Textbook and
Educational Aids

ProSafe-RS

ProSafe-RS
Training Manual

TE Y109JA01-PPRS

YOKOGAWA

TE Y109JA01-PPRS
1st Edition

Introduction

The objective of the Training manual is to acquaint the user with the system layout, operations screens and the terminologies used in the Prosafe-RS safety system.

This training module is designed to add more value to the traditional training. The participant can acquire basic knowledge on the Prosafe-RS system.

The Training manual consists of multiple chapters

Each chapter consists of multiple topics.

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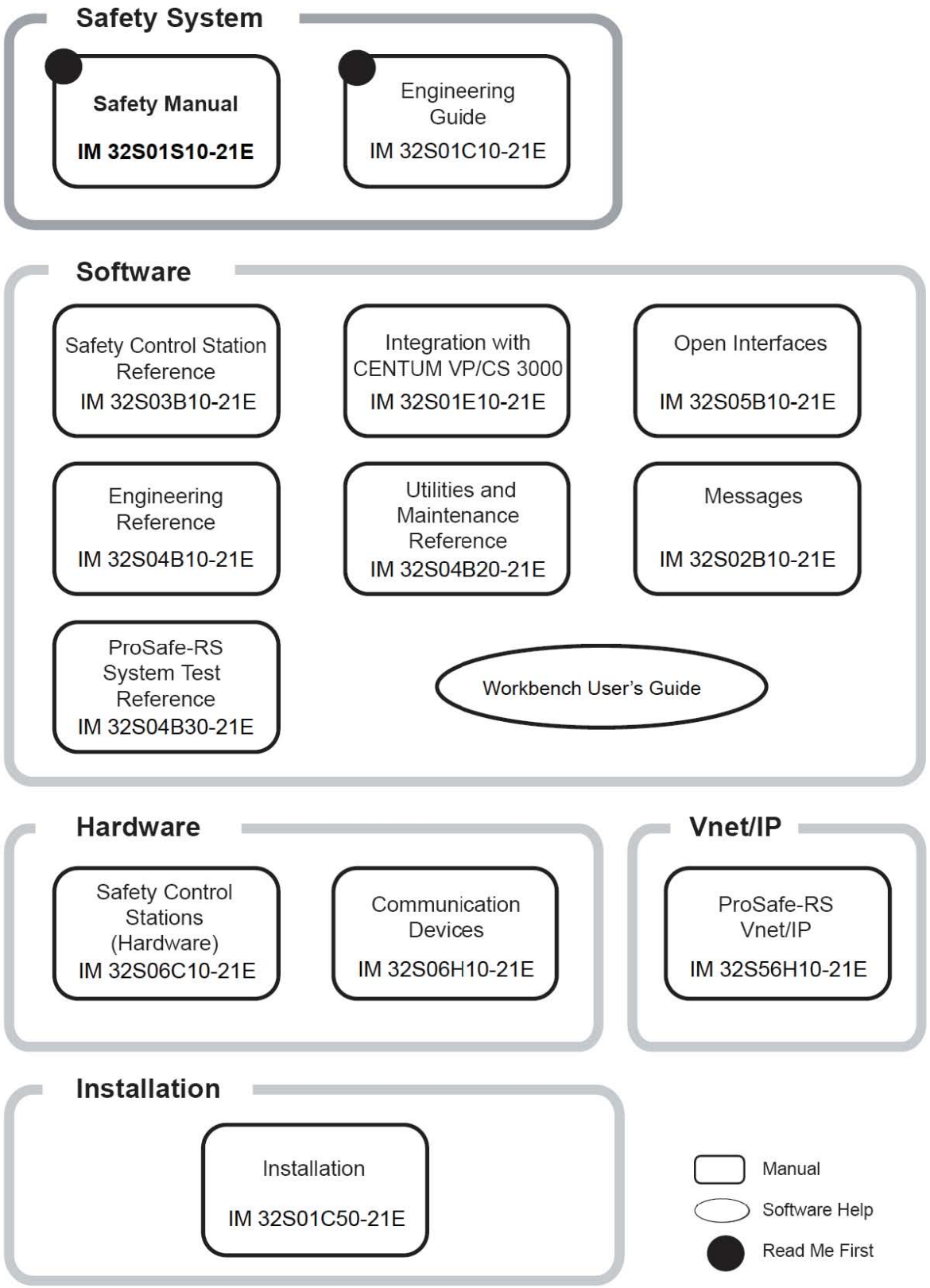
ProSafe-RS Document Map



Safety Precautions

■ Safety, Protection, and Modification of the Product

- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this instruction manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If any protection or safety circuit is required for the system controlled by the product or for the product itself, prepare it separately.
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Indicates that caution is required for operation. This symbol is placed on the product to refer the user to the instruction manual in order to protect the operator and the equipment. In the instruction manuals you will find precautions to avoid physical injury or death of the operator, including electrical shocks.

Identifies a protective grounding terminal. Before using the product, ground the terminal.

Identifies a functional grounding terminal. Before using the product, ground the terminal.

Indicates an AC supply.

Indicates a DC supply.

Indicates that the main switch is ON.

Indicates that the main switch is OFF.

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- Please read the information thoroughly before using the product.
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Typographical Conventions

The following typographical conventions are used throughout the manuals:

Commonly used conventions throughout manuals:

Character string enclosed by a set of single angle-brackets:

Indicates a portion provided with a link. Clicking the string in angle-brackets calls up related topics.

Example:

<Toc> <Ind>

Character string to be entered:

The characters that must be entered are shown in monospace font as follows:

Example:

FI.PV=50.0

"▼" Mark

This symbol indicates the description for an item for which you should make a setting in the product's engineering window.

While operating an engineering window, the help information for the selected item can be accessed from "Builder Definition Items" in the Help menu.

Listing more than one definition item after this symbol implies that the paragraph on the page describes more than one definition item.

Example:

▼ Tag name, Tag importance, Window name

"△" Mark

Indicates a space between character strings that must be entered.

Example:

.AL△PIC010△ -SC

Character string enclosed by brackets ({ }):

Indicates an option that can be omitted.

Example:

.PR △TAG{△.sheet name}

● Conventions used to show key or button operations:

Characters enclosed by brackets ([ ]):

Characters enclosed by brackets within any description on a key or button operation, indicate either a key on the HIS (Human Interface Station) keyboard, a key on the operation keyboard, a button name on a window, or an item displayed on a window.

Example:

To alter the function, press the [ESC] key.

● Conventions used in command syntax or program statements:

The following conventions are used within a command syntax or program statement format:

Characters enclosed by angle-brackets:

Indicate character strings that user can specify freely according to certain guidelines.

Example:

#define <Identifier><Character string>

"..." Mark

Indicates that the previous command or argument may be repeated.

Example:

Imax (arg1, arg2, ...)

Characters enclosed by brackets ([ ]):

Indicate those character strings that can be omitted.

Example:

sysalarm format_string [output_value ...]

Characters enclosed by separators ( ):

Indicate those character strings that can be selected from more than one option.

Example:

opeguide | <format_character_string> [, <output_value> ...] |
OG,<element number>

Symbol Marks

Throughout this manual, you will find several different types of symbols are used to identify different sections of text. This section describes these icons.

CAUTION

Identifies instructions that must be observed in order to avoid physical injury and electric shock or death of the operator.

WARNING

Identifies instructions that must be observed in order to prevent the software or hardware from being damaged or the system from becoming faulty.

CAUTION

Identifies additional information required to understand operations or functions.

TIP

Identifies additional information.

SEE ALSO

Identifies a source to be referred to.

Clicking a reference displayed in green can call up its source, while clicking a reference displayed in black cannot.

Drawing Conventions

Some drawings may be partially emphasized, simplified, or omitted, for the convenience of description.

Some screen images depicted in the manual may have different display positions or character types (e.g., the upper / lower case). Also note that some of the images contained in this manual are display examples.

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Prosafe-RS
Training Manual

TE Y109JA01 1st Edition
TOC

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1. INTRODUCTION TO SAFETY

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1.1 What is a Safety system?

A Safety system is a system that provides an independent and predetermined emergency shutdown path in case a process runs out of control.

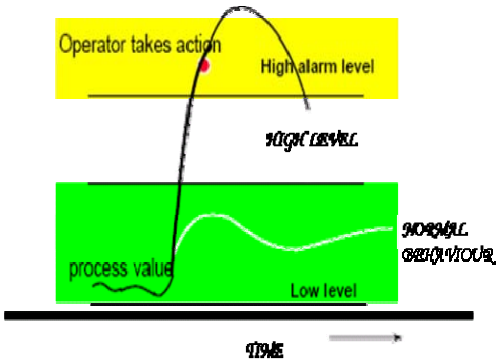
A process that run out of control can cause:

- **Damage to People (Both on & off site)**
- **Damage to Environment**
- **Loss of Equipment**
- **Loss of Production and there by loss of money**

1.2 Why Safety?

Safety is defined as a **"situation in which the risk is not higher than the risk limit".** Safety system takes care to keep the situation within the risk limit.

1.3 Demand for Protective Action

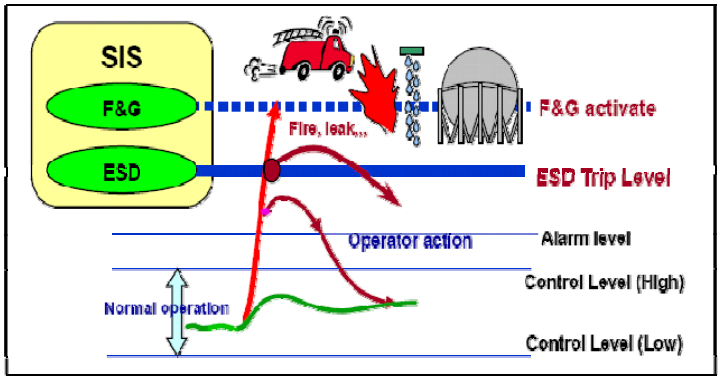


Sometimes things go wrong in the process and an operator takes action to keep the process within limits and It Works!!!!

If that does not work, there may be an accident...

To avoid such situation in some processes, a safety instrumented system (SIS) is also needed. It is configured to automatically respond to certain process conditions and will perform preprogrammed actions to mitigate the process condition.

1.4 Function of a SIS



SIS keeps the process from not crossing the safety limits.

As shown in the above figure while the process is within the range of normal behavior, the Basic Process Control System will meet all requirements to control the process.

As the process becomes more unstable and approaches the high alarm level, the BPCS may or may not be able to regain control of the process value in time to prevent an unsafe condition. It is expected that the operator takes action to control the process.

If the process value continues in a unsafe direction, the trip level is reached. The SIS executes an emergency shutdown action, preventing the process from exceeding the safe levels.

1.5 Safety Systems and their features.

Safety system is a control system comprising of sensors, logic solvers and final control elements designed to take process to a safe state when predetermined conditions are violated .

1.5.1 Applications of a safety system.

Some of the applications of the safety system are

- Emergency shutdown.
- Burner management.
- Fire and gas detection.

1.5.2 Differences between DCS and safety system.

DCS	SIS
Highly flexible	Fixed functionality
Configuration changes can be done online.	Complex procedures are involved in making any change.
Variety of online modifications can be done without much complicacy	The possibility to repair the hardware is limited while the plant is running
During the failure of the control system, state of outputs are unpredictable	Output state is predictable during the functional failure of a system.
Regular testing of control system is not required.	Explicit procedures are followed to test the system hardware.

1.6 Safety standards

The two most important standards for functional safety are IEC 61508 and 61511.The first one is used to design and manufacture safety systems.

The IEC 61511 is normally used during the design, startup and operation of a complete plant.

The standards specify all kinds of requirements for the complete life cycle of the plant. It starts with hazards analysis and definition of safety functions, then the design and testing of the safety system, requirements for operation and maintenance.

1.7 Properties of a Safety System

1.7.1 System failures

Failures can be divided in to

- Hardware failures
- Systematic Failures

Hardware failures are caused by the malfunctioning of the hardware component. Stress is the cause for failure.
The stresses can be of different types. Below are the few examples.

- Heat
- Chemical Corrosion
- Humidity
- Vibration
- Electrostatic Discharge
- Operational and maintenance Errors

Systematic failures are related to errors in software design. This can be corrected by reprogramming.

1.7.2 Process safety time.

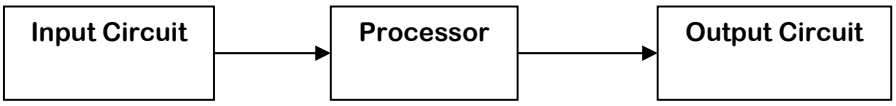
Process safety time is the maximum time between the demand and the necessary shutdown action. It is a property of the process. Reaction time of the safety function should be with in the process safety time.

1.7.3 Reliability

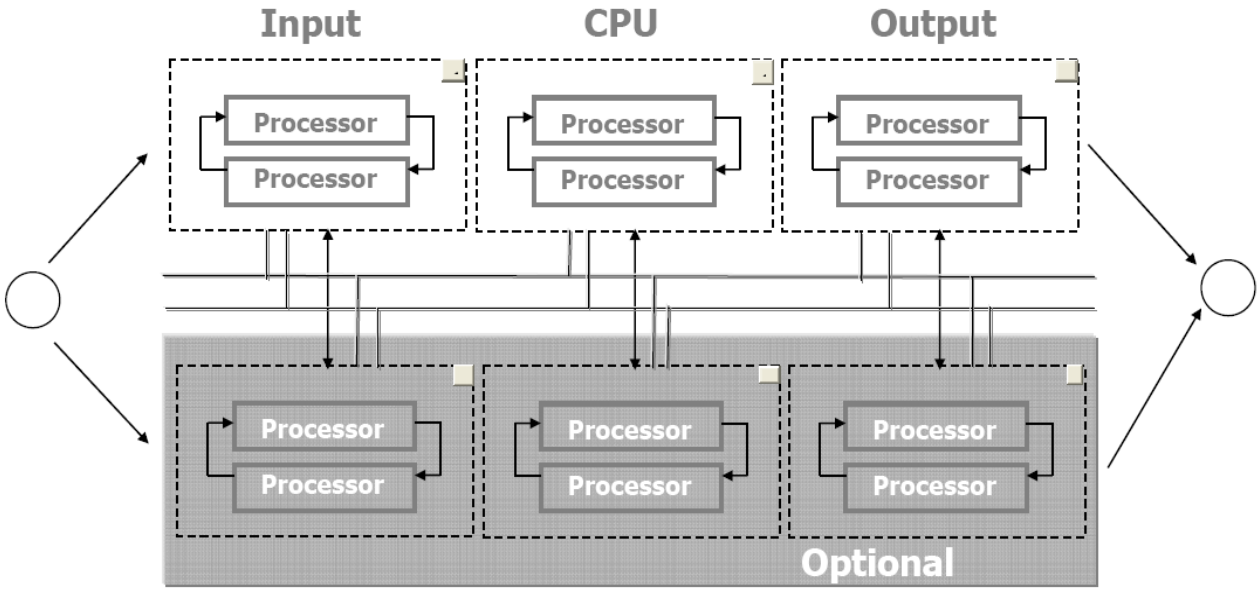
Reliability is a combination of safety integrity and availability.

1.8 Architecture

The simplest architecture of a safety function is shown in figure below. The input is sensed by a single input circuitry, this input will be evaluated by the processor and the output will be placed in the output circuit. The concept of redundancy and voting is common in SIS applications.



The Prosafe-RS is designed with an internal architecture of 1 out of 2 with Diagnostics.



1.9 Yokogawa’s Contribution to Industrial Safety

Industrial automation is at the heart of Yokogawa's business. For more than five decades, we have been developing the most comprehensive process control solutions for process industries worldwide. Deeply ingrained in our corporate culture are the principles that reliability is a top priority, and that system continuity and expandability are essentials.

To deliver a control platform in which our customers can have full confidence in solutions for the evolving safety environment, Yokogawa proudly releases ProSafe-RS, a revolution in safety instrumented systems.

2. PROSAFE-RS HARDWARE OVERVIEW

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2.7.6 SB Bus

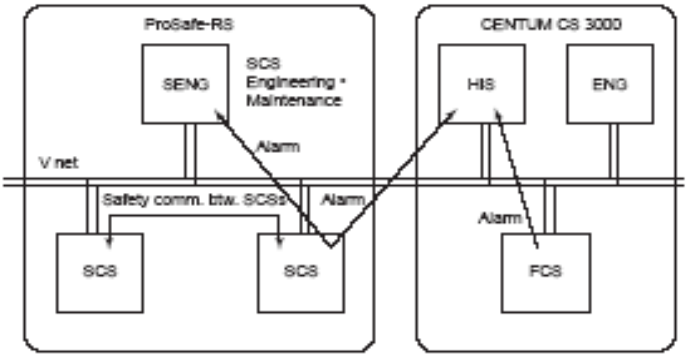
2.1 Introduction

Prosafe-RS is a microprocessor based Safety System designed specifically for critical applications such as: emergency shutdown systems, Burner management systems, fire and gas detection systems and high availability process control.

This chapter provides the details of the safety considerations for building the safety system with the ProSafe-RS.

2.1.1 Overview of ProSafe-RS

The ProSafe-RS is the safety system thatconsist of the safety controller, SCS, and an engineering and maintenance PC, SENG. The minimum configuration includes one SCS and one SENG.



2.1.2 Safety Application

ProSafe-RS is primarily used for the following safety applications. The use of the ProSafe-RS conforming to the standards for each application is also certified.

For the details of the requirements, refer to each standard.

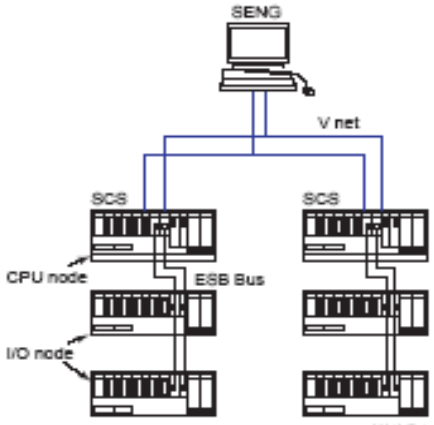
- ESD (Emergency Shutdown System) / PSD (Process Shutdown System)
- F&G (Fire and Gas detection System: EN54, NFPA72)
- BMS (Burner Management System: EN298, NFPA8501, NFPA8502, prEN50156)

2.2 System Configuration

2.2.1 ProSafe-RS Basic Configuration

ProSafe-RS consists of Safety Control Station (SCS) and Safety Engineering PC (SENG). Moreover, ProSafe-RS can build the system connected with CS 3000 and the system connected with other systems than CS 3000 via Modbus. The basic configuration of ProSafe-RS consists of SENG and SCS.

In the following figure, each of two SCSs has the CPU node which is connected to two I/O nodes. (I/O module can be installed in CPU node.)



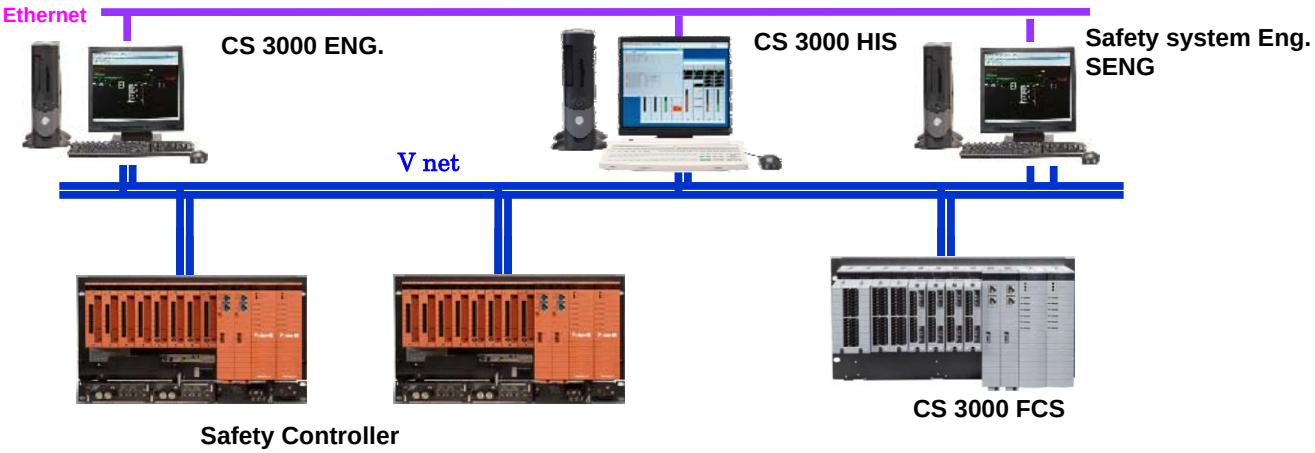
2.2.2 ProSafe-RS/CENTUM CS 3000 Integration Structure

The structure that connects ProSafe-RS with CS 3000 projects is called ProSafe-RS/CENTUM CS 3000 Integration Configuration. The below Figure illustrates an example of the system configuration of ProSafe-RS consisting of one SENG, two SCSs, a HIS and an FCS. SCS and SENG are connected with the control bus called V net. Safety communication through V net allows data to be sent and received between SCSs. In SCS, I/O can be expanded by increasing the number of I/O nodes.

For CS 3000 Integration Structure,

- Both FCS and SCS can be operated and monitored from HIS.FCS can communicate with SCS via V net. The communication has no impact on the safety functions running on SCS.

- SCS engineering is performed from SENG and FCS and HIS engineering from ENG. Engineering of the CS 3000 integration function is performed from both SENG and ENG. SENG functions, ENG functions and HIS functions can also be installed in several PCs as well as one PC



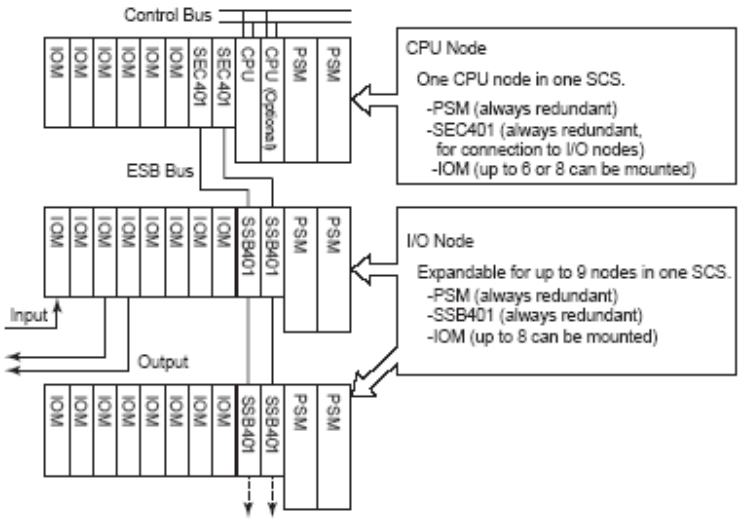
- The SENG is a general-purpose PC on which the engineering functions to build SCS applications are installed. An SCS application created by using of FBD (Function Block Diagram) and/or LD (Ladder Diagram) is called “Application Logic.” Each application logic is managed as part of the SCS project.

- The ENG is a general-purpose PC on which the CS 3000 system generation function is installed. Each CS 3000 application generated on the ENG is managed as part of the CS 3000 project.
- The HIS is a general-purpose PC on which the CS 3000 operation function is installed.
- SCS tags can be accessed from FCS. The data exchange between the SCS and the FCS will not affect the safety communication between two SCS.

2.3 Components of a Safety Control Station

A basic system is called safety control station. A SCS can communicate with the other stations via Vnet/Vnet/IP. SCS consists of a Safety Control Unit (CPU node) and several Safety Node Unit (I/O nodes). Up to nine I/O nodes can be connected.

The following figure is an example of hardware configuration of SCS.



Types of safety control unit:

There are two types of the safety control unit. The standard type safety control unit (Ambient Temperature: -20 to 50 deg.C) and wide range temperature type safety control unit (Ambient Temperature: -20 to 70 degc).

Safety Control Units (for V net)

- Standard Type Safety Control Unit (Model: SSC10S-S)
- Wide Range Temperature Type Safety Control Unit (Model: SSC10S-F)
- Duplexed Standard Type Safety Control Unit (Model: SSC10D-S)
- Duplexed Wide Range Temperature Type Safety Control Unit (Model: SSC10D-F)

Safety Control Units (for Vnet/IP)

- Standard Type Safety Control Unit for Vnet/IP (Model: SSC50S-S)
- Wide Range Temperature Type Safety Control Unit for Vnet/IP (Model: SSC50S-F)
- Duplexed Standard Type Safety Control Unit for Vnet/IP (Model: SSC50D-S)
- Duplexed Wide Range Temperature Type Safety Control Unit for Vnet/IP (Model:SSC50D-F)

2.4 Configuration of Safety Control Unit

2.4.1 Standard Type Safety Control Unit

The components of the standard type safety control unit are illustrated in the figure below.
In this figure, the control unit is a dual-redundantly configured unit. The power supply modules are always paired for redundancy. For a non-redundant configuration, a single processor module will be installed to the left-hand side slot. The slot at the right-hand side will be covered using a dummy cover. If the safety nodes are used, the ESB bus coupler modules will be installed in a redundant configuration

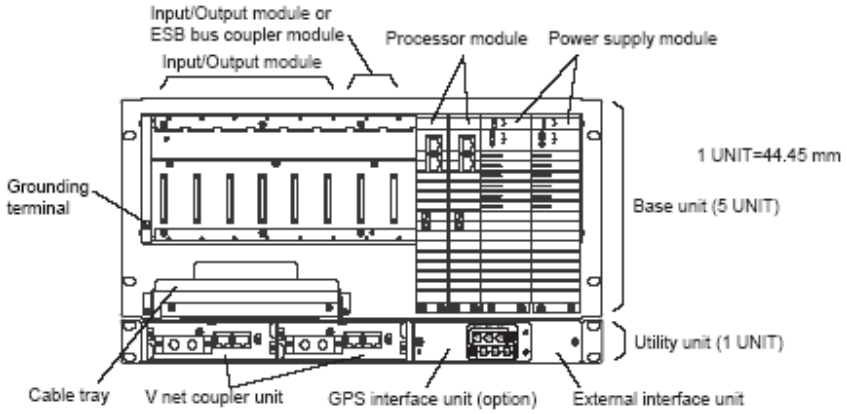


Table containing the components of Standard Type Safety Control Unit

Name	Standard type safety control unit	
	Single configuration	Duplexed configuration
Power supply module (100-120 V AC)	SPW481 2ps	SPW481 2ps
Power supply module (220-240 V AC)	SPW482 2ps	SPW482 2ps
Power supply module (24 V DC)	SPW484 2ps	SPW484 2ps
Processor module	SCP401 1ps	SCP401 2ps
Dummy cover (for processor module) (*1)	T9083VB 1ps	–
Dummy cover (for I/O module) (*2)	SDCV01 as requierd	SDCV01 as requierd
ESB bus coupler module (*3)	SEC401 2ps	SEC401 2ps
V net coupler unit	AIP504 2ps	AIP504 2ps
External interface unit (for standard type safety control unit)	S9158FA 1ps	S9158FA 1ps
GPS interface unit (option)	S9161FA 1ps	S9161FA 1ps

*1: For non-redundant configuration, to cover the slot at right-hand side of the single processor module.
*2: To cover the empty I/O module slot.
*3: Required if the safety nodes are used.

