

ENGINEERING FUNCTIONS OF CENTUM CS 1000

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We have developed the engineering functions for the CENTUM CS 1000, a distributed control system for medium- and small-scale plants. The aim of this development is to supply engineering programs that will enable every engineer to achieve the full performance capability of their CENTUM CS 1000 without special training. The engineering functions run as Windows-based applications on personal computers with the Windows NT*2 operating system. Portability of data has been prioritized to the extent that engineering data can be exchanged between the engineering functions and popular Windows-based spreadsheets or text editor applications in either a comma-delimited text or text file format.

To simplify system engineering, default settings have been prepared as far as possible. The user should use these default settings and modify them as necessary by selecting items from the dedicated menus. Engineering work has also been simplified by the categorization of engineering windows into two levels so that a system can be configured with minimal settings initially and with detailed settings later on as necessary.

In terms of the debugging and inspection phases, the virtual test function is included as one of the engineering functions in order to shorten the cycle time between debugging, correction, and verification. The virtual test function enables the engineer to debug field control station (FCS) databases at the same time from the same personal computer by inputting data values and modifying settings using the virtual FCSs (in that personal computer).

INTRODUCTION

As controlled objects have become more complex, plant operation schemes more concentrated, and plant operators fewer in number, the degree of engineering for a distributed control system (DCS) has both multiplied and diversified. Despite this, systems are required to be configured in a shorter time while engineering results are required to be of higher quality. Furthermore, in most medium- and small-scale plants, the engineering of a DCS is generally performed by inexperienced

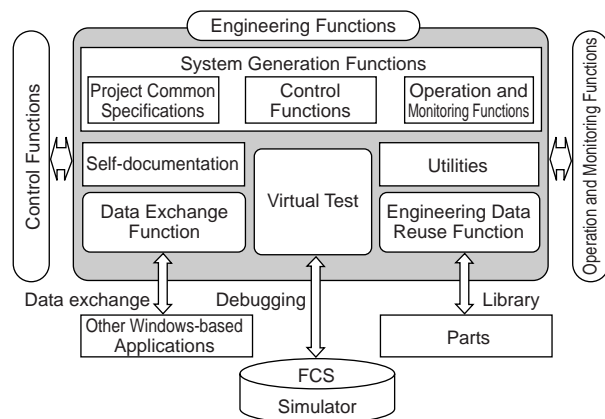


Figure 1 Configuration of Engineering Functions

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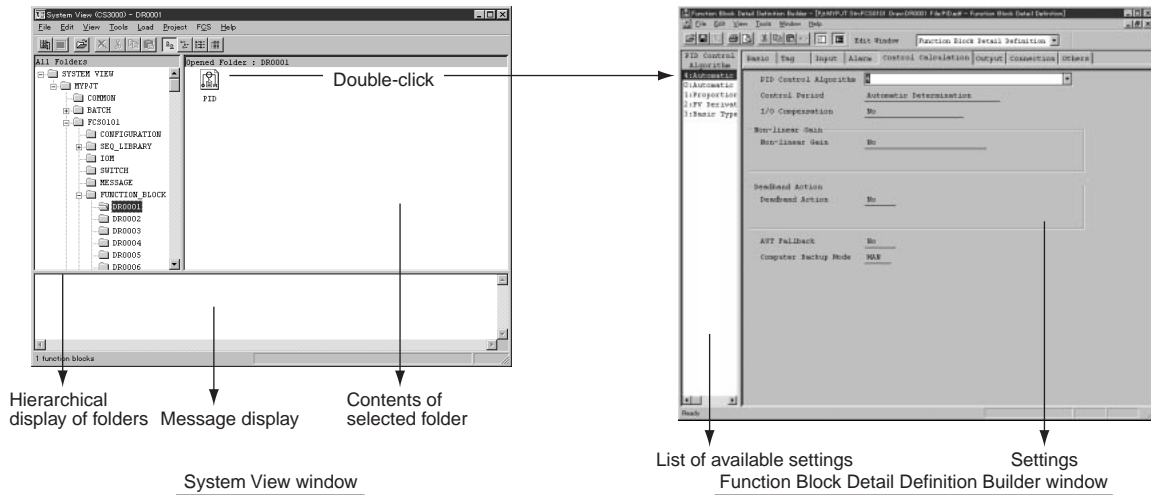


