isolated)	N.A.	✓	✓	✓	✓	N.A.
	NFDR541 (*12) (*15)	Relay Output Module (16-channel, 24 V DC, Isolated)	N.A.	✓ (*5) (*6)	✓ (*13)	N.A.	N.A.	N.A.
Communica -tion Modules	NFLC121	CANopen Communication Module (1-port, 10 kbps to 1 Mbps)	N.A.	N.A.	N.A.	N.A.	✓	N.A.
	NFLF111	Foundation fieldbus Communication Module (4-port)	✓ (*4) (*7)	✓ (*4) (*7)	✓	N.A.	✓	N.A.
	NFLP121	PROFIBUS-DP Communication Module (1-port, 9.6 kbps to 12 Mbps)	N.A.	N.A.	N.A.	N.A.	✓	N.A.

Table List of FCN-RTU's Modules and Descriptions (2/2)

Type	Model	Description	Temp. (-40to+70°C) Altitude (3000m)	Temp. (-20to+70°C) Altitude (2000m)	Explosion Protection		RoHS (*14)	HART Option
					US (FM) NI (Nonincendive) / ATEX Type "n" / Canada (CSA) NI (Non-Incendive)	IECEx Type "n"		
Pressure Clamp Terminal Block	NFTA4S	For Analog (16-channel)	N.A.	✓	✓	✓	✓	(*1)
	NFTT4S	for Thermocouple/mV (16-channel)	N.A.	N.A.	✓	N.A.	✓	
	NFTR8S	for RTD (12-channel)	✓	✓	✓	✓	✓	
	NFTB5S	for Digital Input (32-channel)	N.A.	✓	✓	✓	✓	
	NFTD5S	for Digital Output (32-channel)	N.A.	✓	✓	✓	✓	
	NFTI3S	for Isolated Analog Module (for NFAI135, NFAP135, NFAI835)	✓	✓	✓	✓	✓	
	NFTC4S -70	Pressure Clamp Terminal Block for Digital (16-channel, with dedicated connector, without surge absorber)	N.A.	✓	✓	N.A.	✓	
	NFTF9S	for Foundation fieldbus	✓	✓	✓	N.A.	✓	
Terminal Block	TAS40	MIL Connector Terminal Block (40 Pole Plug Types, M3.5)	✓	✓	✓	✓	✓	
	TAS50	MIL Connector Terminal Block (50 Pole Plug Types, M3.5)	N.A.	✓	✓	✓	✓	
Cable	KMS40	MIL Connector Cable (40 Pole Plug Types)	✓	✓	✓	✓	✓	
	KMS50	MIL Connector Cable (50 Pole Plug Types)	N.A.	✓	✓	✓	✓	

Note: All the modules in this list are available in the temperature range 0 to +55°C.

✓: Available (or conforming)

N.A.: Not available (or Not applicable)

*1: Unconcerned

*2: To use I/O modules as hazardous location equipment (non-incendive), use the specified pressure-clamp terminal blocks or TAS40/TAS50 (MIL connecter terminal blocks) and KMS40/KMS50 (MIL connector cables).

3: I/O modules with suffix code –H "with HART communication" conform to only ATEX Type "n" standards (does not conform to US (FM)-NI, Canada (CSA)-NI, IECEx Type "n")

*4: Use I/O module with suffix codes –S□4 or –S□5 (with Extended Temperature Range (-40 to +70°C) option) Refer to "Limitations of Installation for using in the wide temperature range (-40 to +70°C) and high altitude (2000 to 3000m) environments."

*5: When ambient temperature is higher than 55°C, a blank slot on one side is required to NFAV144 and NFDR541 modules. See "Figure Installation Examples of using NFAV144" in the following page.

*6: When ambient temperature is higher than 55°C, available channels of NFDR541 are up to eight.

*7: When ambient temperature is higher than 55°C, NFAR181, NFAP135 and NFLF111 modules cannot be installed in next slot of the NFAI841.

*8: When ambient temperature is higher than 55°C, NFPW444 module is restricted to 75% of rated output current.

*9: In the case of the use of combination with NFPW426, only one module can be used.

*10: NFAI841, NFAI543 and NFAI835 modules are restricted to the external load and module installation. Refer to "Table Module Arrangement and Restrictions on Installation" in the following page.

*11: The combination of NFAI543 and NFPW426 is not allowed. Use NFPW444 module.

*12: Maximum 8 A is allowed per common.

*13: NFDR541 conforms to US (FM) NI and Canada (CSA) NI standards. NFDR541 does not conform to ATEX Type "n".

*14: The products with the condition of not only adapted models on the table, but also manufactured from September, 2016, compliant with RoHS directive. Manufacturing month and year are marked on the each product.

*15: NFDR541 modules do not conform to CE Marking after July 22, 2017 due to non-conformity to RoHS. In areas requiring CE marking, these modules cannot be used except repair purpose only.

IMPORTANT

For details on installation restrictions and precautions of an FCN-RTU modules, refer to "FCN-RTU Low Power Autonomous Controller Hardware" (GS 34P02Q13-01E).

4. FCN-RTU Software Configuration

■ FCN-RTU Internal Architecture

As shown above, an FCN-RTU operates with the following internal architecture.

The applications that should be created by the user are as follows:

- Control application
- Duolet application

This chapter explains the tools and procedures for developing them, and estimates of performance, etc.

Table FCN-RTU Internal Architecture

Software	Function	Remarks
Real-time OS Process inputs/outputs	Administers and controls the control network, I/O, and so on.	OS
Control execution engine	Platform to run control applications	Platform
Java VM (Virtual Machine)	Platform to run Duolet applications	Platform
Control application	Sequence and loop control programs to be created by users	Users application
Duolet application	To be created by InfoWell and users	Users application

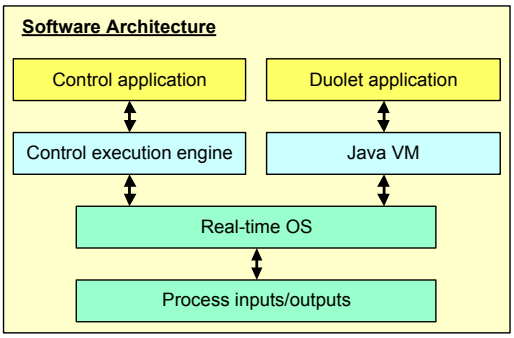


Figure FCN-RTU Internal Architecture

4.1 Development Environment and Tools

“Control applications” and “Duolet applications” under development require specialized development tools and the software license.

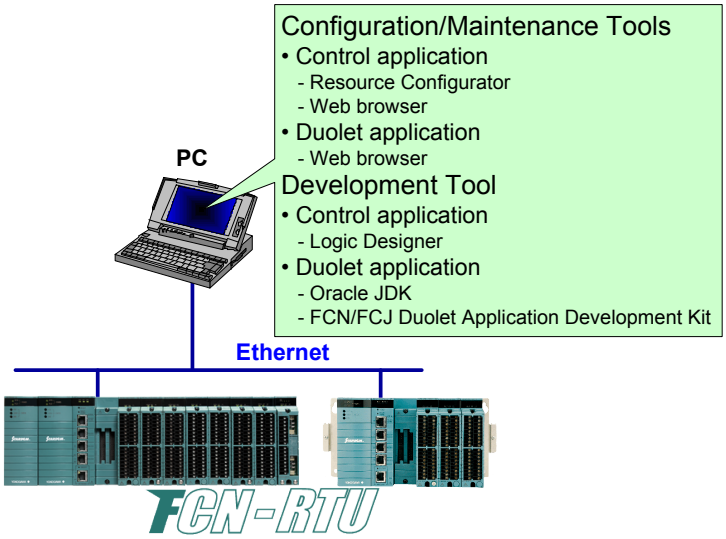


Figure Structure of Development Environment and Tools

- **Control Applications**

A PC connected via Ethernet is used for application development and maintenance of FCN-RTUs. Resource Configurator is a suite of tools to set up configurations including the IP address of individual FCN-RTUs, I/O module settings, and other settings. Accessing FCN-RTUs via a Web browser enables various operations such as setting up information transmission functions changing the date and time in them, and viewing log files. Logic Designer is a suite of tools to develop and debug control applications that are to run in an FCN-RTU, and download them to an FCN-RTU.

SEE ALSO

For more information about the information transmission functions, refer to 2.3, “FCN-RTU Information Transmission Functions.”

Table Development Environment for Control Applications

Item	Specification	
Personal computer	PC/AT-compatible computer	
CPU	Windows 10	1 GHz or higher 64 bit (x64)
	Windows 7 (32-bit)	1 GHz or higher 32-bit (x86) or 64-bit (x64) processor
	Windows 7 (64-bit)	1 GHz or higher 64-bit (x64) processor
RAM	2 GB or more	
Hard disk	20 GB or more free space is required.	
Display	1024 x 768 pixels or more, True Color	
Ethernet adapter	A 1000BASE-T, 100BASE-TX, 10BASE-T, or 10BASE-5 Ethernet port that is supported by the operating systems used is required.	
DVD-ROM drive	A DVD-ROM drive that can run under the operating systems used is required for installation. (DVD-ROM combo drive recommended)	
OS	Windows 10 Enterprise 2016 LTSB (64-bit) Windows 10 IoT Enterprise 2016 LTSB (64-bit) Windows 10 Pro (64-bit) (*1) Windows 7 Professional SP1 (32-bit/64-bit)	

*1: Some functions of the STARDOM software may possibly be restricted when Windows Update is applied to Windows 10 Pro.
Refer to the following Yokogawa Web site (registration is required) for the support status of STARDOM software for Windows 10 Pro.
- "System Requirements" Page in "YOKOGAWA Partner Portal STRADOM" site
  https://partner.yokogawa.com/global/member/rtu/index.htm

● Duolet Applications

Yokogawa FCN/FCJ Duolet Application Development Kit and Oracle Java Development Kit (JDK, JDK 1.4.2) are both required for Duolet application development.
Yokogawa FCN/FCJ Duolet Application Development Kit provides Java class libraries required to develop Duolet applications which are to run in an FCN-RTU, such as for accessing data in control functions and for system management, as well as utilities to help debugging. FCN/FCJ Duolet Application Development Kit is also required for a Web browser to make the Duolet operation settings in each of the FCN-RTU.
In addition, optional Webmetry Basic Library Portfolio or InfoWell simplifies the development of Web-based monitoring applications.

SEE ALSO

For more information about the Duolet application development, refer to 4.1.5, "FCN-RTU Duolet Application Development."

■ Development Tools/Software Products and Their Functions/Software License

Development tools/software products and their functions/software license are shown in the table below.

Table List of Development Tools/Software Products and Their Functions/Software License

Development Tool	Function	Software License	Remarks
Resource Configurator	Tool for making basic FCN/FCJ settings. Mainly has the following functions. - Real I/O and Logical I/O Linked Setting - Network Setting - CPU Module Setting - I/O Module Setting - RAS Information Display	Not required	Refer to 4.1.1.
Web browser	Set detailed information and conduct operation for FCN/FCJ.	Not required	Refer to 4.1.6.
Logic Designer	Tool for creating/debugging control applications. The tool has the following features. - Supports all five IEC 61131-3 programming languages - Powerful debugging function.	Required	Refer to 4.1.2.
Functions and Function Blocks	Parts of creating control applications included as a standard part of Logic Designer	Not required	Refer to 4.1.3.
Application Portfolio (APPF)	Optional parts of creating control applications which have application know-how	Required ✓ (*1)	Refer to 4.1.4.
FCN/FCJ Duolet Application Development Kit	Parts of developing of FCN/FCJ Duolet applications	Required	Refer to 4.1.5.
Oracle Java Development Kit	Java application development environment	Contract with Oracle	Refer to 4.1.5.

*1: The License is bundled with NFCP050 CPU module
For more information about the License, refer to the next page:

■ Software for FCN-RTU

FCN-RTU builds in the FCN/FCJ Basic Software (with Duolet function).

● Application Portfolios

An Application Portfolio is a bundle of useful software parts for FCN-RTU.
The combination of application portfolio can be specified as NFCP050 CPU module suffix code shown in the following table.

Table Bundled Software and NFCP050 CPU module

Software		Controller type (CPU Module)	Specification (GS No. to refer to)	Software Media (Model)
		FCN-RTU (NFCP050-S1☐)		
FCN/FCJ Basic Software (With Duolet function)		X	GS 34P02Q02-01E	NT203AJ
Application Portfolio	PAS Portfolio	X	GS 34P02P20-02E	NT205AJ
	FA-M3 Communication Portfolio	X		
	MELSEC Communication Portfolio	X		
	Modbus Communication Portfolio	X		
	DNP3 Communication Portfolio	X	GS 34P02P22-02E	
	Gas Flow Calculation Portfolio	X	GS 34P02P31-02E	
	Liquid Flow Calculation Portfolio	X	GS 34P02P33-01E	
	Web Application Portfolio	X	GS 34P02P51-02E	
	E-mail Application Portfolio	X		
	Graphic Portfolio	X		
	Logging Portfolio	X		

4.1.1 Resource Configurator

Resource Configurator is a tool that performs the basic settings of FCN/FCJ.
It provides the following functions:

- **Actual I/O and logical I/O link settings**

  Control applications created with Logic Designer are all defined using logical I/O (device label variables). The Recourse Configurator is used to allot the logical I/O (device label variable) to physical I/O (device labels).

  TIP

  - Control applications can be developed independent from the physical I/O. This makes it possible to develop reusable control applications and increase productivity through reuse.
  - Control applications can also be created by using the logical I/O (device label variable) defined as the default in the physical I/O (device label).

  SEE ALSO

  For more information about linking logical I/O (device label variable) and physical I/O (device label), refer to "■ Device Labels and Device Label Variables" in "4.3.4 Input/Output Processing."

- **Network Setting**

  This function allows performing settings related to the network of the controller (IP address, submask, default gateway).
  When FCN-RTU are shipped from the factory, this information has not been set. This information must be set using this function before the FCN-RTU is used.

- **CPU Module Setting**

  This function allows performing settings related to the CPU module.

- **I/O Module Setting**

  This function allows performing settings related to I/O modules. It is possible to acquire the configuration of the I/O modules installed on the controller and perform settings for each I/O module.

- **RAS Information Display**

  This function allows displaying the RAS (Reliability, Availability, Serviceability, hereinafter referred to as RAS) information of the FCN/FCJ.

- **Loop check tool**

  The loop check tool supports the FCN/FCJ I/O wiring check (loop check). The current values and output values of the I/O can be set directly.

4.1.2 Logic Designer

Logic Designer offers the following merits:

- **Applications can be developed by choosing the most suitable programming language for each application or the preference of the user from five IEC 61131-3-compliant languages.**
- **A block of complex control composed of standard functions can be registered as a software part referred to as a "capsule," and hierarchically structured applications can be built by combining capsules, boosting engineering efficiency from design to debugging.**
- **Powerful debugging functions**

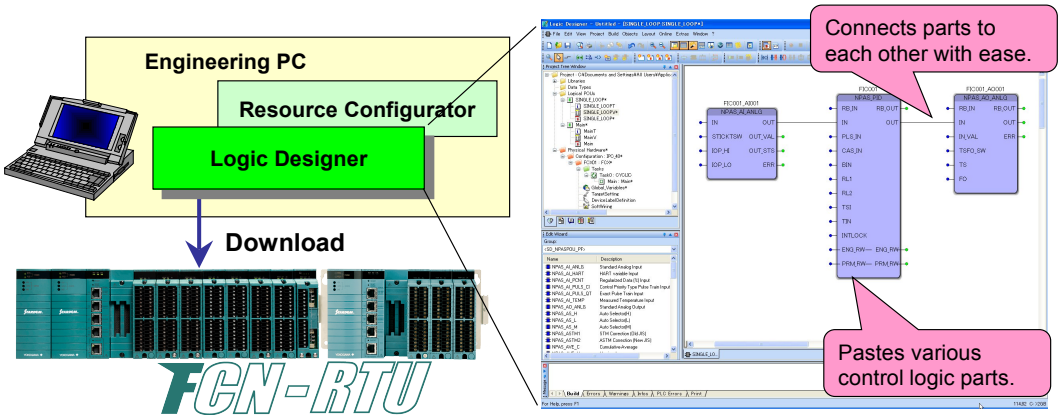


Figure Logic Designer

- **What is POU?**

  POU is an acronym for "Program Organization Unit," and is an independent software unit which has program code for configuring control applications.

■ IEC 61131-3 Compliant Programming Languages

The most suitable programming language can be chosen for each application or the preference of the user from the following five IEC 61131-3-compliant languages. Loop control and sequence control can be coded within the same environment, further improving engineering efficiency.

- Function Block Diagram (FBD)

  Sets of functions are provided as function blocks. Data processing is done by connecting function blocks with signal wires to each other. An application can be built according to the flow of data, so FBD is ideal for regulatory control of analog signals.

- Ladder Diagram (LD)

  Most commonly used for programming of PLC applications. Logical computations are coded using various elements such as contacts of relays and coils.

- Sequential Function Chart (SFC)

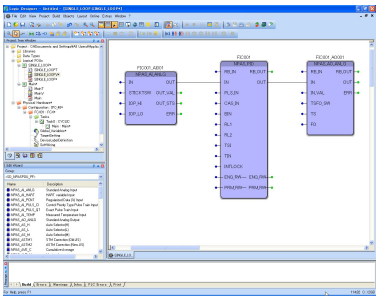
  Useful for building applications which involve sequential phase and step control. Offers a merit that sequence control can be coded explicitly. Concise sequence programs can be built when combined with programs written in other languages, such coding sequence control in SFC and non-sequence control in LD.

- Instruction List (IL)

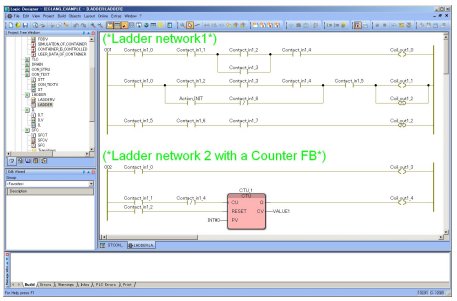
  Standardized mnemonics. Each line consists of an operator and operands, so all expressions are unambiguous but it is difficult to code complex logical relations.

- Structured Text (ST)

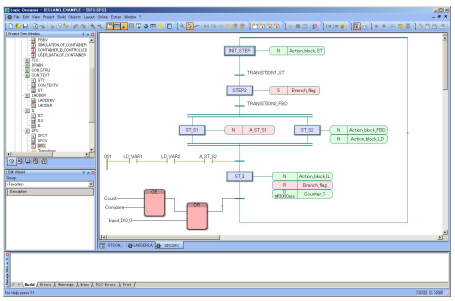
  A text-based language similar to PASCAL, a high-level language. Merits of ST include that branches in an application can be expressed by IF, THEN, and ELSE statements and that complex computations can be easily coded.



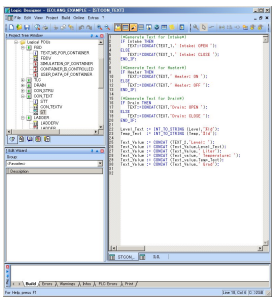
FBD (Function Block Diagram)



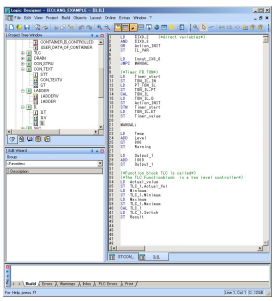
LD (Ladder Diagram)



SFC (Sequential Function Chart)



ST (Structured Text)



IL (Instruction List)

Figure IEC 61131-3 Compliant Programming Languages

■ Encapsulation and Reuse of Control Logic

For FCN-RTU, control application know-how can be made into parts with ease at the user level. Further, registering the created parts in a library enables them to be encapsulated with password protection, thus making them reusable and allowing each application to be structured hierarchically.
This boosts engineering (including debugging) efficiency and program reusability, assisting system expansion and modification.

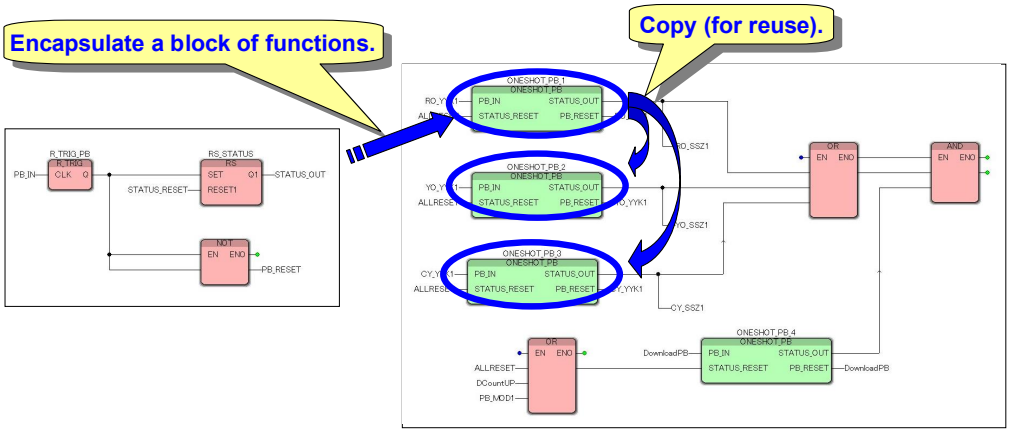


Figure Example of Encapsulated Control Logic

■ Network Templates

In the term “network template”, network refers to control logic connections, and network template refers to a control logic (circuit diagram) model. Model codes are made into templates to enable code reuse. Use of network templates simplifies control logic construction.

Basic control loop templates, published on the Network-based Control System “STARDOM” Members Only Page of the “Partner Portal” website (https://partner.yokogawa.com/global/), can be downloaded and copied into a prescribed folder for reuse. For more details, read the documentation accompanying the templates.

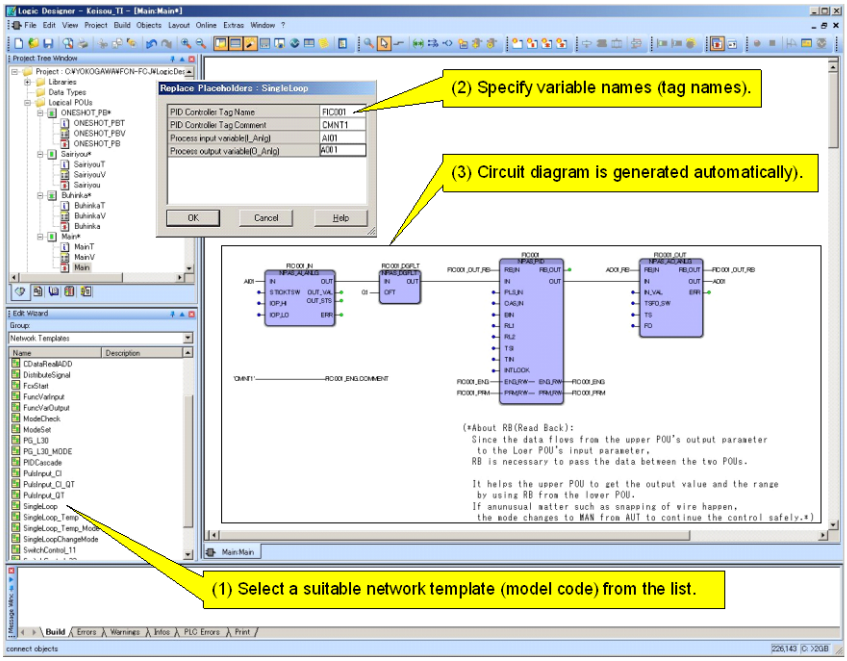


Figure Example of Network Template

■ Debugging Support Functions

Logic Designer offers many powerful functions for debugging and modifying developed control logic, so users do not have to develop a program for debugging.