2.4.2 Wide Range Temperature Type Safety Control Unit

The components of the Wide Range Temperature Type safety control unit are illustrated in the figure below. This type of control unit consists of the standard type control unit and cooling fan unit so as to work in a wider range of ambient environment (-20 to 70 deg. C).

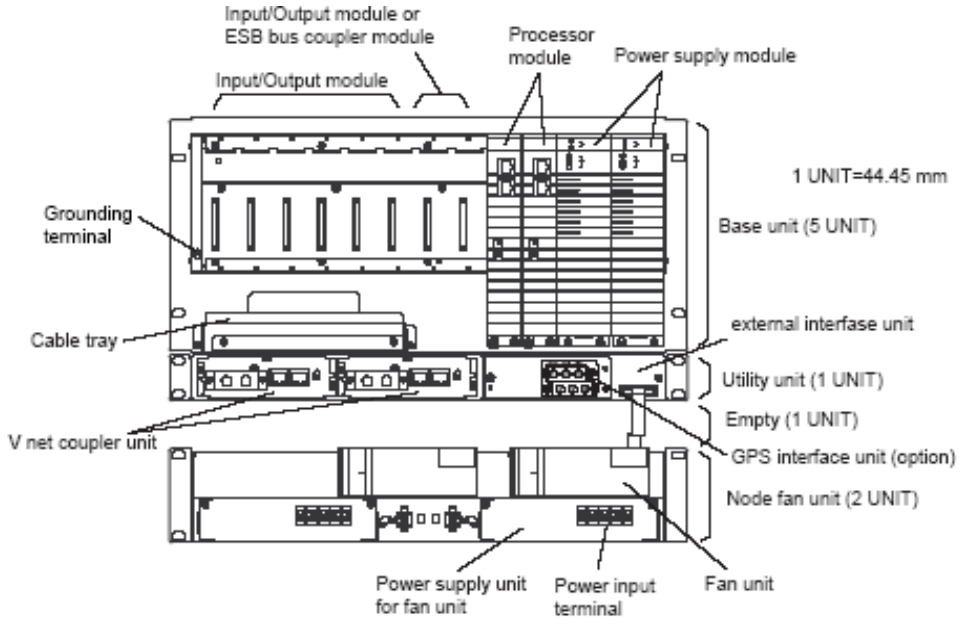


Table containing the components Wide Range Temperature Type Safety Control Unit

Name	Wide range temperature type safety control unit			
	Single configuration		Duplexed configuration	
Power supply module (100-120 V AC)	SPW481	2ps	SPW481	2ps
Power supply module (220-240 V AC)	SPW482	2ps	SPW482	2ps
Power supply module (24 V DC)	SPW484	2ps	SPW484	2ps
Processor module	SCP401	1ps	SCP401	2ps
Dummy cover (for processor module) (*1)	T9083VB	1ps	–	
Dummy cover (for I/O module) (*2)	SDCV01	as requierd	SDCV01	as requierd
ESB bus coupler module (*3)	SEC401	2ps	SEC401	2ps
V net coupler unit	AIP504	2ps	AIP504	2ps
External interface unit (for wide range temperature type safety control unit)	S9156FA	1ps	S9156FA	1ps
Power supply unit for fan unit (100-120/220-240 V AC)	S9159FA	2ps	S9159FA	2ps
Power supply unit for fan unit (24 V DC)	S9160FA	2ps	S9160FA	2ps
Fan unit	AIP602	2ps	AIP602	2ps
GPS interface unit (option)	S9161FA	1ps	S9161FA	1ps

*1: For non-redundant configuration, to cover the slot at right-hand side of the single processor module.
*2: To cover the empty I/O module slot.
*3: Required if the safety nodes are used.

2.4.3 Components of safety control unit SSC10D (for V net)

- **Power supply module (100-120 V AC): SPW481**
- **Power supply module (220-240 V AC) :SPW482**
- **Power supply module (24 V DC): SPW484**

- Processor module SCP401
- Dummy cover (for processor module): T9083VB
- Dummy cover (for I/O module): SDCV01
- ESB bus coupler module :SEC401
- V net coupler unit :AIP504
- External interface unit (for standard type safety control unit) :S9158FA
- GPS interface unit (option): S9161FA

2.4.4 Components of safety control unit SSC50D (for Vnet/IP)

- Power supply module (100-120 V AC)
- SPW481 Power supply module (220-240 V AC) SPW482
- Power supply module (24 V DC) SPW484
- Processor module SCP451
- Dummy cover (for I/O module) SDCV01
- ESB bus coupler module SEC401 2ps
- External interface unit (for standard type safety control unit) S9158FA 1ps

2.4.5 Processor module

- Control algorithm calculations are performed in the processor modules.
- Two types of processor modules are available: one for V net (Model: SCP401) and the other for Vnet/IP (Model: SCP451).

2.4.6 Battery

In order to protect the processor module management information (in the storage memory) during power failure, the Li batteries are used. Since the application program information is stored in the non-volatile memories, thus battery backup is not required.

Battery Back-up Specifications

Battery life Changes according to the ambient temperature.
- Three years if the average ambient temperature is 30 deg. C or less
- One year and a half if the average ambient temperature is 40 deg. C or less
- Nine months if the average ambient temperature is 50 deg. C or less

2.4.7 LED display on processor module

HRDY:

The processor module performs self diagnosis. If the processor module hardware is functioning normally, the green light turns on. If abnormality is found, the light turns off.

RDY:

The green light turns on if both the hardware and software are functioning normally. If either of them is abnormal, the light turns off.

CTRL:

The green light turns on if the processor module is performing control. If the processor module is standby, the light turns off. During the startup phase, the processor module installed at the right-hand side performs control.

COPY:

In the dual-redundant type safety control unit, the green light turns on when program copy is executed and turns off when program copy is completed. When a processor

module has been replaced or when the unit is stopped and then started again, the standby-side processor module automatically copies the program of the control-side processor module. When copy is completed, the light turns off. In the basic (single) safety control unit, the light is always off.

RCV:

Indicates the control bus communication status. 1 stands for control bus bus1 while 2 stands for control bus bus2. When receiving communication frames, the lamp flashes in green, otherwise the lamp is off.

SND:

Indicates the control bus communication status. 1 stands for control bus bus1 while 2 stands for control bus bus2. When sending communication frames, the lamp flashes in green, otherwise the lamp is off.

SYNC:

If the module is synchronizing with V net clock or IRIG-B clock, this lamp turns on green. Otherwise it turns off. If the module is synchronizing with Vnet/IP clock, this lamp turns on green. Otherwise it turns off.

SCTY:

The green light turns on when the security level of the SCS is online-level. If the security level of the SCS is offline-level, the light turns off.

2.4.8 Setting switches on processor module

START/STOP:

This maintenance switch is used for forcing the processor module CPU stop or restart. If this switch is pressed when the processor module is still operating, the CPU will stop. If this switch is pressed when the processor module is not operating, the CPU will restart. This switch is located inside a hole next to the START/STOP sign. Push the switch using a non conductive slender bar of around 1 to 2 mm diameter.

Battery ON/OFF switch:

When this switch is on, battery backup is activated for protecting the processor module management information (in the storage memory) during power failure.

ON: Enables the backup. Select this position during normal operation.

OFF: Disables the backup.

Front setting switch (6-bit DIP switch):

PORT: Port for maintenance (In usual operations, set to 0 position).

DOMN: Indicates the control bus domain number on SATUS LED when this bit is set to 1position. (In usual operations, set to 0 position).

STA: Indicates the control bus station number on SATUS LED when this bit is set to 1position. (In usual operations, set to 0 position).

ON : Force

OFF: Auto

2.4.9 ESB Bus Coupler Module

ESB bus coupler module (Model: SEC401) is installed in the safety control unit for communicating with the ESB bus interface module (Model: SSB401) installed in the safety node unit.

The ESB bus coupler module are always dual-redundantly configured.

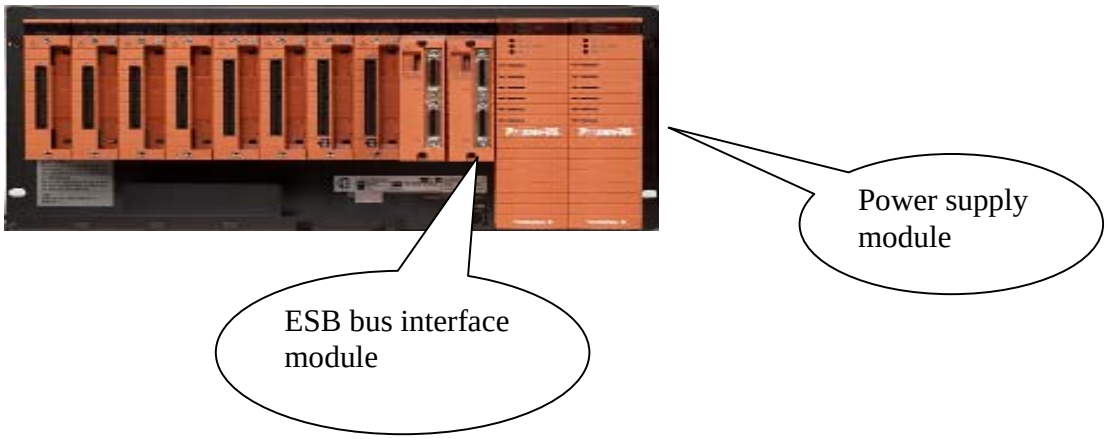
2.4.10 V net Coupler Unit

The V net coupler unit is installed in the safety control unit and located between the processor module and the V net cable so as to perform the signal isolation and signal level conversion.

2.5 Configuration of a Safety Node unit

The components of the safety node unit (Model : SNB10D) are illustrated in the figure below. The power supply modules and ESB bus interface modules are always dual-redundantly configured.

- Power supply module (100-120 V AC) SPW481
- Power supply module (220-240 V AC) SPW482
- Power supply module (24 V DC) SPW484
- ESB bus interface module SSB401
- Dummy cover (for I/O module) SDCV01 as required



2.5.1 Input and Output Modules

The ProSafe-RS input and output modules include the following types:

Analog Input/Output Modules
Digital Input/Output Modules
Communication Modules

2.5.1.1 Analog input modules

Analog input modules are used to read analog signal inputs and convert signals.

External View of Analog Input Module

The connections with the analog input modules vary with the types of adapters. Pressure clamp terminals, terminal boards (with signal cable adapters) and MIL cables are used for the connections.

The ProSafe-RS analog input modules consist of the following types:

- SAI143: 4 to 20 mA input, 16 Channels, Isolated.
- SAV144: 1 to 5V DC/1 to 10V DC input, 16 Channels, Isolated.
- SAI533 : 4 to 20 mA output, 8 Channels, Isolated.

Setup Elements

In the case of current input module, it can be set for each type of transmitter whether or not power is supplied using the setting pins.

Setting of SAI143

The jumper and pin set of S1 to S16 can be used for setting the power supply to the field devices. The jumper and pin set can be found on the right side of the SAI143 current input module. On factory delivery, power supply with two-wire is the default setting for all the channels.

Table Setting Pins of SAI143 Current Input Module

Display of setting pins	Setting pin	Power supply to transmitter		Remarks	Setting pin	Power supply to transmitter		Remarks
		Yes (2-wire)	No (4-wire)	Channel No.		Yes (2-wire)	No (4-wire)	Channel No.
S1 to S16 1 2 3 4 5 6	S1	1 2	2 3	1	S5	1 2	2 3	5
	S2	4 5	5 6	2	S6	4 5	5 6	6
	S3	1 2	2 3	3	S7	1 2	2 3	7
	S4	4 5	5 6	4	S8	4 5	5 6	8
	S9	1 2	2 3	9	S13	1 2	2 3	13
	S10	4 5	5 6	10	S14	4 5	5 6	14
	S11	1 2	2 3	11	S15	1 2	2 3	15
	S12	4 5	5 6	12	S16	4 5	5 6	16

2.5.1.2 Digital Input/Output Modules

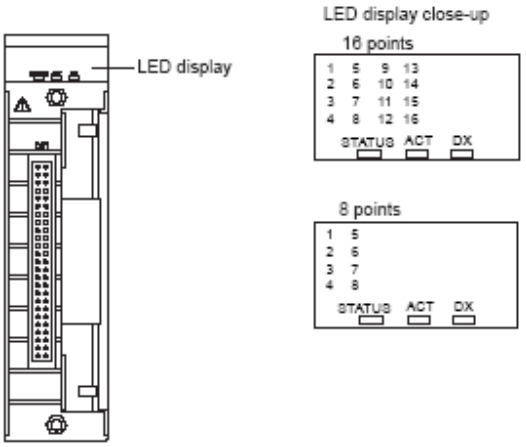
The input digital signals are converted into the internal data in the safety control unit and then the converted data are output.

External View of Digital Input/Output Module

The connections with the digital input modules vary with the types of adapters. Pressure clamp terminals, terminal boards (with signal cable adapters) and MIL cables are used for the connections.

The ProSafe-RS digital input modules consist of the following types:

- SDV144 : Non-voltage contact input, 16 Channels, Isolated
- SDV531 : 24V DC output, 16 Channels, Isolated
- SDV521 : 24 V DC output, 4 Channels, Isolated
- SDV531-L : 24 V DC output, 8 Channels, long distance type.
- SDV541 : 24 V DC output, 16 Channels, Isolated

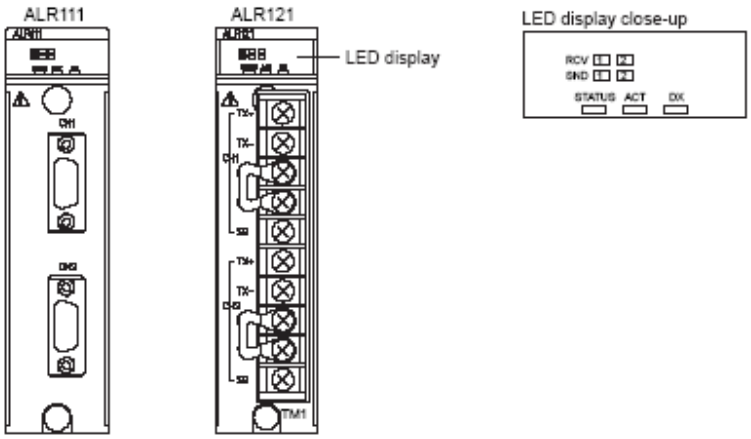


2.5.1.3 Communication Modules

The communication module is used for linking the safety control station with external devices through the communication lines as well as converting the communication data.

External View of Communication Module

The following types of communication modules are available.
- ALR111 : RS-232C communication module
- ALR121 : RS-422/RS-485 communication module



2.5.1.4 Accessories Related to Input/Output Modules

The following accessories related to I/O modules are available:

- Pressure clamp terminal blocks
- Signal cable adapters
- Terminal boards
- Wiring Check Adapter for Digital Input
- Relay boards

Pressure Clamp Terminal Blocks:

The pressure clamp terminal block is used for wiring the field devices directly to the I/O module. The block can be used for either redundant or non-redundant wiring scheme.

Types of Pressure Clamp Terminal Blocks:

The following types of pressure clamp terminal blocks are available according to the purpose.

Configuration	Model	Name	I/O points
Single	STA4S	Pressure clamp terminal block for analog	16-channel
	STB4S	Pressure clamp terminal block for digital input	16-channel
		Pressure clamp terminal block for digital output	8-channel
Dual-redundant	STA4D	Dual-redundant pressure clamp terminal block for analog	16-channel
	STB4D	Dual-redundant pressure clamp terminal block for digital input	16-channel
		Dual-redundant pressure clamp terminal block for digital output	8-channel

Signal Cable Interface Adapters:

The adapters used for linking the signal cables very with the types of I/O modules.
The signal cable adapters are used together with the terminal boards.

Types of Signal Cable Interface Adapters:

The following models of signal cable adapters are available.

Model	Name	Description
STK4A	KS1 cable interface adapter	Used together with SAV143or SAI144, connect to SEA4D by KS1 cables.
STD4A	AKB331 cable interface adapter	Used together with SDV144or SDV531, connect to SED4D by AKB331 cables.

Terminal Boards:

The terminal boards are used to connect the field devices for passing the signals. The terminal boards are used together with the signal cable adapters.

Types of Terminal Boards

Terminal boards are classified into the following types, depending on the number of input/output channels, whether or not they are isolated, etc. Each type supports both single and dual-redundant operation.

Model	Name
SEA4D	Terminal board for analog (single and dual-redundant)
SED4D	Terminal board for digital (single and dual-redundant)

Wiring Check Adapter for Digital Input:

The wiring check adapter for digital input is a device for inspecting the wiring conditions between the digital input module and the field device so as to find out the short circuit and breakage problems.

Types of Wiring Check Adapter

The following two models of wiring check adapters are available.

SCB100 : For testing OFF input loop breakage

Putting this tester in parallel with the sensor switch, the breakage of the loop for the OFF signal can be found.

SCB110 : For testing ON input loop short circuit

Putting this tester in series with the sensor switch, the short circuit of the loop for the ON signal with the power line can be found. The short circuit with other signals channels can also be found. When testing the breakage or short circuits, other than using the wiring check adapters, other diagnostic features of the input modules should also be activated.

Relay Boards:

The relay board amplifies the signals from the digital output module and outputs the amplified signals to field devices.

The following models types of relay board are available with different numbers of contact outputs

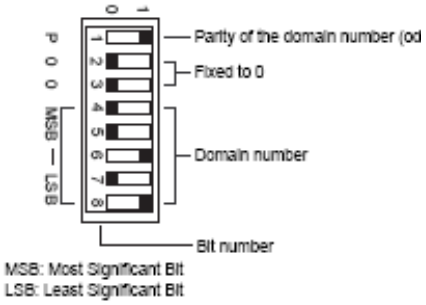
- SRM53D : 8x2 dry contact outputs (M4 terminals)
- SRM54D : 16x1 dry contact outputs (M4 terminals)

2.6 Addressing

2.6.1 Setting the Domain Number

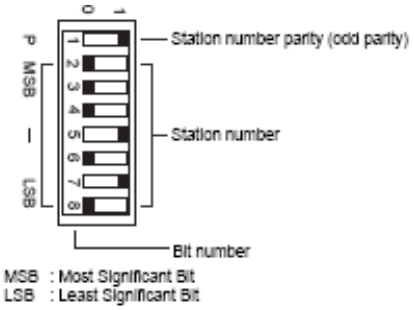
A domain stands for a range of stations connected by a single train of the V net/Vnet IP. Set the domain number to a value from 1 to 31.

To set a domain number, set the dip switches as follows. Bits 2 and 3 must always be zeros (0s).



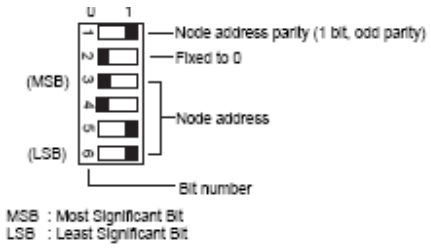
2.6.2 Setting the Station Number

Set the station number to a value from 1 to 64. To set a station number, set the dip switches as follows.



2.6.3 Setting Node Addresses

The node addresses on the ESB bus are set using the node address setting switch. Node numbers on the safety node unit must be designated in the range from 2 to 10. Node number 1 is reserved for the safety control unit. It is possible to match the required node numbers by setting the DIP switches as shown below.



2.7 Redundancy

ProSafe-RS supports dual-redundant configurations of SCS CPU modules and input/output modules. With the dual-redundant configuration, the continuous controllability and operating efficiency can be improved. Moreover, with dual-redundantly configured hardware, the continuity of plant safety monitoring will be guaranteed by swapping the control rights when an error occurs in the SCS hardware.

2.7.1 CPU Module

• The CPU module on the standby side performs the same control processing as the control side even while it is in the standby status. For this reason, it is possible to take over outputting data immediately after the control right is switched. Moreover, the operating mode of the SCS does not change.

• Only the CPU on the control side accesses the hardware composing the SCS and the CPU on the standby side always sets the equivalent value as the processing result. Therefore, the CPU modules on both sides always perform processing using the same data.

• In redundant configuration, if the CPU module on the standby side is not in the STBY status and the control right cannot be switched, the same operation as single configuration CPU module is performed.

• SOE data related to discrete inputs may be lost when the control right is switched between the CPU modules.

2.7.2 Input/Output Modules

In an SCS, it is possible to mount input/output modules of the same type in two adjacent slots (*1) to make them redundant. In the case of redundant configuration, one side becomes the control side and the other becomes the standby side. Switching of the control right is performed by input/output modules. The switching has no influence on the application logic.

• It is not allowed to have redundant configuration across two nodes.

• SOE data related to discrete inputs may be lost when the control right is switched between the input modules even though the frequency is low

Table Operation of Redundant Input/Output Modules

Input/output module	Redundant operation
Analog input module Discrete input module	The input signal from the field is received in discrete input modules on both the control and standby sides. In the SCS, the input data of the input module on the control side is stored in the input variable
Discrete output module	The SCS outputs the same value for output modules on both the control and standby sides. Only the output module on the control side outputs signals to the field. If an error occurs on the module on the control side, the control right is switched and outputting is continued

2.7.3 V Net Communication

The SCS V net communication is redundant. The communication couplers are also redundant. The CPU has a communication interface that supports the redundant V net. In redundant configuration, an SCS performs communication while switching the bus to be used at regular intervals.

2.7.4 Power Supply Module

Redundant power supply modules are mounted on both the CPU nodes and I/O nodes of an SCS. The SCS monitors the power supply status at regular intervals and, if an error occurs, it notifies the fact to the user via the Status Display window of the SENG and HIS as well as through a diagnostic information message.

2.7.5 ESB Bus and SSB401

The ESB bus is redundant. An SSB401 is connected to the two ESB buses, respectively.

• Normally, redundant ESB buses are used in an alternating fashion.

• If an error occurs in an SSB401 on one side, the error is notified to the user via a diagnostic information message. If both modules fail, the error is treated as a node failure.

• If an error occurs in one bus or SSB401, the SCS continues communication using only the normal ESB bus on the other side.

• An erroneous bus is monitored for normal recovery at regular intervals.

• All errors in communication with any I/O node, except for CPU nodes, are judged to be ESB bus errors.

2.7.5 SB Bus

The SB bus is a backboard bus that connects the SSB401 and each input/output module. The SB buses are redundant. Since each bus is connected to one SSB401 in a one-to-one fashion, the SB bus is switched whenever an SSB401 is switched.

• If an error occurs in one SB bus, the error is notified to the user via a diagnostic information message. If both buses fail, the error is treated as a node failure.

• In the case of “one-side” failure of an SB bus, only the ESB bus connected to the normal SB bus is used.

03. INTRODUCTION TO WORKBENCH

Table of contents

3.1 Introduction

Prosafe-RS Workbench is the software program used to configure the Prosafe-RS system.

The workbench also provides the user with the ability to:

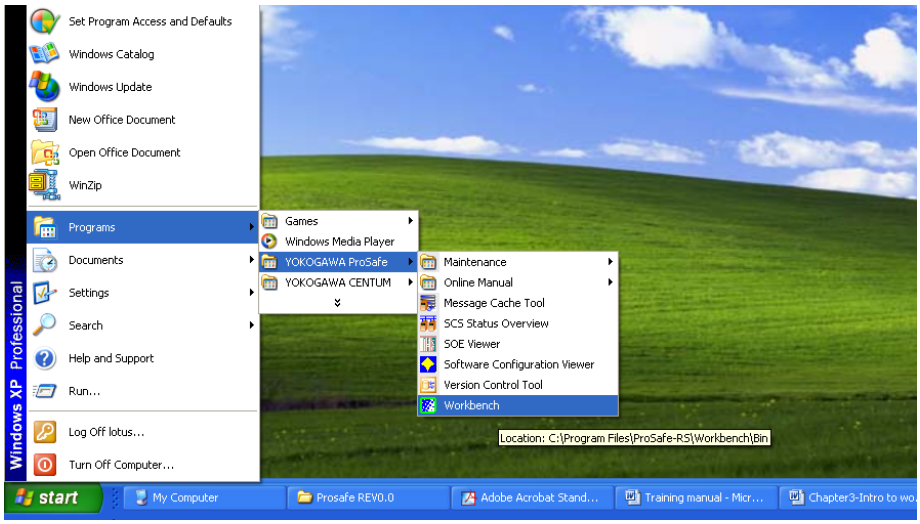
- **Transfer configuration to PLC**
- **Edit a project.**
- **View and update variables.**
- **Perform system troubleshooting.**
- **Produce documentation for a configuration.**

Two languages are available for configuring the Prosafe-RS system.

- **Function Block Diagrams.**
- **Ladder Diagrams.**
- **Structured Text Language**

Launching the work bench

To launch workbench software, click on start->Program-> Yokogawa Prosafe->Workbench.