Figure 2 System View and Builders

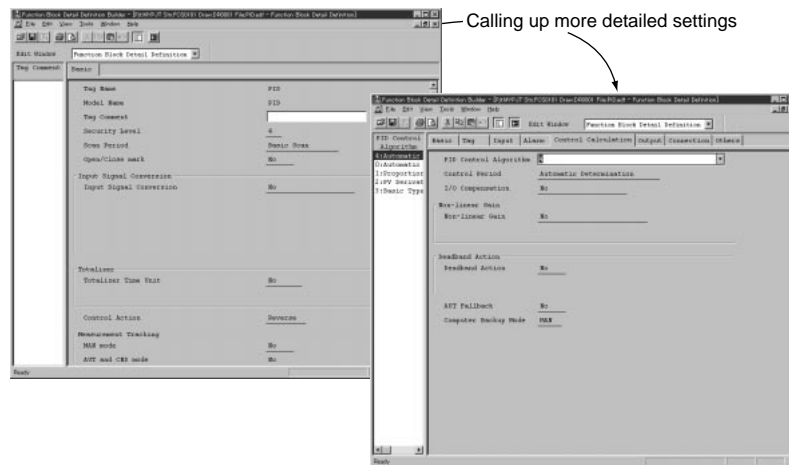


Figure 3 Basic Settings and Detailed Settings

engineers or those not specialized in DCSs. That is, engineers in such plants are rarely experienced in DCS engineering.

To overcome these hurdles, the following features have been incorporated into the engineering functions:

- Runs on Windows/NT based personal computers
Since the engineering functions run under Windows NT, which is used on office personal computers, engineering can be performed anytime and anywhere without requiring a high-performance workstation or dedicated computer.
- Data exchange with popular Windows-based applications
Text files and tables created with commonly used applications such as Microsoft Word^{®2} and Excel^{®2} can be imported to engineering database files, and the contents of engineering database files can be exported to files that can be opened and edited in these applications. This enables initial data to be created quickly and ensures data portability.
- Simple setup procedure involving modification of default settings
The values regarded as the optimums are set as the defaults.

The engineer should only modify these settings where necessary. The engineer can complete the engineering even if he/she does not know the meaning of all of the setting items. This minimizes the number of settings to be made, thus slashing the time required to create a database.

- Basic settings and detailed settings
The number of specification items that need to be set and modified in the basic settings is minimized. When more detailed and specific settings need to be made, the detailed specifications can be retrieved for modification.
- Debugging from a personal computer
Debugging of modified data can be performed from a personal computer even if there is no actual FCS hardware. This not only reduces the cycle time between modification and verification but also ensures a high level of quality during the coding and debugging phases and minimizes the occurrences of problems when carrying out final inspections using target hardware and factory acceptance tests witnessed by the customer.

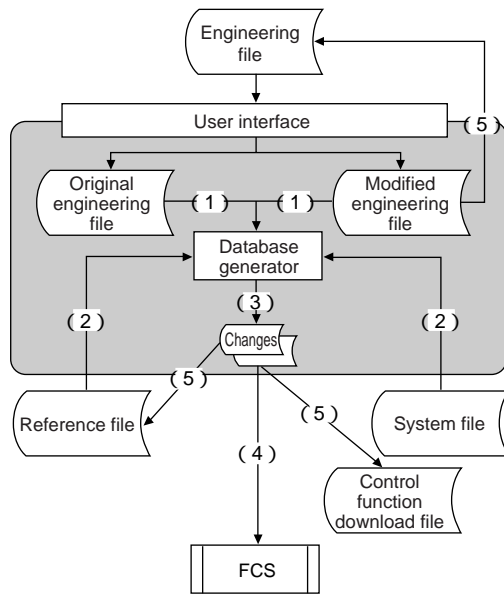


Figure 4 Database Generation using Builder

This report explains each of these features in more detail. Refer to Figure 1 for the configuration of the engineering functions.

