General Specifications

Integrated Production Control
System CENTUM VP
System Overview (V net Edition)

CENTUM VP

GS 33K01A20-50E

[Release 5]

■ GENERAL

This document describes about CENTUM VP Production Control System (for V net) which controls and monitors industrial plants such as oil and gas, petrochemicals, chemicals, electric power, pharmaceuticals, food and beverages, iron and steel, pulp and paper, and water supply and sewage treatment. The CENTUM VP system specifications, system components, and network specifications are found.

■ COMPONENTS AND SOFTWARE

CENTUM VP system consists of various components for operation and monitoring for process control and other equipments. CENTUM VP is composed of and communicates with each of those equipments via V net, a real-time process control network, and Ethernet.

● Human Interface Station (HIS)

CENTUM VP uses computer for its human machine interface. It is called HIS when the software packages for operation and monitoring functions are applied on the computer. The desk top type and a console type with assembled displays are selectable. It is also possible to apply both operation and monitoring functions and engineering functions on the HIS. For more details, refer to the following General Specifications (GS).

- Enclosed Display Style Console Assembly
  (GS 33K50B40-50E)
- Open Display Style Console Assembly
  (GS 33K50B50-50E)
- Standard Operation and Monitoring Function
  (GS 33K05D10-50E)
- Control Bus Interface Card (for V net)
  (GS 33K55C10-50E)

Operation and Monitoring Software

LHS1100	Standard Operation and Monitoring Function
LHS1120	Console HIS Support Package for Enclosed Display Style
LHS1130	Console HIS Support Package for Open Display Style
LHS1140	Eight-loop Simultaneous Operation Package (for AIP831)
LHS1150	Server for Remote Operation and Monitoring Function
LHS2411	Exaopc OPC Interface Package (for HIS)
LHS2412	CENTUM Data Access Library
LHS4000	Million Tag Handling Package
LHS4100	Configured Information Reference Package
LHS4150	Output to External Recorder Package
LHS4190	Line Printer Support Package
LHS4200	Historical Message Integration Package (meeting FDA Regulations)
LHS4410	Control Drawing Status Display Package
LHS4420	Logic Chart Status Display Package
LHS4450	Multiple Project Connection Package
LHS4600	Multiple-Monitor Support Package
LHS4700	Advanced Alarm Filter Package
LHS6510	Long-term Data Archive Package
LHS6530	Report Package
LHS6660	Process Management Package (VP Batch)
LHS6710	FCS Data Setting/Acquisition Package (PICOT)

● Engineering Station (ENG)

CENTUM VP ENG is a computer used for system configuration and maintenance. It is also possible to use a single computer for both HIS and ENG functions. The engineering functions can be realized by applying the engineering-related software as listed below.

Engineering-related Software
Here is a list of engineering-related software for CENTUM VP.
For more details, refer to the following GS.

LHS5100	Standard Builder Function
LHS5110	Access Control Package
LHS5150	Graphic Builder
LHS5165	Batch Builder (VP Batch)
LHS5166	Recipe Management Package (VP Batch)
LHS5170	Access Administrator Package (FDA:21 CFR Part 11 compliant) (*1)
LHS5420	Test Function
LHS5425	Expanded Test Functions
LHS5426	FCS Simulator Package
LHS5427	HIS Simulator Package
LHS5450	Multiple Project Connection Package
LHS5490	Self-documentation Package

*1: This package includes LHS5110 Access Control Package functions.

Both HIS and ENG work on the following Microsoft® Windows OS.

Windows Vista Business Edition
Windows 7 Professional Edition
Windows Server 2008 Standard Edition
Windows Server 2008 R2 Standard Edition

For the combination of CENTUM VP revisions and each of the OS Service Pack, please refer to GS for Standard Operation and Monitoring Function (GS 33K05D10-50E) and Standard Builder Function (GS 33K10D10-50E). As for other the third-party software that works on the Windows OS, contact Yokogawa for limitations in use with CENTUM VP.

Documents

CENTUM VP instruction manuals are provided electronically in the DVD as same as other system software.

LHS5495   Electronic Instruction Manual

For more details, refer to GS for LHS5495 Electronic Instruction Manual (GS 33K01W10-50E).

● **Remote Operation and Monitoring Function (HIS-TSE)**

HIS-TSE enables to operate and monitor a plant, with some limitations, from a remote computer without installing CENTUM VP operation and monitoring functions. By utilizing the Windows server's terminal service (TS) it is possible to operate and monitor CENTUM VP operations simultaneously from several computers via network. Once the network is established, it is possible to display the same HIS views on a remote computer away from the control room.

LHS1150   Server for Remote Operation and Monitoring Function

For more details, refer to GS for LHS1150 Server for Remote Operation and Monitoring Function (GS 33K05D20-50E).

● **Field Control Station (FCS)**

FCS performs control computation functions for each function block and input/output functions for process and software inputs/outputs.

Standard, enhanced, and compact types of FCS are available depending on the functional capacity. Migration type is also available for migrating CENTUM V and CENTUM-XL FCS into CENTUM VP.

There are two categories in standard and enhanced types of FCS. One is to connect Fieldnetwork input/output (I/O) modules (FIO) via ESB or ER buses. The other is to connect Remote I/O (RIO) modules via RIO bus.

Compact type of FCS has two categories. One is to take FIO and the other is to take RIO modules. Migration type is designed based on the standard and enhanced types of FCS, and those include SI bus to connect CENTUM V and CENTUM-XL I/O modules.

Field control units (FCU) listed below are the core of FCS control functions.

Standard Type FCS (Main Memory 16 MB)
AFS30S: Field Control Unit (for V net and FIO, 19-inch Rack Mountable Type)
AFS30D: Duplexed Field Control Unit (for V net and FIO, 19-inch Rack Mountable Type)
AFS40S: Field Control Unit (for V net and FIO, with Cabinet)
AFS40D: Duplexed Field Control Unit (for V net and FIO, with Cabinet)
AFS10S: Field Control Unit (for V net and RIO, 19-inch Rack Mountable Type)
AFS10D: Duplexed Field Control Unit (for V net and RIO, 19-inch Rack Mountable Type)
AFS20S: Field Control Unit (for V net and RIO, with Cabinet)
AFS20D: Duplexed Field Control Unit (for V net and RIO, with Cabinet)

For more details, refer to GS for each of the hardware.

Enhanced Type FCS (Main Memory 32 MB)
AFG30S: Field Control Unit (for V net and FIO, 19-inch Rack Mountable Type)
AFG30D: Duplexed Field Control Unit (for V net and FIO, 19-inch Rack Mountable Type)
AFG40S: Field Control Unit (for V net and FIO, with Cabinet)
AFG40D: Duplexed Field Control Unit (for V net and FIO, with Cabinet)
AFG10S: Field Control Unit (for V net and RIO, 19-inch Rack Mountable Type)
AFG10D: Duplexed Field Control Unit (for V net and RIO, 19-inch Rack Mountable Type)
AFG20S: Field Control Unit (for V net and RIO, with Cabinet)
AFG20D: Duplexed Field Control Unit (for V net and RIO, with Cabinet)

For more details, refer to GS for each of the hardware.