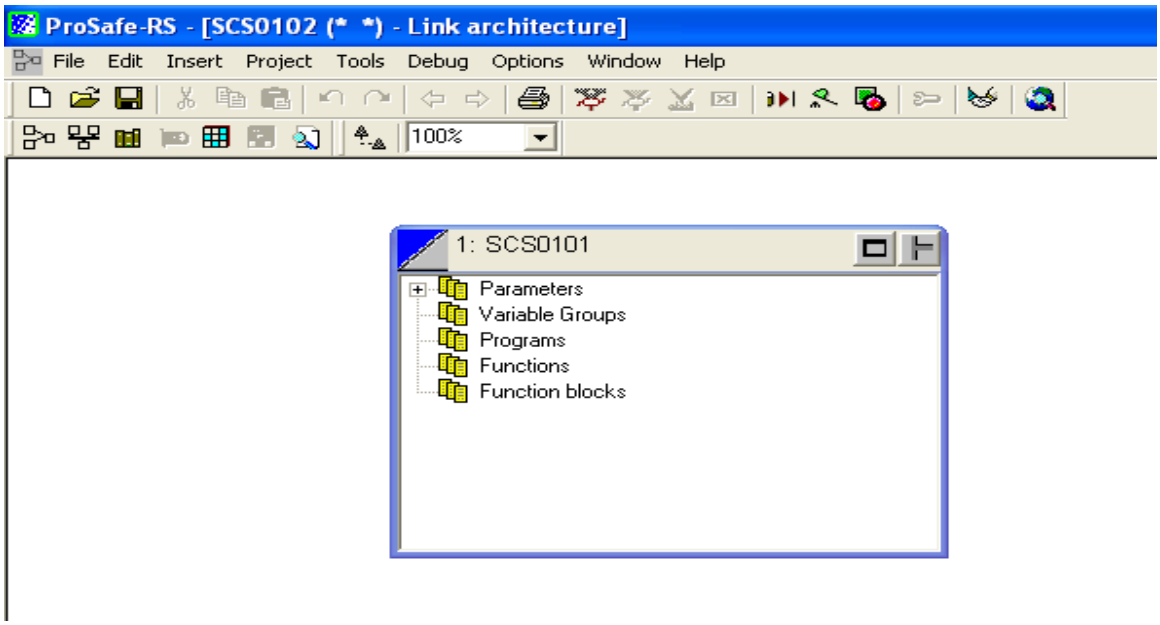


3.2 Main screens of workbench

3.2.1 Link architecture Window

When a new or existing project is opened, the main window of workbench will appear. This window is called Link Architecture window.

Creation, deletion and copying of POU's are performed in Link Architecture View of SCS Manager. Click the "Link Architecture View" button on the toolbar of SCS Manager.



Link Architecture window can be used to, Rename the resource.

The resource name is same as the project name.

Link Architecture window can also be used to, Edit SCS Resource properties.

Right click the resource on Link Architecture View and then choose [Properties] from the pop-up menu so as to display the Resource Properties dialog box. The resource number can be defined on the General tab.

Specify “SCSddss” for the resource name and “ddss” (dd: domain number, ss: station name) for the resource number.

The link architecture view graphically displays the resources of a Project and the resource data links between them. This is the default view of the Workbench providing a main entry point to all editors. In the link architecture view, you manage many aspects of a project

- defining variable groups
- creating and manipulating POUs (Program Organization Units)
- setting up I/O wiring

Resource Window Workspace

The Workspace displays a graphical representation of the various components of each resource.

- Parameters
- Variable Groups
- Programs

- Functions
- Function Blocks

To expand / collapse any branch of the hierarchy

Editing Resource Properties

You need to define several properties at the resource level, intimately linked to targets (and their implementation). These properties determine the behavior of the programs and hardware, e.g., the type of code generated, the timing, and Hardware specific properties. These properties are:

- Resource Identification
- Compilation Options
- Run-time Settings
- Resource Network Parameters

Variable Bindings

Bindings are directional links, i.e., access paths, between variables located in different resources. One variable is referred to as the producing variable and the other as the consuming variable. The value stored in the producing variable is transferred to the consuming variable. The Workbench enables two types of bindings: internal bindings and external bindings. Internal bindings are between resources within the same project. External bindings are between resources belonging to different projects.

Variable Groups

Variables Groups provide a method of managing variables and logically sorting them within a resource. The variable groups are shown in the Variables Tree, their contents are defined within the Dictionary Variables grid. You can perform tasks to manage variable groups:

- Creating Variable Groups
- Opening Variable Groups

POUs (Program Organization Units)

A POU (Program Organization Unit) is a set of instructions written in one of the following languages: ST, FBD, and LD. POUs can be programs, functions, or function blocks.

You can perform many tasks when managing POUs:

- Creating POUs
- Manipulating POUs

You can create, i.e., add, POUs (programs, functions, and function blocks) in resources while in the link architecture view. You add POUs using the main menu or a contextual menu accessed by right-clicking the respective component (Program, Function, or Function Block) within a resource. After having created a POU, you can drag and drop it to a new position in its section, to another section, or to

another resource. POUs belonging to a same section must have different names. POU names must begin with a letter.

Controlling Access to POUs

You can control access to user-defined POUs using a password. When you set a project with the read-only access control, the resources and POUs making up the project are also set to the read-only mode except for those having individual access control. For instance, a POU having its own password remains locked and cannot be viewed without entering its password. When moving or copying a POU using its resources password, the POU retains this password.

The security state of a POU is indicated by its icon in the resource:

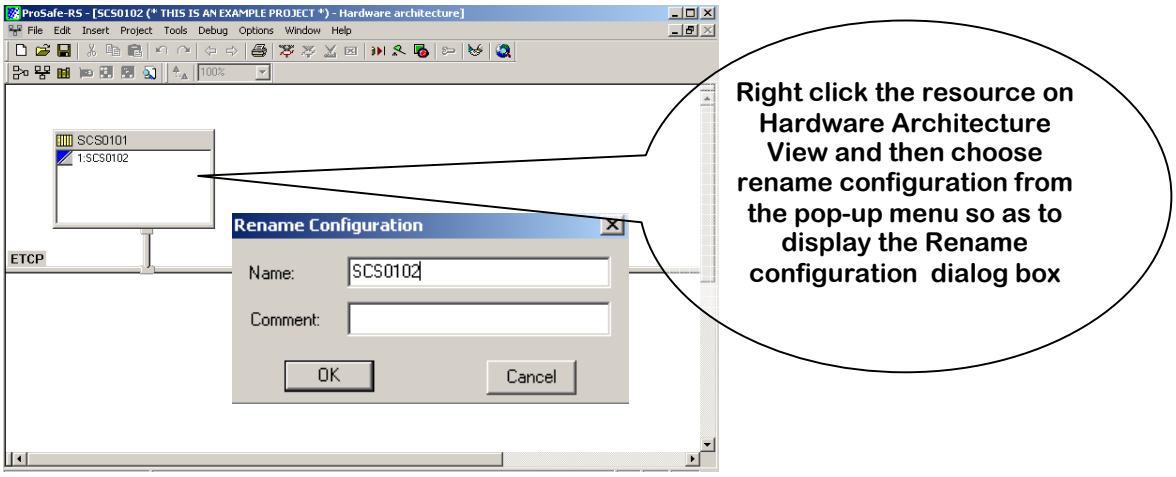
POU Icon	Security State
	Yellow. The POU has no access control. All users have read and write access in the POU. In the dictionary view, local variables and parameters are visible and editable.
	Red. The POU is locked. Users not having the POU password cannot access the POU; these users do not have read or write capabilities. In the dictionary view, local variables and parameters are visible but not editable.
	Cyan. The POU is in read-only mode. Users not having the resource password can view the POU; these users do not have write capabilities. The read-only mode for the POU is inherited from the resource to which it belongs. In the dictionary view, local variables and parameters are visible but not editable.
	Green. The POU is unlocked. User can access the POU; this user has read and writes capabilities. In the dictionary view, local variables and parameters are visible and editable.

3.2.2 Hardware architecture

Hardware architecture window is used to,

Rename the configuration.

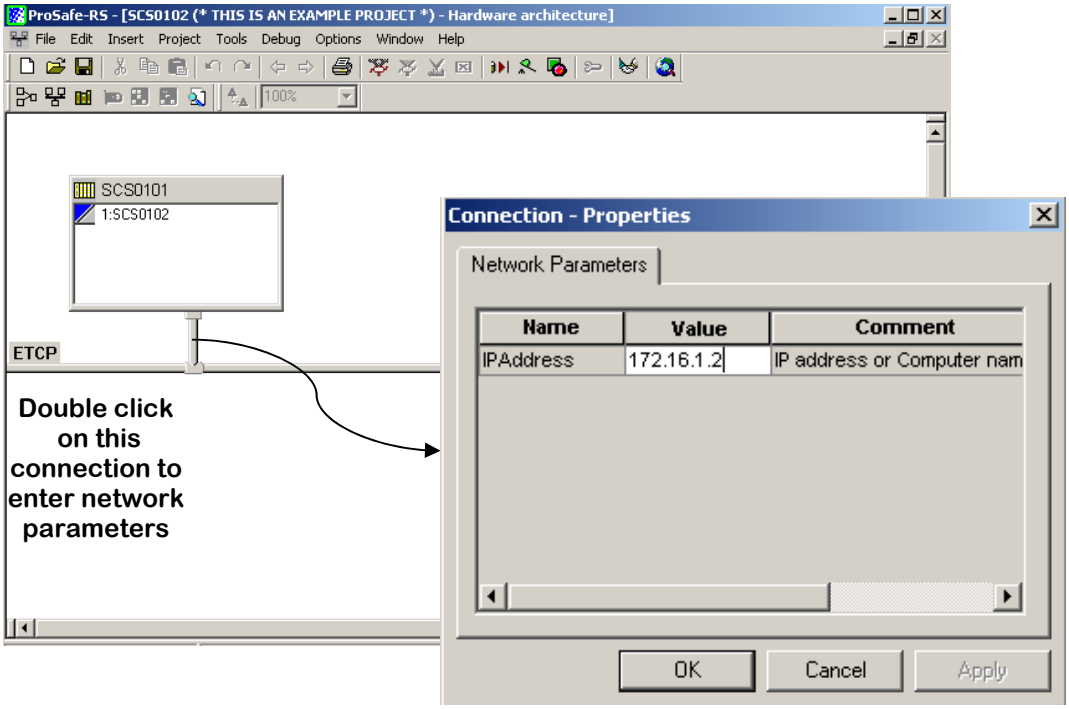
The configuration is same as the project name.



To set the IP address:

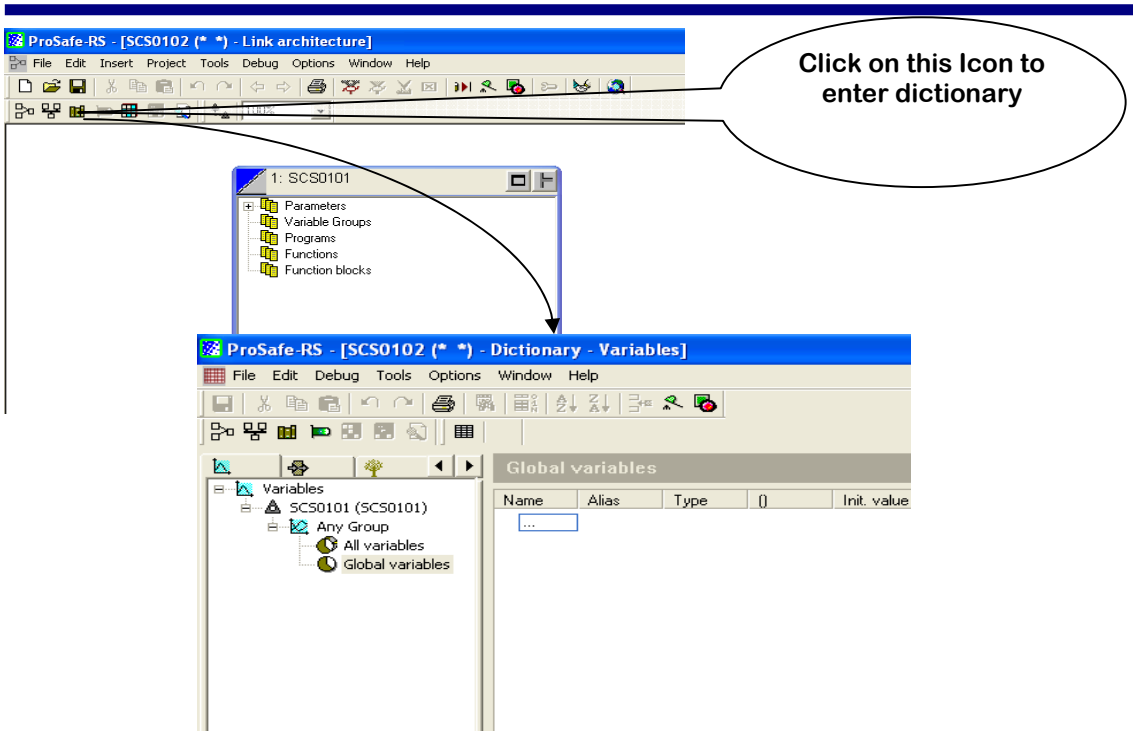
The IP address can be defined on Hardware Architecture View. Double click “Connection” so as to display Connection - Properties dialog box. The IP address needs to be set for “Value” item.

In general the IP address should be “172.16.dd.ss” (dd: domain number, ss: station number).



3.2.3 Dictionary View

Dictionary is an editing tool using tree views and grids for the declaration of the variables, functions, function block parameters, user types and defined words of the project.



The various components are sorted in a tree-like hierarchy, e.g., by resource or by Type. The Tree name is displayed on the window title bar.

The four dictionary tree views are:

- Variables Tree
- Parameters Tree.
- Types Tree
- Defined Words Tree

3.2.3.1 Variable Tree

Under the Variable tree in Dictionary it is possible to define variables in to variable groups.

Local Variables:

Variables those are unique within a POU.

Global Variables:

Variables those are unique within a resource.

Physical IO Variables:

Physical IO signal that are unique within a resource.

Producer/Consumer Variable groups:

To perform the Inter- SCS communication.

***Variables must confirm to the following rules:**

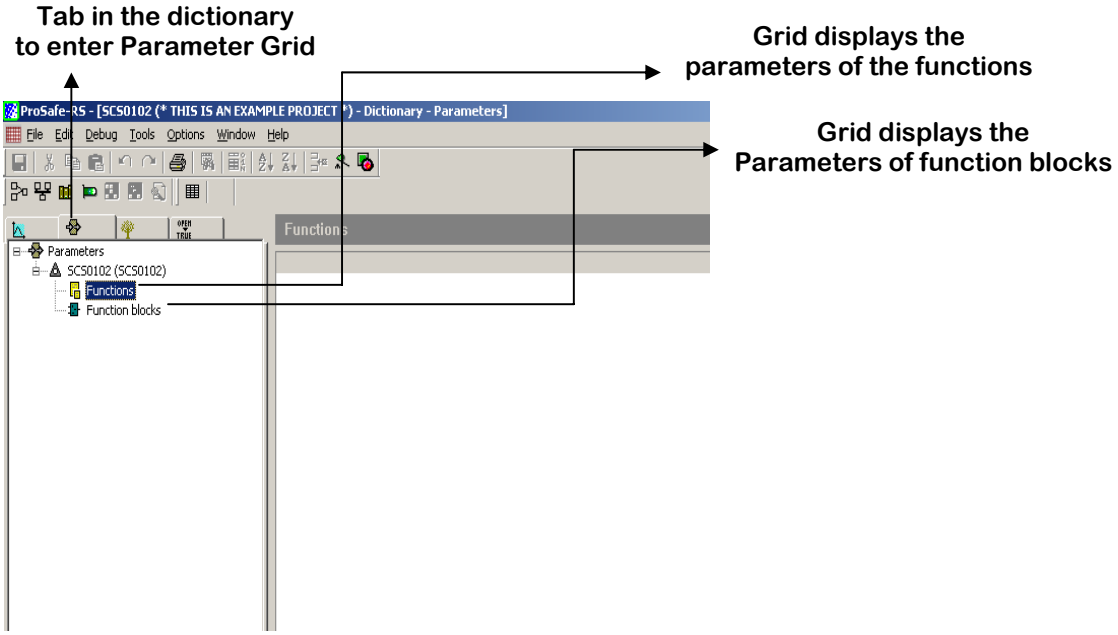
- Names cannot exceed 16 characters.

- The first character must be a letter.
- Subsequent characters can be letters, digits or the underscore character.
- Global variable names may not be duplicated within a resource.

3.2.3.2 Parameter tree

The Parameters grid defines the interface of the functions and function blocks created in the project resources.

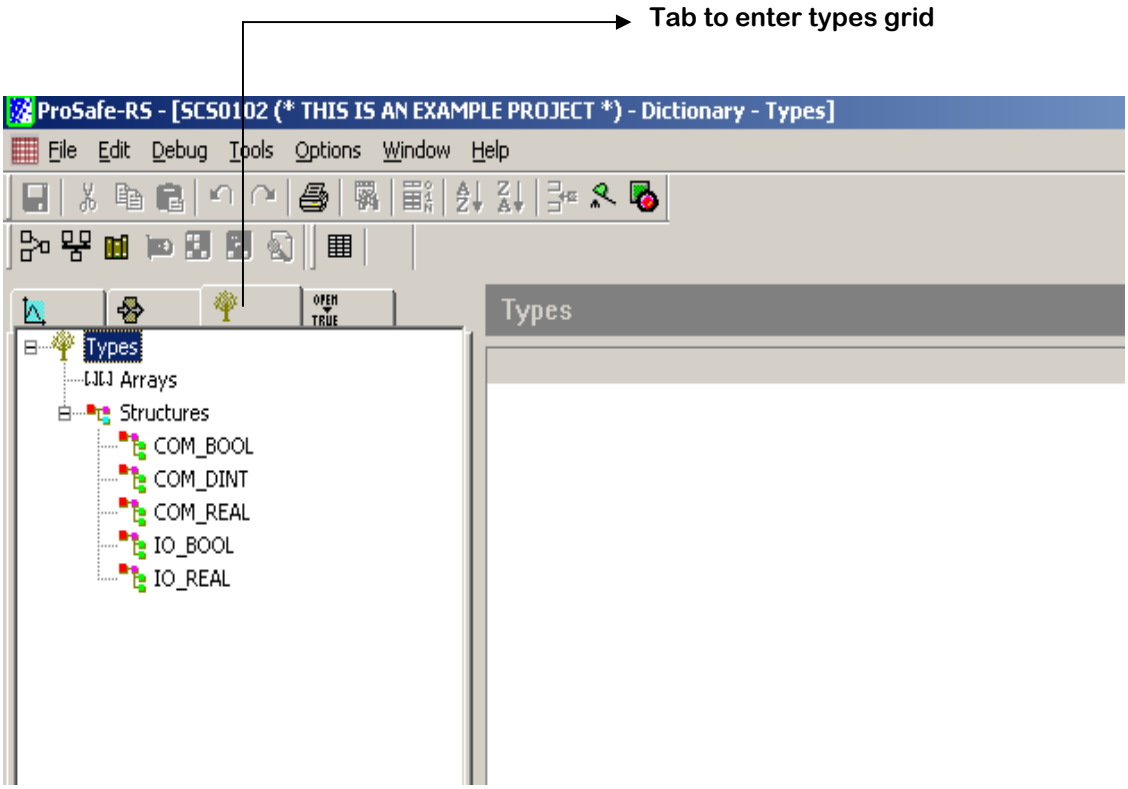
Display of the Parameter Tree in dictionary:



3.2.3.3 Types Tree

This Grid is available only for viewing not for defining new types.

Display of the Types Tree in dictionary



3.2.3.4 Defined words Tree

The defined word grid is used to create terms which are clearer to the user in Ladder logic or in FBD. The term 'Switched_off' is more meaningful than true.

The parameters in defined words tree:

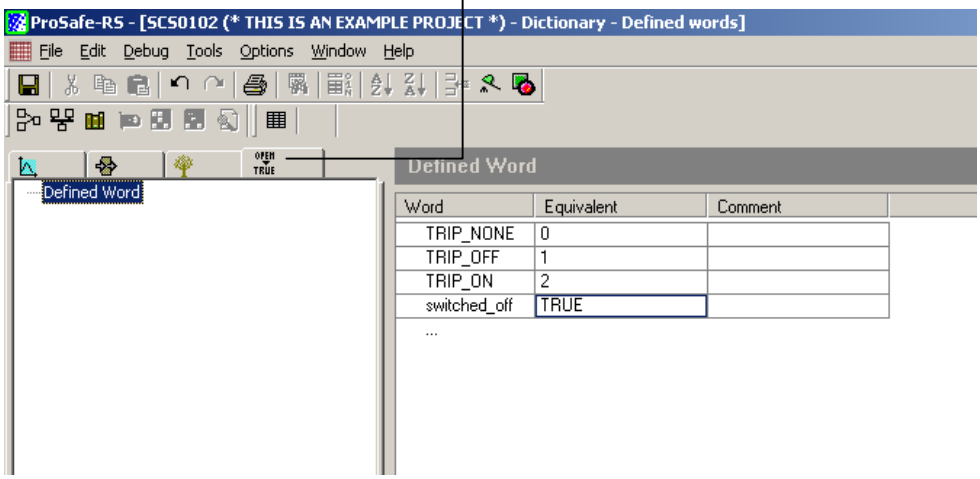
Word:
Name consisting up to 16 alphabetical characters, starting with an alphabetic character.

Equivalent:
Alias name up to 16 alphanumerical characters.

Comment:
Used for more detailed information.

Display of defined words grid in dictionary.

Tab to enter defined words grid in Dictionary

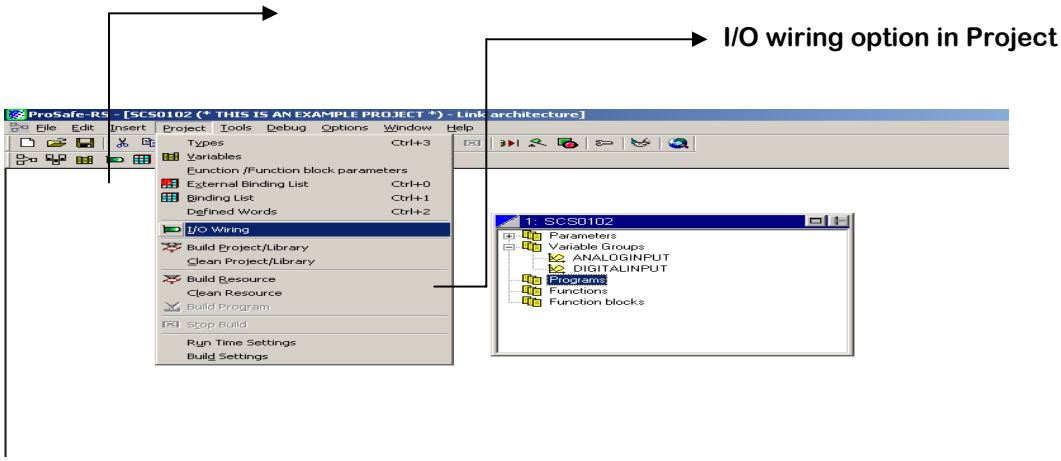


3.2.4 I/O Wiring

I/O wiring enables you to define links between the variables defined in a project and the channels of the devices existing on the target system. Wiring is performed at the resource level; therefore, I/O wiring is only available when a resource is selected in either the link architecture or hardware architecture views.

I/O wiring icon in Link Architecture

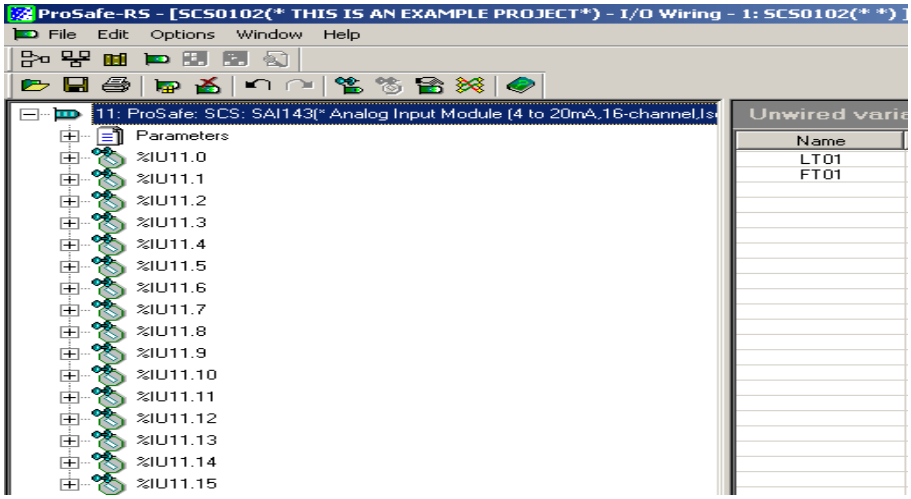
I/O wiring option in Project



Appearance

The I/O Wiring view is displayed in the workspace. The menus and toolbar now reflect I/O Wiring options only.

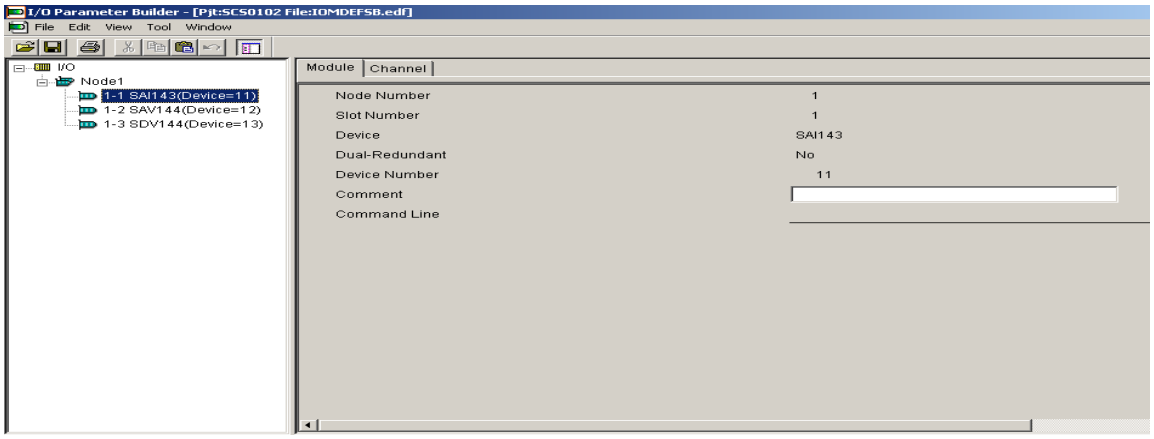
The left of the I/O Wiring Workspace is a hierarchical 'Tree View' of defined I/O modules. The right side of the workspace displays a grid-like table of the free (unwired) variables of the current resource. These unwired variables are listed in alphabetical order. A Splitter is available to change the proportion of the width of the Tree and grid windows.



3.2.5 I/O parameter builder setting.

'I/O Parameter builder' can be selected from Link architecture window by going to Tools->Engineering->I/O Parameter builder.