- Software Wiring

  By using software wiring for definition of wiring connections to the I/O module, and inputting sine waves or other simulated signals, debugging can be conducted without inputting signal externally.

- Online layout and online value display

  The user can view and modify the current values of variables defined in a control application while displaying the program.

- Breakpoint setting

  The user can set breakpoints at desired points in a program, at which the program will stop running. The program can be run step by step, stopping at each breakpoint.

- Logic analyzer

  Records the values of variables at a specified interval and displays the recorded values graphically.

- Watch window

  The values of desired variables can be monitored by registering the variables in the Watch window.

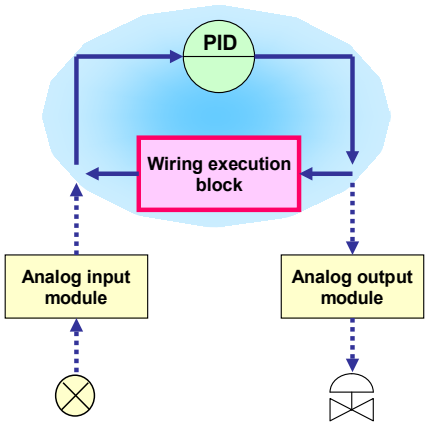


Figure Image of Software Wiring

■ FCN/FCJ Simulator

FCN/FCJ Simulator is a software product that runs on a PC and simulates control applications running on a single FCN-RTU. FCN/FCJ Simulator facilitates the debugging of control applications, thus improving development efficiency.

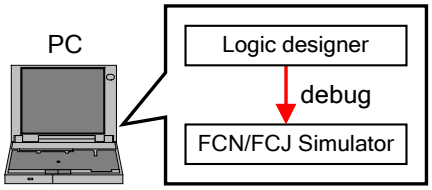


Figure FCN/FCJ Simulator (Example 1)

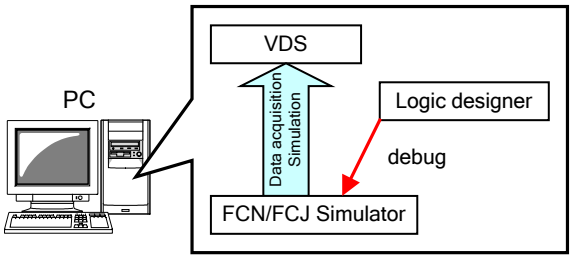


Figure FCN/FCJ Simulator (Example 2)

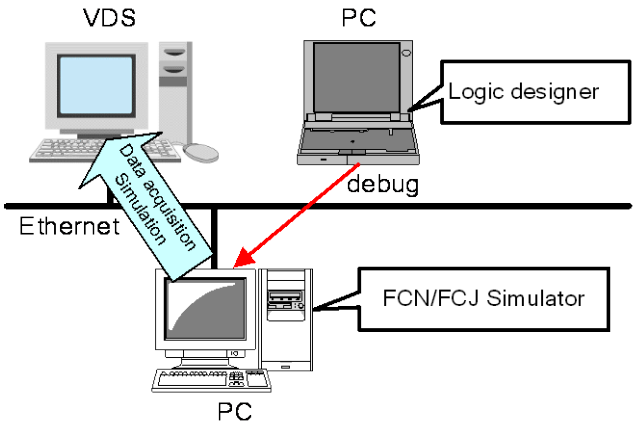


Figure FCN/FCJ Simulator (Example 3)

● Simulator

FCN/FCJ Simulator can be used for the following:

- FCN-RTU control applications created with a Logic Designer can be debugged with an FCN/FCJ Simulator.
- VDS can be debugged by accessing FCN/FCJ Simulator data
- Duolet applications running on the FCN-RTU in conjunction with control applications can be debugged on a PC.

FCN/FCJ Simulator can be operated on the same PC as a Logic Designer or VDS. FCN/FCJ Simulator can also be operated on a different PC. One FCN/FCJ can be simulated per PC.

● Functions Disabled in FCN/FCJ Simulator

FCN/FCJ Simulator does not allow you to use the following functions:

- FCN-RTU I/O modules
  FCN-RTU IO modules always remain separated from the simulator.
- Configuration functions through a Web browser
- Inter-FCN/FCJ communication function and others communication functions
- Back up the retain data

- **POU and APPF Disabled in FCN/FCJ Simulator**

  POUs for communications among POUs and FCN/FCJ Application Portfolios (hereinafter referred to as APPF) do not execute communication with other FCN/FCJ or foreign devices in FCN/FCJ Simulator. If it is executed in FCN/FCJ Simulator, will result in an error.

  Standard POUs (all POUs for communications) that result in errors in FCN/FCJ Simulator are:
  - Inter-FCN/FCJ communication function blocks
  - FA-M3 Emulator (serial) function blocks
  - Ethernet communications function blocks
  - Serial communications function blocks

  Major APPFs that do not function on FCN/FCJ Simulator:
  - FA-M3 Communication Portfolio
  - MELSEC-A Communication Portfolio
  - Modbus Communication Portfolio
  - DNP3 Communication Portfolio

- **Others**
  - A Duolet execution environment is needed on the PC in order to execute Duolet applications. FCN/FCJ Duolet Application Development Kit R4.10.01 or higher is needed.
  - The FCN/FCJ Simulator processing speed depends on the specification of the PC. FCN/FCJ Simulator may provide a processing speed higher than the FCN-RTU. In this case, be sure to confirm the execution speed of control applications on the FCN-RTU.

4.1.3 FUs and FBs of Logic Designer

A list of functions and function blocks provided with the Logic Designer is given below.

SEE ALSO

- For more information about the functions and function blocks provided with the Logic Designer, refer to the Help of Logic Designer.
- For more information about the functional components composing a control application, refer to "■ Logic POU" in 4.3.1, "Control Application Structure."

■ IEC 61131-3 Functions and Function Blocks

The tables below list the functions and function blocks provided with IEC 61131-3 by category.

Table Type Conversion Functions

Function	Description
*_TO_STRING	Converts various data types to STRING data type. Include conversions from BYTE, DWORD, INT, DINT, REAL, LREAL, SINT, TIME, USINT, UINT, UDINT and WORD
B_BCD_TO_*	Converts BCD code of BYTE data type to various data types. Include conversions to DINT, INT and SINT
BCD_TO_DINT	Converts BCD code of DWORD data type to DINT data type.
BOOL_TO_*	Converts BOOL data type to various data types. Include conversions to BYTE, WORD, DWORD, SINT, INT, DINT, USINT, UINT, UDINT and REAL
BYTE_TO_*	Converts BYTE data type to various data types. Include conversions to BOOL, WORD, DWORD, SINT, INT, DINT, USINT, UNIT, UDINT and REAL
D_BCD_TO_*	Converts BCD code of DWORD data type to various data types. Include conversions to SINT, INT and DINT
DINT_TO_*	Converts DINT data type to various data types. Include conversions to BCD, B_BCD, W_BCD, D_BCD, BOOL, BYTE, WORD, DWORD, SINT, INT, REAL, LREAL, TIME, USINT, UNIT and UDINT
DWORD_TO_*	Converts DWORD data type to various data types. Include conversions to BOOL, BYTE, WORD, SINT, INT, DINT, REAL, USINT, UINT and UDINT
INT_TO_*	Converts INT data type to various data types. Include conversions to B_BCD, W_BCD, D_BCD, BOOL, BYTE, WORD, DWORD, SINT, DINT, REAL, USINT, UINT and UDINT
LREAL_TO_*	Converts LREAL data type to various data types. Include conversions to DINT, REAL and, UDINT
REAL_TO_*	Converts REAL data type to various data types. Include conversions to BOOL, BYTE, WORD, DWORD, SINT, INT, DINT, LREAL, USINT, UINT and, UDINT
SINT_TO_*	Converts SINT data type to various data types. Include conversions to B_BCD, W_BCD, D_BCD, BOOL, BYTE, WORD, DWORD, INT, DINT, REAL, USINT, UINT and UDINT
STRING_TO_*	Converts STRING data type to various data types. Include conversions to BYTE, WORD, DWORD, SINT, INT, DINT, REAL, TIME, USINT, UINT and UDINT
TIME_TO_DINT	Converts TIME data type to DINT
TRUNC_*	Converts REAL-type data to various data types by truncating digits after the decimal point. Include conversions to SINT, INT and DINT
USINT_TO_*	Converts USINIT data type to various data types. Include conversions to BOOL, BYTE, WORD, DWORD, SINT, INT, DINT, UINT, UDINT and REAL
UINT_TO_*	Converts UINT data type to various data types. Include conversions to BOOL, BYTE, WORD, DWORD, SINT, INT, DINT, USINT, UDINT and REAL
UDINT_TO_*	Converts UDINT data type to various data types. Include conversions to BOOL, BYTE, WORD, DWORD, SINT, INT, DINT, USINT, UINT, REAL and LREAL
W_BCD_TO_*	Converts BCD code of WORD data type to various data types. Include conversions to SINT, INT and DINT
WORD_TO_*	Converts WORD data type to various data types. Include conversions to BOOL, BYTE, DWORD, SINT, INT, DINT, REAL, USINT, UINT and UDINT

Table Numerical Functions

Function	Description
ABS	Absolute value
ACOS	Arc cosine
ASIN	Arc sine
ATAN	Arc tangent
COS	Cosine
EXP	Exponent
LN	Natural logarithm
LOG	Logarithm to the base of 10
SIN	Sine
SQRT	Square root
TAN	Tangent

Table Arithmetic Functions

Function	Description
ADD	Additor for ANY_NUM
ADD_T_T	Additor for TIME
DIV	Divisor for ANY_NUM
DIV_T_AN	Divisor for TIME
EXPT	Exponentiation
MOD	Modulo divisor
MOVE	Assignment
MUL	Multiplier for ANY_NUM
MUL_T_AN	Multiplier for TIME
NEG	Double complement
SUB	Subtractor for ANY_NUM
SUB_T_T	Subtractor for TIME

Table Bitwise Boolean Functions

Function	Description
AND	AND connection
NOT	Complement
OR	OR connection
XOR	XOR connection

Table Bit-string Functions

Function	Description
ROL	Rotate left
ROL_*	Rotate left for various data types including BYTE, WORD and DWORD
ROR	Rotate right
ROR_*	Rotate right for various data types including BYTE, WORD and DWORD
SHL	Shift left
SHL_*	Shift left for various data types including BYTE, WORD and DWORD
SHR	Shift right
SHR_*	Shift right for various data types including BYTE, WORD and DWORD

Table Selection Functions

Function	Description
LIMIT	Limitation
LIMIT_*	Limitation for various data types including INT, DINT, SINT, REAL and STRING
MAX	Maximum
MAX_*	Maximum for various data types including INT, DINT, SINT, REAL and STRING
MIN	Minimum
MIN_*	Minimum for various data types including INT, DINT, SINT, REAL and STRING
SEL	Binary selection
SEL_*	Binary selections for various data types including BOOL, BYTE, DINT, INT, SINT, REAL, STRING, WORD, DWORD and TIME

Table Comparison Functions

Function	Description
EQ	Comparison: =
GE	Comparison: >=
GT	Comparison: >
LE	Comparison: <=
LT	Comparison: <
NE	Comparison: <>

Table Character String Functions

Function	Description
CONCAT	Extensible concatenation
DELETE	Delete substring
EQ_STRING	Comparison: = for STRING
FIND	Find characters
GE_STRING	Comparison: >= for STRING
GT_STRING	Comparison: > for STRING
INSERT	Insert characters
LE_STRING	Comparison: <= for STRING
LEFT	Leftmost characters
LEN	String length
LT_STRING	Comparison: < for STRING
MID	Middle characters
NE_STRING	Comparison: <> for STRING
REPLACE	Replace characters
RIGHT	Rightmost characters

Table Bistable Function Blocks

Function block	Description
SR	Set dominant
RS	Reset dominant

Table Edge Detection Function Blocks

Function block	Description
F_TRIG	Falling edge detector
R_TRIG	Rising edge detector

Table Counter Function Blocks

Function block	Description
CTU	Up-counter
CTD	Down-counter
CTUD	Up-down-counter

Table Timer Function Blocks

Function block	Description
TP	Pulse
TON	On-delay timer
TOF	Off-delay timer

■ Bit Manipulation Functions

The table below lists the bit manipulation functions. These functions are provided with the “Bit_Util” library.

Table Bit Manipulation Functions

Function	Description
BIT_TEST	Reads the value of a single bit in a bit string
GET_CHAR	Extracts one character out of a string
GET_LSB	Reads the value of the less significant BYTE of a bit string
GET_MSB	Reads the value of the most significant BYTE of a bit string
I_BIT_IN_*	Inverts a single bit in a bit string. Available for various data types including BYTE, WORD and DWORD
PARITY_*	Checks if the number of set bits is even or odd. Available for various data types including BYTE, WORD and DWORD
R_BIT_IN_*	Resets a single bit in a bit string. Available for various data types including BYTE, WORD and DWORD
S_BIT_IN_*	Sets a single bit in a bit string. Available for various data types including BYTE, WORD and DWORD
SET_LSB	Writes a value on the less significant BYTE of a bit string
SET_MSB	Writes a value on the most significant BYTE of a bit string
STRING_TO_BUFFER	Copies characters of a string to a buffer
SWAP	Exchanges the most and the less significant BYTE of a bit string

■ FCN/FCJ Basic Function Blocks

The table below lists the FCN/FCJ basic function blocks.

Table FCN/FCJ Basic Function Blocks

Function block	Description
PAS_GET_POUINSTN	Acquires the instance name of POU.
PAS_GET_TASKSCAN	Acquires the scan period at which the task operates POU.
PAS_GETTIME	Acquires the local time.
PAS_GETTIME2	Getting current time on the millisecond scale and conversion.
PAS_SETTIME	Sets the local time.
PAS_MSG_UPRCALM	Issues the user-specified text as the process alarm.
PAS_MSG_USRALM	Transmits the user-specified text as an alarm.
PAS_MSG_USREVT	Transmits the user-specified text as an event.
PAS_START_ACT	Counts down the windup counter or handles the executable status flag of applications.
PAS_WUP_CHECK	Checks the windup status.
PAS_WUP_CT_INIT	Acquires the initial value of the wind-up counter.
PAS_UNIT_TO_BYTE	Converts the text of the engineering unit from STRING type to BYTE type.
PAS_UNIT_TO_STRING	Converts the text of the engineering unit from BYTE type to STRING type.
PAS_OPR_PRM_DWORD	A POU that operates each bit of DWORD type data.
SD_FIELD_LANCTRL	Changes the current Ethernet status.
SD_FIELD_LANGETSTS	Acquires the current Ethernet status.
SD_FIELD_ACCS_CTRL	Changing access control.
SD_CANSDO_ACCESS	CANopen SDO access
PAS_IS_OLDL_DONE	Detect Online Download execution.
PAS_GET_TASKDELAY	Get the delay time of the Online Download.
SD_CPU_REBOOT	Rebooting control side CPU module to switchover.
SD_COM_OPEN_ERR_DBG	Display parameter error message of Communication Task OPEN POU (For analysis).

Notice: These function blocks are provided with the “SD_FIELD_PF” library.

■ Inter-FCN/FCJ Communication Function Blocks

Inter-FCN/FCJ communication function blocks are used for communication between FCNs/FCJs. The table below lists the inter-FCN/FCJ communication function blocks.

Table Inter-FCN/FCJ Communication Function Blocks

Function block	Description	Remarks
CONNECT	Establishes the connection with the communication partner.	
USEND_1V	Sends data to the communication partner (Unconfirmed).	Sends one piece of data for a single request.
USEND_5V	Sends data to the communication partner (Unconfirmed).	Sends five pieces of data for a single request.
USEND_10V	Sends the data to the communication partner (Unconfirmed).	Sends ten pieces of data for a single request.
URECV_1V	Receives the data from the communication partner (Unconfirmed).	Receives one piece of data for a single request.
URECV_5V	Receives the data from the communication partner (Unconfirmed).	Receives five pieces of data for a single request.
URECV_10V	Receives the data from the communication partner (Unconfirmed).	Receives ten pieces of data for a single request.
WRITE_1V	Sends the data to the communication partner (Confirmed).	Sends one piece of data for a single request.
WRITE_5V	Sends the data to the communication partner (Confirmed).	Sends five pieces of data for a single request.
WRITE_10V	Sends the data to the communication partner (Confirmed).	Sends ten pieces of data for a single request.
READ_1V	Receives the data from the communication partner (Confirmed).	Receives one piece of data for a single request.
READ_5V	Receives the data from the communication partner (Confirmed).	Receives five pieces of data for a single request.
READ_10V	Receives the data from the communication partner (Confirmed).	Receives ten pieces of data for a single request.

Notice: These function blocks are provided with the "SD_FCXCOM_LIB" library.

■ FA-M3 Emulation (Serial Communication) Function Blocks

FA-M3 emulation (serial communication) function blocks emulate FA-M3 commands transmitted from higher level computers (or display equipment) connected to an FCN-RTU via the COM port and RS-232-C communication. The table below lists the FA-M3 emulation (serial communication) function block.

Table FA-M3 Emulation (Serial Communication) Function Blocks

Function block	Description
SD_CFAM3R_OPEN	Activates the FA-M3 emulation task to start RS-232-C communication

Notice: These function blocks are provided with the “SD_CFAM3R_PF" library.

■ Communication Utility Function Blocks

Communication utility function blocks provide functions to complement the various communication libraries. The table below lists the communication utility function blocks.

Table Communication Utility Function Blocks

Function block	Description
SD_CUTIL_TRIG	Generates communication request trigger
SD_CUTIL_W2DW	Converts two WORD type data into one DWORD type data.
SD_CUTIL_W2R	Converts two WORD type data into REAL type data.
SD_CUTIL_DW2W	Converts one DWORD type data into two WORD type data.
SD_CUTIL_DW2R	Converts one DWORD type data into REAL type data.
SD_CUTIL_R2W	Converts one REAL type data into two WORD type data.
SD_CUTIL_R2DW	Converts REAL type data into DWORD type data.
SD_CUTIL_WORDSWAP	Performs endian conversion of WORD type data.
SD_CUTIL_DWORDSWAP	Performs endian conversion of DWORD type data.

Notice: These function blocks are provided with the “SD_CUTIL_PF" library.

■ Ethernet Communication Function Blocks

Ethernet communication function blocks are used for communication between FCN-RTUs and equipment connected over an Ethernet network. The table below lists the Ethernet communication function blocks.

Table Ethernet Communication Function Blocks

Function block	Description
SD_FCXPE_OPEN	Communication task opening
SD_FCXPE_SENDRECV	Send-Receive Request
SD_FCXPE_UDPSEND	UDP Send-Only Request

Notice: These function blocks are provided with the “SD_FCXPLCE_PF" library.

■ Serial Communication Function Blocks

Serial communication function blocks are used for communication between FCN/FCJs and equipment connected using RS communications. The table below lists the Serial communication function blocks.

Table Serial Communication Function Blocks

Function block	Description
SD_FCXPM_OPEN	Communication Task Start Processing
SD_FCXPM_OPEN_EX	Expanded Communication Task Start Processing
SD_FCXPM_SENDRECV	Send/receive processing
SD_FCXPM_SEND	Send processing
SD_FCXPM_RECV	Receive processing
SD_FCXPM_GETCH	Channel Number Acquisition Processing
SD_FCXPS_OPEN	Communication Task Start Processing
SD_FCXPS_SENDRECV	Send/receive processing (Function block of the old version)
SD_FCXPS_SEND	Send processing (Function block of the old version)
SD_FCXPS_RECV	Receive processing (Function block of the old version)

Notice: These function blocks are provided with the “SD_FCXPLCS_PF" library.

4.1.4 Application Portfolios (APPF)

Yokogawa has taken its decades of expertise in configuring control functions and put them into libraries of software parts called capsules optionally offered as Application Portfolios. By selecting necessary capsules from a broad range, from basic capsules such as PID controller and manual loader blocks up to capsules tailored to a particular process and equipment, and modifying them for the controlled objects, a sophisticated control application can be built with ease and reliability. Using standard parts increases the efficiency of debugging and maintenance.

- **PAS Portfolio**
  A library of process control parts such as PID controller and switch instrument blocks
- **Communication Portfolios**
  Libraries of parts for communicating with PLCs such as Yokogawa FA-M3, Mitsubishi MELSEC, Modbus support device and DNP3 support device
- **Application-specific Portfolios**
  Libraries of parts for gas and liquid flow calculation

SEE ALSO

- For more information about the PAS portfolio, refer to “NPAS POU - Overview” (IM 34P02P25-01E).
- For more information about the communication portfolio, refer to “Application Portfolios for FCN/FCJ (FCN-500/FCN-RTU)” (GS 34P02P20-02E).
- For more information about the lists of devices compatible with communication portfolios, refer to “Lists of Devices Compatible with Communication Portfolios” (TI 34P02P21-01E).
- For more information about the DNP3 Communication Portfolio, refer to “DNP3 Communication Portfolio (FCN-500/FCN-RTU)” (GS 34P02P22-02E).
- For more information about the Gas Flow Calculation Portfolio, refer to “Gas Flow Calculation Portfolio (FCN-RTU)” (GS 34P02P31-02E).
- For more information about the Liquid Flow Calculation Portfolio, refer to “Liquid Flow Calculation Portfolio” (GS 34P02P33-01E).

4.1.5 FCN-RTU Duolet Application Development

Most of the information transmission functions achieved with FCN-RTU Duolet applications can be created with the information transmission package InfoWell, without programming. Functions that cannot be achieved with the information transmission package InfoWell must be developed as Duolet applications.

SEE ALSO

For more information about the InfoWell, refer to 2.3.1, “InfoWell.”

■ Development of Duolet Application by User

Oracle Java Development Kit (JDK, JDK 1.4.2) is used to develop a Duolet application and Yokogawa FCN/FCJ Duolet Application Development Kit provides the following libraries and functions required for application development:

- JADE Class Library

  A class library for executing and managing Duolet application multitasking
- JEROS Class Library

  A class library for system management
- Control Data Access Class Library

  A class library for accessing data for the control function

TIP

- Each of the above class libraries are to be installed and used on the PC used for development. They are included as standard in FCN-RTU.
- The Java Standard Class library accompanies Oracle Java Development Kit (JDK).

- Duolet monitor

  Enables users to remotely monitor and debug Duolet applications running in an FCN-RTU, from a Windows computer.
- JEROS emulator

  Emulates a JEROS system service under the Windows operating system for testing Duolet applications. (The JEROS emulator does not support control data access. To test Duolet applications which access control data, run them on the FCN-RTU.)

