Technical Information

CENTUM CS 3000
Integrated Production Control System
System Overview

CENTUM CS 3000
ProSafe-RS

TI 33Q01B10-01E

Blank Page

Introduction

CENTUM CS 3000 is an integrated production control system used to manage and control the operation of plants in a wide variety of industries:

petroleum refineries, petrochemical, chemical, pharmaceutical, food and beverages, paper and pulp, steel and non-ferrous metals, cement, power, gas, water and wastewater.

ProSafe-RS can be used as safety instrumented system for these plants.

Structure of This Manual

This manual provides a simple overview of the CENTUM CS 3000 system. After reading this manual, see the other documents, such as General Specifications, Instruction Manuals, and so forth, for more detailed coverage of various topics. This manual consists of 16 chapters. The first introduces Yokogawa's "Enterprise Technology Solutions" concept, CENTUM CS 3000 System Concepts, Yokogawa solutions, and related software packages. Chapters 2 through 16 introduce CENTUM CS 3000 System Configuration, Operation and Monitoring Functions, Control Functions, Subsystem Communication Functions, Engineering Functions, ProSafe-RS Safety Instrumented System, Advanced Control Functions, Batch Management Functions, Plant Resource Manager, FDA:21 CFR Part 11 Compliant Function, Online Manual, Sequence of Events Manager Function, and CENTUM CS 3000 related software packages. There's an index at the back of the manual.

Target Readership for This Manual

This manual is mainly intended for:

- Managers who are planning to purchase a new control system.

- Instrumentation, Power and Computer Engineers who are evaluating CENTUM CS 3000 and ProSafe-RS for purchase or who will be in charge of installation.

Representation of Panels in This Manual

- Panels are represented in this manual as illustrations; some features may be emphasized, and some simplified or omitted.

- The panel illustrations are to help you understand the functions; dimensions, labels and visible features may differ slightly from those of actual panels.

Trademarks

- CENTUM, Exaopc, Exaquantum, BEST^2, ProSafe, and DARWIN are registered trademarks of Yokogawa Electric Corporation.

- Microsoft, ActiveX, Visual Basic, Visual C++, and Windows are either registered trademarks or trademarks of Microsoft Corporation in United States and/or other countries.

- Adobe and Acrobat are trademarks of Adobe Systems Incorporated in the United States and/or other countries.

- Ethernet is a registered trademark of Xerox Corporation.

- MELSEC-A is a registered trademark of Mitsubishi Electric Corporation.

- Modicon and Modbus are registered trademarks of Schneider Electric and/or such related companies.

- Memocon-SC is a registered trademark of Yaskawa Electric Corporation.

- PLC is a registered trademark of Rockwell Automation, inc.

- SYSMAC is a registered trademark of Omron Corporation.

- SIEMENS and SIMATIC are registered trademarks of SIEMENS Corporation.

- "FOUNDATION" in "FOUNDATION Fieldbus" is a registered trademark of Fieldbus Foundation.

- SmartPlant is a registered trademark of Intergraph Corporation.

- Other product and company names may be registered trademarks of their respective companies (the ™ or ® mark is not displayed).

CENTUM CS 3000
Integrated Production Control System
System Overview

TI 33Q01B10-01E   12th Edition

CONTENTS

1.   System Overview

CENTUM CS 3000 is an integrated production control system for medium and large process control applications. This system is a synthesis of the latest technology with Yokogawa's experience and specialist know-how. This new system has the functionality, flexibility and reliability of our CENTUM CS, and is also based on the V net control bus.

1.1   Yokogawa's Enterprise Technology Solutions Concept

This section introduces Yokogawa's Enterprise Technology Solutions concept.

F010101.ai

Figure   Enterprise Technology Solutions Logo

Enterprise Technology Solutions

- Enterprise: Enterprise viewpoint
- Technology: Latest technology
- Solutions: Optimum solutions

Yokogawa's "Enterprise Technology Solutions" provide management with systems that integrate control of both factory and business, allowing management to improve profits. We use the latest technology, and can provide optimum solutions which satisfy customer requirements. Yokogawa can provide complete solutions: sophisticated information and control systems, plant-simulation production support systems, the latest field instrumentation – complete packages of the latest equipment and software technology, plus a complete range of services: from plant design, installation and startup through maintenance.

1.2   System Concepts

CENTUM CS 3000 is Yokogawa's flagship control-system platform for launching Enterprise Technology Solutions. Its open interfaces facilitate data access from supervisory systems such as Enterprise Resource Planning (ERP) Systems and Manufacturing Execution Systems (MES), and make it easy to create a strategic management information system for your enterprise. CENTUM CS 3000 is a scalable, compatible system-designed to work with your existing systems, and grow with your business, reducing total cost of ownership (TCO).
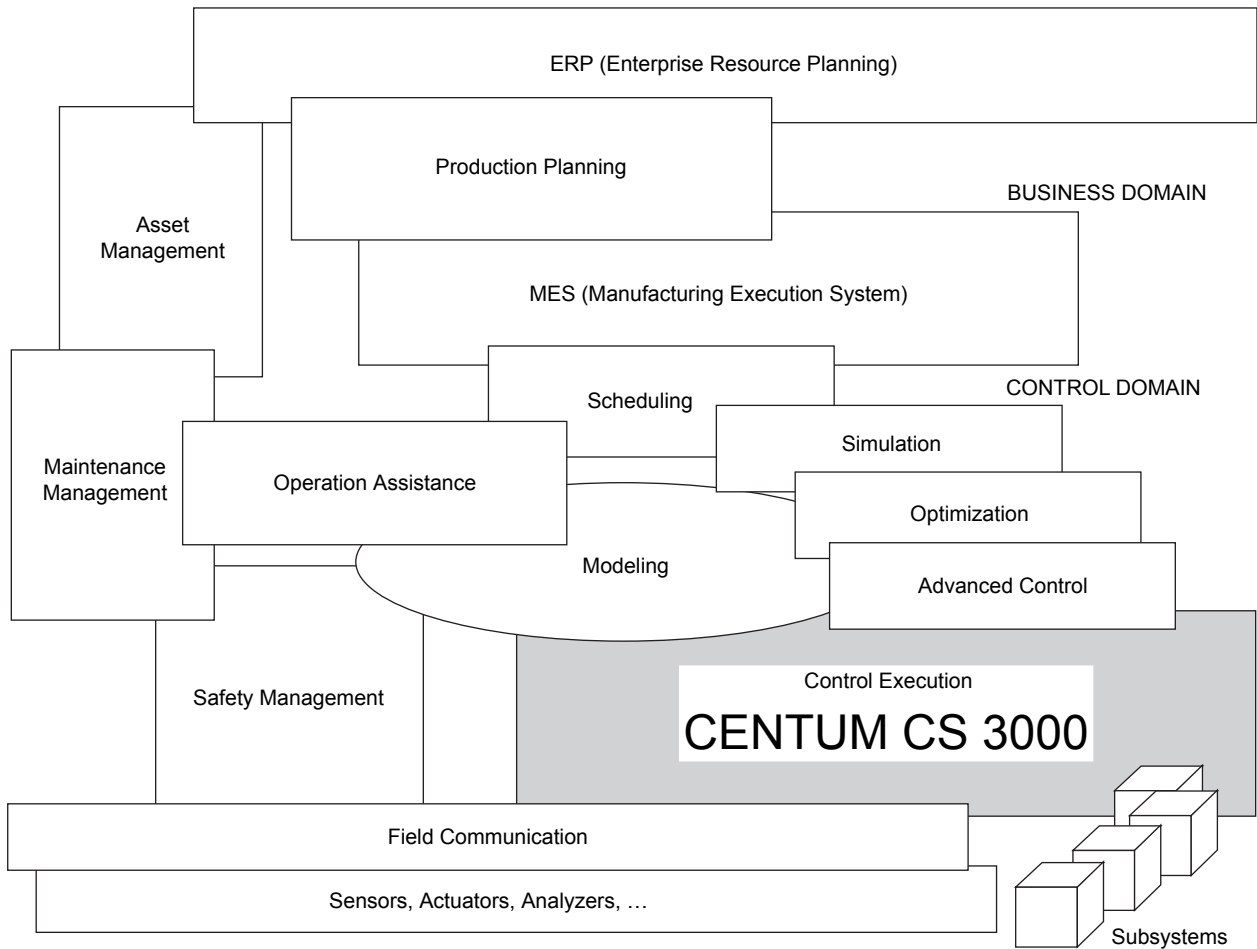
F010102.ai

Figure   Positioning of CENTUM CS 3000

1.3 Solutions Incorporating CENTUM CS 3000

CENTUM CS 3000 is a key part of most of Yokogawa's Enterprise Technology Solutions, and features:

- **Open environment for optimizing the whole enterprise,**

- **Optimal operating environment, hardware upgradeable to the latest technology,**

- **Flexible, durable system that can be optimized for your plant,**

- **Minimize total cost of ownership, increase profits,**

- **Powerful engineering functions,**

- **Improved Security and Safety for Plants.**

1.3.1 Open Environment for Optimizing the Whole Enterprise

Easy Links to Information Systems (ERP, MES systems)

In the past, we used the DCS to optimize the plant on a standalone basis; now there are requests to optimize the plant operation from an Enterprise Resource Planning (ERP) or Manufacturing Execution System (MES) viewpoint.

The Human Machine Interface (HMI) of CENTUM CS 3000 is general-purpose PCs (IBM PC/AT compatibles), running Windows 2000 and Windows XP. Windows 2000 and Windows XP have superb networking functions, and OPC for interfacing with supervisory computers are standard – so supervisory computers can easily access the process, and you can optimize your company at the enterprise level. In addition to OPC for communicating between PCs, we can also provide communication with UNIX machines and the like.

Links to Factory Automation (FA) Systems

In a manufacturing environment, the process control system needs to be synchronized with subsystems including FA systems and Programmable Logic Controllers (PLCs) which control packaging, stock management and the like.

There are packages for creating optimum systems which integrate CENTUM CS 3000 and many types of subsystems.

1.3.2   Optimal Operating Environment, Hardware Upgradeable to the Latest Technology

The Operating Environment can incorporate the Latest Technology

Over the last few years, computer technology and networking technology have continued to progress at an astonishing rate, quickly obsoleting existing HMI hardware.

CENTUM CS 3000 uses general-purpose PCs running Windows 2000 and Windows XP as the HMI, so you can use the latest PC hardware. Windows includes network functions, and future enhancements to Windows will also result in an enhanced HMI.

Synthesis of DCS and Personal Computers

CENTUM CS 3000 is operated by a mouse, like general-purpose Windows software. However, the operating environment – control-specific screens, operation and operator keyboard – is designed to resemble conventional DCSes.

Integrating PCs and DCS provides a user-friendly operation environment.

Operation Environment Customizable to match Plant Configuration and Operating Procedures

Different plants require different operating environments.

CENTUM CS 3000 can support up to 4,000 user-defined windows, so you can customize the operation environment.

You can also use a dedicated operator keyboard and touch screen functions, the same as conventional DCSes, and operate the system with a mouse like an office PC. User applications written in Visual Basic, and third-party resources such as ActiveX controls can be used, so you can create various GUI operating environments.

1.3.3   Flexible, Durable System that can be Optimized for Your Plant

High-Reliability Controllers to Safeguard Your Plant

Controller reliability decides plant reliability, productivity, and business viability.

CENTUM CS 3000 can use high-reliability "pair and spare" dual-redundant controllers, which have been proven in CENTUM CS.

Choose the Type of Control Station Based on Plant Scale

You can select the control station hardware and software based on the size and requirements of your plant.

You can use standard control stations which handle a large number of I/O points, and compact control stations with I/O which can be distributed throughout the plant and can handle high-speed communications with subsystems.

Up to 256 control stations can be used in a system, so CENTUM CS 3000 is ideal for medium to large plants.

The easy-to-wire compact I/O modules – proven in CENTUM CS – can support direct thermocouple and RTD input signals.

Control Functions Support a Wide Range of Applications

The control functions include the wide range of proven CENTUM CS control functions. CENTUM CS 3000 supports basic PID and sequence control, as well as batch control and process management functions based on the ISA S88 specification, so can handle anything from multi-product variable-volume production to large volume production.

The control station is available in several versions with databases preconfigured for different mixes of continuous and sequence control, to effectively use the control-station resources and meet the needs of a wide range of applications.

Support for Intelligent Field Instruments

Not only Yokogawa but also many other field instrument vendors are releasing field instruments based on the new open standard, the Foundation Fieldbus.

Some such instruments – for example, valves – may incorporate internal control functions; others – such as sensors – may support multiple process variables, parameters, and also maintenance and status information which can be read by the DCS. By using intelligent Foundation Fieldbus devices in the field, you can distribute the control load, allowing control stations to be dedicated to performing more complex control tasks.

1.3.4   Minimize Total Cost of Ownership, Increase Profits

Continue to Use Existing User Resources (Hardware, Software, Know-how)

Replacement System

CENTUM CS 3000 is designed to be the optimum replacement for existing systems – it is inexpensive, so will improve competitiveness of your business.

Enhance and Integrate Existing Systems

You can enhance and integrate existing DCS systems.

CENTUM CS 3000 components are designed to be the same size as CENTUM CS and CENTUM-XL components. This makes expansion easy.

Compatible with Other Yokogawa Systems

CENTUM CS 3000 systems can be linked by bus converter to CENTUM CS 3000, CENTUM CS, CENTUM-XL, CENTUM V, CENTUM CS 1000 and µXL. Also CENTUM CS 3000 and CENTUM CS can be linked to the same bus without bus converter.

