Technical Information

RIO System Upgrade Guide

CENTUM VP

TI 33J01B01-01EN

[Release 6]

Introduction

This document is a guideline to introduce how to upgrade an existing CENTUM RIO system (*1) into the latest CENTUM VP R6 system, either by phased upgrade or single-step upgrade, with the minimum shutdown time.

*1: "RIO" stands for "Remote I/O" which is one of the system components adopted by CENTUM CS, CENTUM CS 1000/CS 3000, and CENTUM VP systems.

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RIO System Upgrade Guide

TI 33J01B01-01EN   9th Edition

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1.　Methods of Upgrading

Upgrading the existing RIO systems into the latest CENTUM VP R6 system is implemented in two ways: one is to upgrade the system step by step and the other is to replace the entire system in one time.

1.1　Phased system upgrade

Step-by-step system upgrade is a method to upgrade the components of the existing system in two phases.

Table　Step-by-step system upgrade

Upgrading HMI	Human-machine-interfaces (HMI) of the existing system is upgraded by adding the latest Human-interface-stations (HIS) and V net routers of the CENTUM VP system to the existing RIO systems. Upgrading the operation and monitoring functions of the existing control system realizes the integration with the Enterprise Resource Planning (EPR) and/or Manufacturing Execution System (MES) with production control systems.
Upgrading Field Control Stations (FCS)	Control functions are updated by using the existing cabinets and field wirings. The adoption of the newest CPU achieves increment in computation speed and application capacities as well as advanced control in association with the MES functions. The network function which is essential to the CENTUM VP can be strengthened with the minimum investment.

1.1.1 Upgrading HMI

Operator stations of the existing systems are replaced with the latest CENTUM VP human interface stations (HIS). CENTUM VP communicates with the existing V net via AVR10D duplexed V net routers.

The following system configurations represent cases of upgrading HMI of CENTUM CS system, CENTUM VP (CS 3000) RIO System, and the system with PFC□.

The case of CENTUM CS shows when the upgrading of the CENTUM CS's HMI is performed by dividing the CENTUM CS system and CENTUM VP R6 system into two projects.

The rest of the cases show the upgrading of the entire system as a single project.
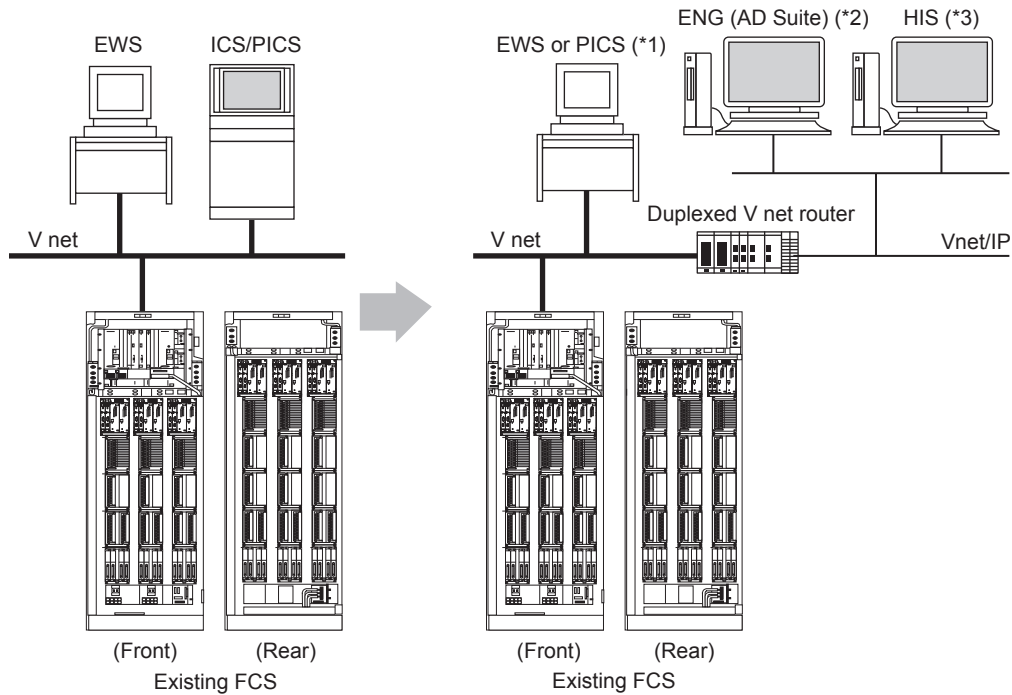
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*1:   At least one unit of the engineering stations (EWS or PICS) must be preserved for engineering and maintenance of the existing FCS.
*2:   ENG is a computer with an integrated engineering environment of Automation Design Suite (AD Suite), and it is used for engineering and maintenance of the upgraded components (V net router and HIS). Refer to "■ AD Suite" in Chapter 5.3 Upgrading HMI software (for engineering) for more details.
*3:   Multiple project connection package is required for operation and monitoring of the entire system.

Figure   Upgrading HMI in CENTUM CS system
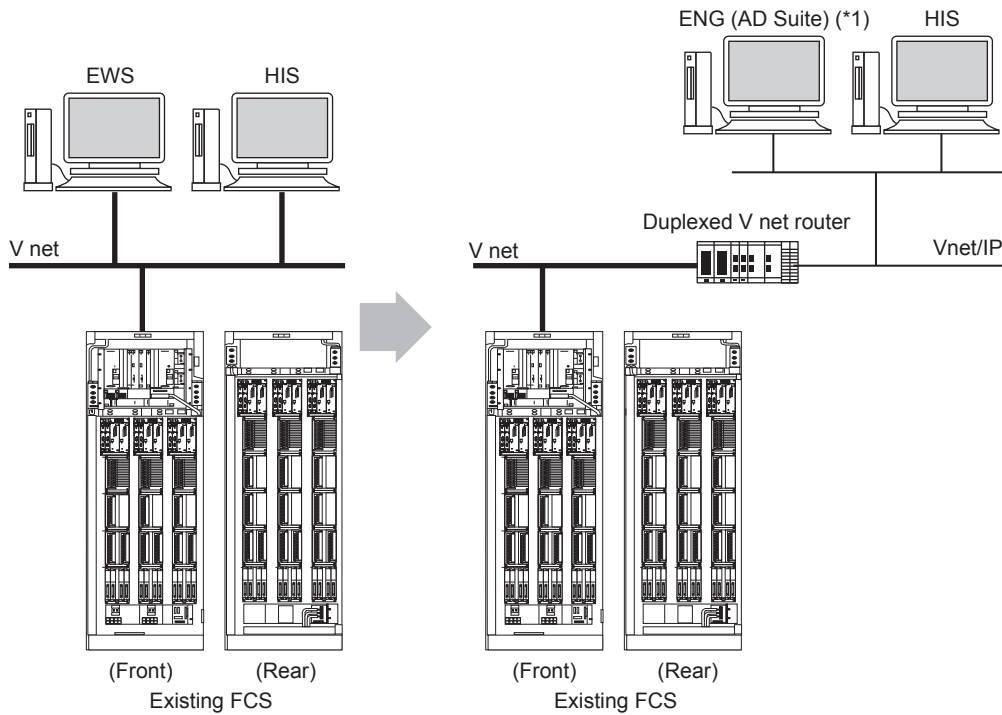
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Note: When the CENTUM VP (CS 3000) RIO system and the CENTUM VP R6 system are divided into two projects for upgrading, at least one unit of the engineering station (EWS or PICS) must be kept for engineering and maintenance of the existing FCS. For operation and monitoring of the CENTUM VP (CS 3000) RIO system, the multiple project connection package is required as well.
*1:   The ENG of the AD Suite is used as a station for engineering and maintenance of the upgraded components (V net router and HIS).

Figure   Upgrading HMI of CENTUM VP (CS 3000) RIO System
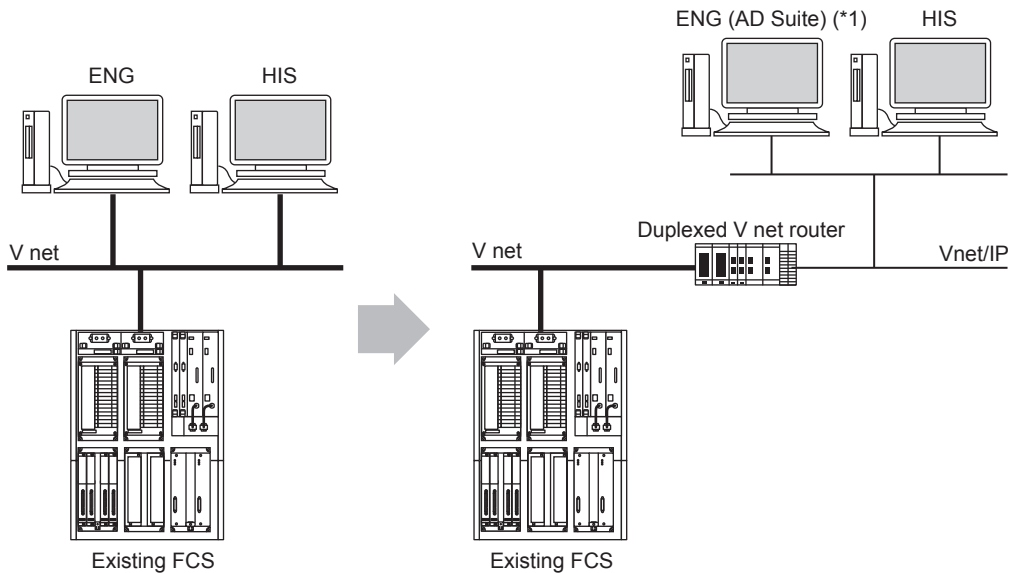
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Note: When the system with PFC□ and the CENTUM VP R6 system are divided into two projects for upgrading, at least one unit of the engineering station (EWS or PICS) must be kept for engineering and maintenance of the existing FCS. For operation and monitoring of the system with PFC□, the multiple project connection package is required as well.
*1:   The ENG of the AD Suite is used as a station for engineering and maintenance of the upgraded components (V net router and HIS).

Figure   Upgrading HMI of a system with PFC□

1.1.2   Upgrading FCS

The existing field control stations (FCS) are upgraded one by one by utilizing the existing cabinets and field wirings. The CPU units (which are field control units or FCU) of the existing FCS and I/Os are upgraded into the latest FCU and I/Os. The latest FCUs improve the processing performance, increase application capacities, comply with the increment of number of input/output channels, and implement control functions in linkage with the network functions. The new I/O units have functions compatible with the existing I/O units and those can be stored in the existing cabinets, which mean the upgrading can be done by modifying inside of the cabinets. The existing field wirings are utilized as they are without changing interfaces with the field devices, which helps to shorten the period for upgrading work.

Table   Overview of upgrading FCS

Upgrading unit	Product name	Descriptions
CPU unit	Field control unit (FCU)	Upgrading to the FCU dedicated for upgrading the RIO system.
Node interface unit	Node interface unit (NIU)	Both rack-mountable and cabinet types have the shapes compatible with the RIO systems. Upgrading to the NIU dedicated for upgrading the RIO system.
I/O modules	Analog I/O module	Upgrading to the I/O adaptor nests and I/O adaptors dedicated for upgrading the RIO system.
	Multiple control analog I/O module, Multiplexer module, and Digital I/O module	Upgrading to the multiple I/O modules dedicated for upgrading the RIO system. The modules are mounted directly into the NIU.
Communication modules	Various communication modules	Upgrading communication modules into FIO system. The modules are mounted on the empty slots of the I/O module slots of the FCU, node units for dual-redundant ESB bus, or node units for dual-redundant optical ESB bus.

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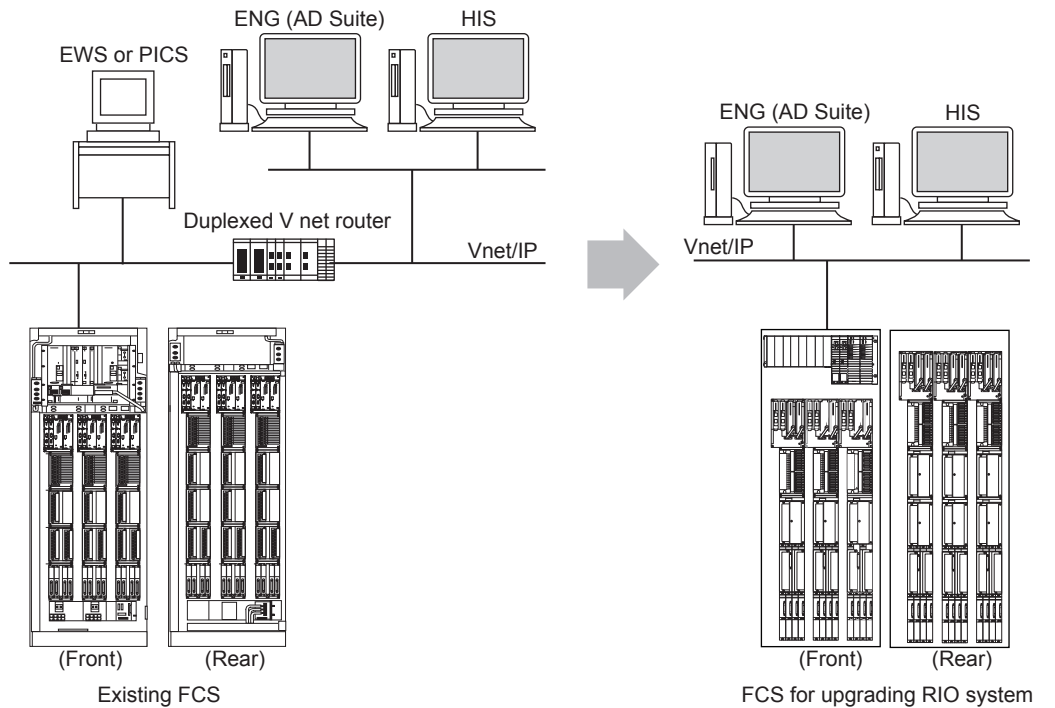
Figure   Upgrading FCS of CENTUM CS system
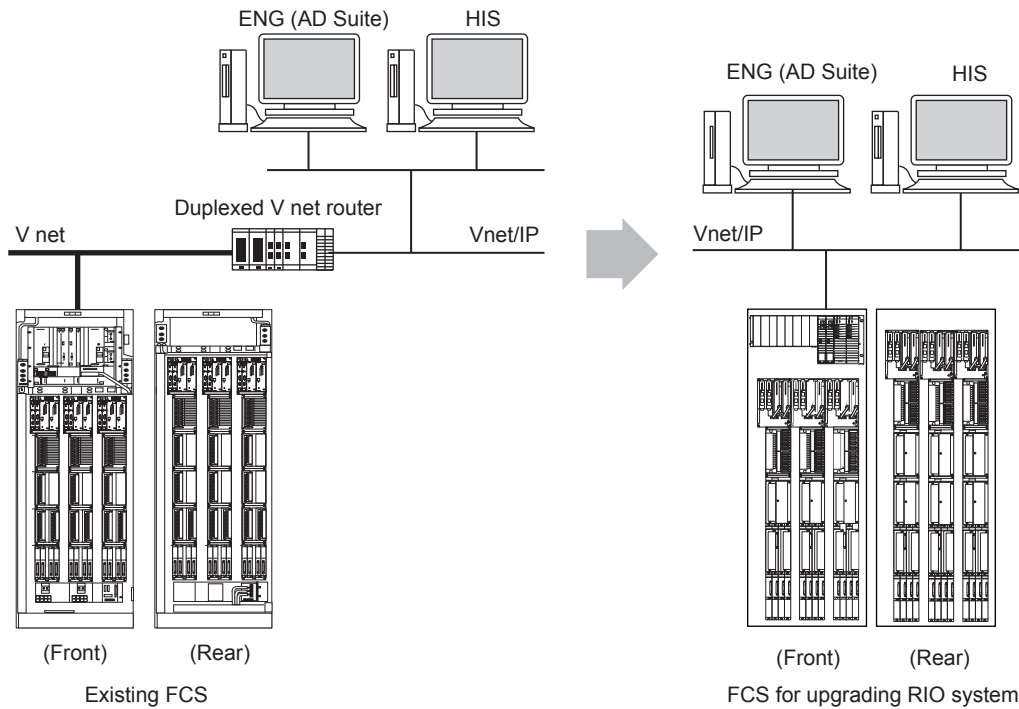
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Figure   Upgrading FCS for RIO System of CENTUM VP (CS 3000)
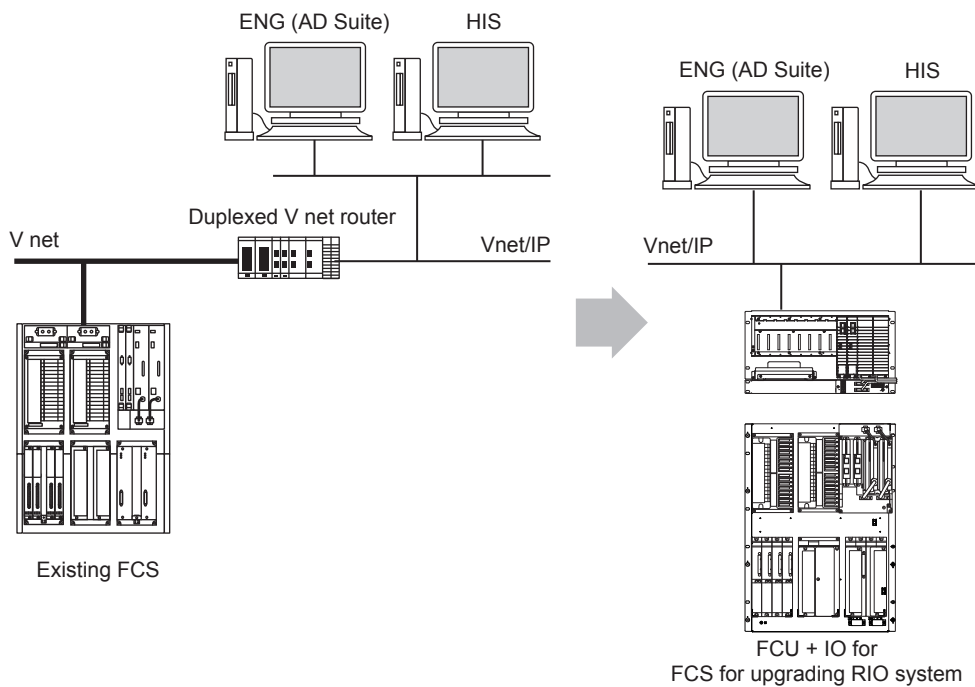
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Figure   Upgrading FCS of a system with PFC□

1.1.3   Remarks for phased system upgrade

When both the existing FCS and new FCS (for upgrading RIO system) exist in a network, communication loading of the V net needs to be attended as AVR10D duplexed V net router is added. For Inter-station communications to be performed via the AVR10D, contact the local Yokogawa office for the communication volume and how to deal with the communication failures.

1.2 Single-step upgrade

The control network of the existing RIO system is replaced with the Vnet/IP and upgrade both HMI and FCS at the same time.
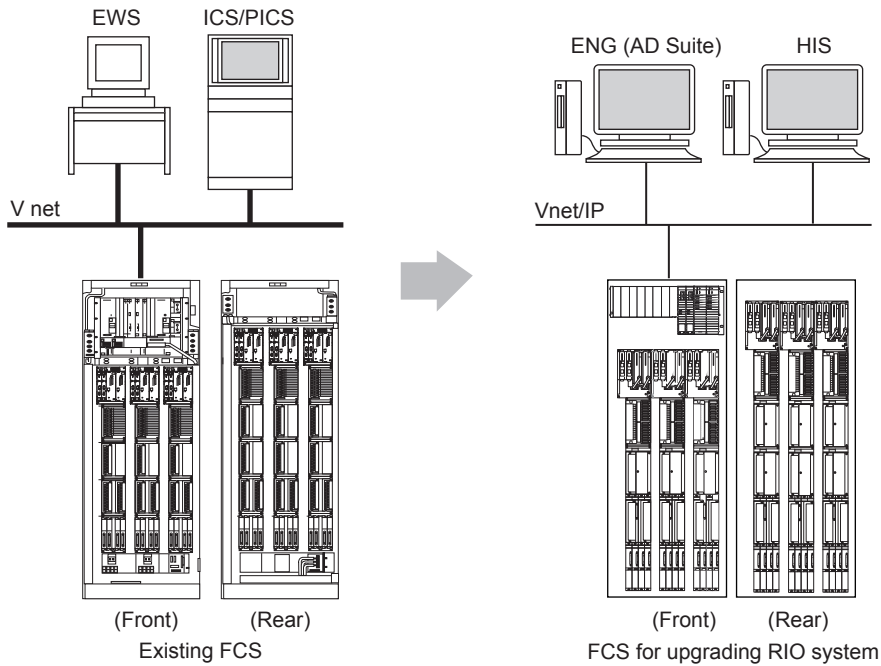
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Figure Single-step upgrade of CENTUM CS system
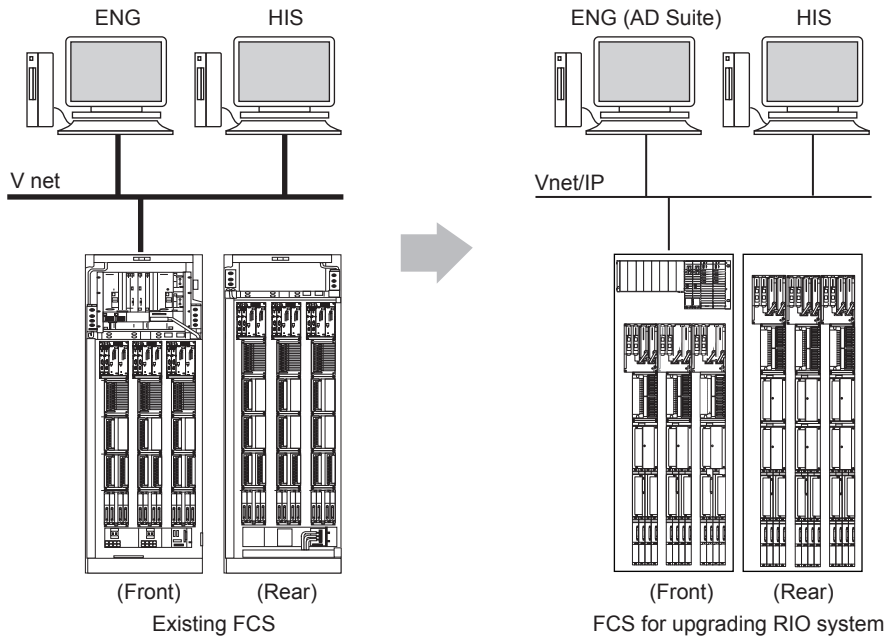
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Figure Single-step upgrade of CENTUM VP (CS 3000) RIO system
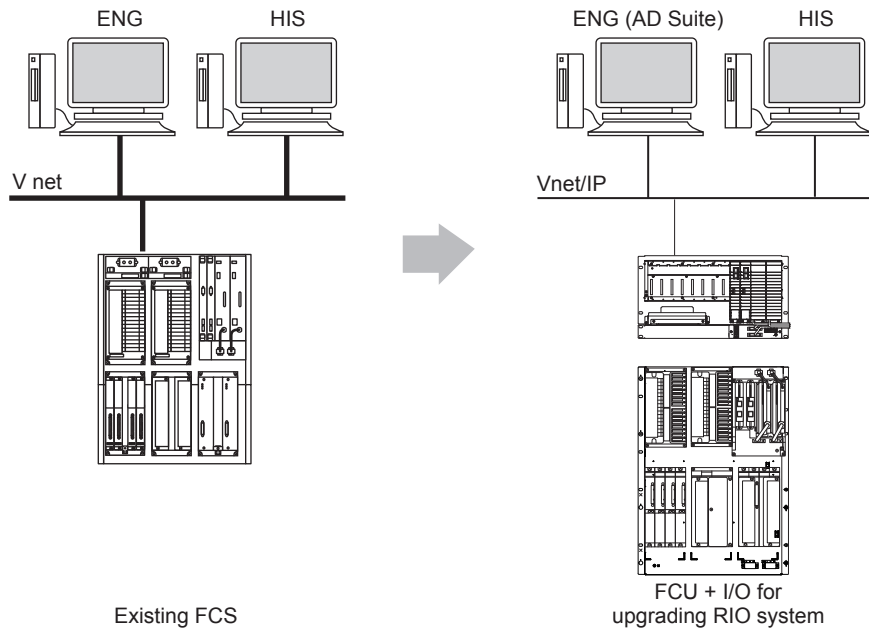
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Figure Single-step upgrade of a system with PFC□

2.   Scope of System Upgrade

The following system configuration shows the scope of applicable hardware for upgrading the RIO system.
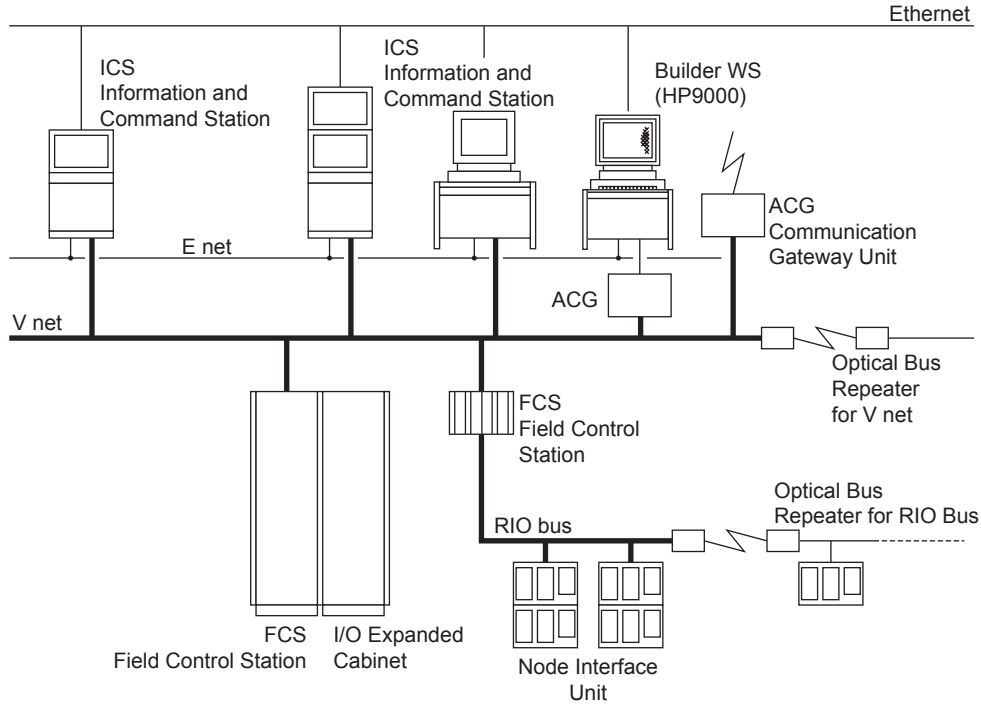
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Figure   Scope of applicable hardware for CENTUM CS System
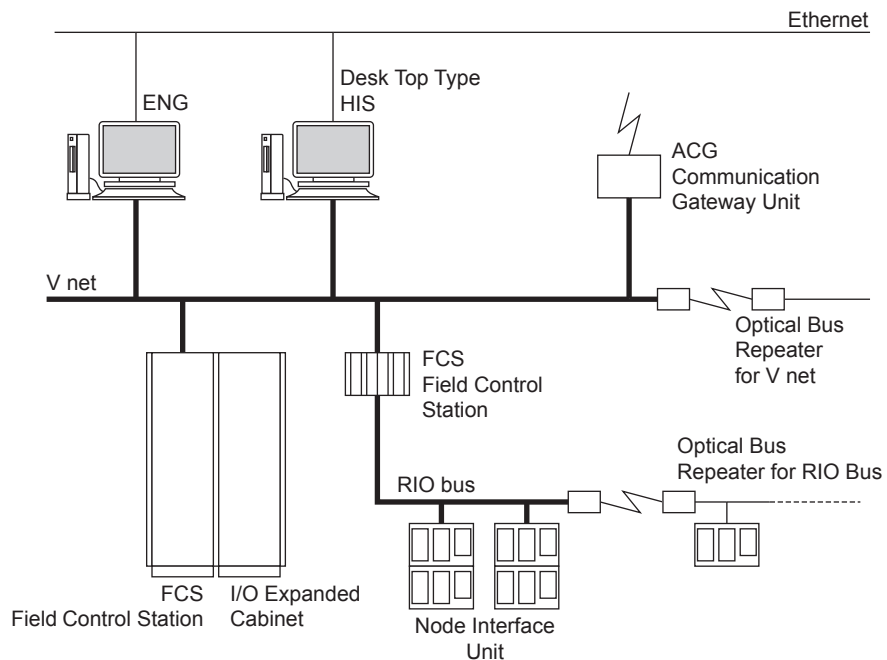
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Figure   Scope of applicable hardware for CENTUM VP (CS 3000) RIO system
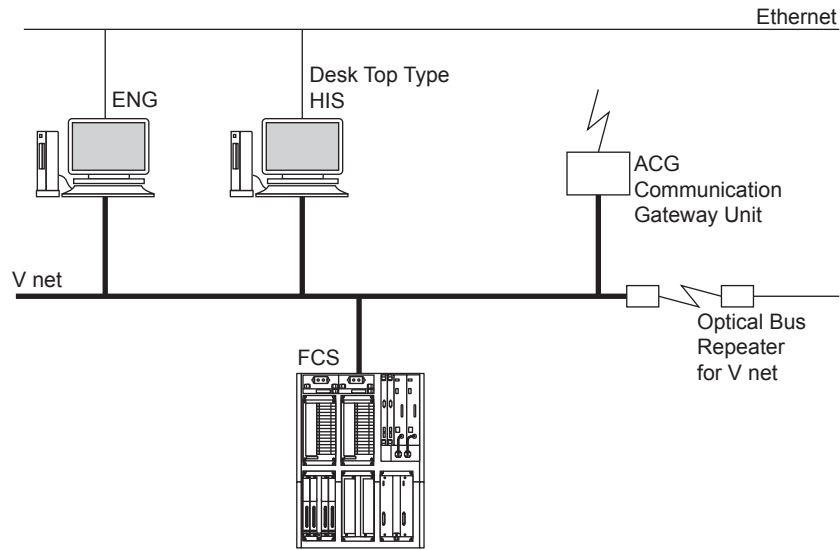
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Figure   Scope of applicable hardware for a system using PFC□

2.1   Applicable hardware of HMI

Followings are the different types of operator stations for upgrading.

| Console Type ICS | Desktop Type ICS | PICS | EWS |
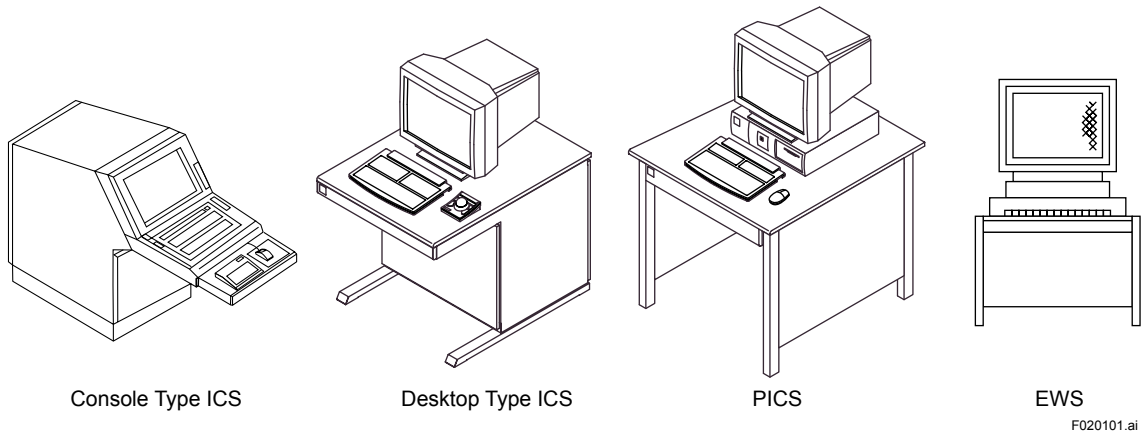
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Table   Operator stations applicable for upgrading

ICS	Information and command station (AIH21C Console type ICS)
	Information and command station (AIH00D Desktop type ICS)
PICS	PC-based information and command station
EWS	Engineering work station

2.2 Applicable Hardware of FCS

The table below shows the FCS models applicable for upgrading. These FCSs are turned into the latest FFCS-R field control station of the CENTUM VP by system upgrading.

