Technical Information

Integrated Production Control System
CENTUM VP
System Overview (FCS Overview)

TI 33J01A12-01EN

[Release 6]

YOKOGAWA

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Introduction

CENTUM VP is an integrated production control system to manage and control wide-ranged plant operation such as petroleum refineries, chemical, steel, food, and power.

This manual (System Overview (FCS Overview)) provides a simple overview of CENTUM VP FCS (Field Control Station). Before reading this manual, read system Overview (General Overview) to understand the overview of CENTUM VP. After reading this manual, read manuals describing the details such as General Specifications.

Relevant Manual

TI 33J01A10-01EN	CENTUM VP System Overview (General Overview)
TI 33J01A11-01EN	CENTUM VP System Overview (HMI Overview)
TI 32R01B10-01E	ProSafe-RS System Overview

Intended Readers for This Manual

This manual is mainly intended for:

Instrumentation, electric and computer engineers considering or executing the install of CENTUM VP.

Description of Figures

Figures in this manual may be highlighted or simplified, or partially omitted for better explanation.

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CENTUM VP
System Overview (FCS Overview)

TI 33J01A12-01EN 7th Edition

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1. Overview of CENTUM VP FCS

Yokogawa developed all the CENTUM Series Field Control Stations (FCSs), including hardware and software, by our own selves. We know every corner of the software and the hardware and that knowledge enables us to sustain the service record of 99.99999% availability.

1.1 Compact Design

The size of each component is designed compact that reduces the overall “footprint” of the control system. It allows make efficient use of the limited spaces of the control and equipment rooms. Both the FCS and its I/O node units can be placed in remote classified locations (IEC Zone2/Class I Div. 2), that provides savings in installation costs.

1.2 Dual-redundancy and Reliability

There is no single point of failure in Yokogawa’s FCS! The processor modules, power supplies, and I/O modules, including the communication bus, support a redundant configuration. The robustness of the FCS comes from this configuration known as “Pair and Spare” and the reliability of calculation results is guaranteed through real-time validation. Two processor modules have two MPUs each. MPU 1 and MPU 2 in the primary processor module are always comparing the calculation result, and if the results do not match, the first processor module goes into maintenance mode while the secondary processor module takes over process control. In order to make this switch over seamless, MPU 3 and MPU 4 are also calculating and comparing the results while the primary processor module is active. Pair and Spare is Yokogawa’s unique technology, supporting impressive levels of availability for CENTUM and ProSafe-RS. This architecture has been approved by TÜV Rheinland for safety instrumented systems. The ProSafe-RS certification was granted to Yokogawa in exceptionally short period of time, and it was due in-part to our Pair and Spare technology.

1.3 Ultimate flexibility

The next-generation software configurable smart I/O, reduces footprint, lowers marshalling costs and allows flexible I/O binding.
Matched with the Field Mate Validator, our commissioning tool, this allows for significantly faster project completion and reduced costs without compromising on quality.

1.4 Online Maintenance

Through an online maintenance function, FCS applications can be modified without shutting down the FCSs. It means, you can change logics and parameters without interrupting the process control. This is useful for expansion or modification of the plant in operation.

1.5 Open Structure and High Reliability

Yokogawa is committed to reduce costs for our customers by enabling the use of commercial off-the-shelf technology where appropriate. Plant reliability is in no way compromised as the communication response is guaranteed (deterministic as opposed to probabilistic) thanks to Yokogawa’s renowned reliability, dedicated protocol, and redundant configuration.

1.6 Function Blocks

The CENTUM VP provides functional blocks for monitoring, control, manipulations, calculations, logic functions, and sequences. Not only continuous control but also advanced control, complicated sequence control, and batch control are all executed in a redundant, secure, and reliable controller environment. Plant systems can be flexibly designed, ranging from small- to large-scale, through the combination of these control blocks.

1.7 Subsystem Integration and Digital Fieldnetworks Support

To meet the growing need for communication with manufacturing equipment including variable speed drives, PLCs, and “smart” motor protection relays for operation and monitoring, as well as with analyzers, weighing machines, smart instruments, and other instruments used for product inspection, CENTUM VP supports a wide variety of communication interfaces and digital fieldnetworks such as FOUNDATION fieldbus, PROFIBUS-DP, Modbus RTU, Modbus TCP/IP, and DeviceNet.

1.8 Unit Instruments

The multiple devices of a process facility which would previously have been handled individually can now be defined, operated, and monitored as a single unit, simplifying operation. Unit instruments can be applied to batch processes and continuous control processes that require complex management, expediting overall plant operation.

2. Hardware

FCS Type

CENTUM VP supports the following FCS.

Table FCS Types

Abbreviation	Product Name	FCU Model	Software Package
FFCS-C	FCS for N-IO	A2FV50☐ (Rack-mount)	VP6F1800 Control Function for Field Control Station
FFCS-V	FCS for FIO	AFV30☐ (Rack-mount) AFV40☐ (Cabinet Type)	VP6F1700 Control Function for Field Control Station
FFCS-R	FCS for RIO System Upgrade	A2FV70☐ (Rack-mount)	VP6F1900 Control Function for Field Control Station

Note: "☐" represents "S" (single) or "D" (duplexed).

FCS for N-IO (FFCS-C):

FFCS-C capable of connecting newly-developed N-IO (network I/O) nodes via the N-ESB bus (Network-Extended Serial Backboard bus) or Optical ESB bus as well as conventional node units via ESB bus or Optical ESB bus. The node units can accommodate communication modules. The new N-IO nodes have the following features:

- A single module can handle analog I/O and digital I/O signals.
- Each channel can handle a variety of signal types by using a suitable I/O adaptor.
- The module lineup includes models for intrinsically safe applications.

N-IO nodes are ideal when distributing a system in order to reduce marshalling.
N-IO field enclosure is a standardized remote I/O enclosure for outdoor use, in which N-IO nodes are equiped.

FCS for FIO (FFCS-V):

FFCS-V capable of connecting node units via ESB bus or Optical ESB bus. The node units can accommodate I/O modules for FIO and communication modules. The FFCS-V is suitable when planning concentrated marshalling.

FCS for RIO system upgrade (FFCS-R):

FFCS-R is dedicated to upgrading RIO type FCS on conventional CENTUM CS, CENTUM CS 1000/CS 3000, and CENTUM VP. The existing field wirings are utilized as they are without changing interfaces with the field devices, which is helpful to shorten the period for upgrading work.

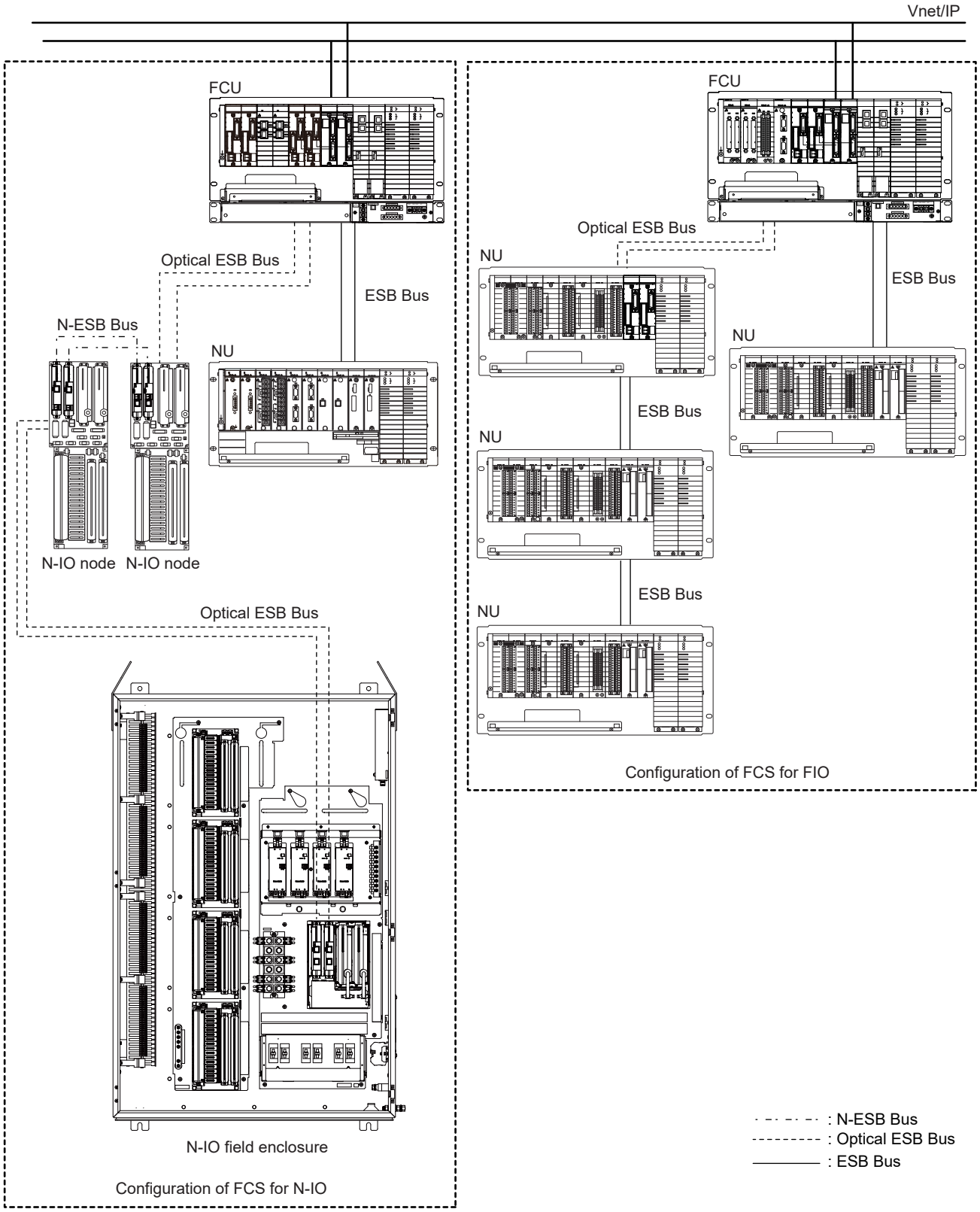


Figure Example configuration of FCSs

2.1 Hardware Configuration of FFCS-C

The hardware of FFCS-C is comprised of the following components.

Field control unit (FCU):
FCU is equipped with a processor for control computation, power supply, control bus interface, and I/O module slots for installing communication modules.

N-IO node:
These convert various process I/O signals and perform data exchange with the FCU.

N-IO field enclosure:
This is a standardized remote I/O enclosure for outdoor use, in which N-IO nodes are equiped.

Node unit (NU):
Communication modules are mounted on NU. And NU transmits those module data to FCS.