CENTUM V and CENTUM-XL Migration to CENTUM CS 3000

CENTUM V and CENTUM-XL can be migrated to CENTUM CS 3000 without changing field devices and wiring connected to I/O cards in existing FCSes.

Hardware

CENTUM CS 3000 is designed to reduce total installation costs.

Remote I/O

Remote I/O units can be mounted near the plant, reducing cabling and installation costs.

Management Cost Reduction

Yokogawa offers an integrated device management tool called Plant Resource Manager (PRM). The PRM tool is designed to reduce the total cost of ownership (TCO) of the plant by fully utilizing the capacity of highly-functionalized field communication and devices and realizing efficient device management and maintenance – all in line with modern device management in field-bus era.

Maintenance Service

Yokogawa's Maintenance Service will keep your CENTUM CS 3000 running smoothly.

"BEST[2]" Maintenance System

You can choose the optimum maintenance support plan for your needs by combining various maintenance packages – with different types of maintenance checks and different maintenance check intervals – depending on your environment and needs.

1.3.5 Powerful Engineering Functions

Easy Function Configuration

No matter how good a system is, it cannot succeed if system configuration is extremely time-consuming and difficult.

CENTUM CS 3000 engineering functions are designed for efficient engineering – they are designed for ease of use, and software reusability; test functions are provided.

- Interactive builder running on general-purpose PC; few settings required to generate a working system.

- You can reuse existing Engineering Data, and edit it using general-purpose Windows software. Consistent engineering screens ("standardization"), and the ability for many people to proceed with work in parallel, mean higher quality engineering and much faster completion.

- You can test the operation of a created control station database on a "virtual system" using test functions which emulate (simulate) control stations running on a PC together with Human Interface Station software. You do not need control station hardware to perform such standalone tests.

Online Documentation

All the manuals are provided as electronic documents on CD-ROM. The file format is Adobe Portable Document Format (PDF), which is the de facto standard for portable documents on the Internet. You can read them sequentially like conventional documents, or search and print necessary parts of these electronic documents "on demand" during engineering, for example.

1.3.6   Improved Security and Safety for Plants

Integrated Safety Instrumented System for Processes

ProSafe-RS realizes the integrated safety solution with control system, achieving both safety and high availability.

Integration with Control System

IEC 61508 standard for functional safety sets the guidelines for separation of functions of control system and safety system. However, in the actual applications, operators often desire to use the same operational environments for both the control and the safety instrumented system. To respond to such demand, ProSafe-RS employs the same architecture as of CS 3000 in its basic architecture, and by connecting directly to CS 3000, it realizes the integrated operational environment.

Achievement of both Safety and High Availability

ProSafe-RS ensures shutting down of plants (safety) as well as reducing the probability of stopping plant operation due to internal failures (low false trip rate or high availability).

Safety Instrumented System

Safety instrumented system acts to prevent damage to plants in case of accidents (emergency shutdown) and to prevent aggravation of damage (fire and gas protection).

As a result of these functions which provide improved plant safety, safety instrumented system contributes to the overall protection of personnel, facilities and environments.

Acquisition of Certification Conforming to International Standard

ProSafe-RS is a safety instrumented system conforming to the safety integrity level SIL3 as defined by IEC 61508. It has been certified by TÜV Rheinland (TÜV), a German certification organization.

Improvement of Plant Safety

IEC 61508 defines a quantitative target for risk reduction in the context of industrial safety, sets guidelines for achieving the goals by specific means and stipulates to manage safety related systems based on safety lifecycles.

The concept of safety, on which this standard is formulated, is based on the idea that safety should be regarded as "Safety, freedom from unacceptable risk."

The concept of "protection layers," in which independent safety measures are in layer structure from outside (local area) to the subject "plant (factory)," is required as a safety measure to materialize this allowable safety.

It is required to introduce the concept of "protection layers" to achieve allowable safety, considering emergency measures not only in plant but in cooperation with local society.

ProSafe-RS is a safety instrumented system providing "prevention layer" and "mitigation layer" in "protection layers."

2.   System Configuration

This chapter introduces the CENTUM CS 3000 system configuration, and the main equipment that CENTUM CS 3000 consists of.

The system configuration diagram below shows representative devices in a basic CENTUM CS 3000 system.
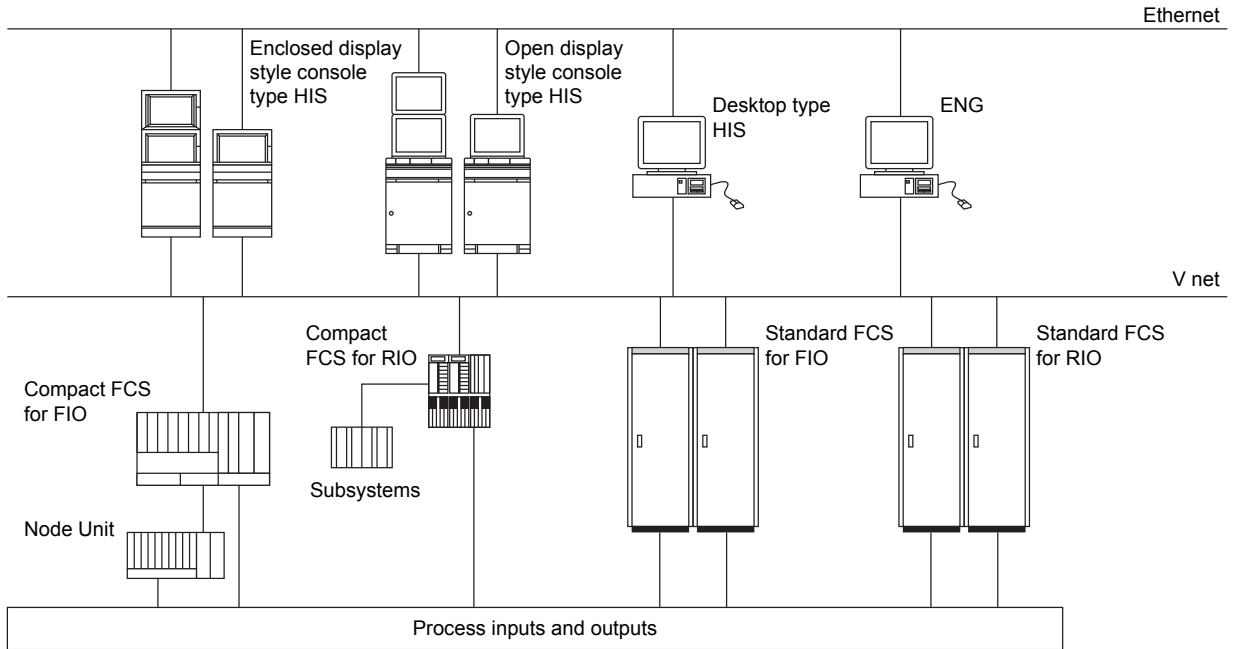
F020001.ai

Figure   CENTUM CS 3000 System Configuration (Basic)

The figure below shows a large system linked to supervisory computers and previous CENTUM and μXL systems – illustrating that CENTUM CS 3000 is an open, expandable system.
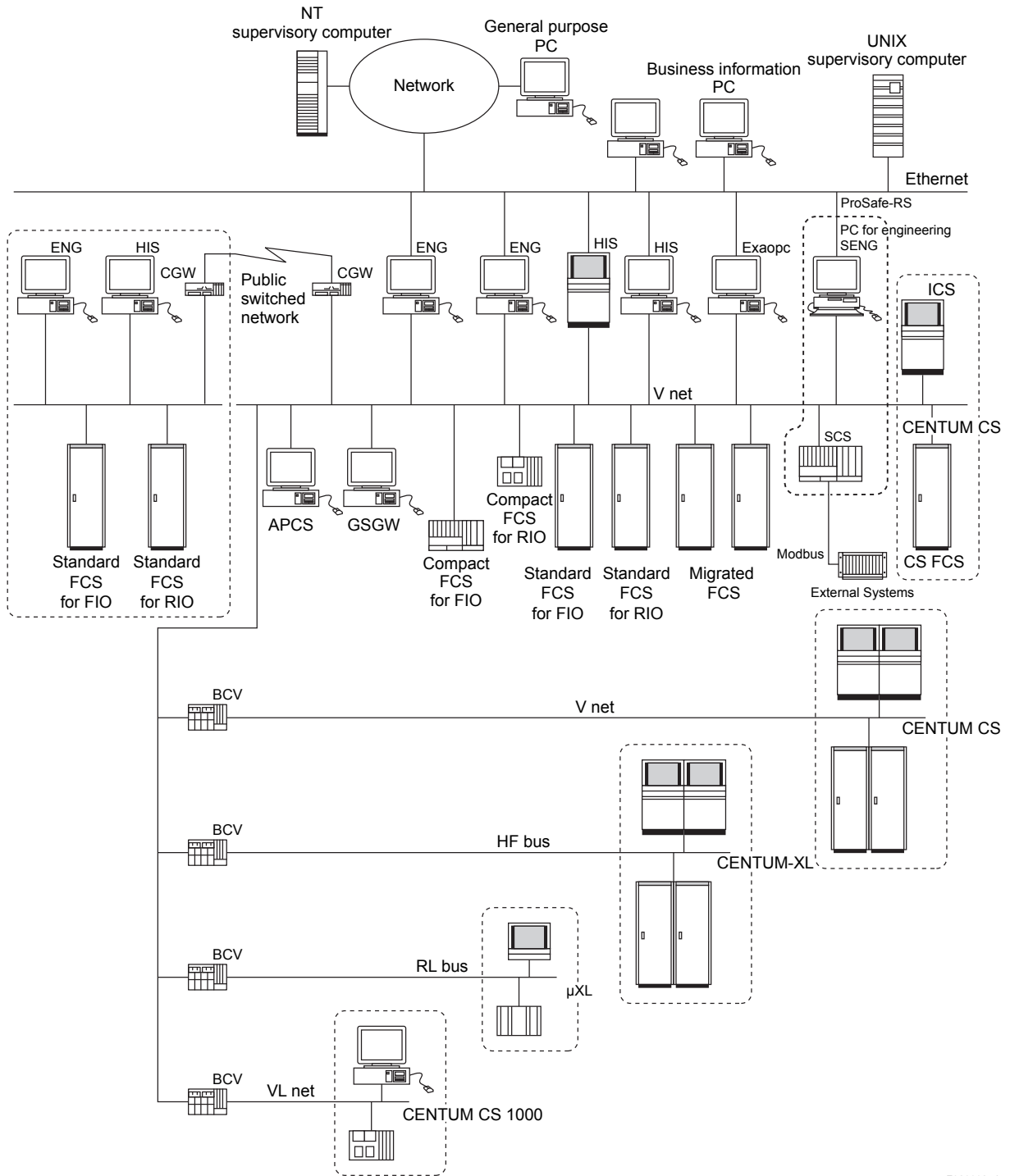
F020002.ai

Figure   CENTUM CS 3000 System Configuration

2.1   System Configuration – CENTUM CS 3000 Equipment

Human Interface Station (HIS)

The HIS is mainly used for operation and monitoring – it displays process variables, control parameters, and alarms necessary for users to quickly grasp the operating status of the plant. It also incorporates open interfaces so that supervisory computers can access trend data, messages, and process data.

- Console Type HIS
  This is a new console type human interface station, at which a general purpose PC is installed.
  There are two types of console type HISs: one is enclosed display style, the appearance of which is usual style, and another is open display style, the configuration of which is selectable.

- Desktop Type HIS
  This HIS uses a general purpose PC.

Field Control Station (FCS)

The FCS controls the plant. By the difference of used I/O modules, there are two models of the FCS; namely the FCS for FIO and the FCS for RIO. In addition to the above models, there is the Compact type FCS.

- FCS for FIO
  This FCS uses the Fieldnetwork I/O (FIO) modules, which are compact and consist of various lineup such as the connector types and so forth. According to the application capacity, there are the standard model and the enhanced model.

- Compact FCS for FIO
  This is a compact FCS with I/O modules integrated into the Field Control Unit.

- FCS for RIO
  This FCS uses the Remote I/O (RIO) modules, which have many installation bases and M4 screw terminals to connect signal cables. According to the application capacity, there are the standard model and the enhanced model.

- Compact FCS for RIO
  This controller is usually installed near the equipment or process it controls, and is ideal for communicating with subsystems.

Engineering PC (ENG)

This is the PC with engineering functions used to perform CENTUM CS 3000 system generation and maintenance management.

It can be the same type of general-purpose PC as the HIS, and can even be the same PC as the HIS.

By having HIS operation and monitoring functions on the same PC, you can use the test (control station emulation) functions to provide an efficient and easy-to-use engineering environment.

Bus Converter (BCV)

This links the V net system bus to another CENTUM CS 3000 domain or to an existing CENTUM or µXL system.

Communications Gateway Unit (CGW)

This links the V net control system bus to an Ethernet bus (to a supervisory computer system or general purpose personal computer).

By CGW wide area communication function, you can also link two CENTUM CS 3000 V nets in different places using a dedicated telephone line.

Migrated Field Control Station (RFCS2)

You can leave the I/O cards and field wiring of a CENTUM-XL or CENTUM V system "as is", and replace the CPU nest with an KFCS, which can be connected to the V net just like a CENTUM CS 3000 system FCS.

SI bus is used as a (dual-redundant) bus connecting existing FCS I/O units to new FCS CPU.