Table   Applicable types of FCS

Upgrading system	System Name	Category	Main Memory	Model
CENTUM CS System	CENTUM CS	LFCS	8 MB	AFE□□□-S
				AFE□□□-L
				AFE□□□-H
			12 MB	AFE□□□-E
				AFM□□□-H
			16 MB	AFH□□□-S
				AFS□□□-H
CENTUM VP (CS 3000) RIO System	CENTUM CS 3000	LFCS	16 MB	AFS□□□-H
		LFCS2	32 MB	AFG□□□-H
	CENTUM VP	LFCS	16 MB	AFS□□□-H
		LFCS2	32 MB	AFG□□□-H
System using PFC□	CENTUM CS 1000	PFCS	8 MB	PFC□-S
			16 MB	PFC□-E
	CENTUM CS 3000	SFCS	8 MB	PFC□-S
			16 MB	PFC□-E
			16 MB	PFC□-H
	CENTUM VP	PFCS	8 MB	PFC□-S
			16 MB	PFC□-E
		SFCS	16 MB	PFC□-H

2.2.1 RIO system hardware components of applicable FCS

Table   I/O Expansion Cabinet

Model	Description
ACB21	I/O expansion cabinet

Table   Node Interface Units

Models	Descriptions
ANS10	Node interface unit for single RIO bus (19-inch rack mount type)
AND10	Node interface unit for dual-redundant RIO bus (19-inch rack mount type)
ANS50	Node interface unit for single RIO bus (19-inch rack mount type)
AND50	Node interface unit for dual-redundant RIO bus (19-inch rack mount type)
ANS20	Node interface unit for single RIO bus (Cabinet Installation Type)
AND20	Node interface unit for dual-redundant RIO bus (Cabinet installation type)

Table   I/O module nests

Models	Descriptions
AMN11	Nest for analog I/O modules
AMN12	High-speed nest for analog I/O modules
AMN21	Nest for relay I/O modules
AMN31	Nest for terminal I/O modules
AMN32	Nest for connector I/O modules
AMN33	Nest for communication modules
AMN34	Nest for multipoint control analog I/O modules
AMN51	Nest for communication cards

Table   I/O modules

Models	Descriptions
Analog I/O module	
AAM10	Current/voltage input module
AAM11	Current/voltage input module
AAM11B	Current/voltage input module (supports BRAIN)
AAM21	mV, thermocouple, and RTD input module
AAM21J	mV, thermocouple, and RTD input module (conforms to IEC584-1995 and IEC751-1995)
APM11	Pulse input module
AAM50	Current output module
AAM51	Current/voltage output module
AMC80	Multipoint analog I/O module
Relay I/O modules	
ADM15R	Relay input module
ADM55R	Relay output module
Multiplexer modules (16 points, terminal type)	
AMM12T AMM11T	Voltage input multiplexer module
AMM22M AMM21M	mV input multiplexer module
AMM22T AMM21T	Thermocouple input multiplexer module
AMM22TJ	Thermocouple input multiplexer module (conforms to IEC584-1995)
AMM32T AMM31T	RTD input multiplexer module
AMM32TJ	RTD input multiplexer module (conforms to IEC751-1995)
AMM42T	2-wire transmitter input multiplexer module
AMM52T	Output multiplexer module
Multiplexer modules (connector type)	
AMM12C	Voltage input multiplexer module
AMM22C	mV input multiplexer module
AMM25C	mV input multiplexer module with thermocouple interface (15 points, RCJ input port added)
AMM32C	RTD input multiplexer module (16 points)
AMM32CJ	RTD input multiplexer module (16 points, conforms to IEC751-1995)

Models	Descriptions
Digital I/O module	
ADM11T	Contact input module (16 points, terminal type)
ADM12T	Contact input module (32 points, terminal type)
ADM51T	Contact output module (16 points, terminal type)
ADM52T	Contact output module (32 points, terminal type)
ADM11C	Contact input module (16 points, connector type)
ADM12C	Contact input module (32 points, connector type)
ADM51C	Contact output module (16 points, connector type)
ADM52C	Contact output module (32 points, connector type)

Table   Communication modules

Models	Descriptions
ACM11	RS-232C communication module
ACM12	RS-422/RS-485 communication module
ACM21	RS-232C general-purpose communication card
ACM22	RS-422/RS-485 general-purpose communication card
ACM71	Ethernet communication module (for PFCS and PFCD)
ACF11	Fieldbus communication module
ACP71	PROFIBUS communication module

The equipment shown below is utilized as they are, and no changes in the existing field wiring is required.

- Signal conditioner cards and signal conditioner nests (when AMC80/AMM12C are used)
- Terminal boards, terminal blocks, and relay boards
- System cables (in between I/O modules and signal conditioner nests; I/O modules and terminal boards; and terminal blocks and relay boards)
- Field devices and field wirings
- Cabinets

2.2.2   Consolidation of intrinsic safety barrier solutions

When upgrading the RIO system, the existing, non-Yokogawa intrinsic safety (I.S.) barrier solutions can be consolidated. Refer to Chapter 4.2.5.2 I.S. barrier solution components for more details.
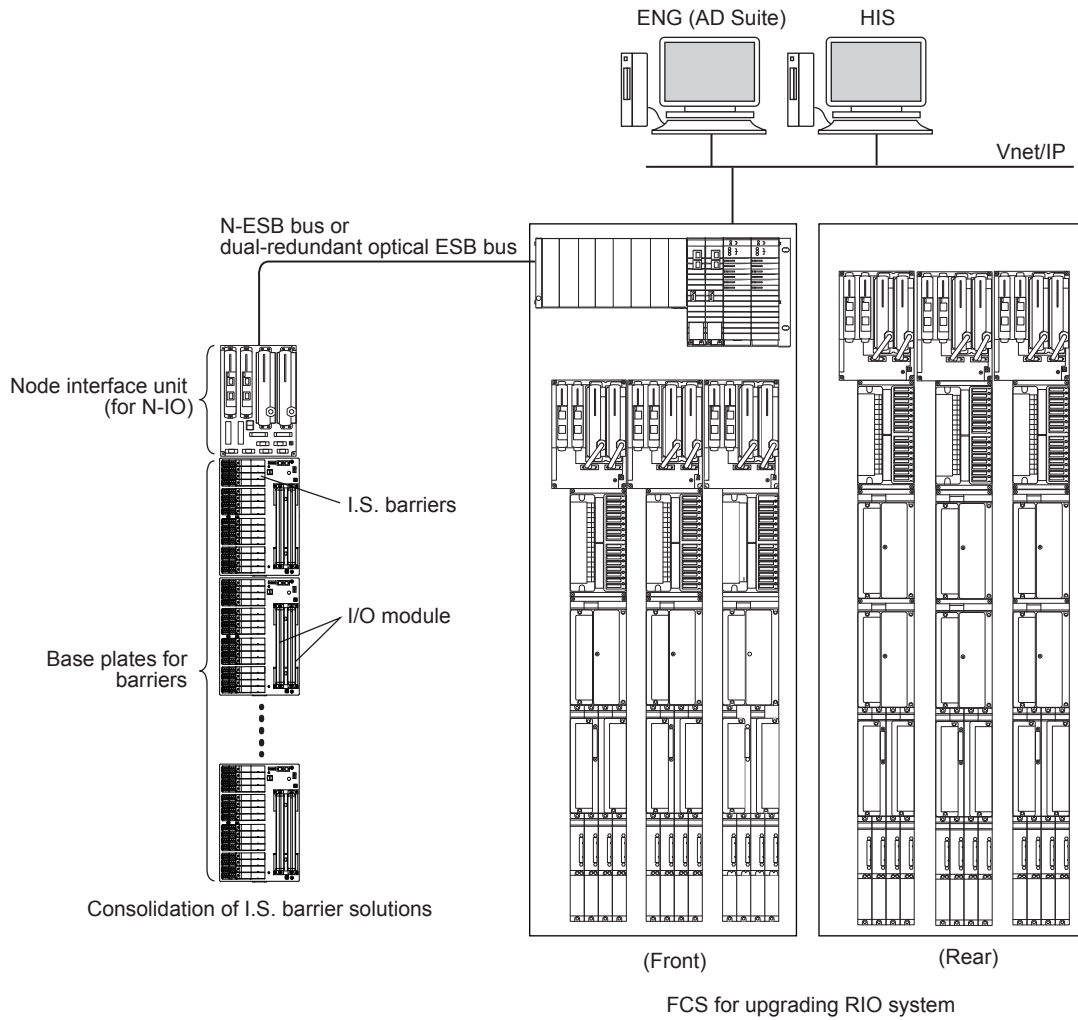
Figure   Consolidation of I.S. barrier solutions

2.3 Other hardware for upgrading

Table   Scope of hardware products for upgrading

Applicable model	Recommended models for replacement	Remarks
ACG10S	For Exaopc Station: General-purpose computer + OPC interface package (NTPF100)	—
YNT5□□□	For control bus : Small Form-Factor Pluggable (SFP) + L2SW/L3SW (network switch)	Upgrading to Vnet/IP (optical interface) (*1)
	For I/O bus: ANT□□□ (optical ESB bus repeater module)	Upgrading to optical ESB bus (*2)

*1:   Refer to functional differences of the FCS control network in Chapter 4.2.8 Functional differences between the existing FCS and upgraded FCS for more details.

*2:   Refer to functional differences of the I/O bus in Chapter 4.2.8 Functional differences between the existing FCS and upgraded FCS for more details.

2.4 Components and functions out of scope of upgrading

In this section, solutions to alternate components and functions (*1) which are out of scope of upgrading for CENTUM CS, CENTUM CS 1000/3000, and CENTUM VP.

*1:   Upgrading of PFC□ is included in the descriptions of CENTUM CS, CENTUM CS 1000/3000, and CENTUM VP.

2.4.1 System overall

■ Upgrading of RIO system from CENTUM CS

The table below shows software packages and functions that are out of scope of the RIO System Upgrade.

Table   Software packages and functions out of scope of RIO System Upgrade

Software package or function	Alternative solution
For power plant application: ・ SIE1100 Standard operation and monitoring function for power plant ・ SHW5112 Builder for power plant ・ SF□8640 Process alarm function for power plant ・ SF□8650 Faceplate block function for power plant ・ SF□8660 SEQ-TBL software license for power plant ・ SF□8670 Logic chart software license for power plant ・ SCE1210 Communication gateway function for power plant	Applications using HMI and FCS standard functions.
BRAIN communication (AAM11B Current/voltage input module (supports BRAIN); SIH5610 Sensor parameter definition package; and SF□2610 Sensor parameter communication package)	FieldMate
Hand Auto Station (HAS) connection	VP6H1150 Remote operation and monitoring package (HIS-TSE), etc.
Plant name	Applicable when a tag name consists of 14 alpha-numeric letters or less. Need change in tag names when a tag name has more than 14 alpha-numeric letters.
EI integration system (connecting with Yasukawa Electric Corp.'s products) ・ CP builder (SHW5122, SIH5122, and SIU5122) ・ CP communication package (SIH2810, SIU2810) ・ Operation sequence support package (SIH4210, SIU4210) ・ Test package for operation sequence (SHW5123, SIH5123, SIU512)	Upgrade with hardware and software from Yasukawa Electric Corp.
Applications for advanced control station (ACS)	Supported by advanced control (engineering), etc. ・ Off-site ACS JOBCON is supported by OIL Movement Suite-VP JOBCON (a software package developed by Yokogawa Solution Service Corp. (YJP)).

■ Upgrading of RIO system from CENTUM CS 1000/CS 3000 and CENTUM VP

The table below shows software packages and functions that are out of scope of the RIO System Upgrade.

Table   Software packages and functions out of scope of RIO System Upgrade

Software package or function	Alternative solution
BRAIN communication, AAM11B Current/voltage input module (supports BRAIN), and Sensor parameter definition package (Tokuchu)	FieldMate

2.4.2 For HMI Upgrade

■ Upgrading of RIO system from CENTUM CS

The table below shows software packages for HMI (operation & monitoring and engineering functions) which are out of scope of RIO System Upgrade.

● For Operation and monitoring functions

Table   Software packages out of scope of RIO System Upgrade

Model code	Description	Alternative solution
SIH120□	Multilingual package for ICS	Contact Yokogawa for languages other than English and Japanese.
SHW509□	Multilingual package for HP9000/700	
SIH2110	Ethernet communication driver	Windows standard function
SIH2120	RS-232C communication driver (TTY-Protocol)	Windows standard function
SIH2410	Remote server package for DDE	VP6H2411 Exaopc OPC interface package (for HIS) or NTPF100 Exaopc OPC interface package
SIH4120	Graphic 4 time size panel display package	Large monitor/panel
SIH4130	ITV window display package	Third-party product
SIH4131	ITV window control package	Third-party product
SIH4170	Voice output package	Windows application
SIH4180	Computer window package	Windows application (server/client)
SIH6500	Data acquisition package for ICS	Replace with the following functions: · VP6H6510 long-term data archive package · VP6H6530 report package · NTPP001 Exaquantum plant information management system
SIH6510	Long-term trend display package	
SIH6520	SQC package for ICS	
SIH6530	Logging package for ICs	
SHW6661	CS batch recipe management interface	Tokuchu software
SIH6663	CS batch production information management interface	NTPF100 Exaopc OPC interface package

● For Engineering functions

Table   Software packages out of scope of RIO System Upgrade

Model code	Description	Alternative solution
SIH5498	CS Database package	Third-party software or NTPP001 Exaquantum plant information management system
SIH5610	Sensor parameter definition package	Defining sensor parameters by FieldMate
SIH6310	Fuzzy-logic control package	Advanced control (engineering)
SIH6330	PREDICTROL package	Advanced control (engineering)
SIH5021	C language execution control package	Tokuchu software
SHW5030	C language development environment package	Tokuchu software

■ **Upgrading of RIO system from CENTUM CS 1000/CS 3000**

The table below shows software packages for HMI (operation & monitoring and engineering functions) which are out of scope of RIO System Upgrade.

● **For Operation and monitoring functions**

Table   Software packages out of scope of RIO System Upgrade

for CS 1000	for CS 3000	Description	Alternative solution
Model code			
PHS2410	LHS2410	Open data interface package for DDE	VP6H2411 Exaopc OPC interface package (for HIS) for NTPF100 Exaopc OPC interface package
—	LHS4130	ITV window package	
PHS7110	LHS7110	Web monitoring package	VP6H1150 server for remote operation and monitoring function

● **For Engineering functions**

No package is out of scope of RIO System Upgrade. (All packages are subject to upgrading.)

■ **Upgrading of RIO system from CENTUM VP**

For upgrading HMI functions (operation and monitoring and engineering functions), no package is out of scope of RIO System Upgrade. (All packages are subject to upgrading.)

2.4.3   For FCS Upgrade

■ **Upgrading of RIO system from CENTUM CS**

The tables below shows software packages which are out of scope of RIO System Upgrade.

Table   Software packages for FCS out of scope of RIO System Upgrade

Model code	Description	Alternative solution
SF□2610	Sensor parameter communication package	FieldMate
SF□3310	Fuzzy-logic control package	Advanced control (engineering)
SF□3330	PREDICTROL package	Advanced control (engineering)
SFH8630	SAMA block package	Tokuchu software

Table   Subsystem communication software packages out of scope of RIO System Upgrade

Model code	Description	Alternative solution
SFH9063	ACM11 Siemens communication function package	Tokuchu software
SFH9078	ACM12 Siemens communication function package	Tokuchu software

Table   I/O modules out of scope of RIO System Upgrade

I/O module related functions out of scope of RIO System Upgrade	Alternative solution
SP1 (Special linearization table)	Supported by control applications: Use the following function blocks. (*1) (*2) (*3) (*4) · FUNC-VAR · ZCTEMP Tokuchu function blocks
SQRT (Square-root process)	Supported by control applications: Use the input signal conversion of function blocks to perform SQRT (square root) calculation. (*4)
NON (Linearization of mV input module)	Supported by control applications: When the following input modules are used in the FCS with those linearization is specified as NON (through mode), use control application to convert them to 0-100%. Applicable modules are: · AMM11T/AMM12T Voltage input multiplexer module · AMM42T Current input module · AMM21M/AMM22M mV input module
Auxiliary voltage output (*5) of analog input modules (AAM10, AAM11, AAM11B, AAM21, and AAM21J) and auxiliary output (*6) of pulse input module (APM11)	Supported by control applications: This module receives and calculates contact pulse, voltage pulse and current pulse from fields. It also carries out signal conversion of input signals to isolated transistor contact pulses, and outputs these as an auxiliary output.

*1:   Use ZCTEMP to convert for either of the followings:
          - Number of conversion table is 16 points or more
          - The quadratic interpolation is specified.
*2:   Alternating RTD input with SP1, specify the process output of the I/O module as RD and then select "RTD input (ohm)" for signal conversion in the IOM builder so that the resistance value (unit ohm) of the RTD can be obtained. Convert this value to a temperature by inputting it into FUNC-VAR or ZCTEMP.
*3:   When alternating SP1 function with the function block, the input range must be set at the default.
*4:   When alternating SQRT and SP1 functions with function blocks, the upper and lower limits of IOP detection differ. As for RIO, the IOP is detected by the value after converted by SQRT or SP1. As for I/O modules for RIO System Upgrade, IOP is detected by the value before conversion.
*5:   The auxiliary voltage output is 1 - 5 V DC signal output from a CN1 connector of AMN11 nest to be used by recorders and analog I/O modules.
*6:   The auxiliary output used for pulse input modules is converted to a transistor contact pulse with input signals isolated.

Table   Other functions out of scope of RIO System Upgrade

FCS related functions out of scope of RIO System Upgrade	Alternative solution
IDCOM-Y	Advanced control (engineering)
Multiple area support	Combine multiple areas into one by engineering (performed by Yokogawa with fee).

■ Upgrading of RIO system from CENTUM CS 1000/CS 3000 and CENTUM VP

The tables below show software packages and functions related to FCS, which are out of scope of RIO System Upgrade.

Table   Software packages for FCS out of scope of RIO System Upgrade

for CS 1000	for CS 3000/ VP	Description	Alternative solution
Model code			
PFS9063	LFS9063	SYSMAC communication package (for ACM11, ACM12)	Tokuchu software
PFS9055	LFS9055	Siemens communication package (for ACM11, ACM12)	Tokuchu software
PFS2211	LFS2211	DARWIN communication package (for ACM11)	Tokuchu software

Table   I/O module functions out of scope of RIO System Upgrade
         (Common for CENTUM CS 1000/CS 3000 and CENTUM VP)

I/O module related functions out of scope of RIO System Upgrade	Alternative solution
SP1 (Special linearization table)	Supported by control applications: Use the following function blocks. (*1) (*2) (*3) (*4) · FUNC-VAR · ZCTEMP Tokuchu function blocks
SQRT (Square-root process)	Supported by control applications: Use the input signal conversion of function blocks to perform SQRT (square root) calculation. (*4)
Duplexed contact output module when both status and pulse-width output are in PFCS/SFCS	Define contact output module independently for status output and for pulse-width output. (*5)
Specifying pulse-width output of PFCS/SFCS contact output module to even-number channels	Pulse-width output is used starting from odd-number channel in output modules for RIO system upgrade. Even-number channels are assigned from even-number channels, which require change in wiring for field signal wirings.
Auxiliary voltage output (*6) of analog input modules (AAM10, AAM11, AAM11B, AAM21, and AAM21J) and auxiliary output (*7) of pulse input module (APM11)	Supported by control applications: This module receives and calculates contact pulse, voltage pulse and current pulse from fields. It also carries out signal conversion of input signals to isolated transistor contact pulses, and outputs them as auxiliary output.

*1:   Use ZCTEMP to convert for either of the followings:
           - Number of conversion table is 16 points or more
           - The quadratic interpolation is specified.
*2:   Alternating RTD input with SP1, specify the process output of the I/O module as RD and then select "RTD input (ohm)" for signal conversion in the IOM builder so that the resistance value (unit ohm) of the RTD can be obtained. Convert this value to a temperature by inputting it into FUNC-VAR or ZCTEMP.
*3:   When alternating SP1 function with the function block, the input range must be set at the default.
*4:   When alternating SQRT and SP1 functions with function blocks, the upper and lower limits of IOP detection differ. As for RIO, the IOP is detected by the value after converted by SQRT or SP1. As for I/O modules for RIO System Upgrade, IOP is detected by the value before conversion.
*5:   Duplexed configuration cannot be selected for contact output module when both the status and the pulse-width output are used at the same time.
*6:   The auxiliary voltage output is 1 - 5 V DC signal output from a CN1 connector of AMN11 nest to be used by recorders and analog I/O modules.
*7:   The auxiliary output used for pulse input modules is converted to a transistor contact pulse with input signals isolated.

3.   RIO system upgrade procedure

3.1   Upgrade procedure

The following diagram shows a typical upgrade procedure of the RIO system. The procedure and tasks may vary by existence of life cycle maintenance agreement, and method of upgrading and inspection.

START

Check items mounted on the existing system

Any items to be used continuously? — Yes →

Information required for investigation
• System configuration

Investigate items be used continuously

Investigation/report items
• Check components of the existing control stations
• Check system history
• Check installation environment
• Evaluate deterioration on site
• Propose life-prolong measures and
  remedial treatment based on the investigation results.

No

Need remedial treatment? — Yes →

Provide remedial treatment

No

Estimation & implementation
• Replacement of deteriorated components
• Inspection and maintenance
  (Disassemle & clean the components)

Estimation and budgeting of hardware expansion & modification and upgrade application software

Information required for estimation
• System configuration
• Existence of non-standard hardware
• Capacity of each application
• Alternative solutions to upgrade the existing functions
• Existence of non-standard software
• Existence of annual maintenance contract and its program
• Count number of actual I/O points and communication I/O points

Inspection of delivered hardware

• Inventory check
• Hardware functional test

Application software upgrade

• Convert engineering data
• Respond to functional differences
• Apply new and expansion functions (*1)
• Debug test under test environment

Operation check on the target system

• Convert and upgrade tuning parameter
• Perform functional check

Hardware modification and expansion

• Install Vnet/IP and add HIS
• Add V net router (for phased system upgrade)
• Upgrade existing FCU in FCS into CENTUM VP FCU
• Upgrade NIU and I/O units
• Onsite tuning after upgrade (performance check between I/O cards and FCU)

On-site system operation check

• Readjustment of tuning parameters
• Check operation timing

END

F030001.ai

*1:   In case new or expanded functions exist at the same time at the system upgrade.
Figure   Upgrade Procedure

3.2 Confirmation of Existing System Configuration

Prior to implement the RIO System Upgrade, confirm what components are mounted in the existing system.

● **Purpose of checking the existing system**

Check the existing system to find out what components are mounted so that items required for RIO System Upgrade can be determined. In case rack-mount type of modules are adopted, confirm the existence of the cabinets, and determine if new (additional) or modification of cabinets are required for upgrading or not.

IMPORTANT

Especially, in case of proposing PFC□ to upgrade, empty space in up/bottom of the cabinet is required to install A2FV70□ FCU. In case such empty space is not available, addition of a cabinet has to be considered.

● **Check the existing system configuration**

The actual system configuration must be conducted against the manufacturing specifications (for hardware and application software) and outputs of self-documents. The items to be confirmed are as shown below:

<System overall>

- · Investigation of power supply systems
- · Installation of network control buses
- · UPS (for the entire systems)
- · Counting the number of actual I/O points and communication I/O points
- · Others

<For HMI>

- · HMI (console, desktop), external contact I/O (push button input, annunciator output)
- · HMI (console, desktop), sound input/output terminal/sound definition information
- · UPS (for HMI)
- · External monitor output (for large screen output)
- · Peripherals (message output printer, color hard copy unit, back-up equipment)
- · Others

<for FCS and cabinets>

- · Special auxiliary output
- · Cold-junction compensation input
- · Shunt resister mounting
- · Relay contact
- · Others

3.3 Check healthiness of instruments to be used continuously

In case some of the existing instruments are used continuously after the system upgrade, check the healthiness of those instruments. The check items may vary by the time-based degrading and the maintenance status.

● **Purpose of checking**

Those existing instruments can be used safely after upgrading the system depending on the healthiness of them. During this pre-assessment, following items are inspected at each control room where those instruments are installed. The results of the investigation will be reported along with the suggestions for remedial treatment and improvements.

● **Workflow**

```
      ┌──────────────┐
      │    Start      │
      └──────┬───────┘
             │
      ┌──────▼───────┐       Examine the history records of the systems
      │ Examine system│      and equipment to be re-used.
      │ history records│
      └──────┬───────┘
             │
      ┌──────▼───────┐       Measure the installation environment by
      │ Assess installation│  using the dedicated measuring instruments.
      │ environment   │
      └──────┬───────┘
             │
      ┌──────▼───────┐
      │ Check equipment│
      │    status     │
      └──────┬───────┘
             │
      ┌──────▼───────┐
      │ Evaluate results of│
      │ investigaion &│
      │ observation   │
      └──────┬───────┘
             │                Judging by the results of investigation and
      ┌──────▼───────┐        observation, Yokogawa proposes improvements
      │ Submission of reports│ and counter-measures for stabilizing the operation
      └──────┬───────┘        of the systems for a long time. If the assessment
             │                is not sufficient for judgment, Yokogawa
      ┌──────▼───────┐        proposes diagnosis of environment and deterioration
      │     End       │        for further details.
      └──────────────┘
```
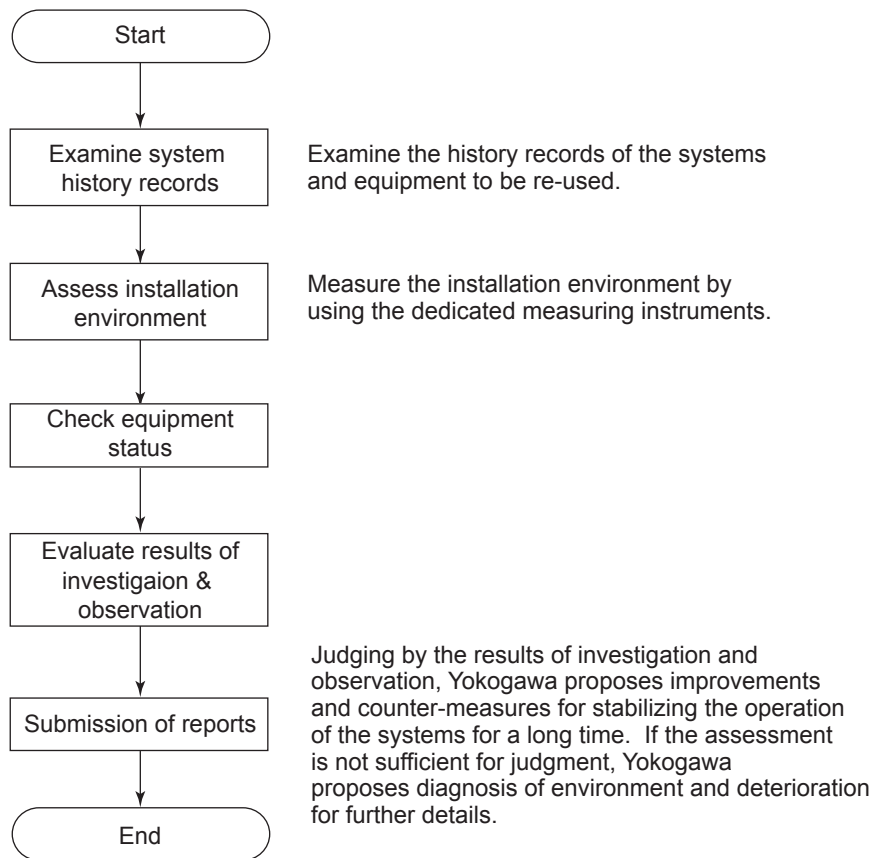
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Figure   Workflow

● **Menu for examining system history records**

- Occurrence of unconformity caused by the installation environment
- Time to replace spare parts with limited life
- Occurrence of unconformity incidents caused by deterioration

● **Assessment menu for installation environment**

Temperature, humidity, volume of floating dust, and density of corrosive gas (H_2S, SO_2, and Cl_2)

● **Check menu for equipment status**

- Inside and outside of cabinets (filters, dusts on fans, corrosion on terminal screws, etc.)
- Dusts on the surface of I/O cards
- Patterns of printed circuit boards (exfoliation, corrosion, etc.)
- Soldering (creeping)
- Surface of components and parts (corrosion on IC read parts)
- Contacts (connectors' gold-plating, pitting by corrosion)
- Inspectors' stamps (condensation)
- Coating of I/O cards and CPU cards (*1) (discoloring, cracking).

Note: Wiring for power supplies (power distribution), signal wiring (between field and I/O signals) are not included in the check menu for equipment status.
*1: For the I/O cards with coating treatment only.

● **Reporting**

In order to continuously use the existing equipment with stability for long years, Yokogawa suggests necessary improvements and countermeasures.

Table   Check menu, countermeasures and remedial treatments

Check menu	Countermeasures and remedial treatments	
• Failures and incidents occurred in the plant through operation history • Temperature, humidity, dusts, corrosive gas • Daily operation environment by interviews • Years of operation for spare parts with limited lifespan	Inspection and maintenance	I/O cards and units are dismounted and cleaned. Functional inspections are performed to confirm the healthiness of the I/O cards and units.
	Replacement of deteriorated components and parts	Spare parts with limited lifespan described in the instruction manuals (IM) (*1) and other spare parts that deteriorate in 10 years or longer are replaced. (*2)
	Partial replacement	In case failures are frequented or deteriorations are severe, and replacement by the part is difficult, the entire unit, card, or cable is replaced.