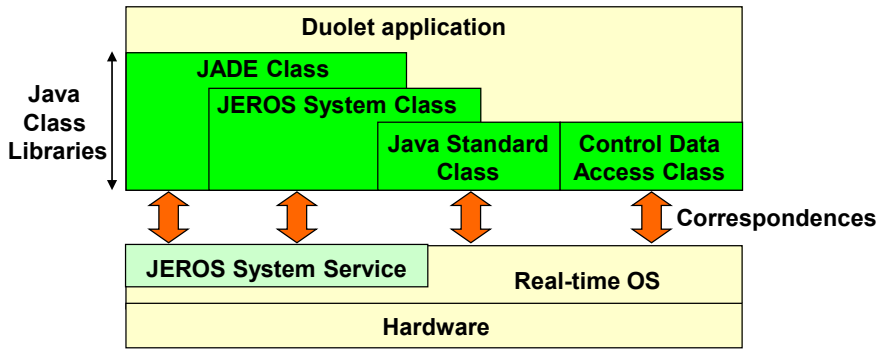


Figure Configuration of FCN-RTU Duolet Function

4.1.6 Settings of FCN-RTU by Web Browser

Use a Web browser in order to perform advanced information settings and operations related to FCN-RTU. This section describes the advanced settings of FCN-RTU that can be made using a Web browser.
The FCN-RTU maintenance homepage is organized as shown in the figure below.

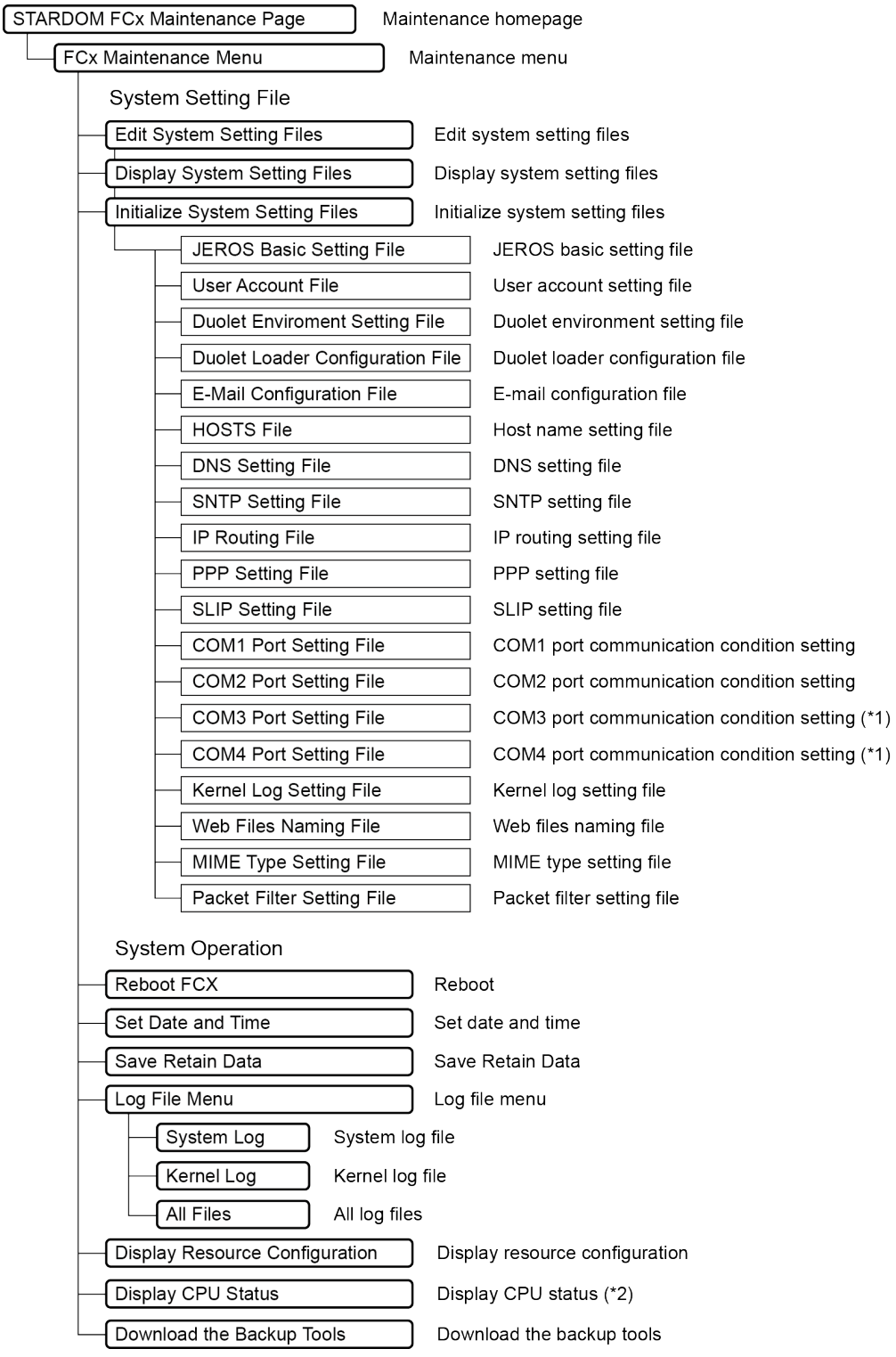


Figure Organization of FCN-RTU Maintenance Homepage

■ Maintenance Homepage

Once the Web browser is connected to the FCN-RTU, the maintenance homepage shown below is displayed. The attributes of the FCN-RTU shown below are displayed in this page.

- Host name
- IP address
- Subnet mask
- MAC address (PORT1)
- FCN/FCJ type
- Hardware serial number
- RS-422/485 Full/Half Duplex
- RS-422/485 Termination On or Off
- OS Version
- Boot ROM version
- JEROS version
- Memory capacity
- SRAM capacity
- On-board Flash Memory (Total)
- On-board Flash Memory (Free)
- Date and time
- Timezone
- Operation status (Maintenance or Online)

SEE ALSO

For more information about the Maintenance page, refer to the Help of each setting screen.

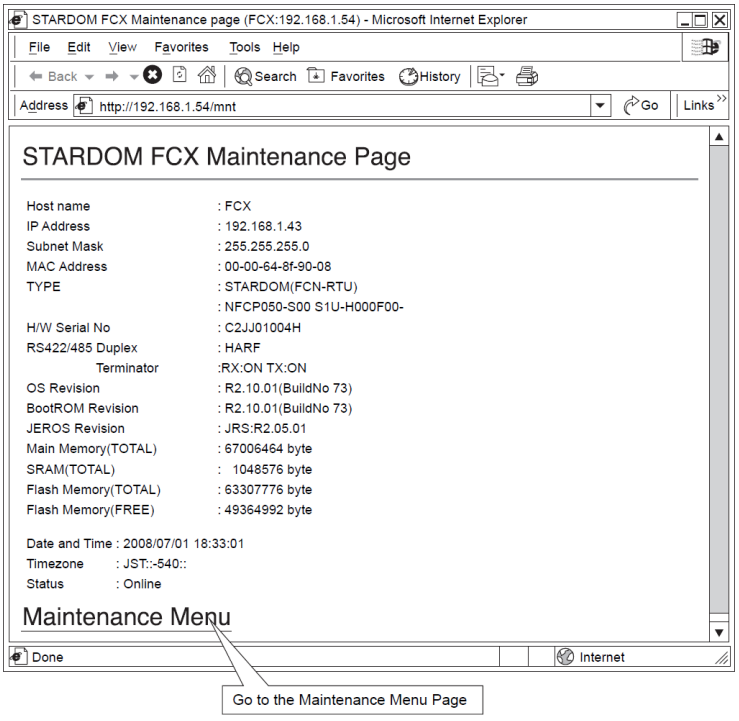


Figure Maintenance Homepage (example of FCN-RTU)

4.2 Procedure for Building FCN-RTU System

An FCN-RTU system is basically built according to the following sequence.

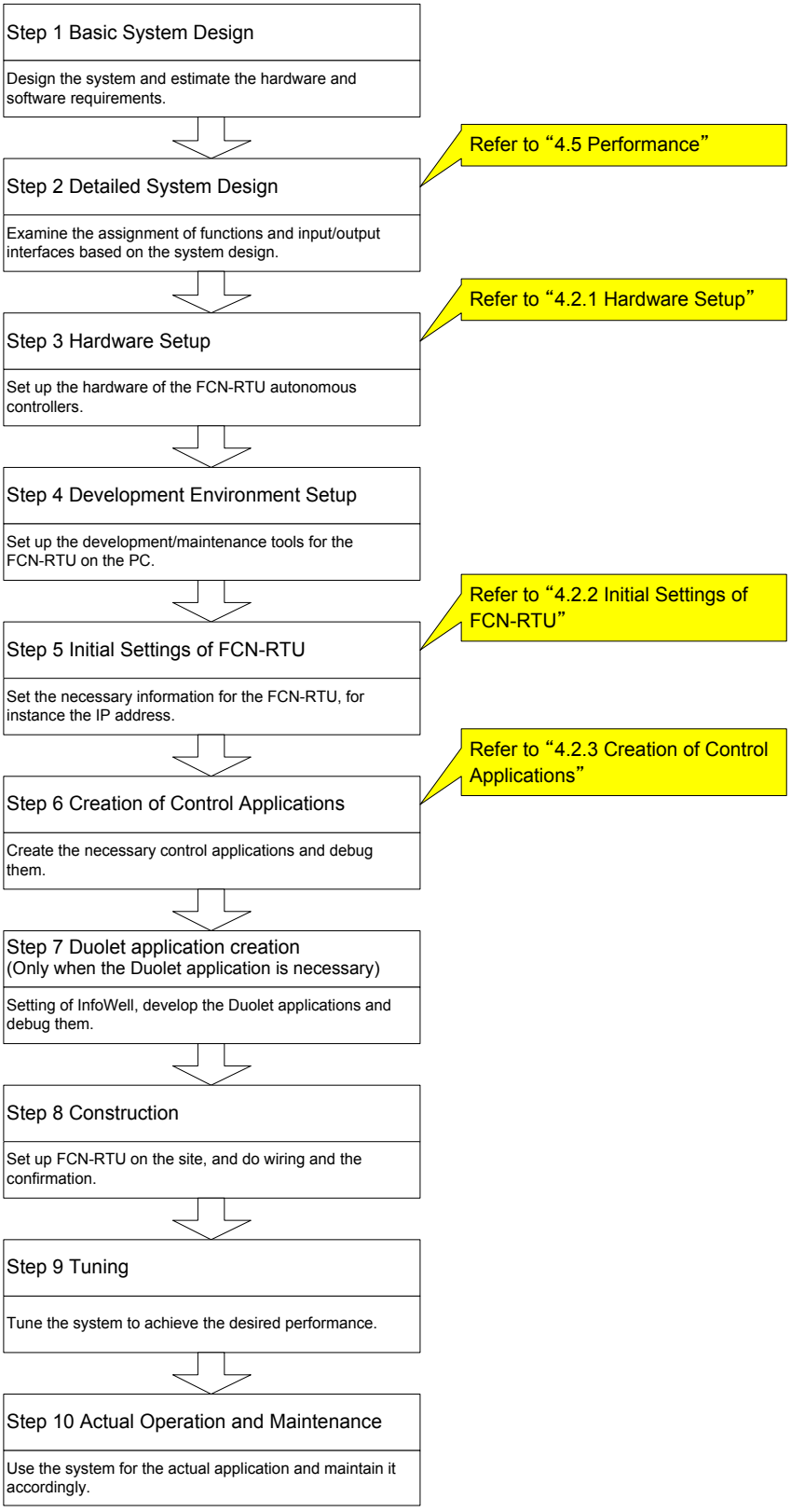


Figure Procedure for Building FCN-RTU System

4.2.1 Hardware Setup

This subsection describes the way of hardware initial settings required for the following modules.

- **NFBU200 Base Module (long)**
  Setting of unit number, setting of the number of CPU modules
- **NFAI141, NFAI143 Current Input Module**
  Power supply YES/NO setting according to the type of transmitter
- **NFAI841 Current I/O Module**
  Power supply YES/NO setting according to the type of transmitter
- **CPU Module for FCN-RTU (NFCP050)**
  RS-485 TX internal termination resistor ON/OFF setting
  RS-485 RX internal termination resistor ON/OFF setting
  RS-485 DUPLEX FULL/HALF setting

■ NFBU200 Base module Settings

The base module for FCN (NFBU200) has the following items that must be set:

- Setting of unit number
- Setting of the number of CPU modules

● Setting of Unit Number (SW1)

SW1 next to the P1 slot must be set according to the silk screen-printed diagram that corresponds to the unit number to be used. (Default factory setting: Unit 1)

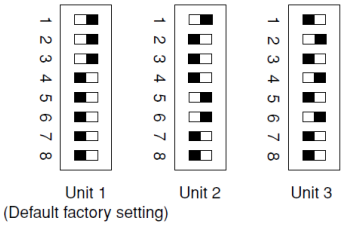


Figure Unit Number Settings (SW1)

● Setting of the Number of CPU Modules (SW2)

When installing NFCP050 CPU modules, set SW2 next to Slot2 to [Other] according to the silk screen-printed diagram. (Default factory setting: Other)

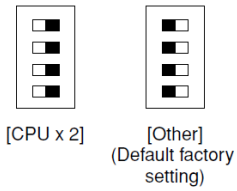


Figure Duplex CPU Module Setting (SW2)

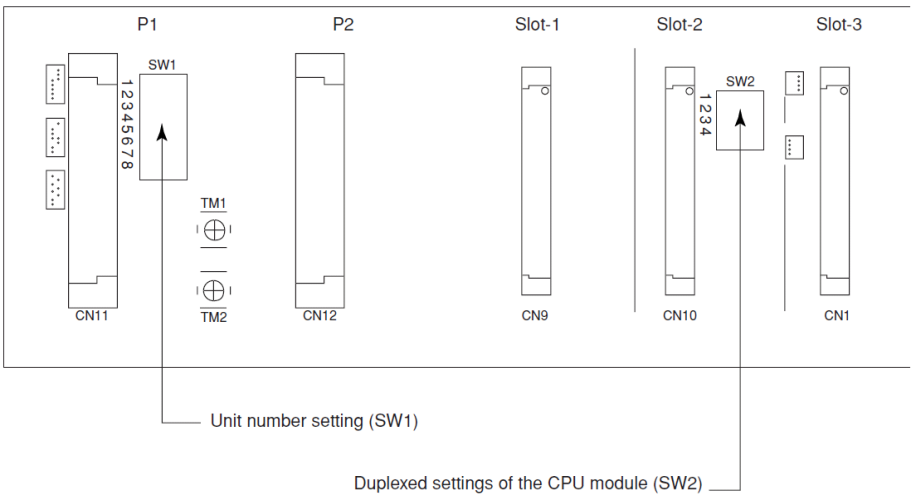


Figure Base Module Settings

■ CPU Module (NFCP050) Settings

The CPU module (NFCP050) has the following items that must be set:

- ON/OFF of RS-485 TX internal termination resistor (120 Ω)
- ON/OFF of RS-485 RX internal termination resistor (120 Ω)
- FULL DUPLEX (2-WIRE)/HALF DUPLEX (4-WIRE) of RS-485

● Hardware Setting for RS-485 (SERIAL 4)

In use of RS-485 (SERIAL 4), set these switch on side body of module according to conditions.

Table Disabling or enabilng internal termination resistor for TX and RX

Switch Name	Position	Function
TX	OFF	Disabling internal termination resistor (120 Ω) for TX
	ON	Enabling internal termination resistor (120 Ω) for TX (factory default)
RX	OFF	Disabling internal termination resistor (120 Ω) for RX
	ON	Enabling internal termination resistor (120 Ω) for RX (factory default)

Table Choice between half duplex or full duplex

Switch Name	Position	Function
DUPLEX	HALF (2-WIRE)	Half duplex (factory default)
	FULL (4-WIRE)	Full duplex

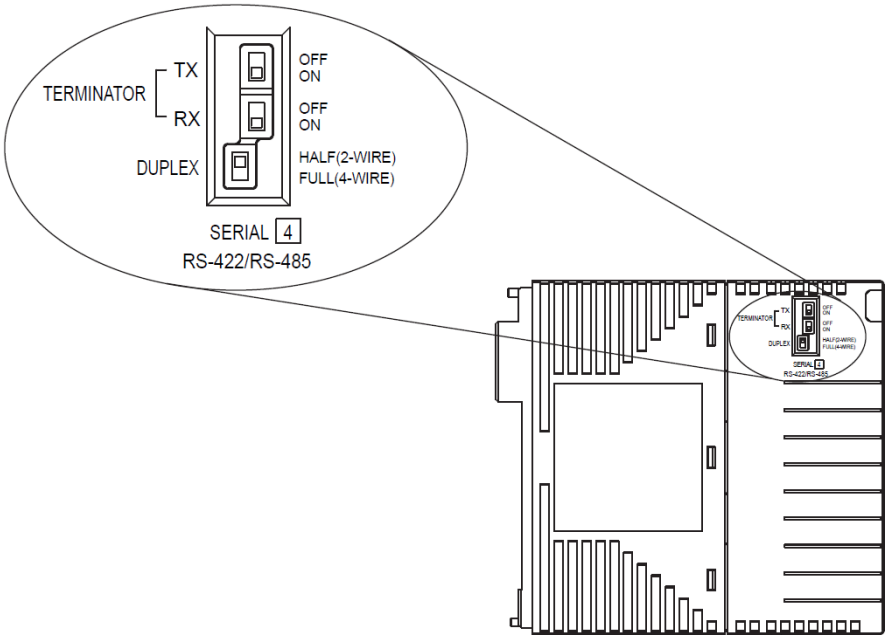


Figure Hardware Settings for RS-485 (SERIAL 4)

■ NFAI141, NFAI143 Settings

Whether to supply power to the connected transmitter is set by the setting pins of the current input modules (NFAI141 and NFAI143).

When 2-wire transmitter is connected, pin is set to “Enabling the power supply”.

When 4-wire transmitter is connected, pin is set to “Disabling the power supply”.

Pin numbers (1-16) correspond to the channel numbers.

As indicated in the figure below, the setting pins are located on the right surface of the NFAI141 and NFAI143 current input module.

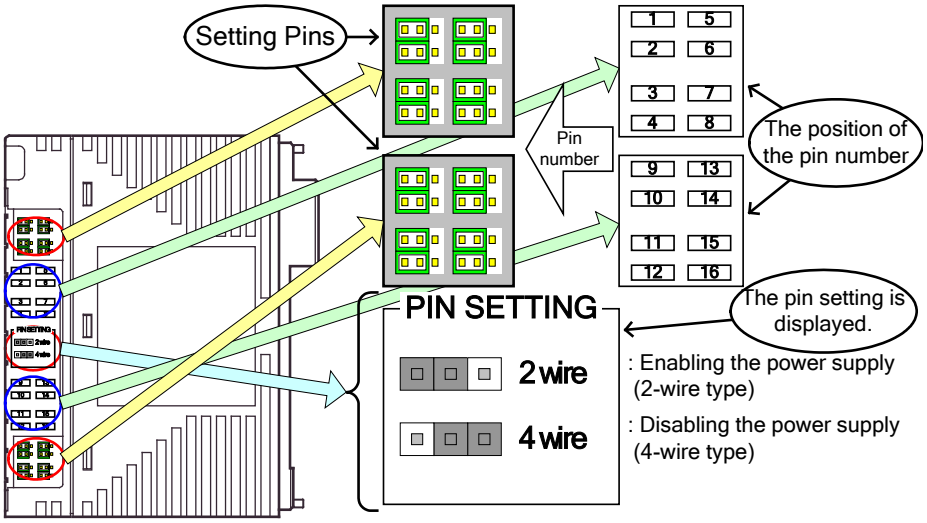


Figure NFAI141, NFAI143 Setting

■ NFAI841 Settings

Whether to supply power to the connected transmitter is set by the setting pins of the current input/output module (NFAI841).

When 2-wire transmitter is connected, pin is set to “Enabling the power supply”.

When 4-wire transmitter is connected, pin is set to “Disabling the power supply”.

Pin numbers (1-8) correspond to the channel numbers.

As indicated in the figure below, the setting pins are located on the right surface of the NFAI841 current input/output module.

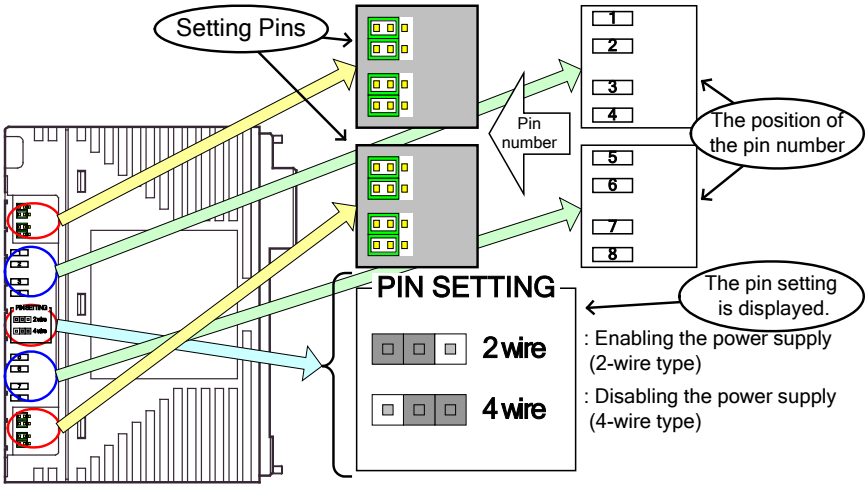


Figure NFAI841 Setting

TIP

Setting power supply is only valid to the input channels.

4.2.2 Initial Settings of FCN-RTU

Once the system design and initial settings of the hardware are completed, perform the initial settings of the FCN-RTU in the system.
The initial settings of an FCN-RTU can be achieved in the following sequence.

- **Step 1 Setting Network Information**

  When FCN-RTU are shipped from the factory, the information related to networking (IP address and net mask) has not been set. This information must be set using Resource Configurator before the FCN-RTU is used.
  The following information must be set:
  - IP address
  - Net mask
  - Subnet mask
  - Gateway
  - Time zone

  IMPORTANT

  The time zone is set to GMT by default. Make sure to change the time zone according to the area where the FCN-RTU is used.

- **Step 2 Reflecting the Setting**

  Once the network information is set, restart the FCN-RTU. The FCN/-RTU starts up with the new setting information.

- **Step 3 Connecting to the FCN-RTU**

  In Resource Configurator, specify the IP address specified above and establish a connection to the FCN-RTU. This allows performing further setting of the FCN-RTU from Resource Configurator.

- **Step 4 Basic Settings with Resource Configurator**

  Set the following information using Resource Configurator:
  - CPU module
  - I/O module

- **Step 5 Downloading Setting Information**

  Once CPU module, and I/O module settings have been made, the setting information is downloaded to the FCN-RTU.

● Step 6 Connecting via Web Browser

Specify the IP address of the FCN-RTU in the Web browser; it can now connect to the FCN-RTU.
It is necessary to place the FCN-RTU in the maintenance status in order to perform the settings from the Web browser. Reboot the FCN-RTU in the maintenance status.

SEE ALSO

- For how to connect to the FCN-RTU via a Web browser, refer to B2.2, “Connecting to FCN/FCJ Autonomous Controllers” in “STARDOM FCN/FCJ Guide” (IM 34P02Q01-01E).
- For how to reboot the FCN-RTU in the maintenance status, refer to B2.4.5, “Reboot” in “STARDOM FCN/FCJ Guide” (IM 34P02Q01-01E).