MODIFYING THE DEFAULT SETTINGS

The system generation functions are composed of the System View window that manages and displays all of the engineering databases, and various builders that are used to modify the default settings in the control, operation, and monitoring functions. (See also Figure 2.)

1. System View

The System View window is the main window for the engineering functions and is used to:

- Manage and display engineering files and folders
- Access individual builders
- Access utilities

As shown in Figure 2, the System View window is composed of three panes. The upper left pane displays the hierarchy of the folders containing engineering data. The contents of the folder selected here are displayed in the right pane. The bottom pane displays messages. If the settings in a particular file need to be modified, that file's builder can be retrieved by double-clicking on the name or icon of that file.

2. Builders

Builders are programs used to modify the settings in the control, operation, and monitoring functions. They are run from the System View window. The builder windows look and feel the same as those of common Windows NT-based applications so users of Windows should not have any problems using them.

- Basic settings and detailed settings

When a builder window is opened, it displays the minimum

Element Number	Tag Name	Tag Comment	Switch position	Label	Label Display Format	Label color	Security L
%SW0001	01SW0301	SETUP FLAG	"ON", "OFF", "ON"	0	R, R, 4, 2, 0		
%SW0002	01SW0302	EXECUTION FL	"ON", "OFF", "ON"	0	R, R, 4, 2, 0		
%SW0003	01SW0303	PREPARE FL	"ON", "OFF", "ON"	0	R, R, 4, 2, 0		
%SW0004	01SW0304	HEAT UP FL	"ON", "OFF", "ON"	0	R, R, 4, 2, 0		
%SW0005	01SW0305	REACTION FL	"ON", "OFF", "ON"	0	R, R, 4, 2, 0		
%SW0006	01SW0306	COOL DOWN FL	"ON", "OFF", "ON"	0	R, R, 4, 2, 0		
%SW0007	01SW0307	TRANSFER FL	"ON", "OFF", "ON"	0	R, R, 4, 2, 0		
%SW0008	01SW0308	BATCH END FL	"ON", "OFF", "ON"	0	R, R, 4, 2, 0		