*1: Spare parts with limited lifespan mean fans, condensers, fuses, filters, and relays.
*2: The table on the next page shows the equipment and components that are to be used continuously and where those are used.

Table   Equipment, components, and parts to be re-used

Product names	Locations (except for products with limited lifespan)	Countermeasures and remedial treatments
Signal conditioner cards	Fuse, variable resistors, aluminum electrolytic capacitors, photo couplers	Deteriorated modules and cards are replaced (overhauled)
Signal conditioner nests	Connectors, printed circuit boards (PCBs)	Replacement by the unit
Terminal boards, terminal blocks, relay boards	Aluminum electrolysis capacitors, connectors, PCBs	Replacement of deteriorated parts or by the unit
KS cables	Connectors	Replacement of cables
Power supply cables	Connectors	Replacement of cables

3.4   Activities for Improvements

Based on the feasibility study of the existing system, Yokogawa proposes an upgrading plan, discusses with customers in details, and take actions for improvements with customers' approval.

The activities for improvements require separate estimation and are implemented with onerous contract.

4. Upgrading hardware

4.1 Upgrading HMI hardware

● Upgrading hardware for operation and monitoring

The following figures show how to upgrade operation and monitoring functions. Install the latest software packages of operation and monitoring functions to an off-the-shelf PC and connect an operation keyboard to upgrade it to the CENTUM VP R6 HIS.

AIH21C console type   AIH00D desk-top type

Information Command Station (ICS)

HIS

PICS PC-based ICS
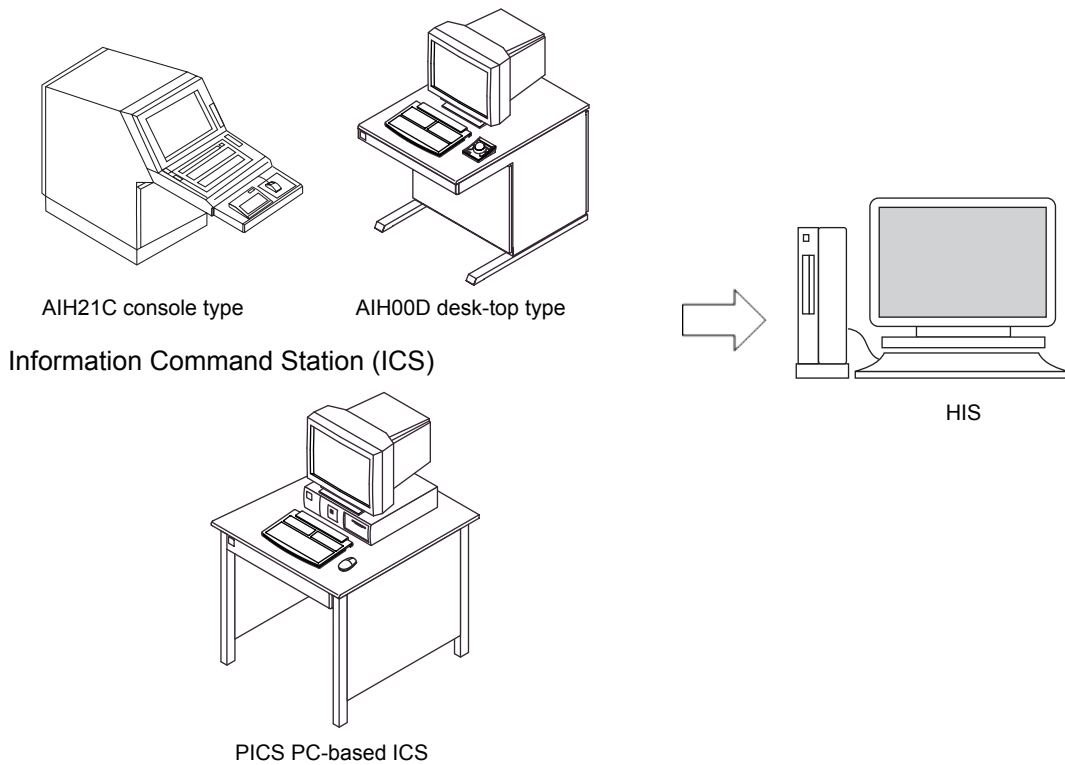
F040101.ai

HIS: Human interface station with AIP83□ operation keyboard

● Upgrading the Engineering Hardware

Upgrading the hardware for engineering functions is to replace old types of engineering stations with a new PC installed with the latest software packages of CENTUM VP R6 ENG (AD Suite) as shown below.

PICS   EWS   ENG (AD Suite)

F040102.ai

4.2 Upgrading hardware of Field control stations

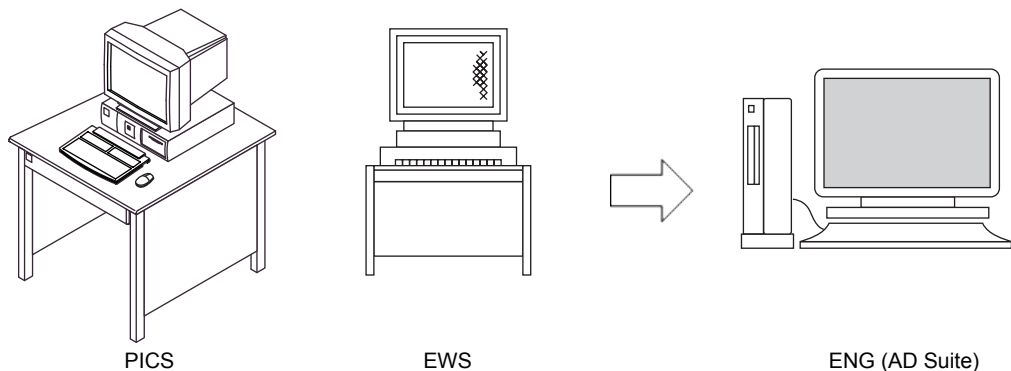By using Field control units (FCU), Node interface units (NIO) and I/O cards exclusively developed for upgrading the RIO systems, the existing field control stations (FCS) for RIO system are upgraded.

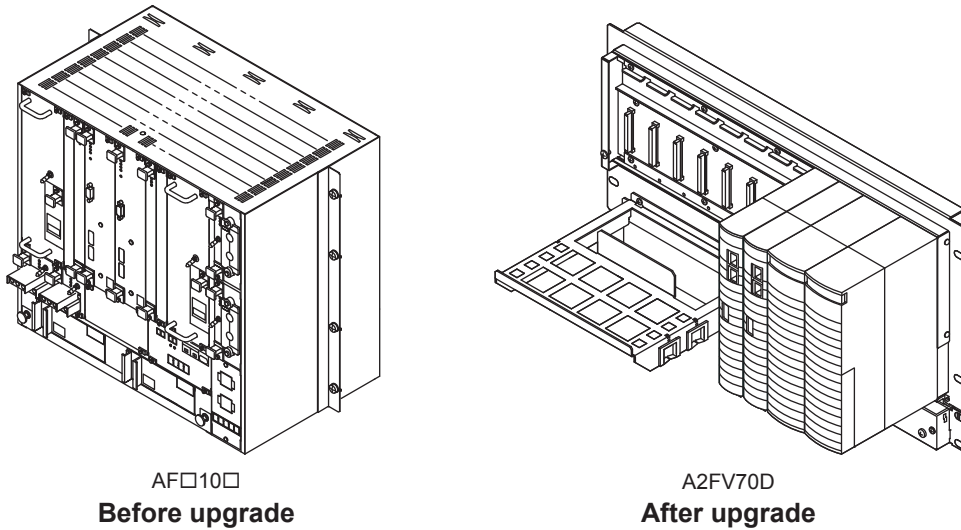## 4.2.1 Upgrading FCU

● Upgrading rack-mountable type FCU

Existing FCU		FCU after upgrading	
Model	Description	Model	Description
AFE10S	Field control unit (19-inch rack mountable type, main memory 8 MB, for V net/RIO)	A2FV70S	Field control unit (for RIO System Upgrade, 19-inch rack mountable)
AFM10S	Field control unit (19-inch rack mountable type, for V net/RIO)		
AFH10S	Field control unit (19-inch rack mountable type, capacity expanded type, for V net/RIO)		
AFS10S	Field control unit (19-inch rack mountable type, capacity enhanced type, for V net/RIO)		
AFG10S	Field control unit (19-inch rack mountable type, for V net/RIO,)		
AFE10D	Duplexed field control unit (19-inch rack mountable type, main memory 8 MB, for V net/RIO)	A2FV70D	Duplexed field control unit (for RIO System Upgrade, 19-inch rack mountable)
AFM10D	Duplexed field control unit (19-inch rack mountable type, for V net/RIO)		
AFH10D	Duplexed field control unit (19-inch rack mountable type, for V net/RIO)		
AFS10D	Duplexed field control unit (19-inch rack mountable, function expanded type, for V net/RIO		
AFG10D	Duplexed field control unit (for 19-inch rack mountable type, for V net/RIO)		

● Upgrade items

The figure below shows an image how the existing rack mountable type FCU is upgraded into A2FV70□ Rack mountable FCU for RIO System Upgrade.

SEE ALSO For the details of the A2FV70□ FCU, after upgrading, refer to the General Specifications (GS), "Field control unit, Cabinet utility kit (for RIO System Upgrade)" (GS 33J64E10-01EN).

AF☐10☐
Before upgrade

A2FV70D
After upgrade

F040201.ai

Figure   Upgrading rack mountable type FCU

● Upgrading cabinet type FCU

Existing FCU types		FCU types after upgrading	
Model	**Description**	**Model**	**Description**
AFE20S	Field control unit (with cabinet, for V net/RIO)	A2FV70S /HKU + A2CUKT3 -C☐☐☐	Field control unit (for RIO System Upgrade, 19-inch rack mountable) (with HKU interface) and Cabinet Utility Kit (for RIO System Upgrade) (for FCU with cabinet (for A2FV70☐/HKU))
AFM20S	Field control unit (with cabinet, for V net/RIO)		
AFH20S	Field control unit (with cabinet, capacity expanded type, for V net/RIO)		
AFS20S	Field control unit (with cabinet, capacity enhanced type, for V net/RIO)		
AFG20S	Field control unit (for RIO, with cabinet)		
AFE20D	Duplexed field control unit (with cabinet, for V net/RIO)	A2FV70D /HKU + A2CUKT3 -C☐☐☐	Duplexed field control unit (for RIO System Upgrade, 19-inch rack mountable) (with HKU interface) and Cabinet Utility Kit (for RIO System Upgrade) (for FCU with cabinet (for A2FV70☐/HKU))
AFM20D	Duplexed field control unit (with cabinet, for V net/RIO)		
AFH20D	Duplexed field control unit (with cabinet, capacity expanded type, for V net/RIO)		
AFS20D	Duplexed field control unit (with cabinet, capacity enhanced type, for V net/RIO)		
AFG20D	Duplexed field control unit (for RIO, with cabinet)		

Note: HKU stands for house keeping unit.

● Upgrade items

The figure below shows an image how the existing FCU with cabinet is upgraded into A2FV70□/ HKU Cabinet for RIO System Upgrade and A2CUKT3-C□□□ cabinet utility kit. The cabinet utility kit includes a fan unit, a housekeeping unit, and other components indispensable for RIO System Upgrade.

SEE ALSO For the details of the A2CUKT3-C□□□ cabinet utility kit, refer to Section 4.2.6 "Upgrading cabinets" and the General Specifications of "Field control unit, cabinet utility kit (for RIO System Upgrade)" (GS 33J64E10-01EN).

Field control unit (for RIO)

Field Control Unit (for RIO System Upgrade)

Node interface unit (for RIO)

Node interface unit (for RIO System Upgrade)

Analog I/O module nest (for RIO)

Cabinet utility kit (for RIO System Upgrade)

I/O adaptor nest (for RIO System Upgrade)

Power distribution board (for RIO)

Multiplexer module (for RIO) or Digital I/O module (for RIO)

Multi-channel I/O module (for RIO System Upgrade)

AF□20□

A2FV70□＋A2CUKT3-C□□□

Before upgrade

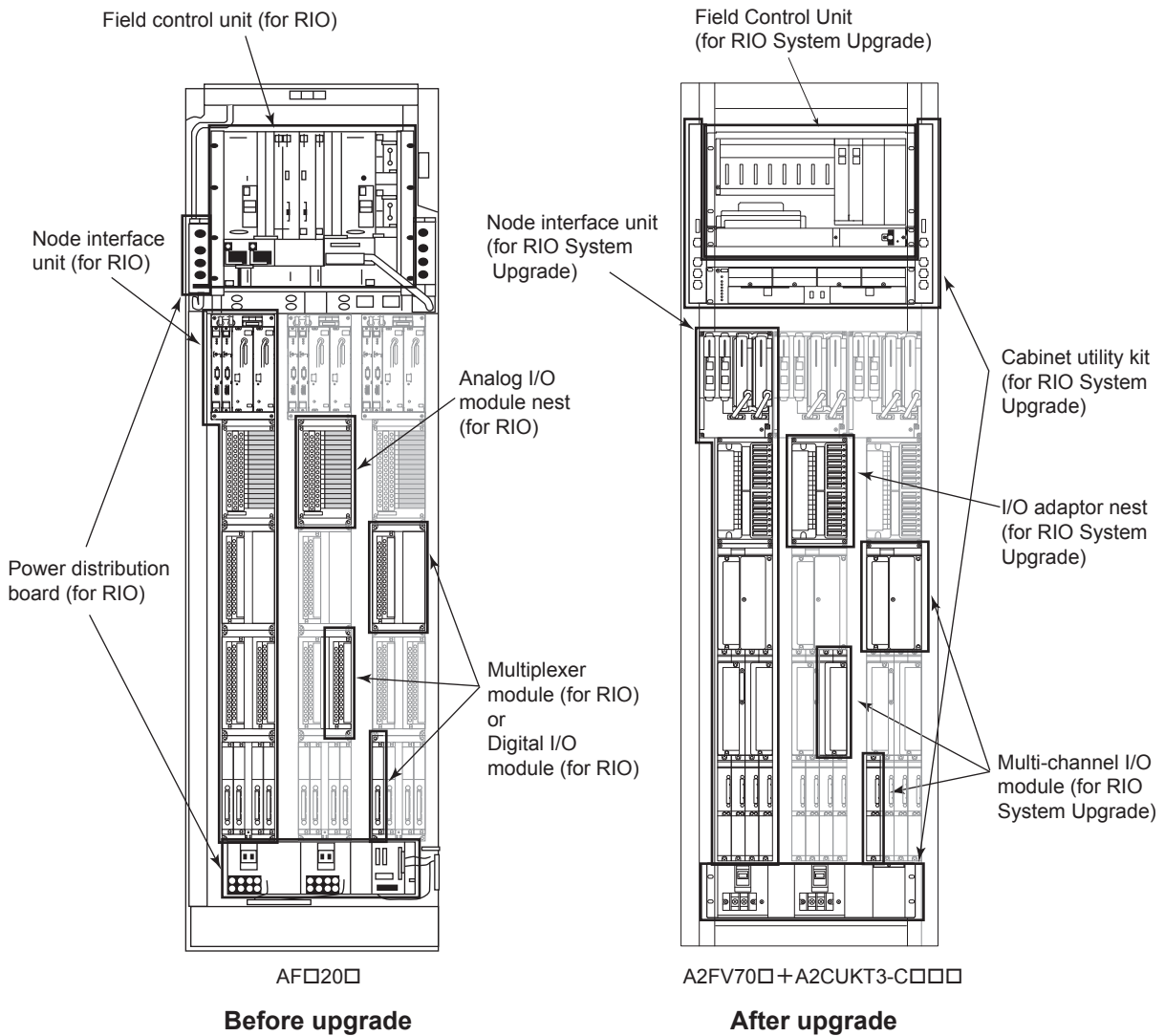**After upgrade**

F040202.ai

Figure   Upgrading FCU with cabinet

4.2.2 Upgrading PFC□

● Upgrading PFC□ control station

Existing model & description		Upgraded model & description	
PFCS	Control station	A2FV70S + A2NN10D □□5□□□□□□	Field control unit (for RIO System Upgrade, 19-inch rack mountable) Node interface unit (for RIO System Upgrade, 19-inch rack mountable) (5 I/O units type)
PFCD	Duplexed control station	A2FV70D + A2NN10D □□5□□□□□□	Duplexed field control unit (for RIO System Upgrade, 19-inch rack mountable) Node interface unit (for RIO System Upgrade, 19-inch rack mountable) (5 I/O units type)

● Upgrade items

The figure below shows an image how the existing PFC□ control station is upgraded by using the A2FV70□ field control unit and the A2NN10D node interface unit, and the installation space expands vertically.

SEE ALSO For the details of the A2FV70□ field control unit, refer to the followings GS:

- ・ Field control unit, cabinet utility kit (for RIO System Upgrade) (GS 33J64E10-01EN)
- ・ N-IO node (for RIO System Upgrade) (GS 33J64F10-01EN)

PFC□

A2FV70□＋A2NN10D-□□5□□□□□□

Before upgrade   **After upgrade**

F040203.ai

Figure   Upgrading PFC□ Control Station

4.2.3 Upgrading I/O expansion cabinet

● **Upgrading I/O expansion cabinet**

Existing model & description		Upgraded model & description	
ACB21	I/O Expansion Cabinet	A2CUKT3 -N□□□	Cabinet Utility Kit (for RIO System Upgrade) (for I/O Expansion Cabinet (for ACB21))

Upgrade items

The figure below shows an image how the existing I/O expansion cabinet is upgraded into A2CUKT3-N□□□ cabinet utility kit. The cabinet utility kit includes a fan unit, a housekeeping unit interface, and other components indispensable for RIO System Upgrade.

SEE ALSO For the details of the A2CUKT3-N□□□ cabinet utility kit, refer to Section 4.2.6 "Upgrading cabinets" and the General Specifications of "Field control unit, cabinet utility kit (for RIO System Upgrade)" (GS 33J64E10-01EN).

ACB21
Before upgrade

A2CUKT3-N□□□
After upgrade

F040204.ai

Figure   Upgrading I/O expansion cabinet

4.2.4 Upgrading node interface unit

● **Upgrading node interface unit (rack mountable type)**

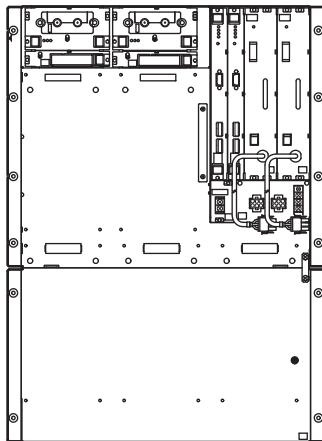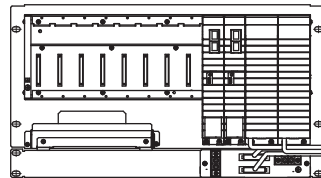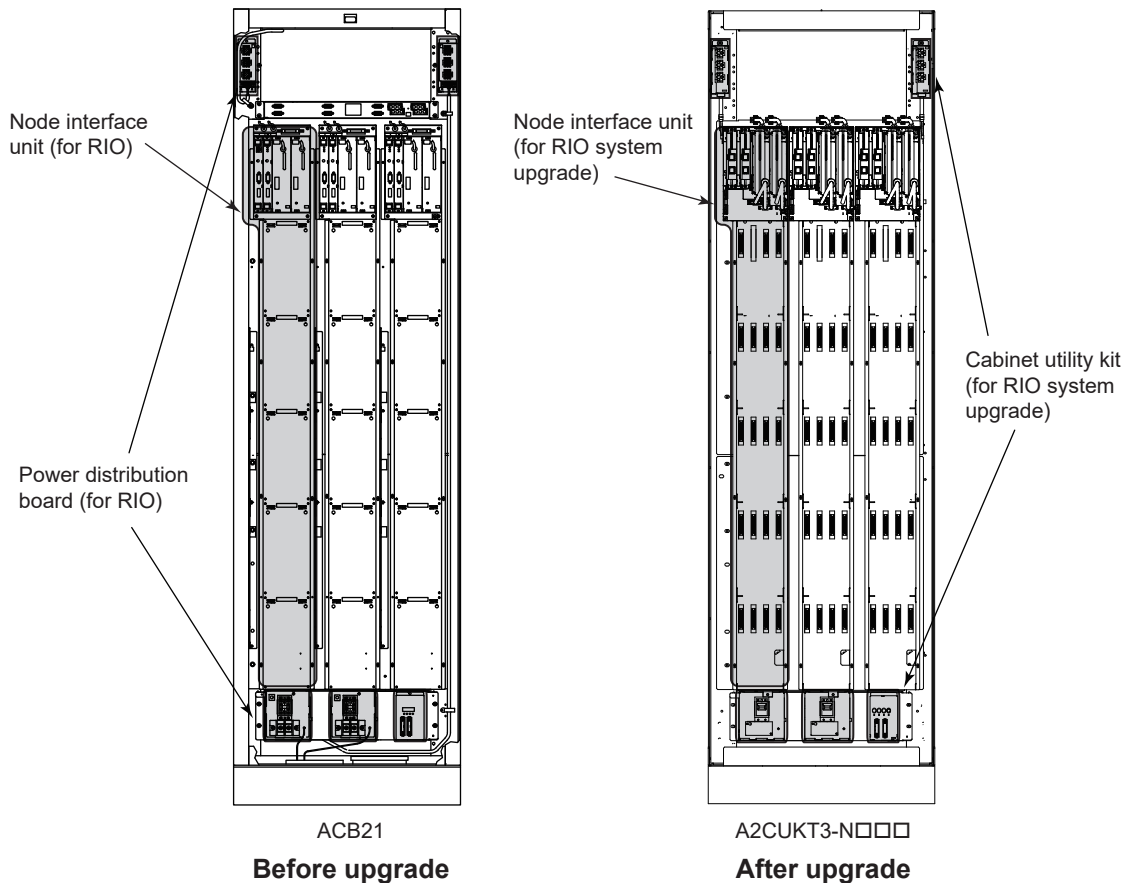| Existing model & description		Upgraded model & description	
ANS10	Node interface unit for single RIO bus (19-inch rack mountable type)	A2NN10D -□□2□□□□□□	Node interface unit (for RIO System Upgrade, 19-inch rack mountable) (2 I/O units type)
AND10	Node interface unit for redundant RIO bus (19-inch rack mountable type)		
ANS50	Node interface unit for single RIO bus (19-inch rack mountable type)	A2NN10D -□□5□□□□□□	Node interface unit (for RIO System Upgrade, 19-inch rack mountable) (5 I/O units type)
AND50	Node interface unit for redundant RIO bus (19-inch rack mountable type)		

Note: ARK11 I/O expansion rack is designed to use in combination with AN□, and upgraded by using A2NN10D-□□5□□□□□□ which is regarded as equivalent to AN□.

Note: ANS11 and AND11 communication expansion node are substituted by ANB10D and ANB11D, and its communication module is upgraded with a communication module for FIO.

Upgrade items

The figure below shows an image how the existing node interface unit (rack mountable type) is upgraded into the node interface unit for RIO System Upgrade which has the same shape. Construction work for dropping commercial power supply and I/O bus is required as the same as the existing system.

SEE ALSO For the A2NN10D node interface after upgrading, refer to the GS for "N-IO node (for RIO System Upgrade)" (GS 33J64F10-01EN).

AN□10   A2NN10D-□□2□□□□□□

AN□50   A2NN10D-□□5□□□□□□

Before upgrade   **After upgrade**

F040205.ai

Figure Upgrading node interface unit (rack mountable type)

● **Upgrading node interface unit (cabinet type)**

	Existing model & description		Upgraded model & description	
ANS20	Node interface unit for single RIO bus (Cabinet type)	A2NN20D	Node interface unit (for RIO System Upgrade, cabinet installation type)	
AND20	Node interface unit for redundant RIO bus (Cabinet type)			

Upgrade items

The figure below shows an image how the existing node interface unit (cabinet type) is upgraded into the node interface unit for RIO System Upgrade which has the same shape.   For upgrading the existing field control stations, two different sizes of the node interface units are provided; one is with four I/O units to upgrade the front and the other with five I/O units to upgrade the rear.

SEE ALSO   For the details of the A2NN20D node interface unit, refer to the GS "N-IO node (for RIO System Upgrade" (GS 33J64F10-01EN).
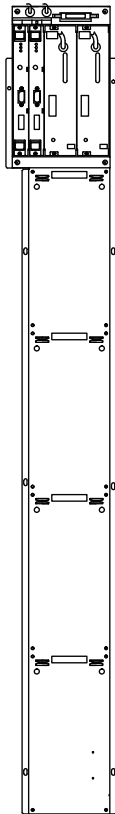
AN□20-F□□   A2NN20D-□□4□□□□□□□

Before upgrade   **After upgrade**

F040206.ai

Figure   Upgrading node interface unit (cabinet type)

4.2.5   Upgrading overall I/O

4.2.5.1 Upgrading RIO System components

● Upgrading I/O module nest

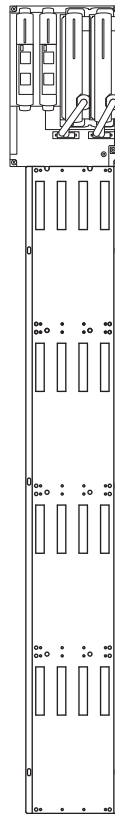| Existing Model			Upgraded Model		
Model	Description	Q'ty (*1)	Model	Description	Q'ty (*1)
AMN11	Nest for analog I/O modules	1	A2BA3D	Nest for I/O adaptor (for RIO System Upgrade, with I/O module)	1
AMN12	High-speed nest for analog I/O modules				
AMN21	Nest for relay I/O modules	1	Multi-channel I/O modules for upgrading are directly mounted to the backboard of the node interface unit. Communication modules are upgraded into communication module for FIO system and mounted to the A2FV70☐ FCU or ANB10D/ANB11D node unit.		
AMN31	Nest for terminal-type I/O modules				
AMN32	Nest for connector-type I/O modules	1			
AMN33	Nest for communication modules	1			
AMN34	Nest for multipoint control analog I/O modules	1			
AMN51	Nest for communication cards and Ethernet communication modules	1			

*1:   Maximum number of units mountable per I/O unit area.

Upgrade items

The figure below shows an image how the existing I/O module nest is upgraded. The existing channel-based AMN11 or AMN12 nests for analog I/O modules are upgraded by A2BA3D I/O adaptor nest which has the same shape. For upgrading, the field wiring has to be removed and then connected with the M4 screw terminal (detachable) again. The position (XYZ coordinates) of the A2BA3D terminal base is almost the same as the existing AMN11 or AMN12 and the existing field wiring can be continually used.

SEE ALSO   For the details of the A2BA3D I/O adaptor nest after upgrading, refer to the GS of "N-IO node (for RIO System Upgrade)" (GS 33J64F10-01EN).

AMN11, AMN12

Before upgrade

A2BA3D

After upgrade
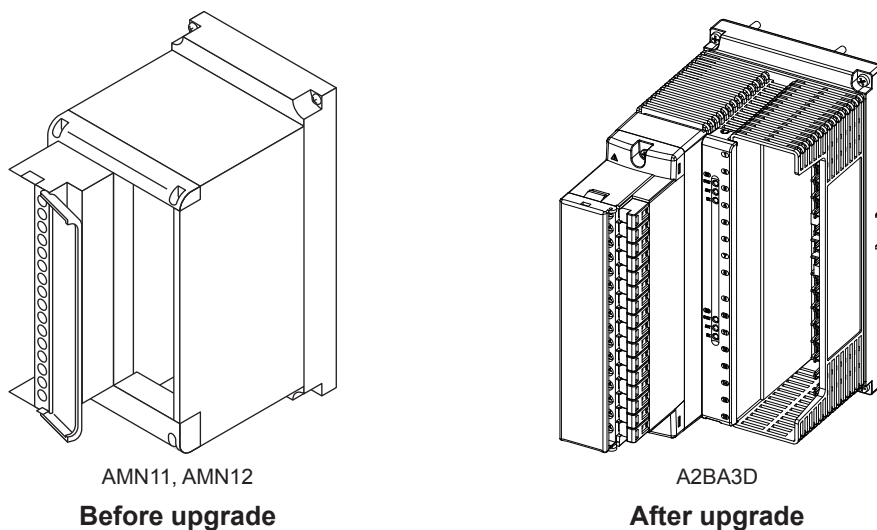
F040207.ai

Figure   Upgrading I/O module nest

● **Upgrading I/O module by the channel**

Existing I/O module			Upgraded I/O module		
Model	**Description**	**Q'ty (*1)**	**Model**	**Description**	**Q'ty (*1)**
AAM10	Current/voltage input module (simplified type)	16	A2SAM105	Current input/voltage input adaptor	16
AAM11	Current/voltage input module				
AAM11B	Current/voltage input module (supports BRAIN)				
AAM21	mV, thermocouple, and RTD input module		A2SAT105 (*2)	mV/TC/RTD Input adaptor	
AAM21J	mV, thermocouple, and RTD input module (conforms to IEC584-1995, IEC751-1995)				
APM11	Pulse input module		A2SAP105	Pulse input signal adaptor (0 -10 KHz)	
AAM50	Current output module		A2SAM505	Current output/voltage output adaptor	
AAM51	Current/voltage output module				

*1: Maximum number of units mountable per nest.
*2: The correspondence between the old and new standards when upgrading the RIO system is shown below.

|	Existing RIO system		RIO System Upgrade	
	Model name	**Compliance standard**	**Model name**	**Compliance standard**
Thermocouple	AAM21	Type N (Old JIS)	A2SAT105	Type J, K, E, B, R, S, T, N IPTS-68
		Type J, K, E, B, R, S, T (Old JIS)		
	AAM21J	Type J, K, E, B, R, S, T, N (New JIS)		Type J, K, E, B, R, S, T, N IPTS-90
RTD	AAM21 or AAM21J	JPT100 (Old JIS)		JPT100
	AAM21	PT100 (Old JIS)		PT100 IPTS-68
	AAM21J	PT100 (New JIS)		PT100 ITS-90

Upgrade items

The figure below shows an image how the existing I/O module is upgraded by the channel. Connection specifications of field wiring (wiring connection types of A, B, and C terminals assigned by the type of signals) are the same before and after upgrading. The A2SAM505 output adaptor for current/voltage output modules can be configured in dual redundant in the same way as AAM51. The short bar used for M4 screw terminal used for dual-redundant configuration, the same product as the existing system can be used.
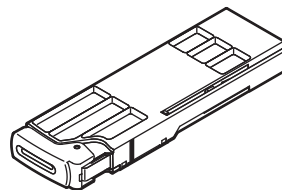
SEE ALSO For the details of the I/O adaptor after upgrading, refer to the GS of "N-IO node (for RIO System Upgrade)" (GS 33J64F10-01EN).
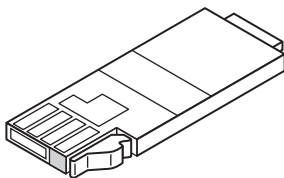
AAM10, AAM11, AAM11B, AAM21, AAM21J, APM11, AAM50, and AAM51

Before upgrade

A2SAM105, A2SAT105, A2SAP105, and A2SAM505

After upgrade

F040208.ai

Figure   Upgrading channel I/O module

● **Upgrading Multi-channel I/O module**

Existing module			Upgraded module		
Model	Description	Q'ty (*1)	Model	Description	Q'ty (*2)
Analog I/O module					
AMC80	Multipoint analog I/O module	2	AAB841 -SK□	Analog I/O module (1 to 5 V input, 4 to 20 mA output, 8-channel input/8-channel output, non-isolated) RIO System Upgrade for AMC80 (KS cable connection type)	2
Relay I/O module					
ADM15R	Relay input module	1	ADV159 -PY□	Digital input module for compatible ST3 (32-channel, isolated channels) RIO System Upgrade for ADM15R (Relay terminal connection type)	1
ADM55R	Relay output module	1	ADV559 -PY□	Digital output module for compatible ST4 (32-channel output, isolated channels) RIO System Upgrade for ADM55R (Relay terminal connection type)	1
Multiplexer module (16 points, Terminal type)					
AMM12T (*3)	Voltage input multiplexer module	2	AAV144 -SM□	Analog input module (-10 to +10 V, 16-channel, isolated) RIO System Upgrade for AMM12T (M4 screw terminal connection type)	2
AMM22M (*4)	mV input multiplexer module		AAT145 -SM□ (*6)	TC/mV input module (16-channel, isolated channels) RIO System Upgrade for AMM22M/ AMM22T/AMM22TJ (M4 screw terminal connection type)	
AMM22T (*5)	Thermocouple input multiplexer module				
AMM22TJ	Thermocouple input multiplexer module (supports IEC584-1995)				
AMM32T (*7)	RTD input multiplexer module	1	AAR145 -SM□ (*8)	RTD/POT input module (16-channel, isolated channels) RIO System Upgrade for AMM32T/ AMM32TJ (M4 screw terminal connection type) (*9)	1
AMM32TJ	RTD input multiplexer module (supports IEC751-1995)	1			1
AMM42T	2-wire transmitter input multiplexer module	1	AAI143 -HM□	Analog input module (4 to 20 mA, 16-channel, isolated) RIO System Upgrade for AMM42T (M4 screw terminal connection type)	1
AMM52T	Output multiplexer module	1	AAI543 -HM□	Analog output module (4 to 20 mA, 16-channel, isolated) RIO System Upgrade for AMM52T (M4 screw terminal connection type)	1
Multiplexer module (Connector type)					
AMM12C	Voltage input multiplexer module	4 (*10)	AAV144 -SK□	Analog input module (-10 to +10 V, 16-channel, isolated) RIO System Upgrade for AMM12C (KS cable connection type)	4
AMM22C	mV input multiplexer module		AAT145 -SK□ (*11)	TC/mV input module (16-channel, isolated channels) RIO System Upgrade for AMM22C/AMM25C (KS cable connection type)	
AMM25C	mV input multiplexer module with thermocouple interface (15 points, RJC input port added)				
AMM32C	RTD input multiplexer module (16 points)		AAR145 -SK□ (*12)	RTD/POT input module (16-channel, isolated channels) RIO System Upgrade for AMM32C/ AMM32CJ (KS cable connection type) (*13)	
AMM32CJ	RTD input multiplexer module (16 points, conforms to IEC751-1995)				

*1: Maximum number of units mountable per nest.
*2: Maximum number of units mountable per I/O unit area.
*3: Including model AMM11T.
*4: Including model AMM21M.
*5: Including model AMM21T.
*6: The correspondence between the old and new standards when upgrading the RIO system is shown below.