After an I/O card has been defined and the variables have been connected to the physical I/O, this builder is used to set the various parameters related to this I/O point. The information differs for every I/O card.



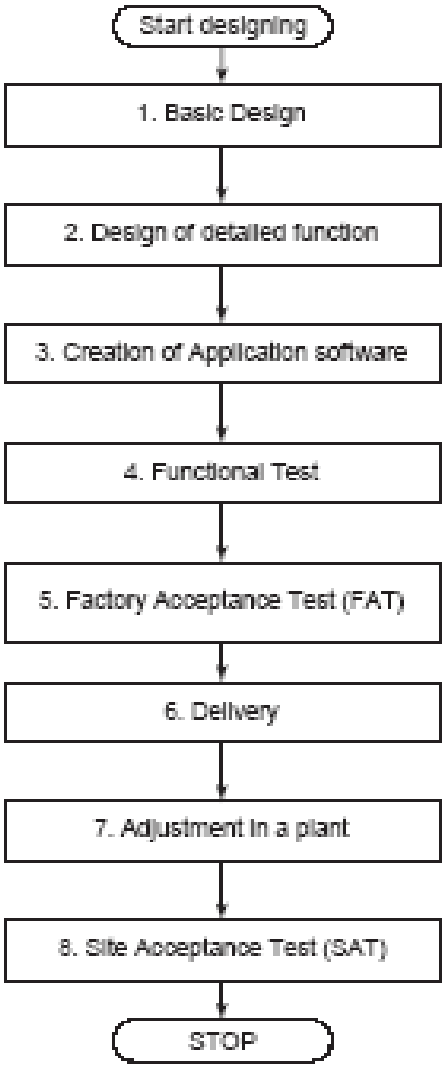
4. ENGINEERING IN PROSAFE-RS

Table of contents

4.1 Procedure for Engineering

Prosafe-RS is the Safety Instrumented System (SIS) comprising Safety Control Station (SCS) and Safety Engineering PC (SENG). Prosafe-RS and CENTUM CS 3000/CENTUM VP which is a Distributed Control System made by Yokogawa, can be integrated.

The regular procedure for engineering from designs to start of operation including manufacturing, inspecting and commissioning is shown as follows.



1. In Basic Design, the following items are decided based on user's requirements and specifications.

- **The making of safety specification**
- **System configuration and hardware**
- **The number of I/Os**
- **Safety level (SIL) of loop**
- **Signal interface with another system**

The following documents are made as a result of these works.

• Diagrams of the system structure

• Hardware specifications

• I/O lists

• System basic design document

• List of interface with other systems

2. Based on the user's requirements and specification, functional specifications are made. Detailed logic like shutdown logic is included in the functional specifications.

3. ProSafe-RS projects and applications are created on a PC installing the SENG Function.

4. Functions of the created application are checked. After making a document about the Test Specification, usually testing of functions is conducted in the following order.

1) Desk test
The created applications are checked with self documents on the desk.

2) Unit test-1
Created application logics are verified. SCS simulation and Logic simulation test on SENG can be used for this verification.

3) Unit test-2
In the target test using SCS, the overall logic etc. are verified.

4) Integration test
The integrated final test is conducted on the SCS target. Before the test, it is required to provide an environment, where SCS can be used, in combination with panel, console, a host computer and other subsystems. The testing for system failure such as hardware failure is also conducted.

5. Hardware and software Factory Acceptance Test (FAT) is conducted in the presence of users.

6. Hardware and software which the user has confirmed in FAT are delivered.

7. Hardware and software which are installed in the plant are adjusted.

8. The Site Acceptance Test (SAT) is conducted to hand over the system to the user.

4.2 Classification of SCS Application

Below are the applications that are running on a SCS.

• Safety Application
This is an application which executes safety functions. The safety application includes application logic written in the language conforming to the IEC 61131-3 standards.

The following programming languages defined in IEC 61131-3 are available for SCS.

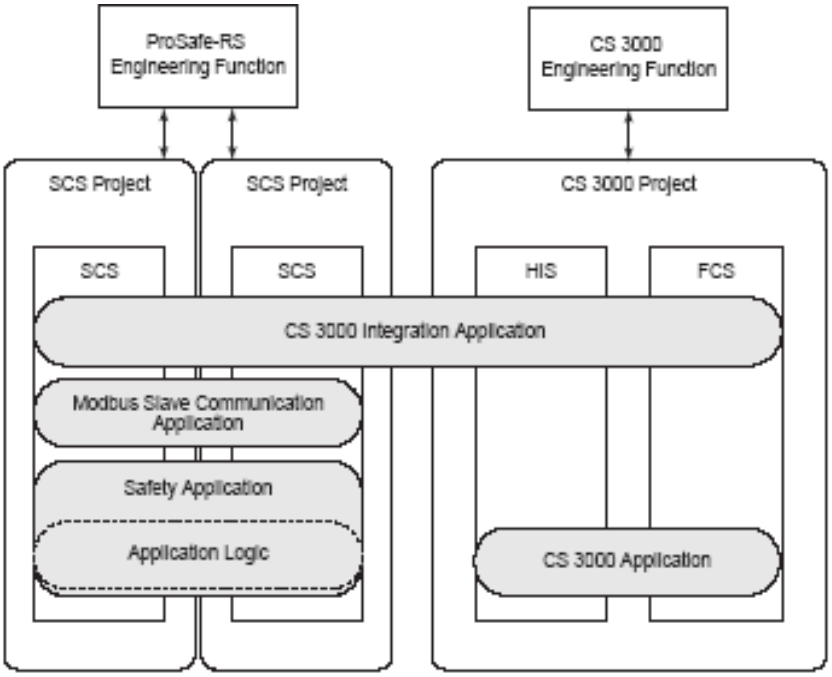
- Function Block Diagram (FBD)

- Ladder Diagram (LD)

- Structured Text (ST)

• CS 3000 Integration Application
This is an application for exchanging data with CS 3000, which is needed for the CS 3000 Integration Structure.

• Modbus Slave Communication Application
This is an application for exchanging data with other systems connected via Modbus.



4.3 Restriction on System configuration

Number of Stations

The maximum number of connectable stations within one system is shown below whether it is the ProSafe-RS Basic Configuration or CS 3000 Integration Configuration. The systems can be extended up to the following numbers.

• Domains that can be connected: 16

• Stations that can be connected in a domain: 64

• Stations that can be connected: 256

• Hierarchy: three-level hierarchy. The range where up to 2 BCV and 2 CGW (two pairs of CGWs) can be used to relay is communicable for Inter-SCS communication. For CS 3000 HIS, the limit is 16 stations/domain at maximum. When using multiple domains, BCV, CGW, V net Routers and CS 3000 ENG function are required.

Number of SENG

One SENG at least is required.

Number of SCS

The number of stations should be within the limit. Connect Vnet/IP domains on each Bus with a Layer 3 switch (L3SW). This also requires the CS 3000/Centum VP ENG function.

Vnet/IP Domains Connection Specifications

• Number of connectable domains: 16 (Total of Vnet/IP domains and V net domains)

• Number of Layer 3 switches (L3SW) allowed: 15 levels

Connection Specifications in a Vnet/IP Domain

• Number of connectable Vnet/IP stations: Max. 64 (Vnet/IP stations including V net routers)

• General-purpose Ethernet communication devices: Max. 124 (PCs, Routers, etc.)

• Distance between stations in a Vnet/IP domain: Max. 40 km

• Distance between Layer 2 switch and a station: Max. 100 m (for Unshielded Twisted Pair (UTP)); Max. 5 km (for fiber-optic cable)

• Distance between Layer 2 switches: Max. 5 km (for fiber-optic cable)

• Number of connectable Layer 2 switches in a domain: Max. 7 per each Bus. (Multilayer by cascade connection allowed)

4.4 Restrictions on Installation of Hardware

There are the following restrictions on installation of hardware in SCS.

• SCS can connect the CPU node to up to 9 I/O nodes.

• When expanding I/O, SEC401s are installed to slots 7 and 8 of the CPU node. In the absence of expandable I.O nodes, I/O modules can be installed to these slots.

• When configuring I/O modules in redundant configuration, install them to any of the following slots in pairs: 1 and 2, 3 and 4, 5 and 6, 7 and 8

• For installation of I/O modules, there are two more limitations other than the above restrictions. One is imposed by electric capacity and another is imposed by ambient temperature conditions (60°C~70°C) for operation.

• The Optical ESB Bus Repeater modules must be mounted within the specified operating temperature range.

• Up to four serial communication modules (ALR111 and ALR121) per SCS can be installed (two pairs in redundant configuration) as subsystem communication master modules and up to two modules can be installed as Modbus slave communication modules. Note that it is not allowed to perform both subsystem communication and Modbus slave communication using the same serial communication module.

• With SCS-IP, you cannot install the serial communication modules for Modbus slave communication (that is, ALR111 and ALR121) to I/O nodes that are located further than 5 km, using the an optical ESB bus repeater module.

• Operating temperature is different between Safety Control unit for Vnet/IP and Safety Control unit for V net.

4.5 Capacity of SCS Applications

Types	Items	Max. capacity	Note
I/O	Number of nodes	10	Node #1 is for CPU node only.
	Number of slots	8 slots/node	When connecting I/O node, the maximum slot number of CPU nodes is 6.
	Number of communication modules	2	For Modbus Slave Communication
		4	For Subsystem Communication
	Number of points of I/O	1000	The value is just for reference.
	Number of Subsystem Communication Data	500	This is the maximum number of producing and consuming data per SCS.
Application logic	Number of programs and user-defined FU/FB (number of POU)	Max. 500	When more than 500 POU are defined in the SCS Manager, an error occurs in building. It may not possible to define 500 POU depending on the type and number of FU/FB or LD elements. A restriction may be imposed depending on SCS performance.
	Definable number of variables	1000 I/O variables. 3000 internal variables.	The numbers are just for reference. It may not be possible to define the maximum variables shown in the left column depending on each type of defined variables and the performance of SCS.
Inter-SCS Safety communication	Producing data	200 data	This is the maximum number of producing data per SCS.
	Consuming data	200 data	This is the maximum number of consuming data per SCS.
SCS Link Transmission	Sending data	128 data	This is the maximum number of sending data per SCS.
	Receiving data	1000 data	This is the maximum number of receiving data per SCS.
CS 3000 Integration Function	Annunciators (%AN)	1000	
	Common switches (%SW)	200	All are system switches.
	External Communication FB	(*1)	
Mapping block to use for connecting CS 3000	Analog input blocks (ANLG_S, ANLGI)	Total 1800	
	Velocity alarm blocks (VEL)		
	Maintenance override blocks (OVR_*, GOV_*)		The total number of blocks for all data types (OVR_B, OVR_I, OVR_R, OVR_IB, OVR_IR, GOV_B, GOV_IB)
	Password blocks (PASSWD)		
	Manual operation blocks (MOB_*, MOA)		MOB_11, MOB_21, MOB_RS, MOA
	Annunciator blocks (ANN)	1000	Mapping to %AN element

4.6 Performance and Scan Period in SCS

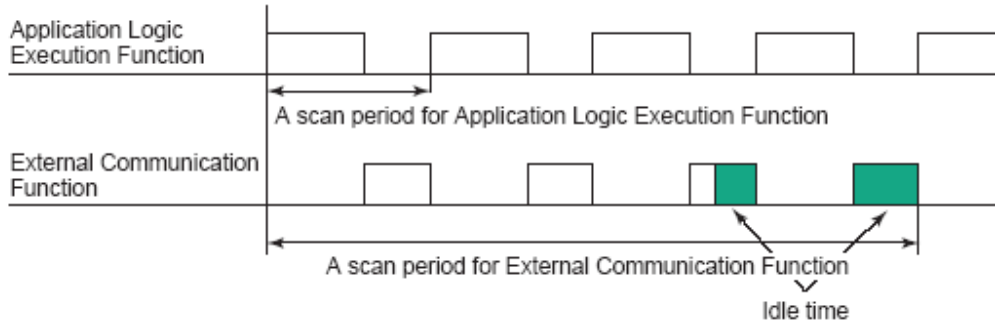
Processing Timing and Scan Period

The periodic processing for SCS falls into two types. : Application Logic Execution Function and External Communication Function. They are executed at an individual scan period.

Application Logic Execution Function

This is the function for monitoring the safety status of a plant and performing operations specified against a fault if it occurs. Main operations are as follows.

- Input of process data from the field device
- Execution of the application logic
- Output of process data to the field device
- Inter-SCS Safety Communication
- SCS Link Transmission
- Communication Data I/O (subsystem communication function)
- Communication with SENG
- Diagnosis



The Application Logic Execution Function has top priority among SCS functions. The External Communication Function is executed in a part where the Application Logic Execution Function is not executed in the CPU processing period. If the External Communication Function finishes its processing before a scan period, the remaining time becomes the idle time on CPU.

Processing of Application Logic Execution Function

The Application Logic Execution Function is executed in the order presented as follows.

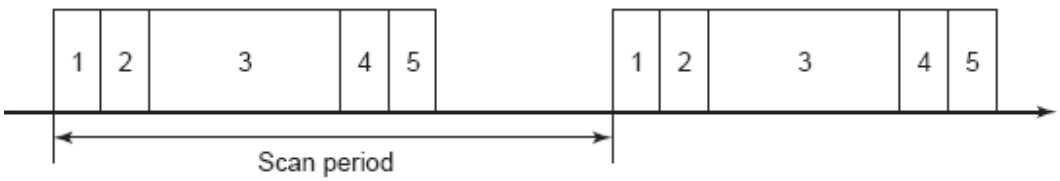


Table Processing of Application Logic Execution Function

	Processing Name	Details
1	Input process data Self-diagnosis	Collects process data from input modules, and generates data values and data status. Stores the generated data in the input variables. Also, the self-diagnostics is executed at this timing.
2	Receive data from other SCS	Receives the data from other SCSs, and stores them to the variables. (Applicable to inter-SCS safety communication and SCS link transmission)
3	Execute Application Logic	Executes application logic in FBD and LD.
4	Transmit Data to other SCS	Transmits data to other SCSs. (Applicable to inter-SCS safety communication and SCS link transmission)
5	Output process data Self-diagnosis	Collects the data from output variables, and writes the data to the output modules. The self-diagnostic processing is executed at this timing.

Processing of External Communication Function

The External Communication Function is a general name for functions used for communicating the information of SCS with external systems. CS 3000 Integration Function and Modbus Slave Communication Function are included in this.

4.7 Time Synchronization

SCS is capable of synchronizing the time between SCSs and DI modules to make the event log accurate. This section describes the time synchronization function on ProSafe-RS.

SCS Type and Time Synchronization

SCS for V net (also called "SCS-V") synchronizes with different time synchronization methods from SCS for Vnet/IP (also called "SCS-IP").

SCS-V: V net time synchronization or IRIG-B time synchronization is selectable.

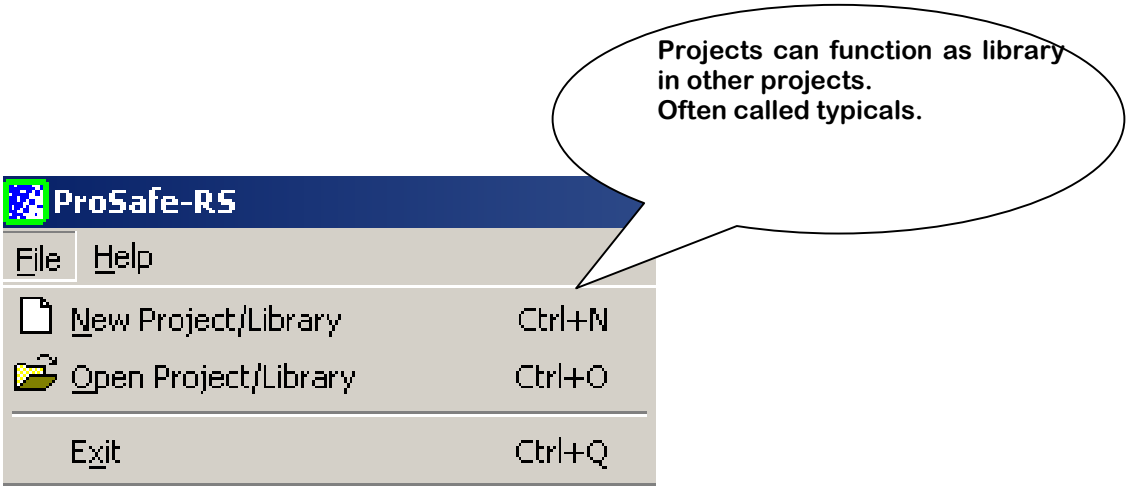
SCS-IP: Vnet/IP time synchronization is the only option.

Type	Target SCS	Description
V net Time Synchronization (Standard)	For V net	The mechanism that synchronizes the clock of devices connected on V net is used. User sets the V net time from Adjust Time dialog box on SENG or CS 3000 HIS.
IRIG-B Time Synchronization (Option)	For V net	GPS unit is used as the standard time server, and the output (IRIG-B) from the unit is connected to each SCS. GPS allows you to collect events with more accurate time stamp.
Vnet/IP Time Synchronization	For Vnet/IP	The system clock of SCS-IP synchronizes with Vnet/IP time. If SNTP server is connected, the clock synchronizes with more accurate absolute time. All the stations in one time group connected with a control bus have the same time data.

4.8 Project Creation

It is possible to create new RS projects in addition to the RS project created at the installation. In this case, use file option in workbench to create a new project.

- **Once the workbench is launched click on file-> New Project/Library**

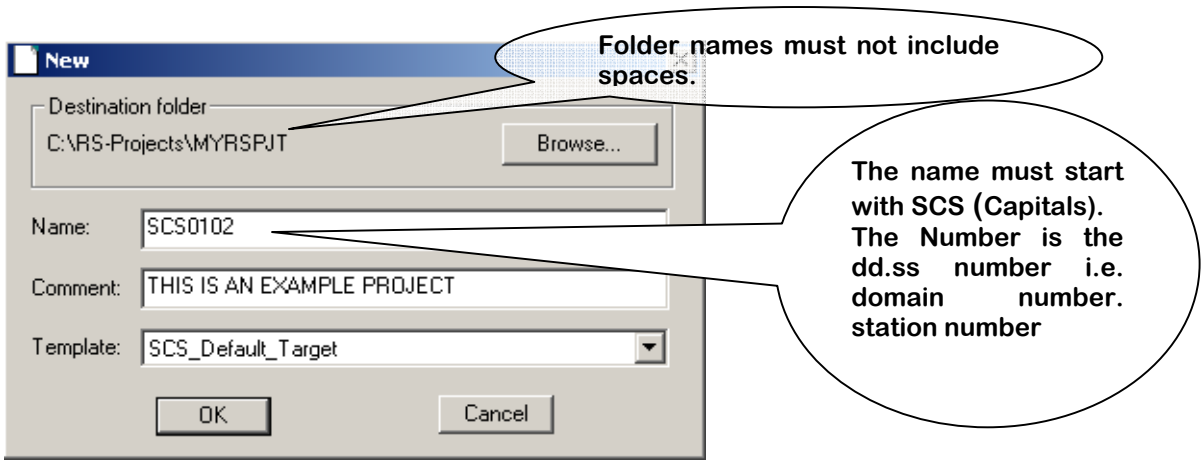


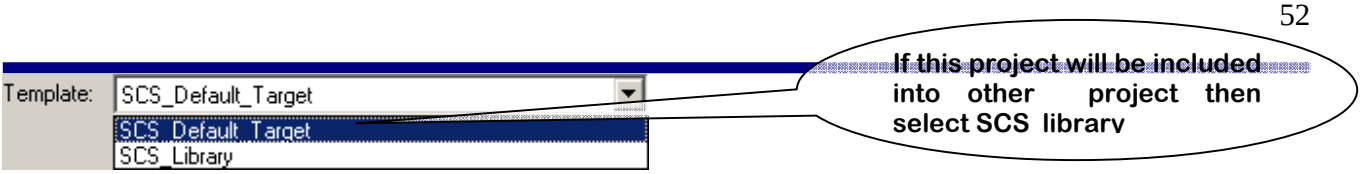
If the new project has to be created the following information has to be added:

- Name of the project.
- Destination folder for the project.
- Project comment (Optional).
- Project template.

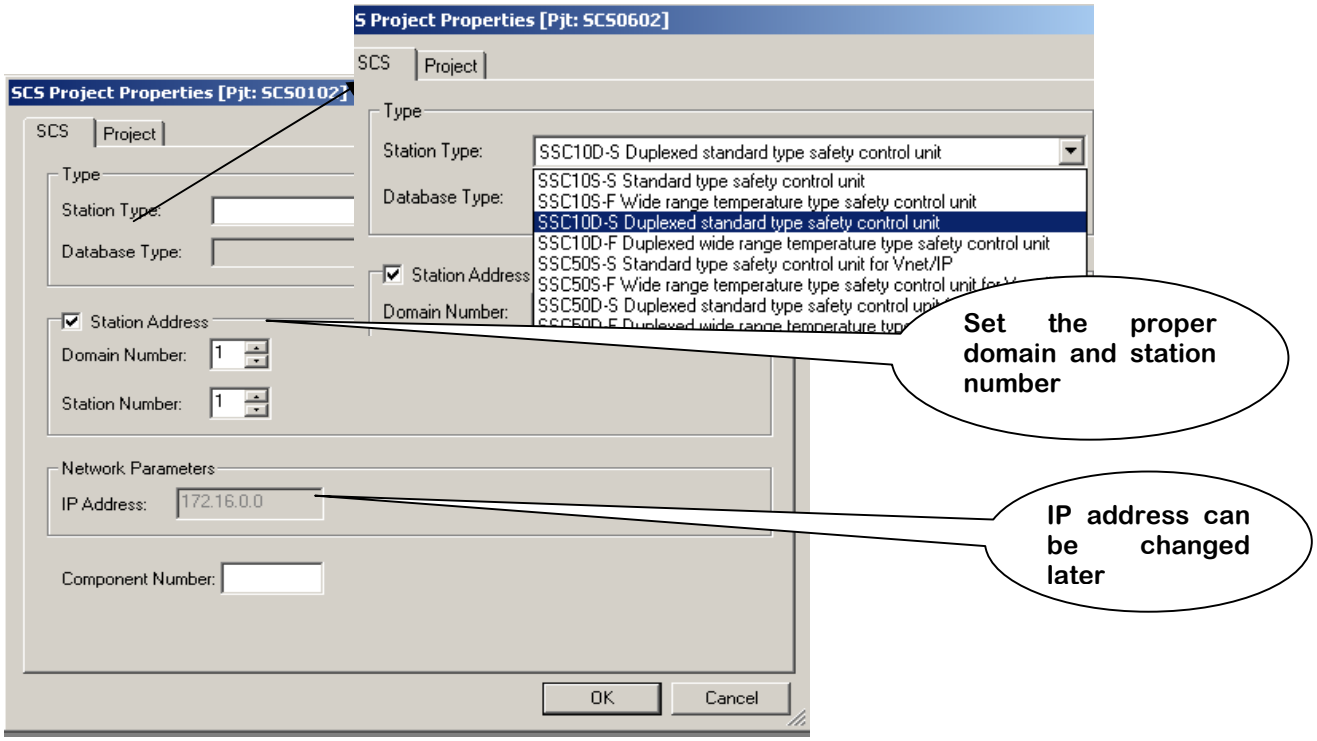
***The path of the folder must not be longer than 256 characters and should not include spaces**

After the New Project/Library "NEW" Dialog box appears following information mode.





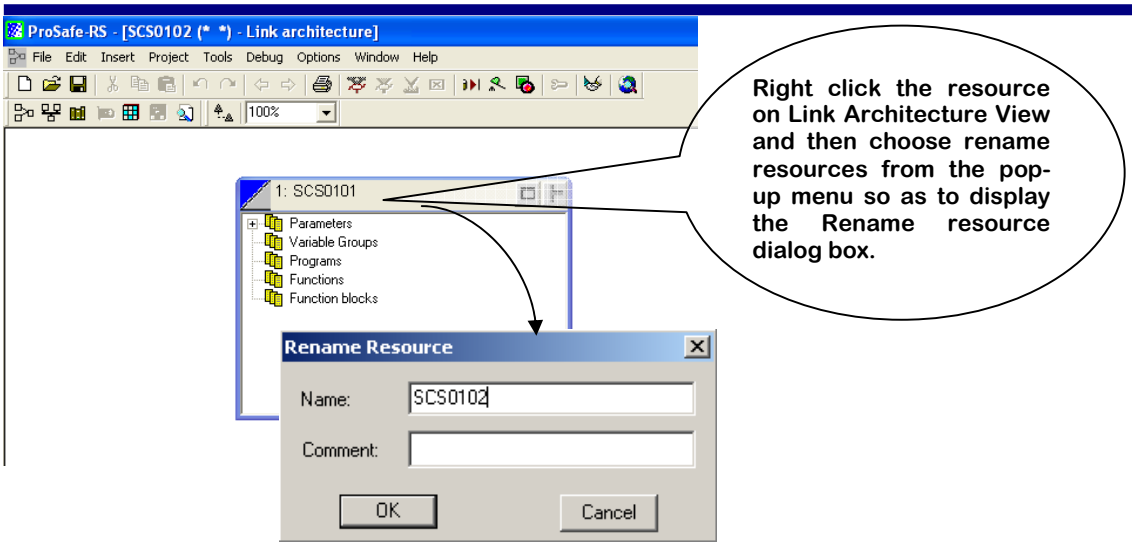
After creation of a new project, the properties of a SCS project will be displayed. Select the suitable Station type.