Compact Type FCS (AFF50□: Main Memory 32 MB, PFC□: Main Memory 8 MB/16 MB)
AFF50S: Field Control Unit (for V net and FIO, 19-inch Rack Mountable Type)
AFF50D: Duplexed Field Control Unit (for V net and FIO, 19-inch Rack Mountable Type)
PFCS: Field Control Station (V net and RIO)
PFCD: Duplexed Field Control Station (V net and RIO)

For more details, refer to GS for each of the hardware.

Migration Type FCS (Main Memory 32 MB)
AFG81S: Field Control Station Migration Kit (for SIO/FIO, for CENTUM V)
AFG81D: Duplexed Field Control Station Migration Kit (for SIO/FIO, for CENTUM V)
AFG82S: Field Control Station Migration Kit (for SIO/FIO, for CENTUM-XL)
AFG82D: Duplexed Field Control Station Migration Kit (for SIO/FIO, for CENTUM-XL)
AFG83S: Field Control Station Migration Kit (for FIO, for CENTUM V)
AFG83D: Duplexed Field Control Station Migration Kit (for FIO, for CENTUM V)
AFG84S: Field Control Station Migration Kit (for FIO, for CENTUM-XL)
AFG84D: Duplexed Field Control Station Migration Kit (for FIO, for CENTUM-XL)

FCS Related Hardware
- For more details, refer to GS of FIO System Overview (for V net) (GS 33K55F10-50E).
- As for more details about FCS related equipments for RIO, refer to the following GS.
    I/O Module Nest, I/O Module (for RIO)
            (GS 33K55R30-50E)
    ANS20, AND20 Node Interface Unit (for RIO, Cabinet Installation Type)
            (GS 33K55R10-50E)
    ANS50, AND50 Node Interface Unit (for RIO, 19-inch Rack Mountable Type)
            (GS 33K55R20-50E)
    Cables (GS 33K50J10-50E)

Basic Software
LFS1300   Control Function for Standard Field Control Station (for V net and FIO)
LFS1330   Control Function for Enhanced Field Control Station (for V net and FIO)
LFS1350   Control Function for Compact type Field Control Station (for V net and FIO)
LFS1120   Control Function for Compact Field Control Station (for PFC□-H and V net)
LFS1100   Control Function for Standard Field Control Station (for V net and RIO)
LFS1130   Control Function for Enhanced Field Control Station (for V net and RIO)
LFS1000   Standard Control Function (for PFC□-S and V net)
LFS1020   Enhanced Control Function (for PFC□-E and V net)
For more details, refer to GS for each of the software.

Subsystem Communication Function
FCS communicates with subsystems and field devices to exchange data via network. The following subsystem communication functions are available for CENTM VP. For more details, refer to the GS for each of the communication hardware.
- Serial Communication
            ALR111, ALR121 Serial Communication Module (for FIO)
            (GS 33K50G10-50E)
- Ethernet Communication
            ALE111 Ethernet Communication Module (for FIO) (GS 33K50G11-50E)
- Foundation fieldbus Communication
            ALF111 Foundation fieldbus Communication Module (for FIO)
            (GS 33K50G20-50E)
- PROFIBUS-DP Communication
            ALP111 PROFIBUS-DP Communication Module
            (GS 33K50G80-50E)

Optional Software
Optional software packages are available that perform special functional blocks on FCS, other than the basic software.

LFS3132   Valve Pattern Monitor Package
LFS8620   Off-site Block Package
For more details, refer to GS for each software package.

● **Generic Subsystem Gateway (GSGW)**

GSGW is a station for operation and monitoring subsystems. By using a computer as a platform, GSGW package establishes communications with subsystems via OPC interface defined by the OPC Foundation. Subsystem data is assigned to the GSGW's function blocks which can be controlled and monitored via HIS as same as other control stations.

LFS1250   GSGW Generic Subsystem Gateway Package
For more details, refer to GS for GSGW Generic Subsystem Gateway Package (GS 33K20F10-50E).

● **System Integration OPC Station (SIOS)**

SIOS is a station to integrate CENTUM VP and the third-party process control systems (PCSs). SIOS enables CENTUM VP exchanges data with and receives alarms and events from the third-party PCSs via OPC interface.

LBC2100   System Integration OPC Client Package
For more details, refer to GS for System Integration OPC client Package (GS 33K20D10-50E).

● **Advanced Process Control Station (APCS)**

APCS performs advanced control and computation for improving plant operation efficiencies.

LFS1200   APCS Control Functions
For more details, refer to GS for APCS Control Functions, APCS Package Set (GS 33K15U10-50E).

● **Bus Converter (BCV)**

BCV relays CENTUM VP communications with CENTUM CS 3000, CENTUM CS 1000, CENTUM CS, CENTUM-XL, CENTUM V, and μXL.

Hardware
ABC11S   Bus Converter
ABC11D   Dual-Redundant Bus Converter
Basic Software
LBC1210   Standard Bus Converter Function (for HF bus-V net)
LBC1220   Standard Bus Converter Function (for RL bus-V net)
LBC1230   Standard Bus Converter Function (for V net-V net)
LBC1260   Standard Bus Converter Function (for VL net-V net)
For more details, refer to GS for Bus Converter, Dual-redundant Bus Converter (GS 33K55D20-50E).

● **Communication Gateway Unit (CGW)**

CGW connects V net system and a supervisory computer via Ethernet.

Hardware
  ACG10S   Communication Gateway Unit
Basic Software
  LGW1240 Text Mode Gateway Unit Function
               (for Model ACG10S-E□□□3)
  LGW1250 Frame Mode Gateway Unit Function
               (Wide Area Communication) (for Model
               ACG10S-F□□□3)
For more details, refer to GS for Communication Gateway Unit (GS 33K55D10-50E).

● **Peripheral Devices**

Printers and other peripherals devices which each OS support are available to use with CENTUM VP. For details of other peripherals, contact Yokogawa for information.

■ RELEVANT SYSTEMS

● **Plant Resource Manager (PRM®)**

PRM is a software package for online asset management of field devices and equipments. By monitoring and managing the device status and the maintenance information, it enables to reduce plant's Total Cost of Ownership (TCO).

PRM communicates with devices with digital communication functions such as FOUNDATION fieldbus, HART, and field wireless (complies with ISA 100.11a) devices, as well as conventional analog devices with no digital communication function.

For more details of the PRM specifications, refer to GS for Plant Resource Manager (GS 33Y05Q10-32E).