	Existing RIO system		RIO System Upgrade	
	Model name	**Compliance standard**	**Model name**	**Compliance standard**
Thermocouple	AMM22T	Type N (Old JIS)	AAT145-SM□	Type J, K, E, B, R, S, T, N IPTS-68
		Type J, K, E, B, R, S, T (Old JIS)		
	AMM22TJ	Type J, K, E, B, R, S, T, N (New JIS)		Type J, K, E, B, R, S, T, N IPTS-90

*7: Including model AMM31T.
*8: The correspondence between the old and new standards when upgrading the RIO system is shown below.

	Existing RIO system		RIO System Upgrade	
	Model name	**Compliance standard**	**Model name**	**Compliance standard**
RTD	AMM32T or AMM32TJ	JPT100 (Old JIS)	AAR145-SM□	JPT100
	AMM32T	PT100 (Old JIS)		PT100 IPTS-68
	AMM32TJ	PR100 (New JIS)		PT100 ITS-90

*9: For RIO System Upgrade, this module is not applicable for potentiometer (POT) input.
*10: Q'ty becomes 2 when mounted on AFS□0□ or AFG□0□.
*11: The correspondence between the old and new standards when upgrading the RIO system is shown below.

	Existing RIO system		RIO System Upgrade	
	Model name	**Compliance standard**	**Model name**	**Compliance standard**
Thermocouple	AMM25C	Type J, K, E, B, R, S, T, N	AAT145-SK□	Type J, K, E, B, R, S, T, N ITS-90

*12: The correspondence between the old and new standards when upgrading the RIO system is shown below.

	Existing RIO system		RIO System Upgrade	
	Model name	**Compliance standard**	**Model name**	**Compliance standard**
RTD	AMM32C or AMM32CJ	JPT100 (Old JIS)	AAR145-SK□	JPT100
	AMM32C	PT100 (Old JIS)		PT100 IPTS-68
	AMM32CJ	PR100 (New JIS)		PT100 ITS-90

*13: For RIO System Upgrade, this module is not applicable for potentiometer (POT) input.

Existing module			Upgraded module		
Model	Description	Q'ty (*1)	Model	Description	Q'ty (*2)
Digital I/O module					
ADM11T	Contact input module (16 points, terminal type)	2	ADV159 -PM□	Digital input module for compatible ST3 (32-channel, isolated channels) RIO System Upgrade for ADM11T (M4 screw terminal connection type) (*14)	2
ADM12T	Contact input module (32 points, terminal type)		ADV169 -PM□	Digital input module for compatible ST6 (64-channel, isolated, common minus side every 16-channel) RIO System Upgrade for ADM12T (M4 screw terminal connection type) (*15)	
ADM51T	Contact output module (16 points, terminal type)		ADV559 -PM□	Digital output module for compatible ST4 (32-channel output, isolated channels) RIO System Upgrade for ADM51T (M4 screw terminal connection type) (*14)	
ADM52T	Contact output module (32 points, terminal type)		ADV569 -PM□	Digital output module for compatible ST7 (64-channel output, isolated, common minus side every 16-channel) RIO System Upgrade for ADM52T (M4 screw terminal connection type) (*15)	
ADM11C	Contact input module (16 points, connector type)	4	ADV159 -PK□	Digital input module for compatible ST3 (32-channel, isolated channels) RIO System Upgrade for ADM11C (KS cable connection type) (*14)	4
ADM12C	Contact input module (32 points, connector type)		ADV169 -PK□	Digital input module for compatible ST6 (64-channel, isolated, common minus side every 16-channel) RIO System Upgrade for ADM12C (KS cable connection type) (*15)	
ADM51C	Contact output module (16 points, connector type)		ADV559 -PK□	Digital output module for compatible ST4 (32-channel output, isolated channels) RIO System Upgrade for ADM51C (KS cable connection type) (*14)	
ADM52C	Contact output module (32 points, connector type)		ADV569 -PK□	Digital output module for compatible ST7 (64-channel output, isolated, common minus side every 16-channel) RIO System Upgrade for ADM52C (KS cable connection type) (*15)	

*1:   Maximum number of units mountable per nest.
*2:   Maximum number of units mountable per I/O unit area.
*14:   Up to 16 I/O points.
*15:   Up to 32 I/O points.

Upgrade items for multi-channel I/O module (Terminal connection type)

- The figures on the next page show images how the existing terminal connection type multi-channel I/O modules are upgraded. After upgrading, the multi-channel I/O module is directly mounted to the backboard of the node interface unit.

- Terminals of the existing RIO system can be continuously used without disconnecting the existing field wiring.

- The mounting position (XYZ coordinates in the cabinet) of the terminal after upgrading is the same as before.

SEE ALSO For the details of the terminal connection type multi-channel I/O modules after upgrading, refer to the GS of "N-IO node (for RIO System Upgrade)" (GS 33J64F10-01EN).

Terminal
(To be used continuously)

ADM15R and ADM55R

Terminal
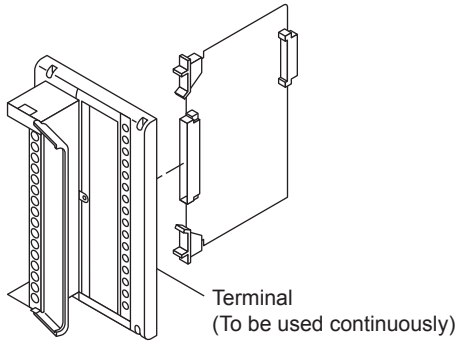
ADV159-PY☐ and ADV559-PY☐

Terminal
(To be used continuously)
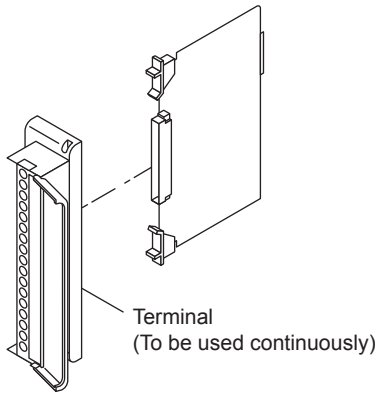
AMM12, AMM11T, AMM22M, AMM21M,
AMM22T, AMM21T, AMM22TJ, AMM42T,
AMM52T, ADM11T, ADM12T, ADM51T, and
ADM52T
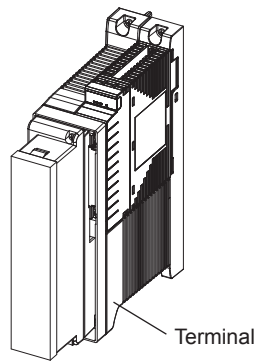
Terminal

AAV144-SM☐, AAT145-SM☐, AAI143-HM☐,
AAI543-HM☐, ADV159-PM☐, ADV169-PM☐,
ADV559-PM☐, ADV569-PM☐

Before upgrade

After upgrade

F040209.ai

Figure   Upgrading multi-channel I/O module 1 (terminal connection type)

Terminal
(To be used continuously)

AMM32T, AMM31T, and AMM32TJ

Before upgrade

Terminal

AAR145-SM□

After upgrade
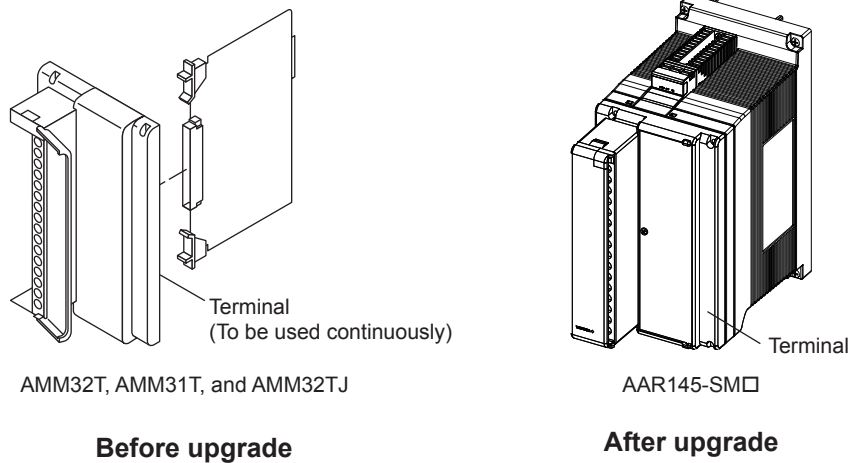
F040210.ai

Figure   Upgrading multi-channel I/O module 2 (terminal connection type)

Upgrade items for multi-channel I/O module (KS cable connection type)

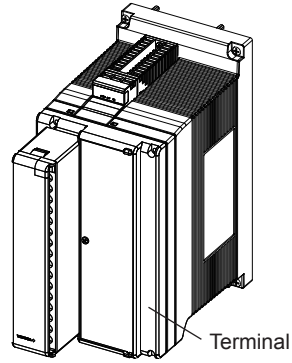- The figures below show images how the existing KS cable connection type multi-channel I/O modules are upgraded. After upgrading, the multi-channel I/O module is directly mounted to the backboard of the node interface unit.

- KS cables of the existing RIO system can be continuously used by connecting to the multi-channel I/O modules.

- The mounting position (XYZ coordinates in the cabinet) of the KS cable connector shifts by 5 cm to the upper side after upgrading.

- AMM□1□ multiplexer module is replaced with model AMM□2□.

SEE ALSO For the details of the KS cable connection type multi-channel I/O modules after upgrading, refer to the GS of "N-IO node (for RIO System Upgrade)" (GS 33J64F10-01EN).

AMC80

AAB841-SK□

Connector
(Not required after upgrading)

AMM12C, AMM22C, AMM25C, AMM32C,
AMM32CJ, ADM11C, ADM12C, ADM51C,
and ADM52C

AAV144-SK□, AAT145SK□, AAR145-SK□,
ADV159-PK□, ADV559-PK□, ADV169-PK□,
and ADV569-PK□,

Before upgrade

After upgrade

F040211.ai

Figure   Upgrading multi-channel I/O module (KS cable connection type)
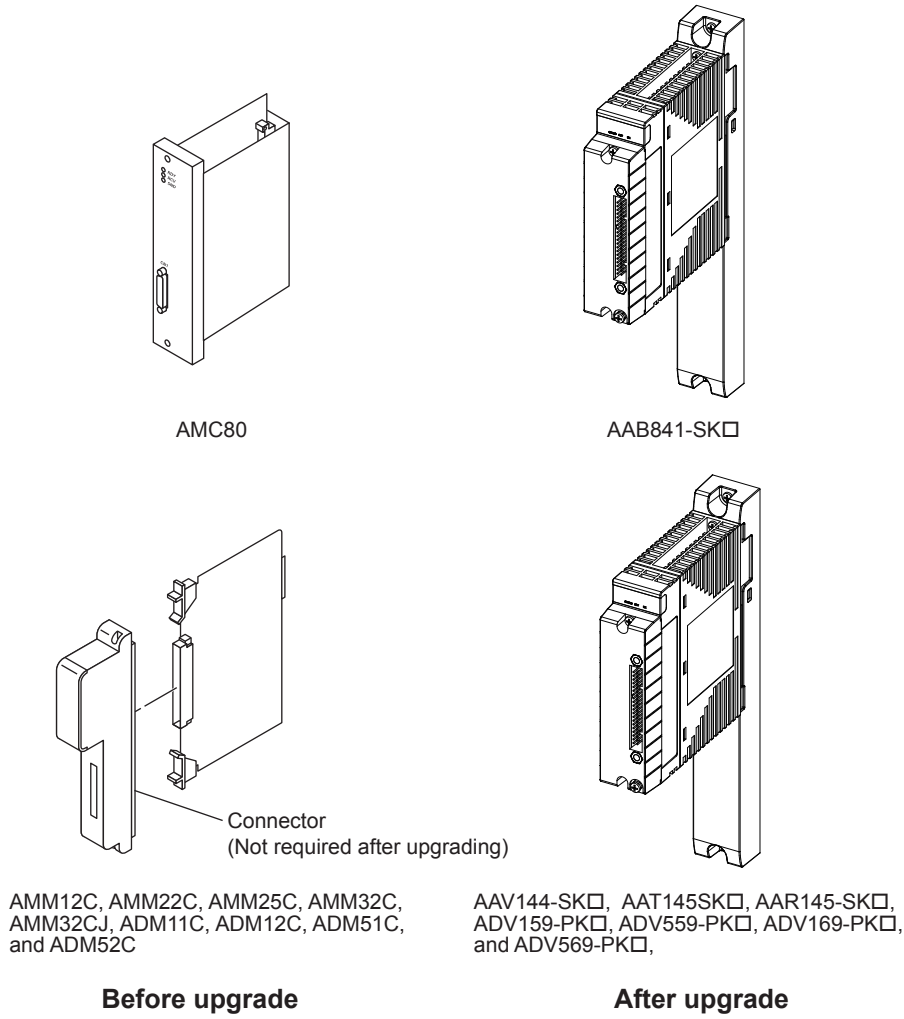
● **Upgrading communication module**

Existing module		Upgraded module	
Model	**Description**	**Model**	**Description**
ACM11	RS-232C communication module	ALR111	Serial communication module (RS-232C, 2-port, for N-IO/FIO)
ACM21	RS-232C general-purpose communication card		
ACM12	RS-422/RS-485 communication module	ALR121	Serial communication module (RS-422/RS-485, 2-port, for N-IO/FIO)
ACM22	RS-422/RS-485 general-purpose communication card		
ACM71	Ethernet communication module (for PFCS/PFCD)	ALE111	Ethernet communication module (for N-IO/FIO)
ACF11	Fieldbus communication module	ALF111	Foundation fieldbus communication module (for N-IO/FIO)
ACP71	PROFIBUS communication module	ALP121	PROFIBUS-DP communication module (for N-IO/FIO)

Upgrade items

- The figures below and on the next page show images how the existing communication modules are upgraded into communication modules for FIO system.

- A communication module for upgrade is mounted on an empty slot of an I/O module slot of A2FV70☐ field control unit, ANB10D node unit for dual-redundant ESB bus, or ANB11D node unit for dual-redundant ESB bus with an optical repeater. The communication module cannot be mounted to the A2NN10D/A2NN20D node interface unit for upgrading.

- The mounting position of the communication module is moved after the upgrading, which may require extending the cable length.

- The specifications of the connecting cable may differ by the module, which may require replacing the communication cable. (*1)

- The ALF111 Foundation fieldbus communication module requires a fieldbus power supply separately.

*1: The connector of ACM11's communication cable has D-sub 25 pins while that of ALR111 has D-sub 9 pins. When replacing ACM11 with ALR111, adopt a conversion cable with appropriate pin layout or replace the communication cable.

SEE ALSO For the details of the communication modules after upgrading, refer to the following GS.

- "Serial Communication Module (for N-IO/FIO)" (GS 33J60G10-01EN)
- "Ethernet Communication Module (for N-IO/FIO)" (GS 33J60G11-01EN)
- "Foundation Fieldbus Communication Module (for N-IO/FIO)" (GS 33J60G20-01EN)
- "PROFIBUS Communication Module (for N-IO/FIO)" (GS 33J60G85-01EN)

ACM11	ACM21	ALR111

ACM12	ACM22	ALR121

Before upgrade   **After upgrade**
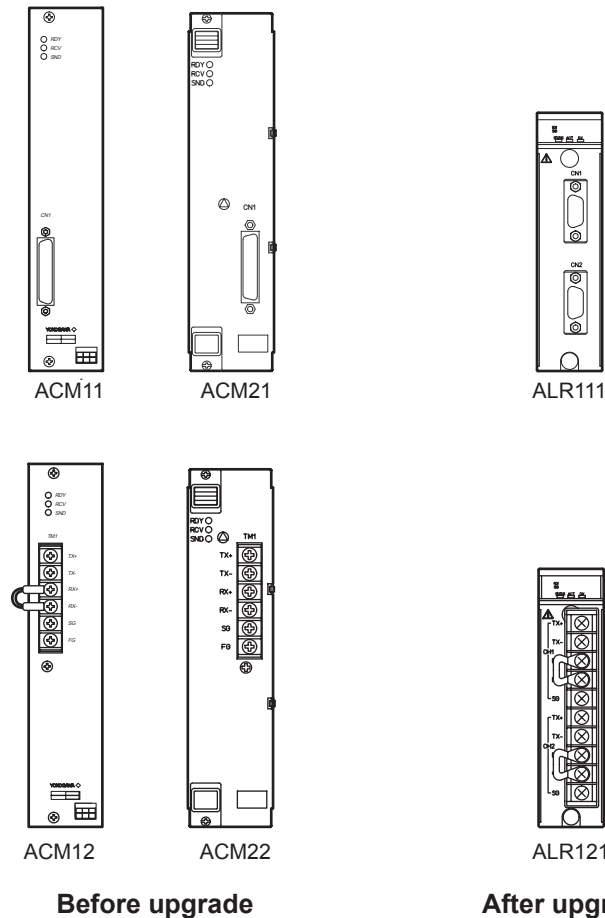
F040212.ai

Figure   Upgrading communication module 1
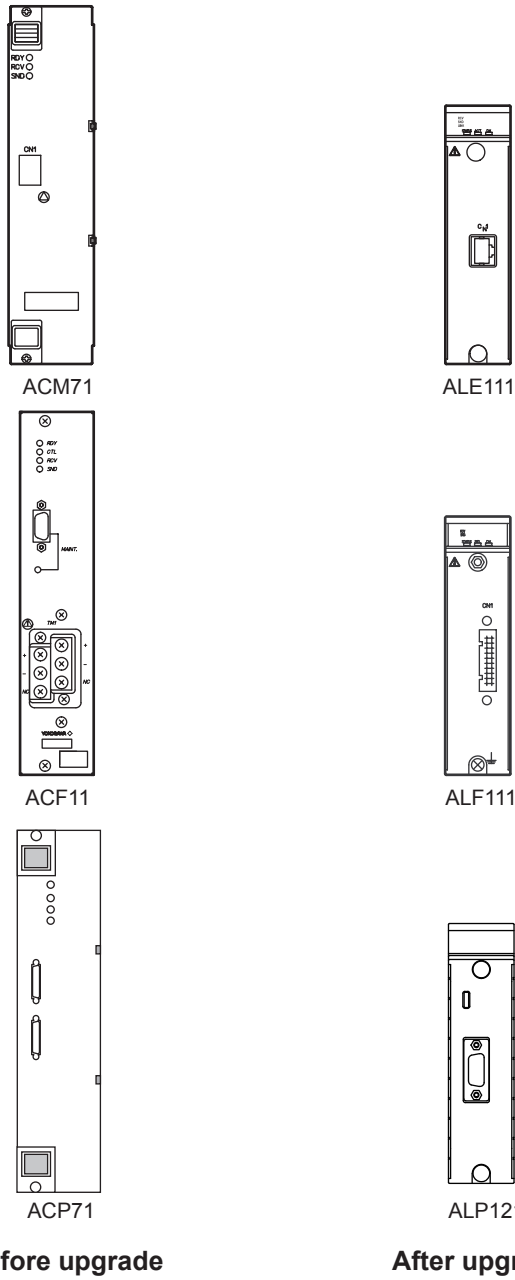
Before upgrade   After upgrade

F040213.ai

Figure   Upgrading communication module 2

4.2.5.2 I.S. barrier solution components

I. S. barrier solution hardware mainly consists of a dedicated node interface unit (for N-IO) and base plates for barriers. I.S. barriers can be mounted on the base plate for barriers by the channel. I/O modules can also be mounted on the base plate for barriers. Communications with a field control unit is done by connecting an N-ESB bus or a duplexed optical ESB bus via a dedicated node interface unit (for N-IO). Up to six (6) base plates for barriers can be connected to a node interface unit (for N-IO) using dedicated cables. When installing the I.S. barrier solutions in a cabinet ensure that any of the following field control unit is not resided, which are A2FV70□, A2NN10D, and A2NN20D.

● Node interface unit (for N-IO)

Model	Name
A2NN30D	Node interface unit (for N-IO)

A power supply unit and an N-ESB bus module are mounted on base plate for node interface unit, which provides communication interface functions in between a field control unit and base plate for barriers as well as an node interface unit. The A2NN30D supply power to the base plates for barriers. Mounting types are selectable from wall-mountable and DIN-rail mountable.

SEE ALSO For more details, refer to the GS of "N-IO node (for RIO System Upgrade)" (GS 33J64F10-01EN).
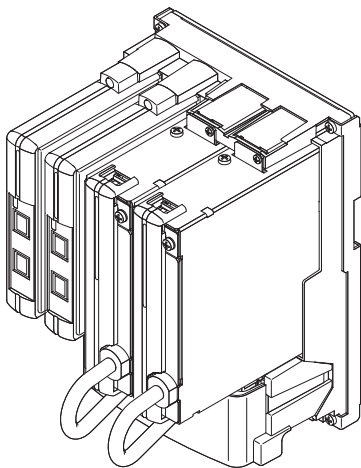
F040221.ai

Figure   A2NN30D node interface unit (for N-IO)

● Base plates for barriers

Model	Name
A2BN4D	Base plate for barrier (for N-IO, MTL barrier)
A2BN5D	Base plate for barrier (for N-IO, P+F barrier)

Note: A2BN3D cannot be used for RIO System Upgrade.

These base plates communicate with the node interface unit via an F-SB bus cable (A2KLF00) bus by connecting a field signal to a terminal on the I.S. barrier mounted on the base plate. I/O

modules (for N-IO) can be configured in a single or dual-redundant configuration. Up to 16 I.S. barriers can be mounted on channels. This base plate consists of a system power supply and field power supply interface to supply power to the I/O module(for N-IO) from the node interface unit via the A2KPB00 power supply cable for base plate, and to supply field power to the I.S. barriers by connecting the specified power line. This base plate for barrier supports both the DIN rail mountable type and wall mountable type.
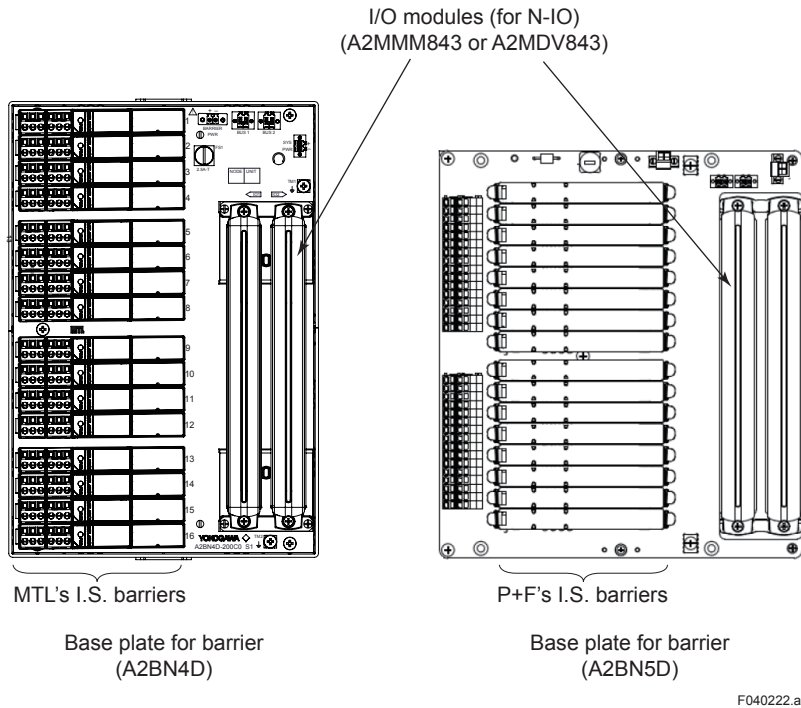
Figure   Hardware configuration of base plate for barrier

The following tables show the I/O module and connecting cables between the Node interface unit and the base plates for barrier.

● I/O Module (for N-IO)

Model	Name
A2MMM843	Analog digital I/O module (16-channel, Isolated)
A2MDV843	Digital I/O module (16-channel, Isolated)

● Cables (for N-IO)

Model	Name
A2KLF00	F-SB bus cable
A2KPB00	Power supply cable for base plate

4.2.6   Upgrading Cabinets

For upgrading an FCU with cabinet and I/O expansion cabinet, use A2CUKT3 cabinet utility kit.

SEE ALSO For the details of the A2CUKT3 and applicable cabinets, refer to the GS "Field Control Unit, Cabinet Utility Kit (for RIO System Upgrade)" (GS 33J64E10-01EN).

The A2CUKT3 are composed of the parts as shown in the table below.

Table   List of A2CUKT3 main parts

Description		Quantity	
		A2CUKT3-C□□□ (for FCU with cabinet)	**A2CUKT3-N□□□ (for I/O expansion cabinet)**
Main power distribution board	Single power source	1	1
	Dual power sources	2	2
HKU interface unit		1	1
Node power distribution board		2	4
FCU power distribution board		2	—
FCU fan unit (with a built-in HKU) (*1)		1	—
Junction adapter		—	1
Fan power supply unit		—	2
HKU (for I/O expansion cabinet)		—	1
Door fan frame (for front side)		1	1
Door fan frame (for back side)		1	1
Thermister		1	1

*1:   HKU stands for house keeping unit.

The following figures shows an example of upgrading an FCU with cabinet and an I/O expansion cabinet using A2CUKT3 cabinet utility kit.