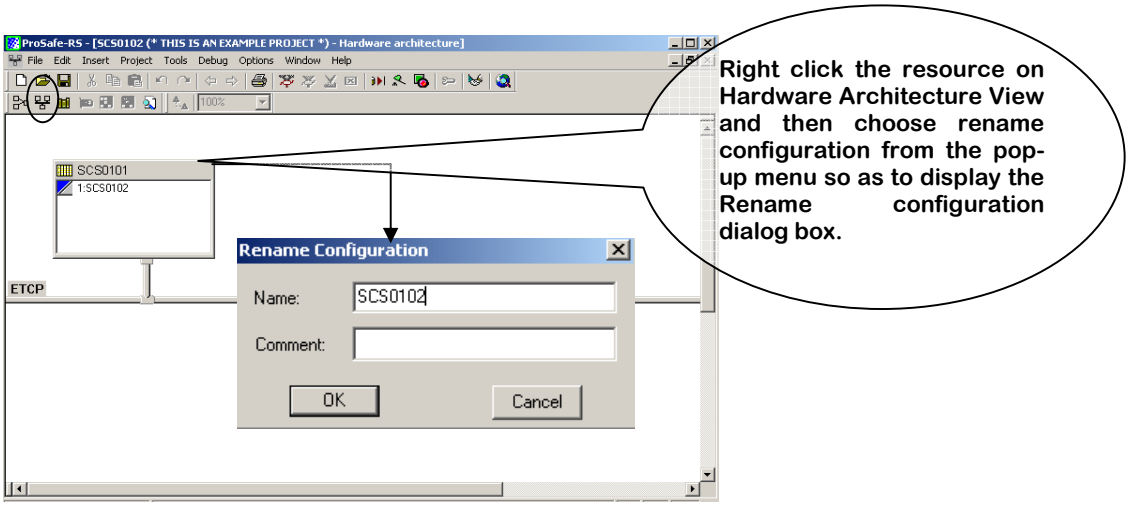
The IP address is an option which is found in Hardware Architecture

- **Use link Architecture window to, Rename the resource.**

The resource name is same as the project name.



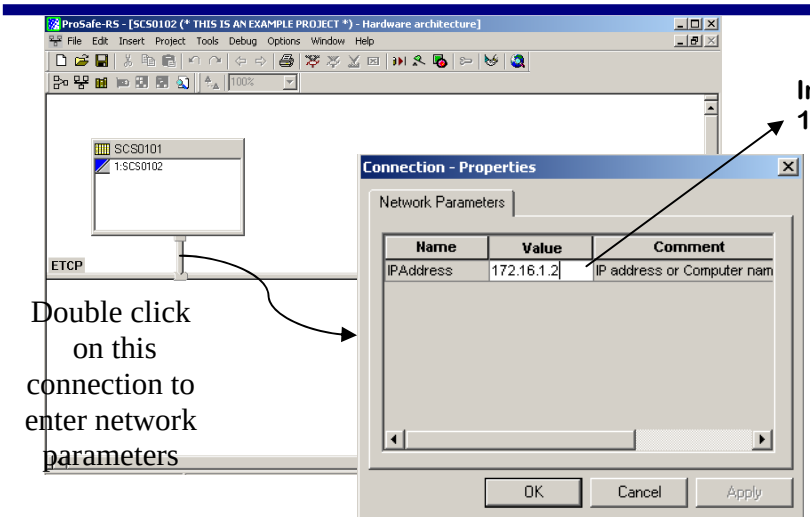
- **Rename the configuration using hardware architecture.**



- **Set the IP address using Hardware architecture**

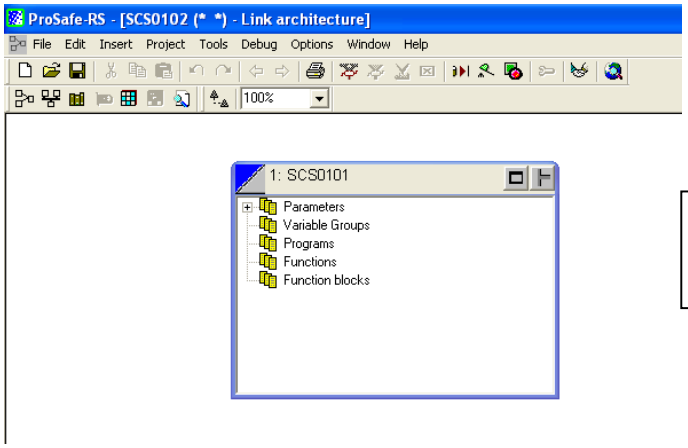
The IP address can be defined on Hardware Architecture View. Double click “Connection” so as to display Connection - Properties dialog box. The IP address needs to be set for “Value” item.

In general the IP address should be “172.16.dd.ss” (dd: domain number, ss: station number).

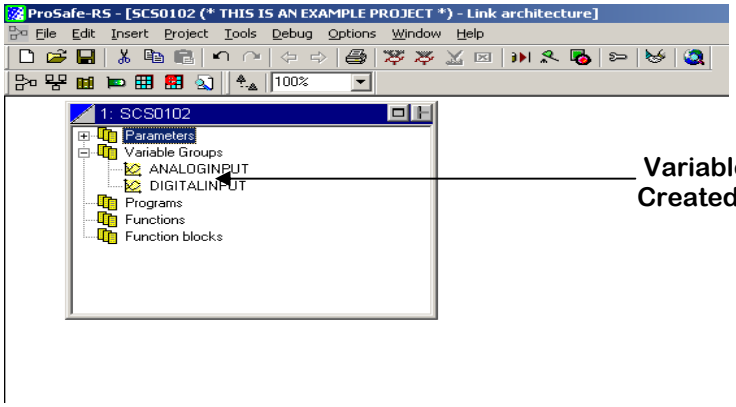


4.9 Creation of variables in dictionary

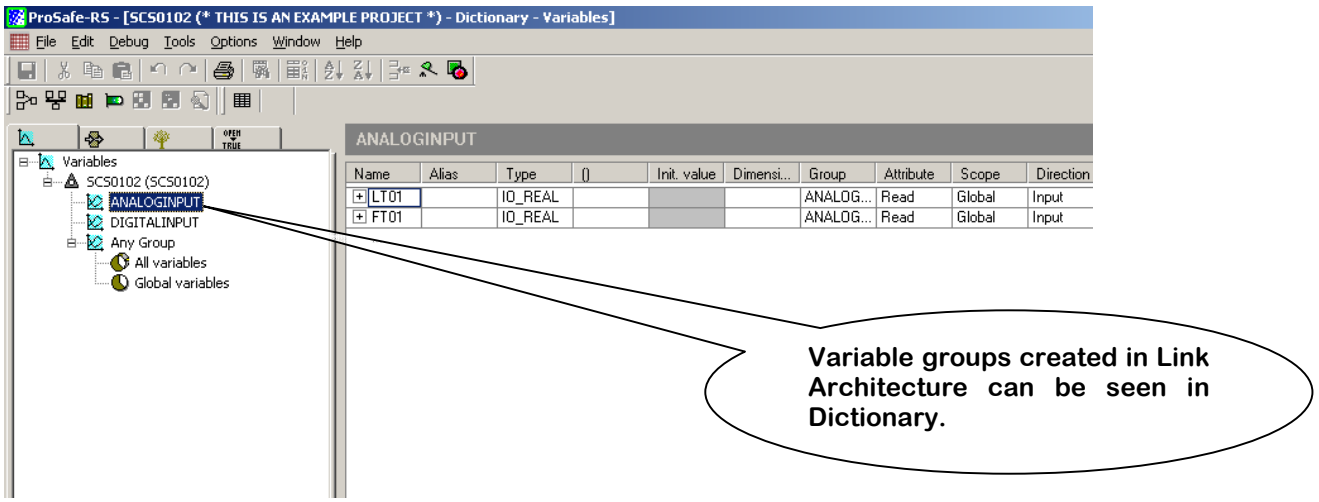
4.9.1 Creation of variable groups



Right click on Variable groups in link architecture to create new variable group

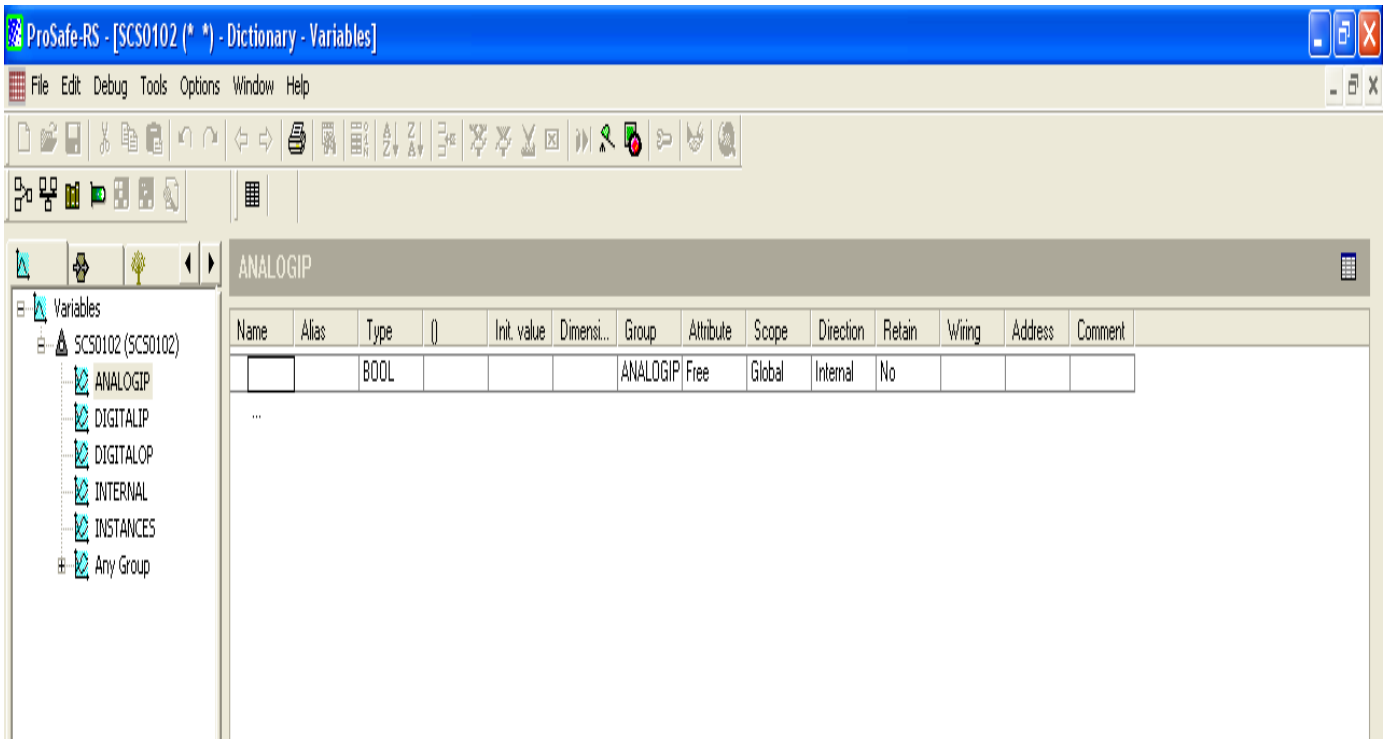


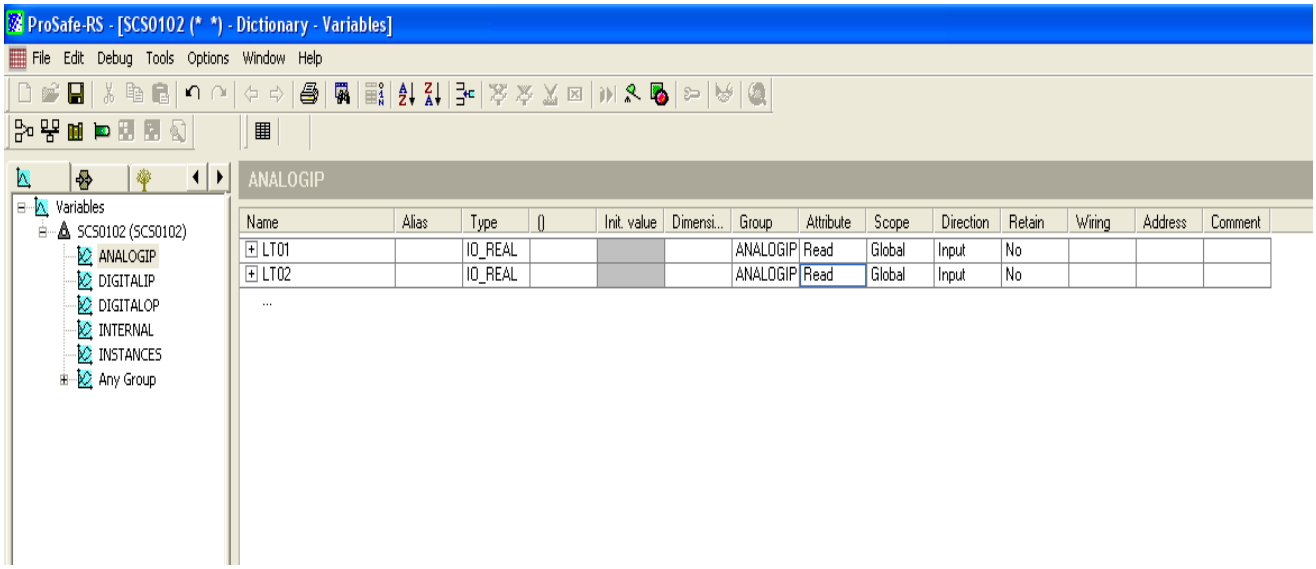
- **One can enter the dictionary by clicking on the variable groups created in link architecture**



4.9.2 Creation of Analog I/O variables in dictionary

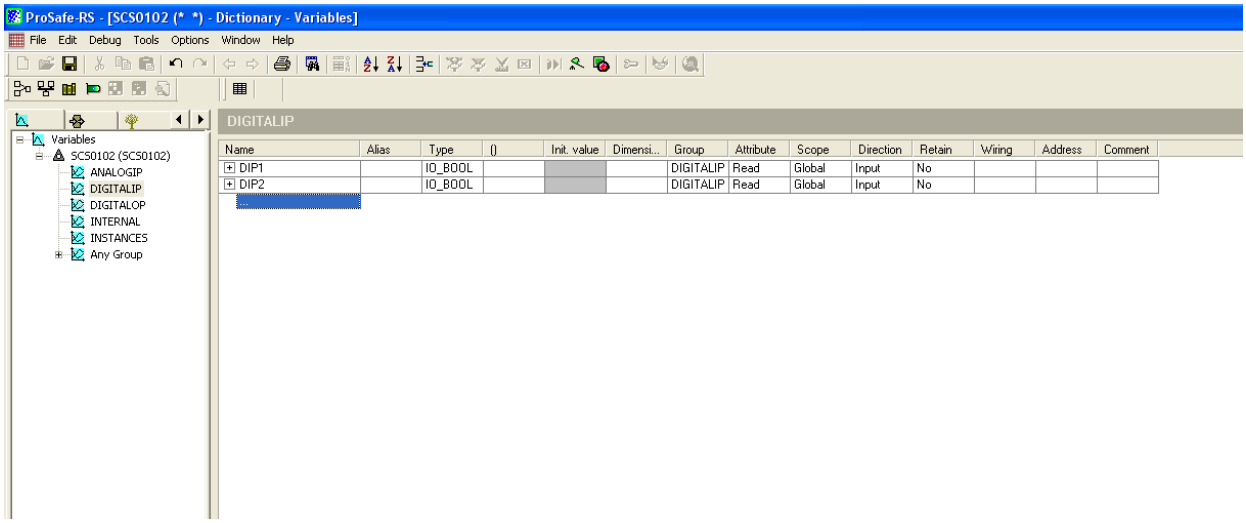
- **Double click on the first row in dictionary .Enter the parameters.**



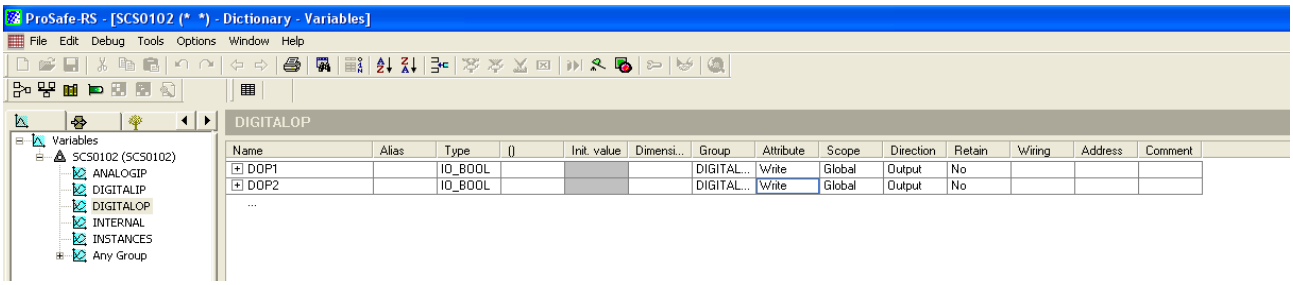


4.9.3 Creation of Digital I/O variables in dictionary.

- **Double click on the variable group "DIGITALIP", to create Digital input variables. The data type for a digital input is IO_BOOL. The attribute for the digital input is read and the direction is "Input"**

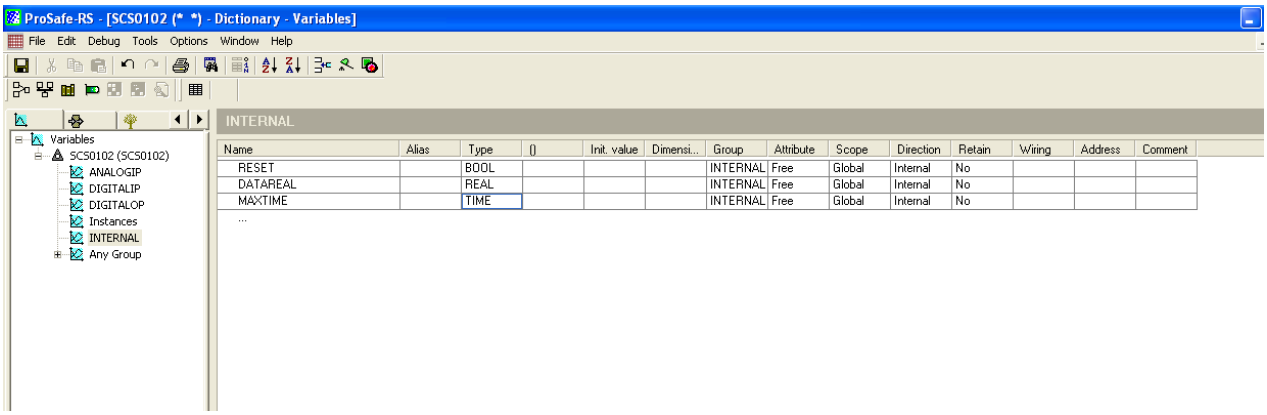


- **Double click on the variable group "DIGITALOP", to create Digital output variable. The data type for a digital output is IO_BOOL. The attribute for the digital output is write and the direction is "output"**



4.9.4 Creation of internal variables in dictionary

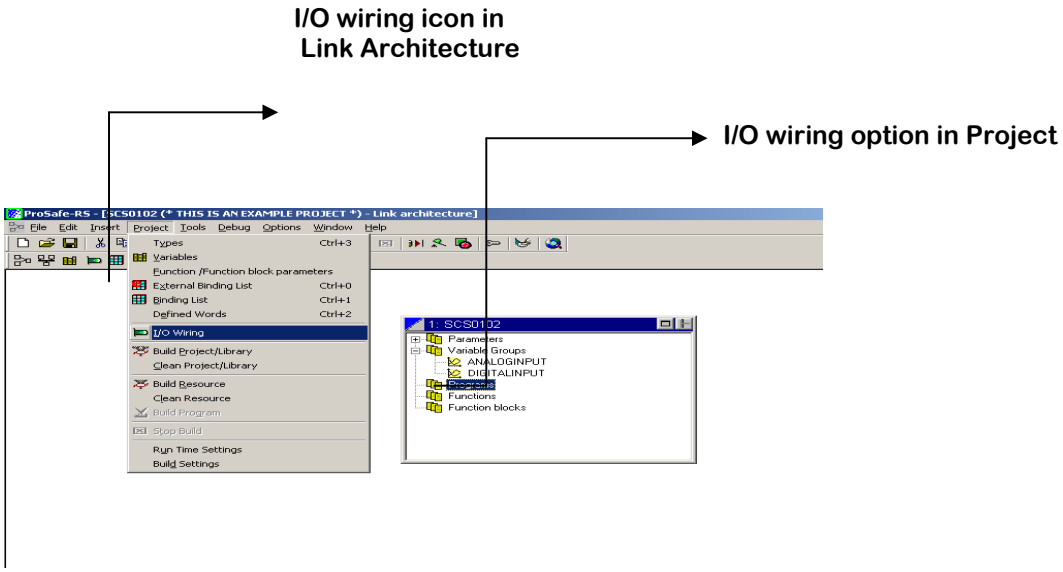
- Double click on the variable group “INTERNAL”, to create INTERNAL variable. The attribute for the internal variable is free and the direction is Internal.



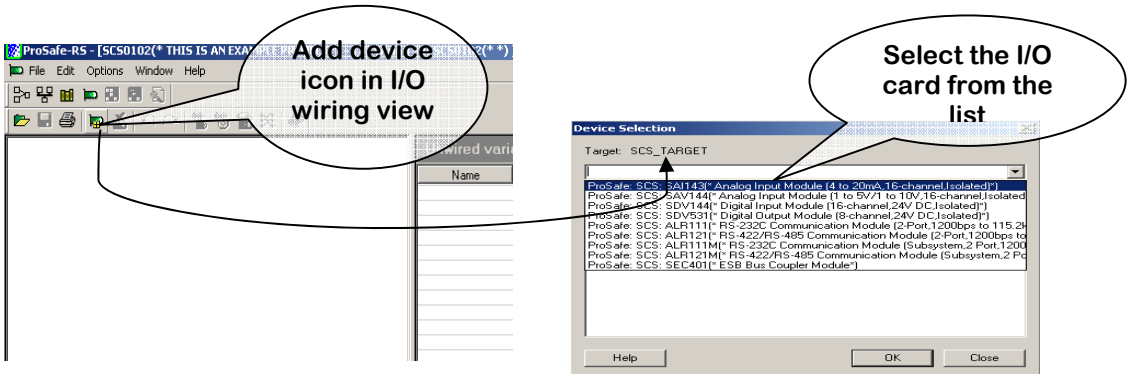
4.10 Creation of I/O cards in I/O wiring view.

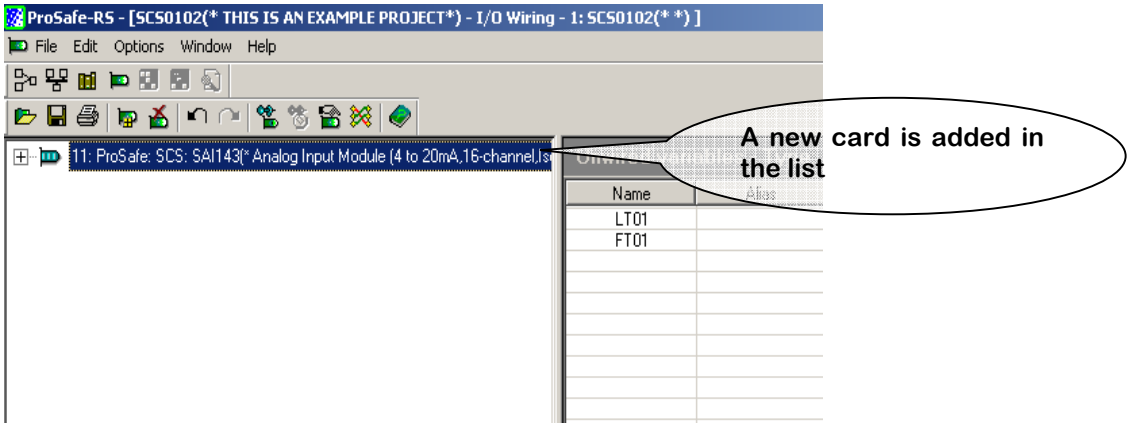
After creating variables in the Dictionary, perform I/O wiring in the I/O wiring tool by adding I/O devices, setting device parameters, then wiring the channel of the devices to variables in the grid. We can also define the mapping of logical channels to physical channels.

Go to I/O wiring option either by clicking I/O wiring icon on SCS Manager or by project menu.

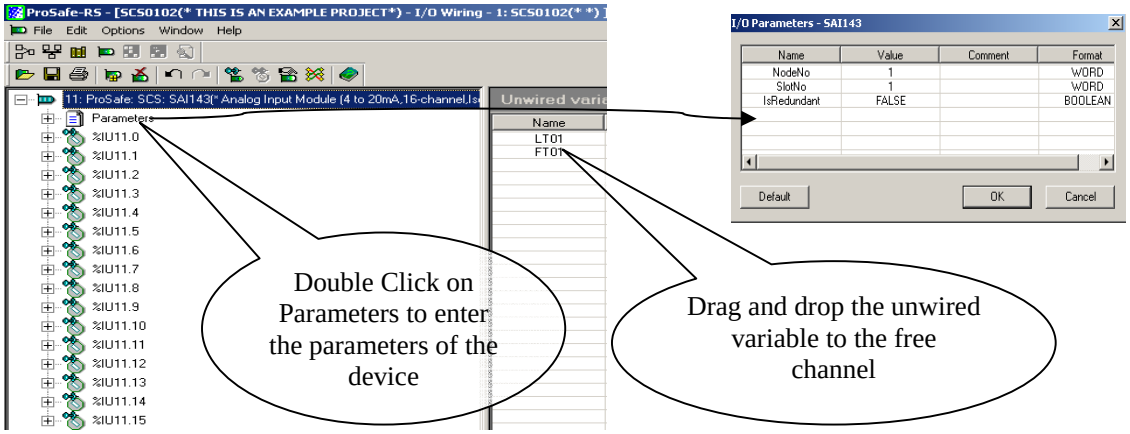


In the I/O wiring view click on add device Icon to create new device (I/O card).





Set the node number and Slot number in Parameter. Assign the unwired Variable to the free channel.