N-ESB bus, ESB bus, and Optical ESB bus:
These are dual redundant buses interconnecting the FCU, N-IO nodes and node units with each other.

2.1.1 FCU of FFCS-C

A duplexed FCU has pairs of processor modules and power supply modules. Communication modules can also be installed in FCU, and installing paired communication modules will make them dual redundant. When connecting N-IO nodes or node units, a pair of bus interface modules is installed in I/O module slots.

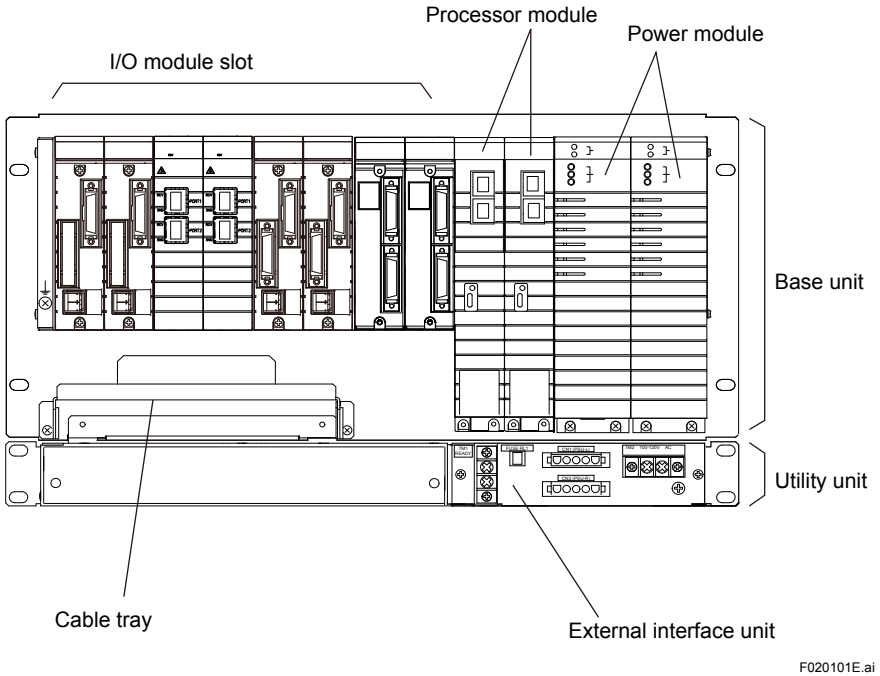


Figure Duplexed FCU Configuration (FFCS-C)

2.1.2 N-IO Node

N-IO node is a signal processing unit which converts process I/O signals from/to the field and transmits the converted data to FCU. N-IO node is comprised of N-IO I/O units and a node interface unit. Both are offered in two types: DIN rail mounting and wall mounting models.

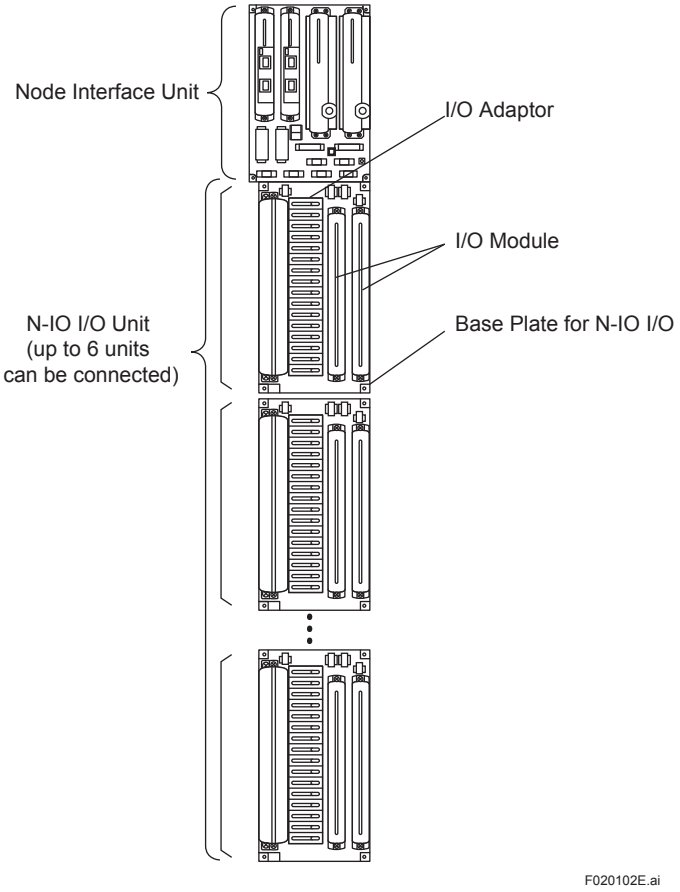


Figure N-IO Node Configuration

2.1.3 Node Interface Unit (for N-IO)

A node interface unit acts as a communication interface between FCU and N-IO I/O units and between node interface units, and supplies power to the I/O units.

2.1.4 N-IO I/O unit

N-IO I/O unit is analog and digital I/O from/to the field and converts the signals. Each unit is comprised of I/O modules, I/O adaptors (converters), intrinsically safe barriers, and N-IO I/O baseplate on which they are installed.

The individual channels by I/O module type can be flexibly configured as analog I/O and digital I/O channels by software, thereby helping to prevent delays in the plant construction schedule due to changes.

Installing pairs of modules will make a redundant module configuration. I/O adaptors for the individual channels can accommodate various types of signals.

Table Base Plates for N-IO I/O

Model	Name
A2BN3D	Base Plate for Adaptor (for N-IO, 16-channel, with Adaptor, Pressure Clamp Terminal or Spring Clamp Terminal)
A2BN4D	Base Plate for Barrier (for N-IO, MTL Barrier)
A2BN5D	Base Plate for Barrier (for N-IO, P+F Barrier)

Table 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)

Table I/O Adaptors (for N-IO)

Model	Name
A2SAM105	Current Input/Voltage Input Adaptor
A2SAM505	Current Output/Voltage Output Adaptor
A2SAT105	mV / TC / RTD Input Adaptor
A2SAP105	Pulse Input Signal Adaptor (0 to 10 kHz)
A2SDV105	Digital Input Adaptor (24 V DC Voltage Input, Dry Contact Input)
A2SDV505	Digital Output Adaptor (24 V DC, Current Source: 0.5 A)
A2SDV506	Relay Output Adaptor (24 V DC, Dry Contact Output: 0.5 A)
A2SMX801	Pass-through I/O Signal Adaptor
A2SMX802	Pass-through I/O Signal Adaptor (with field power output)

For the line of intrinsically safe barriers, refer to “Baseplate (for N-IO)” (GS 33J62F40-01EN).

2.1.5 N-IO Field Enclosure

N-IO field enclosure is a standardized remote I/O enclosure for outdoor use, which provides the accessories including field power supply units with optimized design. The N-IO field enclosure consists of two components, one is a dedicated enclosure with terminal blocks and the other is a base unit with an N-IO node including field power supply units. It is possible to order the enclosure and the base unit individually.

2.1.6 Node Unit (NU)

In FFCS-C, communication modules are installed in I/O module slots of Node Unit, which converts the communication I/O signals from/to the field and exchanges the converted data with FCU. There are two types of Node Units: the ESB node unit and Optical ESB bus node unit. Node Unit is comprised of power supply modules and bus interface modules, namely, ESB bus slave interface modules or Optical ESB bus repeater modules.

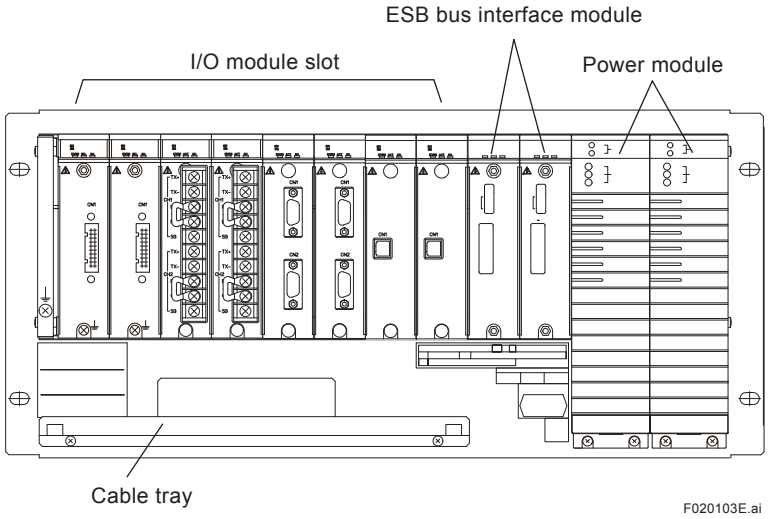


Figure ESB Bus Node Unit Configuration

2.1.7 Communication Modules

The table below shows the communication modules that can be used in FFCS-C. I/O modules for FIO or other communication modules cannot be used.

Table Communication modules

Model	Name
ALR111	Serial Communication Module (RS-232C, 2-port, for N-IO/FIO)
ALR121	Serial Communication Module (RS-422/RS-485, 2-port, for N-IO/FIO)
ALE111	Ethernet Communication Module (for N-IO/FIO)
ALF111	FOUNDATION Fieldbus Communication Module (for N-IO/FIO)
ALP121	PROFIBUS-DP Communication Module (for N-IO/FIO)
A2LP131	PROFINET Communication Module (for N-IO/FIO)

2.1.8 N-ESB Bus, ESB Bus, and Optical ESB Bus

N-ESB bus, ESB bus, and Optical ESB bus are used as the communication bus of FFCS-C. All of them can be laid out in a chain or star topology depending on the purpose and are dual redundant.

N-ESB bus connects FCU and N-IO nodes. ESB bus connects FCU and ESB bus node units. Optical ESB bus uses optical fiber cable and Optical ESB bus repeater modules to enable long-distance transmission of the ESB bus and connects FCU and N-I/O nodes, or FCU and Optical ESB bus node units. Optical ESB bus is useful when deploying N-IO nodes or node units not only within the same cabinet with FCU but also far from FCU.

N-IO nodes support connection with Optical ESB bus without using Optical ESB bus repeater modules.

2.2 Hardware Configuration of FFCS-V

The hardware of FFCS-V is comprised of the following components.

Field control unit (FCU):
This is the “brain” that executes FCS’s control computations as the core and has power supply module and I/O module slots for installing communication modules or bus interface modules.

Node unit (NU):
Input/Output and communication modules are mounted on NU. And NU transmits those module data to FCS.

ESB bus and Optical ESB bus:
These buses can be configured as dual redundant and interconnect FCU and node units with each other.

House-keeping unit (HKU):
HKU is the core of the house keeping functions such as to monitor the inside cabinet environment, as well as the status of FCS itself.

