

General Specifications

GS 32P03B10-01EN

Model RS4F1300
 Safety Control Function (for SSC60□)
 Model RS4F1305
 Safety Control Function for SCS Simulator
 (for SSC60□)



■ GENERAL

Safety Control Function is a software package that works on a Safety Control Station (SCS). (*1) The Safety Control Function is to monitor a plant and ensure its safe operation. This software package performs preset safety operations whenever safety control is required.

RS4F1300 Safety Control Function (for SSC60□) is applied to SSC60□ Safety Control Unit (for Vnet/IP, FIO, Rack Mountable Type). The test functions can be performed by using RS4F1300, or under the virtual test environment where the SCS is not connected, RS4F1305 Safety Control Function for SCS Simulator (for SSC60□) can also be used.

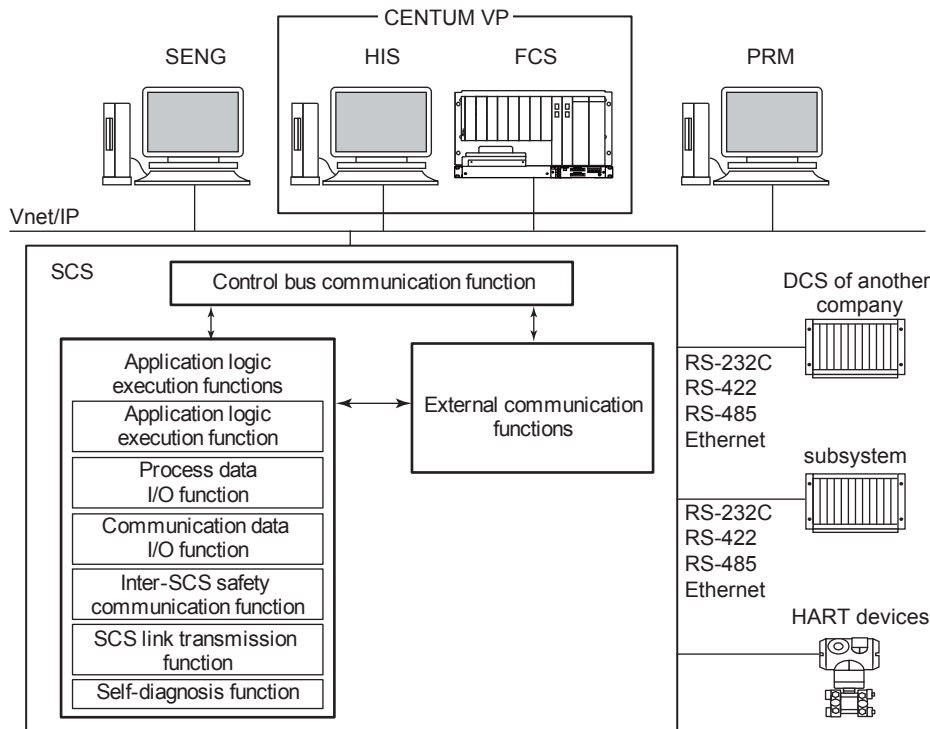
*1: The SCS is composed of a safety control unit and safety node units.

■ FUNCTIONAL SPECIFICATIONS

The following describes the configuration and functions of the package are described as follows:

● Configuration of RS4F1300 Safety Control Function

The functions of the package can be divided into two groups: one is an application logic execution functions group and the other is an external connection functions group.



F01.ai

Application Logic Execution Functions

The following functions compose of the main part of the package that monitors the plant and ensures its safe operation, and performs preset safety operations once an abnormality occurs.

- Application logic execution function
- Process data I/O function
- Communication data I/O function (Subsystem communication function)
- Inter-SCS safety communication function
- SCS link transmission function
- Self-diagnosis function

External Communication Functions

This function group, which performs communications between the application logic execution functions and non-SCS equipment, is composed of the following functions:

- CENTUM VP integration function
- Modbus communication function
- Sequence of events recorder (SOER) function
- Diagnosis information collection function
- PRM-supported HART on-demand communication

● **Application Logic Execution Functions**

Details of Application logic execution function, Process data I/O function, Inter-SCS safety communication function, and SCS link transmission function are given below.

Application logic execution function

Application logics are described by using the Function Block Diagram (FBD), the Ladder Diagram (LD), or Structured Text (ST) compliant to the IEC 61131-3 standard.