● Step 7 Setting via Web Browser

It is possible to perform various advanced settings of the FCN-RTU via the Web browser.

The main items that can be set via the Web browser include:

- Host name
- IP address
- Startup of DNS client
- Time zone
- User account

SEE ALSO

For more information about the settings that can be made via a Web browser, refer to B2.4, “Maintenance Menu” in “STARDOM FCN/FCJ Guide” (IM 34P02Q01-01E).

● Step 8 Restarting in Online Status

Once the settings above are completed, restart the FCN-RTU in the online status.

4.2.3 Creation of Control Applications

The control applications executed by FCN-RTU are created by Logic Designer. Perform the initial settings according to the following sequence.

SEE ALSO

For the detailed information on how to create a control application, refer to the “Programming Guide” in the Help of Logic Designer.

● Step 1 Preparation of Control Application Development Environment

Prepare the necessary equipment for the development environment. The main equipment includes:

- PC
- Software media (DVD-ROM)
- License of Logic Designer
- FCN-RTU
- Network environment for connecting the FCN-RTU and the PC

Once the development environment outlined above is prepared, Logic Designer can be installed on the PC.
The next and subsequent steps are performed using Logic Designer.

● Step 2 Creating a New Project

A control application is handled as a “project.”
The control application is developed by creating a new project and carrying out programming and various setting tasks using Logic Designer.
A project basically consists of the following components. Create and set these components in order to create the control application.

Table Main Components of Project

Component	Summary
Logic POU	A logic POU is a program that the user creates using an appropriate development language.
Task	A task is the executable (instantiated) form of the logic POU.
Library	A library is a collection of POUs (program organization unit) used when creating a logic POU. A library can be a standard or optional package (application portfolio), or a user created library.
Parameter	A parameter can be a global parameter (including a device label variable), and a local parameter.

● Step 3 Creating Tasks

Create tasks. When creating a task, specify an execution interval.

TIP

- A device label variable cannot be defined if a task is not created.
- When using tasks defined as the default, be sure to confirm that the execution cycle and other task definitions have been set correctly.

- **Step 4 Definition of Device Label Variables**

  A device label is a label assigned to each channel of an I/O module. Define a device label variables in order to access the corresponding device label from the control application program.

  SEE ALSO

  For the explanations about device labels and device label variables, refer to "■ Device Labels and Device Label Variables" in 4.3.4, "Input/Output Processing."

- **Step 5 Creation of Logic POU**

  A logic POU is created by combining POUs (program organization units). POUs are provided in libraries.
  POUs can be combined using the five types of development languages that are provided. They can be used according to the specific purpose.

- **Step 6 Task Assignment of Logic POU and Target Setting**

  Assign (instantiate) the created logic POU to tasks.
  Moreover, the IP address (or host name) is specified in the Target Setting dialog box.

- **Step 7 Compile and Download**

  Compile the created tasks, converting them to a format that can be downloaded to the FCN-RTU. Download the created control application to the target FCN-RTU.

- **Step 8 Debug**

  Debug the control application so that it runs correctly.
  The main methods for debugging include:
  - Online display of layout and online display of values
  - Setting break points
  - Watch window
  - Logic Analyzer
  - Software wiring

- **Step 9 Documentation**

  Print out the created control application as a document.

4.2.4 Precautions on the Creation of Control Applications

- **Precautions**
  - In the Target Setting dialog box, uncheck “The task aborts when the execution time of a task exceeds the watch dog time”
  - Recommend to set the task watchdog time to a value greater than the task interval
  - Use patch POUs only for debugging

4.3 Control Applications

Control applications are software created using Logic Designer and can be developed by choosing the most suitable programming language for each application or preference of the user from five languages compliant with the IEC 61131-3 international standard.

This chapter describes:

- **Control application structure**
- **Downloading a control application**

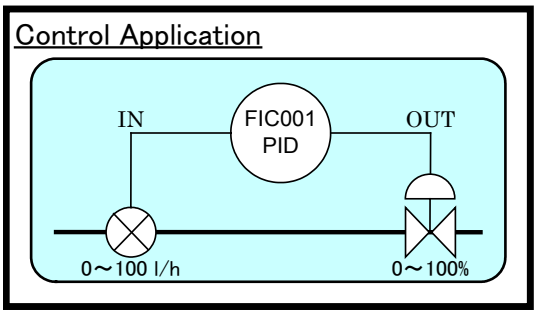


Figure Image of FCN/FCJ Control Application

TIP

For the overview and features of IEC 61131-3-compliant programming languages, refer to Programming Industrial Control Systems Using IEC 1131-3, Revised Edition (written by R. W. Lewis, published by The Institution of Electrical Engineers).

4.3.1 Control Application Structure

The structure of a control application is shown below.

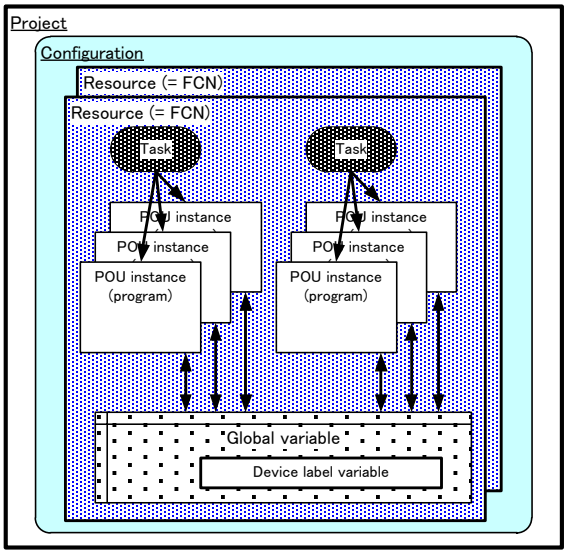


Figure FCN/FCJ Control Application Structure

■ Project (Control Application)

Control applications are handled in units called projects. A project is a unit in application development using Logic Designer.

■ Configuration

A project consists of one or more configurations. A configuration means an abstract unit of logically categorizing resources within a project. Normally, it is recommended to define only one configuration for a project though two or more can be defined.

■ Resource

A configuration consists of one or more resources. A resource means a program that is to be run on a single FCN and comprises multiple tasks and variables. Control applications in executable format are downloaded in units of resources.

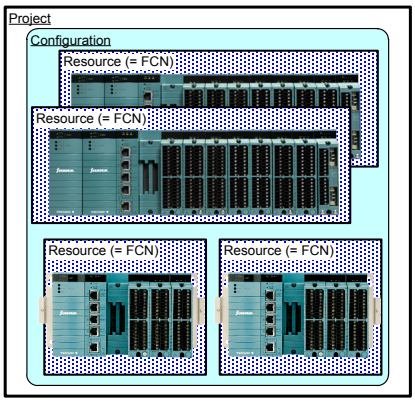


Figure FCN Control Application Structure (Image of Resource)

■ Task

A task is a unit for scheduling execution of control applications. There are one or more program instances under each task. Instantiating (associating) a program POU makes it a program instance. Tasks execute program instances according to their own operation settings. There are three types of tasks:

- **Cyclic**
  A cyclic task is run at a specified interval and is the most commonly used task. For each cyclic task, the execution interval (milliseconds), watchdog timer setting (milliseconds), and priority level need to be specified.
- **Default**
  A default task is run when all other programs are at rest, and is only used for a special purpose. For a default task, the watchdog timer setting (milliseconds) needs to be specified.
- **System**
  A system task is run when an error has occurred upon starting the corresponding FCN-RTU or in the operating system, and is only used for a special purpose.

TIP

- If a task has not finished within the watchdog timer setting, an error results.
- Tasks at the same priority level run in a time-sharing manner alternately at intervals of 30 milliseconds.
- A higher priority task is scheduled as an interrupt to lower priority tasks.
- Up to 16 tasks can be created.

SEE ALSO

For the detailed actions of tasks, refer to 4.3.3, “Task Schedule.”

■ Logic POU

Logic POUs are functional components composing a control application. There are three types of logic POUs:

- Programs
- Function blocks
- Functions

A logic POU typically consists of an assortment of functions and/or function blocks. Since a function block can be used within another function block, a control application can be structured hierarchically.
Logic POUs can be coded in any of the following five IEC 61131-3-stipulated programming languages. The user can choose the most suitable programming language for each application or his/her preference from those five languages when developing a logic POU as appropriate.

- SFC (Sequential Function Chart)
- FBD (Function Block Diagram)
- IL (Instruction List)
- ST (Structured Text)
- LD (Ladder Diagram)

- **Programs POU**

  A programs POU is a logic POU located at the top position in the hierarchical composition of logic POUs. By instantiating (allocating) this programs POU to a control task, POU can be activated.
  A functions POU or function blocks POU can be used when making a programs POU.

- **Functions POU**

  A functions POU is a POU with multiple inputs and only one output. It can be used by defining it inside of another POU. This POU does not have internal memory. Accordingly, the same output value will always be obtained if the input value is the same.
  Other functions POUs can be used when creating functions POUs.

TIP

Global variables cannot be used in functions POUs.

- **Function Blocks POU**

  A function blocks POU is a POU which can have multiple inputs and outputs. It can be used by defining it inside of another function blocks POU or programs POU. This POU has internal memory. By defining this POU inside of another POU, function blocks POU is instantiated and activated.
  Another function blocks POU or functions POU can be used when making a function blocks POU.

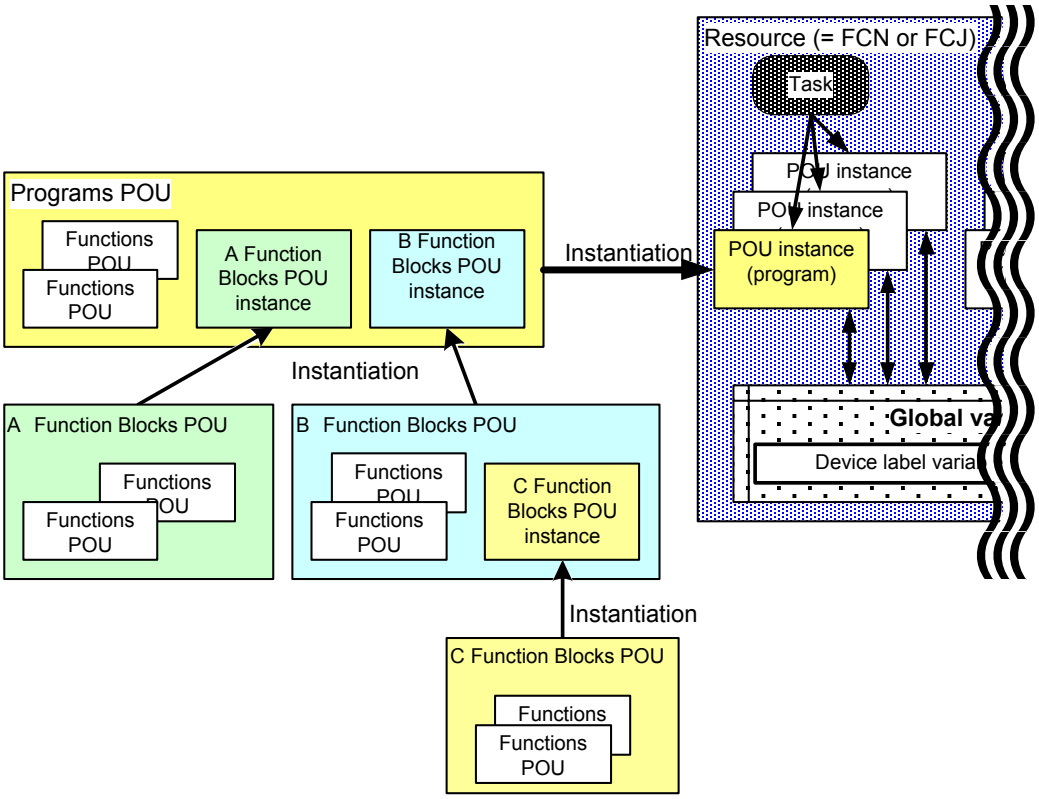


Figure FCN-RTU Control Application Structure

■ Local Variables versus Global Variables

Variables used in a control application are divided into two types by their scope of use as follows.

● Local Variables

The scope of use is limited to the local logic POU. Namely, local variables can be accessed from within only the logic POU that defines the local variables in question.

● Global Variables

The scope of use is limited to a resource. Global variables can be accessed from all POU instances running within the local resource.

- Device label variables
  Device label variables are special global variables expressing inputs and outputs but handled in the same way as other global variables.

TIP

In addition to the scope, variable used in a control application has a number of properties including:

- Retain property
  The value of a variable whose Retain property is set to on is retain when the power of the corresponding FCN-RTU is turned off and warmed start.
- OPC property
  The value of a variable whose OPC property is set to on can be read or written from outside the corresponding FCN-RTU and, Duolet application in FCN-RTU.

4.3.2 Downloading a Control Application

A control application is created using Logic Designer running on a PC, and the developed application is downloaded to FCN-RTUs. What to download can be specified in two ways:

- **Selected resource**
- **Entire source project**

■ Downloading a Selected Resource

Each resource within a control application corresponds to an FCN-RTU. Downloading a resource loads the corresponding programs as executable files. The download destination can be chosen from the following two:

1. Nonvolatile memory
   The resource is downloaded to nonvolatile memory in the target FCN-RTU. This method is used only for debugging of a control application. When that FCN-RTU restarts, the information downloaded to its nonvolatile memory will be completely cleared.
2. On-board flash memory
   Download an application which has finished being debugged, to the on-board flash memory in the target FCN-RTU. When that FCN-RTU restarts, the control application is copied from on-board flash memory to nonvolatile memory and runs.

TIP

Select Boot project when downloading a control application from Logic Designer to the on-board flash memory in an FCN-RTU.

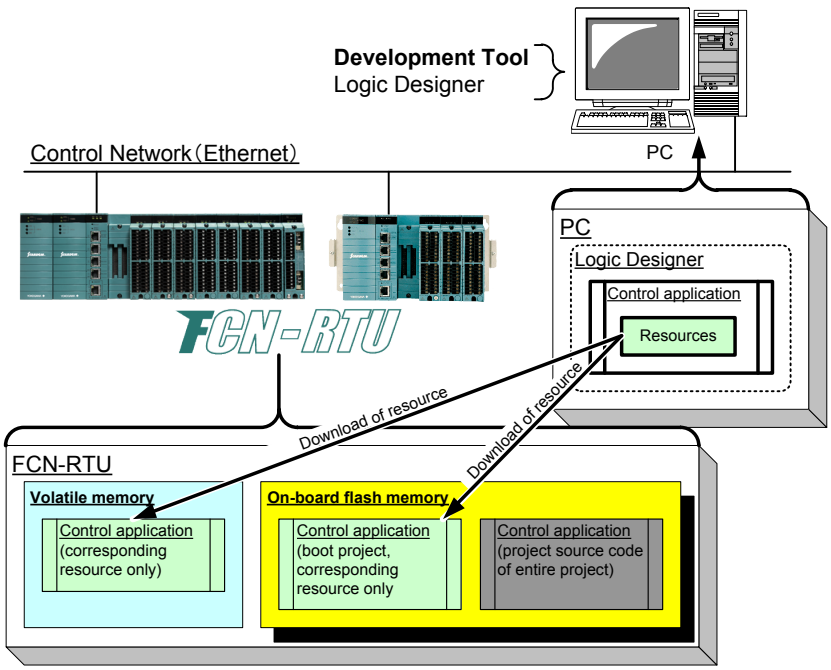


Figure Download Destinations

■ Downloading an Entire Source Project

The source code of the entire project of a control application is downloaded to the on-board flash memory in the selected FCN-RTU. This is used for backing up the control application. This downloaded project source code can be uploaded.

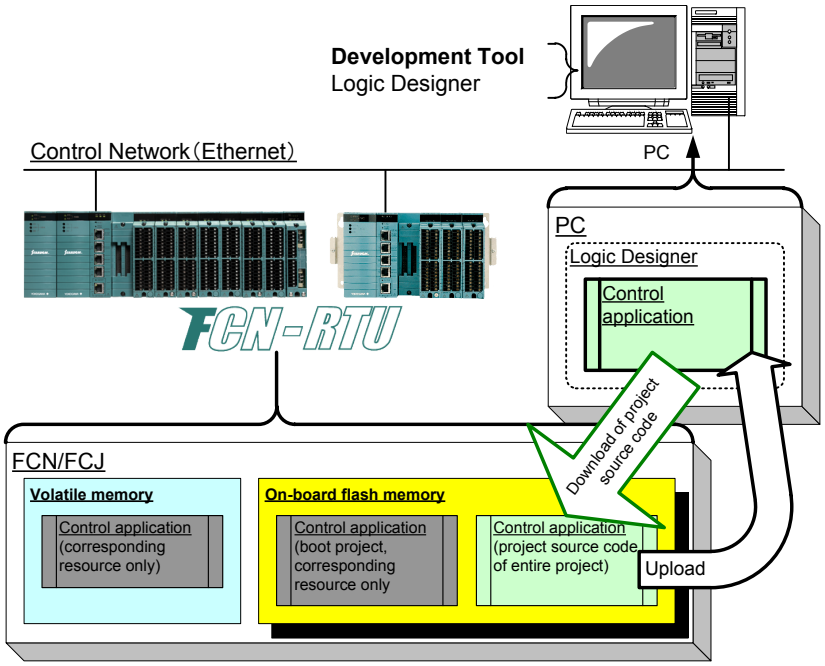


Figure Download Destinations

SEE ALSO

Logic Designer has an online download function which makes it possible to change control applications while continuing FCN-RTU control operation. For information about online downloading, refer to 6.3, "Online Download."

4.3.3 Task Schedule

Cyclic tasks (programs) created with the control application can be executed concurrently on FCN-RTU. Tasks in such cases operate according to the following rules.

- **A task at a higher priority level takes precedence in execution. (Execution of tasks at a lower priority level is interrupted.)**
- **Tasks at the same priority level run in a time-sharing manner alternately at intervals of 30 milliseconds.**
- **When starting execution, each task performs the input processing for the assigned inputs/outputs.**
- **When ending execution, each task performs the output processing for the assigned inputs/outputs.**
- **If a task has not finished execution within the specified time, it will be skipped at the next interval.**
- **Every execution period can be checked with a watchdog timer.**

The following describes these rules using examples.

■ Execution of Tasks at Different Priority Levels

A task at a higher priority level takes precedence in execution and interrupts tasks at a lower priority level. (Highest priority: 0, Lowest Priority: 31)
The following shows an example where three tasks at different priority levels run assuming that the total time period taken for each task to finish the specified actions is constant.

Table Example Tasks

Task Name	Priority Level	Execution Interval	Execution Period
Task-A	High (10)	100 milliseconds	50 milliseconds
Task-B	Medium (15)	300 milliseconds	100 milliseconds
Task-C	Low (20)	1000 milliseconds	100 milliseconds

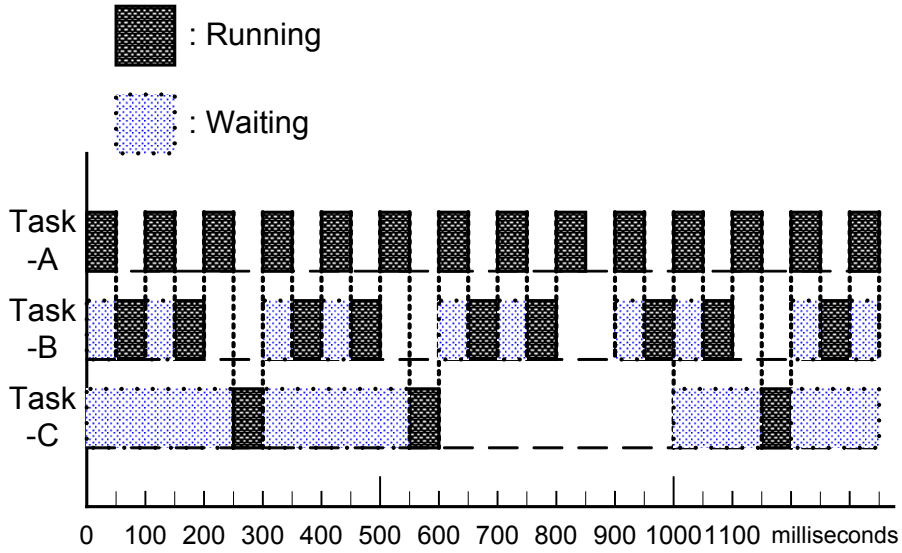


Figure Priority Levels and Task Execution Sequence

As shown in the figure, whenever Task-A at the high priority level starts, other tasks are interrupted and put into the waiting state.

■ Execution of Tasks at Same Priority Level

Tasks at the same priority level, if scheduled overlapping each other, run alternately at intervals of 30 milliseconds. The following shows an example where two tasks at the same priority level run assuming that the total time period taken for each task to finish the specified actions is constant.

Table Example Tasks

Task Name	Priority Level	Execution Interval	Execution Period
Task-A	Medium (15)	300 milliseconds	120 milliseconds
Task-B	Medium (15)	300 milliseconds	90 milliseconds

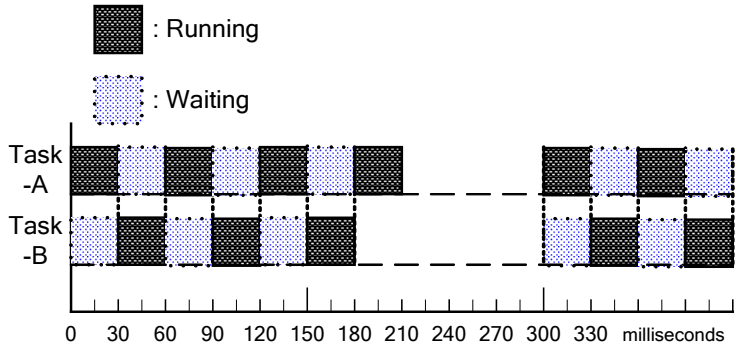


Figure Priority Levels and Task Execution Sequence

As shown in the figure, if two tasks at the same priority level are scheduled overlapping each other, they repeatedly run for 30 milliseconds and wait for 30 milliseconds.

■ Input/Output Processing Timings

In every complete cycle of a task, input processing for the assigned inputs is performed as the preprocessing, and output processing for the assigned outputs as the post-processing.

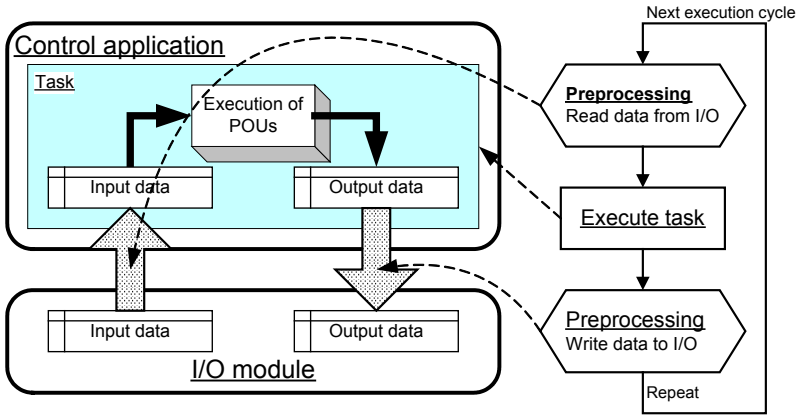


Figure Pre- and Post-processing of Task

TIP

Inputs and outputs are defined as device label variables using Logic Designer. When defining an input or output, the task(s) that uses it should be specified. When this task runs, the input and output processing is performed for the corresponding inputs and outputs.