Front   **Rear**

Figure   Cabinet after upgrading with A2CUKT3-C□□□

Front

Rear

Node pwer
distribution board

Thermister

Node power
distribution board

Main power
distribution
board (front)

HKU interface unit
(for A2CUKT3-N)

Door fan frame

HKU (for I/O
expansion cabinet)

Junction
adapter

Fan power
supply unit

Main power
distribution
board (rear)

Door fan frame
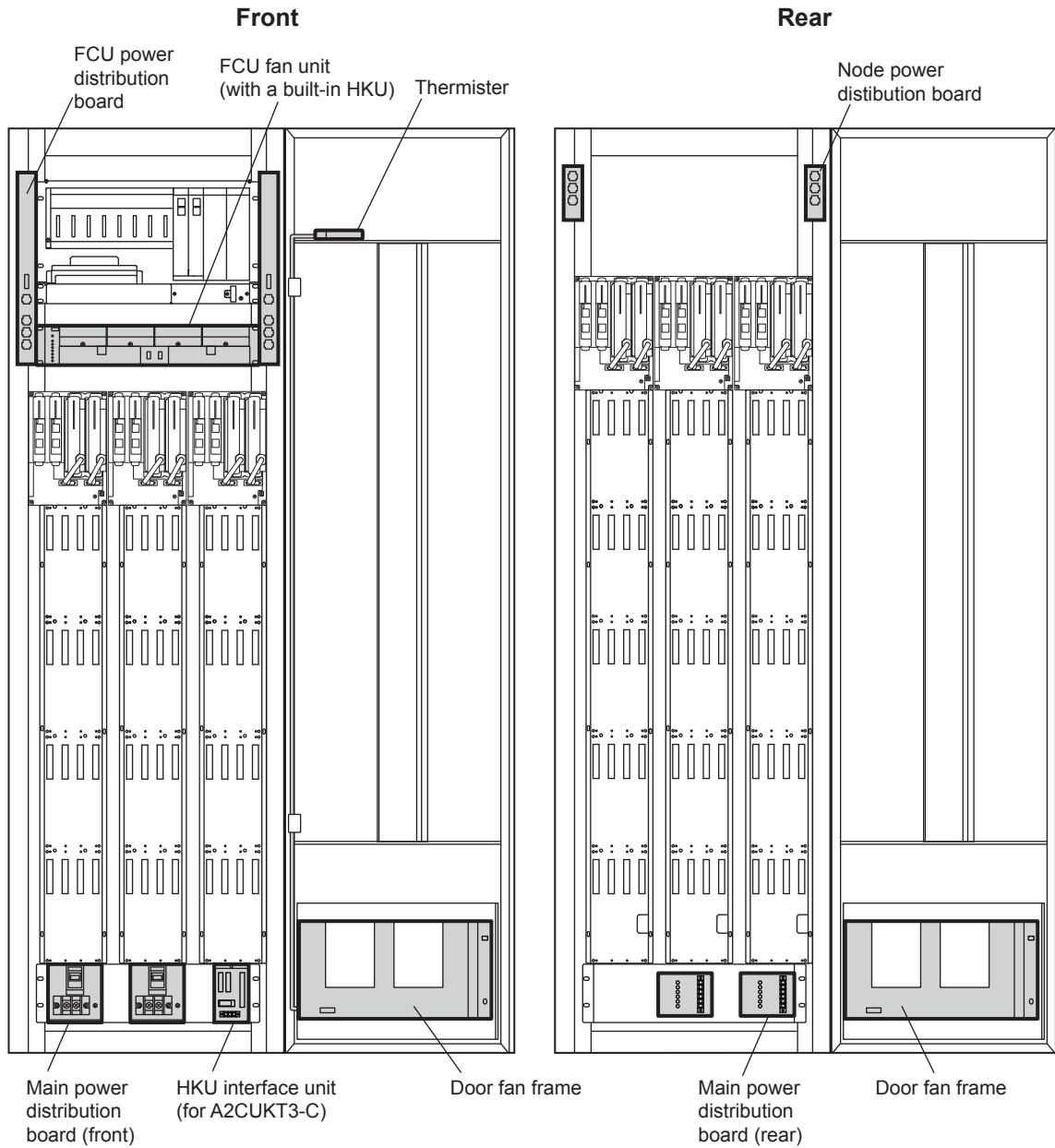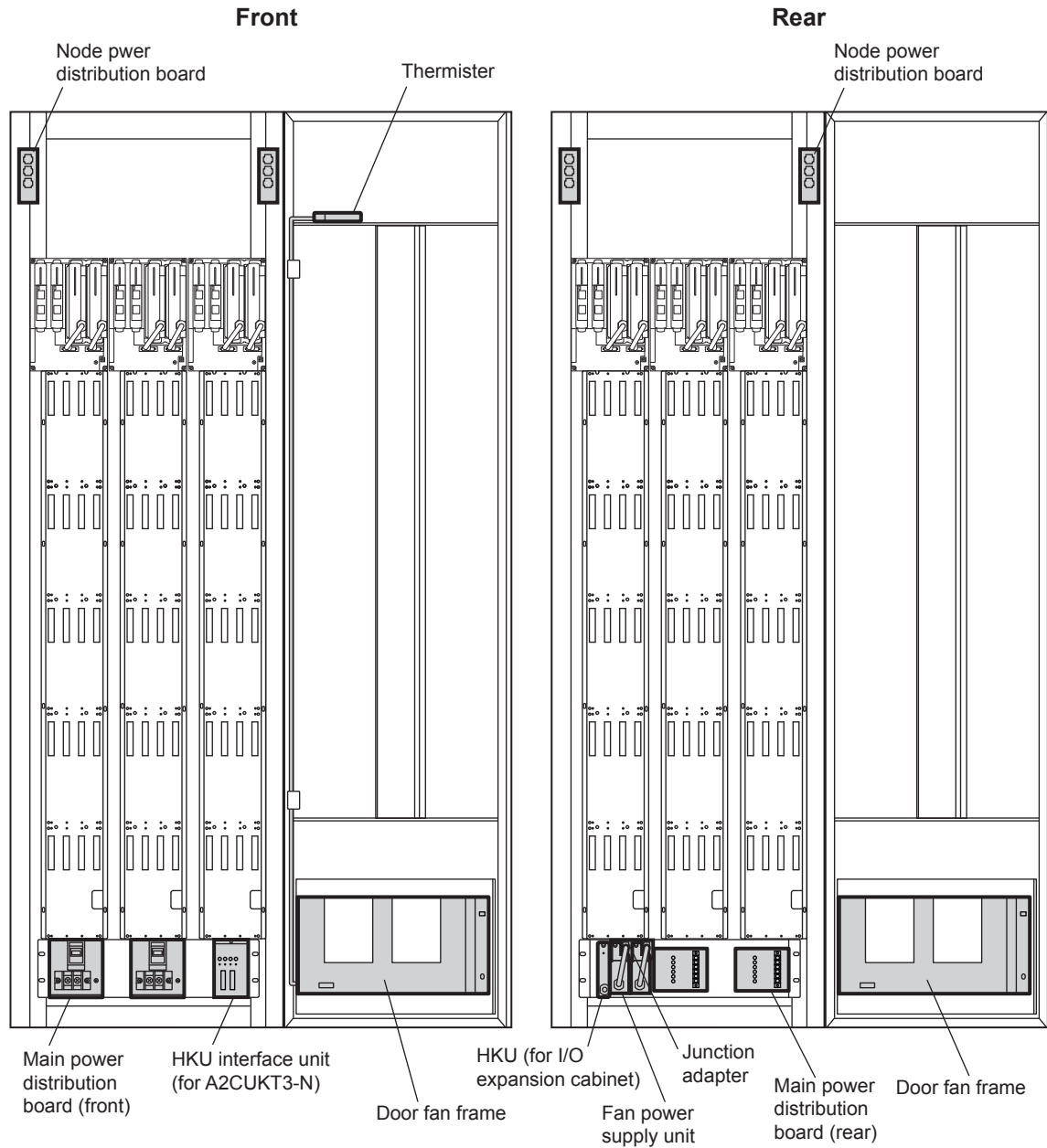
F040215.ai

Figure   Cabinet after upgrading with A2CUKT3-N▢▢▢

4.2.7   Procedures for onsite modification

Procedures for upgrading the existing FCU with cabinet for RIO using A2CUKT3 are as described below.

● FCU with cabinet (front)

1. Check labels, tags, and destinations of all the field wiring.

2. Disconnect the cables connected to the door fan units and remove the front and rear doors of the cabinet.

3. Disconnect the cables in the order of the power supply, the processor module, and the FCU chassis.

4. Dismount the nests for I/O modules from the node and disconnect the field cables for curing.

   - AMN32 (*1), AMN33, AMN34, and AMN51: Remove cables from the I/O modules.

   - AMN21, AMN31, and AMN32 (*1): Remove the existing terminal board from the nest for I/O modules.

   - AMN11 and AMN12: Temporarily remove the wiring from M4 screw terminals as the terminal board and the nest are integrated.

5. Disconnect cables connected to the NIU, and dismount the NIU.

6. Replace the primary power distribution board and the main power distribution board.

7. Install new NIUs, FCU fan units, and FCU, then layout the cables.

8. Replace the HKU interface.

9. Install new multi-channel I/O modules and nest for I/O adaptor for RIO System Upgrade to the NIU.

10. Layout field wirings referring to the labels, tags, and destinations.

   - Multi-channel I/O modules (KS cable connection type): Connect KS cables.

   - Multi-channel I/O modules (terminal connection type): Mount terminal boards.

   - Nest for I/O adaptors: Connect the cables disconnected in step #4 with M4 screw terminals.

11. Replace the door fan assemblies and thermisters. Put the front and rear doors back on to the cabinet, and connect the door fan cable.

Note: The above procedure is an example and orders of some of the steps may be changed due to the conditions on site.

*1:   Disconnect the KS cable from AMN32 when AMM12C, AMM22C, AMM25C, AMM32C, AMM32CJ, ADM11, ADM12, ADM51, and/or ADM52 are mounted. Remove the terminal board when AMM12T, AMM22M, AMM22T, and/or AMM22TJ are mounted.

Before upgrade
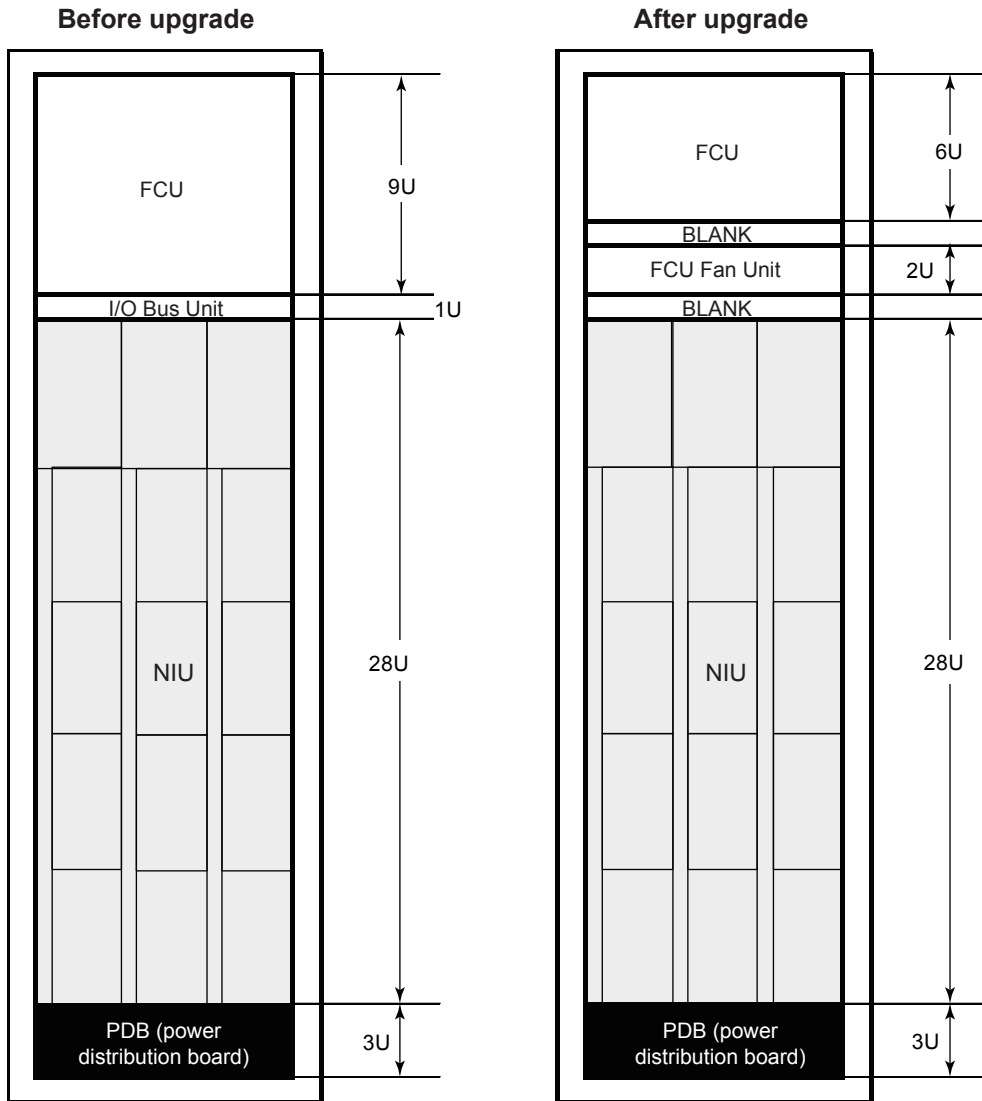
After upgrade

F040216.ai

Figure   FCU with cabinet before and after upgrading (Front)

● FCU with cabinet (rear) and I/O expansion cabinet

1. Check labels, tags, and destinations of all the field wiring.

2. Disconnect the cables connected to the door fan units and remove the front and rear doors of the cabinet.

3. Dismount the nests for I/O modules from the node and disconnect the field cables for curing.

   - AMN32 (*1), AMN33, AMN34, and AMN51: Remove cables from the I/O modules.

   - AMN21, AMN31, and AMN32 (*1): Remove the existing terminal board from the nest for I/O module.

   - AMN11 and AMN12: Temporarily remove the wiring from M4 screw terminals as the terminal boards and the nests are integrated.

4. Disconnect cables connected to the NIU, and dismount the NIU.

5. Replace the primary power distribution board and the main power distribution board.

6. Replace the HKU, HKU interface, junction adapters, and fan power supply unit.

7. Install a new NIU and layout cables.

8. Mount multi-channel output modules and nests for I/O adaptors for RIO System Upgrade to the NIU.

9. Layout field wirings referring to the labels, tags, and destinations.

   - Multi-channel I/O modules (KS cable connection type): Connect KS cables.

   - Multi-channel I/O modules (terminal connection type): Mount terminal boards.

   - Nest for I/O adaptors: Connect the cables disconnected in step #3 with M4 screw terminals.

10. Replace the door fan assemblies and thermisters. Put the front and rear doors back on to the cabinet, and connect the door fan cable.

Note: The above procedure is an example and orders of some of the steps may be changed due to the conditions on site.

*1: Disconnect the KS cable from AMN32 when AMM12C, AMM22C, AMM25C, AMM32C, AMM32CJ, ADM11, ADM12, ADM51, and/or ADM52 are mounted. Remove the terminal board when AMM12T, AMM22M, AMM22T, and/or AMM22TJ are mounted.

Before upgrade

After upgrade

BLANK

3U

BLANK

4U

I/O Bus Unit

1U

NIU

34U

NIU

34U

PDB (power
distribution board)

3U

PDB (power
distribution board)

3U

F040217.ai

Figure   FCU with cabinet (rear) and I/O expansion cabinet before and after upgrading

● **Control station (PFC□)**

1. Check labels, tags, and destinations of all the field wiring.

2. Dismount the nests for I/O modules from the node and disconnect the field cables for curing.

   • AMN32 (*1), AMN33, AMN34, and AMN51: Remove cables from the I/O modules.

   • AMN21, AMN31, and AMN32 (*1): Remove the existing terminal board from the nest for I/O module.

   • AMN11 and AMN12: Temporarily remove the wiring from M4 screw terminals as the terminal boards and the nests are integrated.

3. Remove the PFC□.

4. Install a new FCU and node interface units (for RIO System Upgrade, rack mountable type) and layout cables.

5. Mount multi-channel output modules and nests for I/O adaptors for RIO System Upgrade to the NIU.

6. Layout field wirings referring to the labels, tags, and destinations.

   • Multi-channel I/O module (KS cable connection type): Connect KS cables.

   • Multi-channel I/O modules (terminal connection type): Mount terminal boards.

   • Nest for I/O adaptors: Connect the cables disconnected in step #2 with M4 screw terminals.

Note: The above procedure is an example and orders of some of the steps may be changed due to the conditions on site.

*1: Disconnect the KS cable from AMN32 when AMM12C, AMM22C, AMM25C, AMM32C, AMM32CJ, ADM11, ADM12, ADM51, and/or ADM52 are mounted. Remove the terminal board when AMM12T, AMM22M, AMM22T, and/or AMM22TJ are mounted.
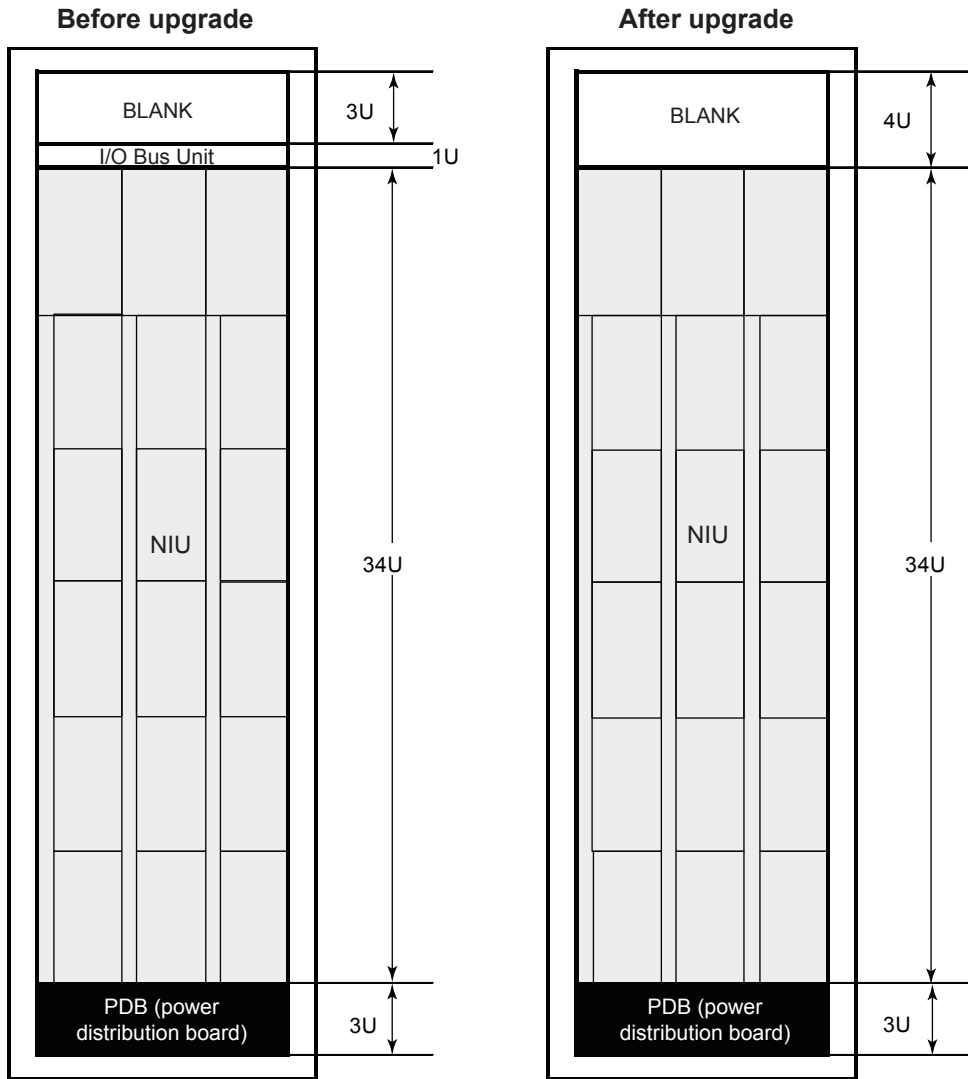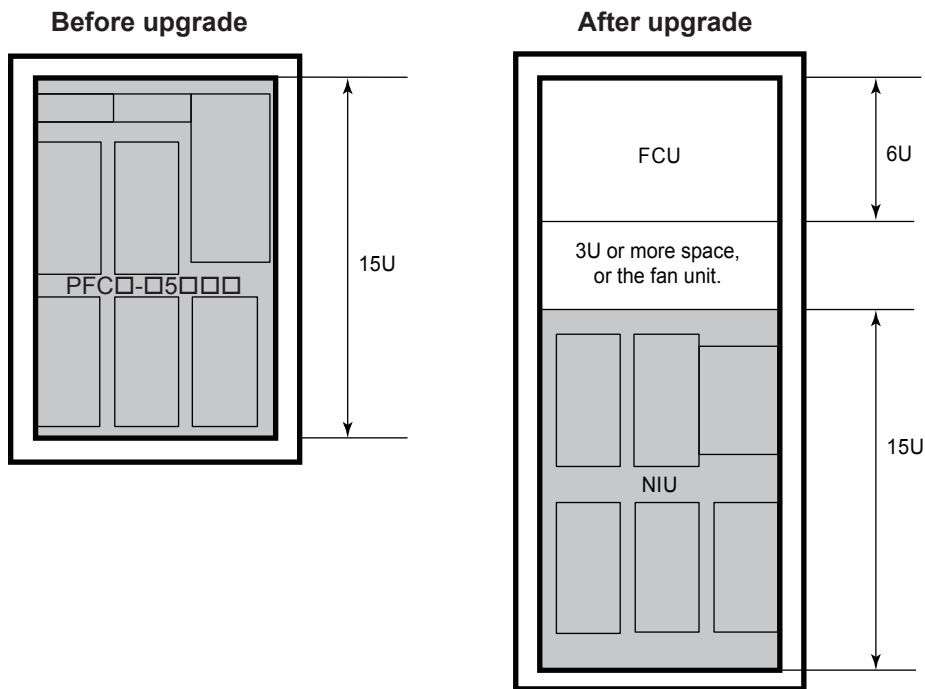

Figure   PFC□ before and after upgrading

4.2.8   Functional differences between the existing FCS and upgraded FCS

■ Hardware of existing RIO system and after system upgrade

Description		CENUTM CS Existing RIO system	CENTUM VP after RIO System Upgrade
Control network		V net	Vnet/IP
FCS Types		LFCS, LFCS2, PFCS, and SFCS	FFCS-R
I/O bus (between nodes)		RIO bus	N-ESB bus Optical ESB bus ESB bus
Node types	Rack mountable type	ANS10, AND10, ANS50, and AND50	A2NN10D (*1)
		ANS11, and AND11	ANB10D, ANB11D
	Cabinet type	ANS20, and AND20	A2NN20D (*1)
	Wall or DIN-rail mountable type	N/A	A2NN30D(*1) (*3)
Channel I/O		Current/voltage input: AAM1□ Current/voltage output: AAM5□ mV/Thermocouple/RTD input: AAM21□ Pulse input: APM11	Current/voltage input: A2SAM105 Current/voltage output: A2SAM505 mV/Thermocouple/RTD input: A2SAT105 Pulse input:A2SAP105
Multi-channel I/O		Current input: AMM42T Current output: AMM52T Voltage input: AMM1□□ mV input, Thermocouple input: AMM2□□ RTD input: AMM3□□ MAC2 compatible input: AMC80 Contact input: ADM1□□ Contact output: ADM5□□ Relay input: ADM15R Relay output: ADM55R	Current input: AAI143-HM□ Current output: AAI543-HM□ Voltage input: AAV144-SK□, AAV144-SM□ mV input, Thermocouple input: AAT145-SK□, AAT145-SM□ RTD input: AAR145-SK□, AAR145-SM□ MAC2 compatible input: AAB841-SK□ Contact input: ADV1□9-PK□, ADV1□9-PM□ Contact output: ADV5□9-PK□, ADV5□9-PM□ Relay input: ADV159-PY□ Relay output: ADV559-PY□
Communication I/O		RS-232C communication: ACM□1 RS-422/RS-485 communication: ACM□2 Ethernet communication: ACM71 Fieldbus communication: ACF11 PROFIBUS communication: ACP71	RS-232C communication: ALR111 (*2) RS-422/RS-485 communication: ALR121 (*2) Ethernet communication: ALE111 (*2) Fieldbus communication: ALF111 (*2) PROFIBUS communication: ALP121 (*2)
Field-side signal connection		M4 screw terminal KS cable interface	
I. S. barrier solution I/O	Base plate	N/A	For MTL barrier: A2BN4D For P+F barrier: A2BN5D
	I/O module	N/A	Analog Digital I/O: A2MMM843 Digital I/O: A2MDV843
	I.S. barrier	N/A	(*4)
	Field-side signal connection	N/A	pressure clamp terminal: A2BN4D spring clamp terminal: A2BN5D

*1:   The N-ESB bus and power supplies are configured dual-redundant.
*2:   Communication modules (ALR111, ALR121, ALE111, ALF111, and ALP121) are mounted on the A2FV70□ FCU, ANB10D node unit for dual-redundant ESB bus, or ANB11D node unit for dual-redundant optical ESB bus.
*3:   For I.S. barrier solutions.
*4:   For the details of various I.S. barrier types, refer to GS of "N-IO node (for RIO System Upgrade)" (GS33J64F10-01EN).

■ Functional differences of the FCS control network

Description	CENUTM CS/CS 1000/CS 3000/VP	CENTUM VP after RIO System Upgrade
Control network type	V net	Vnet/IP
No. of connecting devices	64 units/domain	
Communication method	Read/write communication, message communication, and link transmission	
Link transmission cycle	100 msec	
Line access control	Token passing	Ethernet-compliant (CSMA/CD)
Network configuration	Bus type	Star type
Transmission speed	10 Mbps	1 Gbps or 100 Mbps (with V net router)
Transmission route	Dual-redundant (single route is partly possible)	Dual-redundant only
Transmission cable	Coaxial cable, optical fiber cable	CAT5e cable, optical fiber cable
Transmission distance	Coaxial cable: Max. 500 m Optical fiber cable: Max. 15 km	CAT5e cable: Max. 100 m Optical fiber cable: Max. 5 km (up to 20 Km depending on the condition)
Bus repeater	YNT512□, YNT511□, YNT522□	Network switches for Vnet/IP (Yokogawa recommended models by collaboration with switch vendors)

Remarks for upgrading

- Re-installation of communication cables is required as Vnet/IP is adopted for the control network.

- In the phased system upgrading, when the existing V net and Vnet/IP are connected, network switches for Vnet/IP (or AVR10D V net router) are required.

- Optical fiber cables are required for the transmission distance of 100 m or further.

- A single mode optical fiber (SMF) is recommended for optical fiber cable. For the distance of over 5 km, refer to the Technical Information (TI) "Network Switch for Vnet/IP" (TI 30A10A30-01E). In case the existing multi-mode optical fiber (MMF) is re-used, ensure that performance of the existing MMF satisfies the required specifications of the cables by referring to the TI "Vnet/IP Network Construction Guide" (TI 30A10A05-01E).

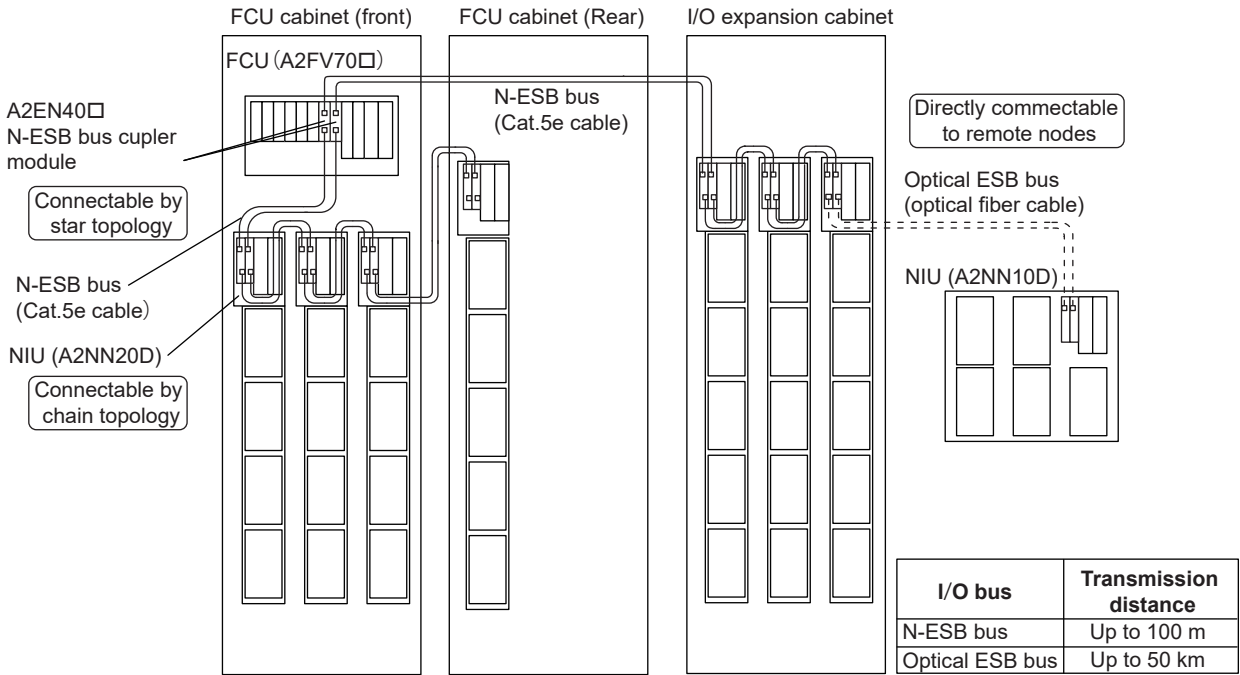## ■ Functional differences of the I/O bus (communications among I/O nodes)

Item	CENUTM CS/CS1000/CS3000/VP RIO system	CENTUM VP for RIO System Upgrade		
Bus type	RIO Bus	N-ESB Bus	Optical ESB Bus	ESB Bus
Number of connectable nodes (/FCU)	RIO node: Max. 8	N-IO node (*1): Max. 8		—
		—	FIO node (*2): Max. 8	
Network topology	Chain connection only	Star connections: Max. 8 lines Chain connections: Max. 8 hops (*3)	Star connections: Max. 8 lines Chain connections: Max. 8 hops (*3) (*4)	Star connections: Max. 2 lines Chain connections: Max. 8 hops
Transmission redundancy	Dual-redundant or Single	Dual-redundant only	Dual-redundant only	Dual-redundant only
Transmission speed	2 Mbps	100 Mbps	192 Mbps	128 Mbps
Transmission cable	Twisted pair cableC or Optical fiber cable	UTP straight cable of CAT5e	Optical fiber cable	Dedicated cable (YCB301)
Transmission distance	Twisted pair cable : Max. 750 m Optical fiber cable : Max. 4 km	Max. 100 m	Max. 50 km	Max. 10 m

*1:   An N-IO node refers to an I/O node consisting of a Node Interface Unit (for RIO system upgrade) [A2NN10D, A2NN20D].
*2:   The FIO node refers to an I/O node consisting of a Node Unit for Dual-Redundant ESB Bus (ANB10D) or a Node Unit for Dual-Redundant ESB Bus with Optical Repeater (ANB11D).
*3   If the N-ESB bus / optical ESB bus communication module (relay function) stops operating due to a power failure or the like, communication with the N-IO node connected thereafter stops. If there is a possibility that power distribution to some nodes during chain connection may be lost, such as when the power supply system is different, please make a star connection.
*4:   Up to 2 hops for chain connection of Optical ESB bus is available when N-ESB bus and Optical ESB bus are used in combination.

Remarks for upgrading

- Only dual-redundant configuration of I/O bus (N-ESB bus, optical ESB bus, and ESB bus) is allowed for FCU for RIO System Upgrade.

- General-purpose N-ESB bus cables and optical fiber cables are adopted.

- Optical ESB buses (optical fiber cables) are required for the transmission distance of 100 m or further. (Single mode (SMF) optical fiber cables are recommended.)

- Acknowledge the followings for using the existing multi-mode fiber (MMF).

  - ANT421 or ANT522 optical ESB bus repeater modules are required.

  - The max. distance of the MMF applicable to the system is 4 km.

  - In case the existing MMF and ANT421/ANT522 are connected, mode conditioning patch code compliant to the IEEE 802.3z standard needs to be inserted.

  - Before utilizing the existing MMF the communication quality must be verified on site. For the verification work, consult the local Yokogawa service office.

- EC40☐ ESB bus coupler module is required when using ANB10D node unit for dual-redundant ESB bus or ANB11D node unit for dual-redundant optical ESB bus.