Advanced Process Control Station (APCS)

The Advanced Process Control Station (APCS) is a personal computer (PC) connected to the V net and applied to advanced process control and efficiency improvement.

Generic Subsystem Gateway Package (GSGW)

GSGW is a PC connected to V net. It uses OPC servers for subsystems, facilitating subsystem data acquisition and setting without creating specific communications programs.

Exaopc

This provides OPC Server functions to enable applications in a supervisory PC to access CENTUM CS 3000 data. It provides a link between control layer and business data processing layer.

Business Information PCs and Supervisory Computers

These can run MES and ERP integrated business management software. They can access the DCS via Exaopc or CGW.

Safety Instrumented System (ProSafe-RS)

ProSafe-RS is a dedicated system to prevent probability and spread of accidents when it is used as an interlock device, emergency shutdown system and fire and gas protection.

Safety Engineering PC (SENG)

This is a component equipped with engineering, test and maintenance functions to generate system and manage maintenance for safety control station (SCS).

Safety Control Station (SCS)

This is a safety controller that executes logics for systems including interlock, emergency shutdown and fire and gas protection.

V net

The V net real-time control system bus links stations such as FCS, HIS, BCV and CGW. Dual-redundant V net support is standard.

Ethernet

Ethernet is used to link HIS, ENG and supervisory systems. It is also used for transferring data files to supervisory computers, and for HIS data equalization.

Fieldbus

The FOUNDATION Fieldbus is a multidrop digital communications bus for field instruments, and is expected to replace the conventional 4 to 20 mA analog interface.

2.2   System Specifications

CENTUM CS 3000 is a flexible system that can handle everything from small to quite large systems.

System Scale

The CENTUM CS 3000 system specifications are as shown below:

- No. of tags that can be monitored: 100,000 tags (expansible up to 1,000,000 tags)

- No. of stations that can be connected: 256 stations (max. 16 domains, 64 stations per domain) – however, HIS is limited to a maximum of 16 stations/domain.

When you reach the maximum of 64 stations in a domain, you can start a new domain and link the two domains using a Bus Converter.

HIS: Human Interface Station
KFCS: Standard FCS for FIO
LFCS: Standard FCS for RIO
FFCS: Compact FCS for FIO
SFCS: Compact FCS for RIO
BCV: Bus Converter
CGW: Communication Gateway Unit
XLFCS: CENTUM-XL FCS

F020201.ai
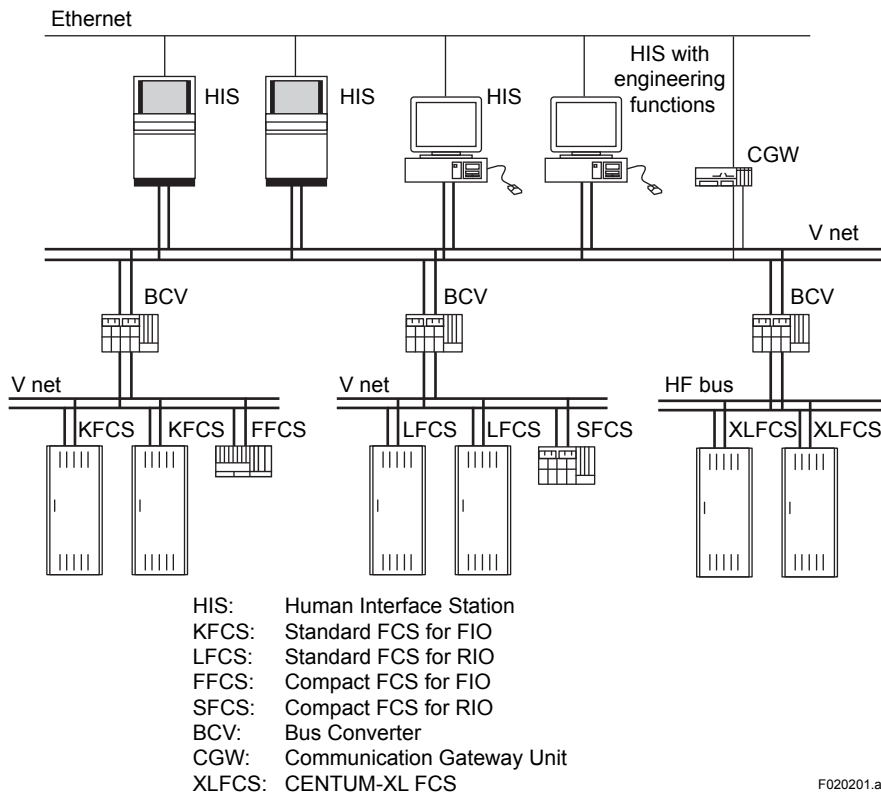
Figure   Example of Large System Configuration

Domain

A domain is a logical V net bus segment. You can use a Bus Converter to link CENTUM CS 3000 domains, or link to previous systems (CENTUM CS, CENTUM-XL, CENTUM CS 1000, µXL etc.). Support will be provided for integrating CS 3000 with previous systems.

Migration from CENTUM CS 1000 to CS 3000

Easy engineering operation can migrate the existing CENTUM CS 1000 system to the CENTUM CS 3000 system.

Single control bus is available when the CENTUM CS 3000 Entry class system is migrated from the CENTUM CS 1000 system. In that case, Ethernet is not required.

SEE ALSO Please refer to GS 33Q01B10-31E for whether the single control bus is allowed and whether Ethernet is required.

2.3   Human Interface Station (HIS)

HIS Function Specifications

2.3.1   Console Type HIS

The console type HIS is composed of a console assembly and a general purpose PC. It is a new type of human interface station that can utilize the latest PC technology while succeeding the operability and functionality of the DCS.

It can be composed of dual stacked LCD, touch panel function, eight-control-key operation keyboard, and auxiliary contact I/O, and a number of console type HISes can be installed in a row.

There are two types of console type HISes: one is enclosed display style console type HIS, the appearance of which is usual style, and another is open display style console type HIS, which is composed of LCD and the configuration of which is selectable.

The appearance of the console type HIS is shown below:

Upper LCD (option)
Touch panel (option)
LCD
Drawer
Operation keyboard
Engineering keyboard (general purpose PC keyboard)
Mouse (general purpose PC mouse)
General purpose PC
Enclosed display style console assembly
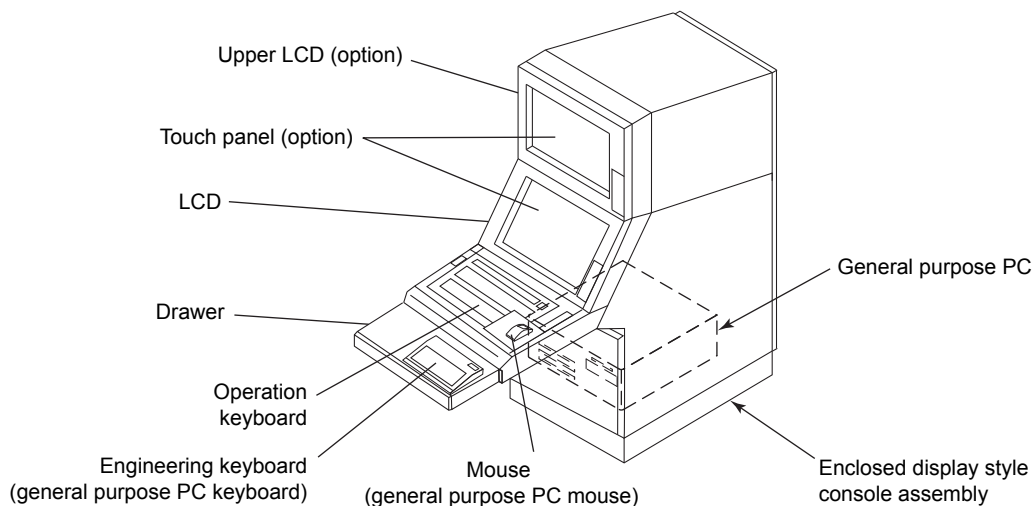
F020301.ai

Figure   Enclosed Display Style Console Type HIS

Upper LCD (option)

Touch panel (option)

LCD

Operation keyboard (option)

Drawer

Engineering keyboard (general purpose PC keyboard)

Mouse (general purpose PC mouse)

General purpose PC

Open Display Style Console Assembly
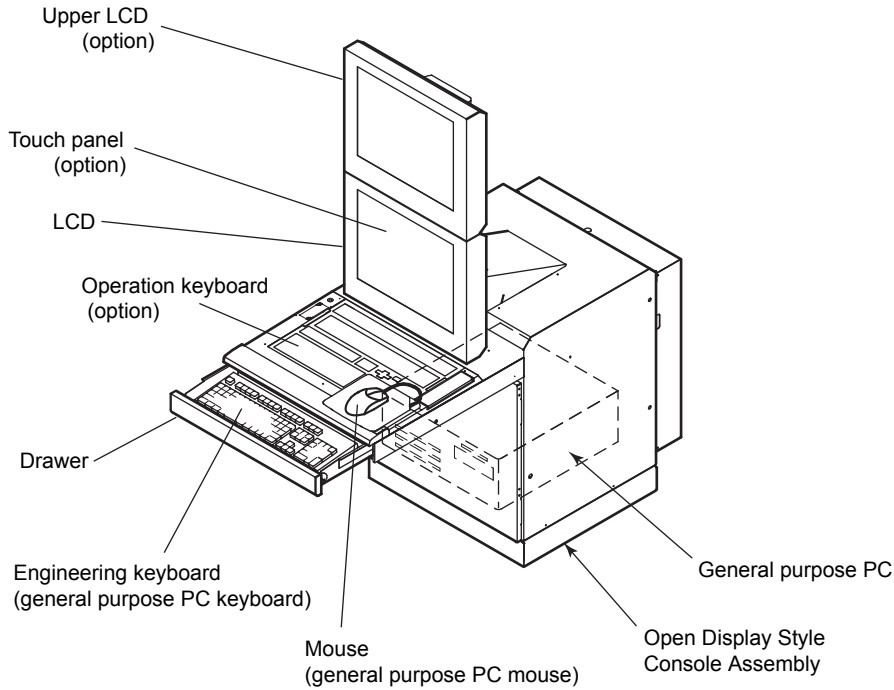
F020303.ai

Figure   Open Display Style Console Type HIS with LCD

Table   Functions of Console Type HIS

		Enclosed Display Style Console Assembly	Open Display Style Console Assembly
Display unit	Single LCD	Standard	Standard
	Dual stacked LCD	Option	Option
	Without LCD	No available	Standard
Touch panel	For lower display unit	Option	Option
	For upper display unit	Option	No available
RAS/Contact I/O	RAS	Standard(*1)	Standard(*2)
	Contact I/O	Standard	Standard
Operation keyboard	Eight-control-key operation keyboard (*3)	Standard	Standard
	One-control-key operation keyboard	No available	Standard
	Without operation keyboard	No available	Standard
	Drawer	Standard	Standard

*1:   Monitoring functions of ventilation fan operations and temperatures of the enclosure, and RAS functions provided in connection with the incorporated PC.
*2:   RAS functions provided in connection with the incorporated PC.
*3:   Not available for HIS without LCD.

2.3.2   Desktop Type HIS

The Desktop Type HIS uses a general purpose IBM PC/AT compatible.

2.3.3   Operation Keyboard

The dust- and drip-proof operation keyboard has functionally arranged flat keys, which enables one-touch operation. The keyboard is available in two types: one is designed for eight-control-key operation for use with console type HISes, and another for one-control-key operation for use with both console type HISes and desktop type HISes.