● **ProSafe-RS Safety Instrumented System**

ProSafe-RS has certified by Technische Überwachungs Verein (TÜV) as a safety system to satisfy safety integrity level (SIL) 3 of IEC 61508.

A safety control station (SCS) of ProSafe-RS monitors plant safety always, and it performs safety functions when needed. Safety engineering PC (SENG) performs engineering and maintenance of SCS. ProSafe-RS can be integrated with CENTUM VP, which enables SCS operation and monitoring from HIS.

For more details, refer to GS for ProSafe-RS Safety Instrumented System (GS 32Q01B10-31E).

■ SECURITY MEASURES

● **Endpoint Security Service**

The Endpoint Security Service helps reduce risks for computer from malware infection and provides various supports in maintaining control system's security throughout its lifecycle.

The Endpoint Security Service provides services such as AV/OS Implementation Service, AV/OS Update Service, Virus Check Service, and Software Backup Service.

For more details, refer to GS for Endpoint Security Service (GS 43D02T30-02EN).

■ SYSTEM SPECIFICATIONS

● **HIS Operation/Monitoring Tags:**

Maximum 100000 per system
(when LHS4000 is in use, up to 1000000 per system).

● **Minimum System Configuration**

A minimum system of CENTUM VP consists of the following equipments:

  HIS x 1 unit
  ENG x 1 unit
  FCS x 1 unit
HIS and ENG can be consolidated in one computer.

● **Maximum System Configuration**

In CENTUM VP, a system separated by BCVs is called a domain. The system configuration for one domain is as shown in the table below.

Applicable stations	No. of units
HIS, ENG, FCS, BCV, CGW, GSGW, SIOS, APCS, SENG, and SCS	Total of 64 stations or less (for the stations described on the left column). As for HIS, however, only up to 16 units or less.)

● **System Expansion**

When the system is configured hierarchically using bus converters, it is possible to expand the system scale exceeding the maximum system configuration per domain. It means that CENTUM VP system can be extendedly connected with other control systems in hierarchical layers beyond its maximum system scale.

  No. of domains: up to 16 domains per layer
  No. of stations: up to 256 stations
               The maximum number of FCS to be configured in the entire system differs by the FCS types. For instance, when the system contains only the AFS30□/AFS40□ with general-purpose type of database, up to 157 FCS can be configured. As for AFS30□/AFS40□ with sequence control (mainly by SFC blocks) type of database only, it is 90 FCS. If the system contains only AFF50□ type, it is up to 64 FCS. In reality, multiple types of FCS can be configured in one system. Please contact Yokogawa for details.
  No. of layers: 3 layers
               (bus converters x 2 units, and Control networks x 3 units)
  No. of operation/monitoring tags: Max. 100000
               (when LHS4000 is in use, up to 1000000 per system)
  Connecting device: Bus converter

● **Accuracy of Real-time Clock**

  System clock accuracy: ± 0.01%
  Time differences among stations:
               Max. 1010 ms (from HIS to HIS) within the same Domain
Accuracy of timer block (TM): 0.01% (the accuracy of the timer block depends on the system clock accuracy. The temporal resolution is equivalent to one control scan.)

Figure An Example of System Configuration

■ MULTIPLE PROJECT CONNECTION

CENTUM VP manages FCS and HIS engineering data, generated by the system builder functions, by the unit of project. The multiple project connection is a function to integrate operation and monitoring of the multiple projects. CENTUM VP HIS integratively monitors CENTUM VP, CENTUM CS 3000, CENTUM CS 1000, and CENTUM CS projects without changing the identical names (e.g. tag name, project name, and plant hierarchy name) and common resources (e.g. engineering unit, and operation mark).

There are two ways of multiple project connection.

● **Hierarchical Connection**

CENTUM VP project on the upper-layer is able to operate and monitor lower-level projects. In this case, CENTUM VP on the upper-level project requires installing a multiple project connection package. From the lower-level projects, operation and monitoring of the CENTUM VP on the upper-level is not available. Following types of multiple connections are available.

CENTUM VP→CENTUM VP　CENTUM VP→CENTUM CS 3000　CENTUM VP→CENTUM CS 1000　CENTUM VP→CENTUM CS

CENTUM VP upper-level project	CENTUM VP upper-level project	CENTUM VP upper-level project	CENTUM VP upper-level project
↓	↓	↓	↓
CENTUM VP lower-level project	CENTUM CS 3000 lower-level project	CENTUM CS 1000 lower-level project	CENTUM CS lower-level project
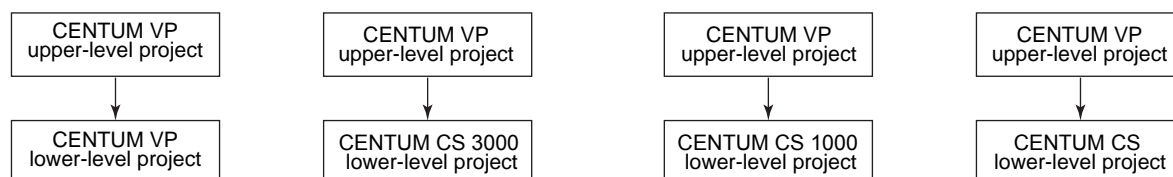
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● **Bi-directional Connection**

Operation and monitoring of the connected projects are enabled bi-directionally. The bi-directional connection is applicable only for CENTUM VP projects and/or CENTUM VP and CENTUM CS 3000 projects. Multiple project connection packages are required for both upper- and lower-levels of the systems.

CENTUM VP→CENTUM VP　　CENTUM VP→CENTUM CS 3000

CENTUM VP upper/lower level project	CENTUM VP upper/lower level project
↓↑	↓↑
CENTUM VP lower/upper level project	CENTUM CS 3000 lower/upper level project
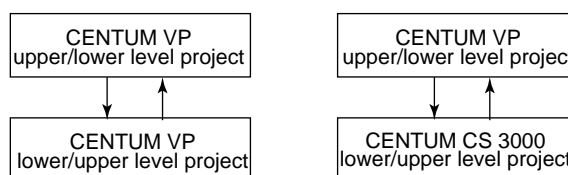
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For more details, refer to GS for LHS5450, LHS4450 Multiple Project Connection Package (GS 33K05K20-50E).

■ NETWORK SPECIFICATIONS

CENTUM VP uses V net and Ethernet for communications among configured devices.

● V net

V net is a real-time process control network establishing communications among system components.

● Communication Specification

Control Communication
No. of stations: 64 stations/domain
Communication method: Read/write communication, message communication, link transmission
Link transmission period: 100 ms
Line access control: Token-passing

Transmission specifications
Network topology: Bus topology
Transmission speed: 10 Mbps
Transmission redundancy: Single or dual-redundant
  Conditions for single transmission;
    It is for CENTUM VP Entry Class.
    There is only one V net domain exists.
    The domain is composed of components only for single communication.