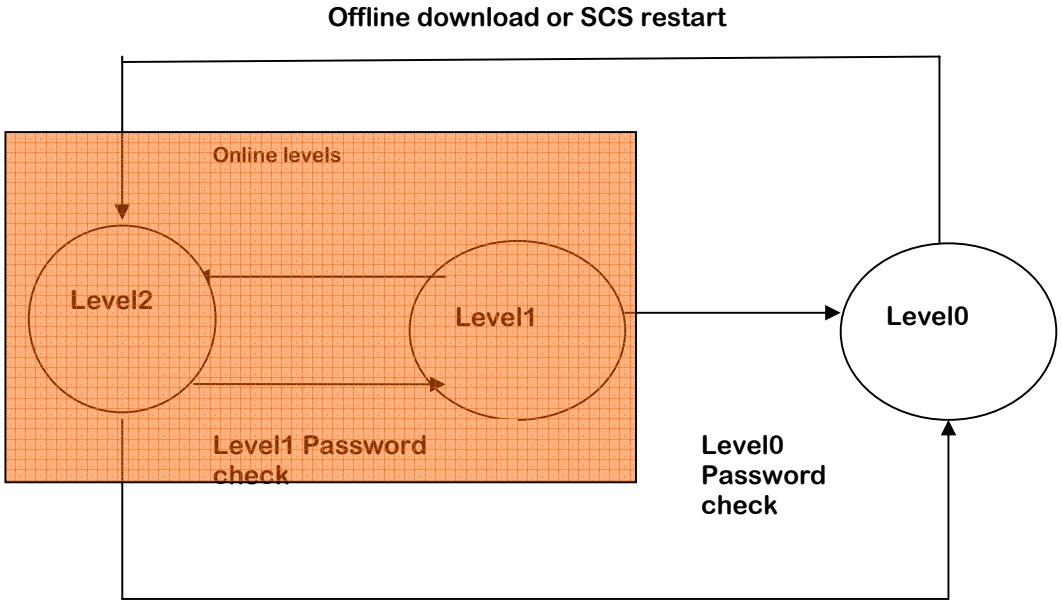
5. SECURITY

Table of contents

5.1 Overview of ProSafe-RS Security

ProSafe-RS has functions to prevent access to the system by the unauthorized users and devices, and inadvertent changes caused by operation mistakes of users. This chapter mainly describes how to use passwords to ensure security

There are two types of security level for an SCS: online level, which is used during normal operation of the SCS, and offline level, which is used when the SCS is not running.



Level 0 Password check

5.1.1 Online Level

The online level is the security level used when the SCS is performing normal operation. Online level is further classified into two security levels.

5.1.2 Offline Level

The offline level is used when the SCS is not performing the normal operation.In this situation the SCS will be in security level 0.

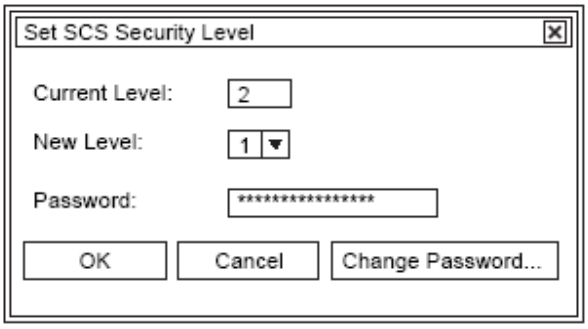
Security Level	Meaning
Security Level 2	This is the highest security level. SCS performs normal operation
Security Level 1	Temporarily used security level. Used during maintenance and online logic modification.
Security level0	Lowest security level. At this level One can have access to the SCS database.

5.2 Security of SCS

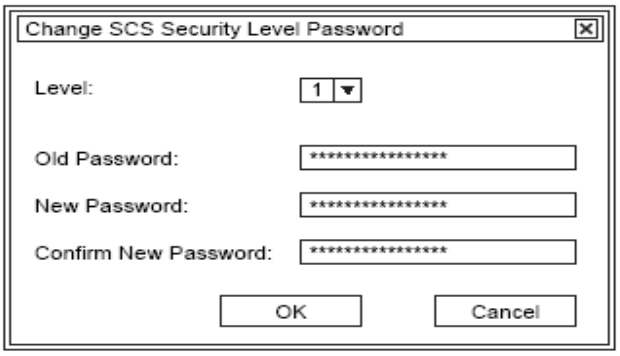
The password used to change SCS security level is stored within the SCS. This password can be set or changed from the Set SCS Security Level dialog box.

5.2.1 Procedure to change the Password

- Select [Maintenance] from the [Tools] menu of SCS Manager. The Maintenance Launcher menu appears.
- Select [Set SCS Security Level] from the Maintenance Launcher menu. The Set SCS Security Level dialog box appears.

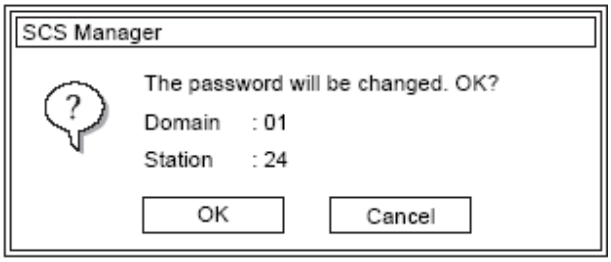


- Click [Change Password] button. The Change SCS Security Level Password dialog box appears.



- Select the security level for which you wish to set the password. It is necessary to set seperate password for each level.
- Enter the current password in [Old Password:] text box, and a new password in [New Password:] and [Confirm New Password:] text boxes. All characters you enter are displayed as asterisks (*). For a password, up to 16 alphanumeric characters and ASCII symbols (*1) can be used. It is not necessary to enter the current password if no password has been set before, or after executing off-line download or master database off-line download.

- Click [OK] button. The confirmation dialog box appears.

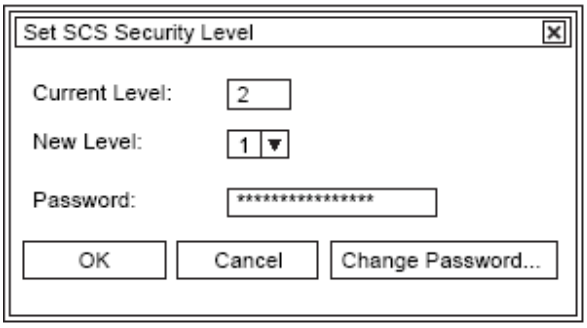


- Click [OK] button. Both new and old passwords will be sent to SCS. If the password is successfully changed, the dialog box notifying the success appears. The new password becomes valid. If the password change fails, a dialog box will be displayed to notify the failure.

5.2.2 Changing the Security level

Open an SCS project in SCS Manager to change the security level of the corresponding SCS.

- Select [Maintenance] from the [Tools] menu of SCS Manager.The Maintenance Launcher menu appears.
- Select [Set SCS Security Level] from the Maintenance Launcher menu. The Set SCS Security Level dialog box appears. The current security level is displayed in [Current Level:]; this item is for display only and cannot be changed.

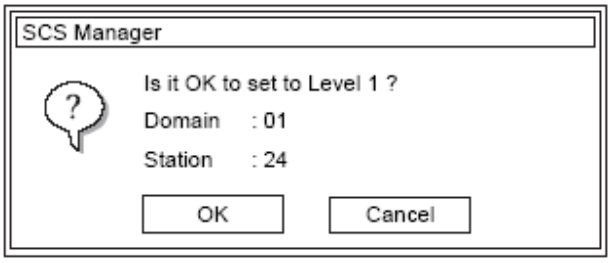


- Select the security level of your choice in [New Level:] and enter the password for the level you want in [Password:] text box. All characters you enter are displayed as asterisks (*). The table below lists the combinations of levels to which the security level changes are allowed.

Current SCS security level \ New SCS security level	Level 2	Level 1	Level 0
Level 2		Allowed	Allowed
Level 1	Allowed		Allowed
Level 0			

It is not necessary to enter a password when changing the security level from Level 1 to Level 2.

- Click [OK] button. The confirmation dialog box appears.



- Click [OK] button. If the security level of SCS is changed, the message showing the result of change is displayed. The error message is displayed if the security level could not be changed. When changing the security level to Level 0, the following confirmation dialog box appears to confirm the change again.

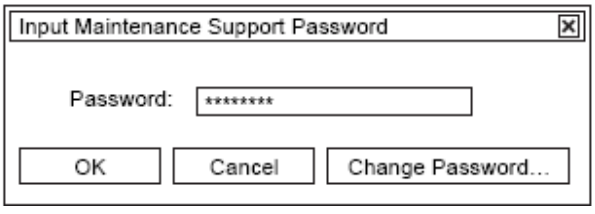
- Click [OK] button. The SCS security level is changed.

5.3 Security of SCS Maintenance Support Tool

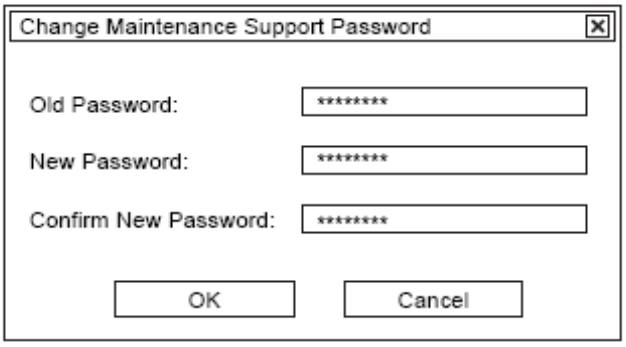
SCS Maintenance Support Tool has a security. This section describes how to set the password to the SCS Maintenance Support Tool.

The Change Maintenance Support Password dialog box is used to specify or change the password. The user must enter the right password when starting SCS Maintenance Support Tool. To use SCS Maintenance Support Tool, make sure to set the password first.

- Open the window related to SCS Maintenance Support Tool from SCS Manager or [Start] menu of Windows. When the window requiring a password is opened, the Input Maintenance Support Password dialog box appears.



- Click [Change Password] button. The Change Maintenance Support Password dialog box appears.



- Enter the passwords before and after change. All characters you enter are displayed as asterisks (*). For the password, up to 16 alphanumeric characters and ASCII symbols (*1) can be used. Password is case sensitive.

- Click [OK] button. The password is set.

5.4 Security of SCS Database

5.4.1 Setting Password for the SCS Project

It is possible to set a password for the SCS project so that only authorized users can make changes to the SCS project. The following settings can be made.

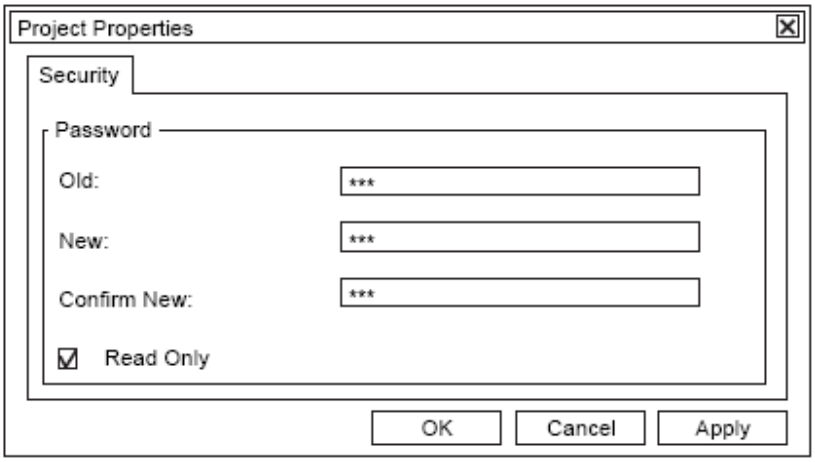
• Password for the SCS project

If you set a password for the SCS project, users are asked to enter the password when they open the SCS project.

• Allowing read-only access without entering a password

If read-only access without entering a password is allowed, users can open the SCS project in the read-only status. In this status, the users are not allowed to edit the application logic or generate databases. Operations on the SCS, such as using the forcing function and downloading data, are possible in the read-only status.

- Select [Project Properties] from the [File] menu of SCS Manager; The following dialog box appears.



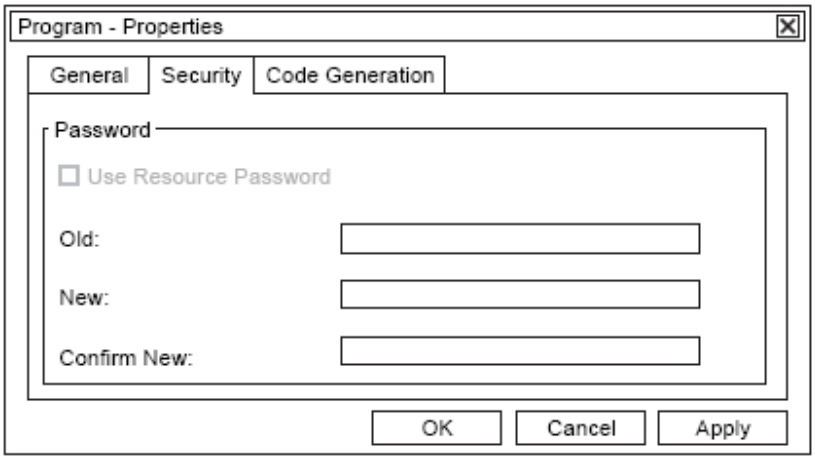
- Enter the current password in the [Old:] field and a new password in the [New:] field. Enter the password entered in the [New:] field in the [Confirm New:] field. For the password, up to 8 alphanumeric characters can be used, and case sensitive.
- Select the [Read Only] check box to allow read-only access without entering a password.
- Click [OK] button.

5.4.2 Setting Password for Each POU

It is possible to set a password for each POU so that only the authorized users can reference and change important POUs. When users attempt to edit a POU for which a password is set, they are

required to enter the password. If you do not know the password, you are not allowed to reference or print the POU.

- Select a POU for which you want to set a password.
- Select [Properties] from the menu displayed by clicking the right mouse button. The following dialog box appears.



- **Enter the current password in the [Old:] field and a new password in the [New:] field.Enter the password entered in the [New:] field in the [Confirm New:] field. For the password, up to 8 alphanumeric characters can be used, and case sensitive.**

- **Click [OK] button.**

6. DOWNLOADING

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6.1 What is Downloading?

The downloading functions transfer SCS program and database, which contains the specifications of an application logic, to an SCS. The SCS database is saved as the master database in the SENG and the same data as in the SCS is maintained at all times. There is no function to upload the SCS execution data to the SENG because the SCS execution data is saved in the SENG as the master database.

6.2 Overview and Types of Downloading

Off-line Download

This function downloads a database generated from application logic created in the SENG. During the download, the functions running on the SCS stops and resume the operation after the completion of downloading.

On-line Change Download

This function downloads only a portion of database generated from application logic, created in the SENG, that have been updated since the last download. The functions running on the SCS keep operating during the download as well. Note that on-line change download may not be possible depending on the content of the updates.

Master Database Off-line Download

This function downloads the execution data that was active in an SCS again after replacing a CPU module. The SCS database saved in the master database on the SENG is downloaded. This download is performed when replacing hardware. In the case of a redundant CPU module, this download is not required if only one module is replaced.

IOM Download

This function downloads the execution data that was active in an input/output module to a new input/output module after replacing it. The data of the input/output module (part of the SCS database) saved in the master database on the SENG is downloaded. This download can only be performed when replacing hardware of input/output modules.

6.3 Downloading Functions and Databases

The destination database for saving varies depending on the type of downloading. The relationship between the different types of downloading and databases is explained below.

Off-line Download

The work database generated by building is downloaded to an SCS. The master database is overwritten by the work database.

On-line Change Download

Only the differences between the work database generated by building and the master database are downloaded to an SCS. The master database is overwritten by the work database.

Master Database Off-line Download

The master database is downloaded to an SCS.

IOM Download

Only the data in the master database related to input/output modules is downloaded to an SCS.

6.4 Downloading and SCS Security Levels

Since the downloading functions attempt to write data to an SCS, the download operations may not be allowed depending on the SCS security level. Before performing the downloading functions, it is necessary to use the SCS security level operation function and change the security level of the SCS. The table below shows whether or not each type of download is allowed according to the security level.

Table Relationship between Downloading Functions and SCS Security Levels

Security level	Off-line download	On-line change download	Master database off-line download	IOM download	Save and Download Operation Marks
Level 2				Allowed (only for failing input/output modules)	Allowed
Level 1		Allowed		Allowed (only for failing input/output modules)	Allowed
Level 0	Allowed	Allowed	Allowed	Allowed (only for failing input/output modules)	Allowed

6.5 Off-line Download

During off-line download, the SCS database, which contains all the information required for operation of an SCS, is transmitted from the SENG to the SCS; meanwhile, the SCS functions are stopped. The SCS database is downloaded via the V net/Vnet-IP and stored in the flash memory of the SCS and the non-volatile memory of input/output modules. The SCS database downloaded to the SCS is saved as the master database together with the source files on the SENG.

6.5.1 Downloaded Items

- **Application database**

The application database created by the Safety application definition function, Modbus connection function and CENTUM CS 3000 integration function is downloaded to the CPU module.

- **I/O configuration information**

The parts of the database created by the I/O definition function related to input/output modules are downloaded to the input/output modules.

- The following operations are performed if you execute off-line download.

• Functions that run on the SCS stop and all the output modules output the fail-safe value specified in I/O Parameter Builder.

• Inter-SCS safety communication is disconnected.

• The forcing function is cancelled.

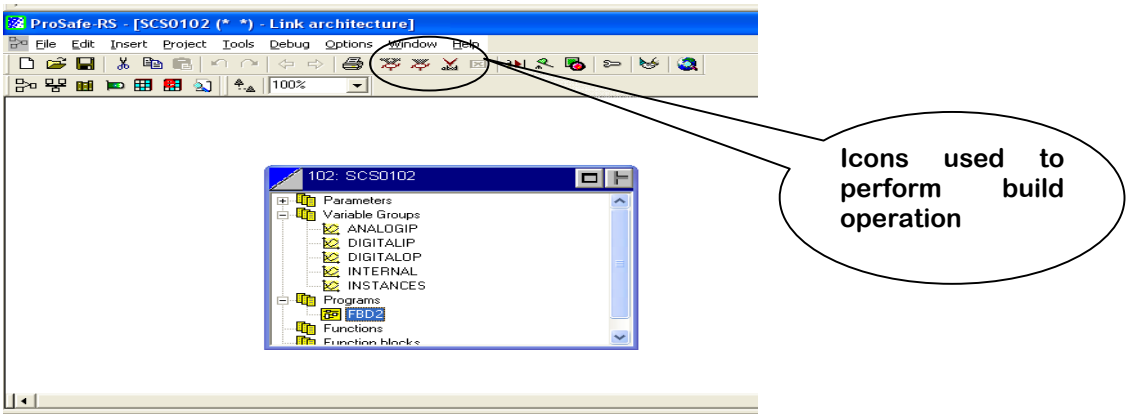
• Override from the HIS is cancelled.

• SOEs and diagnostic information collected so far in the SCS are deleted (they are saved in the battery backup memory, though).

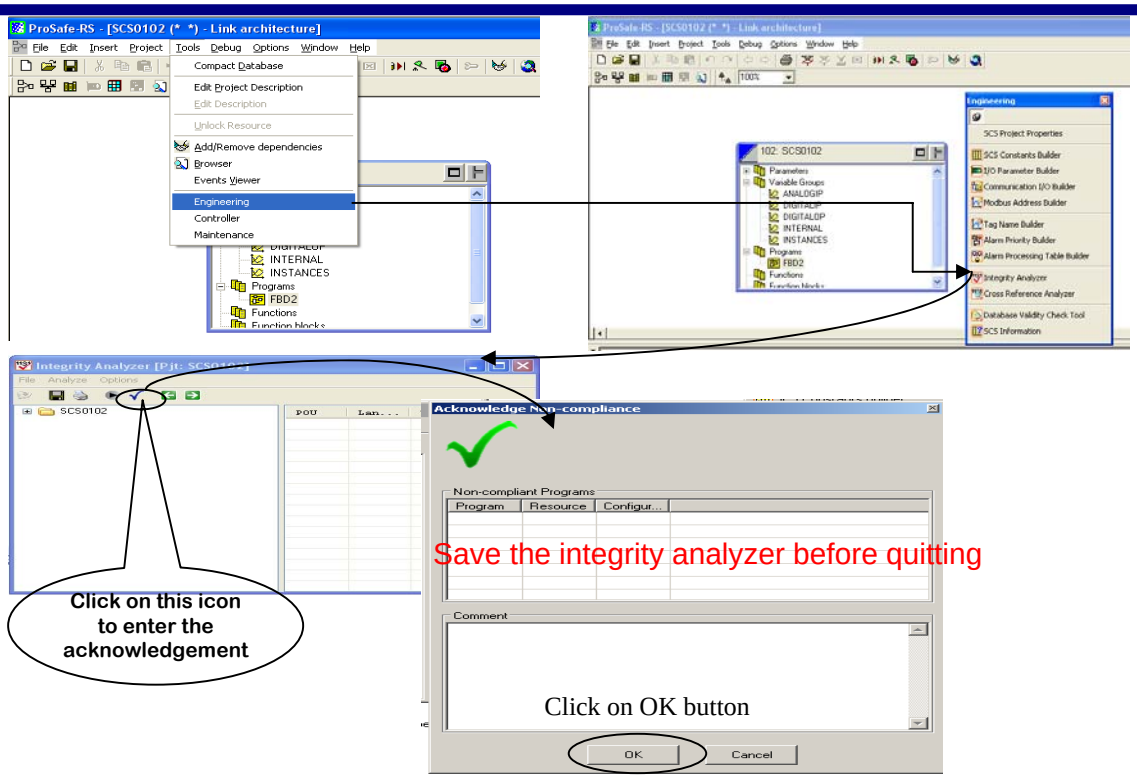
• The password for changing the SCS security level is deleted.

6.5.2 Procedure for offline Download.

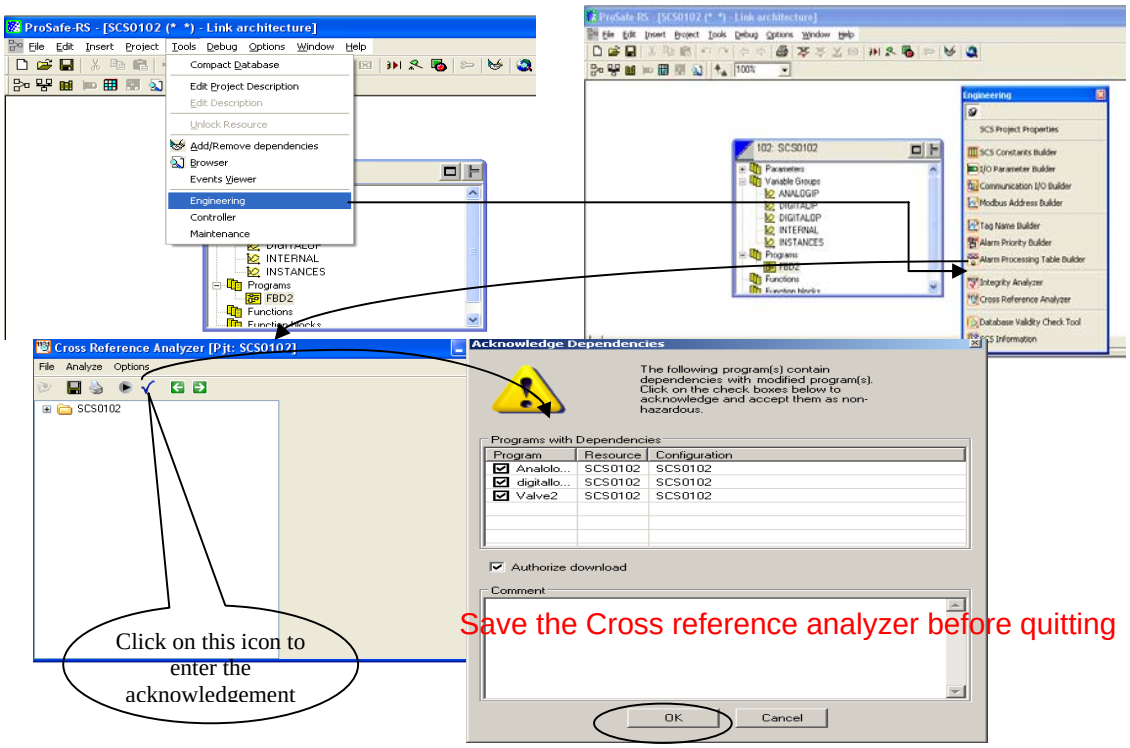
- Perform the building operation. An SCS database is generated based on an application.



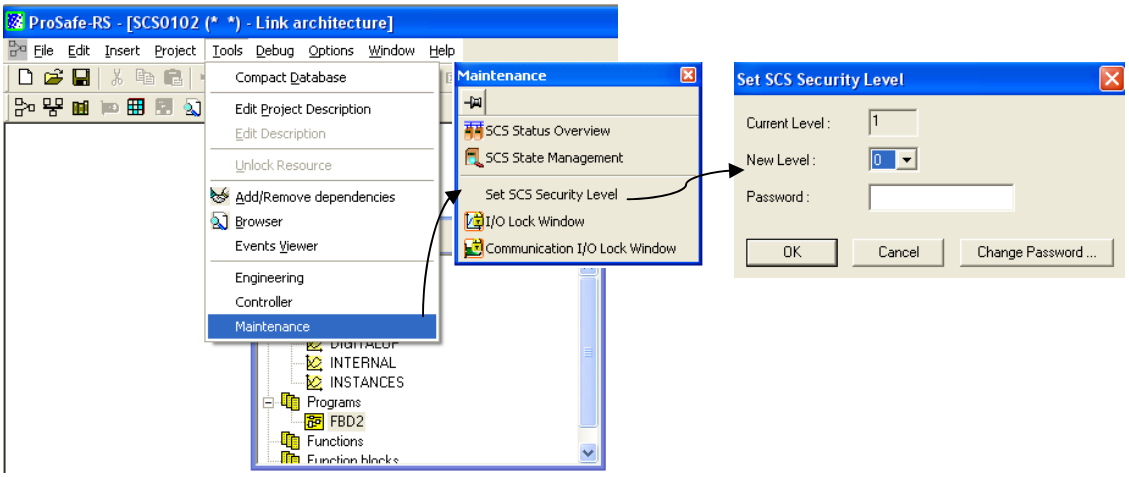
- Launch integrity Analyzer and analyze the database.