■ What Happens If a Task Cannot Finish Execution within One Execution Cycle

The time taken by a task to finish execution is not always the same and may be prolonged depending on the program. If a task cannot finish execution within the specified execution cycle, it will be skipped at the next execution cycle.

Table Example Tasks

Task Name	Execution Interval	Execution Period
Task-A	0.5 second	Varies from 0.2 to 0.6 second

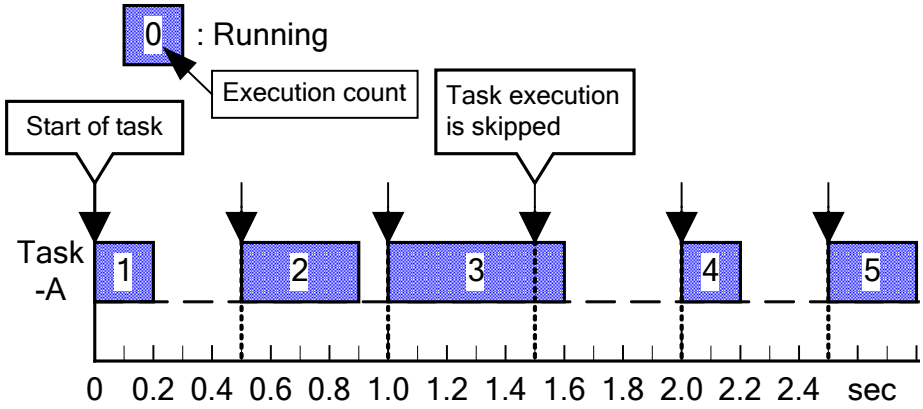


Figure What Happens If a Task Cannot Finish Execution within One Execution Cycle

As shown in the figure, if a task cannot finish execution within the specified execution cycle, it will not be run at the next execution cycle.

TIP

This occurs also if a task at a high priority is running and prevents a task at a lower priority from being executed.

■ Task Execution Cycle and Watchdog Time

Tasks can be monitored to determine whether or not they were executed within a specified amount of time (watchdog time).

Examples of the relationship between the task execution cycle and watchdog time are given below.

● When the task execution time exceeds the watchdog time

Table Example of Task Execution

Task Name	Task Execution Cycle	Task Execution Time	Task Watchdog Time
Task-A	0.5sec	Change from 0.2-0.6sec	0.5sec (*1)

*1: When the task execution cycle and the watchdog time are the same

1. When “The task aborts when the execution time of a task exceeds a watch dog time” checkbox is checked in the Target Setting dialog box

If the execution time of the task reaches or exceeds the watch dog time, and “The task aborts when the execution time of a task exceeds a watch dog time” has been checked in the Target Setting dialog box, an error is generated and the execution task aborts.

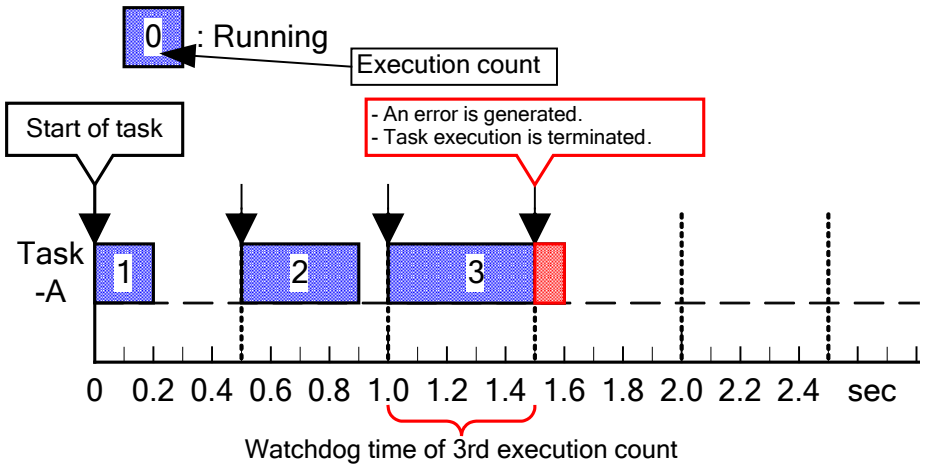


Figure Example of operation when the execution time of the task reaches or exceeds the watchdog time and the task is terminated

2. When "The task aborts when the execution time of a task exceeds a watch dog time" has not been checked in the Target Setting dialog box

If the execution time of the task reaches or exceeds the watchdog time, and "The task aborts when the execution time of a task exceeds a watch dog time" has not been checked in the Target Setting dialog box, an error is generated and the task is not executed in the next execution cycle, but the execution task does not abort.

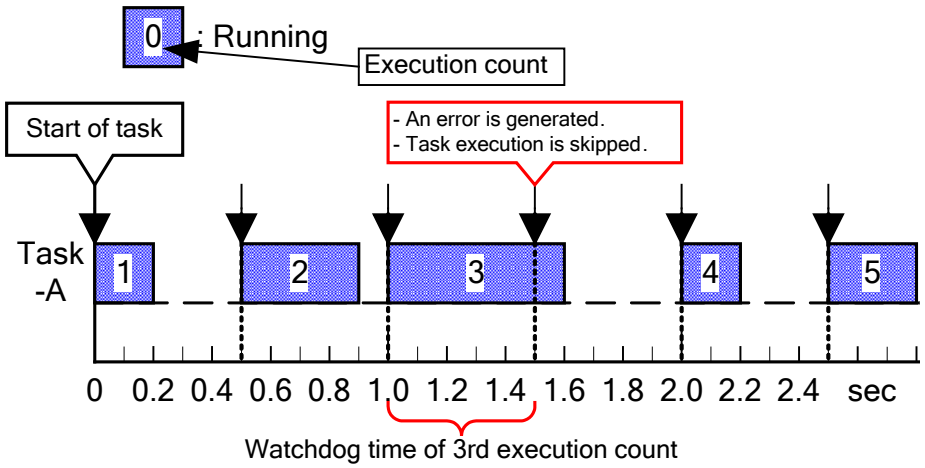


Figure Example of operation when the execution time of the task reaches or exceeds the watchdog time but the task is not terminated

• When the task execution time does not exceed the watchdog time

When the execution time of a task has reached or exceeded the execution cycle but task has been executed within the watchdog time, the task is not executed in the next execution cycle. However, no error is generated, because the watchdog time has not been exceeded.

Table Example of Task Execution

Task Name	Task Execution Cycle	Task Execution Time	Task Watchdog Time
Task-A	0.5sec	Change from 0.2-0.6sec	1.0sec (*1)

*1: When double the task execution cycle is the watchdog time

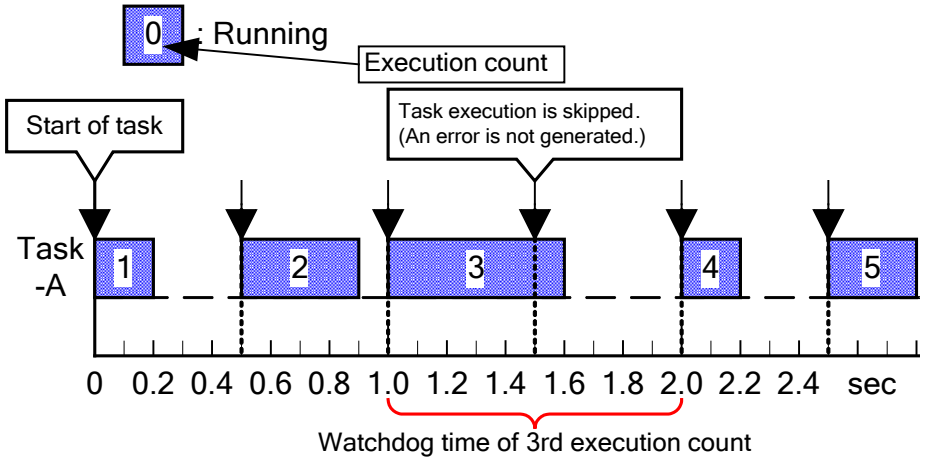


Figure Example of Task Execution within the Watchdog Time

■ CPU Overload

When CPU enters overload status in such case as the task execution time and the execution cycle match, Duolet applications and communication processes executed in free time will be unable to run.

If this CPU overload status continues for longer than 10 seconds, a CPU overload error is generated.
Please reconsider the control application execution time or other conditions if a CPU overload error occurs.

TIP

When a CPU overload error occurs, the following log is stored in the FCN-RTU log file.

Example) CPU overload log

```
2007/06/15 09:20:25,……,Msg=Exception(CPU Overload) in
Task0,
```

● Circumstances in which a CPU overload error occurs

CPU overload errors occur mainly in the following circumstances.

- Pattern 1: When task execution time and the execution cycle match
  When task execution time and the execution cycle match, the CPU free time becomes zero. Because the task execution cycle and watchdog time match, no watchdog error is generated.
  If this status continues for 10 seconds or more, a CPU overload error is generated.

Table Pattern 1: Example of a case in which the task execution time and execution cycle match

Task Name	Task Execution Cycle	Task Execution Time	Task Watchdog Time
Task-A	1.0 sec	1.0 sec	1.0sec

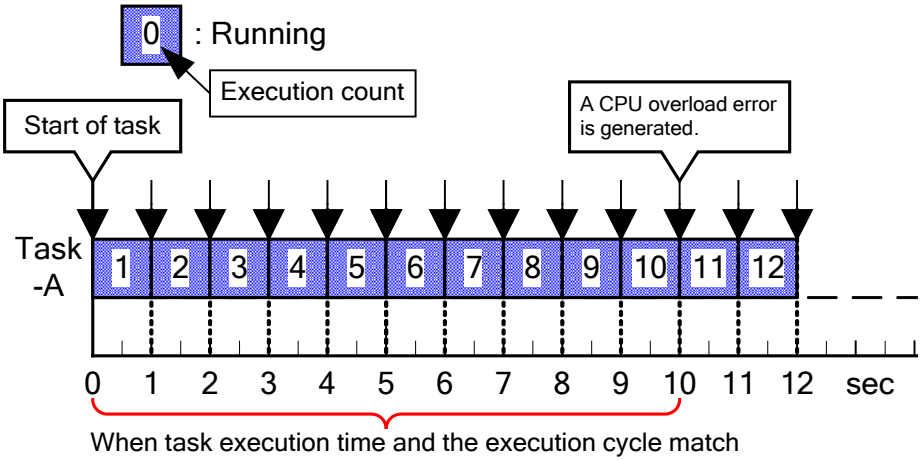


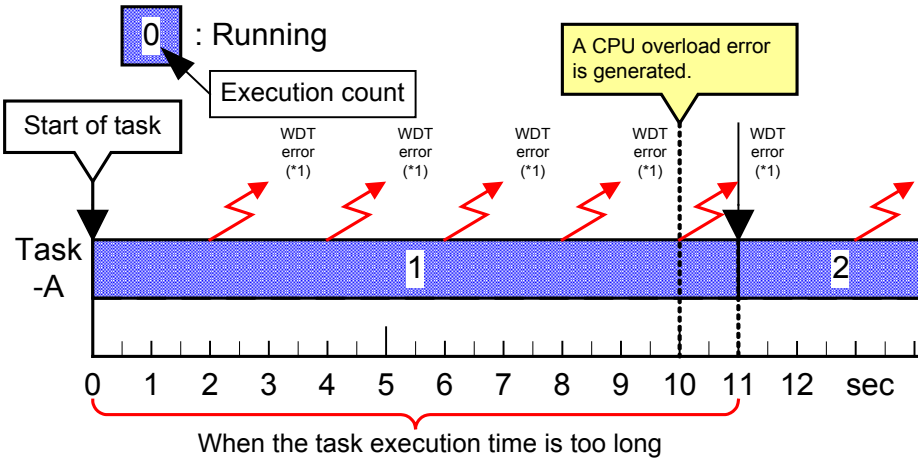
Figure Pattern 1: Example of operation when the task execution time and execution cycle match

- Pattern 2: When the task execution time is too long

  If the execution time for one task continues for 10 seconds or longer, a CPU overload error is generated.
  A watchdog error is generated for each watchdog time.

Table Pattern 2: Example of a case in which the task execution time is too long

Task Name	Task Execution Cycle	Task Execution Time	Task Watchdog Time
Task-A	2.0 sec	11.0 sec	2.0sec



*1: WDT error: A watchdog error is generated.

Figure Pattern 2: Example of operation when the task execution time is too long

TIP

The following are causes of CPU overload errors.

- Repetitive processing of a control application does not end.
  (Example: mistakes in for statement, jump and label of ST language read an application to go into an infinite loop, etc.)
- Processing of a task at a higher priority than the control application was continuously conducted.
  (Example: A device on the Ethernet continued broadcast communication, etc.)

- **Operation when a CPU overloads**

  The following functions will not operate when the CPU is in overload status.

  1. FCN-RTU Ethernet functions
  - Communication with the VDS data server
  - Communication between FCN/FCJ
  - Communication between devices using Modbus and other Ethernet communication or serial communication
  - Operation/setting from Logic Designer or Resource Configurator, etc.

  2. FCN-RTU Doulet functions
  - InfoWell functions
  - User-created Duolet applications, etc.

4.3.4 Input/Output Processing

This chapter describes the concept of input/output processing for functionally linking the hardware (input/output terminal) and software (a control application), and the input/output data update timings.

■ Device Labels and Device Label Variables

A device label and device label variables, which need to be specified for each of the inputs and outputs of an FCN-RTU to allow their data to be read and written, are explained below.

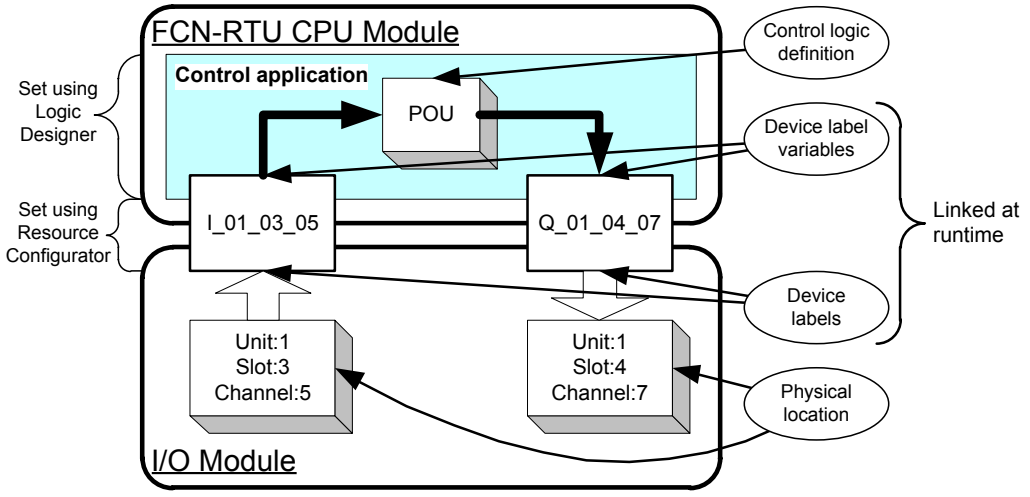


Figure Relationship between Device Labels and Device Label Variables

● Device Labels

Device labels are names assigned to individual physical input/output channels. Resource Configurator is used to set and modify device labels.

TIP

- Device labels are character strings which begin with a letter of the English alphabet or an underscore ("_") and contain a maximum of 16 alphanumeric characters and underscores ("_").
- By default, the following device label is set for each channel and can be used as is:

  FCN: x_uu_ss_cc (where x = signal type [I for input, or Q for output]; uu = unit number; ss = slot number; cc = channel number)

● Device Label Variables

Device label variables are names used to logically reference individual input/output channels when creating a control application using Logic Designer. Use of logical I/O channel names allows the users to develop a control application without considering their actual physical addresses. Device label variables are specified also using Logic Designer.

● Links between Device Labels and Device Label Variables

A device label and a device label variables that has the same name are linked to each other and this link is established when the control application starts running. Since the links between the control application and the physical I/O channels do not need to be established before runtime, the control application can be developed independently of I/O definition.

■ Input/Output Data Update Timings

The CPU module of an FCN-RTU carries out processes synchronously with execution of the control application in the following order:

1. Data input from I/O modules
2. Execution of control application
3. Data output to I/O modules

Whereas, each I/O module performs input/output processing asynchronously with the CPU module. This means that the input/output data updates may be delayed by a maximum of an entire cycle depending on the timings. To avoid this, the data acquisition cycles of I/O modules need to be taken into account when developing a control application.

SEE ALSO

For information about control application input/output response time, refer to 4.5.4, “Input/Output Processing Performance.”

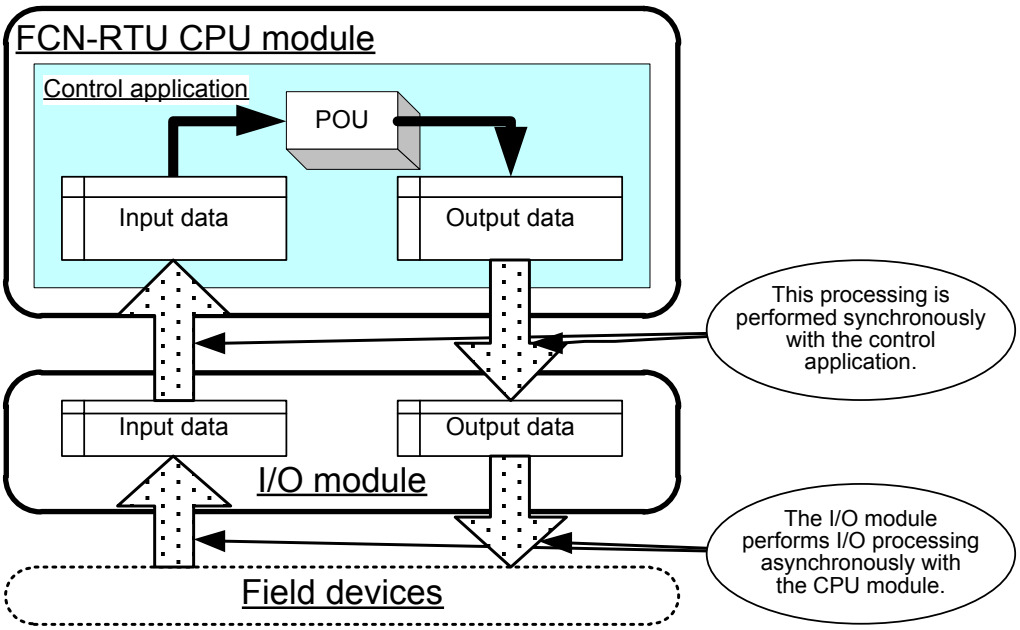


Figure I/O Data Update Timings

4.3.5 Retentive Variables

Retentive variables are those variables whose Retain property is set to on. Normally, the variables whose values need to be retain during power failures should be specified as retentive variables. This chapter describes:

- **Locations where values of the retentive variables reside**
- **Continuity of retentive variables' values**
- **Relationship between initialization of variables and start mode**

TIP

The variable's "retain" property is set to ON by default in the PAS POU access parameters and engineering parameters.

■ Locations Where Values of Retentive Variables Reside

The values of retentive variables reside in:

- Nonvolatile memory (depending on CPU module settings)
- Volatile memory (depending on CPU module settings)
- On-board flash memory (reserved for backup)

● In Nonvolatile Memory

If the Enable Hard-backup for returned data check box is selected in the CPU module settings, the values of the retentive variables of the currently running control application are stored in nonvolatile memory.

TIP

- Nonvolatile memory requires a longer access time than volatile memory, so POUs using retentive variables, if any, slow down the execution speed of the control application.
- Even if "Enable hard-backup for retain data" is selected, when the next control is started (power source restarted or warm start), if the retain structure requested by the application does not match the retain data in the non-volatile memory, the retain data is restored to the On-board flash memory in FCN-RTU.

● In Volatile Memory

If the Enable Hard-backup for returned data check box is not selected in the CPU module settings, the values of the retentive variables of the currently running control application are stored in volatile memory. As it is volatile memory, the retentive variables will be set a system default when the power is turned off.
However, the initial value of the retentive variable is set for retentive variables for which the initial value is set with the control application.

TIP

- If a backup of retentive variables resides in the On-board flash memory in FCN-RTU, its contents will be restored when the control restarts (next time when the power is turned on or warmed start). If the Enable Hard-backup for returned data check box is not selected in the CPU module settings, make a backup of the values of the retentive variables to the On-board flash memory periodically to assure continuity of their values.

- **In On-board flash memory**

  Data retain in memory can be backed up to the On-board flash memory in FCN-RTU. The backup can be performed using the following methods.

  - Execute the backup by setting the interface flag (retain data save switch: GS_RETAIN_SV_SW) to ON. (*1, *2)
  - Execute the backup from “Save Retain Data” on the FCN/FCJ maintenance screen.

*1: The following methods can be used to set the save switch of the retain data to ON.
- Set the switch to ON manually using the Logic Designer debugging mode.
- Create an application to set the interface flag to ON, and execute it.

*2: When the save switch of the retain data is set to ON, the save of the retain data begins.
When the save of the retain data has been completed, the setting automatically changes to OFF.

■ Continuity of Retentive Variables’ Values

System actions for restoring the backup values of retentive variables highly depend on the status of the loaded control application. The following describes system actions of restoring retentive variables’ values, and continuity of those values.

■ When Retentive Variable Area Is in Initial State

If the power to an FCN-RTU is turned on when the retentive variable area is in the initial state (such as when the CPU module is in the initial state, after the nonvolatile memory backup battery has been removed, or after the power to an FCN-RTU was turned off with the Enable Hard-backup for returned data check box not selected in the CPU module settings), the retentive variables are handled in either of the following manners:

- **If On-board Flash Memory in FCN-RTU Does Not Contain a Backup of Retentive Variables**

  The initial value of the retentive variable is set for retentive variables for which the initial value is set with the control application. The system default value is set for other variables.

- **If On-board Flash Memory in FCN-RTU Contains a Backup of Retentive Variables**

  1. The system default value is set for each retentive variable.
     The initial value of the retentive variable is set for retentive variables for which the initial value is set with the control application.
  2. The values backed up in the on-board flash memory in FCN-RTU are restored in the respective retentive variables.

  Namely, the backup values are restored as far as possible.

■ When Retentive Variable Area Is Not in Initial State

If the power to an FCN-RTU is turned on or warmed start when the retentive variable area is not in the initial state (such as after the power to an FCN-RTU was turned off with the Enable Hard-backup for returned data check box selected in the CPU module settings), the retentive variables are handled in either of the following manners:

● Upon Restart with No Change to Retentive Parameter Configurations (Quantity, Data Types, etc.) after Control Stoppage

When control restarts with no change made to the quantity or data types of the retentive parameters (such as when there has been no change to the control application or when there have been changes but they affect neither the quantity nor data types of the retentive parameters), the control application starts with using the contents of the retentive parameter area as they are.

● Upon Restart with Changes to Retentive Parameter Configurations (Quantity, Data Types, etc.) after Control Stoppage

When control restarts with changes made to the quantity or data types of the retentive parameters, restoration takes place in the order below:

1. The system default value is set for each retentive variable.
   The initial value of the retentive variable is set for retentive variables for which the initial value is set with the control application.
2. The values backed up in the on-board flash memory in FCN-RTU are restored in the respective retentive variables.
   Restoration will not be conducted if there is no backup.

