

CONTROL FUNCTIONS OF CENTUM CS 3000

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The basic control functions installed in the CENTUM CS 3000 Field Control Station have been newly developed. High functionality and easy engineering has been realized through the implementation of the acknowledged control functions of the CENTUM CS and expanding the interoperability of communication functions with various field control equipment. Moreover, the efficiency of debugging large-scale applications has been greatly improved by expanding the “Virtual Test Function” originally developed for CS 1000, which uses the FCS simulator of Windows NT.

INTRODUCTION

The trend of open system architecture is becoming an important issue with distributed control systems (hereinafter abbreviated as DCSs). To meet this demand, the operation and monitoring functions, and the system generation functions of the CENTUM CS 3000 system are designed to support Windows NT and OLE for Process Control (OPC). The control functions are no exception, either; they are required to be increasingly “open” so as to support various types of field communication.

Efficient engineering and easy maintenance are also in demand in order to reduce the life-cycle costs of a plant. This demand has had a significant impact on the architecture of the control functions.

This article describes the control functions of the CENTUM CS 3000, focusing on the functions that have been newly developed to achieve interoperability and make engineering more efficient.

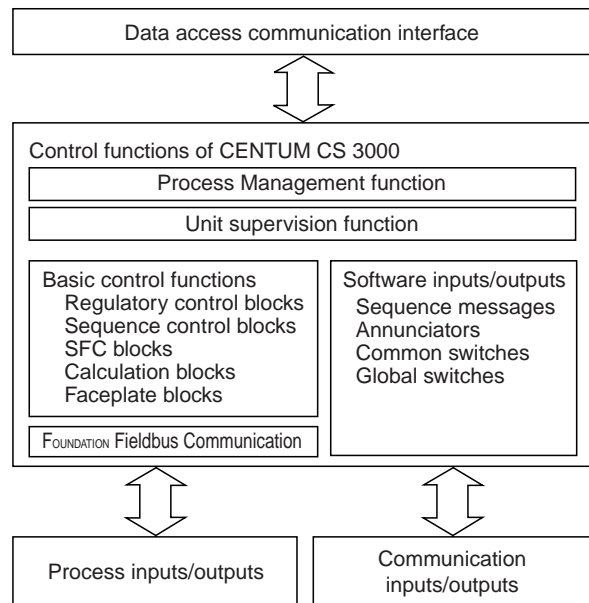


Figure 1 Control Functions of CENTUM CS 3000

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FUNCTION CONFIGURATION

The CENTUM CS 3000 has succeeded the advanced, versatile control functions of its predecessor, the CENTUM CS system.

The basic control functions are a combination of the modules known as “function blocks” which are the minimum control building blocks, such as a PID control block and a selector. The control functions include the unit supervision function that realizes the operation and monitoring functions of the CENTUM CS 3000 for each control unit by integrating these function blocks into a package appropriate for the given control unit. They also include the process management function to deal with batch processes.

Figure 1 illustrates how these functions are configured. They are incorporated into a field control station (hereinafter abbreviated as an FCS).

In addition to the process I/O function that exchanges I/O data with regular sensors and actuators, a communication I/O function that exchanges I/O data using general-purpose communication means, such as RS-232C or Ethernet, has been built into the system. The CENTUM CS 3000 also supports FOUNDATION Fieldbus that is supported by the CENTUM CS. Furthermore, as an engineering tool we provide the virtual test function that uses a Windows NT-based FCS simulator to directly run the control functions on a personal computer. Applications that have been verified to be operable by the virtual test function can be directly run on an actual FCS without having to modify them at all.

HARDWARE

There are two types of hardware available for a control station.

One of the types is a standard FCS (hereinafter abbreviated as an LFCS), which is the hardware used for the CENTUM CS. The hardware has a remote I/O interface (RIO) and is suited for controlling a large number of I/O points from RIO nodes located in separate places.