The following table shows the functions and function blocks used in the FBD. Some of the elements from LD can also be used to describe FBD.

Table Functions (FU) (1/2)

Function	Details
ABS	Gives the absolute (positive) value of a real value
SQRT	Calculates the square root of a real value
+ADD	+, meaning "addition"
× MUL	×, meaning "multiplication"
−SUB	−, meaning "subtraction"
/ DIV	/, meaning "division"
SHL	Make the bits of an integer shift to the left. Shift is made on 32 bits. Zero is used to replace lowest bit.
SHR	Make the bits of an integer shift to the right. Shift is made on 32 bits. Highest bit is copied at each shift.
ROL	Make the bits of an integer rotate to the left. Rotation is made on 32 bits.
ROR	Make the bits of an integer rotate to the right. Rotation is made on 32 bits.
AND	AND
OR	OR
XOR	Exclusive disjunction (exclusive OR)
NOT	Negation
SEL	Selects one of two input values (INTEGER)
SEL_R	Selects one of two input values (REAL)
SEL_T	Selects one of two input values (TIME)
MAX	Selects the larger of two input values (INTEGER)
MIN	Selects the smaller of two input values (INTEGER)
LIMIT	Limits the range of the input values to output (INTEGER)
MUX4	Selects one of four input values (INTEGER)
MUX8	Selects one of eight input values (INTEGER)
MUXBOOL4	Selects one of four input values (BOOL)
MUXBOOL8	Selects one of eight input values (BOOL)
MUXREAL4	Selects one of four input values (REAL)
MUXREAL8	Selects one of eight input values (REAL)
GT	>, meaning "greater than"
GE	>=, meaning "greater than or equal to"
EQ	=, meaning "equal"
LE	<=, meaning "less than or equal to"
LT	<, meaning "less than"
NE	≠, meaning "unequal"
SCALER	Converts a 0-100 % range of input values into a normalized range for outputting

Table Functions (FU) (2/2)

Function	Details
1GAIN	Assignment
IB_TO_V	Converts IO_BOOL-type input to data value
IB_TO_S	Converts IO_BOOL-type input to data status
IR_TO_V	Converts IO_REAL-type input to data value
IR_TO_S	Converts IO_REAL-type input to data status

Table Interference-free (*1) Functions (FU)

Function	Details
ANY_TO_BOOL	Converts to BOOL-type
ANY_TO_DINT	Converts to INTEGER-type
ANY_TO_REAL	Converts to REAL-type
ANY_TO_TIME	Converts to TIME-type
POW	Performs power calculation
POWE	Performs calculation of exponential function with base e
ACOS	Calculates the Arc cosine of a real value
ASIN	Calculates the Arc sine of a real value
ATAN	Calculates the Arc tangent of a real value
COS	Calculates the Cosine of a real value
SIN	Calculates the Sine of a real value
TAN	Calculates the Tangent of a real value
LOG	Calculates the Common logarithm of a real value
LOGE	Calculates the Natural logarithm of a real value
MOD	Calculates the Modulo of an integer value

*1: Functions not affecting the safety loop

Table Function Blocks (FB) (1/3)

Function block	Details
SR	Set dominant bistable
RS	Reset dominant bistable
R_TRIG	Detects a rising edge
F_TRIG	Detects a falling edge
CTU	Count up counter
CTD	Count down counter
CTUD	Count up/down counter
TP	Pulse timer which outputs pulses for a specified duration after rising edge detection
TON	On-delay timer
TOF	Off-delay timer
REPEATTIMER	Alternates TRUE and FALSE outputs at specified intervals
FILTER	First-order lag filter
FILTER_S	First-order lag filter with data status analysis capability
ANLG1002D	1oo2D analog voter
ANLGVOTER	3-input analog voter (IO_REAL)
BOOLVOTER	3-input BOOL voter (IO_BOOL)
ANLG_S (*1)	Outputs high/low alarm with scale conversion (with data status input)

*1: When the ProSafe-RS system is integrated with CENTUM VP, these function blocks can be used by the HIS of CENTUM VP.