2.2.1 FCU of FFCS-V

A duplexed FCU has pairs of processor modules and power supply modules. I/O modules for FIO and communication modules can also be installed in FCU and installing paired I/O and communication modules will make them dual redundant. When connecting node units, a pair of bus interface modules is installed in I/O module slots. When configuring the communication bus as dual redundant, a pair of bus interface modules are installed.

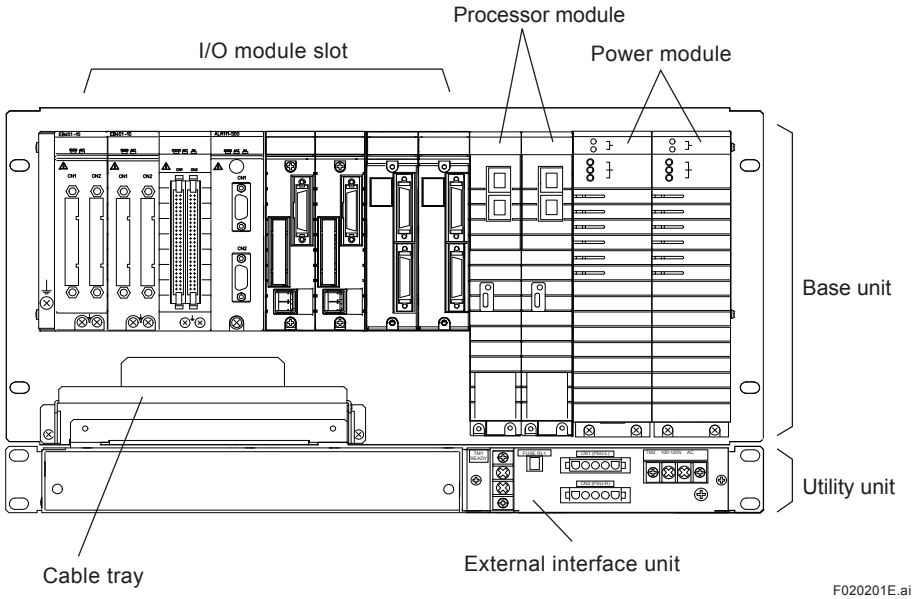


Figure Duplexed FCU Configuration (FFCS-V)

2.2.2 Node Unit (NU)

In FFCS-V, communication modules and I/O modules for FIO are installed in I/O module slots of node unit, which converts process I/O signals such as analog and digital signals from/to the field and the communication I/O signals from/to the field and exchanges the converted data with FCU. There are two types of node units: ESB bus node unit and Optical ESB bus node unit. Node unit is comprised of power supply modules and bus interface modules, namely, ESB bus slave interface module or Optical ESB bus repeater module.

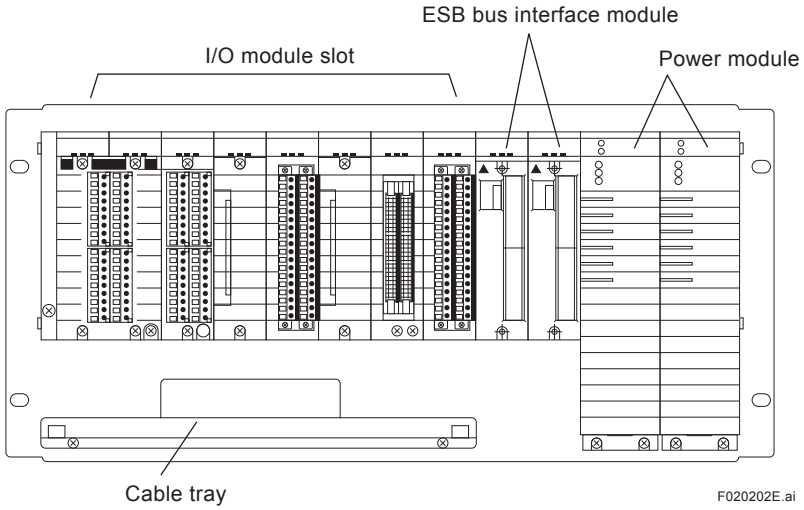


Figure ESB Bus Node Unit Configuration

2.2.3 I/O Modules for FIO

CENTUM VP I/O modules provide various choices for isolated types or connector types to respond flexibly to any requirements.

Table I/O Modules for FIO (1/2)

Models	Name
Analog I/O Modules	
AAI141	Analog Input Module (4 to 20 mA, 16-Channel, Non-Isolated)
AAB141	Analog Input Module (1 to 5 V/4 to 20 mA, Non-Isolated)
AAV141	Analog Input Module (1 to 5 V, 16-Channel, Non-Isolated)
AAI841	Analog I/O Module (4 to 20 mA Input, 4 to 20 mA Output, 8-Channel Input/8-Channel Output, Non-Isolated)
AAB841	Analog I/O Module (1 to 5 V Input, 4 to 20 mA Output, 8-Channel Input/8-Channel Output, Non-Isolated)
AAB842	Analog I/O Module (1 to 5 V/4 to 20 mA Input, 4 to 20 mA Output, 8-Channel Input/8-Channel Output, Non-Isolated)
AAI143	Analog Input Module (4 to 20 mA, 16-Channel, Isolated)
AAI543	Analog Output Module (4 to 20 mA, 16-Channel, Isolated)
AAV144	Analog Input Module (-10 V to +10 V, 16-Channel, Isolated)
AAV544	Analog Output Module (-10 V to +10 V, 16-Channel, Isolated)
AAI135	Analog Input Module (4 to 20 mA, 8-Channel, Isolated Channels)
Analog I/O Modules	
AAI835	Analog I/O Module (4 to 20 mA, 4-Channel Input/4-Channel Output, Isolated Channels)
AAT145	TC/mV Input Module (16-Channel, Isolated Channels)
AAR145	RTD/POT Input Module (16-Channel, Isolated Channels)
AAP135	Pulse Input Module (8-Channel, Pulse Count, 0 to 10 kHz, Isolated Channels)
AAP149	Pulse Input Module for Compatible PM1 (16-Channel, Pulse Count, 0 to 6 kHz, Non-Isolated)
AAP849	Pulse Input Module/Analog Output Module (8-Channel Input/8-Channel Output, Non-Isolated)
Analog I/O Modules with HART Communication Function	
AAI141-H	Analog Input Module (4 to 20 mA, 16-Channel, Non-Isolated)
AAB141-H	Analog Input Module (1 to 5 V/4 to 20 mA, Non-Isolated)
AAI841-H	Analog I/O Module (4 to 20 mA Input, 4 to 20 mA Output, 8-Channel Input/8-Channel Output, Non-Isolated)
AAI842-H	Analog I/O Module (1 to 5 V/4 to 20 mA Input, 4 to 20 mA Output, 8-Channel Input/8-Channel Output, Non-Isolated)
AAI143-H	Analog Input Module (4 to 20 mA, 16-Channel, Isolated)
AAI543-H	Analog Output Module (4 to 20 mA, 16-Channel, Isolated)
AAI135-H	Analog Input Module (4 to 20 mA, 8-Channel, Isolated Channels)
AAI835-H	Analog I/O Module (4 to 20 mA, 4-Channel Input/4-Channel Output, Isolated Channels)

Table I/O Modules for FIO (2/2)

Models	Name
Digital I/O Modules	
ADV151	Digital Input Module (32-Channel, 24 V DC, Isolated)
ADV551	Digital Output Module (32-Channel, 24 V DC, Isolated)
ADV161	Digital Input Module (64-Channel, 24 V DC, Isolated)
ADV561	Digital Output Module (64-Channel, 24 V DC, Isolated)
ADV859	Digital I/O Module for Compatible ST2 (16-Channel Input/16-Channel Output, Isolated Channels)
ADV159	Digital Input Module for Compatible ST3 (32-Channel Input, Isolated Channels)
ADV559	Digital Output Module for Compatible ST4 (32-Channel Output, Isolated Channels)
ADV869	Digital I/O Module for Compatible ST5 (32-Channel Input/32-Channel Output, Isolated, Common Minus Side Every 16-Channel)
ADV169	Digital Input Module for Compatible ST6 (64-Channel Input, Isolated, Common Minus Side Every 16-Channel)
ADV569	Digital Output Module for Compatible ST7 (64-Channel Output, Isolated, Common Minus Side Every 16-Channel)
Communication Modules	
ALR111	RS-232C Communication Module (RS-232C, 2-port for N-IO/FIO)
ALR121	RS-422/RS-485 Communication Module (RS-422/RS-485, 2-port for N-IO/FIO)
ALE111	Ethernet Communication Module (for N-IO/FIO)
ALF111	FOUNDATION fieldbus Communication Module (4-Port, for (N-IO/FIO)
ALP121	PROFIBUS-DPV1 Communication Module (for N-IO/FIO)
A2LP131	PROFINET Communication Module (for N-IO/FIO)
Turbomachinery I/O Modules	
AGS813	Servo Module(Isolated)
AGP813	High Speed Protection Module(Isolated)

Combination between I/O Module and Terminal Block

To connect between I/O module and field devices, mount a pressure clamp terminal or KS cableinterface adapter on I/O module. It is also possible to connect a customer-supplied MIL cable by using a terminal block for MIL connector.

The figure below shows the combination between I/O module and terminal block.