Tuning keys

System maintenance panel

Operation confirmation keys

Function keys (64)

Mouse

Data entry keys
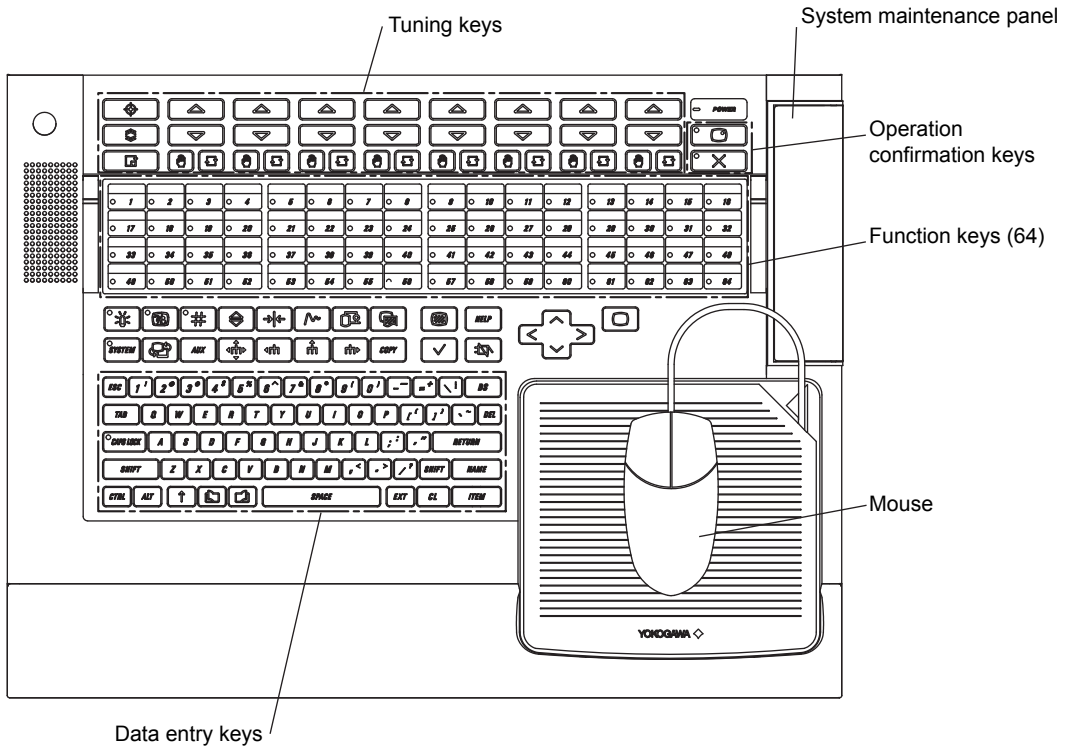
F020304.ai

Figure   Eight-control-key Operation Keyboard
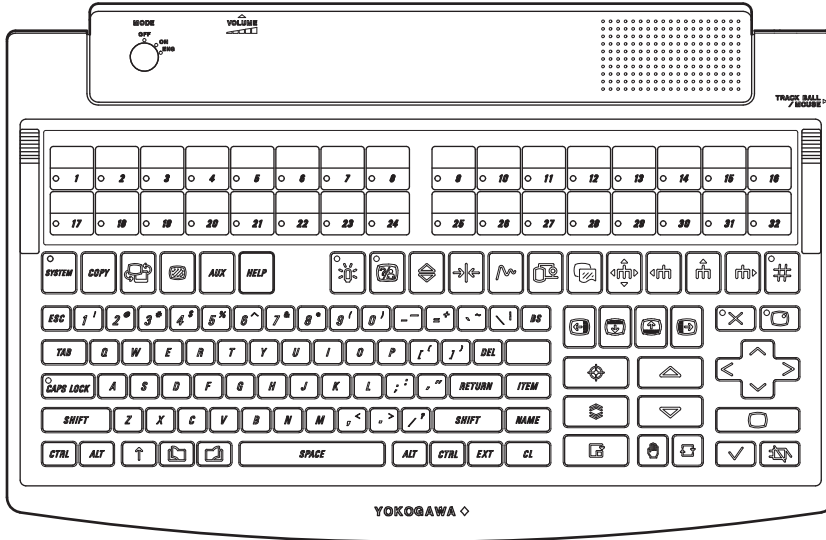
F020305.ai

Figure   One-control-key Operation Keyboard

Process Alarm window call Key		Process overview call Key		Tuning window call Key		Graphic window call Key		Window erase Key		
	Operator guide window call Key		Control window call Key		Trend window call Key		Process Report window call Key		Help dialogue call Key	Cursor Key Display Key

System Key (calls System Status Overview Window)

AUX Key

Circulate Key

Navigator window call Key

Parent window call Key

Upper sibling window call Key

Lower sibling window call Key

Print screen Key

Alarm-acknowledgment Key

Buzzer Stop Key

F020306.ai

Figure   Operation Keys

2.4   Field Control Station (FCS)

The hardware architecture of the Standard Type Field Control Station for FIO (KFCS), the Enhanced Type Field Control Station for FIO (KFCS2), the Standard Type Field Control Station for RIO (LFCS), the Enhanced Type Field Control Station for RIO (LFCS2), and the Compact FCS (SFCS) is described below.

KFCS, KFCS2:	The Field Control Unit (FCU) and the node are connected using ESB(Extended Serial Backboard) or ER(Enhanced Remote) bus.
FFCS:	An FCS in which the FCU and a node unit are combined.
LFCS, LFCS2:	The FCU and the node are connected using RIO bus.
PFC□-H/-S/-E:	The FCU and the I/O units are connected to the same backplate.
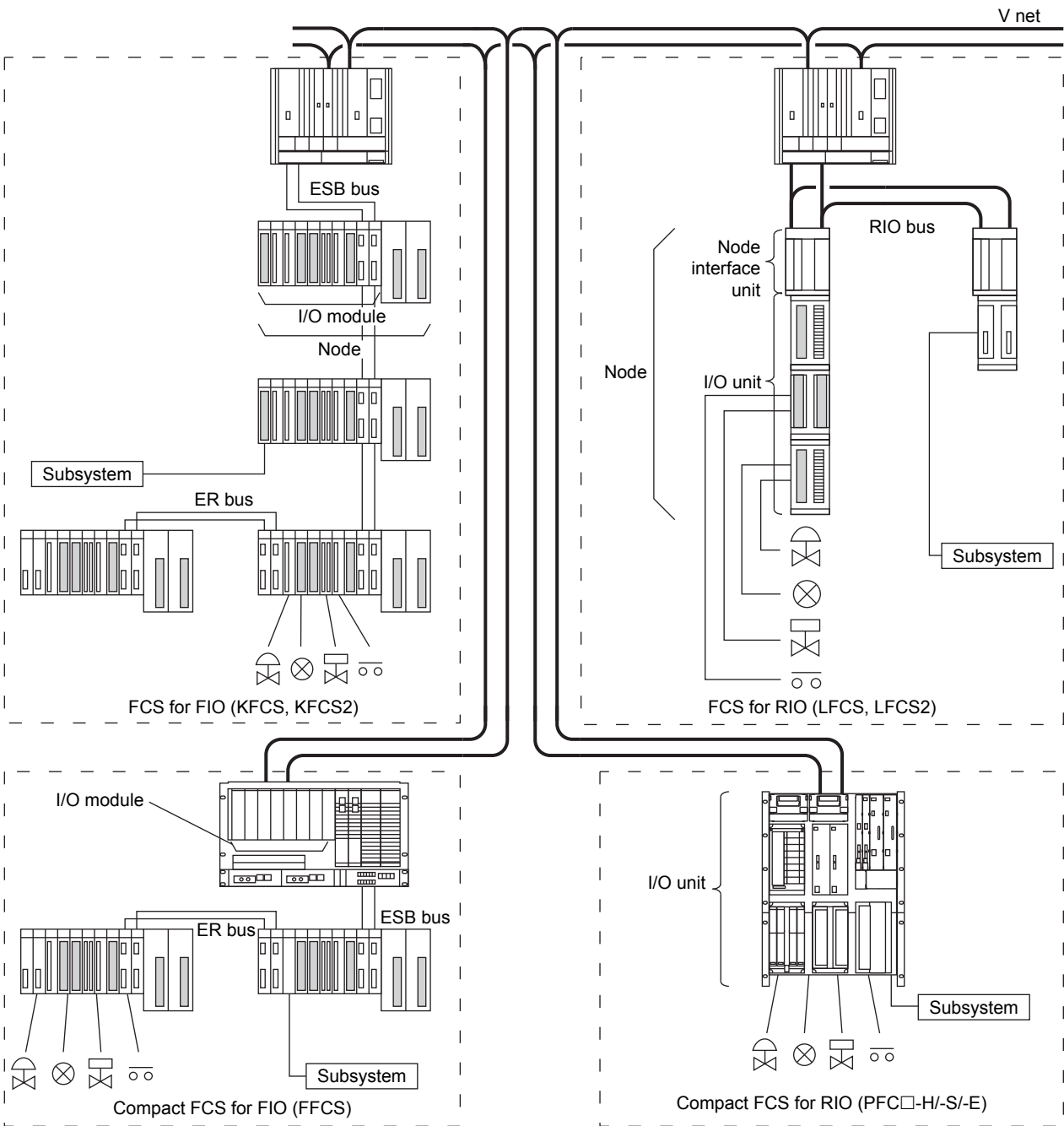
Figure   Field Control Station Configuration

F020401.ai

2.4.1 FCS for FIO (KFCS, KFCS2, FFCS)

The FCS for FIO is composed of an FCU, ESB bus, ER bus and node units. CPU architecture and mounting combinations are available for optimum selection.

CPU architecture: Single or duplexed.

Mounting: cabinet mounting or rack mounting.

ESB bus: Single or dual redundant.

ER bus: Single or dual redundant.

Note: One node unit is integrated into an FFCS. FFCS's are rack-mounted only.

FCS for FIO Application Capacities

SEE ALSO
- For the application capacity of Standard FCS for FIO, refer to GS 33Q03K30-31E.
- For the application capacity of Enhanced FCS for FIO, refer to GS 33Q03K31-31E.
- For the application capacity of Compact FCS for FIO, refer to GS 33Q03K40-31E.

Field Control Unit (FCU)

The FCU consists of cards and units and executes control computation for the FCS. Each FCS is configured as shown in the figure below.

FCU Configuration in KFCS and KFCS2

For the duplexed FCU, the processor cards are duplexed, and power units, battery units and ESB bus interface cards are dual redundant.
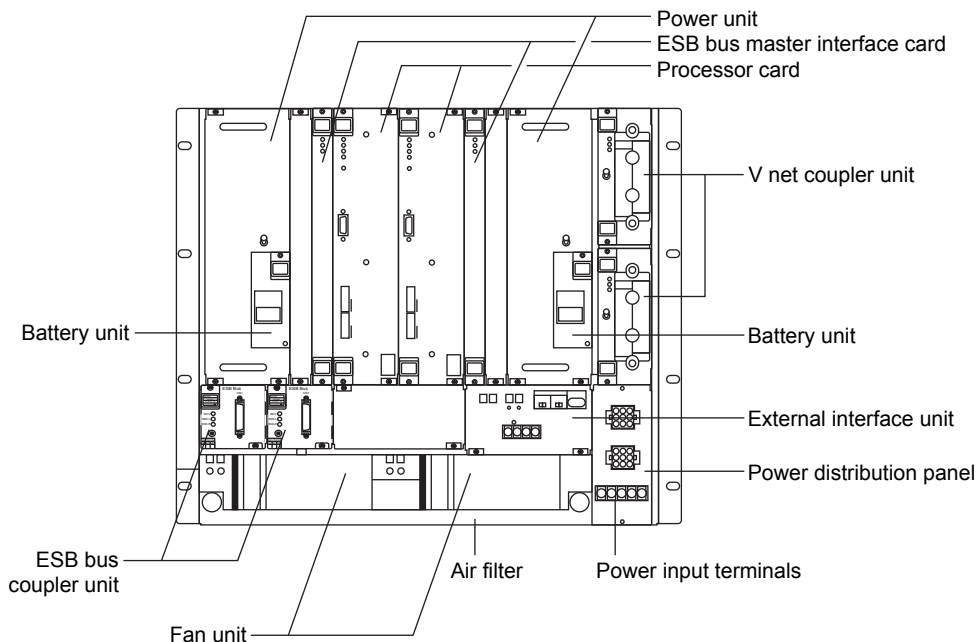
F020402.ai

Figure   Example of Rack Mounting Type FCU for FIO

FCU Configuration in FFCS

For a duplexed FCU, the processor modules, power modules, and I/O modules are all dual-redundant.

If node units are added, install a bus interface module in an I/O module slot. Use two modules for dual-redundant use.
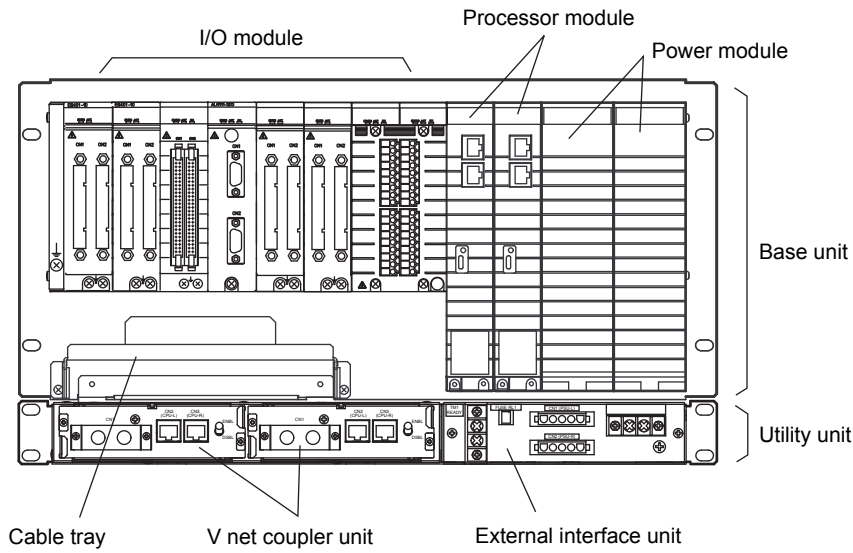
Figure   Example of Compact FCU Configuration for FIO

ESB Bus and ER Bus

The ESB bus (Extended Serial Backboard bus) is a communication bus used in connecting the local nodes, which are installed in the same cabinet for FCU, with the FCU. This bus can be dual-redundant. Maximum transmission distance is 10 meters.

The ER bus (Enhanced Remote bus) is a communication bus used in connecting the remote nodes with the FCU by way of the ER bus interface module installed on the local node (*1). This bus can also be dual-redundant. Using this bus, the nodes can be installed in the same cabinet for FCU or at locations away from the cabinet. Its maximum transmission distance is 185 meters using a Ethernet-compatible 10BASE-2 coaxial cable or 500 meters using a 10BASE-5 coaxial cable, or up to 2 kilometers using general-purpose optical bus repeaters.