Table Function Blocks (FB) (2/3)

Function block	Details
ANLGI(*1)	Outputs high/low alarm with scale conversion
VEL(*1)	Detects the velocity limit exceeded
SYS_STAT	Manages the SCS status
SYS_FORCE	Manages forcing
SYS_DIAG	Outputs diagnosis information
SYS_SECURE	Manages Security level
SYS_SEC_CTL	Protects Security level
SYS_IOALLST	Detects fault in all I/O channels
SYS_NODEST	Detects fault in all I/O channels in node
SYS_OUTST	Detects fault in output module channels (for 8 channels)
SYS_OUTST16	Detects fault in output module channels (for 16 channels)
SYS_INST	Detects fault in input module channels
SYS_CHST	Detects fault in channels
SYS_CERR	Indicates computation errors
SYS_SCANEXT	Indicates the extension of scan period
SYS_OVR	Manages override function blocks
SYS_PSWD	Manages password function blocks
SYS_OUTEN	Indicates Output module output status
SYS_ALLSD	Shuts down Station output
SYS_IOSD	Shuts down Module output
SYS_FORCE_BD	Manages forcing of inter-SCS safety communication data
SYS_FORCE_LT	Manages forcing of SCS Link Transmission
SYS_LTSTS	Indicates SCS Link Transmission reception status
GOV_B (*1)	Grouping overrides from HIS (BOOL)
GOV_IB (*1)	Grouping overrides from HIS (IO_BOOL)
OVR_B (*1)	Overrides from HIS (BOOL)
OVR_I (*1)	Overrides from HIS (INTEGER)
OVR_R (*1)	Overrides from HIS (REAL)
OVR_IB (*1)	Overrides from HIS (IO_BOOL)
OVR_IR (*1)	Overrides from HIS (IO_REAL)
PASSWD (*1)	Manipulates BOOL-type data using password from HIS
MOB_11 (*1)	Data manual operation with two-position answerback (BOOL)
MOB_21 (*1)	Data manual operation with three-position answerback (BOOL)
MOB_RS (*1)	Auto-reset data manual operation (BOOL)
MOA (*1)	Analog-type data manual operation
CONS_B	Receives data on consumer side for inter-SCS safety communication (BOOL)
CONS_I	Receives data on consumer side for inter-SCS safety communication (INTEGER)
CONS_R	Receives data on consumer side for inter-SCS safety communication (REAL)
PROD_B	Transmits data on producer side for inter-SCS safety communication (BOOL)
PROD_I	Transmits data on producer side for inter-SCS safety communication (INTEGER)
PROD_R	Transmits data on producer side for inter-SCS safety communication (REAL)
B_TO_IB	Converts data values and status to IO_BOOL-type outputs
R_TO_IR	Converts data values and status to IO_REAL-type outputs

*1: When the ProSafe-RS system is integrated with CENTUM VP, these function blocks can be used by the HIS of CENTUM VP.

Table Function Blocks (FB) (3/3)

Function block	Details
LTRCV	Receives Safety Link Transmission data
LTSND	Sends Link Transmission data
ANN_FUP (*1)	Detects the first-up alarm and transmits the annunciator message
FUP_RST	Resets the first-up alarm annunciator
HSDTR (*1) (*2)	Outputs high alarm of smoke and heat detector with scale conversion (with reset function)
GASDTR (*1) (*2)	Outputs high/low alarm of gas and flame detector with scale conversion (with reset function)

*1: When the ProSafe-RS system is integrated with CENTUM VP, these function blocks can be operated and monitored by the HIS of CENTUM VP.

*2: Supported by ProSafe-RS R4.03.00 or later.

Table Interference-free (*1) Function Blocks (FB)

Function block	Details
ANN (*2)	Transmits annunciator message
SYS_SCAN	Outputs application logic execution time and percentage of CPU idle time
SYS_IOMDSP	Outputs the IOM status
SYS_NODEINF	Outputs node status
SYS_ESBINF	Outputs ESB bus status
SYS_NETST	Outputs Control bus status
SYS_ALRDSP	Outputs status of subsystem communication modules
SYS_ALARM	Outputs alarm transmission status
SYS_TIME	Outputs SCS clock information
SYS_FORCE_SC	Manages forcing of subsystem communication data
SYS_STAT_SC	Indicates output enable operation in subsystem communication
SOE_B	BOOL-type data SOER
SOE_I	INTEGER-type data SOER
SOE_R	REAL-type data SOER
ECW_B (*2)	Sets data of a BOOL-type variable from an external device
ECW_I (*2)	Sets data of a INTEGER-type variable from an external device
ECW_R (*2)	Sets data of a REAL-type variable from an external device
AVERAGE	Calculates the average of a specified duration
LIM_ALARM	Hysteresis on a real value for high and low limits
SCI_B (*2)	Input from subsystem (BOOL)
SCI_I (*2)	Input from subsystem (INTEGER)
SCI_R (*2)	Input from subsystem (REAL)
SCO_B (*2)	Output to subsystem (BOOL)
SCO_I (*2)	Output to subsystem (INTEGER)
SCO_R (*2)	Output to subsystem (REAL)
LTFCS	Receives Interference-free Link Transmission data
SYS_SETTIME	Sets the SCS time