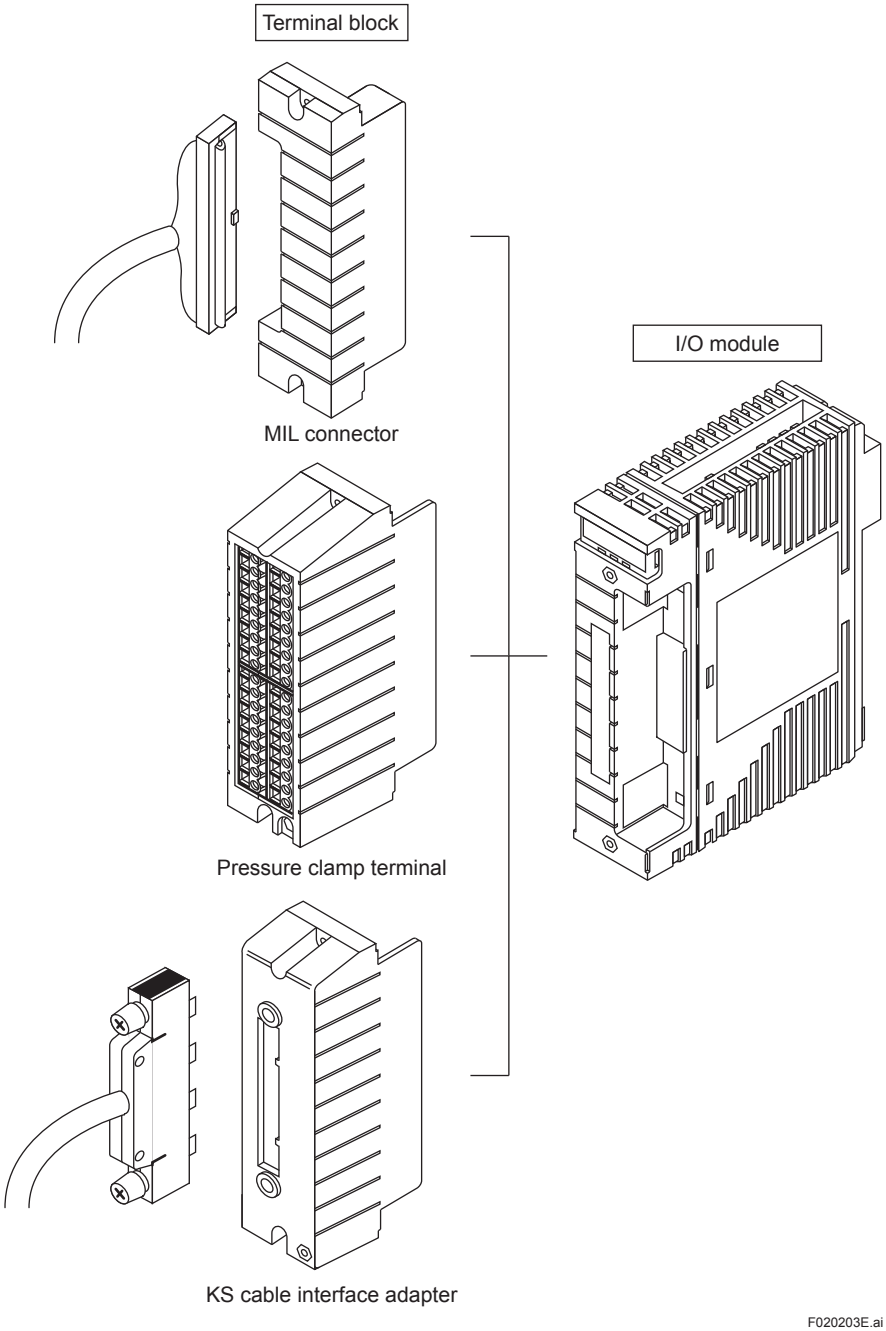


Figure Terminal Blocks and I/O Module

- **Field wiring using Pressure Clamp Terminal**

  A field signal cable whose end is uncovered can be directly connected to analog or digital I/O module equipped pressure clamp terminal block. Two to three signal cables can be connected for every I/O channel.

- **Field wiring using KS Cable Interface Adapter**

  I/O module equipped with KS cable interface adapter can be connected to a terminal board with KS cable. Field signal cables are connected to a terminal board with M4 screws.

2.2.4 ESB Bus and Optical ESB Bus

ESB bus and Optical ESB bus are used as the communication bus of FFCS-V. They can be laid out in a chain or star topology depending on the purpose and can be made dual redundant. ESB bus connects FCU and ESB bus node units. Optical ESB bus uses optical fiber cable and Optical ESB bus repeater modules to enable long-distance transmission of ESB bus and connects FCU and Optical ESB bus node units. Optical ESB bus is useful when deploying node units not only within the same cabinet with FCU but also far from FCU.

2.2.5 House Keeping Unit (HKU)

CENTUM VP FCS is equipped with a house keeping function that is to monitor the environment in the cabinet where FCS is mounted or the status of FCS itself. The FCS's reliability is improved by this house keeping function. Taking an example of FFCS-V, details of the house keeping unit (HKU) are described here.

HKU hardware is composed of HKU, DPU, fan power supply unit, node fan unit, vertical type power distribution unit, and utility unit. All of these are set inside the FCS cabinet. The table below shows an overview of each function unit.

Table Overview of the HKU Function Units

Unit Name	Description
HKU (House Keeping Unit)	Alarm information such as cabinet temperature and performance status of cooling fans are controlled and monitored.
PDU (Power Distribution Unit)	Composed of a circuit breaker and a noise filter, PUD supplies power to the cabinet and protect it from malfunctions such as inrush current.
Fan Power Supply Unit	Supplies power to door fan, node fun, HKU, and contact output relays.
Node Fan Unit	FCU and nodes are cooled.
Power Supply Bus Unit, Vertical Type	Powers to the cabinet is distributed.
Utility Unit	Power supplies to FCU are supplied, and provide interfaces between FCU and HKU.

The HKU and its related units for AFV40D (with cabinet) is shown here.

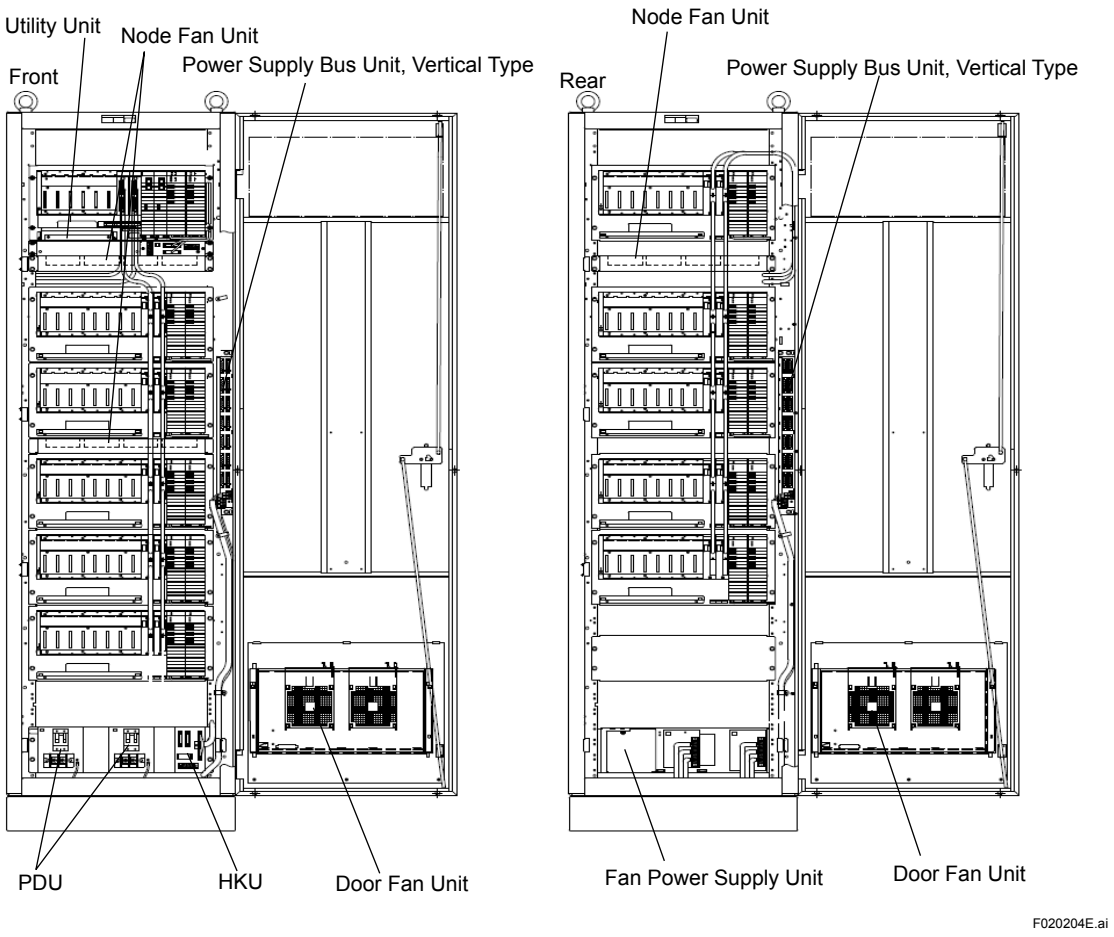


Figure HKU and its related units

HKU main unit displays the information given from each functional unit by the LED on the front. The table below shows the elements of the HKU for FFCS-V.

Table HKU display elements

Name	Color	Description
RDY	Green	The initial HKU information is being collected when it is blinking. When blinking stops, HKU is in routine operation. (Both represent normal operation status.)
LNK	Green	HK-BUS CARRIER DETECT
D-FAN	Red	The DFAN UNIT (door fan/roof fan) failed.
N-FAN1	Red	Either node FAN Unit 1 or SC FAN Unit on the front failed.
N-FAN2	Red	Node FAN Unit 2 failed.
N-FAN3	Red	Either node FAN Unit 3 or SC FAN Unit on the rear failed.
N-FAN4	Red	Node FAN Unit 4 failed.
PSU HK /AUX HK	Red	Either the fan power unit or the contact I/O failed.
PSU TB	Red	PS4 power unit failed, when it is installed.
ID1	Red	Displays the failure 1. (See the table “Combination of the failed units.”)
ID2	Red	Displays the failure 2. (See the table “Combination of the failed units.”)
ID3	Red	Displays the failure 3. (See the table “Combination of the failed units.”)
ID4	Red	Displays the failure 4. (See the table “Combination of the failed units.”)

Table Combination of the failed units

ID	D-FAN	N-FANx	PSU HK / AUX HK	PSU TB	Temperature anomaly
ID1	Door Fan 1	1st from the left	Fan Power Supply 1	Front, Left	AIR OUT
ID2	Door Fan 2	2nd from the left	Fan Power Supply 2	Front, Right	AIR IN
ID3	Door Fan 3	3rd from the left	–	Rear, Left	–
ID4	Door Fan 4	4th from the left	Contact Input	Rear, Right	–

When the cabinet is installed in a remote location, the HK information is transmitted to FCU via an optical ESB bus. All these HK information can be monitored on an HIS through FCS status display view.