■ Relationship between Initialization of Retentive Variables and Start Mode

During debugging using Logic Designer, the start mode of the control engine should be chosen from three: cold start, warm start, and hot start. The biggest difference between these three modes is the initialization of variables. The table below summarizes the initialization of variables depending on the start mode of the control engine.

Table Initialization of Variables and Start Mode of Control Engine

Start Mode	Usual Variables	Retentive Variables	Remarks
Cold start	Initialized: · Those variables for which the initial value is specified are reset to the initial values. · Those variables for which the initial value is not specified are set to the defaults (zeros).	Initialized: · Those variables for which the initial value is specified are reset to the initial values. · Those variables for which the initial value is not specified are set to the defaults (zeros).	
Warm start	Initialized: · Those variables for which the initial value is specified are reset to the initial values. · Those variables for which the initial value is not specified are set to the defaults (zeros).	The values are retain. (*1)	(*2)
Hot start	The values are retain.	The values are retain.	Resetting or downloading the control application after the application has stopped, disables a hot start.

*1: Initialized if there is a change to the configurations of the retentive parameters residing in nonvolatile memory. If the retentive parameter values have been saved, the saved values will be restored after initialization.

*2: If the Enable Hard-backup for returned data check box is not selected in the CPU module settings, the values of the retentive variables of the currently running control application are stored in volatile memory. For information about actions when retentive variables are stored in volatile memory, refer to "● In Volatile Memory" in "■ Locations Where Values of Retentive Variables Reside" within this chapter.

TIP

- Turning on the power (i.e., starting a controller with the boot project) always causes a warm start.
- Even if the online download function is used to change the control application, the values are retain for non-retentive variables and retentive variables.
  However, the values are not retain for variables for which the variable name or data type have been changed.

4.4 Function Specifications

The table below shows the function specifications of the CPUs for the FCN-RTU. For your information, refer to also the guideline for the control application capacity, and an example of maximum configurations.

Table CPU Function Specifications

Execution speed	Approx.50 µs per kilo step (in an IL program)
Number of control applications	Max.16 tasks
Task priority	Can be specified (in 16 levels)
Control cycle	10 ms or longer (in 10 ms-increments)

*1: When using the I / O module, task execution cycle is recommended more than 20 msec.

Table Function Specifications

Control application capacity	Max.3 Mbytes (approx.360 kilo steps in an Instruction List program)
Data area (*1)	Max.8 Mbytes
Retain data (*2)	Max.350 Kbytes
Duolet application capacity	Max.32 Mbytes

*1: The data is not retained when the power is off.

*2: The data is retained even if the power is off. The data is retained during a power failure (can be used to store tuning parameter settings for the control application).

SEE ALSO

For more information about control application capacity, refer to 4.5.2, “Calculation of Control Application Capacity.”

■ Maximum Available Functions

- **Loop control: 512 blocks**
  - Regulatory control blocks (e.g., indicators and controllers): 128
  - Others (e.g., calculation, switch instrument, and PLC communication blocks): 384
- **Sequence: 180 kilo steps in Ladder Diagram**
  - Approx.128 sequence tables (with 32 conditions and 32 actions for each)
- **Example of a control application**
  - Inputs/outputs: 96 AIs, 32 AOs, 256 DIs, and 256 DOs
  - PID loops: 32
  - Sequence program: 128 sequence tables
  - Control cycle: 1 second

4.5 Performance

This chapter describes the execution speed, etc., of FCN-RTU control applications.

4.5.1 FCN-RTU Scan Cycle and Control Cycle

FCN-RTU control functions are executed according to a fixed cycle defined for each task. This cycle is called the scan cycle. Reading from the I/O module to the CPU and writing from the CPU to the I/O module are executed for each of these scan cycles.
The NPAS POU processing is executed at the time by integral multiples of "scan cycle."
The cycle for executing this control computation is called the control cycle. The control cycle can be set either "for each NPAS_POU" or "processing for each FCN-RTU." However, to respond promptly to problems with input signals, etc., and to conduct display to HMI, alarm processing and input/output processing are conducted for each scan cycle.

Table Control Function Operation (CPU)

No.	Processing			Execution Timing	Remarks
<1>	Reading from the I/O module to the CPU			For each scan cycle	Driver program
<2>	NPAS_POU processing	(1)	Input processing	For each scan cycle	
		(2)	Control computation processing	For each control cycle	
		(3)	Alarm processing	For each scan cycle	
		(4)	Output processing	For each scan cycle	
<3>	Writing from the CPU to the I/O module			For each scan cycle	Driver program

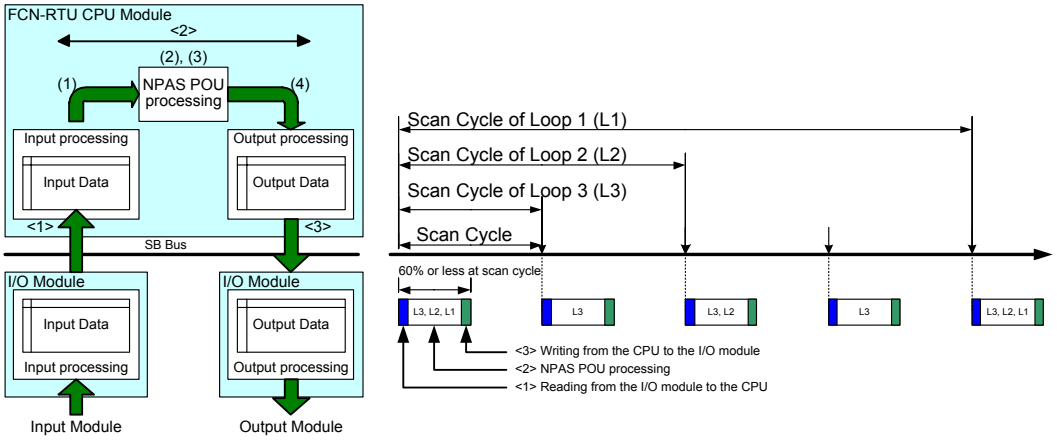


Figure CPU Control Function Operation, Scan Cycle, and Control Cycle

- **Scan cycle setting**

The scan cycle is determined when the task is created. The scan cycle can be set in 10 ms units beginning at 10 ms. The optimum scan cycle is determined, taking into consideration process attributes, performance, etc.

Notice: When using the I/O module, task execution cycle is recommended more than 20 msec.

4.5.2 Calculation of Control Application Capacity

The maximum storage capacity of control application programs is prescribed according to the following 3 types of capacity.

1. **Control application capacity: 3 Mbytes**
   The size of the memory which holds the main part of the control program written with NPAS_POU, etc. (Approximately 360 Ksteps with IL language conversion)
2. **ADLST capacity: 4 Mbytes**
   ADLST is an acronym for the application data list. ADLST capacity is the size of the variable area.
3. **Retain data capacity: 350 Kbytes**
   Retain data is an abbreviation of the retentive variable, and is the data that is retain during a power down.

■ Approximation Method when Using NPAS_POU

Of the three aforementioned types of capacity restriction, the effect of the restrictions on ADLST capacity and retain data capacity is the most significant. (The reason is that, even if NPAS-POU is used to the upper limit of ADLST capacity, it will only be about 15% of the program capacity.) Accordingly, ADLST capacity and retain data capacity are calculated and confirmed as shown below.

● ADLST capacity calculation

ADLST capacity is calculated using the following calculation formula, referring to the table below.

ADLST capacity = fixed size (approximately 17 Kbytes)
+ total NPAS_POU ADLST size
+ total ADLST size of the variable checked for OPC

Table NPAS POU ADLST size (estimate)

Type	NPAS_POU Name	Estimated ADLST Size (Bytes)
Continuous Control	NPAS_PVI	8,000
	NPAS_PID	17,000
	NPAS_MLD	5,000
	NPAS_MID_PB	8,000
	NPAS_RATIO_RT	13,000
	NPAS_PG_L30_BP	7,000
	NPAS_VELLIM_PB	9,000
Mathematical	NPAS_FUNC_VAR	6,000
	NPAS_BDBUF_R/T	1,000
Sequence	NPAS_SO_2	4,000
	NPAS_SIO_22	6,000

Note: Program instance names are calculated with 4 characters, and POU instance names with 6.

Table Total ADLST Size of the Variable Checked for OPC (estimate)

Type	Variable Data Type	Estimated ADLST Size (Bytes)
Variable Checked for OPC	BOOL	160
	REAL	160
	STRING	160
	CData_REAL	160
	Dtag_I_Anlg/_O_Anlg	160
	Dtag_I_Sts/_O_sts	160

Note: Program instance names are calculated with 4 characters, and variable names with 6.

- Calculation Example:

  When NPAS_PVI x 100, NPAS_PID x 50, variables checked for OPC x 20

  ADLST size = 17,000 + 8,000 x 100 + 17,000 x 50 + 160 x 20
  = 1,670,200 Bytes < 4 Mbytes

● Retain data capacity calculation

Retain data capacity is calculated using the following formula and the table below.

Retain data capacity = total NPAS_POU retain data size
+ total retain data size of variables checked for retentive variables

Table NPAS POU Retain Data Capacity

Type	NPAS_POU Name	Estimated Retain Data Size (Bytes)
Continuous Control	NPAS_PVI	350
	NPAS_PID	800
	NPAS_MLD	250
	NPAS_MID_PB	350
	NPAS_RATIO_RT	650
	NPAS_PG_L30_BP	500
	NPAS_VELLIM_PB	450
Mathematical	NPAS_FUNC_VAR	550
	NPAS_BDBUF_R/T	450
Sequence	NPAS_SO_2	200
	NPAS_SIO_22	250

Note: Program instance names are calculated with 4 characters, and POU instance names with 6.

Table Retentive Variable Retain Data Capacity

Type	Variable Data Type	Retain Data Size (Bytes)
Variable Checked for Retentive Variables	BOOL	1
	REAL	4
	STRING	86
	CData_REAL	32

Note: Program instance names are calculated with 4 characters, and variable names with 6.

- Calculation Example:

  When NPAS_PVI x 100, NPAS_PID x 50, CData_REAL variables checked for retentive variables x 20

  Retain data capacity = 250 x 100 + 800 x 50 + 32 x 20 = 75,640Byte < 350 Kbytes

4.5.3 Confirmation of Performance

This section gives a guide for the control logic execution time, and explains the method of calculating the control cycle from that value. In addition, the guide for the estimating the number of maximum control, is shown below when the accuracy of control cycle is required.

■ NPAS_POU Execution Time and Control Cycle

The method of confirming performance when the control content is relatively concrete is described below.

● Conditions

- Retentive variable specification: Enabled (with hard backup)

● Execution time of a representative POU

Table Execution Time of a Representative POU

POU Name	Execution Time
NPAS_PID	Approx.1.1 ms
NPAS_PVI	Approx.0.4 ms

● Execution time of other NPAS_POU

Following the table below, replace it with NPAS_PID or NPAS_PVI and make the conversion.

Table Performance Guide (by NPAS_POU)

Classification	NPAS_PID Equivalent	NPAS_PVI Equivalent
Continuous Control	NPAS_PID	NPAS_PVI
	NPAS_PI_HLD	NPAS_MLD
	NPAS_ONOFF	NPAS_MLD_PB
	NPAS_ONOFF_G	NPAS_MLD_BT
	NPAS_RATIO	NPAS_AS_H/M/L
	NPAS_RATIO_RT	
	NPAS_PG_L30	
	NPAS_PG_L30_BP	
	NPAS_VELLIM	
	NPAS_VELLIM_PB	
Mathematical	NPAS_FUNC_VAR	NPAS_FOUT
	NPAS_TP_CFL	NPAS_LDLAG
		NPAS_DLAY
		NPAS_AVE_M/C
		NPAS_T_CFL
		NPAS_P_CFL
		NPAS_SW13/SW31
		NPAS_SW19/SW91
		NPAS_ASTM1/2
		NPAS_BDBUF_R/T
Sequence Control		NPAS_SIO*
		NPAS_TM
		NPAS_CT

● Guide for POU Number and Control Cycle

The control cycle can be calculated with the following calculation formula.

$$\text{Control Cycle (ms)} > \frac{(\text{NPAS\_PID equivalent POU quantity} \times 1.1\ \text{ms}) + (\text{NPAS\_PVI equivalent POU quantity} \times 0.4\ \text{ms})}{\text{Maximum CPU load factor}}$$

Note: Maximum CPU load factor = 0.6 (60%)

■ Guide for Control Cycle and Maximum Loop Number

The guide for the estimating the number of maximum control, is shown below when the accuracy of control cycle is required.

● Conditions

- Loop configuration: Analog input (1), analog output (1), NPAS_PID (1)
- Retentive variable specification: Enabled, Control cycle: Same as scan cycle, CPU (FCN-RTU)

● Maximum Loop Count Guide

Table Maximum Loop Count Guide

Control Cycle (ms)	Maximum Loop Count (recommended value)
	Single CPU
20	8
50	24
100	50
200	103

4.5.4 Input/Output Processing Performance

■ Input/Output Response Time

The time from when the input signal is read into the input I/O module, and control is executed in the CPU to when the signal is output from the output I/O module, is called the “input/output response time.” The method of estimating the input/output response time is shown here.

■ Input/Output Response Time Breakdown

The input/output response time is the sum of the following 3 processing times.

Ti: Input processing time in the input I/O module

Tcpu: Time required for FCN-RTU control function processing

To: Output processing time in the output I/O module

SEE ALSO

For more information about FCN-RTU control function execution cycles, refer to 4.5.1, “FCN-RTU Scan Cycle and Control Cycle.”

■ Operation and Timing

An example is given below when POU processing such as PID, is executed using an analog input module and an analog output module as the I/O module. Because input signal changes are asynchronous with the scan cycle, Tcpu fluctuates from Tcpu (min) to Tcpu (max).

Tcpu (min): When read into the CPU immediately after the input signal changes

Tcpu (max): When read into the CPU immediately before the input signal changes, and the signal change is recognized with a 1-cycle delay

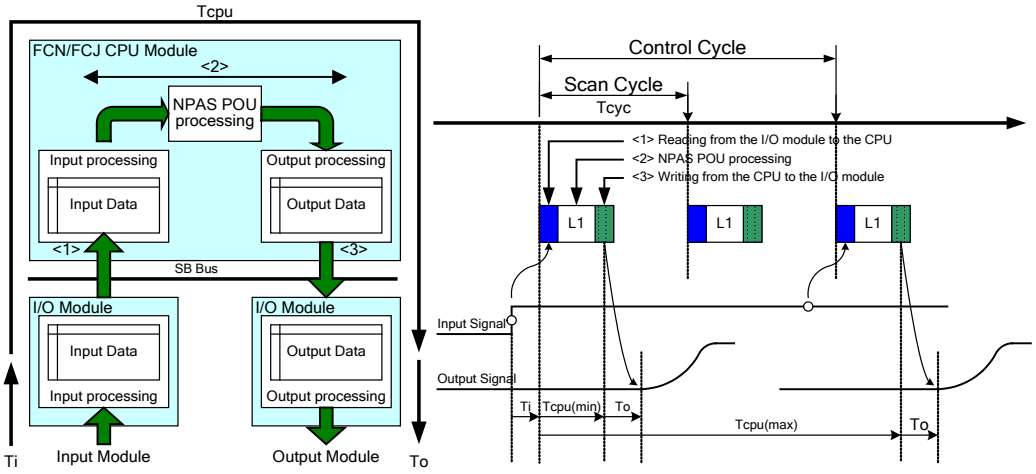


Figure Input/Computation/Output Mechanism and Input/Output Timing

SEE ALSO

Control processing such as PID is executed for each control cycle. The control cycle is set as a cycle that is an integral multiple of the scan cycle. For more information about the relationship between the control cycle and the scan cycle, refer to 4.5.1, “FCN-RTU Scan Cycle and Control Cycle.”

■ Guide for Input/Output Response Time (for PID control, etc.)

The response speed of Tcpu changes only an amount equivalent to the amount of time of the control cycle. Accordingly, use the following simple calculation formula to calculate the estimates response time.

● Calculation formula (when the control cycle is 50 ms or more)

[Conditions] Analog input/output module: NFAB841, single CPU (FCN-RTU)

Input/output response time = Ti + To + Tcpu

Input/output response time (min) = 25 ms + scan cycle x 0.6

Input/output response time (max) = 25 ms + scan cycle x 0.6 + control cycle

● Calculation example

[Conditions] Scan cycle: 100 ms, Control cycle: 100 ms

Input/output response time (min) = 25 + 100 x 0.6 = 85 ms

Input/output response time (max) = 25 + 100 x 0.6 + 100 = 185 ms

TIP

The input/output response time will not change according to the number of I/O modules installed.

5. Products

TIP

When using FCN-RTU, consider the system card as the on-board flash memory in this chapter.

5.1 Software Offerings

Software offerings for the FCN-RTU consist of media containing various programs and software licenses that enable those programs to run.

● Software Media

Various software programs and documentation are supplied on a DVD-ROM, from which they should be installed in the computer to be used for developing control applications.

- FCN/FCJ software media
  Supplies Logic Designer, Resource Configurator, PAS Portfolio, FCN/FCJ OPC Server for Windows and electronic documents for FCN/FCJ (user's manuals).
- Application Portfolio software media
  Supplies the programs and electronic documents (user's manuals) for all Application Portfolios excluding PAS Portfolio.

Table Software media

Name	Model	Suffix	Remarks
FCN/FCJ software media	NT203AJ	-PC11E	DVD-ROM
Application Portfolio software media	NT205AJ	-PC11E	DVD-ROM

● Software Licenses

Software licenses to enable the software to run are supplied as paper forms called an order ID sheets with the order ID and password entries for each. Access the specified Web site of Yokogawa and enter the order ID and password shown. Then, the respective license IDs for the supplied software titles will be given.

SEE ALSO

Software licenses are bundled with NFCP050 CPU modules for FCN-RTU. For more information, refer to "■ Software Licenses for FCN-RTU" in "4.1 Development Environment and Tools".

Table FCN/FCJ Development Tool License

Name	Model	Suffix	Remarks
FCN/FCJ Logic Designer	NT751FJ	-LW11A	(*1), (*2)
FCN/FCJ Simulator	NT752AJ	-LW11A	(*1), (*2)
FCN/FCJ Duolet Application Development Kit	NT755FJ	-LW11A	(*1), (*2)

*1: There are included in the media (DVD-ROM) of FCN/FCJ Software (Model NT203AJ).

*2: This license is required for each PC.

Table FCN/FCJ OPC Server License

Name	Model	Suffix	Remarks
FCN/FCJ OPC Server for Windows	NT781AJ	-LW11A	(*1), (*2)

*1: There are included in the media (DVD-ROM) of FCN/FCJ Software (Model NT203AJ).

*2: This license is required for each PC.

5.2 Software Required to Develop Applications

- **Logic Designer and FCN/FCJ Duolet Application Development Kit**

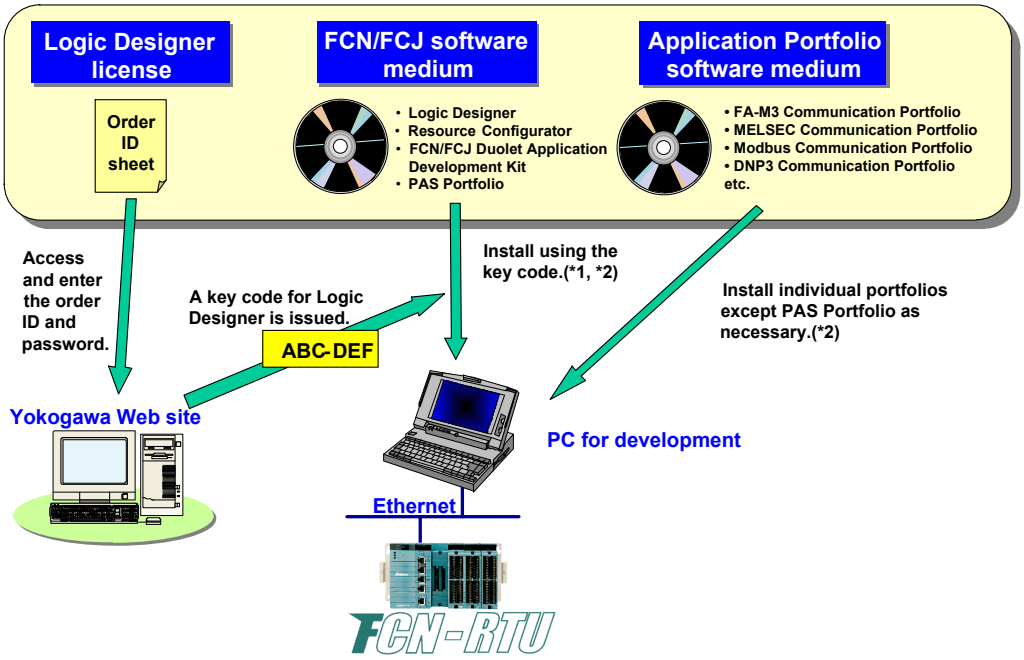
  To install Logic Designer and FCN/FCJ Duolet Application Development Kit in the PC used for development, you need respective licenses in addition to an FCN/FCJ software medium. Each license is supplied in paper form called an order ID sheet with the order ID and password entries. Access the specified Web site of Yokogawa and enter the order ID and password shown. A key code will then be given. This key code enables the corresponding software to be installed and run in a PC for development.

- **Resource Configurator**

  Resource Configurator does not require a license and can be installed from an FCN/FCJ software medium and run in the PC used for development.

- **Application Portfolios**

  As is the case with Resource Configurator, application portfolios can also be installed and run in the PC used for development. Nevertheless, to download to an FCN-RTU a control application that includes functions provided by portfolios and run it, the license for the corresponding portfolios need to be registered in that FCN-RTU.



*1: Resource Configurator can be installed and run without the key code.

*2: Each application portfolio can be installed and run in a PC without the key code, but use an FCN-RTU that an application portfolios license is bundled.

Figure Software Required to Develop Applications

5.3 Hardware Lists

The table below shows the hardware of FCN-RTU.