● **Generic upgrading (Replace RIO bus with N-ESB bus or Optical ESB bus)**

FCU cabinet (front) — FCU cabinet (Rear) — I/O expansion cabinet

FCU（A2FV70□）

A2EN40□
N-ESB bus cupler
module

Connectable by
star topology

N-ESB bus
(Cat.5e cable)

NIU (A2NN20D)

Connectable by
chain topology

N-ESB bus
(Cat.5e cable)

Directly commectable
to remote nodes

Optical ESB bus
(optical fiber cable)

NIU (A2NN10D)

I/O bus	Transmission distance
N-ESB bus	Up to 100 m
Optical ESB bus	Up to 50 km

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● **Connecting node units to install communication modules
(using ESB bus/Optical ESB bus)**

FCU cabinet
(front)

ANT4□1 optical ESB bus repeater module

EC40□ ESB bus coupler mdule (*1)

ESB bus (YCB301 cable)

A2EN40□ N-EBS bus
coupler module

N-ESB bus
(Cat.5e cable)

A2EN501
N-ESB bus module

ANB10D node unit for
dual-redundant ESB bus

Optical ESB bus
(optical fiber cable)

ANB11D node unit for
dual-redundant optical
ESB bus

I/O bus	Transmission distance
ESB bus	Up to 10 m
N-ESB bus	Up to 100 m
Optical ESB bus	Up to 50 km
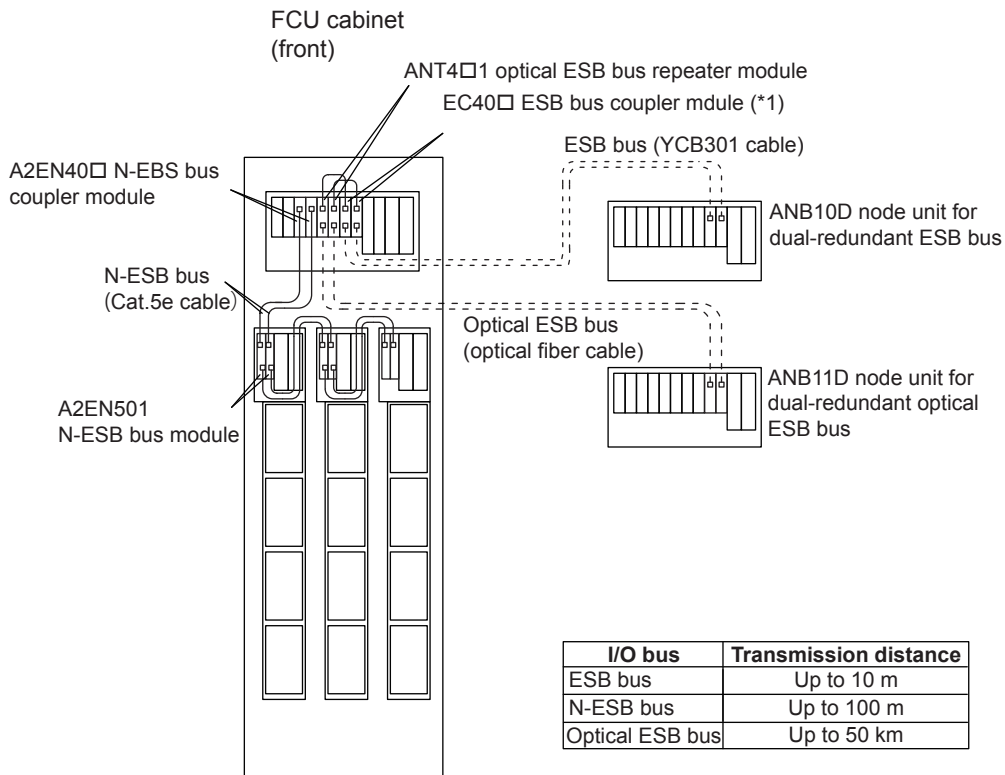
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*1: When connecting ANB10D or ADB11D to this module, install EC40□ bus coupler module to the A2FV70□ FCU.

SEE ALSO For the details of the bus interface modules, node units, and installation unit for optical ESB bus repeater module, refer to the GS shown in the next table.

Table   General Specifications (GS) for I/O bus and its peripherals

Model	Descriptions	Remarks	Reference GS
EC401	ESB bus coupler module (for N-IO/FIO, 1-port)	ESB bus communication module	GS 33J60E50-01EN
EC402	ESB bus coupler module (for N-IO/FIO, 2-port)		GS 33J60E51-01EN
A2EN402	N-ESB bus couple module (for N-IO, 2-port)	N-ESB bus communication module	GS 33J62E50-01EN
A2EN404	N-ESB bus couple module (for N-IO, 4-port)		
ANT401	Optical ESB bus repeater master module 5 km (for N-IO/FIO)	Optical ESB bus communication module	GS 33J60F51-01EN
ANT502	Optical ESB bus repeater slave module 5 km (for N-IO/FIO)		
ANT411	Optical ESB bus repeater master module 5 to 50 km (for N-IO/FIO)		GS 33J60F52-01N
ANT512	Optical ESB bus repeater slave module 5 to 50 km (for N-IO/FIO)		
ANB10D	Node unit for dual-redundant ESB bus	Node expansion unit for mounting to communication module	GS 33K60F20-01EN
ANB11D	Node unit for dual-redundant optical ESB bus		GS 33J60F30-01EN
ANT10U	Unit for optical ESB bus repeater module (for N-IO/FIO)	A node expansion unit for connecting optical ESB bus in a star or chain configuration	GS 33J60F50-01EN

4.2.9   Installation environment

■ System installation requirements

The system installation requirements before and after the upgrading are the same as before.

> **SEE ALSO** For further details, refer to the GS "Field Control Unit, Cabinet Utility Kit (for RIO System Upgrade)" (GS 33J64E10-01EN).

■ Regulatory compliance

Hardware products for the RIO System Upgrades are in compliance with the safety standards and EMC standards; however, the contents of the conformity may be different from the existing products.

> **SEE ALSO** For more details, refer to the GS "Integrated Production Control System CENTUM VP Overview" (GS 33J01A10-01EN). Depending on the existing instrumentation form, additional measures such as arrester may be required.
>
> For the details of the explosion proof standards, refer to the TI of "Explosion Protection" (TI 33J01J30-01EN).

■ Power consumption, heat dissipation, and in-rush current

The power consumption, heat dissipation before and after the upgrading are the same or less. As for the in-rush currents, using the breakers that satisfies the Yokogawa specified rating is recommended. When the 24 V DC power supply is used in the existing system, the in-rush current to the equipment for upgrading will increase slightly. In case the existing system uses 24 V DC power supply and the rating of the existing breaker is less than what YOKOGAWA recommended, contact the local Yokogawa office.

> **SEE ALSO** For further details of power consumption, heating value, actual in-rush current measurement data, and breaker specifications for each component of RIO system, refer to "Appendix 2. CENTUM RIO system installation specifications."

5.   Upgrading Standard/Optional Software

In this chapter, the software packages that need to be upgraded and after upgrading are described.

5.1   CENTUM VP software license

For upgrading the RIO system, the following software licenses are required other than the ones for RIO System Upgrade of the human machine interface (HMI) and field control stations (FCS).

● **Project ID license**

"Project ID license" is a license in 8-digit numeric (provided on a sheet of paper) assigned per CENTUM VP project to identify CENTUM VP system, introduced from CENTUM VP R4 and after. When upgrading the existing systems of CENTUM CS, CENTUM CS 1000 and/or CENTUM CS 3000, a new Project ID license is mandatory.

● **Project IO license**

"Project IO license" determines the number of input and output points to be used on a single CENTUM VP project. All the number of analog, contact, fieldbus, and communication inputs/outputs defined for the CENTUM VP project is converted into logical I/O points based on the significance of each I/O point. Then, the number of logical I/O points determines the number of the Project I/O license. For further details of the Project I/O license and how to figure out the logical I/O licenses, refer to the General Specifications (GS) of "VP6F3100 Project I/O License" (GS 33J15A10-01EN).

5.2   Upgrading HMI software (for operation and monitoring)

In this section, the operation and monitoring software packages that need to be upgraded and those packages after upgrading are described.

■ CENTUM CS operation and monitoring software package

Table   List of operation and monitoring packages for upgrading

CENTUM CS		CENTUM VP R6 or later	
Model	Description	Model	Description
SIH1100	Standard operation and monitoring functions	VP6H1100	Standard operation and monitoring function
SIH1800	ICS start-up screen		
SIH4150	External I/O nest support functions (for recorder output)	VP6H4150	Output to external recorder package
SIH4410	Control drawing status display package	VP6H4410	Control drawing status display package
SIH4420	Control drawing status display package	VP6H4420	Logic chart status display package
SIH4430	SEBOL status display package	VP6H1100	Standard operation and monitoring function
SIH4440	SFC status display package		
SIH4450	CS 1000/CS 3000 project connection package	VP6H4450	Multiple project connection package
SIH4820	Historical message/trend text conversion message	VP6H1100	Standard operation and monitoring function
SIH6600	CS batch recipe management package	VP6E5166	Recipe management package
SIH6610	CS batch recipe management package	VP6H6660	Process management package
SIH6620	Unit supervision package	VP6H1100	Standard operation and monitoring function
SIH6662	CS batch production planning and scheduling interface	VP6H6660	Process management package
SIH6680	Standard recipe data management package	ES41VLN55	Recipe management for VP software
SIH6681	Client recipe data management functions		

■ CENTUM CS 1000 operation and monitoring software package

Table   List of operation and monitoring packages for upgrading

CENTUM CS 1000		CENTUM VP R6 or later	
Model	Description	Model	Description
PHS1101	Standard operation and monitoring function	VP6H1100	Standard operation and monitoring function
PHS1130	Console HIS support package for open display style	VP6H1130	Console HIS support package for open display style
PHS2411	Exaopc OPC interface package (for HIS)	VP6H2411	Exaopc OPC interface package (for HIS)
PHS2412	CENTUM data access library	VP6H2412	CENTUM data access library
PHS4100	Configured information reference package	VP6H4100	Configured information reference package
PHS4190	Line printer support package	VP6H4190	Line printer support package
PHS4200	Historical message integration package (meeting FDA regulations)	VP6H4200	Historical message integration package (meeting FDA regulations)
PHS4410	Control drawing status display package	VP6H4410	Control drawing status display package
PHS4420	Logic chart status display package	VP6H4420	Logic chart status display package
PHS4510	Expert trend viewer package	VP6H1100	Standard operation and monitoring function
PHS4600	Multiple-monitor support package	VP6H4600	Multiple-monitor support package
PHS4700	Advanced alarm filter package	VP6H4700	Advanced alarm filter package
PHS6510	Long-term data archive package	VP6H6510	Long-term data archive package
PHS6530	Report package	VP6H6530	Report package
PHS6710	FCS data setting/acquisition package (PICOT)	VP6H6710	FCS data setting/acquisition package (PICOT)
PHS6600	CS Batch 1000 process management package	VP6H6660	VP Batch process management package

■ CENTUM CS 3000 operation and monitoring software package

Table   List of operation and monitoring packages for upgrading

CENTUM CS 3000		CENTUM VP R6 or later	
Model	**Description**	**Model**	**Description**
LHM1101	Standard operation and monitoring function for new installation	VP6H1100	Standard operation and monitoring function
LHS1100	Standard operation and monitoring function		
LHS1120	Console HIS support package for enclosed display style	VP6H1120	Console HIS support package for enclosed display style
LHS1130	Console HIS support package for open display style	VP6H1130	Console HIS support package for open display style
LHS1150	Server for remote operation and monitoring function	VP6H1150	Server for remote operation and monitoring function
LHM1150			
LHS4510	Expert trend viewer package	VP6H1100	Standard operation and monitoring function
LHS4800	Consolidated alarm management software CAMS for HIS		
LHS2411	Exaopc OPC interface package (for HIS)	VP6H2411	Exaopc OPC interface package (for HIS)
LHS2412	CENTUM data access library	VP6H2412	CENTUM data access library
LHS4000	Million tag handling package	VP6H4000	Million tag handling package
LHS4100	Configured information reference package	VP6H4100	Configured information reference package
LHS4150	Output to external recorder package	VP6H4150	Output to external recorder package
LHS4190	Line printer support package	VP6H4190	Line printer support package
LHS4200	Historical message integration package (meeting FDA regulations)	VP6H4200	Historical message integration package (meeting FDA regulations)
LHM4410	Control drawing status display package (for AFF30□)	VP6H4410	Control drawing status display package
LHS4410	Control drawing status display package		
LHM4420	Logic chart status display package	VP6H4420	Logic chart status display package
LHS4420			
LHS4450	Multiple-project connection package	VP6H4450	Multiple-project connection package
LHS4600	Multiple-monitor support package	VP6H4600	Multiple-monitor support package
LHS4700	Advanced alarm filter package	VP6H4700	Advanced alarm filter package
LHS6510	Long-term data archive package	VP6H6510	Long-term data archive package
LHS6530	Report package	VP6H6530	Report package
LHM6710	FCS data setting/acquisition package (PICOT)	VP6H6710	FCS data setting/acquisition package (PICOT)
LHS6710			
LHM6600	CS batch 3000 process management package (for CENTUM CS 3000 entry class)	VP6H6660	VP Batch process management package
LHS6600	CS batch 3000 process management		

CENTUM VP operation and monitoring software package

Table   List of operation and monitoring packages for upgrading

Up to CENTUM VP R5		From CENTUM VP R6 and after	
Model	**Description**	**Model**	**Description**
LHM1101	Standard operation and monitoring function for new installation (for CENTUM VP entry class)	VP6H1100	Standard operation and monitoring function
LHS1100	Standard operation and monitoring function		
LHS1120	Console HIS support package for enclosed display style	VP6H1120	Console HIS support package for enclosed display style
LHS1130	Console HIS support package for open display style	VP6H1130	Console HIS support package for open display style
LHS1140 (*1)	Eight-loop simultaneous operation package (for AIP831)	VP6H1140	Eight-loop simultaneous operation package (for AIP831)
LHS1150	Server for remote operation and monitoring function	VP6H1150	Server for remote operation and monitoring function
LHM1150	Server for remote operation and monitoring function (for CENTUM VP entry class)		
LHS2411	Exaopc OPC interface package (for HIS)	VP6H2411	Exaopc OPC interface package (for HIS)
LHS2412	CENTUM data access library	VP6H2412	CENTUM data access library
LHS4000	Million tag handling package	VP6H4000	Million tag handling package
LHS4100	Configured information reference package	VP6H4100	Configured information reference package
LHS4150	Output to external recorder package	VP6H4150	Output to external recorder package
LHS4190	Line printer support package	VP6H4190	Line printer support package
LHS4200	Historical message integration package (meeting FDA regulations)	VP6H4200	Historical message integration package (meeting FDA regulations)
LHM4410	Control drawing status display package (for CENTUM VP entry class)	VP6H4410	Control drawing status display package
LHS4410	Control drawing status display package		
LHM4420	Logic chart status display package (for CENTUM VP entry class)	VP6H4420	Logic chart status display package (for CENTUM VP entry class)
LHS4420	Logic chart status display package		
LHS4450	Multiple-project connection package	VP6H4450	Multiple-project connection package
LHS4510	Expert trend viewer package	VP6H1100	Standard operation and monitoring function
LHS4600	Multiple-monitor support package	VP6H4600	Multiple-monitor support package
LHS4700	Advanced alarm filter package	VP6H4700	Advanced alarm filter package
LHS4800	Consolidated alarm management package CAMS for HIS	VP6H1100	Standard operation and monitoring function
LHS6510	Long-term data archive package	VP6H6510	Long-term data archive package
LHS6530	Report package	VP6H6530	Report package
LHS6710	FCS data setting/acquisition package (PICOT)	VP6H6710	FCS data setting/acquisition package (PICOT)
LHM6710	FCS data setting/acquisition package (PICOT) (for CENTUM VP entry class)		
LHM6660	VP Batch process management package (for CENTUM VP entry class)	VP6H6660	VP Batch process management package
LHS6660	VP Batch process management package		

*1:   VP R5.03 or later

5.3 Upgrading HMI software (for engineering)

In this section, software packages for engineering that need to be upgraded and those packages after upgrading are described.

The RIO System Upgrade engineering is performed in the environment of the Automation Design Suite (AD Suite) which requires AP6E5100 Standard engineering function and VP6E5000 Engineering server function.

■ AD Suite

The AD suite is an engineering environment introduced from CENTUM VP R6 (and later versions), which enables Module-based engineering, tuning parameter management, configuration management, and bulk editing of data.

For further details of the AD suite, refer to the General Specifications (GS) relevant to the AD suite.

- VP6E5000 engineering server function, VP6E5100 standard engineering function (GS 33J10D10-01EN)
- VP6E5210 Module-based engineering package (GS 33J10D22-01EN)
- VP6E5215 Tuning parameter management package (for module-based engineering) (GS 33J10D24-01EN)
- VP6E5216 Bulk-editing package (for module-based engineering) (GS 33J10D26-01EN)
- VP6E5250 Change management package (GS 33J10D28-01EN)
- VP6E5260 Dependency analysis package (GS 33J10D30-01EN)

■ CENTUM CS engineering software package

Table   List of engineering packages for upgrading

CENTUM CS		CENTUM VP R6 or later	
Model	Description	Model	Description
SIH5100	Standard builder functions	VP6E5000 VP6E5100	Engineering server function Standard engineering function
SIH5101	System definition functions		
SIH5102	System utility		
SIH5103	Maintenance utility		
SIH5110	ICS builder		
SIH5111	Operator utility		
SIH5120	FCS builder		
SIH5210	Bus converter builder		
SIH5410	Wireless debugging package		
SIH5620	Off-site block builder		
SHW5121	I/O list builder		
SHW5162	Unit supervision builder		
SHW5163	Valve pattern monitor package		
SIH5150	Graphic builder	VP6E5150	Graphic builder
SIH5420	FCS simulation communication package	VP6E5420	Test function
SIH5450	CS 1000/CS 3000 project connection builder	VP6E5450	Multiple project connection package
SIH5490	Standard self-documentation package	VP6E5490	Self-documentation package
SIH5492	Enhanced self-documentation package		
SHW5130	Recipe data management builder	ES41VLN55	Recipe management for VP software
SHW5131	Recipe data management self-documentation		
SHW5160	CS batch recipe management builder	VP6E5166	VP Batch recipe management package
SHW5161	CS batch process management builder	VP6E5165	VP Batch builder
SHW5170	CS batch self-documentation package	VP6E5490	Self-documentation package
SHW5175	Standard batch report builder	VP6H6530	Report package

■ CENTUM CS 1000 engineering software package

Table   List of engineering packages for upgrading

CENTUM CS 1000		CENTUM VP (RIO System Upgrade)	
Model	Description	Model	Description
PHS5100	Builder function	VP6E5000 VP6E5100	Engineering server function Standard engineering function
PHS5110	Access control package	VP6E5110	Access control package
PHS5120	Control drawing package	VP6E5000 VP6E5100	Engineering server function Standard engineering function
PHS5150	Test function	VP6E5420	Test function
PHS5151	Graphic builder	VP6E5150	Graphic builder
PHS5155	Expanded test functions	VP6E5425	Expanded test function
PHS5156	FCS simulator package	VP6E5426	FCS simulator package
PHS5157	HIS simulator package	VP6E5427	HIS simulator package
PHS5160	CS batch 1000 builder	VP6E5165	VP Batch builder
PHS5161	CS batch 1000 recipe management package	VP6E5166	VP Batch recipe management package
PHS5170	Access administrator package (FDA:21 CFR Part 11 complied)	VP6E5170	Access administrator package (FDA: 21 CFR Part 11 compliant)
PHS5490	Self-documentation function	VP6E5490	Self-documentation package

■ CENTUM CS 3000 engineering software package

Table   List of engineering packages for upgrading

CENTUM CS 3000		CENTUM VP (RIO System Upgrade)	
Model	Description	Model	Description
LHM5100	Standard builder function (for CENTUM VP entry class)	VP6E5000 VP6E5100	Engineering server function Standard engineering function
LHS5100	Standard builder function		
LHS5110	Access control package	VP6E5110	Access control package
LHS5150	Graphic builder	VP6E5150	Graphic builder
LHM5150	Test function	VP6E5420	Test function
LHS5160	CS batch 3000 builder	VP6E5165	VP Batch builder
LHS5161	CS batch 3000 recipe management package	VP6E5166	VP Batch recipe management package
LHS5170	Access administrator package (FDA: 21CFR Part 11 compliant)	VP6E5170	Access administrator package (FDA: 21 CFR Part 11 compliant)
LHS5420	Test function	VP6E5420	Test function
LHS5425	Expanded test functions	VP6E5425	Expanded test function
LHS5426	FCS simulator package	VP6E5426	FCS simulator package
LHS5427	HIS simulator package	VP6E5427	HIS simulator package
LHS5450	Multiple project connection package	VP6E5450	Multiple project connection package
LHM5490 LHS5490	Self-documentation package	VP6E5490	Self-documentation package
LHS5495	Electronic instruction manual	VP6C5495	Electronic instruction manual
LHS5500	User custom block development environment package	VP6E5500	User custom block development environment package

■ CENTUM VP engineering software package

Table List of engineering packages for upgrading

Up to CENTUM VP R5		CENTUM VP R6 or later	
Model	Description	Model	Description
LHM5100	Standard builder function (for CENTUM VP entry class)	VP6E5000 VP6E5100	Engineering server function Standard engineering function
LHS5100	Standard builder function		
LHS5110	Access control package	VP6E5110	Access control package
LHS5150	Graphic builder	VP6E5150	Graphic builder
LHM5150	Test function (for CENTUM VP entry class)	VP6E5420	Test function
LHS5165	VP batch builder	VP6E5165	VP Batch builder
LHS5166	VP batch recipe management package	VP6E5166	VP Batch recipe management package
LHS5170	Access administrator package (FDA: 21CFR Part 11 compliant)	VP6E5170	Access administrator package (FDA: 21 CFR Part 11 compliant)
LHS5420	Test function	VP6E5420	Test function
LHS5425	Expanded test functions	VP6E5425	Expanded test function
LHS5426	FCS simulator package	VP6E5426	FCS simulator package
LHS5427	HIS simulator package	VP6E5427	HIS simulator package
LHS5450	Multiple project connection package	VP6E5450	Multiple project connection package
LHM5490	Self-documentation package (for CENTUM VP entry class)	VP6E5490	Self-documentation package
LHS5490	Self-documentation package		
LHS5495	Electronic instruction manual	VP6C5495	Electronic instruction manual
LHS5500	User custom block development environment package	VP6E5500	User custom block development environment package

5.4 Upgrading FCS software (for control functions)

In this section, the control function software packages that need to be upgraded and those packages after upgrading are described.

■ CENTUM CS FCS software package

Table List of FCS software packages for upgrading

CENTUM CS		CENTUM VP R6 or later	
Model	Description	Model	Description
SFE1100	Standard control functions (for AFE□□□, AFM□□□ Field control unit)	VP6F1900	Control function for field control station (for A2FV70□) (*1)
SFH1100	Standard control functions (for AFS□□□ Field control unit)		
SFH3130	CS Batch process management package (for AFS□□□)	VP6H6660	Process management package
SFH3131	Unit supervision package (for AFS□□□)	VP6E5100	Standard engineering function
SFH3132	Valve pattern monitor package	VP6F3132	Valve pattern monitor package
SFH8620	Off-site block package (for AFS□□□)	VP6F8620	Off-site block package

*1: Command line (except for SP1 and SQRT) for RIO for CENTUM CS is supported.

■ CENTUM CS sub-system communication software package

Subsystem communication for CENTUM CS is upgraded by subsystem communication package for FIO. The table below shows the applicable subsystem communication functions for FIO. From CENTUM VP R5.01.00, these subsystem communication packages are bundled into the standard engineering functions.

Table   List of sub-system communication software packages for upgrading

CENTUM CS		CENTUM VP R6 or later	Remarks
Model	**Description**		
SFH9054	ACM11/12 A & B communication function	PLC-5 communication	Applicable only for ACM11, and A (ASCII) and B (BCD) commands for ACM11 are supported. The communication size per definition is as follows: CS ACM11: Analog input module/analog output module 128 words; Contact input module/contact output module 8 words
SFH9053	ACM11/ACM12 MODBUS communication package	MODBUS communication (for ALR111/ALR121)	—
SFH9036	ACM11/ACM12 simplified dual redundant communication function (read only)	—	Dual-redundant communication is performed by a standard function of FIO.
SF□2210	FA500/FA-M3 communication package	FA-M3 communication (for ALR111/ALR121)	Setting values for timers and counters can be written only for CENTUM CS.
SF□2261	MELSEC-A communication package	MELSEC-A communication (for ALR111/ALR121)	—
SF□9040	YS instrument communication package	YS communication (for ALR121)	—
SF□2310	FA500/FA-M3 communication package for communication node	FA-M3 communication (for ALR111/ALR121)	Maximum communication data capacity: For ACM2□ Max. 1024 words For ALR111/ALR121 Max. 1000 words
SF□2361	MELSEC-A communication package for communication node	MELSEC-A communication (for ALR111/ALR121)	Maximum communication data capacity: For ACM2□ Max. 1024 words For ALR111/ALR121 Max. 1000 words
SF□2350	Gas chromatograph communication package for communication node	MODBUS communication package (for ALR111/ALR121)	FIO does not support gas chromatograph communication. This function is substituted by MODBUS communication package for ALR. Communication data capacity per communication module is: For ACM21 1408 words For ALR121 1000 words Dedicated commands can be used for gas chromatograph communication package, and generic commands (register) is used for MODBUS communication.

■ CENTUM CS 1000 FCS software package

Table   List of FCS software packages for upgrading

CENTUM CS 1000		CENTUM VP R6 or later	
Model	**Description**	**Model**	**Description**
PFS1100	Standard control function (for V net, for RIO)	VP6F1900	Control function for field control station (for A2FV70□) (*1)
PFS1120	Enhanced control function (for PFC□-H, for V net)		

*1:   Command line (except for SP1 and SQRT) for RIO for CENTUM CS 1000 is supported.

■ CENTUM CS 1000 sub-system communication software package

Subsystem communication for CENTUM CS 1000 is upgraded by subsystem communication package for FIO. The table below shows the applicable subsystem communication functions for FIO. From CENTUM VP R5.01.00, these subsystem communication packages are bundled into the standard engineering functions.

Table   List of sub-system communication software packages for upgrading (1/2)

CENTUM CS 1000		CENTUM VP R6 or later	Remarks
Model	**Description**		
PFS9074	PLC-5/SLC 500 communication package (for ACM71)	PLC-5/SLC 500 communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
PFS9062	MELSEC-A communication package (for ACM11, ACM12)	MELSEC-A communication (for ALR111, ALR121)	Max. data volume for communication: For ACM1□ - 1024 words For ALR111/ALR121 1000 words
PFS9056	SLC 500 communication package (for ACM11)	SLC 500 communication (for ALR111, ALR121)	—
PFS9054	A-B communication package (for ACM11, ACM12)	PLC-5 communication	Applicable only for ACM11. A (ASCII) and B (BCD) commands for ACM11 are supported. The communication size per definition is as follows: ALR111/121: Analog input module/ analog output module 114 words; Contact input module/contact output module 16 words
PFS9053	Modbus communication package (for ACM11, ACM12)	Modbus communication (for ALR111, ALR121)	Max. data volume for communication: For ACM1□ - 1024 words For ALR111/ALR121 1000 words
PFS2253	Modbus communication package (for ACM71)	Modbus communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
PFS2232	DARWIN/DAQSTATION communication package (for ACM71)	DARWIN/ DAQSTATION communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
PFS2231	FA-M3 communication package (for ACM71)	FA-M3 communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128

Table   List of sub-system communication software packages for upgrading (2/2)

CENTUM CS 1000		CENTUM VP R6 or later	Remarks
Model	**Description**		
PFS2230	MELSEC-A communication package (for ACM71)	MELSEC communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
PFS2220	YS communication package (for ACM11, ACM12)	YS communication (for ALR121)	—
PFS2210	FA-M3 communication package (for ACM11, ACM12)	FA-M3 communication (for ALR111, ALR121)	Max. data volume for communication: For ACM1☐ - 1024 words For ALR111/ALR121 1000 words

Table   List of FOUNDATION fieldbus communication software packages for upgrading

CENTUM CS 1000		CENTUM VP R6 or later	Remarks
Model	**Description**		
PFS2510	FOUNDATION fieldbus communication package (for ACF11)	For FOUNDATION fieldbus communication	—

Table   List of PROFIBUS communication software packages for upgrading

CENTUM CS 1000		CENTUM VP R6 or later	Remarks
Model	**Description**		
PFS2540	PROFIBUS communication package (for ACP71)	PROFIBUS-DP communication (for ALP121)	—

■ CENTUM CS 3000/CENTUM VP FCS software package

Table   List of FCS software packages for upgrading

CENTUM CS 3000/VP		CENTUM VP R6 or later	
Model	**Description**	**Model**	**Description**
LFS1300	Control function for standard field control station (for FIO)	VP6F1900	Standard control function (for A2FV70☐) (*1)
LFS1330	Control function for enhanced field control station (for FIO)		
LFS1100	Control function for standard field control station (for RIO)		
LFS1130	Control function for enhanced field control station (for RIO)		
LFS1000	Standard control function (for PFC☐-S)		
LFS1020	Enhanced control function (for PFC☐-E)		
LFS1120	Control function for compact field control station		
LFS3132	Valve pattern monitor package	VP6F3132	Valve pattern monitor package
LFS8620	Off-site block package	VP6F8620	Off-site block package

*1:   Command line (except for SP1 and SQRT) for RIO for CENTUM VP/CS 3000 is supported.

■ CENTUM CS 3000/CENTUM VP sub-system communication software package

Subsystem communication for CENTUM CS 3000/VP is upgraded by subsystem communication package for FIO. The table below shows the applicable subsystem communication functions for FIO. From CENTUM VP R5.01.00, these subsystem communication packages are bundled into the standard engineering functions.