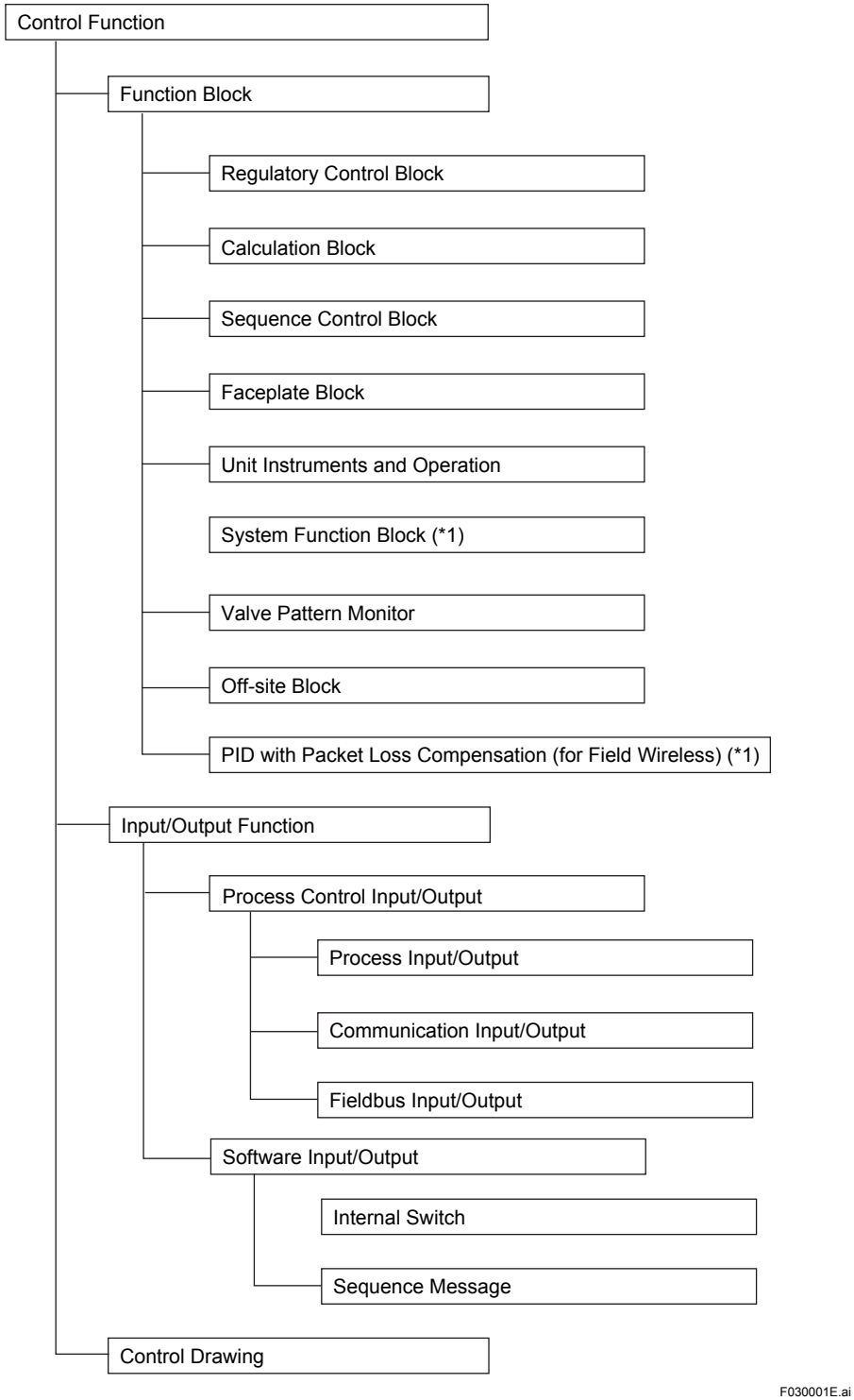
2.3 Hardware Configuration of FFCS-R

About FCS for RIO system upgrade (FFCS-R), please refer to the following documents.

- GS 33J64E10-01EN
  Field Control Unit, Cabinet Utility Kit (For RIO System Upgrade)
- GS 33J64F10-01EN
  N-IO Node (For RIO System Upgrade)
- TI 33J01B01-01EN
  RIO System Upgrade Guide

3. Control Function

The following figure shows Configuration of Control Functions.



*1: These functions are supported by FFCS-C, FFCS-V, and FFCS-R.

Figure Configuration of Control Functions

3.1 Function Block

Function block is a basic unit for control and calculations. Continuous control, sequence control (sequence tables and logic charts) and calculations are performed by function blocks. Regulatory control blocks, calculation blocks, and sequence control blocks are interconnected in a manner similar to the conventional instrument flow diagrams.

Regulatory Control Block

Regulatory control block performs calculation using analog process values for process control and monitoring.

Table Regulatory Control Blocks (1/2)

Block type	Model	Name
Input Indicator Block	PVI	Input Indicator Block
	PVI-DV	Input Indicator Block with Deviation Alarm
Controller Block	PID	PID Controller Block
	PI-HLD	Sampling PI Controller Block
	PID-BSW	PID Controller Block with Batch Switch
	ONOFF	Two-Position ON/OFF Controller Block
	ONOFF-E	Enhanced Two-Position ON/OFF Controller Block
	ONOFF-G	Three-Position ON/OFF Controller Block
	ONOFF-GE	Enhanced Three-Position ON/OFF Controller Block
	PID-TP	Time-Proportioning ON/OFF Controller Block
	PD-MR	PD Controller Block with Manual Reset
	PI-BLEND	Blending PI Controller Block
	PID-STC	Self-Tuning PID Controller Block
Manual Loader Block	MLD	Manual Loader Block
	MLD-PVI	Manual Loader Block with Input Indicator
	MLD-SW	Manual Loader Block with Auto/Man SW
	MC-2	Two-Position Motor Control Block
	MC-2E	Enhanced Two-Position Motor Control Block
	MC-3	Three-Position Motor Control Block
	MC-3E	Enhanced Three-Position Motor Control Block
Signal Setter Block	RATIO	Ratio Set Block
	PG-L13	13-Zone Program Set Block
	BSETU-2	Flow-Totalizing Batch Set Block
	BSETU-3	Weight-Totalizing Batch Set Block
Signal Limiter Block	VELLIM	Velocity Limiter Block
Signal Selector Block	SS-H/M/L	Signal Selector Block
	AS-H/M/L	Auto-Selector Block
	SS-DUAL	Dual-Redundant Signal Selector Block
Signal Distributor Block	FOUT	Cascade Signal Distributor Block
	FFSUM	Feed-Forward Signal Summing Block
	XCPL	Non-Interference Control Output Block
	SPLIT	Control Signal Splitter Block
Alarm Block	ALM-R	Representative alarm (*1)
Pulse Count Input Block	PTC	Pulse Count Input Block

*1: This block is classified into a Sequence Auxillary 2 as the database.

Table Regulatory Control Blocks (2/2)

Block type	Model	Name
YS Instrument Block	SLCD	YS Controller Block
	SLPC	YS Programmable Controller Block
	SLMC	YS Programmable Controller Block with Pulse-Width Output
	SMST-111	YS Manual Station Block with SV Output
	SMST-121	YS Manual Station Block with MV Output Lever
	SMRT	YS Ratio Set Station Block
	SBSD	YS Batch Set Station Block
	SLCC	YS Blending Controller Block
	SLBC	YS Batch Controller Block
	STLD	YS Totalizer Block
FOUNDATION fieldbus Faceplate Block	FF-AI	FOUNDATION fieldbus Analog Input Block
	FF-DI	FOUNDATION fieldbus Discrete Input Block
	FF-CS	FOUNDATION fieldbus Control Selector Block
	FF-PID	FOUNDATION fieldbus PID Control Block
	FF-RA	FOUNDATION fieldbus Ratio Block
	FF-AO	FOUNDATION fieldbus Analog Output Block
	FF-DO	FOUNDATION fieldbus Discrete Output Block
	FF-OS	FOUNDATION fieldbus Output Splitter Block
	FF-SC	FOUNDATION fieldbus Signal Characterizer (Totalizer) Block
	FF-IT	FOUNDATION fieldbus Integrator Block
	FF-IS	FOUNDATION fieldbus Input Selector Block
	FF-MDI	FOUNDATION fieldbus Multiple Discrete Input Block
	FF-MDO	FOUNDATION fieldbus Multiple Discrete Output Block
	FF-MAI	FOUNDATION fieldbus Multiple Analog Input Block
	FF-MAO	FOUNDATION fieldbus Multiple Analog Output Block
	FF-SUNV	Simple Universal Block

Sequence Block

Sequence block performs sequence control such as interlock sequence or process monitoring sequence processed according to a defined order.

Table Sequence Block

Block type	Model	Name
Sequence Table Block	ST16	Sequence Table Block
	ST16E	Rule Extension Block
Logic Chart Block	LC64	Logic Chart Block
	LC64-E	External Connection Logic Chart Block
SFC Block	_SFCSW	3-Position Switch SFC Block
	_SFCPB	Pushbutton SFC Block
	_SFCAS	Analog SFC Block
Switch Instrument Block	SI-1	Switch Instrument Block with 1 Input
	SI-2	Switch Instrument Block with 2 Inputs
	SO-1	Switch Instrument Block with 1 Output
	SO-2	Switch Instrument Block with 2 Outputs
	SIO-11	Switch Instrument Block with 1 Input and 1 Output
	SIO-12	Switch Instrument Block with 1 Input and 2 Outputs
	SIO-21	Switch Instrument Block with 2 Inputs and 1 Output
	SIO-22	Switch Instrument Block with 2 Inputs and 2 Outputs
	SIO-12P	Switch Instrument Block with 1 Input, 2 One-Shot Outputs
	SIO-22P	Switch Instrument Block with 2 Inputs, 2 One-Shot Outputs
	SI-1ALM	Switch instrument block with 1 input and discrete-status alarm
Enhanced Switch Instrument Block	SI-1E	Enhanced Switch Instrument Block with 1 Input
	SI-2E	Enhanced Switch Instrument Block with 2 Inputs
	SO-1E	Enhanced Switch Instrument Block with 1 Output
	SO-2E	Enhanced Switch Instrument Block with 2 Outputs
	SIO-11E	Enhanced Switch Instrument Block with 1 Input and 1 Output
	SIO-12E	Enhanced Switch Instrument Block with 1 Input and 2 Outputs
	SIO-21E	Enhanced Switch Instrument Block with 2 Inputs and 1 Output
	SIO-22E	Enhanced Switch Instrument Block with 2 Inputs and 2 Outputs
	SIO-12PE	Enhanced Switch Instrument Block with 1 Input, 2 One-Shot Outputs
	SIO-22PE	Enhanced Switch Instrument Block with 2 Inputs, 2 One-Shot Outputs
Sequence Auxiliary Block	TM	Timer Block
	CTS	Software Counter Block
	CTP	Pulse Train Input Counter Block
	CI	Code Input Block
	CO	Code Output Block
Valve Monitoring Block	RL	Relational Expression Block
	RS	Resource Scheduler Block
	VLVM	Valve Monitoring Block
	LSW	32-Point Local Switch

Calculation Block

Calculation block supplements Regulatory control and Sequence control performing general-purpose calculation of analog and contact signals.