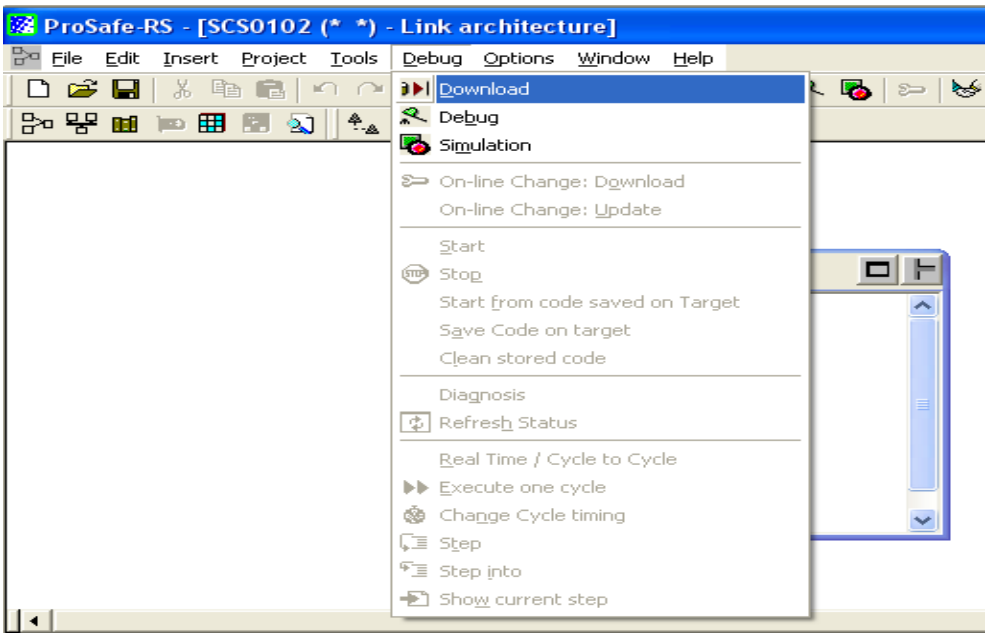
- **Launch cross reference Analyzer and analyze the database.**



- Use SCS security level operation to set the security level to 0.



- Select [download] from the [debug] menu of SCS manager. The off-line download confirmation dialog box appears.



- Click the [OK] button.
- Specify the password used when changing the SCS security Level.
- Use Version Control tool to save the SCS project.

6.5.3 Integrity analyzer

Integrity Analyzer analyzes application logics, detects “functions that are not allowed to be used” for the functions for safety and displays them in the window by highlighting for visual emphasis.

The user can check whether or not functions prohibited from use for safety applications are used or not. Analysis results can be printed as well. If there is a program that intentionally makes use of functions prohibited from use for application, the user can acknowledge their use for each program upon examining the program based on the results of the analysis.

If functions prohibited from use for safety applications are used unintentionally, the application logic must be modified. Make changes to the application logic, perform a build operation and then analyze the application logic with Integrity Analyzer again.

6.5.4 Cross reference analyzer

Cross Reference Analyzer displays the differences between the previously downloaded application (the application currently running in an SCS) and the application to be downloaded, and the extent to which the download will affect the operation in a window by highlighting them visually, in order to limit the range of re-testing caused by changes in an application logic. The user can check programs that require re-testing, and print the analysis results.

Cross Reference Analyzer detects programs that depend on the changed program as programs requiring re-testing. A list of programs requiring re-testing is displayed; they can be acknowledged upon checking the analysis results of each program. If unintended program changes and dependencies are detected, the application logic must be modified. Modify the application logic, perform a build operation and then analyze the application logic with Cross Reference Analyzer again.

If no program is found for retesting, retesting will not be performed. However, since the modifications on a certain items may not be discovered for retesting, these modified items need to be tested accordingly.

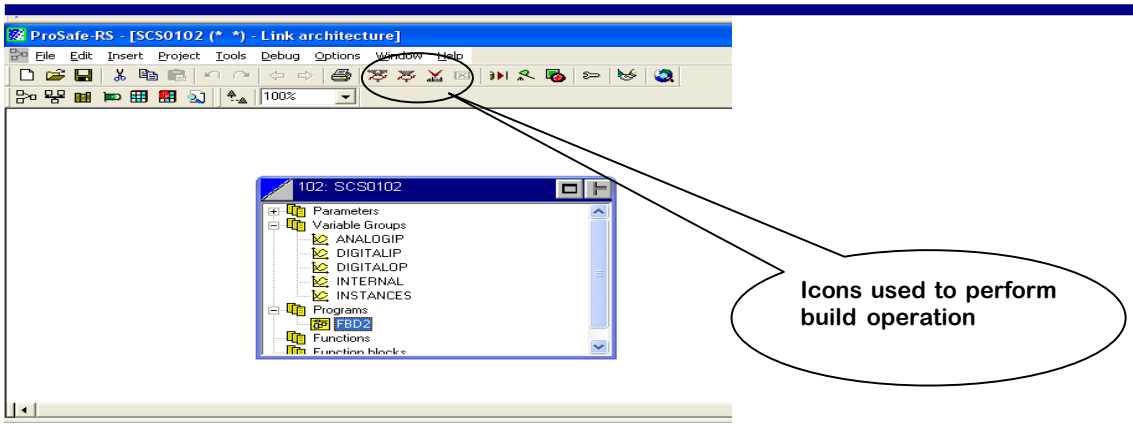
6.6 Online Change Download

On-line change download changes a part of an application without interrupting the SCS functions. In SCS, the data stored in the main memory of the CPU module is updated and changes are stored in the flash memory of the CPU module as well.

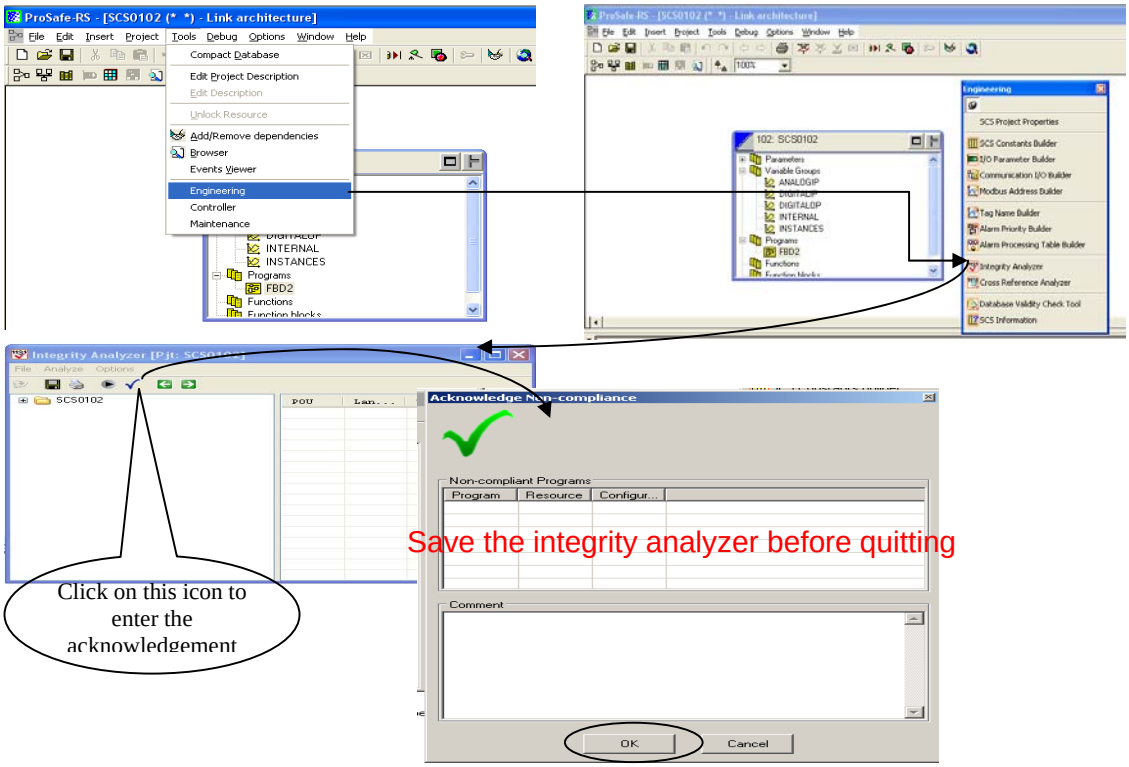
When performing on-line change download of I/O definitions, changes are also reflected in the non-volatile memory of the input/output modules. Data downloaded to an SCS is also saved in the master database on the SENG.

6.6.1 Procedure for On-line Change Download

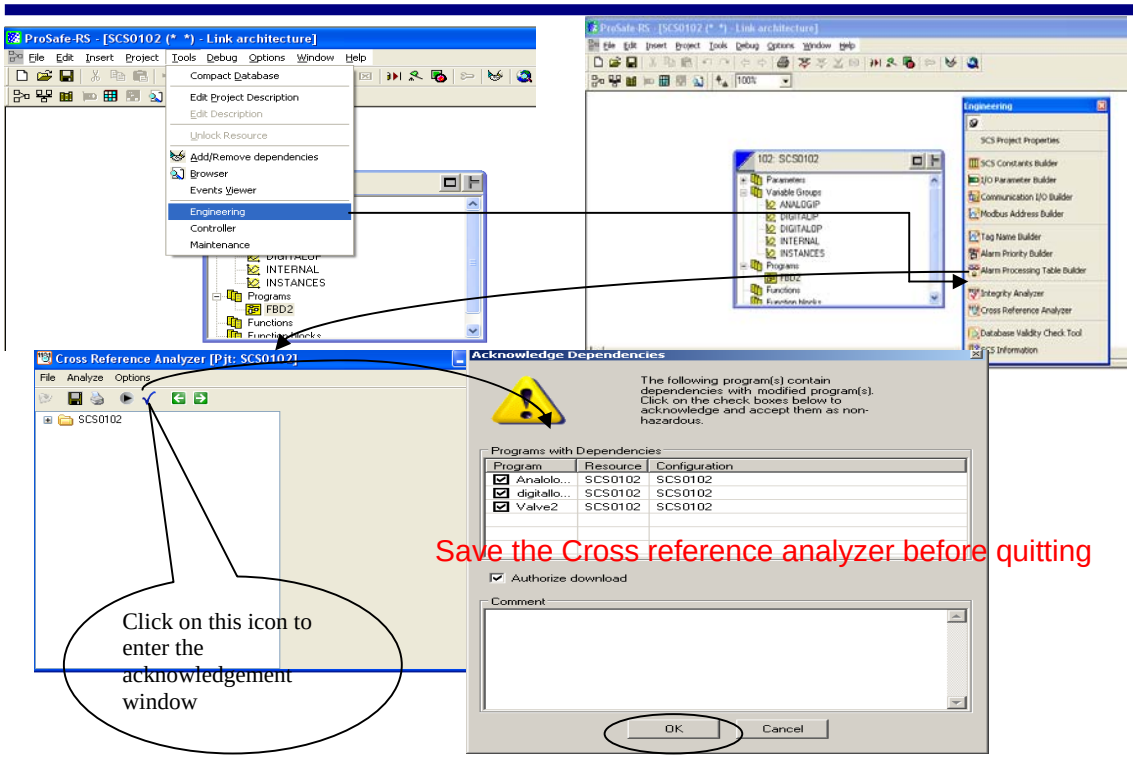
- Perform the building operation.



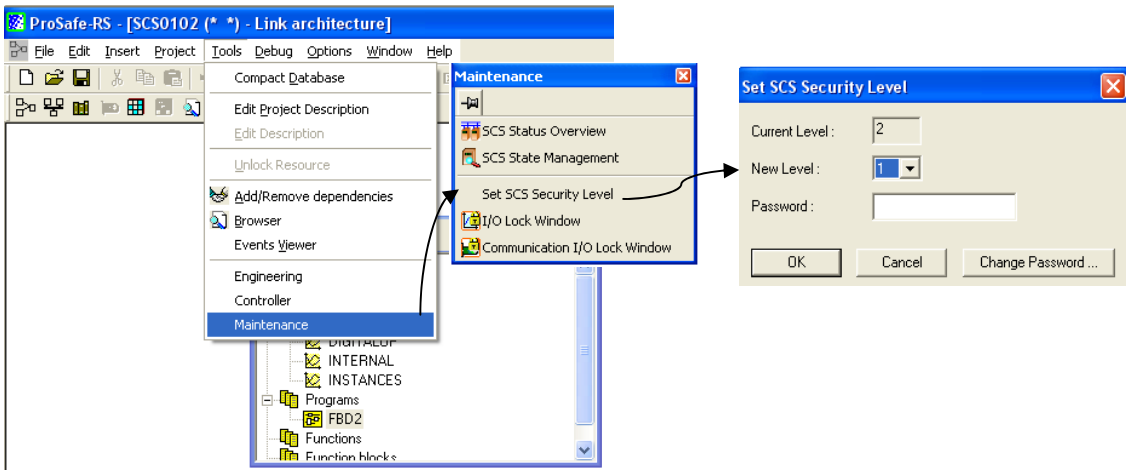
- **Launch integrity Analyzer and analyze the database**



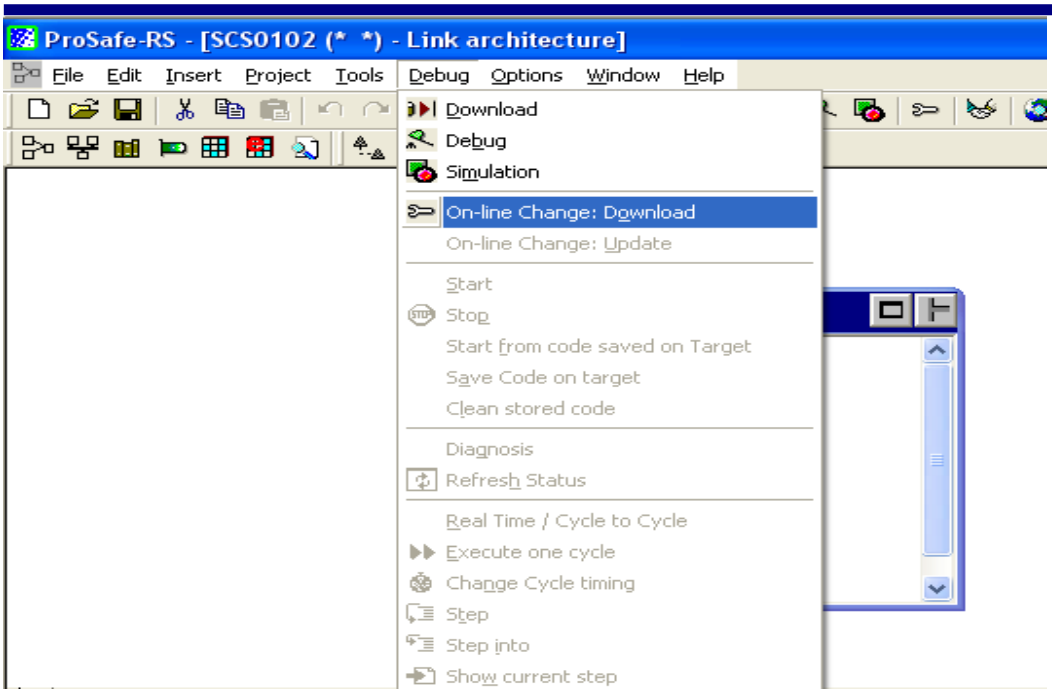
- **Launch cross reference Analyzer and analyze the database**



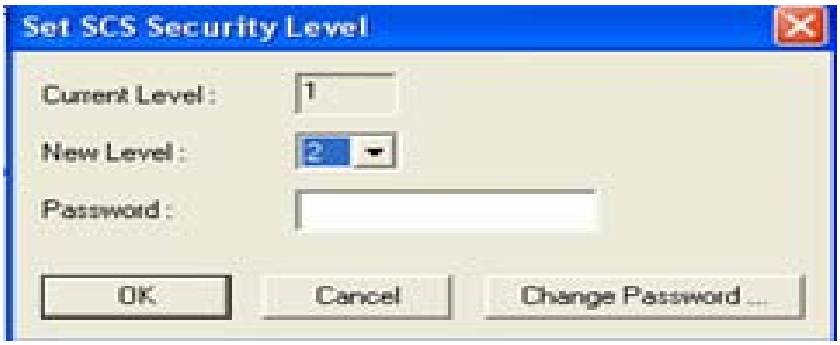
- **Use SCS security level option to set the security level to 1.**



- **Choose [On-line Change: Download] from the [Debug] menu of SCS manager or click the "On-line change download" button on the toolbar. The on-line change download confirmation dialog box appears. Click OK button.**



- **Use the SCS security level option to return the security level to level 2.**



6.7 Master database off-line Download

During master database off-line download, the master database stored in the SENG is loaded to an SCS. Since the downloaded SCS database is identical to the master database, it is possible to download the information downloaded previously to the SCS even while changing the work database of an SCS project.

Use this download function to download the database downloaded in the past again, for example when the CPU module of an SCS is replaced. In the case of a redundant CPU module, this download is not required if only one module is replaced.

6.7.1 Procedure for Master database off-line Download

What to Do before Master Database Off-line Download

Use the SCS security level operation function to set the SCS security level to Level 0.

Start the Master Database Off-line Download

Select [Controller] from the [Tools] menu of SCS Manager. The [Controller] launcher menu appears.

Select [Master Database Off-line Download] of [Reset SCS] from the [Controller] launcher menu.

The master database off-line download confirmation dialog box appears.

6.8 List of Applicable Items for On-line Change

- POU Information that is Changeable On-line

Modification	POU (Program Organization Unit)		
	Program	User-Defined FB	User-Defined FU
Adding/deleting variables	Enabled	Enabled (*1)	Enabled (*4)
Adding a variable to be named the same as that of a deleted variable	Disabled	Disabled	Disabled
Changing attributes of variables	Disabled	Disabled	Disabled
Adding/deleting I/O variables	Enabled	-	-
Adding/deleting FU	Enabled	Enabled	Enabled
Adding/deleting user-defined FU (*3)	Enabled	Enabled	Enabled
Adding/deleting FB instances	Enabled	Disabled	-
Adding/deleting user-defined FB (*3)	Enabled	Disabled	-
Adding a FB to be named the same Instance as that of a deleted FB	Disabled	-	-
Changing logic	Enabled	Enabled (*1)	Enabled (*1)
Creating/deleting programs Changing program names	Disabled (*2)		
Creating/deleting user-defined Function Blocks Changing user-defined Function Block names	Disabled (*2)		
Creating/deleting user-defined Functions Changing user-defined Function names	Disabled (*2)		

- **I/O Module Information that is Changeable On-line**

Modification	Enabled/Disabled
Adding nodes	Disabled
Deleting nodes	Disabled
Changing parameters of nodes	Enabled
Adding I/O modules	Disabled
Deleting I/O modules	Disabled
Changing redundant I/O modules	Disabled
Changing parameters of I/O modules	Enabled
Changing parameters of channels	Enabled
Changing subsystem communication definitions	Enabled
Defining link between a variable and an idle channel	Enabled
Deleting link between a channel and a variable	Enabled
Changing link between a channel and a variable	Enabled
Adding, changing or deleting subsystem communication definitions	Enabled
Changing wiring of communication input/output FBs	Enabled

- **Constants and Network Information that are Changeable with On-line**

Classification	Modification	Enabled/Disabled
Configuration	Name	Disabled
	Password	Disabled (*1)
Resource	Name	Disabled
	Resource Number	Disabled
	Scan period	Disabled
	Number of variables permitted for online maintenance	Disabled
	Size of temporary variables and constants area	Disabled
Network	IP address	Disabled
	Station address	Disabled
	Inter-SCS safety Communication (Binding)	Disabled
Optional ESB BUS Repeater	With or without optional ESB bus repeater	Disabled
	Max. extension distance	Disabled

- **Builder Definitions that are Changeable with On-line**

Builders	Enabled/Disabled
SCS Constants Builder	Disabled
I/O Parameter Builder	Enabled
Communication I/O Builder	Enabled
SCS Link Transmission Builder	Enabled
Modbus Address Builder	Enabled
Tag Name Builder	Enabled
Alarm Priority Builder	Disabled
Alarm Processing Table Builder	Disabled

7. IEC61131-3 FBD-LD

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7.1 Introduction

IEC61131-3 deals with all aspects of PLC application to Industrial process measurement and control.IEC61131 standard defines the following programming methods

- Function block diagram
- Ladder diagrams
- Instruction list
- Structured text
- Sequence function charts

The Prosafe-RS supports Function block diagrams, ladder diagrams and Structured text.

The standard was developed to standardize the programming of PLCs available in the market. This has several advantages:

- A common language means the user need not learn different languages for different PLCs.
- Portability of program across different PLCs.
- Allows program to be broken in to functional elements called program organization unit.
- Strong data typing
- Self check to detect when wrong data type is assigned to the variable.
- Can describe the complex Sequential behavior.

7.2 Function and Function elements

7.2.1 Common elements

Common elements include Identifiers, Comments and Functions.

7.2.1.1 Identifiers

Identifiers are used for naming different elements such as,

- Variables
- Function blocks
- Programs

The identifiers can be string of letters, digits and underlines provided that:

- The first character is not a digit
- There are no two or more underline characters to getjer
- There are no embedded spaces

7.2.1.2 Comments

Comments of various lengths can be inserted in FBDs and LD.Comments of various length can be inserted in FBD and LD.The comment can be of single line or multi line.

Comments can not be nested.

Ex: (*Boiler interlock logic*)

7.2.1.3 Functions

Functions are POUs with the following attributes:

- They have multiple input Parameters and exactly one output parameter.
- Within a function it is possible to call another function
- The abbreviation for the functions is FU.

7.2.1.4 Function blocks

- Multiple input / output parameters and internal memory
- Within a function block it is possible to call another function block or functions.
- The abbreviation for function blocks is FB.

7.2.2 Variable Types

Variables in Prosafe-RS can be either local variables or global variables.

7.2.2.1 Local Variables:

Local variables can be used only within a POU and can not be accessed else where.

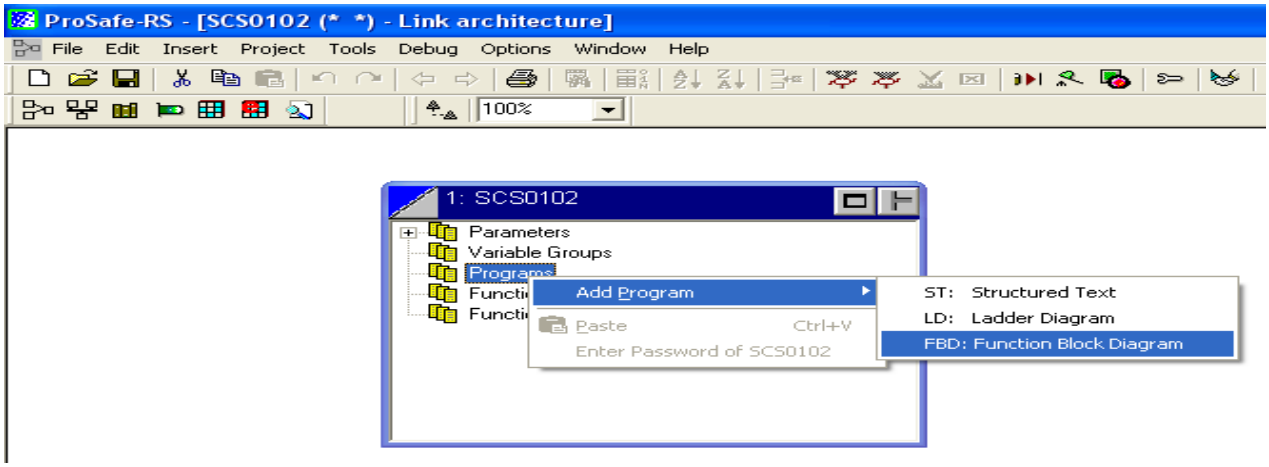
7.2.2.2 Global variables:

Global variables can be accessed by all POUs.

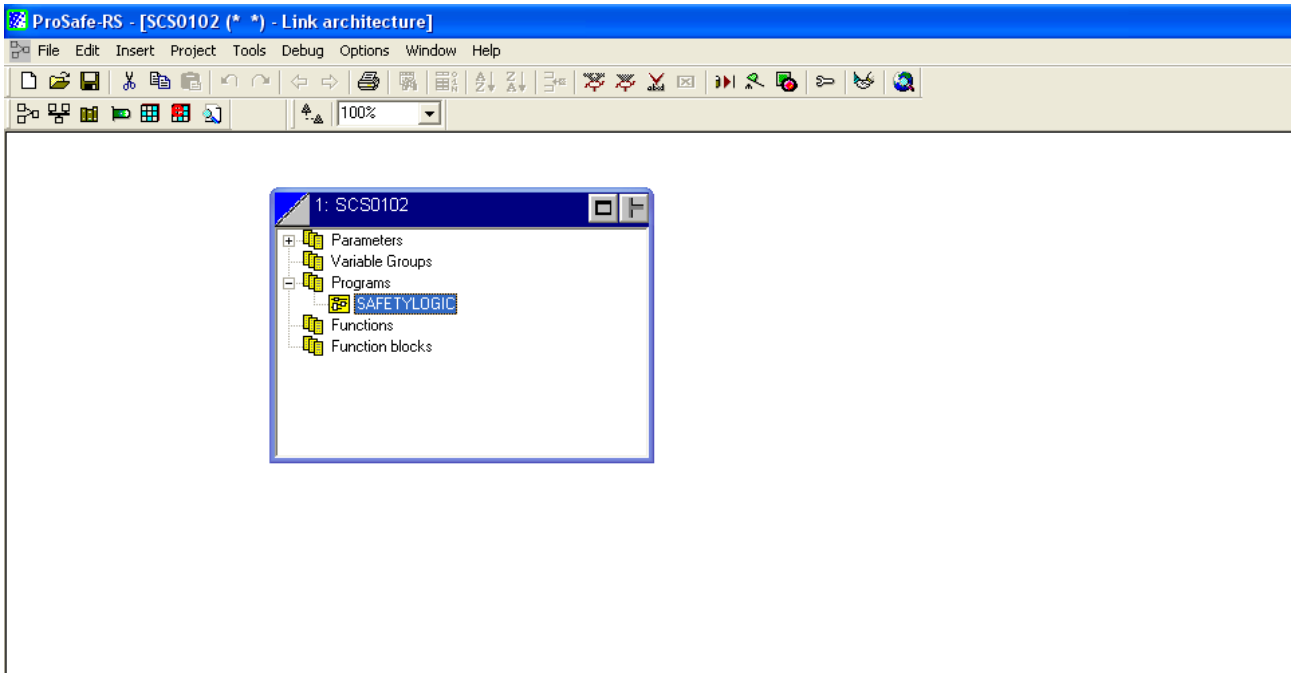
7.3 Function Block Diagram

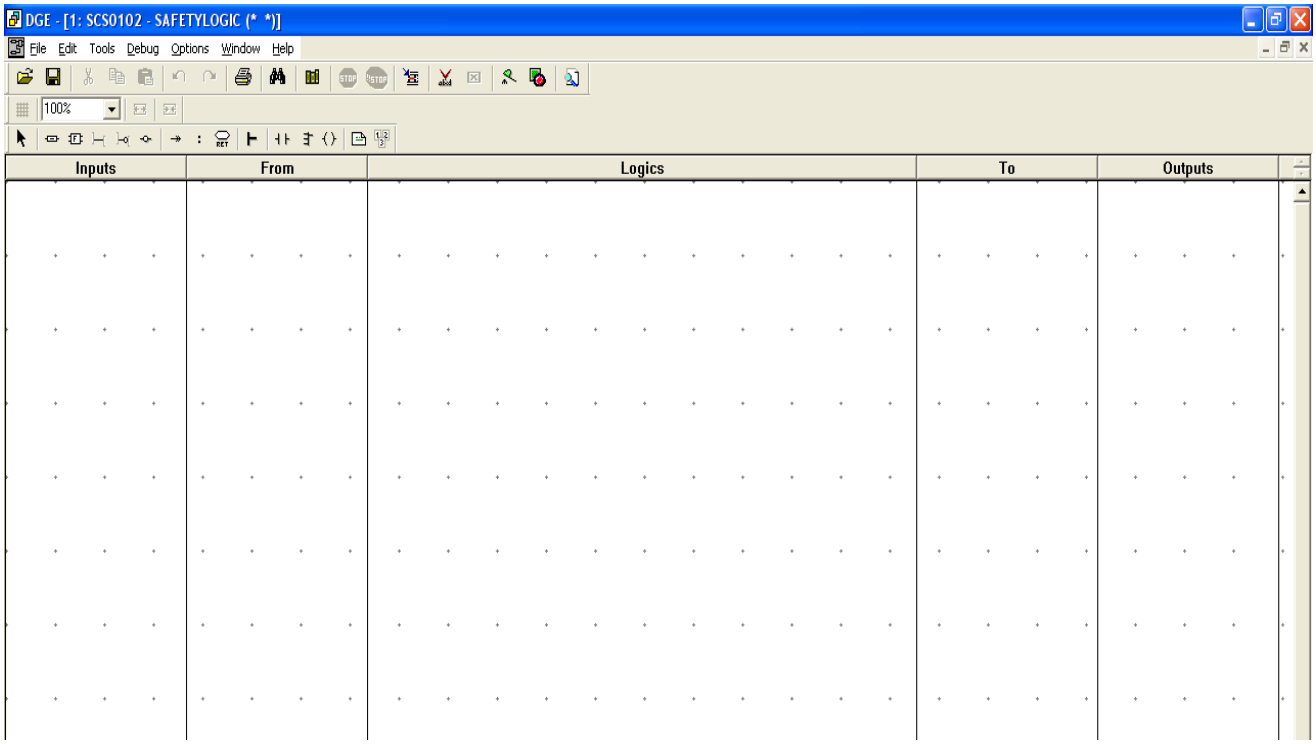
7.3.1 Creation of a FBD.