Table FCN-RTU Hardware Lists (1/2)

	Model	Name
FCN-RTU common hardware	NFBU200	Base Module (long)
	NFBU050	Base Module (short)
	NFPW426 NFPW444	Power Supply Module
	NFCP050	CPU Module for FCN-RTU
Analog I/O modules	NFAI135	Analog Input Module (4 to 20 mA, 8-channel, Isolated channels)
	NFAP135	Pulse Input Module (8-channel, Pulse Count, 0 to 10 kHz, Isolated channels)
	NFAI141	Analog Input Module (4 to 20 mA, 16-channel, Non-Isolated)
	NFAV141	Analog Input Module (1 to 5 V, 16-channel, Non-Isolated)
	NFAT141	TC/mV Input Module (16-channel, Isolated)
	NFAI143	Analog Input Module (4 to 20 mA, 16-channel, Isolated)
	NFAV144	Analog Input Module (-10 to +10 V, 16-channel, Isolated)
	NFAR181	RTD Input Module (12-channel, Isolated)
	NFAI835	Analog I/O Module (4 to 20 mA, 4-channel input/4-channel output, Isolated channels)
	NFAI841	Analog I/O Module (4 to 20 mA input, 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)
	NFAB841	Analog I/O Module (1 to 5 V input, 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)
	NFAI543	Analog Output Module (4 to 20 mA, 16-channel, Isolated)
Digital I/O modules	NFDV151	Digital Input Module (32-channel, 24 V DC, Isolated)
	NFDV551	Digital Output Module (32-channel, 24 V DC, Isolated)
	NFDR541	Relay Output Module (16-channel, 24 V DC, Isolated)
Communication modules	NFLF111	Foundation fieldbus Communication Module
	NFLC121	CANopen Communication Module (1-port, 10 kbps to 1 Mbps)
	NFLP121	PROFIBUS-DP Communication Module (1-port, 9.6 kbps to 12 Mbps)

Table FCN Hardware Offerings (2/2)

	Model	Name
Dummy covers	NFDCV01	Dummy Cover for I/O Module Slot
	NFDCV02	Dummy Cover for Power supply Module Slot
	NFCCC01	MIL Cable Connector Cover
Pressure Clamp Terminal Block	NFTA4S	Pressure Clamp Terminal Block for Analog (16-channel)
	NFTT4S	Pressure Clamp Terminal Block for Thermocouple/mV (16-channel)
	NFTR8S	Pressure Clamp Terminal Block for RTD (12-channel)
	NFTB5S	Pressure Clamp Terminal Block for Digital Input (32-channel)
	NFTD5S	Pressure Clamp Terminal Block for Digital Output (32-channel)
	NFTI3S	Pressure Clamp Terminal Block for Isolated Analog Module and Pulse Module (for NFAI135, NFAP135, NFAF135: 8-channel, NFAI835: 4-channel input, 4-channel output)
	NFTC4S	Pressure Clamp Terminal Block for Digital (16-channel, with dedicated connector, without surge absorber)
	NFTF9S	Pressure Clamp Terminal Block for Foundation fieldbus
Terminal Block	TAS40	MIL Connector Terminal Block for Analog, NFCP050 Built-in I/O
	TAS50	MIL Connector Terminal Block for NFDV151, NFDV 161, NFDV532, NFFV551, NFDV561
Cable	KMS40	MIL Connector Cable for Analog, NFCP050 Built-in I/O
	KMS50	MIL Connector Cable for NFDV151, NFDV 161, NFDV532, NFFV551, NFDV561

SEE ALSO

- For more information about the hardware of FCN-RTU, refer to 3., “FCN-RTU Hardware.”
- For more information about the function of modules, refer to GS (General Specifications.)

6. Maintenance

6.1 Backup/Restore of all data

For FCN-RTU, the regular backup of the CPU module on-board flash memory image is recommended for the CPU module or other system failures.

- **Chapter 6.1.1 to 6.1.3 describes backup, restore and upgrading CPU module using PC.**

6.1.1 Backup of all data using PC

Follow the procedure below to back up.

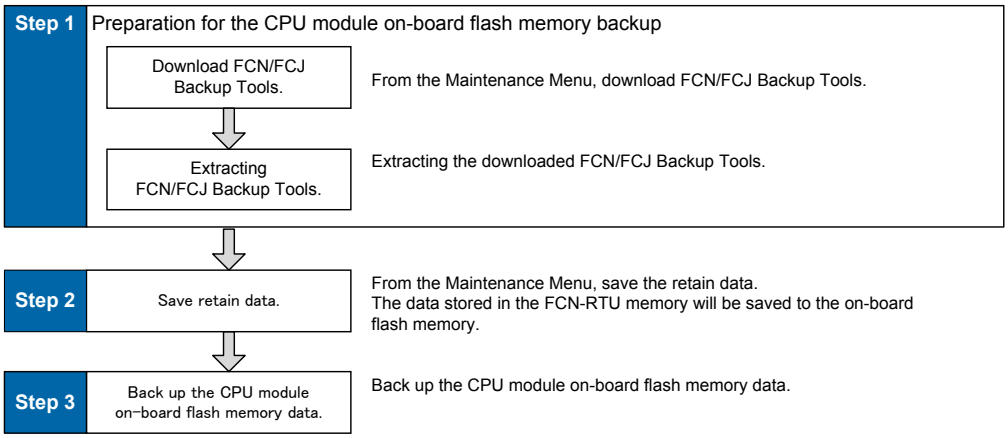


Figure Backup of all data Flowchart

IMPORTANT

Logging data is not save using this backup procedure. For more information on backup, refer to the user manual of each logging tool.

■ Step 1: Preparing for the CPU Module On-board Flash Memory Backup

● Downloading FCN/FCJ Backup Tools

1. Run the Web browser and open the “STARDOM Maintenance Page.”
2. Click [Maintenance Menu].
   The FCX Maintenance Menu is displayed.
3. Click [Download the Backup Tools].
   The self-extracting compressed file FCN/FCJ Backup Tools (FCXTOOL.exe) is downloaded.

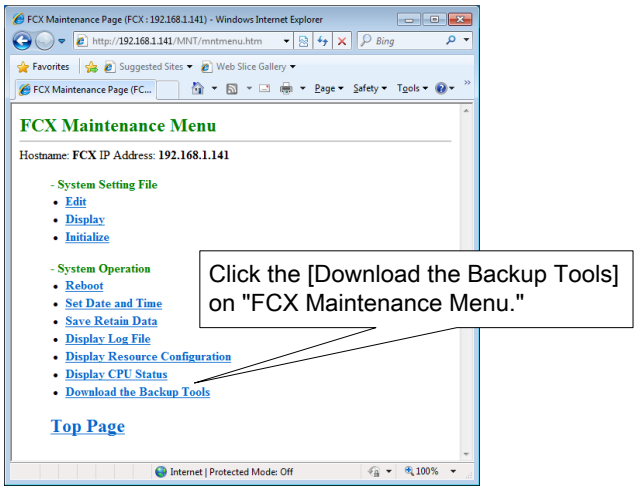


Figure Downloading FCN/FCJ Backup Tools

● Extracting FCN/FCJ Backup Tools

1. Double-click “FCN/FCJ Backup Tools” (FCXTOOL.EXE).
2. Specify a folder for storing extracted files and click the [Install] button.
   The FCN/FCJ Backup Tools are extracted.

TIP

For example, if the specified folder for storing extracted files is “C:\temp”, the following files will be created in that folder:

```
C:\temp\FcxTool\FcxBackup.exe
C:\temp\FcxTool\FcxRestore.exe
C:\temp\FcxTool\backuplist.txt
C:\temp\FcxTool\backuplist_all.txt
```

IMPORTANT

When specifying a folder name for storing extracted files, do not include any space character (for example, “C:\Documents and Settings\Default User\My Documents” is invalid).
If you execute the above command with a folder name containing one or more space characters, the backup or restore command will be aborted with error during execution.

■ Step 2: Saving Retain Data

1. Run the Web browser and open the “STARDOM Maintenance Page.”
2. Click “Maintenance Menu.”
   The FCX Maintenance Menu is displayed.
3. Click “Save Retain Data.”
   The last time and data when the retain data was saved is displayed.
4. Click the [SAVE] button.
   The retain data is saved.

TIP

The [SAVE] button is not displayed in the maintenance mode.

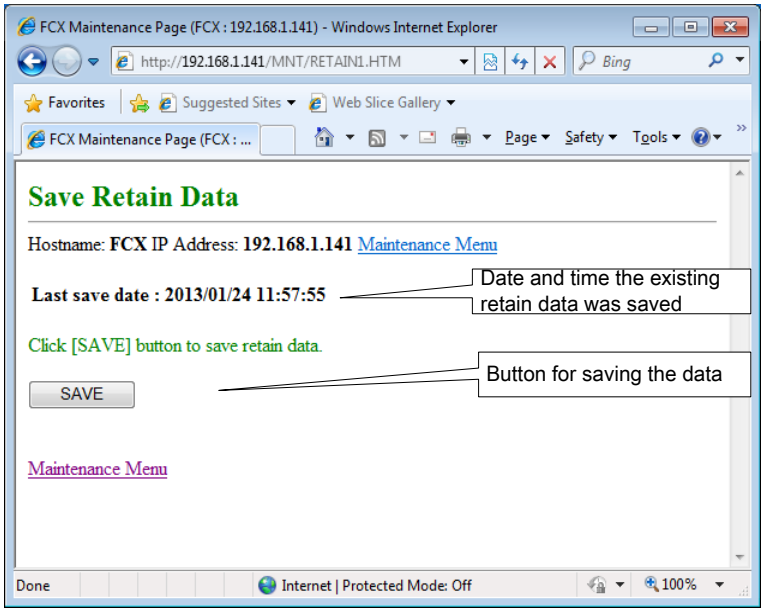


Figure Saving Retain Data

SEE ALSO

For the Web browser operation procedure, refer to 6.2 “Maintenance Menu.”

■ Step 3: Backing up the CPU Module On-board Flash Memory Data

1. Run the command prompt.
2. In the command prompt window, change the current directory to the folder containing the extracted FCN/FCJ Backup Tools.
   Supposing that the FCN/FCJ Backup Tools have been extracted to the folder C:\temp, type “cd C:\temp\FcxTool,” and press the [Enter] key.
3. Type “FcxBackup -all -u <user name> -p <password> <host name or IP address>,” and press the [Enter] key.
   The “BACKUP” folder will be created in the current directory.

TIP

- If you want to back up the system configuration file in the FCN/FCJ maintenance mode, switch the “FCX Maintenance Menu” to the “STARDOM Maintenance Page.”
  Backup would fail if you are still on the FCX Maintenance Menu or have exited the web browser with the FCX Maintenance Menu left open.
  If you have exited the web browser with the FCX Maintenance Menu left open, run the web browser again, open the FCX Maintenance Menu from the FCX Maintenance Page, and return to the STARDOM Maintenance Page before exiting the web browser.
- It will take approximately 15 minutes to back up the data on the CPU module on-board flash memory.
- Addition the "-all" in [FcxBackup] command, backed up file is different. Please add the "-all" always. If you do not want to add the "-all".

Backed up file	With "-all"	Without "-all"
Control application	✓	✓
Configuration (I/O, IP address, etc.)	✓	✓
Retain save data	✓	✓
FCN/FCJ Basic software	✓	-
Duolet application	✓	-
Logging data	-	-
Trend data	-	-
Report data	-	-

- Addition the “-u <user name> -p <password>” in [FcxBackup] command after R4.10, specifies the user name and password for the FCN administrator account. If you have changed the user name and password from the initial value, be sure to specify them always.

IMPORTANT

If backup fails, check the following:

- Check the FCN-RTU host name or IP address.
  Use the Ping command to verify.
- Check whether you have executed a command below a directory name containing a space character.
  If a directory name contains a space character, move the command below a directory name that includes no space character.
- Check the contents of the following backup operation log file if the above measures do not solve the problem.

  `FcxTool\TEMP\FTPLOG.TXT.`

6.1.2 Restore of all data using PC

If you are not replacing the CPU module, skip to step 3 of the procedural flowchart shown below.
If you are replacing the CPU module, start with step 1 and follow the instructions given.

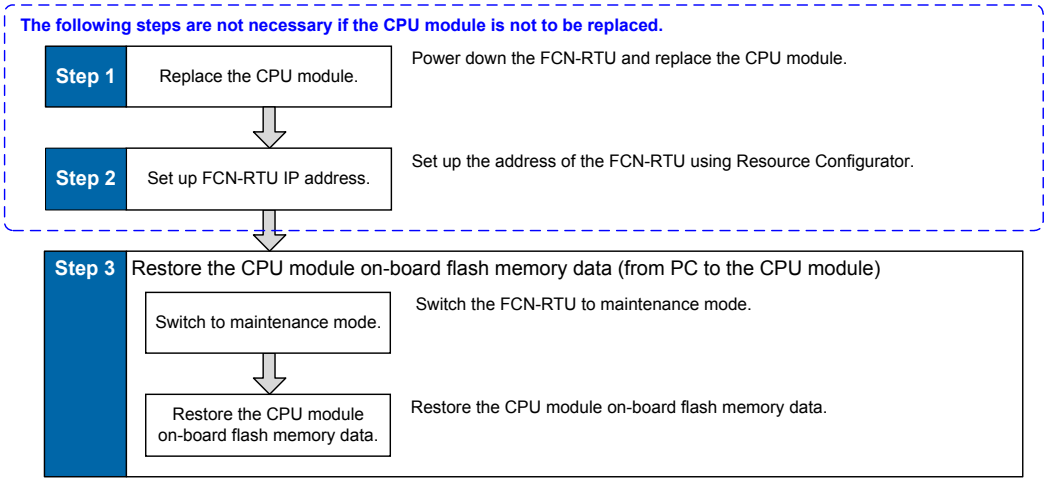


Figure Restore of all data using PC flowchart

■ Step 1: Replacing the CPU module

Power down the FCN-RTU and replace the CPU module.

TIP

- If you are not replacing the CPU module, you can skip this step (for replacing the CPU module).

■ Step 2: Setting IP Address of FCN-RTU

Set up the IP address of the FCN-RTU using Resource Configurator.

TIP

- If you are not replacing the CPU module, you can skip this step (for setting the FCN-RTU IP address).
- For details on how to set the IP address of the FCN-RTU, see the online help of Resource Configurator.

■ Step 3: Restoring in the CPU module on-board flash memory Data

● Switching to Maintenance Mode

1. Run the Web browser and open the “STARDOM Maintenance Page.”
2. Select “Maintenance Menu.”
   The FCX Maintenance Menu is displayed.
3. Select “Reboot.”
   The Reboot Menu is displayed.
4. Select “Reboot (Maintenance Mode)” and click the [OK] button.
   The FCN/FCJ reboots in maintenance mode.

- **Restoring with the single CPU module**

1. Run the command prompt.
2. In the command prompt window, change the current directory to the folder containing the extracted FCN/FCJ Backup Tools.
   Supposing that the FCN/FCJ Backup Tools have been extracted to the folder C:\temp, type “cd C:\temp\FcxTool”, and press the [Enter] key.
3. Type “FcxRestore <host name or IP address>,” and press the [Enter] key.

TIP

- If you want to perform restoration from a PC (“restoration PC”) that is not the one (“backup PC”) with which you have performed backup, you must first copy all files under the “Backup” folder of the backup PC into the folder of the restoration PC containing the extracted FCN/FCJ Backup Tools, before proceeding with the first step listed above (for running the command prompt).

IMPORTANT

It is saved in a backup file with FCN/FCJ Basic software when you execute FcxBackup command with '-all" option. When restre the backup file to CPU module, The CPU module used to restore the system will be the release and revision of the backup file.
If you want to new release/revision , upgrading the CPU module release/revision.

6.1.3 Upgrading CPU Module Version

For FCN-RTU, if you want to upgrade the CPU Module to the latest version, upgrade the CPU module on-board flash memory version/revision.
Prior to upgrade the CPU module version, it is recommended to execute "6.1.1 Back up of all data using PC".

■ Upgrading the CPU Module Version

IMPORTANT

About 10 Megabytes of free flash memory space is required to perform version upgrade or downgrade of the CPU module on-board flash memory.
For available memory space, check the "Flash Memory (FREE)" value displayed on the "STARDOM Maintenance Page." If free memory space is insufficient, delete unnecessary files.

SEE ALSO

For details on how to upgrade or downgrade the CPU module on-board flash memory version, see the release note of the FCN/FCJ Basic Software Package.

● Obtaining FCN/FCJ Basic Software Package

1. Insert the system DVD-ROM for the new release/revision in the DVD drive.
2. Select "DVD Contents."
3. Double-click the FCN/FCJ Basic Software Package.
   - Pkg_FCNRTU.exe in the Pkg_FCNRTU folder for FCN-RTU.
4. Specify a folder for saving extracted files, and click the [Install] button.
   The FCN/FCJ Basic Software Package is extracted.

TIP

For example, if the specified folder for storing extracted files is "C:\temp", the following files will be created in that folder:

```
C:\temp\FCNRTU\FcxRevup.exe (for FCN-RTU)
```

● Switching to Maintenance Mode

1. Run the Web browser and open the "STARDOM Maintenance Page."
2. Select "Maintenance Menu."
   The FCX Maintenance Menu is displayed.
3. Select "Reboot."
   The Reboot Menu is displayed.
4. Select "Reboot (Maintenance Mode)" and click the [OK] button.
   The FCN/FCJ boots up in maintenance mode.

- **Upgrading the CPU module on-board flash memory Version**

  1. Run the command prompt.
  2. In the command prompt window, change the current directory to the folder containing the extracted FCN/FCJ Basic Software Package.
     Supposing that the FCN/FCJ Basic Software Package has been extracted to the folder “C:\temp”, type “cd C:\temp\FCNRTU” for FCN-RTU, and press the [Enter] key.
  3. Type “FcxRevup <host name or IP address>,” and press the [Enter] key.

TIP

Version upgrade takes about 10 to 20 minutes for FCN-RTU to complete.

6.2 Maintenance Menu

Select Maintenance Menu in the maintenance homepage to display the Maintenance Menu page.
The following functions can be called from this window.
Note that there are some limits on the range of operations depending on the status of the FCN-RTU.

Table Operations that can be Carried Out from Maintenance Menu

Operation item	Operation status	
	Maintenance status	Online status
Common operations - Connecting to the WWW server - Starting/exiting maintenance operation	✓ (*1) (*2)	✓ (*1) (*2)
Changing the content of system setting files - Edition - Initialization	✓ (*1)	
Displaying system setting files - Displaying system setting files - Displaying kernel/system log files	✓ (*1)	✓ (*3)
Setting date and time	✓ (*1)	✓ (*4)
Rebooting/shutting down	✓ (*1)	✓ (*4)
Save retain data		✓ (*4)
Others - Displaying I/O configuration - Displaying CPU status	✓ (*1)	✓ (*3)

✓: Operation allowed

Blank: Operation prohibited

*1: It is necessary to enter a user name and password that have access to the /JEROS directory when the operation is carried out if “Maintenance Security” of the JEROS basic setting file is set to “YES.”

*2: It is necessary to enter a user name and password that have access to the /JEROS/SYS/MNT/HTML, where the HTML files are located, when the operation is carried out.

*3: It is necessary to enter a user name and password that have access to the file you want to display.

*4: It is necessary to enter a user name and password that have access to the /JEROS directory when the operation is carried out.

IMPORTANT

To perform maintenance of the FCN-RTU, it is necessary to specify a user name and password that have the appropriate access rights for each operation.
Access rights may be changed for individual operations.

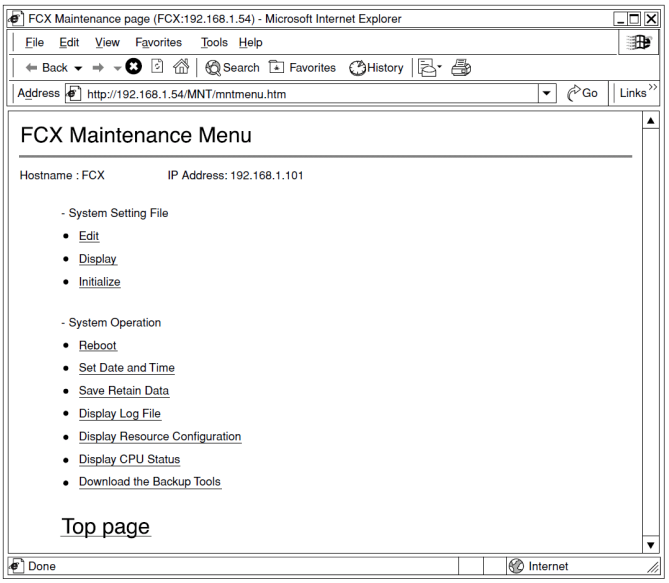


Figure Maintenance Menu

6.2.1 System Setting Files

The system setting files of an FCN-RTU are stored in the CPU module on-board flash memory, and the controller operates according to the data in these files.
It is thus possible to control the operation of the FCN-RTU by editing these files. The system setting files can be edited and displayed. Moreover, it is possible to return them to the factory default setting. There are the following system setting files.

Table System Setting Files

Setting file	Description
JEROS Basic Setting File	Definitions related to the operation of the entire system
User Account File	User registration of the FTP/WWW server functions
Duolet Environment Setting File	Settings of the Duolet runtime environment
Duolet Loader Configuration File	Contains Duolet loader configuration
E-Mail Configuration File	Settings of the e-mail transmission/reception functions
HOSTS File	Registration of IP address and host name
DNS Setting File	DNS settings (only available for the Java runtime environment)
SNTP Setting File	Settings of the time synchronization function
IP Routing File	Network routing information
PPP Setting File	PPP settings
SLIP Setting File	SLIP settings
COM1 Port Setting File	Settings of default communication conditions of COM1 port
COM2 Port Setting File	Settings of default communication conditions of COM2 port
COM3 Port Setting File	Settings of default communication conditions of COM3 port
COM4 Port Setting File	Settings of default communication conditions of COM4 port
Kernel Log Setting File	Log settings of the operating system
Web Files Naming File	Settings of alias names for files of the WWW server
MIME Type Setting File	Registration of the MIME type of files of the WWW server
Packet Filter Setting File	Packet filter settings

SEE ALSO

For how to set the various system setting files, refer to the Help of each setting screen.

6.3 Online Download

The Online Download Function makes it possible to change a control application without stopping the control operation on the FCN-RTU. System messages for the execution result of Online Download are displayed on VDS.
This chapter describes Online Download.

SEE ALSO

For more information about the Online Download Function, refer to B3., “Online Download” in “STARDOM FCN/FCJ Guide” (IM 34P02Q01-01E).

A function may be limited by the combination of a style number of operating hardware, a release number of the software and making conditions of the control application.

Please check it on the following homepage.

https://partner.yokogawa.com/global/

-> Members Page: Partner Portal

6.3.1 Outline of Online Download Function

The followings show the changes covered by Online Download and changes not covered by Online Download.

- **Changes to a control application covered by Online Download**

  Online Download is valid in the following changes.
  - Change of the logical POU (change of local variable definitions, change of code, etc.)
  - Change of the physical hardware configuration (addition/deletion of configurations, addition/deletion of resources, etc.)
  - Change of resource definitions (change of device label variable definitions, change of global variable definitions, etc.)
  - Change of the user library to which the program refers
  - Change of data type definitions

- **Changes to a control application not covered by Online Download**

  Online Download is not valid in the following changes.
  - Addition/deletion of tasks
  - Change of the task type (CYCLIC/SYSTEM/DEFAULT)
  - Change of task settings (task cycle, watchdog time, priority, stack size, SPG)
  - Change of PLC type in configuration
  - Change of processor type in resource

6.4 Maintaining FCN-RTU Hardware

This section describes the precautions and replacement procedure for maintenance and replacement operations.

6.4.1 The Precautions when Performing FCN Maintenance and Replacement Operations

This section describes the precautions when performing FCN maintenance and replacement operations.