*1: Functions not affecting the safety loop.

*2: When the ProSafe-RS system is integrated with CENTUM VP, these function blocks can be used by the HIS of CENTUM VP.

Table Ladder Elements

Ladder	Details
Direct Contact	Direct contact
Inverted Contact	Inverted contact
Contact with Rising Edge Detection	Contact with rising edge detection
Contact with Falling Edge Detection	Contact with falling edge detection
Direct Coil	Direct coil
Inverted Coil	Inverted coil
SET Coil	SET coil
RESET Coil	RESET coil
Coil with Rising Edge Detection	Coil with rising edge detection
Coil with Falling Edge Detection	Coil with falling edge detection

Scan period of Application Logic Execution Function

50 milliseconds – 1 second (by the unit of 10 – milliseconds within these ranges)

Process Data I/O Function

For process data I/O function, analog I/O modules and digital I/O modules are used. The table below shows the I/O modules that SCSs can employ.

Table I/O Modules

Model	Module Name
SAI143	Analog input module (4 to 20 mA, 16-channel, module isolation)
SAV144	Analog input module (1 to 5 V/1 to 10 V, 16-channel, module isolation)
SAT145	TC/mV input Output (16-channel, isolated channels)
SAR145	RTD input module (16-channel, isolated channels)
SAI533	Analog output module (4 to 20 mA, 8-channel, module isolation)
SDV144	Digital input module (16-channel, dry contact, module isolation)
SDV521	Digital output module (4-channel, 24 V DC/2 A, module isolation)
SDV526	Digital output module (4-channel, 100-120 V AC, module isolation)
SDV531	Digital output module (8-channel, 24 V DC, module isolation)
SDV53A	Digital output module (8-channel, 48 V DC, module isolation)
SDV541	Digital output module (16-channel, 24 V DC, module isolation)

Table Interference-free (*1) Communication Modules

Model	Module Name
ALR111	Serial communication module (RS-232C, 2-port)
ALR121	Serial communication module (RS-422/RS-485, 2-port)
ALE111	Ethernet communication module (1-port)

*1: I/O modules that do not affect the safety loops

Inter-SCS Safety Communication Function

When the inter-SCS safety communication function is employed, a safety loop up to SIL 3 (Safety Integrity Level) can be configured among multiple SCSs via the Vnet/IP. This function ensures authenticity, quality, appropriate sequence, and timelines of the data.

Communication Specifications:

- An SCS is capable of communication up to 16 SCSs. (*1)
- Up to 200 data items can be transmitted per SCS.
- Up to 200 data items can be received per SCS.

*1: In case the SCS performs bi-directional communications or a multiple communications, the number of SCSs becomes less than 16.

For the compatibility of Inter-SCS safety communication by the release numbers of the system programs, refer to the GS “ProSafe-RS Safety Instrumented System Overview (for Vnet/IP)” (GS 32P01B10-01EN).

SCS Link Transmission

Two types of SCS link transmissions are available - SCS Link Transmission Safety Communication and SCS Global Switch Communication.

The SCS Link Transmission Safety Communication is the SIL 3-supported safety communication function to simultaneously transmits data to multiple number of SCSs in a periodic interval. It also receives the data transmitted by other stations and refers them by the application logic.

The SCS Global Switch Communication enables to refer the data transmitted between the SCS and the FCS. This function is interference-free.