*1:   A compact FCS for FIO allows the installation of an ER bus interface module in a node unit integrated into the FCU.
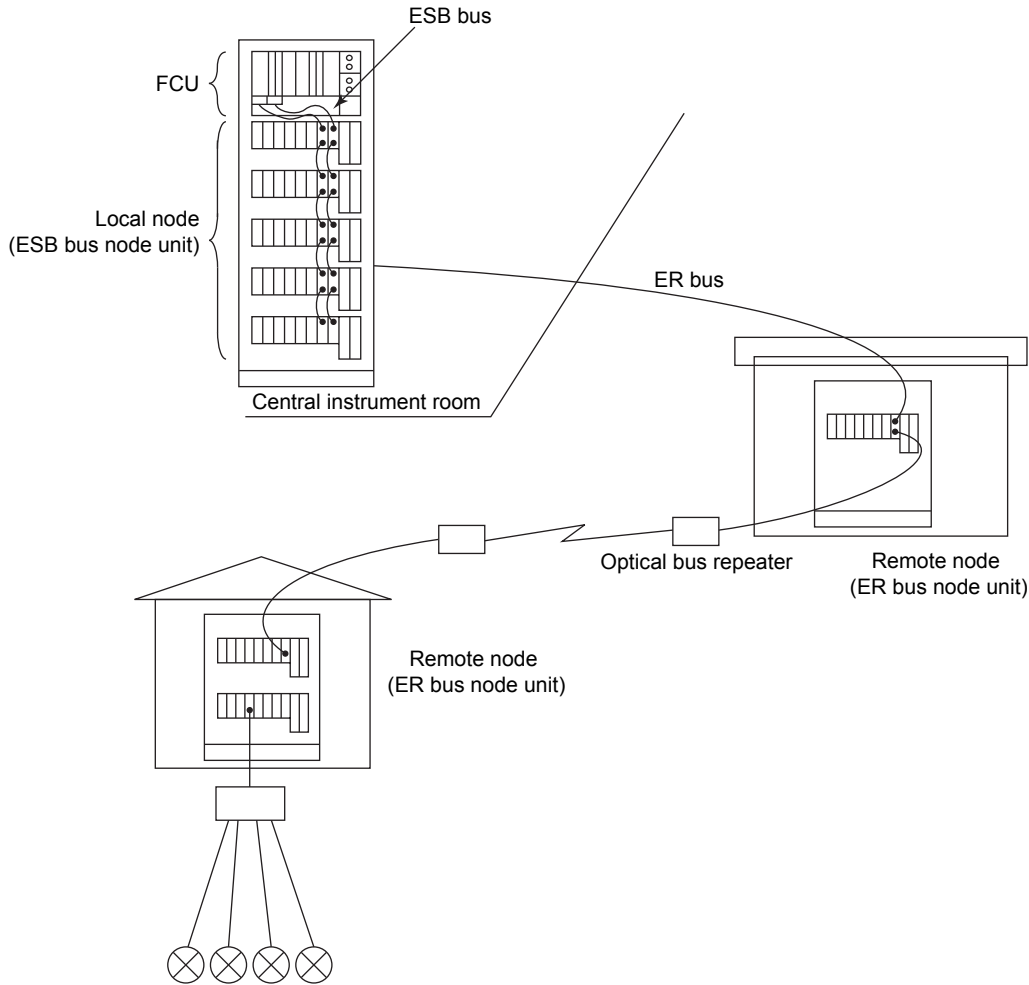
F020403.ai

Figure   Example of Distributed Node Units (KFCS, KFCS2)

Node Units (NU) for FIO

The node units (NU) for FIO are signal processing units which convert and transmit analog or digital process I/O signals received from the field devices to the FCU for FIO.

The node units (NU) for FIO have ESB bus node units (local nodes) installed at the FCS station and ER bus node units (remote nodes) installed in cabinets and etc. on the plant-site. The node unit is composed of an ESB bus slave interface module or ER bus slave interface module and I/O modules. In addition, a compact FCS for FIO includes one node unit integrated into the FIO.

ESB Bus Slave Interface Module

This module is installed in the local node to enable communication with the FCU. The module can be duplexed.

ER Bus Interface Module

This module has an interface master module, which is installed on the local node, and an interface slave module, which is installed on the remote node. Both modules can be dual-redundant.

Note: A compact FCS for FIO allows the installation of an ER bus interface master module in a node unit integrated into the FCU.

I/O Module

These modules input, convert, and output analog and digital field signals.
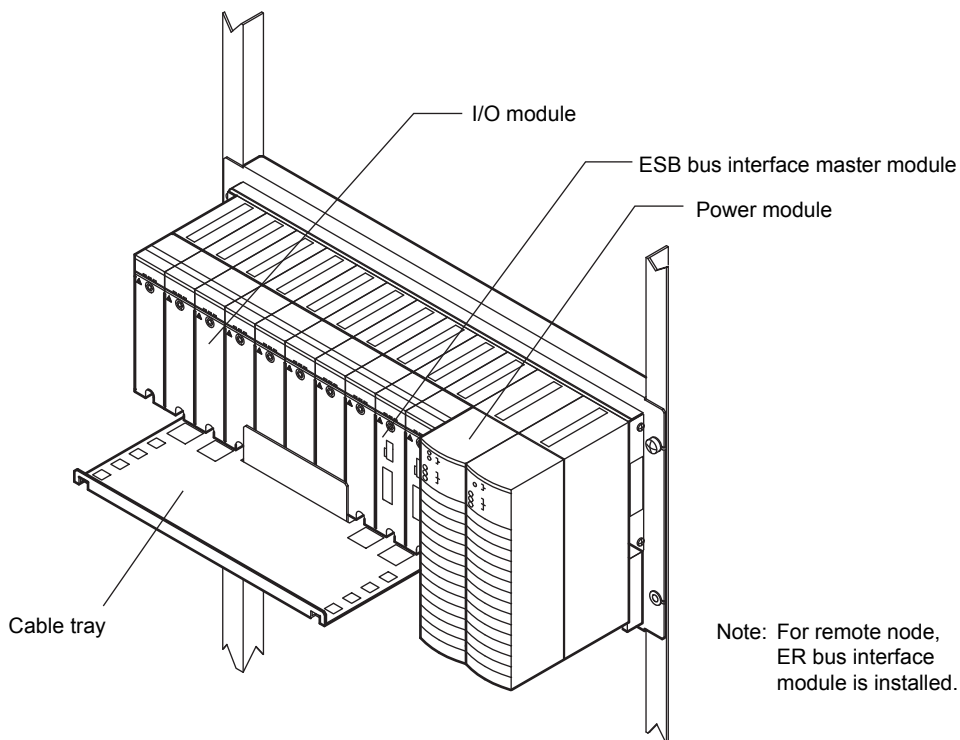
Figure   Local Node Configuration

Mounting of FCS for FIO

Mounting of KFCS and KFCS2

The FCU and node units (NU) for FIO are mounted in a dedicated cabinet, general-purpose racks or general-purpose cabinets.

Mounting and combinations of FCU and nodes are user definable. For example, the FCU and some node units are mounted in a dedicated cabinet and the remaining node units are mounted in general-purpose racks on the plant-site. Up to 10 node units for FIO can be connected to the FCU of each standard FCS for FIO (up to 15 for each enhanced FCS for FIO), and up to 8 I/O modules can be installed in each node unit.

- FCU for FIO Dedicated Cabinet

    Front: 1 FCU, 5 node units

    Rear: 4 node units

- I/O Expansion Cabinet

    Front: 4 node units

    Rear: 4 node units
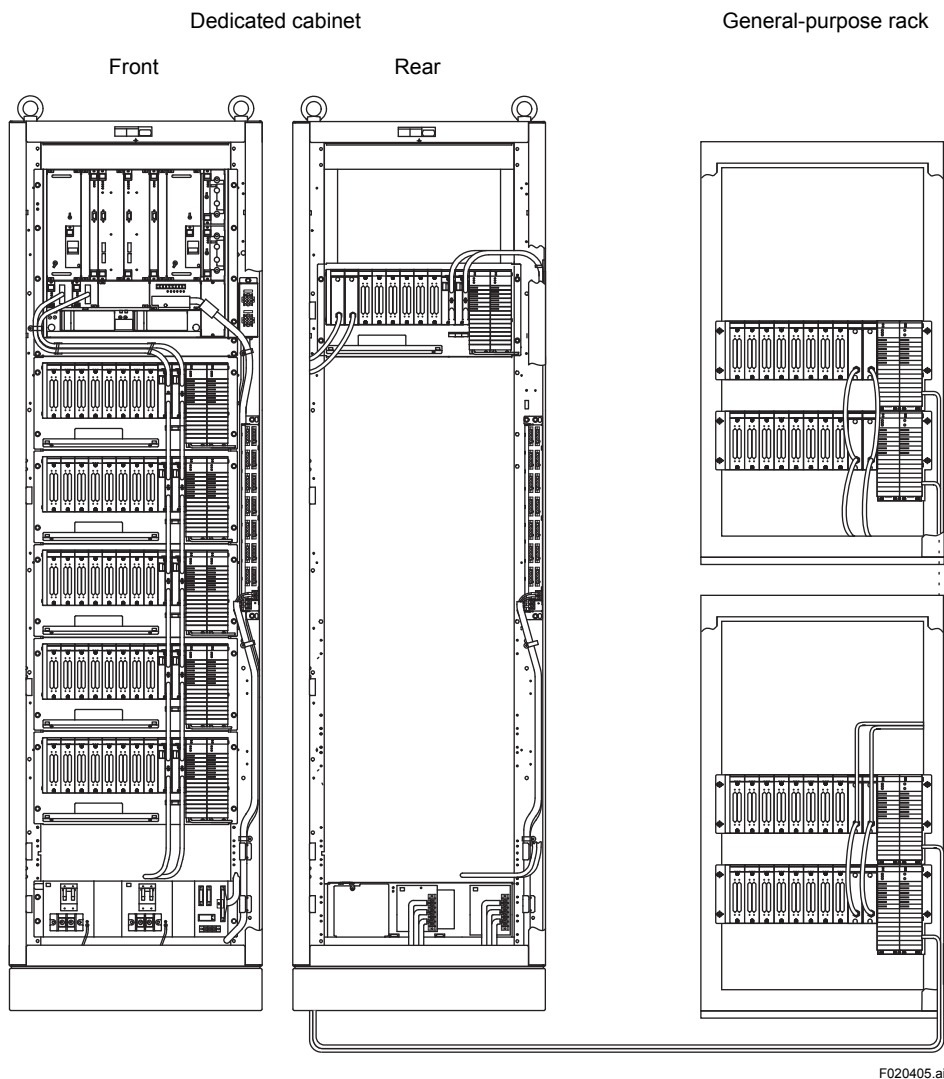
Figure   Example of Mounting FCU and Node Unit using Dedicated Cabinet

Mounting of FFCS

An FCS on which FCUs and I/O modules are mounted can be mounted in a rack. Up to three node units (NUs) for FIO can be connected to an FCS. Up to eight I/O modules (*1) can be mounted on a node unit integrated into the FCU. Up to 30 I/O modules can be mounted on an FCS, adding to additional node units for FIO.

*1:   If node units (NUs) are added, up to six I/O modules can be mounted on node units integrated into the FCU for installing communication modules for NU connection.

2.4.2   FCS for RIO (LFCS, LFCS2)

For the FCS for RIO, with the FCU connected by RIO bus to nodes, there are FCU CPU redundancy and RIO bus redundancy options, and cabinet or rack mounting options.

CPU redundancy: single or duplexed (dual redundant).

Mounting: cabinet mounting or rack mounting.

RIO bus: single or dual redundant.

FCS for RIO Application Capacity

SEE ALSO
- For the application capacity of Standard FCS for RIO, refer to GS 33Q03K10-31E.
- For the application capacity of Enhanced FCS for RIO, refer to GS 33Q03K11-31E.