Table Components for Single Communication

Station	Station Type	Remarks
FCS	PFCS-S Field Control Station (Standard type)	PFCS with 8 MB main memory
	PFCS-E Field Control Station (Enhanced type)	PFCS with 16 MB main memory
	GSGW Generic Subsystem Gateway	
	AFF50S Field Control Unit (for V net and FIO, 19-inch Rack Mountable Type)	
HIS	HIS computer with operation and monitoring functions	
	LPCKIT Enclosed Display Style Console Assembly	
	YPCKIT Open Display Style Console Assembly	
BCV	ABC11S-Q Bus Converter (For single V net)	
	ABC11S-A Bus Converter (For single VL net)	
	ABC11S-L Bus Converter (For single RL bus)	
CGW	ACG10S-E Communication Gateway Unit (Text mode)	
	ACG10S-F Communication Gateway Unit (Frame mode)	

Transmission Cable:
For coaxial cables (YCB111 and YCB141):
          YCB141 is used with HIS and a compact type FCS (for FIO).
          YCB111 is used for other components. When connecting YCB141 and YCB111 with cables, use a Bus
          Adapter Unit (YCB147 or YCB149) or Bus Repeater (YNT512□).
          For YCB111 cable, a ground unit (YCB117) is required per segment (*1).
For optical fiber cable:
          Use YNT511D/YNT522D Optical Bus Repeater

   *1:   In case V net is connected with optical bus repeater, the definition of a segment is an area segmented by repeaters.

Transmission Distance:
For coaxial cables (YCB111 and YCB141):
   Transmission distance: Max. 500 m (for YCB111),
                 Max. 185 m (for YCB141)
          When only YCB141 cable is used, the number of stations to be connected is max. 30 stations/segment.
When YCB111 and YCB141 are used in combination:
          Length of YCB141 + 0.4 x Length of YCB111 ≤ 185 m0

   *1:   In case V net is connected with optical bus repeater, the definition of a segment is an area segmented by repeaters.

For Bus Repeater and Optical Bus Repeater:

With bus repeater (YNT512S or YNT512D), the transmission distance is extended up to 500 m.

With a pair of optical bus repeaters (YNT511S or YNT511D) it is up to 4 km.

With a pair of optical bus repeaters (YNT522S, YNT522D) it is up to 15 km.

Bus repeaters and optical repeaters can be mounted on to the two stations are maximum 8 units.

And the optical repeaters are used by a pair (2 units/pair).

The number of bus repeaters limits the transmission distance:

$L = 24 - n$

L: Transmission distance (km)

n: Number of bus repeaters and optical bus repeaters

The total transmission distance is the smaller of the sum of the maximum extension distance for each device and the length of the coaxial cable length, and the value of L calculated by the above calculation.
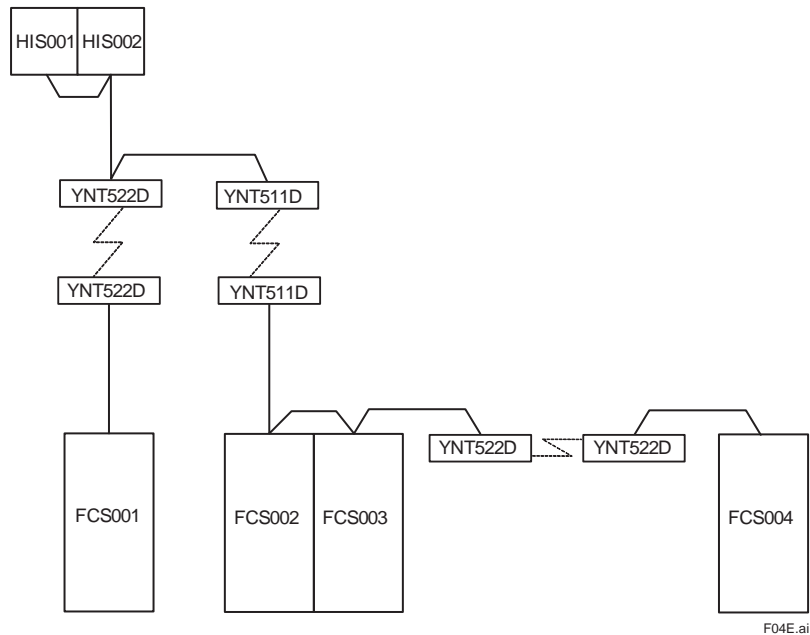

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Figure Example of Optical Bus Repeater Connection

Case 1: From HIS001 to FCS001

When a pair of optical bus repeater for 15 km is mounted, the transmission distance by the number of bus repeater and optical bus repeater is 24 - 2 = 22 km, while the sum of the maximum extension distance for each device and coaxial cable length = 0.5 + 15 + 0.5 = 16 km. Therefore, the total transmission distance is 16 km.

Case 2: From HIS001 to FCS004

When 4 optical bus repeaters (one pair of 4 km and one pair of 15 km) are mounted, the transmission distance by the number of bus repeaters and optical bus repeaters is 24 - 4 = 20 km, while the distance for each device and coaxial cable length = 0.5 + 4 + 0.5 + 15 + 0.5 = 20.5 km. Therefore, the total transmission distance is 20 km.

Case 3: From FCS001 to FCS004

When 6 optical bus repeaters (one pair of 4 km and two pairs of 15 km) are mounted, the transmission distance by the number of bus repeater and optical bus repeater is 24 - 6 = 18 km, while the sum of the maximum extension distance for each device and coaxial cable length = 0.5 + 15 + 0.5 + 4 + 0.5 + 15 + 0.5 = 36 km. Therefore, the total transmission distance is 18 km.