- **Precautions regarding Static Electricity**
  - Always store or carry maintenance parts contained in static-free bags
    (When FCN are shipped from the factory, they are contained in static-free bags with static electricity warning labels)
  - When performing maintenance, use a grounded wrist strap with a 1MΩ grounding resistance
    Be sure to ground the wrist strap
  - When performing operations on a table, be sure to perform operation on an anti-static sheet that is properly grounded with 1MΩ of grounding resistance
    Be sure to wear wrist straps when performing operations
    Avoid placing plastic items that may conduct electricity
  - Avoid touching maintenance parts without using conductive sheets or wrist straps

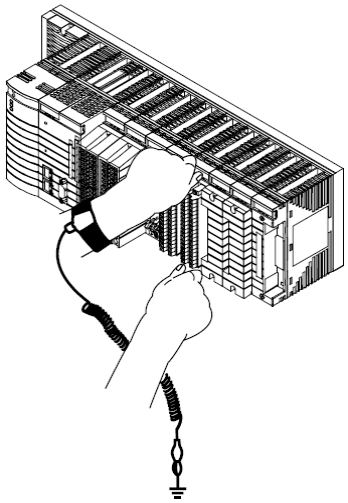


Figure Example when Handling Modules

- **Precautions regarding Electric Shock**
  - Always turn off the power supply of the equipment that will be handled when exchanging power modules
  - Turn off the field-side power supply when wiring 100 V AC or 200 V AC signal wires

- **Precautions regarding Explosions**
  - Maintenance operations cannot be performed while power is supplied unless it is verified that there are no explosive gases in the environment

6.4.2 Replacing FCN-RTU Modules

The following describes the procedure to replace FCN-RTU modules. The FCN can use duplex Power Supply modules. Duplex modules can have hardware replaced while online.

- **Replacing Power Supply Modules**

  Follow the procedure below to replace Power Supply modules

  Duplex Power Supply modules can be replaced without stopping the system (The replacement procedure is the same as single configuration)

  1. Shut off the power supply to the power supply module that is being replaced
  2. Remove the power supply cable and line filter grounding cable from the terminal block
  3. Remove the target Power Supply module from the Base module
  4. In reverse order of above, install the Power Supply module, power supply cable, and line filter grounding cable
  5. Turn on the power supply

- **Replacing Single NFCP050 CPU Modules**

  Follow the procedure below to replace single-CPU modules.

  1. Save retain data to the on-board Flash Memory
  2. Backup system files using backup command
  3. If the target CPU is on, use the shutdown switch to turn it off
  4. Turn off the power
     (If a CPU module is replaced without cutting off the power supply, the I/O module will operate in accordance with the fallback instructions)
  5. Remove the control network cable
  6. If CPU module built-in I/O is connected, remove the MIL connector cable
  7. Remove the CPU module from the Base module
  8. Install the new CPU module in the Base module and connect the control network
  9. If CPU module built-in I/O was connected, re-connect the MIL connector cable that was removed.
  10. Turn on FCN-RTU and start on maintenance mode
  11. Restore backup files using Restore command
  12. Reboot FCN-RTU on online mode

IMPORTANT

- After hardware failure, data stored on the on-board Flash Memory can not be retrieved. It is recommended to backup retain data and system files.
- For the backup and restore procedure, refer to "6.1 Backup/Restore of all data".

- **Replacing I/O Modules**

  Follow the procedure below to replace an I/O module online

  1. Remove the pressure clamp terminal block of MIL connector cable
  2. Remove the malfunctioning I/O module
  3. Settings for I/O modules for which hardware settings have been made must be the same as before
  4. Install the new I/O module
  5. Install the Pressure clamp terminal block or MIL connector cable that was removed
  6. Using Resource Configurator, download the I/O module settings information
     (This step is not normally necessary)
     (It needs to be performed, however, if “Enable I/O Module Auto-Load” is not set in Resource Configurator)

6.5 Parts with Limited Lifespan

This section describes parts that have limited lifespan.
Parts with limited lifespan are those parts that decrease in performance and reliability over time, resulting in loss of function or ultimately to breakdown.
For FCN-RTU, parts with limit lifespan are defined as "parts that are estimated to have function loss and malfunction due to wear within 10 years when the temperature of the air intake from the bottom of the module is 45°C on the average."

6.5.1 FCN-RTU CPU Module Batteries

The FCN-RTU CPU module have Li batteries installed for use to maintain data when the power is off and for the RTC (Real-time clock).
The recommended replacement period varies depending on the operating environment and status (operation time and ambient temperature).

Table Limited Lifespan Component (Battery)

Product name	Part number
Battery	S9883FA

■ Recommended Replacement Period

The battery lifespan greatly depends on ambient temperature. The following shows the ambient temperatures and recommended replacement periods of the battery.
A label on which battery replacement dates may be written is supplied with the unit. As a guide, write the year and month when the unit should be replaced next time on the label and affix it to an easily visible location.

Table FCN-RTU Ambient Temperatures and Recommended Replacement Periods of the Battery

Ambient temperature (*1)	Replacement period
-40°C	10 years
25°C	10 years
35°C	8 years
45°C	4.5 years
55°C	3 years
70°C	2 years

*1: The ambient temperature is the average temperature in which the unit is used.

Figure Battery Replacement Period Label

IMPORTANT

- Even when the average ambient temperature is below 25°C, the battery should be replaced after 10 years.
- When the unit is used over the recommended exchange period, the battery may leak.
- If the battery leaks, a strong odor may be produced and the metal parts may be corroded.
- Replace batteries that have leaked as soon as possible.
- Replacing the battery clears the data storage memory and clock setting. Before requesting a battery replacement, back up the data (retain data, etc.) using a software tool. Set the clock in the first turning on the FCN-RTU power.

SEE ALSO

For more information about the saving retain data procedure, refer to B2.4.7, “Saving Retain Data” in “STARDOM FCN/FCJ Guide” (IM 34P02Q01-01E).

■ The Battery for CPU Module

The battery for CPU module of FCN is mounted on the back side of CPU module.

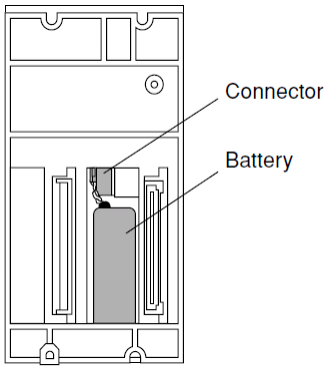


Figure Example of mounting battery (FCN)

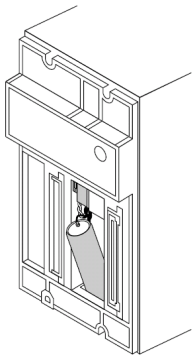


Figure Top of Battery being removed (FCN)

SEE ALSO

For more information about replacing the FCN CPU module’s battery, refer to C4.3.1, "FCN CPU Module/FCJ Batteries” in “STARDOM FCN/FCJ Guide” (IM 34P02Q01-01E).

6.5.2 Power Supply Module

The lifespan of the electrolytic capacitor used in the power supply module is 8 years provided that the temperature of the air intake from the bottom of the module is 45°C on the average. The power supply module will be required to be replaced periodically.

6.5.3 I/O Module (NFDR541)

The relay used in NFDR541 of the I/O module has a limited lifespan that is affected by the number of times used and load conditions.

TIP

The relay cannot be replaced by itself. The entire module must be replaced.

Table Relay Lifespan

Relay lifespan	Mechanical lifespan	20,000,000 times		
	Electric lifespan	Resistance load	220 V AC: 2 A	250,000 times
			100 V AC: 2 A	370,000 times
			24 V DC: 2 A	270,000 times
			110 V DC: 0.4 A	250,000 times
		Inductive load	220 V AC: 1 A	220,000 times
			100 V AC: 2 A	160,000 times
			24 V DC: 0.6 A	300,000 times
			110 V DC: 0.1 A	350,000 times

Note: From place order in December 2017, the NFDR 541 module can only use DC 24 V.

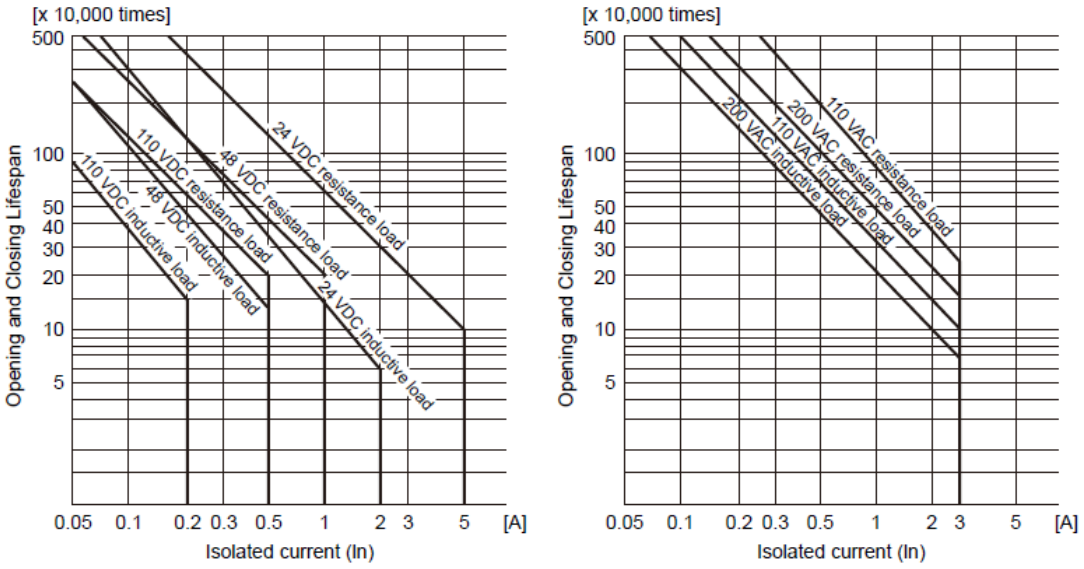


Figure DC Load Lifespan Curve and AC Load Lifespan Curve of the Electric Lifespan

7. Other Features and Settings

7.1 License

This section provides an overview of the STARDOM software license (hereinafter referred to as license.)
The licensing can be obtained and set using the following procedure.

1. **Purchase a STARDOM software license and obtain an Order ID sheet.**
2. **Perform user registration using the Web browser. (User registration is required for the first time only)**
3. **Issue the license by entering the Order ID and password written on the Order ID sheet using the Web browser. (There are two types of licensing: Key Code and License ID)**
4. **This license must be set to the STARDOM using tools when installing the software. (The license setting procedure differs depending on the software used.)**

7.1.1 Types of Licenses

The STARDOM software license is comprised of the following types:

- **Key Code**

  This is the license that is required when installing the following software.
  - Logic Designer
  - FCN/FCJ OPC server for Windows
  - Duplexed Network Function License for FCN/FCJ OPC Server
  - FCN/FCJ Simulator (NT752AJ-LW11A: R4.10 or later)

- **License ID**

  This is the license that is required to run the following software.
  - FCN/FCJ Simulator (NT752AJ-LU11A)

7.1.2 Key Code

A key code is a code required to verify that the user is the genuine license holder when installing the software. It is provided using ASCII character strings. For STARDOM, a key code is issued by purchasing a license that is separate from the DVD-ROM where the software is stored.

7.1.3 License ID

A license ID is a code comprised of ASCII strings that is required to register the license when the software is executed.

The license file is provided by a file that contains one or more license IDs.
The execution license of STARDOM is validated by registering the license ID using a dedicated tool to a set registration location. The following chart describes the software that requires an execution license, the license ID registration location, and license registration tool.

Table License Registration Locations and License Registration Tools

Software that requires a execution license	Registration location	License registration tool
FCN/FCJ Simulator (NT752AJ-LU11A)	ID module	FCN/FCJ Simulator Utility

For STARDOM, a license ID is issued by purchasing a license that is separate from the DVD-ROM where the software is stored.

7.1.4 Issuing a License

The STARDOM license is issued using the following procedure.
For details the various operations for the License Management System, refer to the online help that is provided.
This section provides the basic flow of operation to issue a license.

■ Order ID Sheet

When a STARDOM software license is purchased, an Order ID sheet paper will be provided. On this order sheet, a list of purchased licenses and the order ID and password that is the key to connecting to the License Management System will be printed.

■ License Management System

The STARDOM License Management System uses Web environments. Start a Web browser such as Microsoft Internet Explorer on a computer connected to the Internet and enter the URL printed on the Order ID sheet. The first window of the License Management System will be displayed.

■ Login

User registration must first be performed in order to use the License Management System. Set the User ID and password that were issued during user registration into the initial window to validate the user (login). If user registration is not completed, use the following guest account to temporarily login.

```
User ID: guest
Password: stardom_license
```

■ User Registration

When the guest account is used, the user registration menu window will be displayed. Select [New Registration]. In the User Registration, there are input fields for relevant information. Input the required items and click on the [Register] button. When registration is accepted, the customer ID will be issued automatically. (A password must be set by the user.)

■ Specifying an Order and Issuing a License

When the user is validated, the license issuance menu window will be displayed. Select "Issue License" to display the window to specify the order. Enter the type of license to be issued and the Order ID and password printed on the Order ID sheet.

SEE ALSO

The operating procedure will differ depending on the type of license. For details, refer to the Help.

■ License

When license issuance is completed, a “Key Code” or a “License File” can be obtained. Use this license and each license registration tool to perform setup.

SEE ALSO

For setting procedures of the FCN/FCJ licensing, refer to the Help of Resource Configurator.

■ Logoff

Be sure to log off when you are finished using the License Management System. If you close the Web browser without logging off, you will be unable to log in again for 30 minutes.

7.2 Behavior when Power is On and when Power Fails

This section describes operation when power to the FCN/FCJ is on and when it fails. Because the outbreak of a momentary power failure or a power failure is recorded, you can analyze it later.

7.2.1 Insensitive Momentary Power-failure Time

Insensitive momentary power-failure time is the minimum momentary power-failure time for which it can be guaranteed that control will not be affected when there is a momentary power failure (when the power supply line voltage temporarily drops for only a certain period of time). If it is within this amount of time, FCN-RTU control is not affected, even if the voltage drops to zero.

The specifications for the power supply module's insensitive momentary power-failure time are shown in the table below.

Table Power supply module insensitive momentary power-failure time

Model	Rated Input Voltage	Minimum Input Voltage	Insensitive Momentary Power-failure Time
NFPW444	24 V DC	21.6 V	2 msec
NFPW426	10 ～30 V DC	10 V	2 msec

7.2.2 Behavior when Power Momentarily Fails/Power Fails

A momentary power failure is a power failure that a power supply returns in momentary power-failure time.

- **FCN behavior when power momentarily fails**
  1. If a decrease of input voltage in the power supply module is detected, and that state exceeds the insensitive momentary power-failure time, a power failure warning signal is sent to the CPU module.
  2. When the CPU module receives the power failure warning signal, it immediately records the generation of an AC failure in the system alarm.
  3. After that, the CPU module records the recovery from the AC failure state in the system alarm.

- **FCN behavior when power fails**
  1. If a decrease of input voltage in the power supply module is detected, and that state exceeds the insensitive momentary power-failure time, a power failure warning signal is sent to the CPU module.
  2. When the CPU module receives the power failure warning signal, it immediately records the generation of an AC failure in the system alarm.

7.2.3 Behavior after Recovery from Power Failure

When recovering from a power failure, operation is the same as when power is turned on normally. As for tuning parameters (including modes), specified retentive data set by the user, etc., the data stored in the retentive variable memory is used. However, the modes of the NPAS POU connected to the I/O module will be forced to MAN (manual operation status).

- **Time until returning to normal control after recovery from power failure**

  The total time required after an FCN power failure until recovery and return to a normal control status is as sum of the following time.

  1. OS startup time:
     CPU module (single configuration): Approximately 20 seconds
  2. I/O startup time: 10 seconds
  3. Control logic startup time:
     The time equivalent to 30 scan cycles (If a scan cycle is 1 second, it will be 30 seconds.)

  Note: The time described above is a guide for an estimate. The value may be changed by application or project size and so on.

7.3 Behavior when a Malfunction Occurs

7.3.1 Self-diagnostics

■ RAS Functions

The RAS (*1) functions of FCN support stable operation of FCN through CPU module self-diagnostics and I/O module status monitoring.

The following self-diagnostics functions are available.

- **CPU module**
  - ECC memory diagnostics
  - Internal bus diagnostics
  - Diagnosis through WDT (*2)

  Etc.

- **I/O module**
  - Detection of whether analog input circuits are open or shorted
  - Analog output readback
  - Internal CPU timer and other resources

  Etc.

*1: Acronym for “Reliability,” “Availability,” and “Serviceability.”

*2: Acronym for “Watch Dog Timer.”

7.3.2 Operation Status

The operation status of an FCN-RTU changes as shown in the figure below. Each status is indicated by the three LED display of the CPU module as follows:

1. H (HRDY) lights when the hardware is normal.
2. R (RDY) lights when the system is normal.
3. C (CTRL) lights when the control actions are carried out normally.

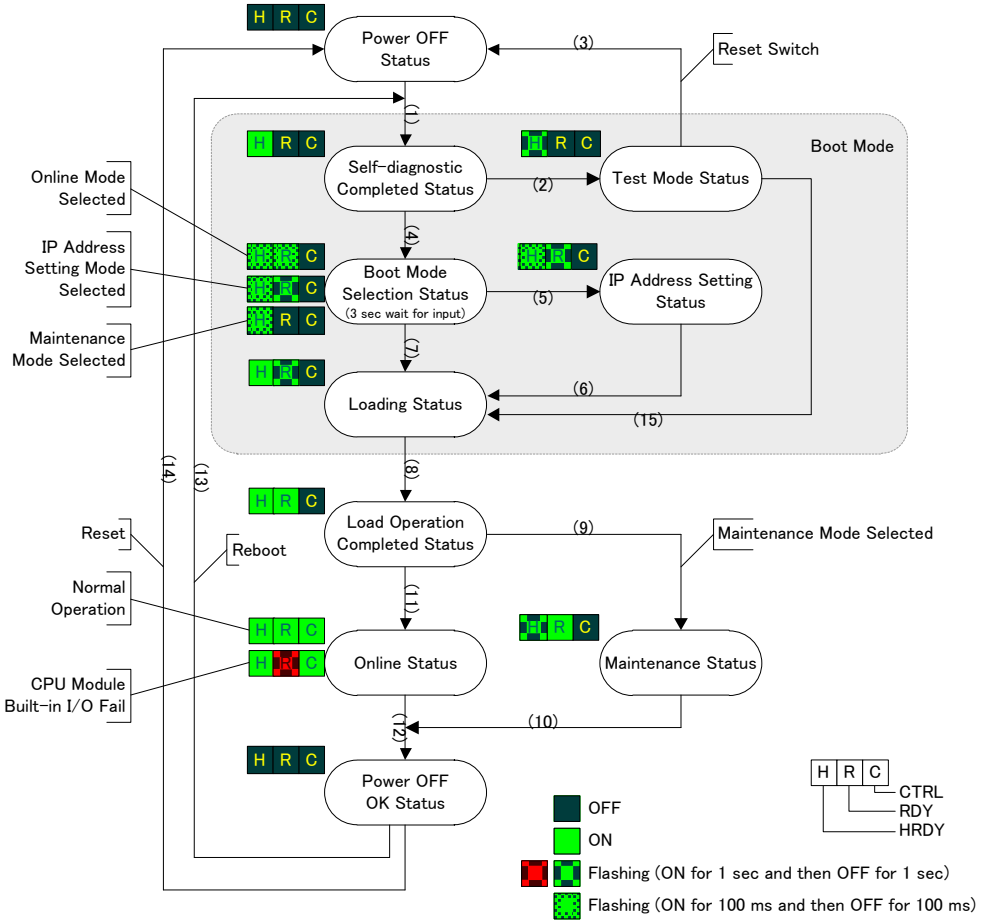


Figure Operation Status of FCN-RTU

1: When the power is applied, and the self-diagnosis process is executed from the Boot ROM in the system card.

2: If one of the following condition is met, the FCN-RTU CPU module is entered into the 'Test Mode Status'.
   a. If the power is applied while the shutdown switch is kept pressed.
   b. If no system software is installed.
   c. If the system cannot be started because of a fatal error (file system error, etc.)

3: When the reset switch is pressed, and the restart process is executed again.

4: When the self-diagnosis process is completed.

5: First enters the 'Online Mode' in the 'Boot Mode Selection Status'.
If the shutdown switch is pressed again at this point in time, shifts to the 'IP Address Setting Mode'.
If the shutdown switch is pressed once again, the mode shifts to the 'Maintenance Mode'.
And if the shutdown switch is pressed once again, the mode returns to the 'Online Mode'.
Subsequently, these transitions will be repeated every time the shutdown switch is pressed.
If the shutdown switch is not pressed for 3 seconds, it will be transitioned into the 'IP Address Setting Status' or the 'loading Status', depending on the selected mode.
Specifically, it will be transitioned into the 'IP Address Setting Status' if the 'IP Address Setting Mode' is continued for 3 seconds.

6: When the IP address is set with the Resource Configurator.

7: First enters the 'Online Mode' in the 'Boot Mode Selection Status'.
If 3 seconds has elapsed in this mode, it will be transitioned into the 'Loading Status'.
For information about the operation of the 'Boot Mode Selection Status', refer to (5).

8: When the OS is started after the system software (OS, control application, etc.) is loaded from the system card into the memory.

9: If the system is started when the 'Maintenance Mode' is selected.

10: When the shutdown switch is pressed or a shutdown is requested from the Web browser.

11: when the loading is completed.

12: When the shutdown switch is pressed or a shutdown is requested from the Web browser.

13: When a reboot is requested from the Web browser in the 'Online Status' or the 'Maintenance Status'.

14: When the reset switch is pressed.

15: When the boot command is executed.

- **Boot Mode Selection Status**

  Boot mode selection has the following three statuses. If the shutdown switch is pressed during a boot mode selection status, selection of the transition of statuses is progressive.

  1. Online mode selection status (default)
  2. IP address setting selection status
  3. Maintenance mode selection status

  If the shutdown switch is not operated for three seconds, the selected status is activated. However, if an IP address has not been set, the status remains in the “IP address setting selection status.”

- **Test Mode Status**

  This is a status notifying abnormality; for example system is not installed. This status is only applied to FCN-RTU.

- **IP Address Setting Status**

  This is a status where the IP address of the FCN-RTU can be set. Once the IP address has been set, the FCN-RTU switches to the loading status.

- **Loading Status**

  This is a status where the information stored in the CPU module on-board flash memory is loaded into the memory.

- **Load Operation Completed Status**

  This is a status where the loading is completed and the OS is started. Depending on the execution mode, the FCN-RTU switches to either the online or the maintenance status.

- **Online Status**

  This is the normal operation status (the control application and other functions can be executed).

  - Task execution: This is in the state where the task is executing.
  - Task stop: This is in the state stopped from loading on purpose, or the state where there is no boot project and it has stopped.
  - Task irregular stop: This is in the state where the task stopped for the exception.

- **Maintenance Status**

  This is a status where the minimum OS functions are performed. The control application is stopped, allowing maintenance operations such as advanced configurations and backup/ restoration of files to be carried out.

- **Power Off OK Status**

  This is a status where it is allowed to turn the controller's power off.
  The on/off status of the LED display on the CPU module is the same in both the power off status and the power off OK status; check the LED of the power supply module to identify in which status the FCN-RTU is in.

Revision Information

Document name : FCN-RTU Technical Guide
Document No. : TI 34P02A14-01E

May. 2017 /1st Edition /R4.10 or later

- New publication

Jun. 2018 /2nd Edition /R4.20 or later

- Deleted NFDV157, NFDV557, NFTC5S for order stopped
- Changed specification of NFDR541
- Corrected errors.

■ For Questions and More Information

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