Table   List of sub-system communication software packages for upgrading (1/2)

CENTUM CS 3000/VP		CENTUM VP R6 or later	Remarks
Model	Description		
LFS9074	PLC-5/SLC 500 communication package (for ACM71)	PLC-5/SLC 500 communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
LFS9062	MELSEC-A communication package (for ACM11, ACM12)	MELSEC-A communication (for ALR111, ALR121)	Max. data volume for communication: For ACM1□ - 1024 words For ALR111/ALR121 1000 words
LFS9056	SLC 500 communication package (for ACM11)	SLC 500 communication (for ALR111, ALR121)	—
LFS9054	A-B communication package (for ACM11, ACM12)	PLC-5 communication	Applicable only for ACM11, and A (ASCII) and B (BCD) commands for ACM11 are supported. The communication size per definition is as follows: ALR111/121: Analog input module/ analog output module 114 words; Contact input module/contact output module 16 words
LFS9053	Modbus communication package (for ACM11, ACM12)	Modbus communication (for ALR111, ALR121)	Max. data volume for communication: For ACM1□ - 1024 words For ALR111/ALR121 1000 words
LFS2253	Modbus communication package (for ACM71)	Modbus communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
LFS2232	DARWIN/DAQSTATION communication package (for ACM71)	DARWIN/ DAQSTATION communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
LFS2231	FA-M3 communication package (for ACM71)	FA-M3 communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
LFS2230	MELSEC-A communication package (for ACM71)	MELSEC communication (for ALE111)	Max. number of definition per communication module: For ACM71 - 208 For ALE111 - 128
LFS2220	YS communication package (for ACM11, ACM12)	YS communication (for ALR121)	—

Table   List of sub-system communication software packages for upgrading (2/2)

CENTUM CS 3000/VP		CENTUM VP R6 or later	Remarks
Model	Description		
LFS2212	Gas chromatograph communication package (for ACM21)	Modbus communication (for ALR111/ALR121)	FIO does not support gas chromatograph communication. This function is substituted by MODBUS communication package for ALR. Communication data capacity per communication modules are: For ACM21 1408 words For ALR121 1000 words Dedicated commands can be used for gas chromatograph communication package, and generic commands (register) is used for MODBUS communication.
LFS2210	FA-M3 communication package (for ACM11, ACM12)	FA-M3 communication (for ALR111, ALR121)	Max. data volume for communication: For ACM1□ - 1024 words For ALR111/ALR121 1000 words

Table   List of FOUNDATION fieldbus communication software packages for upgrading

CENTUM CS 3000/VP		CENTUM VP R6 or later	Remarks
Model	Description		
LFS2510	FOUNDATION fieldbus communication package (for ACF11)	For FOUNDATION fieldbus communication (for ALF111)	—

Table   List of PROFIBUS communication software packages for upgrading

CENTUM CS 3000/VP		CENTUM VP R6 or later	Remarks
Model	Description		
LFS2540	PROFIBUS communication package (for ACP71)	PROFIBUS-DP communication (for ALP121)	—

5.5 Upgrading software for upper gateway

ACG10S communication gateway, which functions as an upper gateway, is replaced by Exaopc OPC interface (*1). For details of the Exaopc, refer to the GS "NTPF100 Exaopc OPC interface package" (GS 36J02A10-01E).

*1: Control application has to be regenerated, including the upper side.

■ CENTUM CS

● For HMI

Table   ACG10S related software package and its replacement (for HMI)

Applicable software		Replacement software	
Model	Description	Model	Description
SIH2210	Communication gateway	NTPF100	Exaopc OPC interface package
SIH2820	Communication gateway package (for AUC10S)		
SIH5240	Communication gateway builder function (for ICS)		
SHW5240	Communication gateway builder function (for HP9000/7xx)		
SIU5240	Communication gateway builder (for PICS)		

● For ACG

Table   ACG10S related software package and its replacement (for ACG)

Applicable software		Replacement software	
Model	Description	Model	Description
SGW1240	Text-mode communication gateway unit function	NTPF100	Exaopc OPC interface package
SGW1250	Frame-mode communication gateway unit function		

■ CENTUM CS 1000/3000 and CENTUM VP

Communication gateway builder functions for CENTUM CS 1000, CS 3000, and VP are bundled into the package of the standard engineering functions since CENTUM CS 1000 and after.

Text-mode communication gateway unit function and Frame-mode communication gateway unit function are bundled into the standard engineering functions package since CENTUM VP R5.01.00.

● For ACG

Table   ACG10S related software package and its replacement (for ACG)

Applicable software			Replacement software	
Model		Description	Model	Description
for CS 1000	for CS 3000/VP			
PGW1240	LGW1240	Text-mode communication gateway unit function	NTPF100	Exaopc OPC interface package
PGW1250	LGW1250	Frame-mode communication gateway unit function		

6. Upgrading Application Software

6.1 Application capacity of FFCS-R

Application capacity of CENTUM VP's FFCS-R control station after the RIO System Upgrade is as shown in the table below. The application capacity for VP6F1905 control function for FCS simulator is equivalent to that of VP6F1900 control function for field control station (for A2FV70□). As for the application capacities of the field control stations (FCS) of the CENTUM CS, CS 1000, CS 3000, and VP, refer to the relevant General Specifications (GS).

■ Application capacity

Table   Application capacity of FFCS-R

Item		Types of A2FV70□ (FFCS-R)		
		VP6F1900-V1□C01 (Standard)	VP6F1900-V1□C02 (Expanded)	VP6F1900-V1□C03 (Large capacity)
Number of tags	Elements per FCS (*1)	18000	18000	18000
	Function block (*2)	5500	5500	9000
Process I/O	Analog I/O points	1760	1760	1760
	Contact I/O points	4096	4096	4096
Communication I/O (*3)	Data volume (in 16-bit units)	8000	8000	8000
Internal switches	Common switch	9999	9999	9999
	Global switch	256	256	256
Message output	Annunciator message	4000	4000	4000
	Print message	4000	4000	4000
	Operator guide message	4000	4000	4000
	Sequence message request	200	200	200
	Event message	4000	4000	4000
Control function	Control drawings	200	200 (300/400/500) (*4)	
1-sec trend	Acquisition points	1024	1024	1024
ADL points	Number of accesses to other stations	512	512	512

*1:   The elements per station show the number of tags assigned to contact I/O (%Z), common switch (%SW), global switch (%GS), and communication I/O (%WB/%XB). The maximum number of tags assigned to %WB/%XB are up to 4000 each.
*2:   The function block shows the number of tags assigned to function block (%BL) and annunciator (%AN).
*3:   The sum of communication I/O is 8000 words; 4000 words for communication I/O (%WW and %WB) and 4000 words for expanded communication I/O (%XW and %XB).
*4:   Number of control drawings can be selected from 200, 300, 400, or 500. The default is set as 200. When selecting number of control drawings for 300 or more, the total number of FCS for the entire project may be restricted. For details refer to the GS "Integrated production control system CENTUM VP system overview" (GS 33J01A10-01EN).

■ Data base

Number of function blocks depends on the types of database selected at generating a system. The maximum number is fixed by the types of the function blocks. Configuration of the FFCS-R database is as shown below:

Table Database (generic type) of FFCS-R

Item	Database type - General		
	VP6F1900-V1□C01 (Standard)	VP6F1900-V1□C02 (Expanded)	VP6F1900-V1□C03 (Large capacity)
FIO nodes (*1) (*2)	9	9	9
N-IO nodes (*2)	8	8	8
N-IO I/O units (*2)	40	40	40
No. of ALF111 module	64	64	64
No. of ALR, ALE, and ALP modules	32	32	32
Total No. of communication modules (*3)	64	64	64
Regulatory control blocks/calculation blocks (FF-FP block) (*4) (ZWOPID block) (*5)	400 (400) (100)	1000 (1000) (100)	1500 (1000) (100)
Sequence block (standard) (*6)	100	200	400
Sequence block (Medium-size) (*7)	50	100	150
Sequence block (Large-size) (*8)	50	100	150
General-purpose calculations	120	250	350
SFC block	100	200	300
Operation block (unit sequence)	250	500	700
Switching instrument block (*9)	800 (500)	1000	1500
Sequence element block 1	500	700	1100
Faceplate block	50	100	150
Logic operation block	50	100	150
Sequence element block 2	50	100	150
Batch data block	50	100	150
Unit instruments (*9)	20 (30)	60	80
Unit operation instruments	150	300	400
Offsite blocks	30	40	60
Valve pattern monitor	0	0	0
System function block	4	4	4
SEBOL daemon	840	840	840
SFC simultaneous operation	600	600	600
SEBOL user function	280	280	280
Control recipe area	2 MB	2 MB	2 MB
Option area	320 KB	320 KB	320 KB

Note: When upgrading from an existing RIO system, the number of I/O modules for RIO System Upgrade which allows high speed reading of the N-IO nodes is up to 40 per FCS.
*1: The number of FIO nodes includes the number of CPU nodes.
*2: The number of N-IO I/O units is determined by VP6F3100 project I/O license, not by the base model of VP6F1900. Refer to GS 33J15A10-01EN for further details.
*3: The sum of ALR111, ALR121, ALE111, ALF111, ALP121, and A2LP131 communication modules.
*4: The number of FOUNDATION fieldbus faceplate blocks (FF-FP) is included in the regulatory control blocks and calculation blocks.
*5: The number of PID controller with output loss compensation for wireless block (ZWOPID) is included in the regulatory control blocks and calculation blocks.
*6: The sum of input and output is 64, or max. 32 rules.
*7: The sum of input (32 – 64) and output (32 – 64) is 96, or max. 32 rules.
*8: Input 64 and output 64 are fixed, or max. 32 rules.
*9: Figures in the brackets apply for CENTUM VP R6.03 or earlier.

● **Option area**

Using the following function blocks require option areas as shown.

- Enhanced ON/OFF controller, Enhanced motor control, and Enhanced switch instrument: 64 KB (*1)

- Offsite block: 80 KB

- Valve pattern monitor: 90 KB

- PID controller with output loss compensation for wireless block: 120 KB

*1:   All the 64 KB area is consumed even when only one of the three function blocks is used.

Sum of the function block sizes to be used should not exceed the size of the option area in the database.

6.2   Functional specifications of FFCS-R

The overview of the control functions of the FFCS-R is described in this section.

Differences in control functions before and after upgrading as well as remarks for the control functions after upgrading are explained.

6.2.1   Control function overview

The figure below shows the process data flow in the FFCS-R.
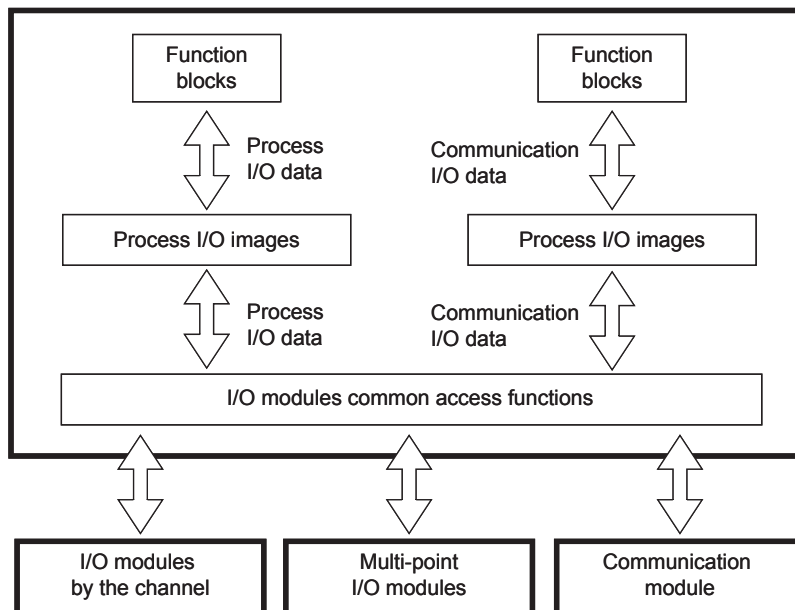
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Figure   FFSC-R I/O functions

■ Recovery from power failure/error

Recovery mode

When the FCS's power fails, its CPU and I/O modules stop operating. The table below describes the start conditions and the start operations when the power recovers.

Start condition		Start action
Initialization (MAN)	—	Initial cold start
Timer (TIM)	Prolonged power failure (FCS power failure time ≥ Momentary power failure tolerant time)	Initial cold start
	Momentary power failure (FCS power failure time < Momentary power failure tolerant time)	Restart
Continuous (AUT)	—	Restart

Depending on the start action, switch instruments and regulatory control instruments perform the following actions.

Initial cold start: MAN (MV re-reads the card images before the power failure/error.)
Restart: AUT (continuous operation)

	Control station for RIO system	FFCS-R Control station for RIO System Upgrade
Initialization	MAN	MAN
Timer	TIM	TIM
Continuous	AUT, AUT2 (*1)	AUT (*1)

*1:   "AUT" for CENTUM CS means "restart," which is to trigger MAN fall back after system power failure/error occurs for 16 seconds or longer. "AUT2" for CENTUM CS means "restart," which is to avoid MAN fall back. AUT for CENTUM CS 1000/CS 3000 and VP is equivalent to AUT2 of CENTUM CS (No such function as equivalent as AUT of CENTUM CS is available).

■ Online maintenance

Online maintenance can be performed for I/O definitions of the I/O modules for the RIO System Upgrade. The differences between the online maintenance of the I/O modules of RIO and the RIO System Upgrade are as shown below.

	RIO	I/O modules for RIO System Upgrade
Differences in online maintenance	Initialized loading only	Restart (sustaining output) (*1) (*2)

*1:   For addition of new I/O module(s) and online maintenance of single/dual-redundant setting need initialized loading.
*2:   For online maintenance of the digital I/O modules, output hold and output reset are selectable.

6.2.2 Input/output functions

■ Process control input/output

The process control input and output exchange data between the FCS and field devices, sub systems, or devices on the field buses.

● Types of process control input/output

The following process control I/O can be used by the FFCS-R.

Table List of process control I/O

I/O type	Description	Symbol	Symbol name
Process I/O	I/O to exchange signals between field devices and the FCS	%Y	Process I/O
Communication I/O	I/O to let FCS access to various data from subsystems such as PLC.	%WW (*1)	Communication I/O word data
		%WB (*1)	Communication output bit data
Fieldbus I/O	I/O to let FCS access to the various data from field devices on the fieldbus.	%Y	Fieldbus I/O

*1: When the FFCS-R uses expanded communication I/O function, %XW is converted to word data and %XB to bit data.

The following types of process I/O are available.

Table List of process I/O types

Category 1	Category 2	Types of process input/output
Input	Analog	Current, voltage, mV, thermocouple, RTD, potentiometer, pulse input, HART variables
	Contact	Status, pushbutton
Output	Analog	Current, voltage
	Contact	Status, flushing, pulse, pulse-width, time proportion on-off

● Identification of I/O points of process control input/output

Analog I/O and contact I/O

Terminal numbers of the process I/O are labeled by the physical positions of the mounting. For the contact I/O, either tag names or user-defined label names can be used. For the analog I/O, user-defined label names can be used.

%Ynnusmm

%Y	:	Process I/O identifier (I/O module for the RIO System Upgrade)
nn	:	Node number (01 to 32)
u	:	I/O unit number (1 to 5)
s	:	Slot number (1 to 4)
mm	:	Terminal number (01 to 64)
		01 to 32: Analog I/O or contact I/O
		33 to 64: HART variable

● **I/O value**

Analog I/O value

(1) Analog input: Following analog input types are available.

- Current input

- Voltage input

- mV input

- Thermocouple input

- RTD input

- Potentiometer input

- Pulse input

- HART variable

(2) Analog output: Following types of analog output types are available.

- Current output

- Voltage output

When IN terminal of the function block is connected to the process I/O, the inputs from I/O modules are converted into the following industrial units.

(1)   Process data are indicated in 0 – 100%

    0 – 100% of the input data are converted to SL to SH of the function blocks.

(2)   Process data are indicated in industrial units (measured temperature, HART variable)

     Input data are used as they are without converting.

(3)   Process data are indicated in pulse counter (with time stamps)

     Process data are converted into the actual value by using the pulse-row input process in the function blocks.

Input value ranges:
    CENTUM CS's FCS assigned definitions of actual value scales to each analog input channel. As for I/O modules for the RIO System Upgrade, the actual value scales are fixed to 0 to 100% (except for thermocouple input and RTD input). Conversion to the actual value is performed in the function blocks. However, sub input terminals of the computation block does not have converting functions to the actual value. When upgrading an application connecting %Z with sub-input of computation blocks, convert them to the actual values by PVI, and then input them into the computation block.

    When the OUT terminal of the function block is connected with the process I/O, the output to the I/O module is directly converted into the output range from 0-100% of MV.

OOP clear time:
    The OOP clear time of RIO could have been specified by the unit of 0.1 second. For I/O modules for RIO System Upgrade, the OOP clear time is specified by the unit of a second.

Contact I/O value

(1)   Contact input: Following contact input types are available.

- Status input

- Push-button input

The contact input filter time of the I/O modules for RIO System Upgrades can be specified by the unit of 2 ms and up; while the RIO did so from 0 ms. (*1)

(2)   Contact output: Following types of contact output types are available.

- Status output

- Pulse output (*2) (*3)

- Pulse-width output (*4)

- Time-proportioning ON/OFF output

- Flushing output

*1:   The sampling cycle within the IOM for RIO System Upgrade is 2 ms while that of the RIO was 20 ms.   The sensitivity to the noise of the upgraded system is as the same as the RIO.
*2:   Conversion from/to the CENTUM CS's FCS is enabled by specifying the point mode to "Pulse output" in the IOM builder and defining them as H-type operation in the sequence table
Conversion from/to the PFCS/SFCS is enabled by specifying the point mode as "Status output" in the IOM builder and defining them as P-type operation in the sequence table.
*3:   The pulse width time of the pulse-width output is specified by the second. When the pulse width time of the pulse-width output for the RIO System Upgrade is specified at 0 second, the pulse-width output is less than 1 second or remains as output off.
*4:   When the pulse-width output is used starting from even-number channels of the PFCS/SFCS, start using them in odd-number channels for FFCS-R.

The pulse-width output and time proportioning output, except for PFCS and SFCS, used to specify output operation mode by the I/O module; however, the digital I/O module of the FFCS-R is able to use all the status output, pulse-width output, and time proportioning output within an identical I/O module by specifying the point mode to either one of the status output, pulse-width output, and/or time proportioning on/off output by the channel.

The pulse-width output of the FFCS-R is to specify odd-number channel as the starting point of the contact output. Thus, in the digital I/O modules of the existing FCS, changing of the field signal wiring is required for the pulse-width output specifying even number channels as the starting point.

The unit of pulse width time and the data change timing of the pulse-width output are different for I/O modules for the RIO System Upgrade and the RIO for LFCS and LFCS2.

Pulse-width time of pulse-width output:
The pulse width time of the pulse-width output is specified by the unit of second for I/O modules for the RIO System Upgrade; while that of the RIO of LFCS and LFCS2 was specified by the unit of 0.01 second. (*1)

*1:   The contact input filter time of the I/O modules for RIO System Upgrades can be specified by the unit of 2 ms and up; while the RIO did so from 0 ms.

Data change timing of pulse-width output:
For I/O modules for the RIO System Upgrade and RIO for PFCS and SCS, both the terminal block value and the actual terminal output become off only after the defined pulse-width time is elapsed when a function block turns on and off the terminal (%Y) in shorter time cycle than the defined pulse-width time.
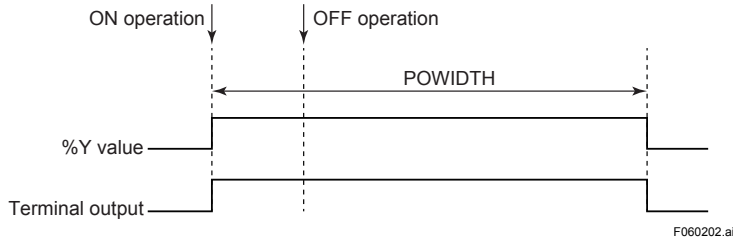

F060202.ai

Figure   Data change timing of pulse-width output (same for PFCS and SFCS)

On the other hand, for RIO for LFCS and LFCS2, the terminal block value becomes off but the actual terminal output remains on until the predefined pulse-width time ends when a function block turns on and off the terminal (%Z) in shorter time cycle than the defined pulse-width time.
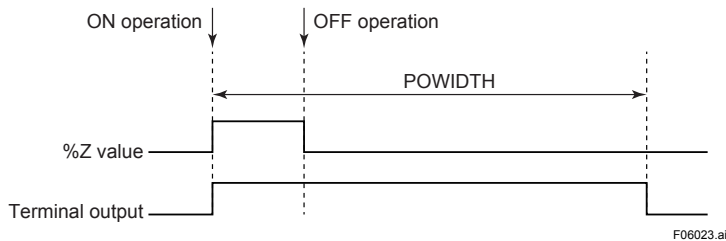

F06023.ai

Figure   Data change timing of pulse-width output for LFCS and LFCS2

● Dual-redundancy of I/O module for FFCS-R

Dual-redundant I/O module by the analog channel

I/O modules for A2BA3D take dual-redundant configuration only. As for I/O adaptor by the channel, only A2SAM505 analog output module (current output with HART) takes dual-redundant configuration. The A2SAM505 assigned to the odd-number channel and its annexed channel is used dual-redundantly.

Dual-redundant digital I/O module

Digital I/O modules can be configured in dual-redundant pair while the mounting positions are not annexed. (*1) (*2) (*3) (*4)

*1:   The operation status display displays I/O module models and control/on hold/stop, which is the same as dual-redundant I/O modules of FIO. However, when the paired modules for dual redundancy are not in the annexed positions, the operation status display does not show which two of the I/O modules are paired. Which I/O modules are paired for dual redundancy must be confirmed by the I/O module definition in the builder. I/O module loading can be done by selecting each I/O module.
*2:   In case of digital I/O modules, the control right does not switch over from the module in control to a module on the stand-by when a KS cable (connector type) or a M4 screw terminal block (terminal type) falls of from a module as it is not considered as a module failure.
*3:   Dual-redundant configuration is not available for the pulse-width output and time proportional output. If configured redundant, the output timing from the redundant digital output modules slips to cause inaccurate control. (The same situation as when the pulse-width output and time proportional output for RIO is configured redundantly.)
*4:   When the digital output module is configured in redundant, the sum of logics of control and slave outputs comes out.
In the environment where the redundant digital I/O is specified as "all points suspend the current values" with or without fallback with the output is ON, when the only one side of the I/O module fails to communicate with an FCU, the I/O module retains ON output. Thus, the sum of logics of the two I/O modules becomes ON. In other words, the output to a field device is fixed as ON when the I/O module is turned on or off from the normal side. In case of communication failure with fall back, by specifying "all points off" enables to avoid fixing the output as OFF.

The table below shows the functional differences of digital I/O module in dual-redundant configuration for CENTUM CS and FFCS-R.

Table   Functional differences of digital I/O module in dual-redundant Configuration between LFCS and FFCS-R

Item	LFCS for CENTUM CS	FFCS-R
Control drawings	Both of the %Z elements of the dual-redundant pair can be used in the control drawings.	In the dual-redundant pair, the elements of the smaller of the node number; the smaller of the unit number when the node numbers are the same; or the smaller of the slot number when the unit number and node numbers are the same for the control drawings is used.
Tag name	Both of the %Z elements of the dual-redundant pair can be named with tag names.	In the dual-redundant pair, the elements of the smaller of the node number; the smaller of the unit number when the node numbers are the same; or the smaller of the slot number when the unit number and node numbers are the same for the tag names is used.

The table below shows functional differences between the PFCS/SFCS and FFCS-R for digital I/O module in dual-redundant configuration.

Table   Functional difference of digital I/O module in dual-redundant Configuration between PFCS/SFCS and FFCS-R

Item	PFCS/SFCS	FFCS-R
Coexistence of status output and pulse-width output	Digital output module can take dual-redundant configuration where the status output and pulse-width output are coexistent.	Digital output module for status output and for pulse-width output has to be defined independently.

Dual-redundant configuration for analog multiplexer module

Among all the analog multiplexer modules, AAB841-SK□ can be used in dual-redundant configuration. The identical pair mounted in the annexed slots, of the identical functions of AAB841, the IOM (defined in slot 1 and 2) can take dual-redundant configuration.

● HART communication function

The FFCS-R can use HART devices compliant to HART5 and HART7 in the same environment. The FFCS-R can refer to 4 - 20 mA analog I/O data with HART devices such as transmitters or valve positioners as well as HART variables (*1). On demand communication is also available.

*1:   HART variables can be read by HART commands.

I/O module by the analog channel (when using A2SAM105-H or A2SAM505-H)

HART devices compliant to HART7 specifications can be used. HART variables assigned by the IOM builder are updated by the cycle of 1-second. However, in case Plant Resource manager (PRM, revision R3.31.00 or later) communicates with HART devices, which influences the communication of the HART variables, the periodic update cycle is not guaranteed, and may fluctuate by 1 or 2 seconds.

Connecting multiple HART devices to an identical I/O module does not influence the update cycle when the connecting I/O channels are different. However, multiple HART devices are connected to an identical I/O channel of an I/O module in multi-drop method, the updating cycle becomes 1 second x number of HART devices.

Analog Multiplexer Module (AAI143-HM or AAI543-HM)

HART devices compliant to HART5 specifications can be used. HART variables assigned by the IOM builder are updated by the cycle of 1 to 16 seconds, depending on the number of HART devices connected to the network. However, in case the PRM communicates with the HART devices, which influences the communication of the HART variables, the periodic update cycle is not guaranteed, and may fluctuate by 1 to 32 seconds.

■ Software Input/Output

● Global switch

Specifications related to the global switch (%GS) are unchanged. Number of switches has not been changed since CENTUM CS (256 points). (*1)

*1: By using AVR10D V net router with Style S3 or later, link transmissions between the FCS on V net and the FFCS-R on Vnet/IP can be established by the virtual domain link transmission function. For details of the virtual domain link transmission, contact Yokogawa office.

● Common Switch

The number of common switches (%SW) has been increased to 9999 points for the FFCS-R.

%SW0001 - %SW8000: Users can freely refer to and assign applications.
%SW8001 - %SW9999: Used as system switches

The system switch reflects the system status of the FCS in the form of ON/OFF status of the common switches so that the data can be used in applications.

The system switch information on the FFCS-R is as follows:

No. 8033 - 8047 and No. 8097 - 8216 shows the status of FIO nodes.
Statuses of N-IO node are added to No. 8221 and after.

Table   System switches of FFCS-R (1/3)

Switch No.	Name	Description
8001	Initialization start	1 (initial cold start), 0 (restart)
8002	Restart	1 (restart), 0 (initial cold start)
8003	Reserved	0 fixed
8004	Sequence table initial cold start command	1 (re-execution from start step)
8005	Sequence table restart command	1 (restart from the current step)
8006	Reserved	0 fixed
8007	Momentary power failure/prolonged power failure	0 (reset start when power failure exceeds the momentary power failure tolerant time) 1 (power failure within the momentary power failure tolerant time)
8008 to 8014	Reserved	
8015	Write down output value to the output module during OOP	0 (void), 1 (valid)
8016	Online revision up flag	0 (normal), 1 (start triggered by online revision up)
8017	Right-side CPU status	0 (normal), 1 (abnormal)
8018	Left-side CPU status	0 (normal), 1 (abnormal)
8019	CPU temperature	0 (all normal), 1 (abnormal, either left or right side)
8020	CPU node (FCU) temperature	0 (normal), 1 (abnormal)
8021	CPU node power supply status	0 (all normal), 1 (abnormal, either left or right side)
8022	I/O node power supply status (*1)	0 (all normal), 1 (abnormal, one or more)
8023 to 8026	Reserved	Reserved for future
8027	Right-side CPU control status	1 (control), 0 (other)
8028	Left-side CPU control status	1 (control), 0 (other)
8029	Reserved	Reserved for future

*1: The node power supply status of both N-IO node and FIO node. Either one of the power supplies of the N-IO node or the FIO node fails the status is "1."

Table   System switches of FFCS-R (2/3)

Switch No.	Name	Description
8030 to 8032	Reserved	Reserved for future
8033	FIO Node 1 communication status	0 (normal, communicable), 1 (abnormal, both sides)
:	Communication status of the applicable FIO node	0 (normal, communicable), 1 (abnormal, both sides)
8047	FIO node 15 communication status	0 (normal, communicable), 1 (abnormal, both sides)
8048 to 8064	Reserved	Reserved for future
8065 to 8072	CPU idle time (second)	8-bit integer
8073 to 8080	Communication load (%) (*2)	8-bit integer
8081 to 8089	Cabinet HKU status	HKU alarm status of cabinet address 1 to 9. 0 (normal, or no connection), 1 (abnormal) (*3)
8090 to 8096	Reserved	For future
8097	IOM status of slot 1 of FIO node 1	0 (normal or not defined), 1 (IOM abnormal)
8098	IOM status of slot 2 of FIO node 1	
:	IOM status of the applicable slot of FIO node	
8176	IOM status of slot 8 of FIO node 10	0 (normal or not defined), 1 (IOM abnormal)
8177	IOM status of slot 1 of FIO node 11	
:	IOM status of the applicable slot of FIO node	
8216	IOM status of slot 8 of FIO node 15	
8217 to 8220	Reserved	Reserved for future
8225	Communication status of N-IO node 1	0 (normal, communicable), 1 (abnormal on both sides) (*4)
:	Communication status of applicable node	0 (normal, communicable),1 (abnormal on both sides)
8232	Communication status of N-IO node 8	0 (normal, communicable), 1 (abnormal on both sides)
8233 to 8288	Reserved	Reserved for future
8289	Reserved	
:	Reserved	
8320	Reserved	
8321 to 8352	Reserved	
8321 to 8352	Reserved	
8353	IOM status of slot 1, unit 1 of N-IO node 1	0 (normal or no definition), 1 (IOM abnormal)
8354	IOM status of slot 2, unit 1 of N-IO node 1	
8355	IOM status of slot 3, unit 1 of N-IO node 1	
8356	IOM status of slot 4, unit 1 of N-IO node 1	
8357	IOM status of slot 1, unit 2 of N-IO node 1	

*2:   The average of communication load is shown in %.
*3:   Indicates "1" when any one or more of the HKU of the cabinet, temperature, fan, or power supply fails.
*4:   "1" is displayed while the N-IO node is under maintenance.

Table   System switches of FFCS-R (3/3)

Switch No.	Name	Description
8358 to 8371	IOM status of applicable slot/unit	0 (normal or no definition), 1 (IOM abnormal)
8372	IOM status of slot 4, unit 5 of N-IO node 1	
8373 to 8376	Reserved	Reserved for future
8377	IOM status of slot 1, unit 1 of N-IO node 2	0 (normal or no definition), 1 (IOM abnormal)
8378 to 8544	IOM status of applicable slot/unit (up to N-IO node 8)	
8545 to 9999	Reserved	Reserved for future

■ I/O module for reliable-RIO System Upgrade

Fall back action and diagnosis of KS cable and/or terminal block drop outs in terms of reliability of the I/O modules for the RIO System Upgrade are described in this section.

● Fall back movement

I/O adaptor, multiplexer modules, and digital I/O modules of the RIO System Upgrade have different timings for fall back actions. For instance, when the FCU stops, the I/O adaptor starts fall back action one second earlier than the multiplexer module or digital I/O module.

● Diagnosis of KS cable drop out for analog I/O module

AMC80 of RIO, either single or dual-redundant configuration, has diagnosis for KS cable drop out. AAB841-SK□ I/O module for the RIO System Upgrade has, by default, no KS cable drop out diagnosis in a single configuration and with KS cable drop out diagnosis in a dual-redundant configuration.

- When the AAB841-SK□ is in a single configuration, function block receives failure of KS cable drop outs by detecting the field signal disconnection, even the I/O module does not become abnormal status. In the same way as AMC80, specify in the command line to notify I/O module failure by the KS cable drop out.

- When AAB841-SK□ is in dual-redundant configuration, once both sides fail as the KS cable drops off from both of the I/O modules, the control side does not recover even the KS cable is connected to the I/O module on the ex-stand-by side. AAB841-SK□ recovers when the KS cables are re-connected to both sides or stop the ex-control side and forcibly switches the control rights.