The other type is a compact FCS (hereinafter abbreviated as an SFCS), which was developed for the CENTUM CS 1000. This hardware employs a method in which an I/O module (IOM) is directly controlled from the CPU. As a result, the control functions can be distributed so that each FCS covers a smaller number of I/O points. This strategy can narrow the range of influence of a system shutdown upon a plant. Accordingly, it is possible to improve system maintainability and reduce possible risks through diversification. The hardware can connect to a general-purpose communication nest designed to accommodate communication modules or boards equipped with an RS-232C or Ethernet interface. Thus the hardware is also positioned as an open platform whose focus is on communication.

BASIC CONTROL FUNCTIONS

This section introduces the control functions of the CENTUM CS 3000, focusing on the following topics to discuss the

expansion from the control functions of the CENTUM CS.

- (1) Support of Open Architecture
- (2) Development of High-packaging-density I/O Modules
- (3) Availability of Application-by-application Templates

Support of Open Architecture

There are a wide variety of control devices located in the field and their data types and communication interfaces are also diversified. System building and remodeling may become an extremely hard task if any given control application is dependent on these data types and/or communication interfaces.

The CENTUM CS 3000 control functions have solved this problem by 1) separating the communication-executing block from the control application and 2) coding communication programs using a user language.

- (1) Separation of Communication-executing Block from Control Application

The CENTUM CS 3000 control functions temporarily stores data obtained via communication in a common area called the communication I/O area. Then, control applications, such as function blocks, gain access to the communication I/O area as if they were gaining regular access to process I/Os to exchange data with other field control devices. This access to the communication I/O area is possible by the use of relative numbers within the area or user-defined labels. The types of data (integer, floating-point and other types) stored in the area are automatically identified; we therefore need not be conscious of data types when configuring control applications. As a result, the communication-executing block is functionally separated from control applications. This eliminates the need to modify control applications in the case of a change in the communication protocol, for example.

- (2) Use of C Language for Coding Communication Programs

As a station focusing on communication functions, the highly distributive control station of the CENTUM CS 3000 supports connection to other field control devices with different types of general-purpose communication interfaces (including RS-232C and Ethernet). Therefore the required communication protocol also varies depending on the type of field control device to be connected to the station. For standard protocols, we provide a communication package as a product, while for non-standard protocols we offer a tool for describing the protocols using the C language.

Figure 2 shows how data flows through the communication I/O interfaces.

Development of High-packaging-density I/O Modules

For the LFCS and SFCS, we have developed the AMC80 analog multiplexer for multi-point control I/O applications, in addition to IOMs used in CENTUM CS FCSs. Thus we have realized a high-packaging density, low-cost IOM.

A maximum of two AMC80 modules can be installed in each I/O unit. By configuring the two modules in a dual-redundant way, it is possible to have a duplexed I/O unit of 8 inputs and 8

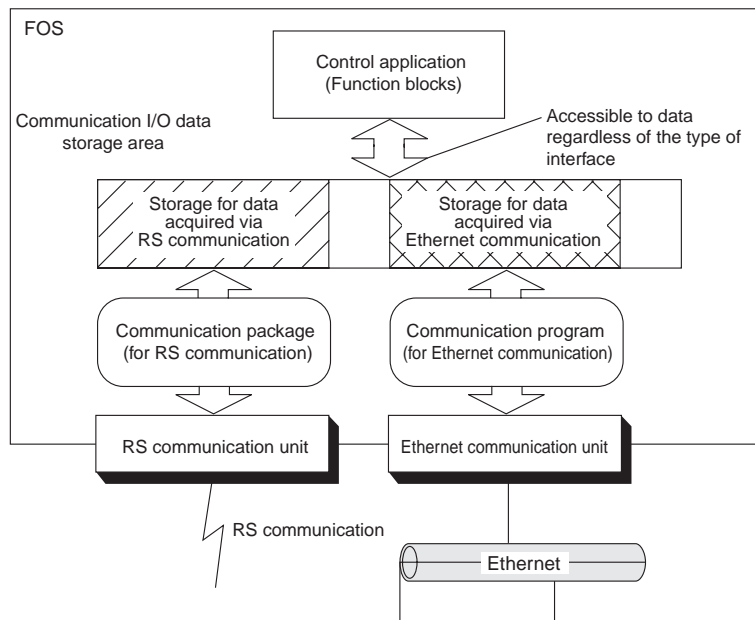


Figure 2 Data Flow through Communication I/O Interfaces

outputs. Alternatively, as many as 16 inputs and 16 outputs can be installed in the system with just one I/O unit by connecting the two modules to different I/O points.