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@DATE_1998/07/21,14:24
@Element Number.Tag Name.Tag Comment.Switch position Label.Label Display Format.Label color.L
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%SW0007.01SW0307.TRANSFER FL."ON", "OFF", "ON".0.R,R,4,2,0
%SW0008.01SW0308.BATCH END FL."ON", "OFF", "ON".0.R,R,4,2,0
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%SW0010..System Reserved."ON", "OFF", "ON".0.R,R,4,2,0
%SW0011..System Reserved."ON", "OFF", "ON".0.R,R,4,2,0
%SW0012..System Reserved."ON", "OFF", "ON".0.R,R,4,2,0
%SW0013..System Reserved."ON", "OFF", "ON".0.R,R,4,2,0
  
```

Tag Name	Element Number	Tag Name	Tag Comment	Switch position
%SW0001	01SW0301	SETUP FLAG	ON, OFF, ON	
%SW0002	01SW0302	EXECUTION FL	ON, OFF, ON	
%SW0003	01SW0303	PREPARE FL	ON, OFF, ON	
%SW0004	01SW0304	HEAT UP FL	ON, OFF, ON	
%SW0005	01SW0305	REACTION FL	ON, OFF, ON	
%SW0006	01SW0306	COOL DOWN FL	ON, OFF, ON	
%SW0007	01SW0307	TRANSFER FL	ON, OFF, ON	
%SW0008	01SW0308	BATCH END FL	ON, OFF, ON	

Figure 5 Data Exchange with Microsoft Excel

required settings. If necessary, click Detailed Setting Item from the View menu to display a list of the more detailed setting items. Figure 3 shows the builder window for setting the parameters of a PID controller block. For the basic setting, the window contains only one tabbed page. Multiple page tabs for more detailed settings will appear after the Detailed Setting Item is chosen from the View menu.

- Saving changes to a database
- Changes made in each builder window are saved to the system database when the Download command in the File menu is carried out. The following example of database generation shows the procedure for modifying control function settings. (See Figure 4.)
- (1) The database generator receives the original data and modified data from the user interface.
 - (2) The database generator creates a database that can be interpreted by the control functions, from the data in the reference file and system file after modification.
 - (3) The database generator compares the modified data with the

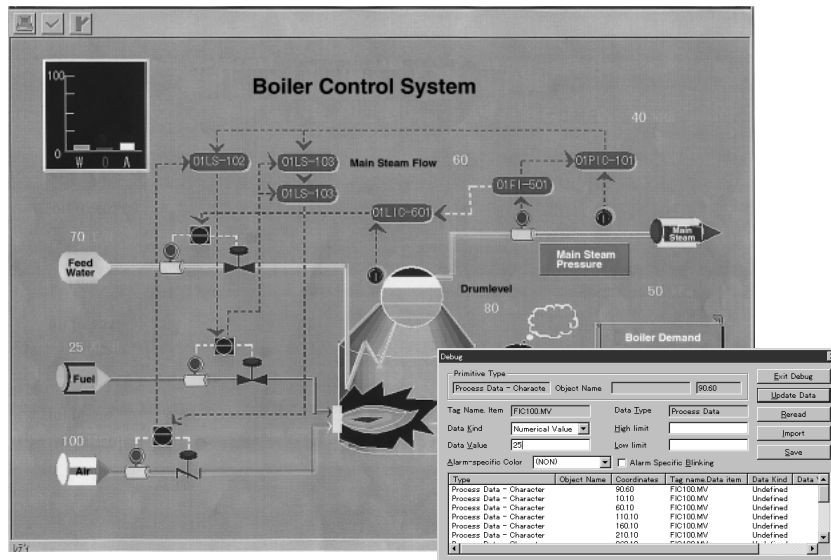


Figure 6 Debugging a Graphic Window

original, and extracts the changes.

- (4) The changes only are then downloaded to the corresponding on-line FCS.
- (5) When the on-line loading has been completed normally, the contents of the control function download file, reference file, and engineering file are updated to reflect the changes. The changes in settings are reflected in the system in these quick five steps.

DATA EXCHANGE WITH OTHER WINDOWS-BASED APPLICATIONS

Engineering data can be created using familiar Windows-based applications and imported into the corresponding builder. Conversely, builder-created files can be exported and opened in Windows-based applications for complex editing. In order to import and export data, the created data must be saved in a compatible file format: either the comma-delimited file format common to spreadsheet applications such as Microsoft Excel, or the text file format common to word processing and text editor applications such as Microsoft Word. Figure 5 shows an example of data exchange between a builder file and an Excel file.

DEBUGGING FUNCTIONS

There are two kinds of debugging functions: one for debugging the control functions and the other for debugging graphic windows. The former is referred to as a test function as it allows the engineer to debug control functions using either actual FCS hardware (a target test) or one of the virtual FCSs within a personal computer (a virtual test). The details of the test function will be described in another report.

The debugging functions for graphic windows allow graphic window actions, such as modifications according to specific process conditions, to be tested even when the tags whose data are assigned in the graphic window have not yet been created in the system. When the debugging functions are run, a graphic window and the debugging dialog box appear. By specifying a tag name, the data item and data value in the dialog box, the graphic window can be debugged. (See also Figure 6.)

The capability for multiple engineers to generate and debug graphic windows independently is of great benefit considering the system requires engineering of a large number of graphic windows.

OTHER FEATURES

The system also supports:

- **Concurrent engineering:** whereby engineers can simultaneously perform engineering on the same system from different personal computers over a network.
- **Self-documentation:** a function that prints out engineering data as "As Built" documentation to be submitted to the customer.

CONCLUDING REMARKS

The use of personal computers for the engineering platform of the CENTUM CS 1000 system, offers the following advantages: a dedicated computer is no longer necessary, popular Windows-based applications can be used, and the most up-to-date hardware and software can be employed to keep up with technological advancements. From now on, we intend to exploit these merits to improve the engineering functions and develop more sophisticated applications. ◆