● Diagnosis of KS cable drop out for I/O module (connector type)

I/O modules for both RIO and the RIO System Upgrade share the same diagnosis of drop out of the KS cable for the connector type of analog multiplexer modules and digital I/O modules.

- RIO does not have the drop out diagnosis of KS cable.

- I/O modules for the RIO System Upgrade does not have the drop out diagnosis of KS cable by default. (Only AAB841-SK□ is able to detect KS cable drop out by command line.)

● **Diagnosis of terminal block drop out for M4 terminal type IOM**

As for terminal type RIO analog multiplexer modules and digital I/O modules, the I/O module fails when an M4 terminal block is dismounted from the I/O module. As for terminal type I/O modules for the RIO System Upgrade, the I/O module does not fail even when the M4 terminal block is dismounted.

- System alarms to notify I/O module failure does not occur when the M4 terminal block is removed.

- System switches to display I/O module statuses (%SW8353 ~ 9116) remain normal even when the M4 terminal block is removed.

- Analog I/O modules do not fail when the M4 terminal block is removed; however, function blocks receive a failure of disconnection of a field signal cable.

- Digital I/O modules have no influence over function blocks when the M4 terminal block is removed as the disconnection of a field signal cable is not detected.

6.2.3   Function block

■ Function block execution timing

The function block execution timing of function blocks (or internal instruments) of the FFCS-R remains unchanged from CENTUM CS's LFCS, except that the FFCS-R's SEBOL/SFC (*1) execution timing has become selectable.

Table   Execution timing

Item	CENTUM CS LFCS	CENTUM VP FFCS-R
Scan period	• Basic: 1 sec. (fixed) • Medium-speed: 1 sec, 500 msec, or 200 msec • High-speed: 500 msec, 200 msec, 100 msec, or 50 msec	• Basic: 1 sec. (fixed) • Medium-speed: 1 sec, 500 msec, or 200 msec • High-speed: 500 msec, 200 msec, 100 msec, or 50 msec
Function block	An FCS executes its functions in the sequence of Function blocks -> Annunciator messages -> SEBOL/SFC by the specified scan period. The function block executes its applications in the order of control drawings or the functional block number in the control drawings.	An FCS executes its functions in the sequence of Function blocks -> Annunciator messages -> SEBOL/SFC (*1) by the specified scan period. The function block executes its applications in the order of control drawings or the functional block number in the control drawings.

*1:   SEBOL/SFC application processing timing is changed from during the CPU's idle time (time share execution) to the basic scan period (periodic execution). This enables to describe sequence controls in the language applications other than using sequence tables or logic charts. In the FFCS-R, the time-share execution or periodic execution of SEBOL is selectable.

■ System function block

The system function blocks display operation status inside of the FCS.

Table   System function block

Block name	How to call up from HIS	Description
FCS_CPU	%BL0001Sddss01	Displaying CPU loading information
FCS_COM	%BL0002Sddss01	Displaying control communication loading information
FCS_IOC	%BL0003Sddss01	Displaying I/O loading information
FCS_SBL	%BL0004Sddss01	Execution status of SEBOL-related application

dd: Domain number;   ss: station number;   The last two digits are always "01."

■ Local switch block

Local switch blocks (LSW) used in the CENTUM CS's FCS can also be used in the FFCS-R.

The LSW is a function block with 32 points of switches to be locally used inside the control area only. This function block has no processing function but it refers to and sets the status of the switches in other function blocks using an HIS.

■ SEBOL block

CENTUM CS's SEBOL blocks are converted into SFC blocks in the FFCS-R.   The monitor data access comments (ssdtwrite) used in the subsystem communication and bit field comments (sssdtwritebit) can be substituted by the subsystem data write (ssdwrite) and subsystem data bit field comment (sswritebit).

■ Unit instruments and SFC block

The function block builder of the CENTUM CS is implemented by defining user-defined data items of the FFCS-R such as unit instruments and SFC blocks. SEBOL blocks of the CENTUM CS are replaced by SFC blocks in the FFCS-R.

The maximum numbers of the entry check patterns and menu definitions for the SFC blocks and the unit instruments in the FFCS-R are as shown in the table below:

Table   Number of entry check patterns and menu definitions of FFCS-R

Function block type	No. of user-defined data item	No. of check pattern	No. of menu definition
SFC block	32	16	8
Unit instruments	256	64	32

■ Control area integration

The CENTUM CS had control function execution units in its FCS called "Area" (control area) which could be logically divided up to 8 groups. When upgrading the existing CENTUM CS system consisting of multiple control areas in an FCS, the control areas have to be integrated into one, as the FFCS-R has only one (integrated) control area.

● Increment in number of elements

Annunciator messages, printing messages, operator guide messages, and event messages of the CENTUM CS are elements of the control area. An element number is given to each element by the control area, which means that an Element 1 exists in control area #1 and control area #2. In an application where each of the element is referred to or set by the system element name (e.g. %AN0001), those element numbers must be changed so that the same number does not exist.

● Annunciator message with data

When upgrading, the CENTUM CS's FCS annunciator messages with data used in multiple control areas need to be merged into one control area. For the efficiency of merging, the areas for annunciator message with data can be defined by dividing them up into 8 groups.

[How to specify the builder]

In the FCS property, eight sets of the following parameters can be specified.

- Header number of annunciator message
- Last number of annunciator message
- Head number of print out message

● Connecting control areas

In the FFCS-R, connections in between the control areas (ADL) in the same station are substituted by the connection within the control area.

■ Alternative function blocks and differences from CENTUM CS

The table below shows the CENTUM CS's function blocks which are upgraded by using alternative function blocks with remarks in upgrading.

Table   Differences of function blocks between CENTUM CS and FFCS-R

Function block name	CS FCS	FFCS-R	Differences
Sequence type face plate block (5 push-button switch block)	PBST5	PBS5C	Lamps and buttons are segregated.
Sequence type face plate block (10 push-button switch block)	PBST10	PBS10C	Lamps and buttons are segregated.
Hybrid type face plate block (Standard operation station block)	HAST3	HAS3C	Lamps and buttons are segregated.
Hybrid type face plate block (Push-button switch block with input indicator)	HASTPV	HAS3C	Lamps and buttons are segregated. Number of indicator: 1 to 3
Hybrid type face plate block (Push-button switch block with expanded input indicator)	HASPVC	HAS3C	Number of indicator: 1 to 3
One-batch string data set block	BDSET-1	BDSET-1L	Set limit function is added.
Two-batch string data set block	BDSET-2	BDSET-2L	Set limit function is added.
Batch data acquisition block	BDA	BDA-L	Set limit function is added.
Logic chart block	LC16	LC64	Number of signals
Line function block	FUNC	FUNC-VAR	Builder is specified by tuning parameters.

● Sequence type faceplate block/Hybrid type faceplate block

The sequence and hybrid types of CENTUM CS faceplate blocks are replaced by FFCS-R's expanded type faceplate block. (The expanded type faceplate block is a function available in the CENTUM CS.) Differences in the conventional type and expanded type are that the lamp input function and button output function are segregated.

- By connecting Qnn lamp input and Bnn button output to the same element, these faceplate blocks function as the same as the conventional type.

- A button action of "Check button" is replaced by "Alternate button." (*1)

- For the faceplate blocks where the switch types are "button" or "button with lamp," and those buttons are operated by the sequence tables, describe MVnn in place of PVnn for data item.

- For the "button" or "button with lamp" switch faceplate blocks where the operation results are referred from sequence tables, describe data items as MVnn (from PVnn). In case the PVnn is used as the data item name in the sequence table, time lag for the length of single-scan time occurs until PVnn changes.

- For the "lamp" faceplate block, describe and refer to data items as PVnn in the same way as CENTUM CS.

*1:   The check button and the alternate button are the same functions but named differently.

As for the hybrid type faceplate block, only the three-indicator type HAS3C is supported. Substitute HASTPV or HASPVC with HAS3C where only PVs are referred to.

● **Batch data setting block (1-batch or 2-batch types) and Batch data acquisition block**

CENTUM CS's batch data setting block and batch data acquisition block are substituted by BDSET-1L, BDSET-2L or BDA-L.

- CENTUM VP is equipped with Set limit function, which is different from CENTUM CS. The set limit function limits the value of the current batch data DTnn and the next batch data NXnn (to be used by BDSET-2L), both of which are set from outside, within a specified range (between high/low limits).

- The default high/low limits are set at [0, 10000] which can be changed as needed.

- The high/low limit values themselves have no setting ranges. (The ranges can be set within the range of double-precision floating-point numbers.) However, the reverse setting of the high and low limits ($DH_{nn} < DL_{nn}$) cannot be applied.

● **Logic chart block**

Use LC64 or LC64-E to substitute CENTUM CS's logic chart blocks.

- Number of I/O signals to be handled is different. LC64 (LC64-E) handles greater number of I/O signals so that it can be used in place of LC16.

● **Line chart function block**

Use FUNC-VAR to substitute CENTUM CS's line chart function block.

- How to specify the segments of the line chart function is different from the CENTUM CS.

- X1 to X15 and Y1 to Y15 of FUNC builders are to be converted into X01 to X15 and Y01 to Y15 of the FUNC-VAR tuning parameters.

Convert the "number of sections" in the FUNC builder to SECT (number of sections) of FUNC-VAR tuning parameter.

■ Differences in detailed definitions of function blocks

● **Default setting**

The default settings of the definitions of the functional block detailed definition builder are different between the CENTUM CS and CENTUM VP as shown in the table below. The setting of the detailed definitions has to be changed as necessary.

Table   Differences in detailed definitions of function blocks

Function block names	Items	CENTUM CS	CENTUM VP
PID, PI-HLD, PID-BSW, PD-MR, PID-BLEND, PID-STC	Measure tracking	Not available	Available (when "CAS and CND")
PID, PID-BSW, PID-STC	PID control algorithm	Auto decision	Auto decision 2
RATIO	SV scale upper limit	100.0	4.0
PID-BSW	Output upper/lower limit expansion	Not valid (fixed) (*1)	Valid

*1:   This condition is applicable to the FCS for not only CENTUM CS but also CENTUM CS 1000/CS 3000 R3.06 or earlier.

● **Processing pulse train input signal such as PID**

Both of the pulse train input signals (PULSEE and QTPUL) specified by the CENTUM CS's function block detailed definition builder are substituted by BTHPUL in the FFCS-R.

Table Specifying pulse train input signals for CENTUM CS's FCS and FFCS-R

Item	CENTUM CS's FCS	FFCS-R	Applicable functional blocks
Input signal conversion type	・Control input pulse train input conversion (PULSE) ・Totalization pulse train input conversion (QTPUL)	Pulse train input (BTHPUL)	PVI, PVI-DV, PID, PI-HLD, PID-BSW, ONOFF, ONOFF-G, PID-TP, PD-MR, PI-BLEND, PID-STC, MLD-PVI, RATIO, BSETU-2, DSET-PVI

● **Specifying upper-level equipment**

In the CENTUM CS system, names of the upper-level equipment of the annunciators and function blocks are specified by the command lines. In the CENTUM VP, names of the upper-level equipment are specified by the annunciator builder and function block detailed builder.

6.3 Application database conversion service and functional check

Yokogawa undertakes the engineering work to upgrade the RIO systems from the existing CENTUM CS, CENTUM CS 1000, CENTUM CS 3000, or CENTUM VP system. Knowing the differences in file systems and database configurations in the existing systems, Yokogawa provide services to upgrade them into the latest systems efficiently and accomplish the task with good quality.

■ Application database conversion service

All the CENTUM CS application software for FCS has to be re-engineered either by customers or others.

When converting the CENTUM CS's FCS applications into FFCS-R, Yokogawa offers "Application database conversion service" (with fee) to accomplish the conversion efficiently with good quality. For details, contact Yokogawa office.

■ Functional test

Debugging and functional tests after converting the applications from the existing CENTUM system can be performed mainly by customers. For more details, contact Yokogawa sales personnel.

■ Work category of the application software conversion

The conversion of application software by the application database conversion service is performed in the following procedures.

(1) Save the project database after tuning parameters of all the stations in the existing system are saved.

(2) Convert the application software by using tools (*1)

(3) Manual conversion and tunings (for application software that cannot be converted by using the tools, but needed modifications) (*1)

(4) Debugging (confirmation of actions)

(5) Various tests (in-house test, factory acceptance test, on-site test, etc.) are conducted by customers or undertaken by Yokogawa.

*1: Application software cannot be fully converted only by the tools and manual conversion and tunings are required.

Work scope	Saving project	Conversion	Transfer	Debugging	Inspection
By Yokogawa	X	X	X	X	X
By customer	D	NG	D	D	X

X: Can be performed.　　NG: Cannot be performed.
D: To be discussed (how to split the work scope between the customer and Yokogawa).

7. On-site performance test

After all the upgrading works are done, overall performance test, such as fine adjustments of tuning parameters and confirmation of operation timings, shall be conducted using the target system on site.

Appendix 1. Maintenance products continuously used from the existing system

Table   Terminal block, cable, terminal board, relay board, and fan unit

Product	Model	Description
Terminal block (for RIO)	AMT16M	Terminal block (for AMM12T, AMM22M, AMM42T, and AMM52T)
	AMT16T	Terminal block (for AMM22T)
	AMT16R	Terminal block (for AMM32T)
	ADT16	Terminal block (for contact I/O module)
	ADT32	Terminal block (for contact I/O module)
	ADT16A	Terminal block (for relay input module)
	ADT16B	Terminal block (for relay output module)
Cable	KS1	Signal cable (40-40 pin)
	KS2	Signal cable (40-40 pin)
	KS3	Signal cable (40-37 pin)
	KS8	Signal cable (50-50 pin)
	KS9	Signal cable (50-50 pin)
	KS10	Signal cable (50-50 pin)
	AKB335	Signal cable (50-50 pin)
	AKB336	Signal cable (20-20 pin)
Terminal board	MUB	General-purpose terminal board (16 points (TE16) x 2)
	MUD	General-purpose terminal board (32 points (TE32) x 2)
	MCM	Terminal board for control I/O
	MTC	Terminal board for thermocouple
	MRT	Terminal board for RTD
Terminal block (for RIO/FIO)	TE16	Terminal block for 16-point input
	TE32	Terminal block for 32-point input
	TE08	Terminal block for 8-point input
	TETC	Terminal block for thermocouple input
	TERT	Terminal block for RTD
Relay board	MRI	Relay input board
	MRO	Relay output board
Fan unit	AIP601	Fan unit (*1)

*1:   To be replaced periodically. (Recommended replacement cycle: 4 years)

Table   Signal conditioners

Product	Model	Description
Signal conditioner nest	MHC	I/O signal conditioner nest
	MHM	Control I/O signal conditioner nest
Signal conditioner card for input	ET5	Thermocouple input card
	ER5	Resistance thermometer sensor input card
	ES1	Potentiometer input card
	EM1	mV input card
	EH1	Input isolator card (1 to 5 V)
	EH5	Input isolator card (1 to 5 V, with square root extraction)
	EA1	2-wire transmitter input card
	EA2	2-wire transmitter input card (with BRAIN series communication function)
	EA5	2-wire transmitter input card (with square root extraction)
	EP1	Pulse train input card
	EP3	Frequency input card
	EA9	I/O non-isolator distributor
Signal conditioner card for output	EC0	Control output isolator card
	EA0	Output isolator card (4 to 20 mA)
	EH0	Output isolator card (1 to 5 V)
Common signal conditioner card	ESC	Communication card for BRAIN terminal (installed in SC nest)
	EXT	Extension card (for BRAIN terminal)
	EX1	I/O through card

Appendix 2. Installation conditions for CENTUM RIO System

Table   Electricity consumption table for RIO system instruments

Equipment	Input-voltage range		Max. power consumption (*1) (VA, A)	Heating value (J//h)
	Voltage (VAC)	Frequency (Hz)		
AFG10S, AFS10S, AFH10S, AFM10S, and AFE10S Field control unit (19-inch rack mountable type) (Node unit is excluded.)	100-120	50/60 ± 3	250 VA	432 × 10³ (120 W)
	220-240		250 VA	
	24V DC	—	4.5 A	
AFG10D, AFS10D, AFH10D, AFM10D, and AFE10D Duplexed field control unit (19-inch rack mountable type) (Node unit is excluded.)	100-120	50/60 ± 3	400 VA	720 × 10³ (200 W)
	220-240		410 VA	
	24V DC	—	8 A	
AFG20S, AFS20S, AFH20S, AFM20S and AFE20S Field control unit (with cabinet) (Node unit is excluded.)	100-120	50/60 ± 3	300 VA	540 × 10³ (150 W)
	220-240		330 VA	
	24V DC	—	6 A	
AFG20D, AFS20D, AFH20D, AFM20D, and AFE20D Duplexed field control unit (with cabinet) (Node unit is excluded.)	100-120	50/60 ± 3	450 VA	828 × 10³ (230 W)
	220-240		480 VA	
	24V DC	—	10 A	
AFG20S, AFS20S, AFH20S, AFM20S, and AFE20S Field control unit (with cabinet) (Node unit is included.)	100-120	50/60 ± 3	1700 VA	3960 × 10³ (1100 W)
	220-240		2000 VA	
	24V DC	—	50 A	
AFG20D, AFS20D, AFH20D, AFM20D, and AFE20D Duplexed field control unit (with cabinet) (Node unit is included.)	100-120	50/60 ± 3	1700 VA	3960 × 10³ (1100 W)
	220-240		2000 VA	
	24V DC	—	50 A	
PFCS Field Control Station (With maximum number of I/O modules mounted.)	100-120	50/60 ± 3	200 VA	680 × 10³ (190 W)
	220-240		300 VA	
	24V DC	—	9 A	
PFCD Duplexed Field Control Station (With maximum number of I/O modules mounted.)	100-120	50/60 ± 3	200 VA	680 × 10³ (190 W)
	220-240		300 VA	
	24V DC	—	9 A	
ACB21 I/O expansion cabinet (With maximum number of nodes mounted.)	100-120	50/60 ± 3	1600 VA	3240 × 10³ (190 W)
	220-240		1700 VA	
	24V DC	—	42 A	
ANS10, ANS20, and ANS50 Node interface unit for single RIO bus	100-120	50/60 ± 3	320 VA	540 × 10³ (190 W)
	220-240		320 VA	
	24V DC	—	7.5 A	
AND10, AND20, and AND50 Dual-redundant node interface unit for duplexed RIO bus	100-120	50/60 ± 3	320 VA	540 × 10³ (190 W)
	220-240		320 VA	
	24V DC	—	7.5 A	

*1:   Power consumption in steady operation is indicated in VA (AC) or A (DC). When power consumption varies according to the installed number of equipment, power consumption by the maximum number of units installed is listed.

*2:   Heating value in steady operation is indicated in Joule/hour. When heating value varies according to the installed number of equipment, heating value by the maximum number of units installed is listed.

Table   Actual in-rush current data measured for each component of the RIO System

Equipment	In-rush current (A) for 100 V AC		In-rush current (A) for 220 V AC		In-rush current (A) for 24 V DC	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
AFG10S, AFS10S, AFH10S, AFM10S, AFE10S Field Control Unit (19-inch rack mountable type)	32	38	103	45	17	21
AFG10D, AFS10D, AFH10D, AFM10D, AFE10D Duplexed Field Control Unit (19-inch rack mountable type)	56	58	208	67	32	39
AFG20S, AFS20S, AFH20S, AFM20S, AFE20S Field Control Unit (with Cabinet) (with maximum no. of nodes installed)	133	118	418	267	67	59
AFG20D, AFS20D, AFH20D, AFM20D, AFE20D Duplexed Field Control Unit (with Cabinet) (with maximum no. of nodes installed)	133	118	418	267	67	59
PFCS Field Control Station (incl. 5 I/O units)	24	17	36	19	25	24
PFCD Duplexed Field Control Station (incl. 5 I/O units)	24	17	36	19	25	24
ACB21 I/O expansion cabinet (with maximum no. of nodes installed)	117	117	440	256	64	63
AND10/AND20/AND50 Node interface unit (duplexed) (with 5 I/O units loaded)	31	66	173	88	18	12

Peak values and waveforms of the input currents may change influenced by input impedance, by the system configurations, and/or how the power supply lines are shared with other systems. The above figures are measured under the following conditions. In reality, the in-rush currents vary by the installation conditions.

The power input circuit is equipped with an inrush current limiting circuit and restrains primary in-rush current, turning any current exceeding the limit to secondary and successive rush current.

● Measuring Conditions

Input voltage: 132/264 V AC, 50 Hz, and 24 V DC

Power line impedance: Approx. 0.4 ohms

In a power supply unit (with an external power line and internal impedance of he power supply), the turn-on timing is measured at 90° and 5 ms (50 Hz) after the AC zero-crossing point. (The data is almost identical at 60 Hz.)

● Remarks

- The timing when the primary/secondary in-rush currents becomes maximum values varies by the device.

- The in-rush current when starting-up after a momentary power failure exceeds the figures shown in the above table and its timing is different as well.

- For a system composed of multiple units of equipment, the in-rush current is normally smaller than the sum of the in-rush currents than the individual ones.

Table   Breaker Specifications of RIO System

Equipment	Built-in breaker rating (A/V)	External breaker rating (Recommend) (A/V) (*1)
PFCS field control station (100 V AC system)	6.3/250 (fuse)	15/250
PFCS field control station (220 V AC system)	6.3/250 (fuse)	15/250
PFCS field control station (24 V DC)	15/250 (fuse)	30/24
PFCD dual-redundant field control station (100 V AC system)	6.3/250 (fuse)	15/250
PFCD dual-redundant field control station (220 V AC system)	6.3/250 (fuse)	15/250
PFCD dual-redundant field control station (24 V DC)	15/250 (fuse)	30/24
AFS10S/AFS10D, AFG10S/AFG10D field control unit (100 V AC)	8/250 (fuse)	15/250
AFS10S/AFS10D, AFG10S/AFG10D field control unit (220 V AC)	6.3/250 (fuse)	15/250
AFS10S/AFS10D, AFG10S/AFG10D field control unit (24 V DC)	15/250 (fuse)	30/24
ANS50/AND50 Node interface unit (100 V AC)	8/250 (fuse)	15/250
ANS50/AND50 Node interface unit (220 V AC)	6.3/250 (fuse)	15/250
ANS50/AND50 Node interface unit (24 V DC)	15/250 (fuse)	30/24
AFS20S/AFS20D, AFG20S/AFG20D field control unit (100 V, 220 V AC)	15/250 (two) (*2)	40/250
AFS20S/AFS20D, AFG20S/AFG20D field control unit (24 V DC)	30/24 (two)	100/24
ACB21 I/O expansion cabinet (100 V, 220 V AC)	15/250 (two) (*2)	40/250
ACB21 I/O expansion cabinet (24 V DC)	30/24 (three)	100/24

*1:   Recommended.
*2:   Breaker consists of two 15AT NFBs (no-fuse breakers), as shown in the following figure. Up to 30 A can be fed. However, when 15 A or more passes through one breaker, both NFBs shut down.

Appendix 3. Remarks when upgrading from FCS for RIO to FFCS-R

Check of memory size of unit instrument data defined by user is required in advance when considering update of existing RIO FCS to FFCS-R.

The memory size of the user-defined unit instrument data may be insufficient in the template database after the system upgrade, because the memory size of the unit instrument data define d by user per unit instrument in the PFCS/SFCS template database differs from that of the unit instrument data defined by user per unit instrument in the template database after the system upgrade.

When the capacity is insufficient, it is necessary to expand the capacity according to the memory size of the existing unit instrument data defined by user (*1).
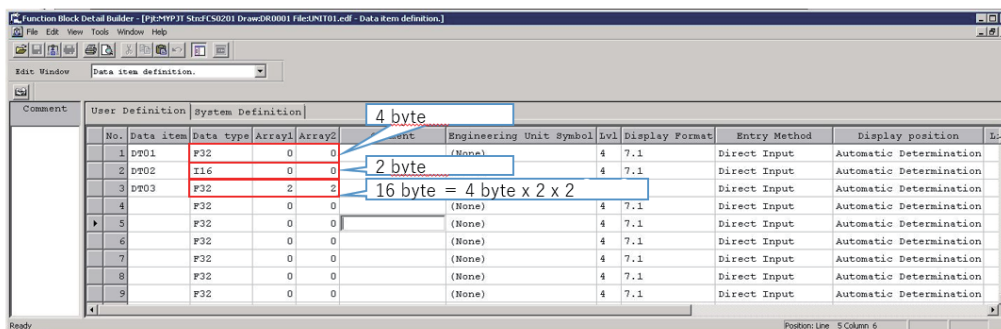
When using user-definable template in LFCS/LFCS2 and using unit blocks of variable master list size (UT2 to UT8) with the control application, it is also necessary to expand the capacity according to the memory size of existing unit instrument data defined by user (*1).

*1:   In addition to upgrading to FFCS-R, similar expansions are required when upgrading to FFCS-V or FFCS-C.

■ When existing FCS is PFCS/SFCS

● Prior check item

1. Check whether the memory size of the unit instrument data defined by user exceeds 8 Kbytes (8192 bytes).

2. For each unit instrument, activate the function block detail builder and open the "Data Item Definition" window.

3. Calculate the data area of the data item listed on the "User Definition " tab sheet.

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Figure   Calculation example of memory size of unit instrument data defined by user

Memory size of unit instrument data defined by user (sum of DT01 to DT03) = 24 byte

DT01:   4 byte (F32)
DT02:   4 byte = 2 byte (I16) + 2 (for Alignment adjustment)
DT03:   16 byte = 4 byte (F32) x 2 x 2

Alignment adjustment

Alignment adjustment is a function to adjust the start address of the area according to the data type of the data item.

In the above example, a 2 byte spare area is added after DT02 so that the beginning of DT03 is 4 byte boundary.

Byte size required for spare areas varies depending on the data type defined in each data item.

Table   Alignment adjustment

Data type		Boundary unit	Correct byte width
I16	16-bit signed integer	2 byte unit	—
I32	32-bit signed long integer	4 byte unit	2 byte
F32	32-bit single-precision floating-point real number	4 byte unit	2 byte
F64	64-bit double-precision floating-point real number	8 byte unit	4 to 6 byte (*1)
CHR2 to 16	character string data with 2 to 16 bytes of characters	2 byte unit	—

*1:   When the data type of the previous item is I32 or F32, the compensation byte width of the F64 type is 4 bytes. When the data type of the previous item is I16 or character string type, the compensation byte width of the F64 type is 6 bytes.

● **Countermeasure when memory size of unit instrument data defined by user exceeds 8 KB**

Expand the capacity according to the memory size of existing unit instrument data defined by user (*1).

*1:   Conversion of FCS (template) database is required. For details, contact Yokogawa office.

■ When the existing FCS is LFCS/LFCS2

● **Prior check item**

Check if unit blocks of variable master list size (UT2 to UT8) are used in control application with user-defined template.

● **Countermeasure when using unit blocks of variable master list size**

When using unit blocks of variable master list size, "Application database conversion service" (with fee) is required (chargeable). For details, contact YOKOGAWA.

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Revision Information

- Title : RIO System Upgrade Guide
- Manual No. : TI 33J01B01-01EN

Nov. 2020/9th Edition
Introduction   Updated descriptions of trademark.
4.2.8   Correction of the Table of "■ Functional differences of the I/O bus (communications among I/O nodes), added note.

July 2019/8th Edition
4.2.8   Correction of the figure "FCU cabinet (Rear)" of "■ Generic upgrading (Replace RIO bus with N-ESB bus or Optical ESB bus)".
6.1   Added A2LP131 to the note *3 of "Table Database (generic type) of FFCS-R".

Dec. 2018/7th Edition
4.2.5   "● Upgrading I/O module by the channel" Add note accompanying JIS standard change.
   "● Upgrading Multi-channel I/O module"Add note accompanying JIS standard change.
4.2.8   "■ Functional differences of the I/O bus (communications among I/O nodes)".
   Add note when connecting I/O bus chain.

Aug. 2018/6th Edition
5.2   Correction of mistake in "Table List of operation and monitoring packages for upgrading" for "■ CENTUM CS 1000 operation and monitoring software package", "■ CENTUM CS 3000 operation and monitoring software package", and "■ CENTUM VP operation and monitoring software package"
5.3   Correction of mistake in "Table List of engineering packages for upgrading" for "■ CENTUM CS 1000 engineering software package", "■ CENTUM CS 3000 engineering software package", and "■ CENTUM VP engineering software package".
Appendix 3. Remarks when upgrading from FCS for RIO to FFCS-R" are added.

Mar. 2017/5th Edition
2.2   Applicable Hardware of FCS
   With I.S. solutions addition, divided into a chapter of 2.2.1 and 2.2.2.
2.4.3   Remarks for alternative solutions for SP1 and SQRT are added for "■ Upgrading of RIO system from CENTUM CS" and "■ Upgrading of RIO system from CENTUM CS 1000/CS 3000 and CENTUM VP."
4.2.5   Upgrading I/O module nest
   Title name is changed to "Upgrading I/O".
   With I.S. barrier solutions addition, divided into a chapter of 4.2.5.1 and 4.2.5.2.
   Remarks on communication cable when replacing ACM11 to ALR111 are added for "● Upgrading communication module."
4.2.8   Revised "■ Hardware of existing RIO system and after system upgrade"
   Revised "■ Generic upgrading (Replace RIO bus with N-ESB bus or Optical ESB bus)"
   Revised "■ Connecting node units to install communication modules (using ESB bus/Optical ESB bus)"
4.2.9   Added reference of regulatory compliance
5.4   Remarks on the command line are added for "■ FCS software package for CENTUM CS."
6.1   Data base for FFCS-R is corrected.
6.2   A note on functional specifications of FFCS-R is modified.
6.2.2   Remarks on I/O module functions after upgrading are added.

Nov. 2016/4th Edition
6.1   Correction of "Large capacity" for "Number of tags (Function block)" in the table.

Oct. 2016/3rd Edition
2.2   Added ACP71.
2.3   Added about upgrading ACP71.
4.2.5   Added about upgrading ACP71.
4.2.7   Correction of the figure FCU with cabinet before and after upgrading (Front).
   Correction of the figure PFC□ before and after upgrading.
4.2.8   Added about upgrading ACP71.
   Clerical error correction for "● Generic upgrading (Replace RIO bus with N-ESB bus or Optical ESB

bus)".
5.4   Revised erroneous descriptions of the CENTUM CS 1000/CS 3000/VP sub-system communication software packages.

June 2016/2nd Edition
Introduction   Remove the "■ Terminology"
1.1   Added cases of the phased system upgrade.
       Changed name of a system configuration component.
1.2   Changed name of a system configuration component.
2.4   Added the OIL Movement Suite-VP JOBCON to the alternative solution of ACS.
4.1   Changed name of a system configuration component.
4.2.9 Added the "■ Regulatory compliance"
       Revised notes of in-rush current.
5.2   Revised erroneous descriptions of the CENTUM VP R6 software packages.

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Subject to change without notice.