Field Control Unit (FCU) for RIO

The FCU for RIO consists of processor, cards and units. For the duplexed (dual-redundant) FCU, the processor card, power unit, battery unit and RIO bus interface card are all dual redundant.
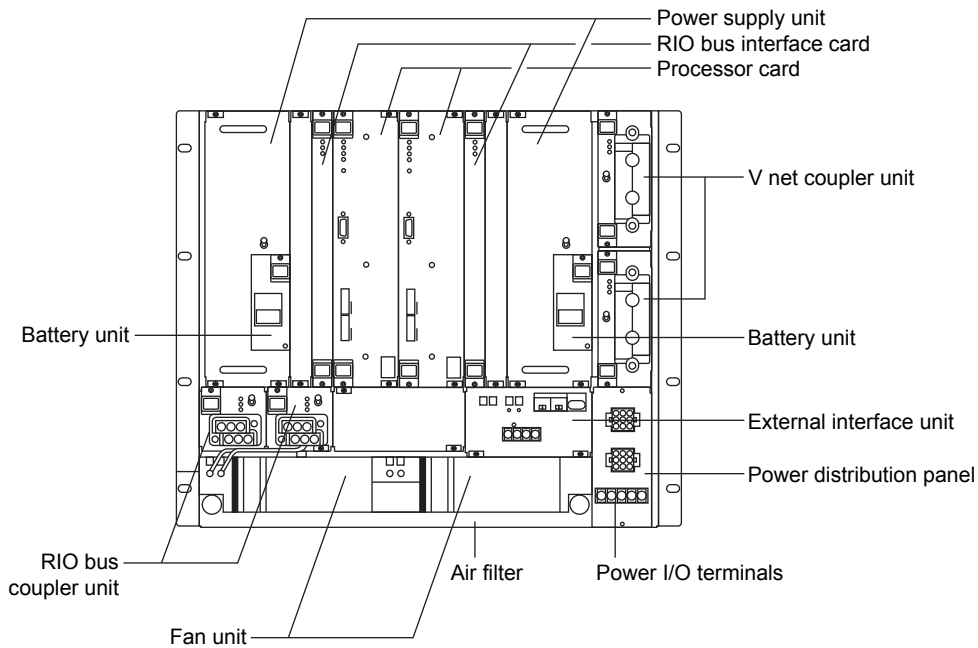
F020406.ai

Figure   Example of Rack Mounting Type FCU for RIO Configuration

RIO Bus

The Remote I/O bus (RIO bus) connects the FCU to I/O nodes, and can be dual redundant. I/O nodes do not need to be in the FCU cabinet, they can be mounted remotely. Shielded twisted pair cable is used for distances up to 750 m, and bus repeaters or optical fiber links can be used for longer distances – up to 20 km. Bus repeaters and optical fiber links can be mixed, up to four in total.
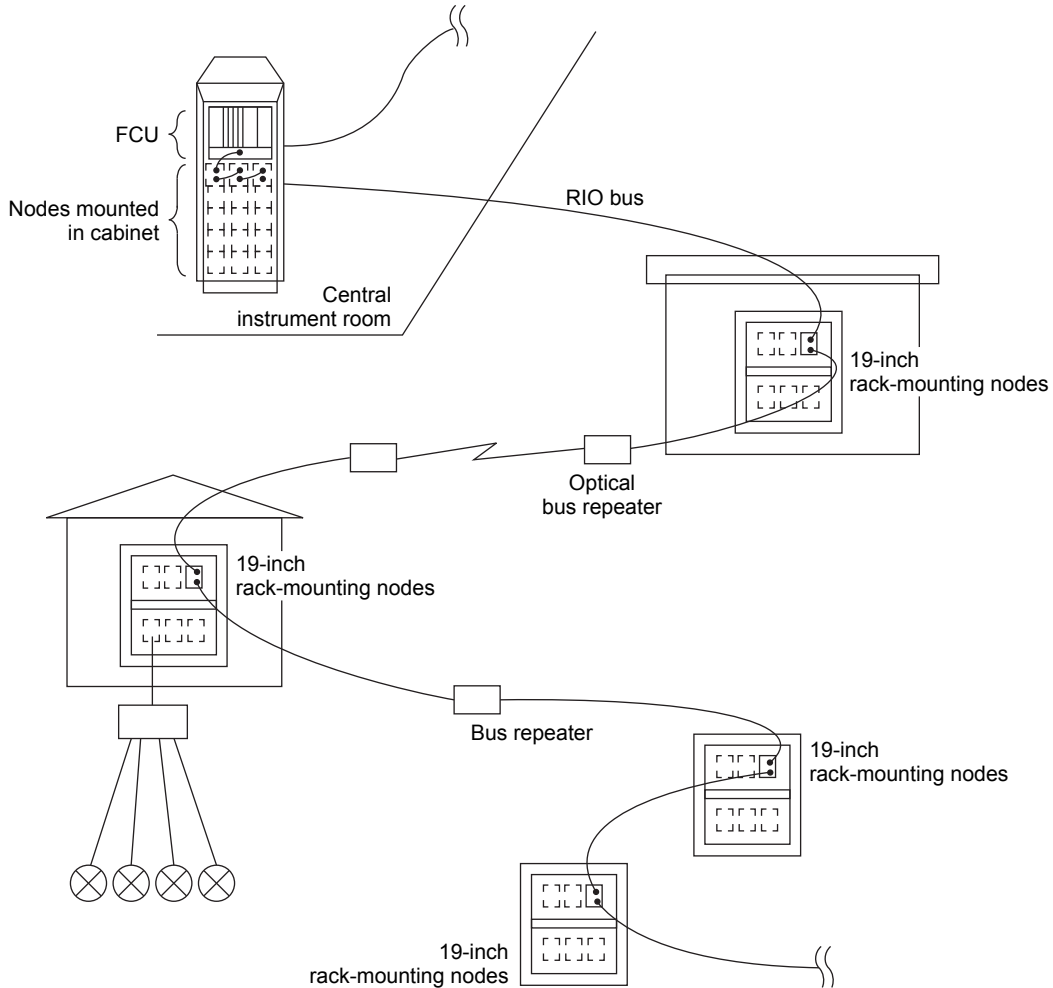
F020407.ai

Figure   Example of Distributed Nodes – Extending the RIO Bus

Nodes

Nodes consist of I/O Units, which interface with analog and digital field signals, and Node Interface Units which communicate via the RIO Bus with Field Control Units (FCU).

Node Interface Units (NIU)

Node Interface Units consist of RIO bus communication cards and power cards, both of which can be dual redundant.

I/O Units (IOU)

I/O Units consist of I/O Module Nests containing I/O Modules, which connect to the process.
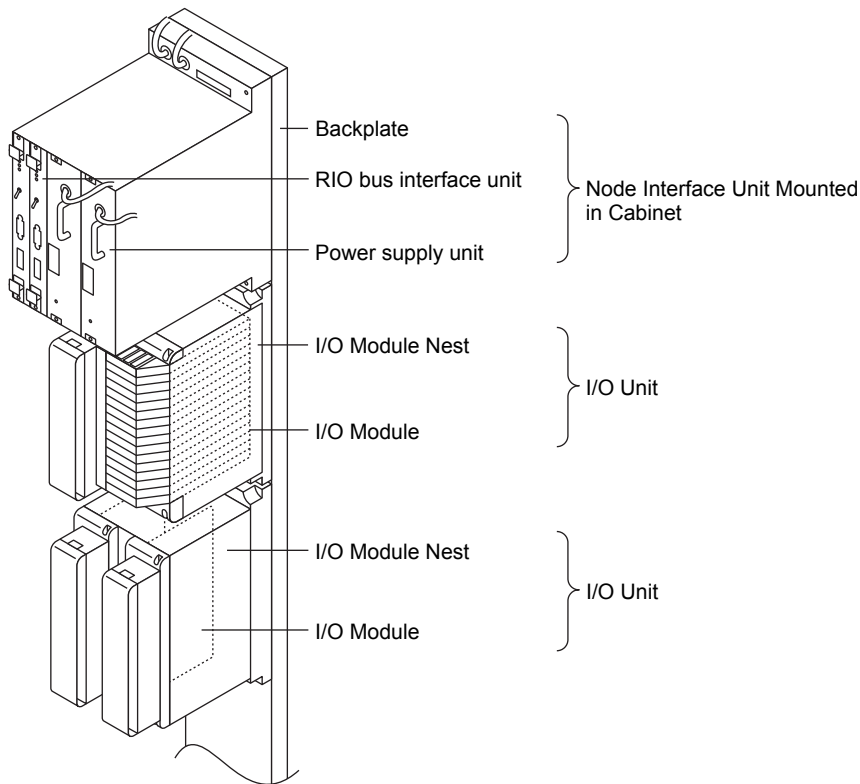
F020408.ai

Figure   Cabinet Mounting

I/O Module Nest

I/O Module

I/O Unit

RIO Bus
Interface Card

Power Supply Unit

Rack Mounting
Node Interface Unit

Backplate

I/O Module Nest

I/O Unit

I/O Module
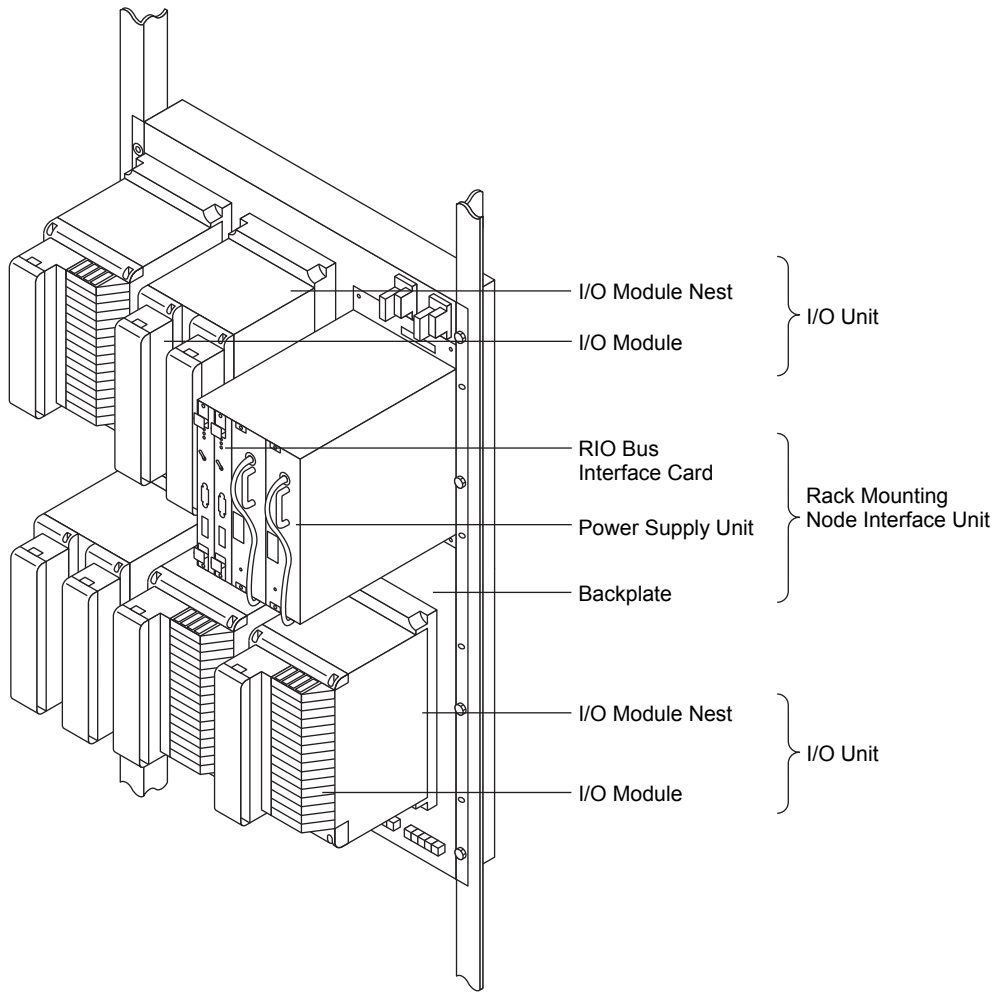
F020409.ai

Figure   Example of Rack Mounting

Mounting of LFCS FCUs and Nodes

FCUs and nodes can be mounted in dedicated cabinets or in general-purpose 19-inch racks.

FCUs and nodes can be mounted together or separate – you can mount some nodes in the same cabinet (or on the same rack) as the associated FCU, and some in racks in the field, if you wish. Each FCU can connect to up to eight nodes, and each Node Interface Unit (NIU) can connect to up to five I/O units.

Dedicated Cabinets

- Cabinets which contain FCUs

    Front: One FCU, three nodes (with up to four I/O units in each node).

    Back: Up to three nodes (with up to five I/O units in each node).

- I/O Expansion Cabinets

    Front: Up to three nodes (with up to five I/O units in each node).

    Back: Up to three nodes (with up to five I/O units in each node).

NIU: Node Interface Unit
IOU: I/O Unit
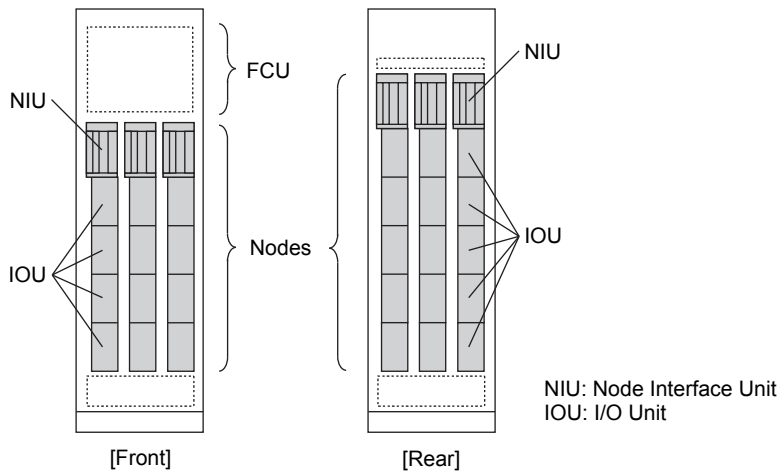
F020410.ai

Figure   Example of Cabinet with FCU
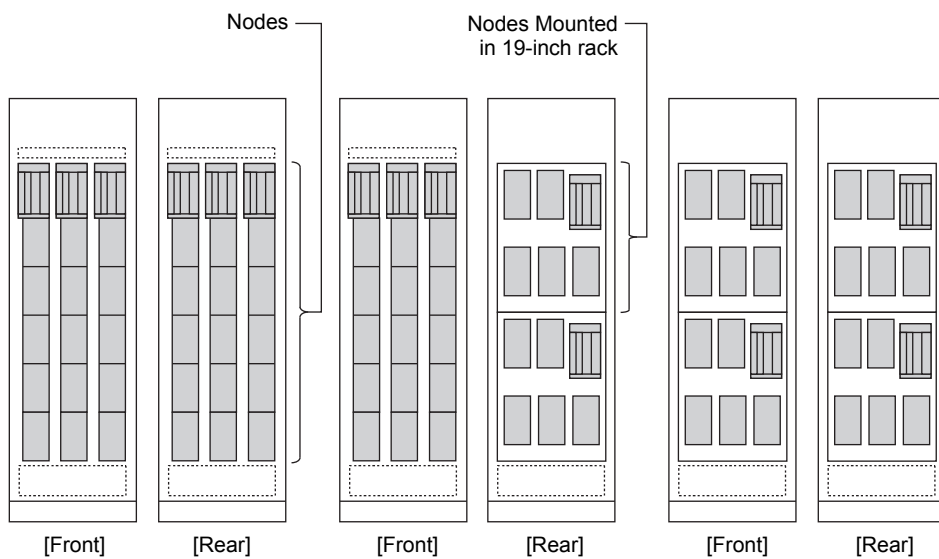
F020411.ai

Figure   Examples of I/O Expansion Cabinets

Rack Mountable Node

Up to five I/O Units may be connected to one node; they may be mounted in the same general-purpose 19-inch rack.