As discussed above, we can achieve installation of high packaging density at low cost using the AMC80 module. Furthermore, use of dual-redundant configuration ensures an adequate reliability level by preventing any failure in the AMC80 module from affecting additional I/O points.

Availability of Application-by-application Templates

A control application is configured by combining a variety of function blocks. These control blocks use different types of internal resources, however, depending on their type. A high level of know-how is therefore required to estimate how much of the resources are allocated if no limit is to be placed on the way the function blocks are combined. To avoid this problem, we provide “application-by-application templates.” With the templates, preadjustments are made to the number of function blocks of the respective types, according to the type of each anticipated application (as to whether the type of control is regulatory control or sequence control, or whether the main purpose is monitoring or control), so that the allocation of the internal resources is optimized.

VIRTUAL TEST FUNCTION

In the CENTUM CS 3000, engineering efficiency has been increased by the “virtual test function” that uses the Windows NT-based FCS simulator developed for the CENTUM CS 1000. Furthermore, the system enables two or more FCS simulators to run at the same time. Thus the CENTUM CS 3000 permits most

engineering to be performed on intended systems, such as large-scale plants and batch systems, without needing a target system (FCS hardware). As noted above, these features have dramatically increased engineering efficiency.

FCS Simulator

An FCS simulator operates as one of the processes on a Windows NT platform. Like a real FCS, it reads the definitions of a control application generated by the engineering functions and implements exactly the same control activity as the real FCS. The system communicates with the FCS simulator using the Vnet communication emulator. This emulator enables the use of exactly the same communication protocol as the control bus (Vnet) for process-to-process communication within a personal computer. With this communication function, users can perform the same operations when using the operation and monitoring functions (HIS functions) or the virtual test functions, without having to be conscious of whether the communication counterpart is a real FCS or an FCS simulator.

Multi-FCS Simulation

In such large-scale plants or batch systems that the CENTUM CS 3000 is intended for, there is usually an application with two or more FCSs operating in conjunction with each other to execute control functions. To support application such as these, the CENTUM CS 3000 enables two or more FCS simulators to run at the same time and communicate with each other. With this feature, it is possible to debug an application that involves more than one FCS with just one personal computer.

Function for Simulating Communication with Other Stations

The CENTUM CS 3000 has a function for simulating communication with other stations, where the system uses an FCS simulator to simulate data-exchange communication with other stations. As discussed in the previous section, there are cases when engineering is carried out for a control application where two or more FCSs exchange data with each other. With the CENTUM CS 3000, it is possible to debug the application with two or more FCSs running in conjunction with each other. In the early phase of debugging, however, the situation may arise where other relevant FCSs have not yet been debugged. Therefore, to ensure ease of debugging it is very often more advantageous if the application of each FCS is separated from the rest of the FCSs. With the above-mentioned function, it is possible to globally simulate other FCSs referencing and setting data of the FCS being debugged. This strategy will increase the efficiency of debugging significantly.

By enabling the function for simulating communication between one FCS simulator and other stations, it is also possible to test a control application that involves multiple FCSs, without increasing the CPU load.

CONCLUSION

In this article, we have presented an overview of the control functions that the CENTUM CS 3000 provides.

Although it is needless to say that it is a requirement for the control functions of a DCS to be reliable, it seems likely demand for open interfaces and platform-free architecture will also increase. The CENTUM CS 3000 meets these requirements by supporting general-purpose communication interfaces and offering such functions as the Windows NT-based FCS simulator.

On the basis of these core technologies, we hope to proceed with such tasks as expanding our range of field communication interfaces. As explained earlier, the Windows NT-based FCS simulator permits the use of the advanced control functions of the CENTUM CS 3000 without the need for any FCS hardware. The simulator is therefore promising also as a platform for such applications as advanced control. ◆

* Windows NT is a registered trademark of Microsoft Corporation.

* CENTUM CS is a trademark of Yokogawa Electric Corporation.