Communication Specifications:

- Communication range: Within to the same domain
- Control bus: Vnet/IP
- Number of communicable stations: Maximum 63
(The number of stations that can be referred to, depend on the CPU and communication loadings)
- Transmission cycle: 100 ms fixed

Transmission Data Reference/Setting:

- Number of input function block definition: Max. 1000 per SCS
- Number of output function block definition: Max. 128 per SCS
- The number of assignments per receiving station is not limited

Software Requirements:

- SCS program: R2.03.00 or later
- FCS system program: R3.08.50 or later

● **External Connection Functions**

The CENTUM VP integration function, Modbus communication, sequence of events recorder (SOER), and diagnosis information collection functions are described below:

Scan period of External Connection Function

1 or 2 seconds.

CENTUM VP Integration Function

The SCS can be monitored by CENTUM VP’s human interface station (HIS) using the tag name interface in the same way as control tags. When the tag name is defined using the CENTUM VP integration function, the HIS is enabled not only to monitor the SCS but also to perform maintenance override. Annunciator messages assigned with priority levels can be sent from the SCS.

As for the types of SCS data and function blocks to assign tag names, refer to the GS “CENTUM VP Integration Package” (GS 32P04D10-01EN).

Modbus Communication Function

The SCS communicates with external equipment such as sequencers via the Modbus protocol. The SCS acts as the Modbus master which enables to read and write external equipment data. The external equipment also acts as the Modbus master which enables to read and write the SCS data. Connecting with the Modbus communication module is interference-free. ALR121 serial communication module supports ProSafe-SLS communication function which extends the Modbus communication function.

For more details, refer to the GS “ALR111/ALR121 Serial Communication Module” (GS 32P06K50-01EN) or “ALE111 Ethernet Communication Module” (GS 32P06K51-01EN).

Modbus communication function	SCS acts as a Modbus master	SCS acts as a Modbus slave
Communication module		
Serial communication module	X	X
Ethernet communication module	X	X

X: Supported

● **Sequence of Events Recorder (SOER) Function**

The SOER function is composed of event collection sub-function, event storage sub-function, and time synchronization sub-functions. When an SOE viewer is used on the CEMTUM VP's HIS, the event information can be displayed on the HIS.

• **Event collection and storage sub-function**

Event information is collected and stored in a digital input module or a CPU module of an SCS.

Time stamp resolution of events collected by a digital input module is 1 ms.

Other events are collected by a CPU module by the SCS's scan period as the time stamp resolution.

• **Objective event information**

The SCSs collect the following event information when defined by the user definition.

Information to be collected	Trigger for event collection and location for collection
Digital input	Changes in the data value input into the digital input module trigger to collect events. The SOE collection can be enabled or disabled by the channel. (*1) (*3)
Digital output	Changes in the data value output to the digital output module trigger CPU to collect events. The SOE collection can be enabled or disabled by the channel. (*2) (*3)
Analog input	The analog input function block determines the level of the data value to collect events. (*4)
Application logic variable	Each of the SOE event collection function blocks for BOOL-type, INTEGER-type, and REAL-type collect events. (*4)

*1: When the digital input module is dual-redundant, the module with control authority collects events.

*2: When the status of output channel is abnormal (the data status is BAD), no events are collected.

*3: Channel comments (a string composed of a maximum of 32 single-byte characters or 16 double-byte characters) needs to be defined.

*4: A sequential event identifier (a string composed of maximum of 32 single-byte characters or 16 double-byte characters) needs to be defined for the input terminal ID of a function block. Analog output events are to be collected by a function block for SOE event collection for constants.

• **Storage of Event Information**

Event information is stored in an event information file in an SCS. Such event information can be seen from multiple SOE viewers.

Two kinds of event information files are provided – an event log file and a trip signal file. The event log file contains collected event data. The trip signal file contains events before and after a trip signal specified by a user.

Table Event Information File Specification

	Event log file (*1)	Trip signal file (*2)(*3)
Number of events	Max. 15000 events	Max. 1500 events (500 before signal generation and 1000 after signal generation)
Number of files	Max. 1	Max. 2

*1: A diagnosis information message is sent to the user at occurrence of every 12000 events.

*2: Upon completion of collecting trip signal file, a diagnosis information message is sent to a user.

*3: In case the number of events does not reach 1000 in 30 minutes after the trip signal is generated, a trip signal file creation is terminated and a diagnosis information message is sent to a user.

Diagnosis Information Collection Function

An SCS sends a diagnosis information message when an abnormal condition is detected, and the message is stored in the memory of the SCS as the diagnostic information. The message contains the time, location, type, and other information of the abnormality. The SCS can store up to 5000 pieces of information.