Rack-Mountable Node
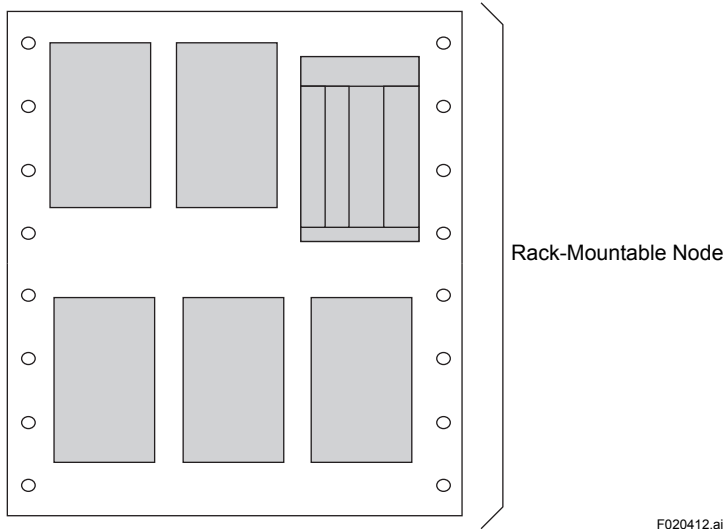
F020412.ai

Figure   Example of Rack-Mountable Node

2.4.3   Compact FCS for RIO (PFC□-H/-S/-E)

Duplexed (dual redundancy) CPU is supported.

Dual redundant power supplies are also available.

Application Capacity of Compact FCS for RIO

SEE ALSO For the Application Capacity of Compact FCS (PFC□-H) for RIO, refer to GS 33Q03K20-31E.

For the Application Capacity of Compact FCS (PFC□-S/-E) for RIO, refer to GS 33Q03K90-31E.

Configuration and Mounting of Compact FCS for RIO
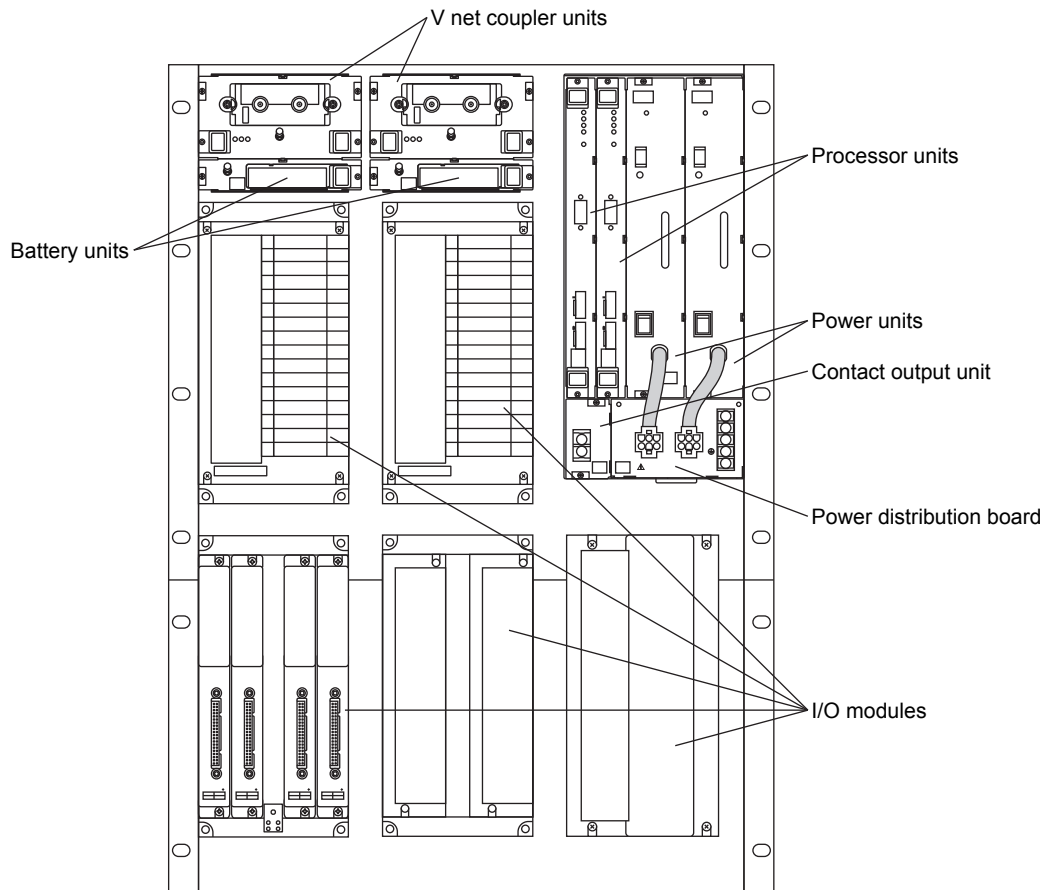
F020413.ai

Figure   Example of Compact FCS Configuration

Mounting of I/O Units

The compact FCS mounts in a general-purpose 19-inch rack. One FCS is connected to up to five I/O Units.
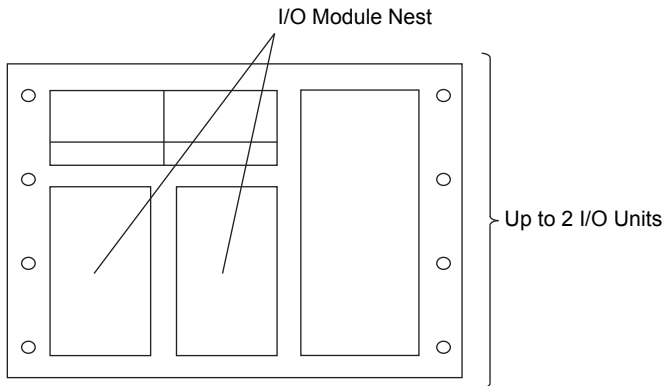
F020414.ai

Figure   Compact FCS with Two I/O Units
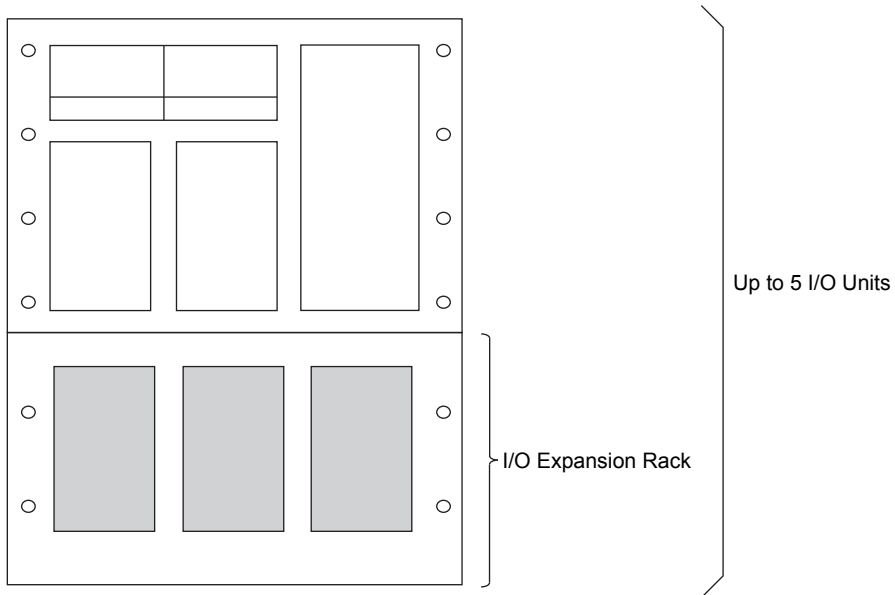
F020415.ai

Figure   Compact FCS with Five I/O Units

2.5 I/O Module Nests and I/O Modules

This section describes input modules, which convert process signals to digital data format used in the FCS, and output modules, which convert the digital data to analog or contact signals.
For I/O modules, there are the Fieldnetwork I/O (FIO), which are compact and consist of various lineup, and the Remote I/O (RIO), which have many installation bases.

2.5.1 Fieldnetwork I/O (FIO)

The FIO modules are used in the FCS for FIO. They are compact and consist of the lineup of abundant variety, such as the connector types, the isolation types, and so forth, to correspond flexibly to the applications.

Table   List of KFCS I/O Modules (1/2)

| Model	Name	I/O channels per Module	Pressure Clamp Terminal	Yokogawa-specific Cable (*1)	MIL Cable
			Connection Signal		
Analog I/O Modules					
AAI141-S	Analog Input Module (4 to 20 mA, Non-Isolated)	16	x	x	x
AAI141-H	Analog Input Module (4 to 20 mA, Non-Isolated, HART protocol)	16	x	x	x
AAV141	Analog Input Module (1 to 5 V, Non-Isolated)	16	x	x	x
AAV142	Analog Input Module (-10 V to +10 V, Non-Isolated)	16	x	x	x
AAI841-S	Analog I/O Module (4 to 20 mA Input, 4 to 20 mA Output, Non-Isolated)	8 input/8 output	x	x	x
AAI841-H	Analog I/O Module (4 to 20 mA, Non-Isolated, HART protocol)	8 input/8 output	x	x	x
AAB841	Analog I/O Module (1 to 5 V Input, 4 to 20 mA Output, Non-Isolated)	8 input/8 output	x	x	x
AAV542	Analog Output Module (-10 V to +10 V, Non-Isolated)	16	x	x	x
AAI143	Analog Input Module (4 to 20 mA, Isolated)	16	x	x	x
AAI543	Analog Output Module (4 to 20 mA, Isolated)	16	x	x	x
AAV144	Analog Input Module (-10 V to +10 V, Isolated)	16	x	x	x
AAV544	Analog Output Module (-10 V to +10 V, Isolated)	16	x	x	x
AAT141	TC/mV Input Module (TC: JIS R, J, K, E, T, B, S, N /mV: -100 to 150 mV, Isolated)	16	x	–	x
AAR181	RTD Input Module (RTD: JIS Pt100 ohm, Isolated)	12	x	–	x
AAI135-S	Analog Input Module (4 to 20 mA, Isolated Channels)	8	x	x	x
AAI135-H	Analog Input Module (4 to 20 mA, Isolated Channels, HART protocol)	8	x	x	x
AAI835-S	Analog I/O Module (4 to 20 mA, Isolated Channels)	4 input/4 output	x	x	x
AAI835-H	Analog I/O Module (4 to 20 mA, Isolated Channels, HART protocol)	4 input/4 output	x	x	x
AAT145	TC/mV Input Module (TC: JIS R, J, K, E, T, B, S, N /mV: -100 to 150 mV, Isolated Channels)	16	–	x(*2)	–
AAR145	RTD/POT Input Module (RTD: JIS Pt100 ohm /POT: 0 to 10 kohm, Isolated Channels)	16	–	x(*2)	–
AAP135	Pulse Input Module (Pulse Count, 0 to 10 kHz, Isolated Channels)	8	x	x	x
AAP149	Pulse Input Module for compatible PM1 (Pulse Count, 0 to 6 kHz, Non-Isolated)	16	–	x(*2)	–
AAP849	Pulse Input/Analog Output Module for compatible PAC (Pulse Count Input, 4 to 20mA Output, Non-Isolated)	8 input/8 output	–	x(*2)	–

Table   List of KFCS I/O Modules (2/2)

Mode	Name	I/O channels per Module	Connection Signal		
			Pressure Clamp Terminal	Yokogawa-specific Cable (*1)	MIL Cable
Digital I/O Module					
ADV151	Digital Input Module (24 V DC)	32	x	x	x
ADV551	Digital Output Module (24 V DC)	32	x	x	x
ADV141	Digital Input Module (100 V to 120 V AC)	16	x	x(*2)	–
ADV142	Digital Input Module (220 V to 240 V AC)	16	x	x(*2)	–
ADV157	Digital Input Module (24 V DC, Pressure Clamp Terminal Support Only)	32	x	–	–
ADV557	Digital Output Module (24 V DC, Pressure Clamp Terminal Support Only)	32	x	–	–
ADV161	Digital Input Module (24 V DC)	64	–	x(*2)	x
ADV561	Digital Output Module (24 V DC)	64	–	x(*2)	x
ADR541	Relay Output Module (24 to 110 V DC/100 to 240 V AC)	16	x	x(*2)	–
ADV859	Digital I/O Module for Compatible ST2 (Isolated Channels)	16 input /16 output	–	x(*2)	–
ADV159	Digital Input Module for Compatible ST3 (Isolated Channels)	32	–	x(*2)	–
ADV559	Digital Output Module for Compatible ST4 (Isolated Channels)	32	–	x(*2)	–
ADV869	Digital I/O Module for Compatible ST5 (Common Minus Side Every 16-Channel)	32 input /32 output	–	x(*2)	–
ADV169	Digital Input Module for Compatible ST6 (Common Minus Side Every 16-Channel)	64	–	x(*2)	–
ADV569	Digital Output Module for Compatible ST7 (Common Minus Side Every 16-Channel)	64	–	x(*2)	–
Communication Modules					
ALR111	RS-232C Communication Module (1200 bps to 115.2 kbps)	2 port	–	x(D-sub9 pin) (*2)	–
ALR121	RS-422/RS-485 Communication Module (1200 bps to 115.2 kbps)	2 port	–	x(M4 terminal block 5-pole) (*2)	–
ALE111	Ethernet Communication Module (10 Mbps)	1 port	–	x(RJ-45) (*2)	–
ALF111	Foundation Fieldbus (FF-H1) Communication Module (31.25 kbps)	4 port	x	x(*2)	–
ALP111	PROFIBUS-DPV1 Communication Module	1 port	–	x(*2)	–

x: Can be connected.
–: Cannot be connected.
*1: Yokogawa-specific cable that connects I/O Module and a terminal board or the like.
*2: Can be connected directly with Yokogawa-specific cable, without a terminal block.