Table Calculation Block (1/2)

Block type	Model	Name
Arithmetic Calculation Block	ADD	Addition Block
	MUL	Multiplication Block
	DIV	Division Block
	AVE	Averaging Block
Analog Calculation Block	SQRT	Square Root Block
	EXP	Exponential Block
	LAG	First-Order Lag Block
	INTEG	Integration Block
	LD	Derivative Block
	RAMP	Ramp Block
	LDLAG	Lead/Lag Block
	DLAY	Dead-Time Block
	DLAY-C	Dead-Time Compensation Block
	AVE-M	Moving-Average Block
	AVE-C	Cumulative-Average Block
	FUNC-VAR	Variable Line-Segment Function Block
	TPCFL	Temperature and Pressure Correction Block
	ASTM1	ASTM Correction Block: Old JIS
	ASTM2	ASTM Correction Block: New JIS
Logic Operation Block	AND	Logical AND Block
	OR	Logical OR Block
	NOT	Logical NOT Block
	SRS1-S	Set-Dominant Flip-Flop Block with 1 Output
	SRS1-R	Reset-Dominant Flip-Flop Block with 1 Output
	SRS2-S	Set-Dominant Flip-Flop Block with 2 Output
	SRS2-R	Reset-Dominant Flip-Flop Block with 2 Output
	WOUT	Wipeout Block
	OND	ON-Delay Timer Block
	OFFD	OFF-Delay Timer Block
	TON	One-Shot Block (rising-edge trigger)
	TOFF	One-Shot Block (falling-edge trigger)
	GE	Comparator Block (greater than or equal)
	GT	Comparator Block (greater than)
	EQ	Equal Operator Block
	BAND	Bitwise AND Block
	BOR	Bitwise OR Block
	BNOT	Bitwise NOT Block
General-Purpose Calculation Block	CALCU	General-Purpose Calculation Block
	CALCU-C	General-Purpose Calculation Block with String I/O

Table Calculation Block (2/2)

Block type	Model	Name
Calculation Auxiliary Block	SW-33	3-Pole 3-Position Selector Switch Block
	SW-91	1-Pole 9-Position Selector Switch Block
	DSW-16	Selector Switch Block for 16 Data
	DSW-16C	Selector Switch Block for 16 String Data
	DSET	Data Set Block
	DSET-PVI	Data Set Block with Input Indicator
	BDSET-1L	1-Batch Data Set Block
	BDSET-1C	1-Batch String Data Set Block
	BDSET-2L	2-Batch Data Set Block
	BDSET-2C	2-Batch String Data Set Block
	BDA-L	Batch Data Acquisition Block
	BDA-C	Batch String Data Acquisition Block
	ADL	Station Interconnection Block

Faceplate Block

Faceplate block is a function block displaying unified multiple function blocks as a single tag.

Table Faceplate Block

Block type	Model	Name
Analog Faceplate Block	INDST2	Dual-Pointer Indicating Station Block
	INDST2S	Dual-Pointer Manual Station Block
	INDST3	Triple-Pointer Manual Station Block
Sequence Faceplate Block	BSI	Batch Status Indicator Block
	PBS5C	Extended 5-Pushbutton Switch Block
	PBS10C	Extended 10-Pushbutton Switch Block
Hybrid Faceplate Block	HAS3C	Extended Hybrid Manual Station Block

Unit Instrument and Operation

Unit instruments handle the operation and control of a whole process unit. Operations handle the operation and control of each phase of a process unit.

Table Unit Instrument and Operation

Block type	Model	Name
Unit Instrument	_UTSW	3-Position Switch-Type Unit Instrument
	_UTPB	5-Pushbutton-Type Unit Instrument
	_UTAS	Analog-Type Unit Instrument
Non-Resident Unit Instrument	_UTSW-N	Non-Resident Unit Instrument with 3-Position Switch
	_UTPB-N	Non-Resident Unit Instrument with 5-Pushbutton Switch
	_UTAS-N	Analog Non-Resident Unit Instrument
	_UTSW-SN	Non-Resident Unit Instrument with 3-Position Switch and Recipe Operation
	_UTPB-SN	Non-Resident Unit Instrument with 5-Pushbutton Switch and Recipe Operation
	_UTAS-SN	Analog Non-Resident Unit Instrument with Recipe Operation
Unit Operation Instrument	UTOP-SN	Non-Resident Unit Operation Function Instrument
Operation	OPSBL	SEBOL-Type Operation
	OPSFC	SFC-Type Operation
	OPSFCP1	SFC-Type Operation with Floating-Data Parameters
	OPSFCP2	SFC-Type Operation with Character-Data Parameters
	OPSFCP3	SFC-Type Operation with Floating/Character-Data Parameters
	OPSFCP4	SFC-Type Operation with Integer/Character-Data Parameters
	OPSFCP5	SFC-Type Operation with Floating/Integer-Data Parameters

System Function Block

System function block acts as an interface for notifying FCS's internal operation status to the outside of FCS. These blocks are provided by FFCS-C, FFCS-V, and FFCS-R.

Table System Function Block

Block type	Model	Name
System Function Block	FCS_CPU	CPU Load Information
	FCS_COM	Communication Load Information
	FCS_IOC	I/O Load Information
	FCS_SBL	SEBOL Operation Information

Valve Pattern Monitor

Valve pattern monitor is a function block for unified monitoring of open-close status of multiple valves.

Table Valve Pattern Monitor

Block type	Model	Name
Valve Pattern Monitor	VPM64	64-Data Valve Pattern Monitor
	VPM128	128-Data Valve Pattern Monitor
	VPM256	256-Data Valve Pattern Monitor
	VPM512	512-Data Valve Pattern Monitor
	VPM64A	64-Data Valve Pattern Monitor with Alarm
	VPM128A	128-Data Valve Pattern Monitor with Alarm
	VPM256A	256-Data Valve Pattern Monitor with Alarm
	VPM512A	512-Data Valve Pattern Monitor with Alarm

The valve pattern monitor is an optional package (VP6F3132).

Off-site Block

Off-site block is a function block for batch blending and shipment control performed off-site of oil refineries or other plant facilities.

Table Off-site Block

Block type	Model	Name
Off-Site Block	FSBSET	Batch Set Control Block
	BLEND	Blending Master Control Bloc

The off-site block is an optional package (VP6F8620).

PID with Packet Loss Compensation (for Field Wireless)

The PID with packet loss compensation (for field wireless) is a PID regulatory control block that has a compensation mechanism for packet loss on data communication with a wireless field device.

Table PID with Packet Loss Compensation (for Field Wireless)

Block type	Model	Name
PID with Packet Loss Compensation (for Field Wireless)	ZWOPID	PID Controller with Output Loss Compensation for Wireless

The PID with packet loss compensation (for field wireless) is an optional package (VP6F3210).

3.2 Input and Output Functions

There are two types of input and output (I/O) functions: Process I/O exchanges data with field devices outside FCS; and software I/O is for virtual data exchange within the FCS.

Process Control Inputs/Outputs

Using process inputs/outputs, an FCS can receive signals from process detectors and output signals to process control elements.

Table Process Control Inputs/Outputs

Type	Symbol	Name
Process I/O	%Z	Process I/O (FIO)
	%Y	Process I/O (N-IO)
Communication I/O	%WW	Communication I/O - Word data
	%WB	Communication I/O - Bit data
	%XW (*1)	Expanded Communication I/O - Word data
	%XB (*1)	Expanded Communication I/O - Bit data
Fieldbus I/O	%Z	Fieldbus I/O

*1: In case of using expanded communication I/Os on FFCS-C, FFCS-V, and FFCS-R.

Software Inputs/Outputs

Software inputs/outputs are virtual inputs/outputs that are provided by the FCS's internal software.

Two types of software inputs/outputs are available: an "internal switch," which is used to exchange logical values between function blocks or other application functions; and a "message output," which is used to inform the occurrence of an event.

Table Software Inputs/Outputs

Type	Symbol	Name
Internal Switch	%SW	Common Switch
	%GS	Global Switch
Message Output	%AN	Annunciator Message
	%PR	Print Message
	%OG	Operator Guide Message
	%VM	Multimedia Start Message
	%RQ	Sequence Message Request
	%CP	Supervisory Computer Event Message
	%M3	Supervisory Computer Event Message for PICOT
	%EV	Signal Event Message
	%RE	SFC/SEBOL Return Event Message

3.3 Control Drawing

Small control groups composed by function blocks and inputs/outputs are to be described in the control drawings. Engineering and maintenance works are simplified by unifying the process device control as a control drawing. Monitoring the whole plant or each process can also be specified as control drawings instead of specifying individual process unit or functions in between the different devices. The features of control drawings are described below.

- Connecting I/O and control blocks
  By connecting a line between the I/O and function block, or between the function blocks, the data flow definition can be visualized.
- Defining the order of control block implementation
  The implementation priority or order of performance can be determined among several function blocks described in the control drawing.
- Mix of Regulatory Control and Sequence Control
  Regulatory control and Sequence control can be mixed in Control drawing. Control functions can be flexibly configured according to the requirement for process.
- Free Signal Flow between Control Drawing
  Function block belonging to different Control drawing can be connected to another Control drawing.

Control Drawing example

An example of a simple reactor process mounted in Control drawing is shown below.

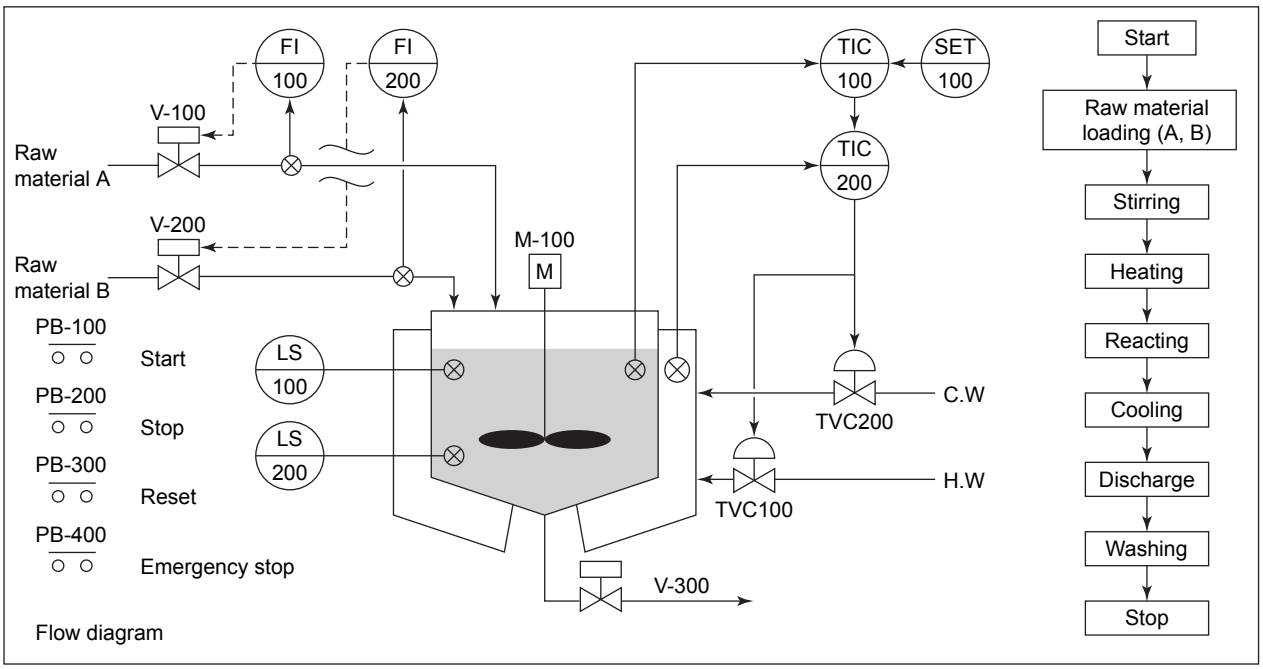


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Figure Reactor Process Flow Diagram