Limitations to Optical Bus Repeater

Optical bus repeaters can be installed up to 4 pairs (8 units) among stations. The following figure shows an example of the optical bus repeaters.
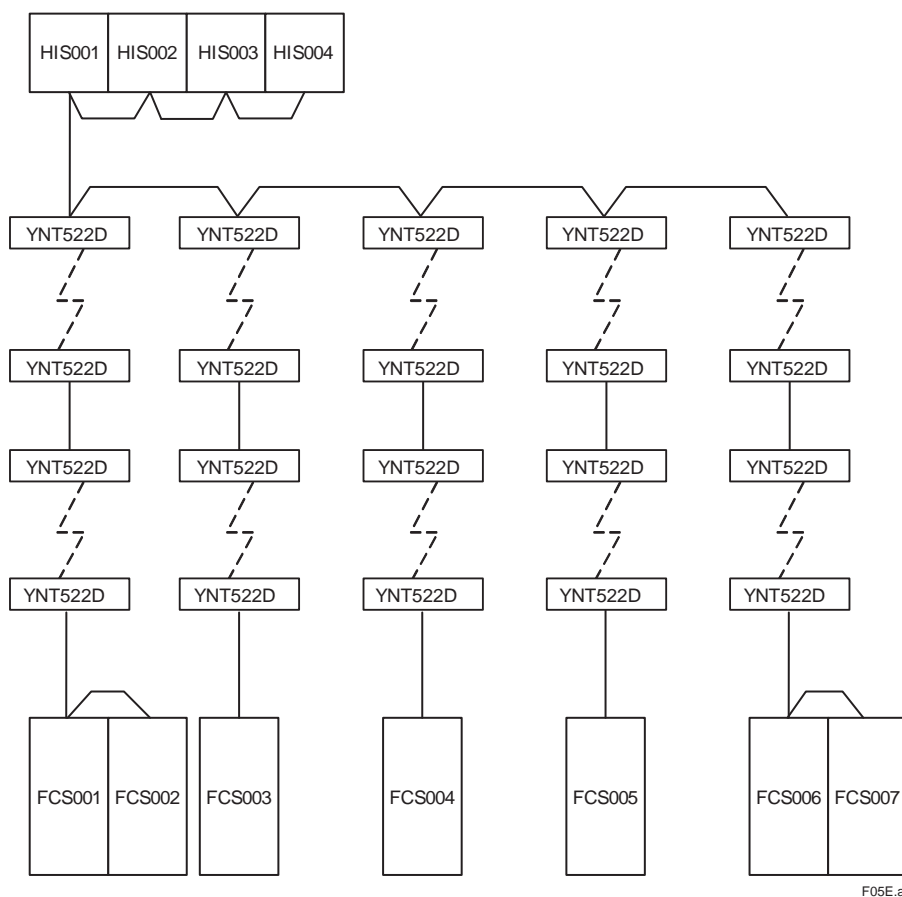
Figure Optical Bus Repeater Connecting by Star Topology

● Ethernet

Ethernet is a network used for file transfer and information communication among HIS, ENG, and other general-purpose Ethernet instruments.

Communication Protocol
Based on IEEE802.3

Conditions for Ethernet Communication using V net
When both of the following conditions are met, it is enabled to perform Ethernet communication by using V net Network.

  The target system is CENTUM VP Entry Class.
  There is only one V net domain.
When one or more components are added to the system and any of the below conditions are met, it is necessary to perform Ethernet communication independent from the V net network.

  There are two or more domains in the system and communication for equalization among domains is required.
  When the V net loading is high.
  Number of graphics exceeds 1000, or trend blocks exceed 8.
  Consolidated alarm management system (CAMS for HIS) used.
  Nine units or more of HIS are connected per project.
  It exceeds more than 8000 tags per project.
  Added a component that requires Ethernet communication.

Table Components Requiring Ethernet

Station Type	
APCS	Advanced Process Control Station
GSGW	Generic Subsystem Gateway
SIOS	System Integration OPC Station
HIS-TSE	Server for Remote Operation and Monitoring Function
CGW	Communication Gateway Unit
SENG	Safety Engineering Station

■ I/O COMMUNICATIONS BUS

In CENTUM VP V net system, ESB bus, ER bus, or RIO bus are used for FCS node communications.

● ESB Bus

An ESB bus is used as an input/output communication bus connecting an FCS's intelligent part with an ESB bus node unit.

Communication Specifications
Applicable units: ESB Bus Node Unit (ANB10□)

No. of Communication Units
Numbers of ESB bus node units that can be connected to ESB bus varies depending on the control functions.

Field Control Unit	Control Function	No. of ESB Bus Node Units	No. of ESB Bus Node Units and ER Bus Node Units
AFF50□	Control Function for Compact Field Control Station (LFS1350) (*1)	Max. 3/FCU	Max. 3/FCU
AFG30□ AFG40□	Control Function for Enhanced Field Control Station (LFS1330) plus node expansion package	Max. 10/FCU	Max. 15/FCU
Other than above		Max. 10/FCU (*2)	Max. 10/FCU (*2)

*1: For connecting ESB bus node unit to the FCUs (AFF50S and AFF50D), insert ESB Bus Coupler Modules (EC401) in slots No. 7 and 8.
*2: As for AFG81□ and AFG82□, the sum of SIO (CENTUM V and CENTUM-XL I/O) and number of nests are shown here. The maximum 5 units/FCS of SIO nests can be installed.

Transmission Specifications
Network topology: Bus topology
Transmission: Dual-redundant or single. When the processor module has a dual-redundant configuration, the dual-redundant transmission is mandatory.
Transmission speed: 128 Mbps
Transmission cable: Dedicated cable (YCB301)
Transmission distance: Max. 10 m (*2)

● ER Bus

An ER bus is used as a remote input/output communication bus connecting ER Bus Node Unit with ESB Bus Node Unit or a compact type FCU (for FIO).

Communication Specifications
Applicable devices: ER Bus Node Unit (ANR10□)
No. of ER bus: Max. 4/FCU

Transmission Specifications
Network topology: Bus topology
Redundancy in transmission: Dual-redundant configuration is available.
Transmission speed: 128 Mbps
Transmission cable: Dedicated cable (YCB301)
Transmission distance: Max. 10 m

No. of Communication Units
Numbers of ESB bus node units and optical ESB bus node units that can be connected to ESB bus varies depending on the control functions.

Field Control Unit (FCU) Types	Control Function	No. of ER Bus Node Units	No. of ESB Bus Node Units and ER Bus Node Units
AFF50□	Control Function for Compact Field Control Station (LFS1350)	Max. 3/FCU	Max. 3/FCU
AFG30□ AFG40□	Control Function for Enhanced Field Control Station (LFS1330) plus node expansion package	Max. 14/FCU (*1)	Max. 15/FCU
Other than above		Max. 9/FCU (*1) (*2)	Max. 10/FCU (*2)

*1: Up to 8 units of ER Bus Node Unit (ANR10□) can be connected per one ER bus system.
*2: As for AFG81□ and AFG82□, the sum of SIO (CENTUM V and CENTUM-XL I/O) and number of nests are shown here. The maximum 5 units/FCS of SIO nests can be installed.