PRM-supported HART On-demand Communication

On-demand communication with a HART device is implemented by Plant Resource Manager (PRM) which sends a HART command, and then receives a response from the HART device via the SCS. Analog input/output modules with HART function (SAI143-H and SAI533-H) serve as communication relays.

● **Test Function**

The test function supports performance tests of the user-made applications. Three test modes are available: “target test” employs the actual systems in operation; “virtual test” (SCS simulation test) uses the SCS simulator; and “logic simulation test” uses the logic simulator.

The CENTUM VP test functions and ProSafe-RS test functions constitute the virtual test environment. For details of the CENTUM VP test functions, refer to the GS of CENTUM VP “Test Function” (GS 33J10D50-01EN). Under the virtual test environment, either RS4F1300 safety control function (for SSC60□) or RS4F1305 safety control function for SCS simulator (for SSC60□) can be used.

SCS Simulator

The SCS simulator activates the SCS system software that works on the SCS on a computer. Communications with virtual HIS, with FCS simulator, and safety communications among the SCSs can be performed just by the computer.

For operator training, Exatif (*1) DCS interface for training simulator can be used.

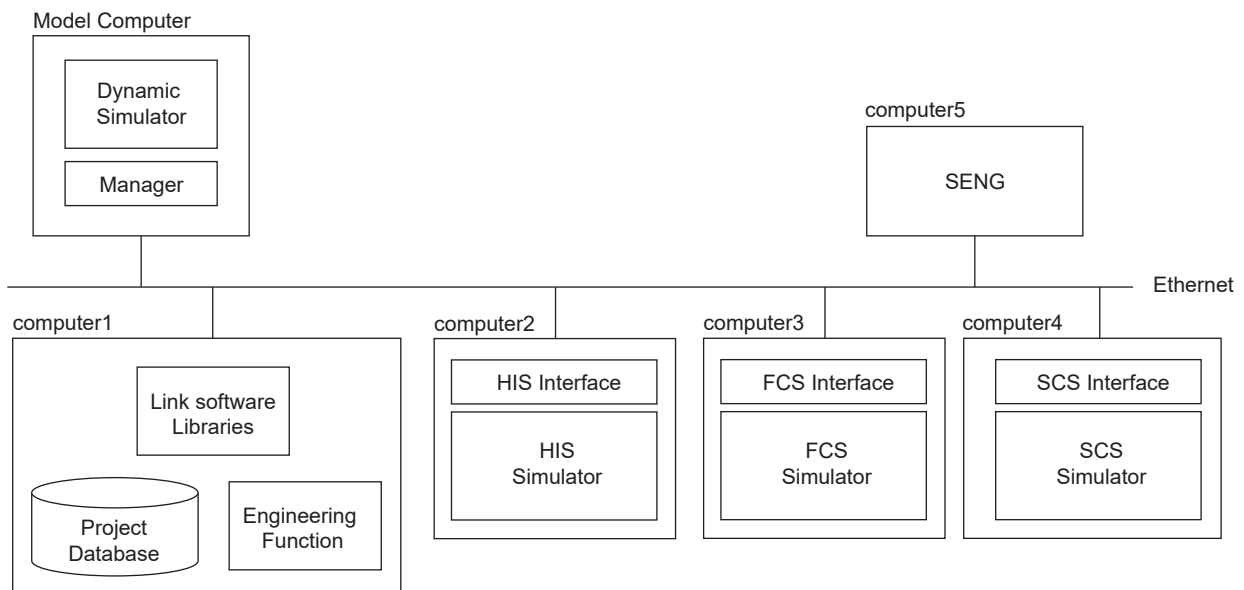
*1: Exatif is a product of Omega Simulation Co., Ltd. For the details of its functions, refer to the General Specification (GS) issued by Omega Simulation Co., Ltd.

● **Connecting to Plant Training System (using Exatif Package)**

The Vnet/IP interface to constitute the environment for plant training simulator is supported.

In order to stabilize the performance for longer hours than using it as a test function, configuring the simulator with a following system configuration is required.

For more details, please refer to the GS of CENTUM VP “Expanded Test Functions, FCS Simulator Package, HIS Simulator Package” (GS 33J10D60-01EN).