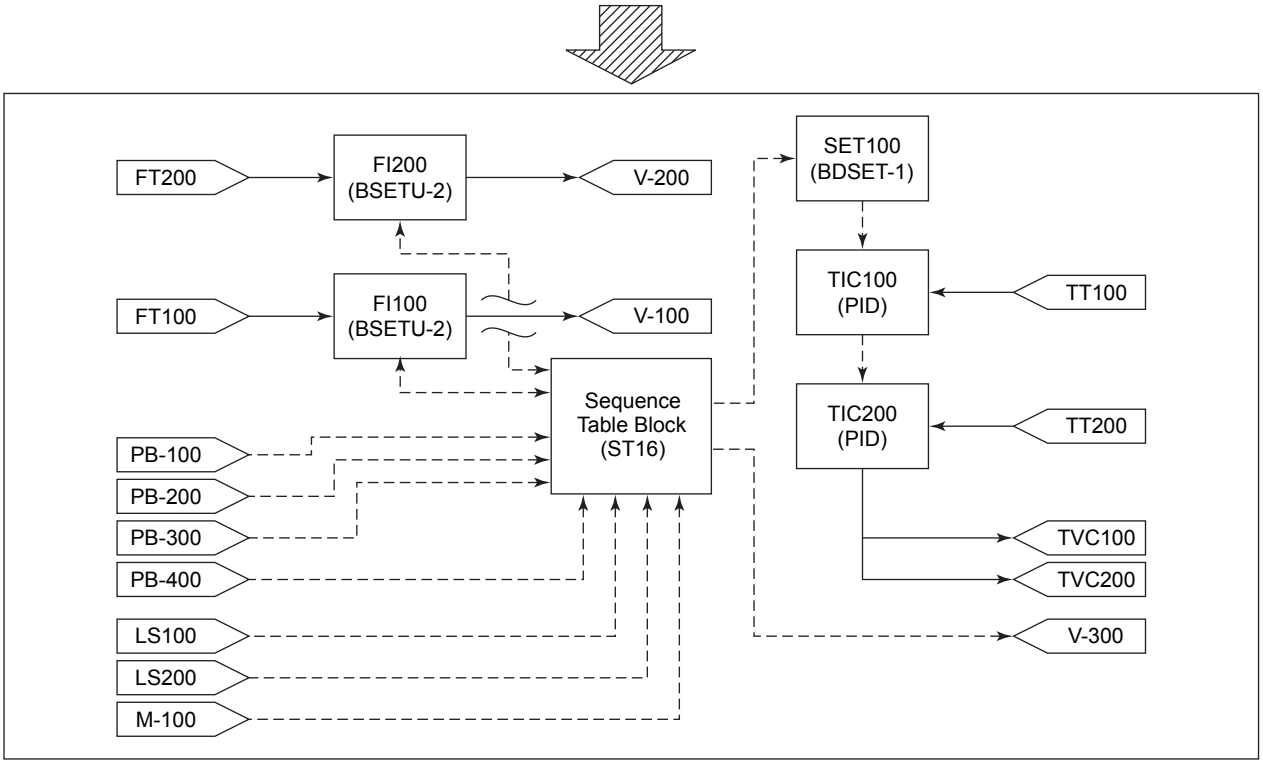

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Figure Example of Control Drawing

Scan Period

The scan period is the period at which the function block is executed periodically. The periodic execution function block executes a process based on the scan period.

There are three types of scan periods: the basic scan, the medium-speed scan (*1) and the high-speed scan. One of these scan periods can be selected for each individual function block. However, the medium-speed scan and high-speed scan cannot be selected for some function blocks.

- Basic Scan: Fixed to 1 second.
- Medium-Speed Scan: Select [200 ms] or [500 ms].(*2), default is 500ms.
- High-Speed Scan: Select [200 ms] or [500 ms].(*2), default is 200ms.

*1: The medium-speed scan setting is not available for the PFCS and SFCS.
*2: [50 ms], [100 ms] or [250 ms] can also be specified by direct entry from keyboard.

Order of Process Execution

The order of process execution refers to a sequence in which the control drawing and individual function block are executed in the periodic execution. The process timing of a periodic execution regulatory function block is determined by the orders of execution of the control drawings and the function blocks.

The following section describes the orders in which the control drawings and individual function blocks are executed in the periodic execution.

Order of Process Execution for Control Drawings/Function Blocks

The diagram below shows an example of executing control drawings each consisting of function blocks being executed in the high-speed scan, medium-speed scan and basic scan. In this example, three control drawings are processed. The groups of high-speed scan function blocks in the respective drawings are indicated as A, B and C. Similarly, the groups of medium-speed scan function blocks in the respective control drawings are indicated as A', B' and C'; and the groups of basic scan function blocks, a, b and c. In the diagram below and the explanation that follows, the processing of the function blocks belonging to A, B and C is referred to as "high-speed processing"; processing of the function blocks belonging to A', B' and C', "medium-speed processing" ; and processing of the function blocks belonging to a, b and c, "basic processing." "Other processing" indicates processing of SFC blocks.

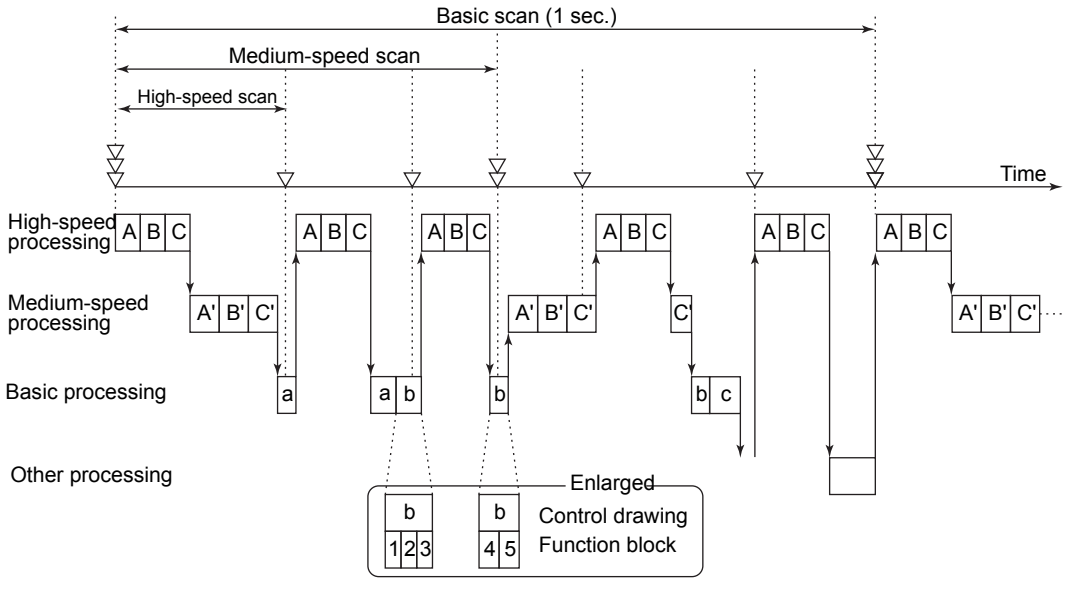


Figure Example of Control Drawings/Function Blocks Process Execution

- The high-speed processing has priority over the medium-speed processing or basic processing. The medium-speed processing has priority over the basic processing.
- Once processing of all high-speed function blocks have been completed, the medium-speed processing is executed.
  When execution of all high-speed and medium-speed processes of function blocks have been completed, the basic processing is executed.
- In case that the high-speed processing gets its timing for execution during the basic processing or medium-speed processing is being executed, the high-speed processing interrupts the basic processing or medium-speed processing by making the basic processing or medium-speed processing pause at the gap among function blocks' basic processing or medium-speed processing. Once all function blocks of high-speed processing are completed to execute, the basic processing or medium-speed processing is resumed from where it was interrupted.
- In case that the medium-speed processing its timing for execution during the basic processing is being executed, the medium-speed processing interrupts the basic processing by making the basic processing pause at the gap among function blocks' basic processing. Once all function blocks of medium-speed processing are completed to execute, the basic processing is resumed from where it was interrupted.
- The high-speed processing of function blocks are executed for each of the control drawings containing the function blocks and in the order of control drawing numbers. Function blocks having the same scan period within the same control drawing are executed in the set execution order (order of the function block numbers defined).
  The medium-speed processing and basic processing of function blocks are executed in the same order as applied to the high-speed processing.
- Processing of each function block is executed only once per single scan period.
- Other processes are executed in the idle time after the high-speed processing, medium-speed processing and basic processing are completed.

Periodic SEBOL

SEBOL is a programming language used for process control to describe unit step processing of the SFC blocks. SEBOL usually runs during the CPU's idle time. However, FFCS-C, FFCS-V, and FFCS-R is able to run and process the SEBOL according to the scan period. It is called the periodic SEBOL, to segregate it from the conventional type of SEBOL. By using the periodic SEBOL, sequence controls can be described by the programming language applications instead of performing them by the sequence tables or logic charts.

3.4 Online Maintenance Function

Online maintenance function enables the modification of the control functions during online control, without any effect on other than the modified function, namely the effect on plant operation is minimized. Most settings can be modified using online maintenance functions. The settings which can not be modified using online maintenance function are described below.

- FCS power switching from single to dual-redundant
- Fast scan period
- MC (Motor Control) instrument block pulse width setting
- MC instrument block start interval
- MLD-SW block auto mode (AUT/CAS) setting
- SEBOL statement “Drive” statement operation type
- SS-DUAL PV update during deviation alarm
- Alarm notify action when all AOF released
- User-defined status character string
- Alarm processing table
- Alarm priority level
- Status change command character string
- State transition matrix

3.5 Subsystem Communication

FCS can communicate with each subsystem such as PLC or analytical equipments. Subsystem communication function supports dual-redundant communication. CENTUM VP supports the following subsystem communications.