Transmission Specifications
Network topology: Bus topology
Transmission: Dual-redundant or single. When the processor module has a dual-redundant configuration,
                         the dual-redundant transmission is mandatory.
Transmission speed: 10 Mbps
Transmission cable: Coaxial cable (YCB141 or YCB311) is used. When connecting YCB141 with YCB311, use
                         Bus Adapter Unit (YCB147/YCB149). When YCB311 is in use, apply a Grounding Unit
                         (YCB117) per segment (*1) should be used.
Transmission distance:
            For YCB141: Max. 185 m
            When YCB141 and YCB311 are combined: Length of YCB141 + (185/500) x Length of YCB311 ≤ 185 m
            No. of bus adapter units: Max. 4 per segment (*1)

            For General-purpose Ethernet repeater:
            The total transmission distance is limited by the number of repeaters.
            $L \le 4 - 0.5 \times n$
            L: Total transmission distance (Km)
            N: No. of general-purpose Ethernet repeater (Max. 4 repeaters)

    *1:   When ER bus is used with repeaters, it is called segment when each section of the ER bus is segmented by a repeater.
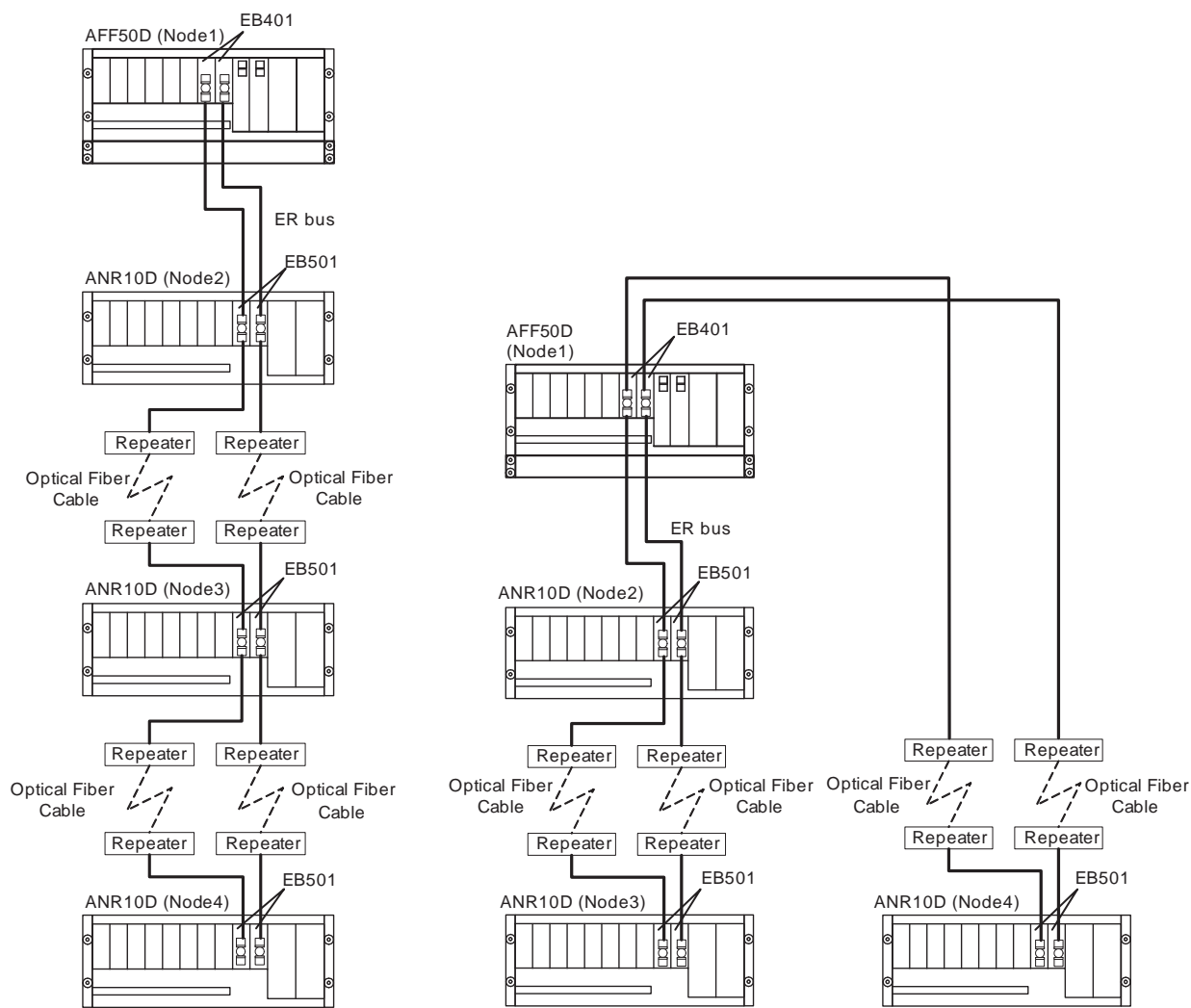

Figure Example of ER Bus connection

● **RIO Bus (Standard Type FCS/Enhanced Type FCS for RIO)**

An RIO is used as an input/output communication bus connecting an FCS's intelligent part with a remote I/O node unit.

Communication Specifications
No. of communication nodes: 8 nodes

Transmission Specifications
Network topology: Bus topology
Transmission: Dual-redundant or single. When the processor module has a dual-redundant configuration, the dual-redundant transmission is mandatory.
Transmission speed: 2 Mbps
Transmission cable: Twisted-pair cable, or optical fiber cable (with YNT511□ optical bus repeater)
Transmission distance:
  For a twisted-pair cable: Max 750 m
  For using bus repeater or optical bus repeater:
    Max. 750 m with a Bus Repeater (YNT512S or YNT512D).
    Max. 4 km with an Optical Bus Repeater (YNT511S or YNT511D)
    Max. 8 units of bus and Optical Bus Repeaters can be applied in between two stations, and the optical bus repeaters are used by the pair (2 units/pair).
         The transmission distance is limited by the number of repeaters.
         $L = 30 - 2.5 \times n$
           L: Transmission distance (km)
           n: No. of bus repeaters and optical bus repeaters
The total transmission distance is the smaller of the sum of the maximum extension distance of each device and the coaxial cable length, and the value (L) calculated by the above equation.

■ REMARKS FOR SYSTEM CONFIGURATIONS

● Use of server due to the number of computer in a system

When a CENTUM VP system consists of five or more computers, for use as HIS and others, consider if a server (OS: Windows Server) is required or not for storing CENTUM VP project data. A server is required when a CENTUM VP system with nine or more computers and LHS5425 Expanded Test Functions are applied. In case LHS5170 Access Administrator Package (for FDA:21 CFR Part11 Compliant) is applied where there are nine or more computers connected, provide a server for historical data storage.

Project Data Storage

When a CENTUM VP system consists of more than five clients use below calculations to judge if it requires a data storage server or not. In case the calculated value is greater than the value on the right side (i.e. 9) save the project data in a server.

Judging Criteria
• SSS5700 Engineering Tool for Fieldbus is not in use

Equation 1	No. of Exaopc + No. of HIS + {(No. of ENG – 1) x 2} ≥ 9

• SSS5700 Engineering Tool for Fieldbus is in use

Equation 2	No. of Exaopc + No. of HIS + {(No. of ENG – 1) x 2} + 2 ≥ 9

• LHS4450 Multiple Project Connection Function is in use.
  Calculate and judge by the criteria shown in the below table. When the number of stations is greater than the value on the right side of the equation, project data has to be stored on a server. Prepare two servers when the calculation results require one each for both upper and lower levels of the project. However, a server is not required when CENTUM CS is used for the lower-level project, and calculation is applied only for the upper-level project.