Table   List of KFCS I/O Modules with Built-in Barrier

Model	Name	I/O channels per Module	Connection Signal		
			Pressure Clamp Terminal	Yokogawa-specific Cable (*1)	MIL Cable
Analog I/O Modules					
ASI133	Analog Input Module (4 to 20 mA, Isolated)	8	x	–	–
ASI533	Analog Output Module (4 to 20 mA, Isolated)	8	x	–	–
AST143	TC/mV Input Module (TC: B, E, J, K, N, R, S, T /mV: -100 V to 150 mV, -50 to 75 mV, Isolated)	16	x	–	–
ASR133	RTD/POT Input Module (RTD: Pt50, Pt100, Pt200, Pt500, Pt1000, Ni100, Ni200, Ni120 /POT: 0 to 10 K ohm, Isolated)	8	x	–	–
Digital I/O Modules					
ASD143	Digital Input Module (NAMUR compatible, Isolated)	16	x	–	–
ASD533	Digital Output Module (U>12 V at I=45 mA, Isolated)	8	x	–	–

x: Can be connected.
–:   Cannot be connected.

Combination of I/O Modules and Terminal Blocks

For connection between field devices and I/O modules, KS cable interface adapter and pressure clamp terminal block can be used. MIL cable, which is provided by user, is also available for the connection.

SEE ALSO For pressure clamp terminals, terminal blocks and pin arrangement of MIL connector for I/O modules, refer to GS 33Q06Q50-31E Field Connection Specifications (for FIO).

Combination of I/O modules and terminal blocks is shown below.

Terminal block

MIL connector

I/O module

Pressure clamp terminal

KS cable interface adapter
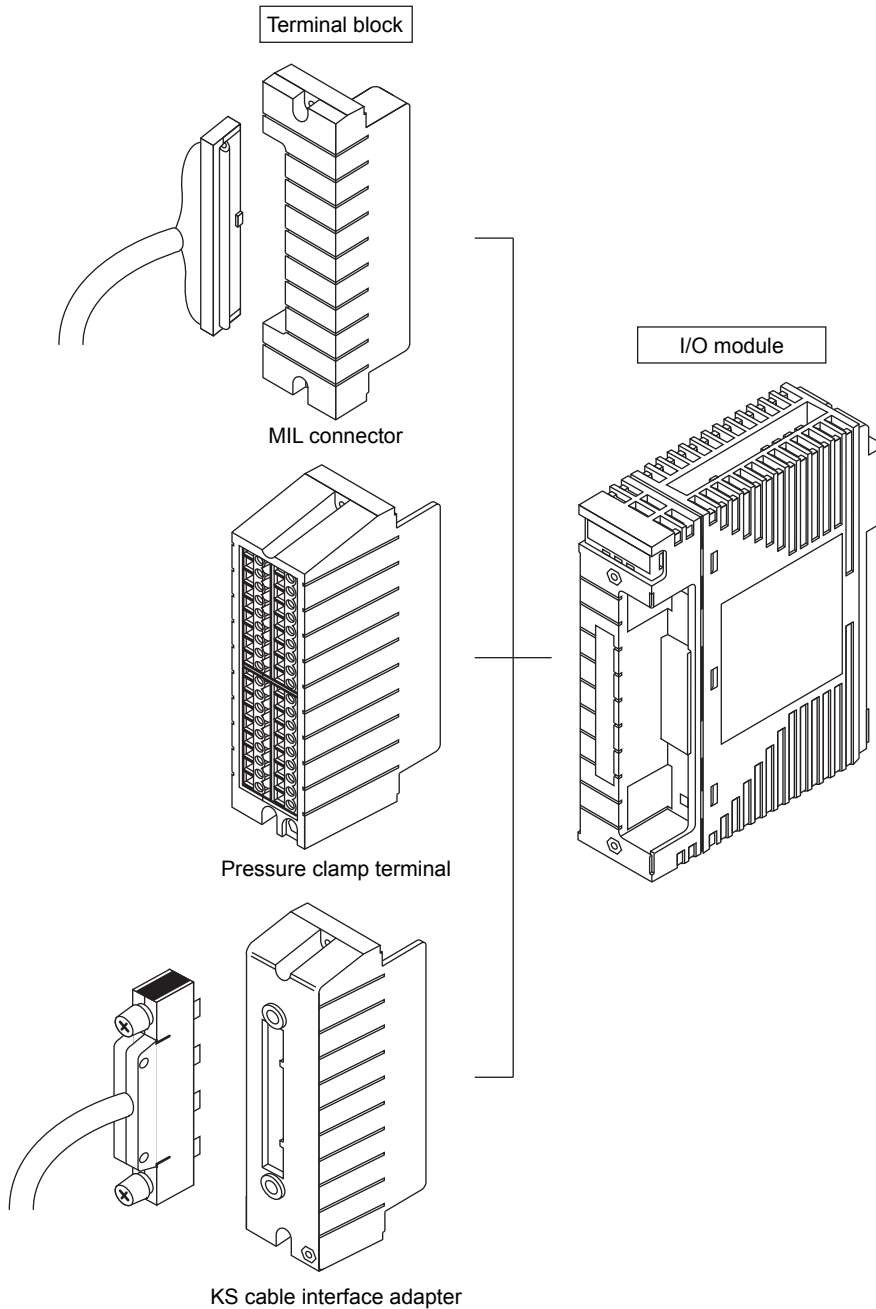
F020501.ai

Figure Combination of I/O Modules and Terminal Blocks

Field Wiring Using Pressure Clamp Terminals

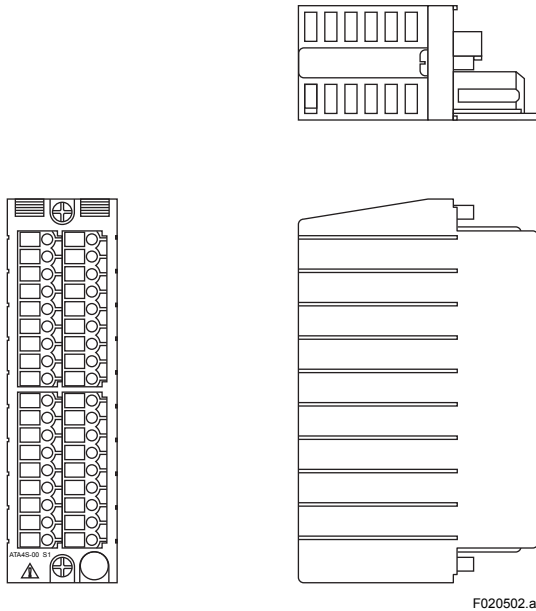A field signal cable, with its end uncovered, can be connected directly to an analog or digital I/O module equipped with the pressure clamp terminal block. Two to three signal cables can be connected for every I/O channel.

F020502.ai

Figure Field Wiring Using Pressure Clamp Terminals

Field Wiring Using KS Cable Interface Adapter

An analog or digital I/O module equipped with the KS cable interface adapter can be connected with the terminal board using the KS cable and field signal cables are connected to the terminal board with M4 screws.
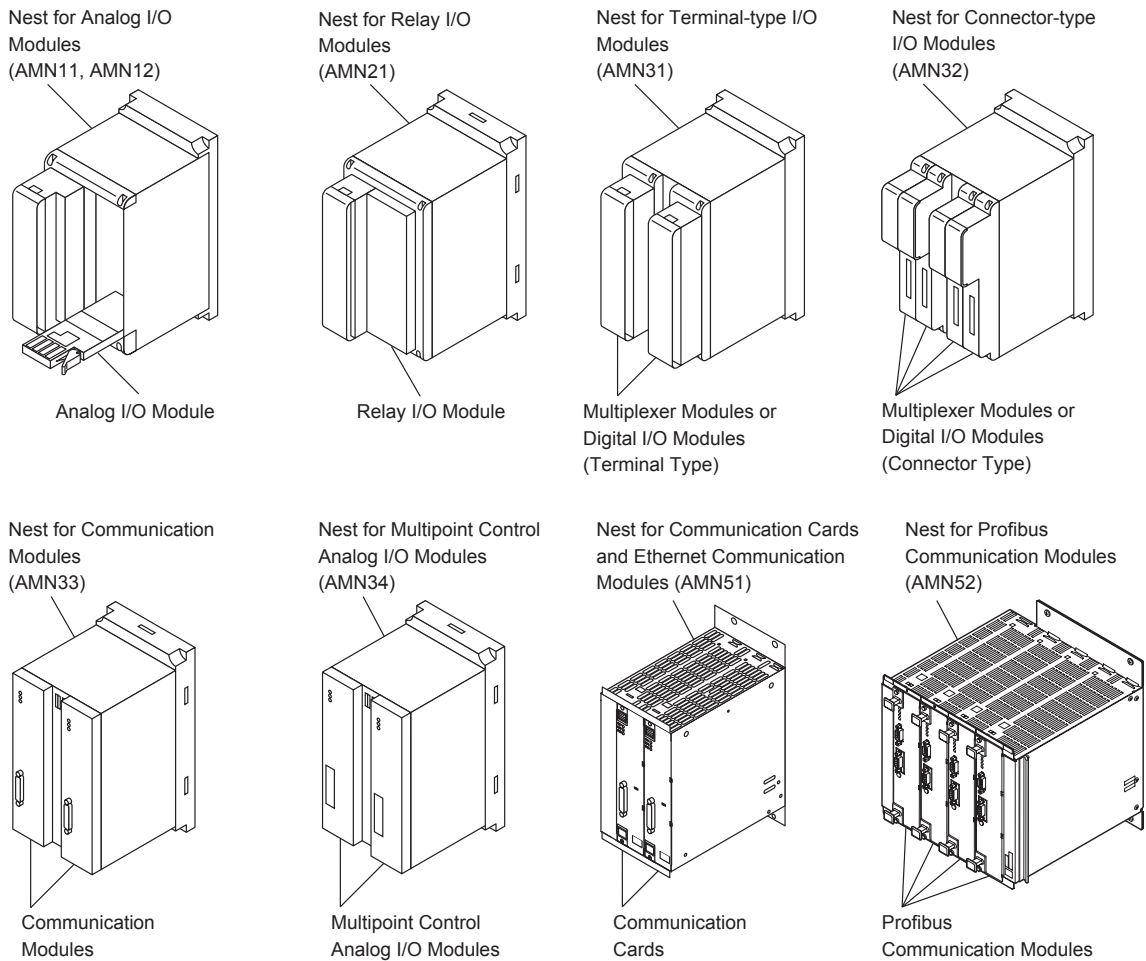
2.5.2　Remote I/O (RIO)

The RIO modules are used in the FCS for RIO and Compact FCS. They are field-proven by the many installation bases, and designed basically by the isolated channels and M4 screw connections. The RIO modules are installed in the I/O module nests.

I/O Module Nests

I/O Modules Nests are available in the following types:

- AMN11:　Nest for Analog I/O Modules
- AMN12:　High-Speed Nest for Analog I/O Modules (for LFCS only)
- AMN21:　Nest for Relay I/O Modules
- AMN31:　Nest for Terminal-type I/O Modules
- AMN32:　Nest for Connector-type I/O Modules
- AMN33:　Nest for Communication Modules
- AMN34:　Nest for Multipoint Control Analog I/O Modules
- AMN51:　Nest for Communication Cards and Ethernet Communication Modules (for Compact FCS only)
- AMN52:　Nest for Profibus Communication Module (in Compact FCS only)

Nest for Analog I/O Modules (AMN11, AMN12)

Analog I/O Module

Nest for Relay I/O Modules (AMN21)

Relay I/O Module

Nest for Terminal-type I/O Modules (AMN31)

Multiplexer Modules or Digital I/O Modules (Terminal Type)

Nest for Connector-type I/O Modules (AMN32)

Multiplexer Modules or Digital I/O Modules (Connector Type)

Nest for Communication Modules (AMN33)

Communication Modules

Nest for Multipoint Control Analog I/O Modules (AMN34)

Multipoint Control Analog I/O Modules

Nest for Communication Cards and Ethernet Communication Modules (AMN51)

Communication Cards

Nest for Profibus Communication Modules (AMN52)

Profibus Communication Modules

F020503.ai

Figure　I/O Module Nest Configuration