- computer1: Engineering Function
- computer2: HIS Simulator
- computer3: FCS Simulator
- computer4: SCS Simulator
- computer5: SENG

F02.ai

Figure Example of System Configuration

Table Software Packages required for the Plant Training System

Product	Package	computer1	computer2	computer3	computer4	computer5
ProSafe-RS	RS4F1305 Safety Control Function for SCS Simulator (for SSC60□) (*1)	—	—	—	X	—
	RS4E5100 Automation Design Suite (AD Suite), Safety System Engineering and Maintenance Function	—	—	—	—	X
	RS4E5600 CENTUM VP Integration Package	—	—	—	—	X
CENTUM VP (*2)	VP6H1100 Standard Operation and Monitoring Function	—	X	—	—	— (*3)
	VP6E5100 Standard Engineering Function	X	—	—	—	—
	VP6E5420 Test Function (*4)	X	—	—	—	—
	VP6E5425 Expanded Test Function	X	—	—	—	—
	VP6E5426 FCS Simulator Package (*5)	—	—	X	X	—
	VP6E5427 HIS Simulator Package	—	X	—	—	— (*3)
	VP6F1□05 Control Function for FCS Simulator (*6)	—	—	X	—	—
Plant training system (*7)	Exatif	X				—

X: Required —: Not Required

- *1: When using multiple SCS simulators, RS4F1305s of the number same as the SCS simulators are required. RS4F1300 safety control function can be also used.
- *2: CENTUM VP R4.02 or later is required.
- *3: In order to launch the SCS maintenance support tool, this package must be installed in the computer5.
- *4: Including the FCS simulator and HIS simulator.
- *5: Including the SCS simulator.
- *6: When using multiple FCS simulators, VP6F1□05s of the number same as the FCS simulators are required. VP6F1□00 control function can be also used.
- *7: Installing this package on each computer is required.

■ APPLICATION CAPACITY

A term “application capacity” refers to the capacity to execute SCS’s safety control functions. The application capacity for an SCS differs by the selection of ESB bus coupler modules of SEC401 or SEC402. The same rule applies when calculating the maximum application capacity when RS4F1305 Safety Control Function for SCS Simulator under a virtual test environment.

Table Application Capacity

Category	Item	Maximum capacity
I/O-related items	Number of safety node units	13 (*1)
	Number of communication modules	6 (2 modules as slaves and 4 modules as masters)
	Number of I/O points	1500 (*1) (*2)
	Number of subsystem communication data items	2000 (maximum communication data items per SCS) (*3)
Application logic	Number of POUs (*4)	500
	Number of variables	1500 I/O variables (*2) 4500 internal variables (*2)
Inter-SCS Safety Communication	Number of produced data	200
	Number of consumed data	200
SCS Link Transmission	Number of transmitted data	128
	Number of received data	1000
CENTUM VP integration function	Number of analog input blocks	total 2700
	Number of velocity alarm blocks	
	Number of override blocks	
	Number of password blocks	
	Manual operation function block	
	Number of communication I/O blocks	2000 (*5)
	Number of annunciators	2000

*1: The maximum capacity of the SEC401 is up to 9 units of safety node units and 1000 I/O points.

*2: The numbers are for reference.

*3: The maximum number of communication data items per SCS earlier than ProSafe-RS R4.03.10 is up to 500.

*4: POU stands for (Program Organization Unit) representing the programs, user defined function blocks, and user defined functions.

*5: The maximum number of communication I/O blocks per SCS earlier than ProSafe-RS R4.03.10 is up to 500.

■ OPERATING ENVIRONMENT

RS4F1300 safety control function (for SSC60□) works on the following safety control units:

SSC60S, SSC60D

■ MODELS AND SUFFIX CODES

Safety Control Function (for SSC60□)

		Description
Model	RS4F1300	Safety Control Function (for SSC60□)
Suffix codes	-V	Software License
	1	Always 1
	1	English Version

Safety Control Function for SCS Simulator (for SSC60□)

		Description
Model	RS4F1305	Safety Control Function for SCS Simulator (for SSC60□)
Suffix codes	-V	Software License
	1	Always 1
	1	English Version

■ ORDERING INFORMATION

Specify the model and suffix code(s).

■ TRADEMARKS

- ProSafe, CENTUM, PRM, STARDOM, FAST/TOOLS, Exaopc, FieldMate, and Vnet/IP are either registered trademarks or trademarks of Yokogawa Electric Corporation.
- Other company and product names appearing in this document are registered trademarks or trademarks of their respective holders.