Table Judging Criteria

		SSS5700 Engineering Tool for Fieldbus	
		Not in use	In use
Multiple Project Connection Function is in use	Upper-level project	Equation 1	Equation 2
	Lower-level project	Equation 3	Equation 4

Judging Criteria

Equation 3	No. of Exaopc + No. of HIS + {(No. of ENG – 1) x 2} + α ≥ 9
Equation 4	No. of Exaopc + No. of HIS + {(No. of ENG – 1) x 2} + 2 + α ≥ 9

α: No. of HIS with LHS4450 Multiple Project Connection Packages on the upper-level project
No. of Exaopc: No. of computer with NTPF100 Exaopc OPC interface package.
 (LHS2411 Exaopc OPC interface package is excluded.)
No. of HIS: No. of computer with LHS1100 Standard Operation and Monitoring Function
 (Count all the number of this package used in the project.)
No. of ENG: No. of computer with LHS5100 Standard Builder Function.
 (Count all the number of this package used in the project. When it is resided with the standard operation and monitoring function, count them independently.)

Audit Trail Management Data Storage

When the sum of computers is nine or more (for ENG, and Recipe Management computer) for stations connected to CENTUM VP while LHS5170 Access Administrator Package (FDA: 21 CFR Part11 compliant) is resided, save the audit trail management data in a server. Calculate the sum of computers to be connected by using the following Equation 5. When the calculation result is eight or less, there is no need for server.

Equation 5	No. of stations connected = No. of recipe management package + No. of ENG

No. of Recipe Management Package: No. of computer with LHS5166 Recipe Management Package (VP Batch).
ENG: No. of computer with LHS5100/LHM5100 Standard Builder Function.

■ COMPLIANCE TO FDA: 21 CFR PART 11

Part 11 of Title 21 of the Code of Federal Regulations (21 CFR Part 11) is a regulation issued by the U. S. Food and Drug Administration (FDA) providing a criteria of electronic records, electronic signatures, and handwritten signatures executed to electronic records as equivalent to paper records and handwritten signatures executed on paper. The main categories of the FDA: 21 CFR Part 11 requirements to the process control system can be interpreted as "limiting system access to authorized individuals" and "audit trail" functions.

● Limiting System Access (Individual Authentication)

CENTUM VP has two approaches for limiting access to the system; one is "engineer/operator authentication" and the other is "confirmation of authentication." Engineer/operator authentication is to identify engineers and operators in operation as well as to maintain operation records. Names of the engineers and operators are registered to the system in advance, and if their names and the passwords are not identified, the control system does not allow them to perform further operations. Confirmation of authentication is to confirm if an engineer or an operator has appropriate authorities to perform certain operations. The engineer/operator authentication and the confirmation of authentication will be performed independently as necessary.

● Audit Trail Management

CENTUM VP audit trail function saves change data to the predefined database whenever an engineering work that may influence the product quality such as data downloads to FCS. All the actions performed are also stored in the historical log file. With this function, who, when, what, how, and why data is changed can be traced back.

Here is an example of CENTUM VP system configuration complied with 21 CFR Part 11. LHS5166 Recipe Management Package of VP Batch is adopted for recipe management.
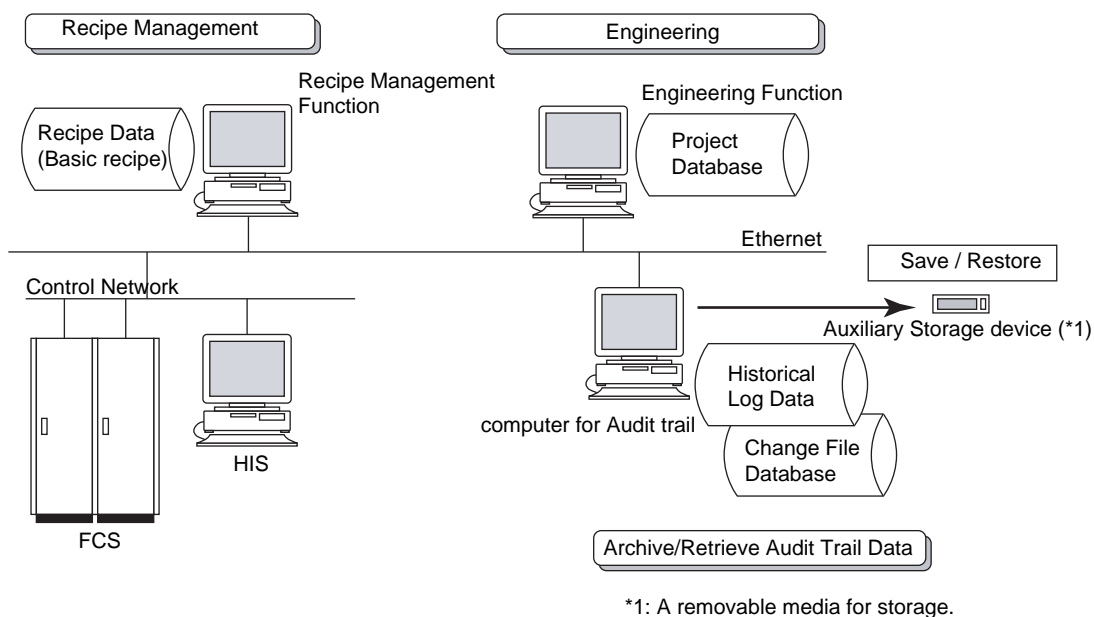

*1: A removable media for storage.

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Figure An Example of System Configuration

■ CENTUM VP ENTRY CLASS SYSTEM CONFIGURATION

CENTUM VP Entry Class is a system designed for a small-scale project. CENTUM VP Entry Class controls and monitors up to 8000 tags.

● **System Configuration and Software**

CENTUM VP Entry Class offers the following software packages.

Model Code for CENTUM VP Entry Class	Description	Remarks
LHM1101	Standard Operation and Monitoring Function	No. of Tags: Maximum 8000
LHM1150	Server for Remote Operation and Monitoring Function	—
LHM4410	Control Drawing Status Display Package	—
LHM4420	Logic Chart Status Display Package	—
LHM6660	Process Management Package	No. of Active Recipe: Type A: 4 or less Type B: 10 or less Type C: 999 or less
LHM6710	FCS Data Setting/ Acquisition Package (PICOT)	—

Software for Engineering

Model Code for CENTUM VP Entry Class	Description	Remarks
LHM5100	Standard Builder Function	—
LHM5150	Test Function	—
LHM5490	Self-documentation Package	—

The same packages for CENTUM VP system can be used other than the above packages. There is no limitation in FCS.