- FA-M3 communication (for Yokogawa's FA-M3 and FA500)
- DARWIN/DAQSTATION communication (for Yokogawa's DARWIN and DAQSTATION)
- MELSEC communication (for Mitsubishi general-purpose MELSEC sequencers)
- MELSEC-A communication (for Mitsubishi general-purpose MELSEC-A sequencers)
- PLC-5/SLC 500 communication (for Rockwell Automation's PLC-5/SLC 500 family of programmable controllers)
- Modbus communication (for Yokogawa's STARDOM, Schneider's Modicon and Yasukawa Electric Corporation's Memocon-SC)
- YS communication (for Yokogawa's YS100 SERIES and YEWSERIES 80)
- YS communication with direct connection (for Yokogawa's YS100 SERIES)

CENTUM VP may be able to communicate with other subsystems that are not listed here. For more details, please contact Yokogawa.

4. Redundancy

FCS is directly connected to processes. Therefore, FCS is required to have high reliability, high availability, data accuracy and data reliability. CENTUM VP FCS responds to these requirements realizing the availability over the best of 99.99999% (seven nines).

This chapter describes the redundancy of FCS supporting this high availability.

4.1 Redundancy Features

In addition to field-proven dual-redundancy technology, synchronous process execution on paired MPUs (microprocessor units) of active and standby processor modules in CENTUM VP FCS. realizes seamless execution of each process control functions or user applications regardless of the switching of processor module.

This duplexed FCS has reliable features as follows:

(1) ECC memory (*1), WDT function (*2), and other technologies contribute establishing hardware reliability.

(2) Pair and Spare methodology detects transient control computation errors as well as hardware failures (*3) to avoid wrong data output. In case an error is detected, the active processor module is switched to the other processor module.

(3) Seamless switchover between the active and the standby processor modules is realized. Thus it is not necessary to consider dual-redundancy by software, productivity and quality of the software development have greatly been improved.

(4) One of the redundant processor modules can be replaced online when it is failed while the operation continues without stopping the process.

The features described above are field-proven and reliable technologies developed originally for CENTUM CS and it is inherited by CENTUM VP with enhancements.

*1: Error check and correct (ECC) memory detects memory error as well as to identify where, in which bit, the error is occurred, and correct it by itself.
*2: Watch dog timer (WDT) function watches software malfunction and hang up by setting a periodical watch dog operation (timer reset).
*3: Unrecoverable hardware breakdown.

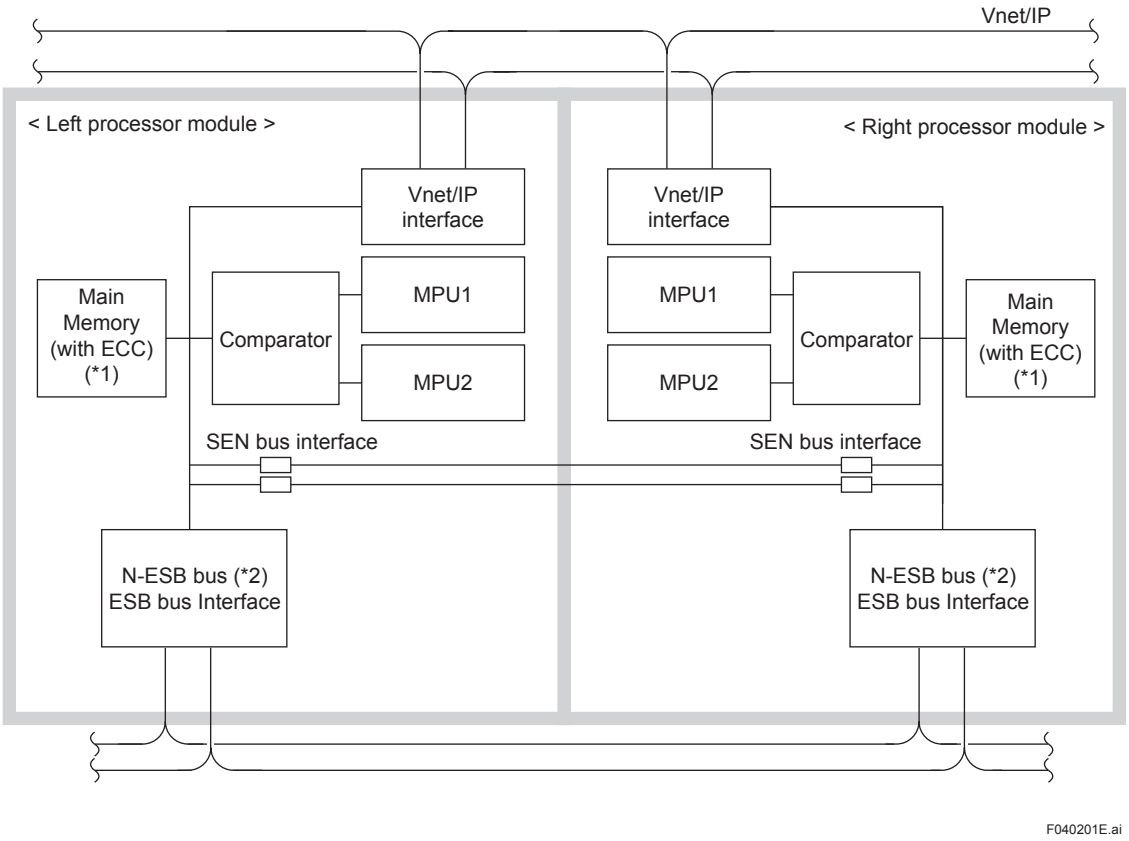
4.2 Redundancy Details

Duplexed FCUs are available for both FFCS-C, FFCS-V, and FFCS-R. A duplexed FCU has dual redundant main components such as processor and power supply modules.

In FFCS-C and FFCS-R, When connecting N-IO nodes and FCU or connecting node units and FCU, a pair of N-ESB bus coupler modules or a pair of ESB coupler modules are installed, respectively. When connecting Optical ESB bus too, a pair of Optical ESB bus repeater modules is installed.

In FFCS-V, When connecting node units and FCU, whether to install a pair of ESB coupler modules or a single ESB coupler module can be selected.(However, in a duplexed FCU, ESB bus interface module needs to be duplexed.)

For FFCS-C, FFCS-V, and FFCS-R with a duplexed FCU, an uninterruptible switchover of the control right takes place in case of a failure on one side.



*1: ECC:Error-Correcting Code.
*2: N-ESB bus may be used only for FCU in FFCS-C and FFCS-R.

Figure Example of Duplexed (Dual-redundant) Processor Module Configuration

Dual-redundancy methodology is described below.

Processor Module

- Each processor module has two MPU. MPU1 and MPU2 mounted on each module perform same control computations and the results are compared by a comparator for each calculation. When the results of both MPU are same, the module is assumed to be normal and the results are transmitted to main memory devices and bus interface modules. The main memory devices with ECC (error-correcting code) correct transient reversed-bit errors.
- If the results from MPU1 and MPU2 are not same the comparator assumes it “calculation abnormal” , the active processor module is switched to another one.
- Watch Dog Timer detects abnormal functions of active processor module. In case abnormal functions are detected, active processor module would be switched to another processor module.
- The standby processor module performing the same computations as the active module, switching to active status without interruption is possible.
- The processor module with calculation error performs self-diagnosis; if the hardware is not assumed abnormal, the error is assumed transient and the module status recovers from ”abnormal” to “standby”
- Each processor module can connect to the dual redundant Vnet/IP control bus.

N-ESB and ESB bus

The processor module of FFCS-C and FFCS-R incorporates N-ESB and ESB bus interface functions. The processor module of FFCS-V incorporates ESB bus interface functions. When the processor module is duplexed, the bus interface of the processor in service is used, and the bus interface of the stand-by processor stands by. If the bus interface of the processor in service fails, the stand-by processor modules takes over the control right and its bus interface becomes the control bus master, starting communication with the node units.

In FFCS-C and FFCS-R, N-ESB bus and ESB bus are dual redundant, whereas ESB bus of FFCS-V can be made dual redundant or single. In the dual redundant ESB bus, two lines are used alternately. When one line fails, the other is used exclusively to continue communication. Whether the failing line should be recovered and put back into service is monitored at constant intervals. If all extended local nodes are detected as failing, the case is regarded as a failure of the communication bus.

N-IO Node

N-IO node has dual redundant N-ESB modules and power supply units. The communication bus connecting node interface units and N-IO I/O units is also dual redundant. I/O modules installed in N-IO I/O units can be selected as dual redundant or single.

Node Unit (NU)

In node unit of FFCS-C and FFCS-R, the bus interface modules and power supply modules are dual redundant. The communication bus connecting the bus interface modules and the individual I/O modules is also dual redundant.

In node unit of FFCS-V, the bus interface modules, power supply modules, and the communication buses are able to select as dual redundant or single.

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2.1.7 Communication Modules
Table Communication modules [Added A2LP131]
2.2.3 I/O Modules for FIO
Table I/O Modules for FIO [Added A2LP131]
3. Control Function [Added FFCS-R to the note of PID with Packet Loss Compensation (for Field Wireless)]
3.1 Function Block
■ System Function Block[Added FFCS-R]
3.2 I / O function [Added FFCS-R to the note of Communication I/O]
3.3 Control Drawing [Added FFCS-C and FFCS-R to the target of periodic SEBOL]
4.2 Redundancy Details [Added FFCS-R]

Dec. 2018/6th Edition
Front page Changed logo mark
2. Hardware [Added the description of N-IO field enclosure.]
Figure Example configuration of FCSs [Added the figure of N-IO field enclosure.]
2.1 Hardware Configuration of FFCS-C [Added the description of N-IO field enclosure.]
2.1.5 N-IO Field Enclosure [Added the description of N-IO field enclosure.]

Mar. 2017/5th Edition
2.1.4 N-IO I/O unit
Table I/O Module (for N-IO) [Added A2MDV843]
Table I/O Adaptor (for N-IO) [Added A2SAM105, A2SAM505, A2SAT105, and A2SMX802]
3.1 Added SI-1ALM into the Sequence Block

Oct. 2016/4th Edition
2.2.3 I/O Modules for FIO
Table I/O Modules for FIO [AAV142, AAV542, AAR181, AAT141, ADV141, ADV142, ADR541, ADV157, ADV557, and ADV851 were deleted.]

June 2016/3rd Edition
2. Added FFCS-R (FCS for RIO system upgrade)
2.3 Added Hardware Configuration of FFCS-R
3.1 Added LSW into the Sequence Block

June 2015/2nd Edition
2.1.4 N-IO I/O unit
Table Base Plates for N-IO I/O [A2BN5D is added]

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