LHS4000 Million tag handling package (for one million tag) is not applicable to CENTUM VP Entry Class HIS. As for multiple project connection function for CENTUM VP Entry Class, refer to GS for Multiple Project Connection (GS 33K05K20-50E).

■ INSTALLATION ENVIRONMENT

Hardware standard installation environment is described as below, except for that of computer, Enclosed Display Style Console, Node Units and I/O Modules for FIO. For more details, refer to the specifications or GS for computer, HIS for enclosed display style console, open desktop style console, Node Units and I/O Modules for FIO node unit.

Ambient temperature:
    5 - 40 °C (Desk for CENTUM (YAX101),
    General-purpose Desk(YAX801))
    0 - 50 °C (FCS, BCV, Bus Repeater,
    CDGW, Node Unit, (FIO))
Ambient humidity:
    20 - 80 % RH
    10 - 90 % RH (FCS, BCV, Bus Repeater,
    CGW, Node Unit (RIO)
    With no dew condensation)
Temperature change rate:
    ± 10°C/hour
Power supply:
    100 - 120V AC ± 10%, Frequency; 50/60
    Hz ± 3 Hz
    220 - 240V AC ± 10%, Frequency; 50/60
    Hz ± 3 Hz
    24 V DC ± 10%
Withstanding Voltage:
    100 - 120 and 220-240 V AC: 1500 V AC
    for 1 minute
    24 V DC: 500 V AC for 1 minute
Insulation resistance:
    20 MΩ/500 V DC
    10 MΩ/500 V DC
    (for YAX101 and YAX801)
Grounding: Independent ground of up to 100 Ω
    resistance
Noise:
  Electrical Field:
    Up to 3 V/m (26 MHz to 1.0 GHz)
    Up to 3 V/m (1.4 to 2.0 GHz)
    Up to 1 V/m (2.0 to 2.7 GHz)
  Magnetic Field:
    Up to 30 A/m (AC), Up to 400 A/m (DC)
  Static: Up to 4 kV (direct discharge), Up to 8 kV
    (aerial discharge)
Continuous Vibration:
    Displacement amplitude: Up to 0.25 mm
    (1 to 14 Hz)
Acceleration: Up to 2 m/s^2 (14 to 100 Hz)

■ REGULATORY COMPLIANCE

CENTUM VP hardware conforms to the standards listed below. See respective GS to find out what standards each hardware complies.

Safety Standards (*1) (*2) (*3)
[CSA]
  CAN/CSA-C22.2 No.61010-1
[CE Marking] Low Voltage Directive
  EN 61010-1 and EN 61010-2-030

EMC Conformity Standards (*2)
[CE Marking] EMC Directive
  EN 55011 Class A Group 1 (*4)
  EN 61000-6-2 (*5)
  EN 61000-3-2 (*6)
  EN 61000-3-3 (*7)
[C-Tick Marking]
  EN 55011 Class A Group 1 (*4)
[KC Marking]
  Korea Electromagnetic Conformity Standard

Standards for Hazardous Location Equipment
For selecting the right products for explosion protection, please refer to TI 33Q01J30-01E without fail.

[CSA Non-Incendive] (*8)
  Class I, Division 2, Groups A, B, C and D Temperature
          code T4
  CAN/CSA-C22.2 No. 0-M91
  CAN/CSA-C22.2 No. 0.4-04
  CAN/CSA-C22.2 No. 157-92
  C22.2 No. 213-M1987
  TN-078
  (for 100-120 V AC and 24 V DC power supply)
[FM Non-Incendive] (*9)
  Class I, Division 2, Groups A, B, C and D Temperature
          code T4
  Class 3600:2011
  Class 3611:2004
  Class 3810:2005
  (for 100-120 V AC, 220-240 V AC and 24 V DC power
          supply)
[Type n] (*10) (*11)
  ⟨Ex⟩ II 3 G Ex nA IIC T4 Gc X
  EN 60079-0:2009
  EN 60079-0:2012
  EN 60079-15:2010
  (for 24V DC power supply)
  ⟨Ex⟩ II 3G EEx nA II T4 X
  EN 50021: 1999
  (I/O Module with built-in barrier, for 24 V DC power
          supply)
[Type i (Intrinsic Safety)]
  ⟨Ex⟩ II (1) G D [EEx ia] II C
  EN 50014:1997 +A1 +A2
  EN 50020:1994
[FM Intrinsic Safety]
  Associated intrinsically safe apparatus for connection to
  Class I, II and III, Division 1, Groups A, B, C, D, E, F
          and G or
  Class I, Zone 0, Group II C
  Class 3600: 2011
  Class 3610: 2010
  ANSI/ISA-60079-0: 2009
  ANSI/ISA-60079-11: 2009

Note: According to the New Approach Directive, the manufacturer and the representative office in EU are indicated below:
    Manufacturer: Yokogawa Electric Corporation (2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan).
    Representative office in EU Community: Yokogawa Europe B.V. (Euroweg 2, 3825 HD Amersfoort, The Netherlands).

*1: For ensuring all the hardware devices to satisfy the safety standards, the dedicated breakers in the power supply distribution board must conform to the following specifications.
        [CSA] CSA C22.2 No.5 or UL 489
        [CE Marking] EN 60947-1 and EN 60947-3
*2: To conform to the safety standards and the EMC conformity standards, install the 19-inch rack mountable type devices in a keyed metallic cabinet.
*3: Measurement inputs of this equipment are applied to Measurement category I for IEC/EN/CSA 61010-1:2001 and O (Other) for EN 61010-2-030. For details, see "CENTUM VP Installation Guidance" (TI 33K01J10-50E).
*4: A Class A hardware device is designed for use in the industrial environment. Please use this device in the industrial environment only.
*5: A lightening arrestor or the like is required to meet this surge immunity standard. The length of the cable to feed the external power supply for AGS813 AO channels should not exceed 30 meters.
*6: An external device such as a power unit with harmonic current neutralizer and an active harmonics conditioner must be connected to meet this harmonic current emission standard.
*7: The specified limits of voltage drop across wiring must be satisfied to meet this standard.
*8: To meet the standard for hazardous location equipment, 19-inch rack-mounted devices must be installed in a keyed metallic cabinet approved by CSA or non-incendive regulator in your area.
*9: To meet the standard for hazardous location equipment, 19-inch rack-mounted devices must be installed in a keyed metallic cabinet approved by FM or non-incendive regulator in your area.
*10: "X" indicates specific condition of use. To be compatible with Type n, for example the requirements of cabinet must be met. For details, refer to the Explosion Protection (TI 33Q01J30-01E).
*11: ADR541 does not comply with Type n.

■ TRADEMARKS
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