The path for the creation of a FBD is shown below. Click Program->Add Program->FBD in Link architecture. A new FBD will be created.



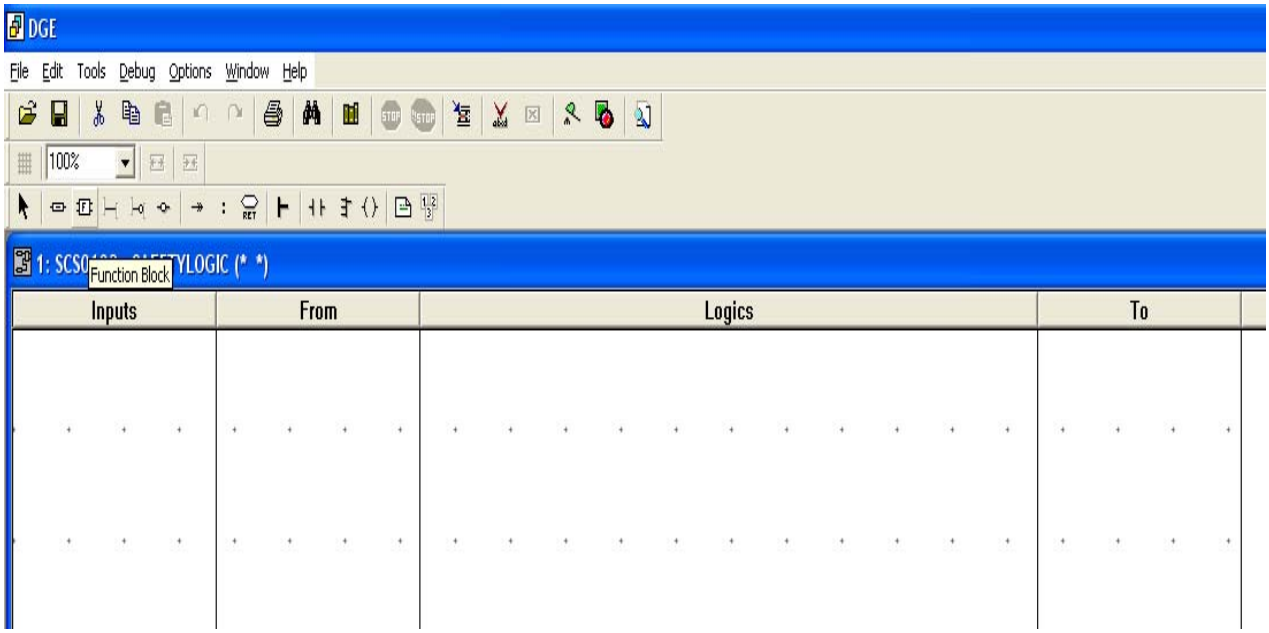
- **Rename the newly created FBD. Double click to open the newly created FBD to enter the builder page.**



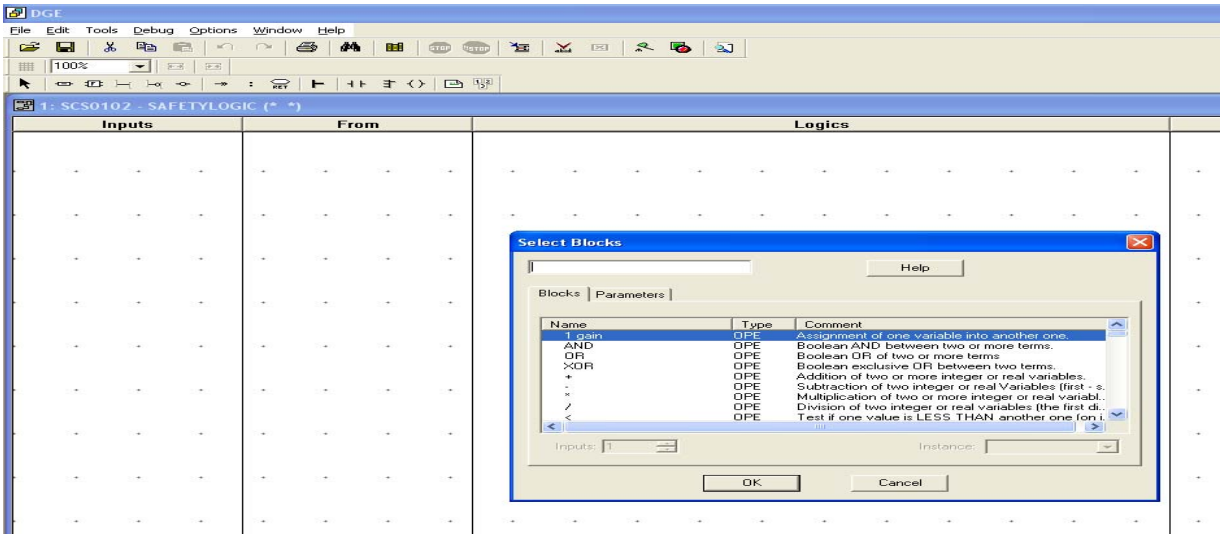


7.3.2 Creation of logics

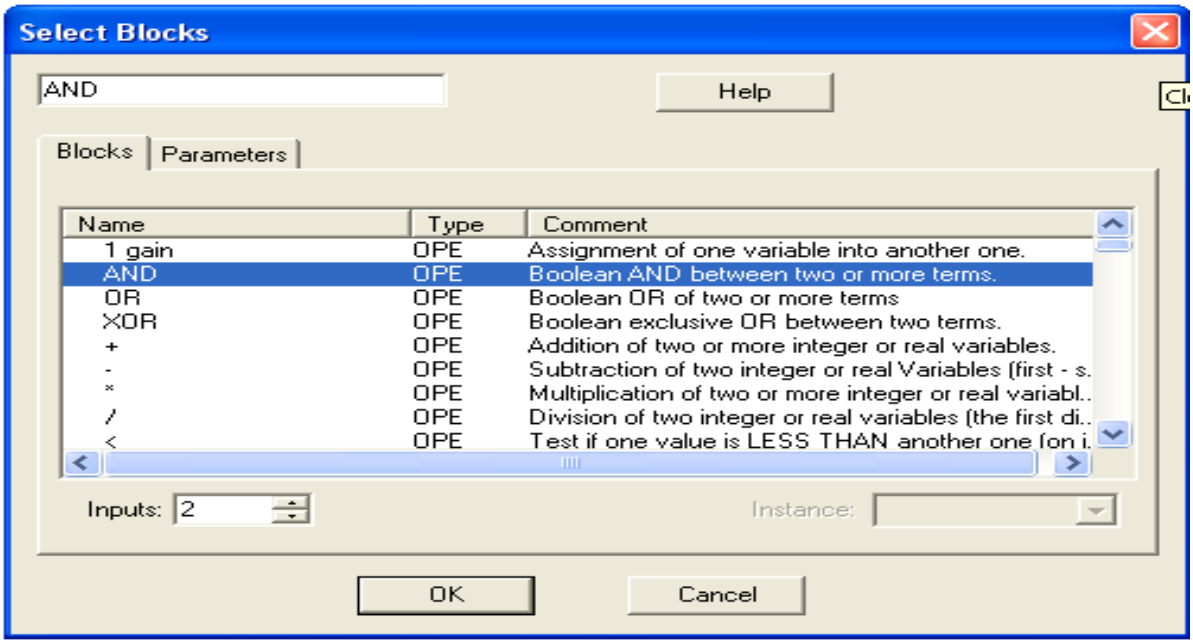
- **Select Function block option from editor window.**



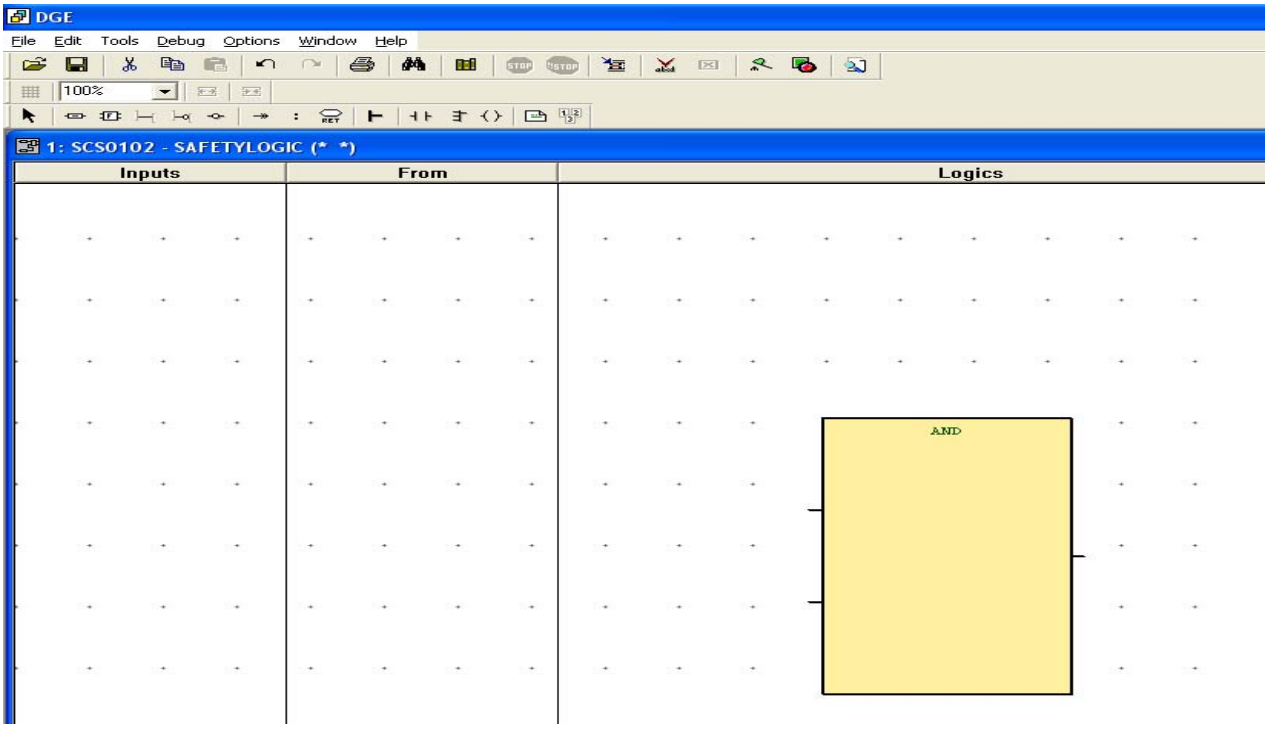
- **Click on the FBD. Select Blocks dialog box appears.**



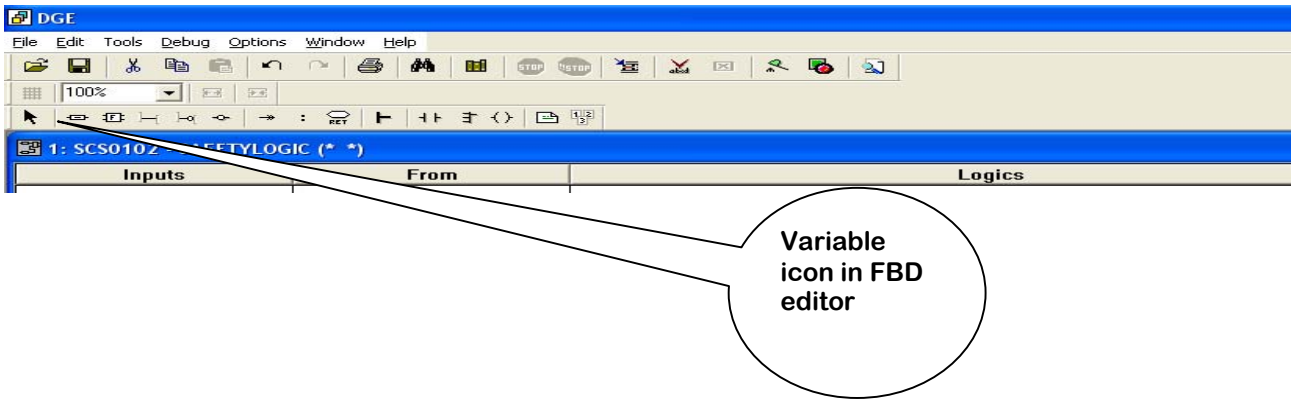
- **Select a suitable function block from the select blocks option for example select an AND block.**

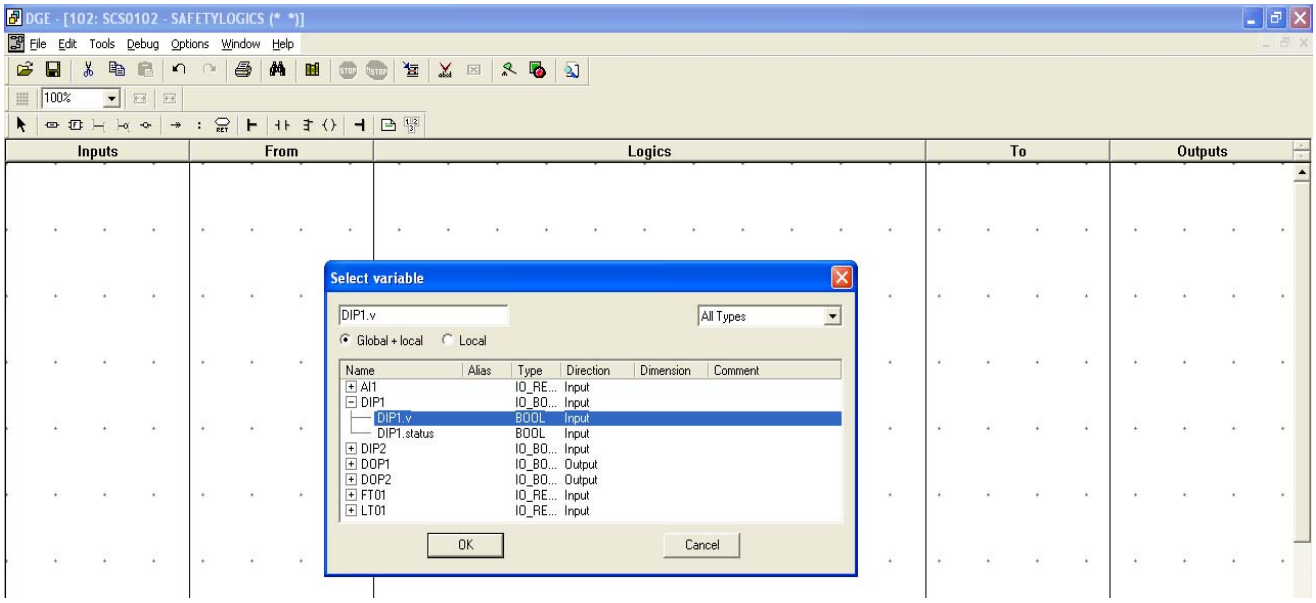


- **Click on the FBD page to display the AND block.**

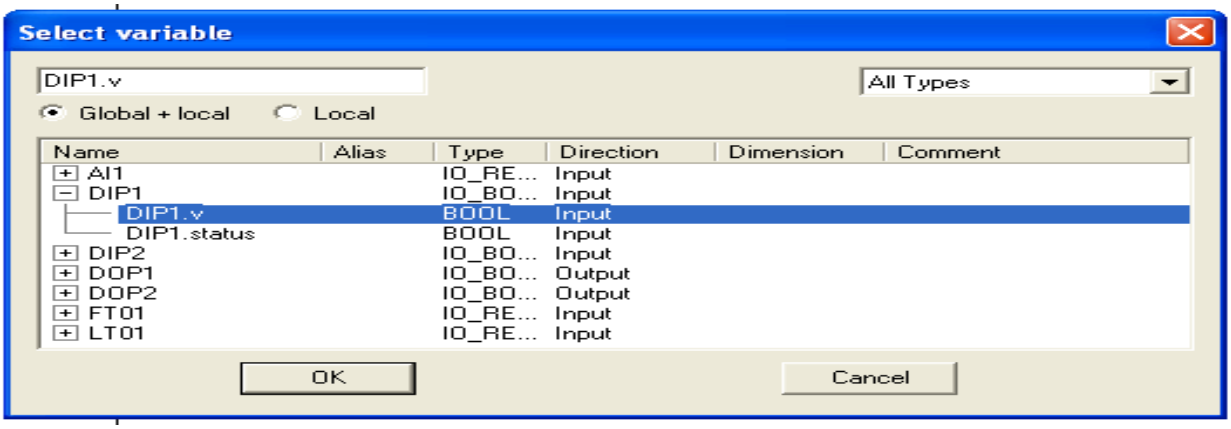


- **Select variable Icon in the editor window to use the already defined variables.**

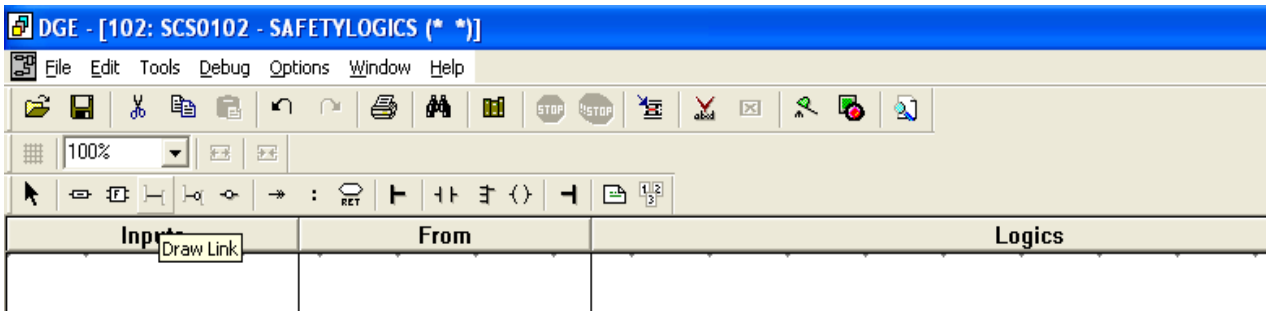




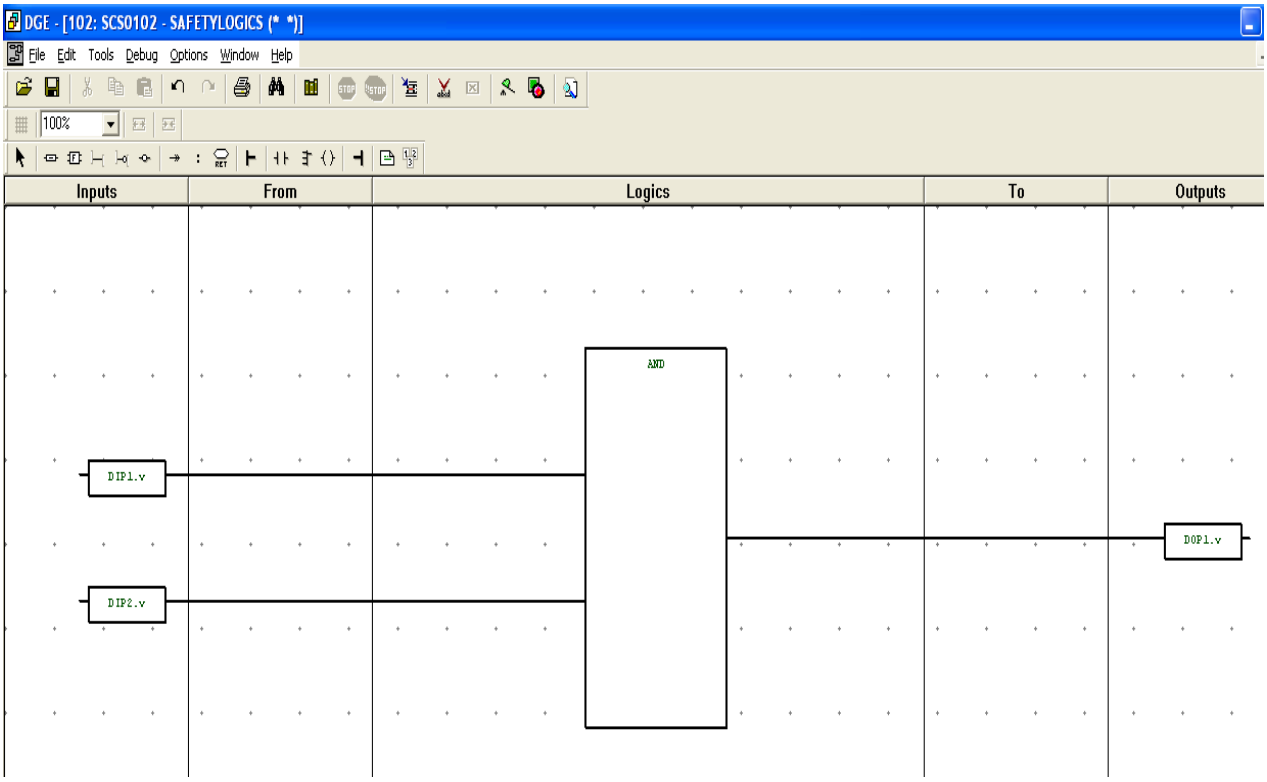
- **Select the desired variable from the list.**



- Select the draw link Icon in the editor window.



- **Draw the link from the variables to the function block.**



- **Perform a download and test the program in debug mode.**

7.4 Function blocks

7.4.1 MUXBOOL4 (BOOL-Type Multiplexer with 4 Entries)

A MUXBOOL4 function is a 4-input multiplexer for BOOL-type data. It selects one value

Out of four input values.

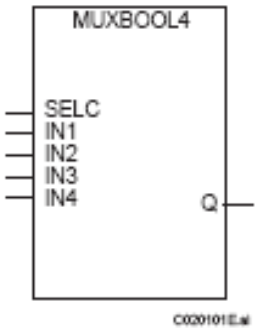


Figure MUXBOOL4

Arguments

Table Arguments of MUXBOOL4

IN/OUT	Arguments	Data type	Description
IN	SELC	DINT	Selector value (0 to 3)
	IN1	BOOL	Input value 1
	IN2	BOOL	Input value 2
	IN3	BOOL	Input value 3
	IN4	BOOL	Input value 4
OUT	Q	BOOL	Output value = Input value 1 (SELC = 0) = Input value 2 (SELC = 1) = Input value 3 (SELC = 2) = Input value 4 (SELC = 3) = FALSE (SELC is a value other than the above)

Description

The MUXBOOL4 function is a 4-input multiplexer for BOOL-type data. It selects one value out of four input values.

If a value other than 0 to 3 is specified for SELC, the output value becomes FALSE.

7.4.2 MUXREAL4 (Real-Type Multiplexer with 4 Entries)

A MUXREAL4 function is a 4-input multiplexer for real number-type data. It selects one value out of four input values.

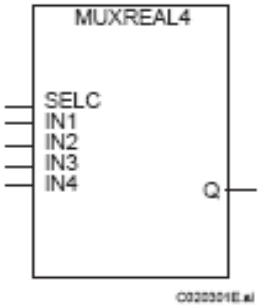


Figure MUXREAL4

Arguments

Table Arguments of MUXREAL4

IN/OUT	Arguments	Data type	Description
IN	SELC	DINT	Selector value (0 to 3)
	IN1	REAL	Input value 1
	IN2	REAL	Input value 2
	IN3	REAL	Input value 3
	IN4	REAL	Input value 4
OUT	Q	REAL	Output value = Input value 1 (SELC = 0) = Input value 2 (SELC = 1) = Input value 3 (SELC = 2) = Input value 4 (SELC = 3) = 0.0 (SELC is a value other than the above)

Description

The MUXREAL4 function is a 4-input multiplexer for real number-type data. It selects one value out of four input values.

If a value other than 0 to 3 is specified for SELC, the output value becomes 0.0.

7.4.3 SCALER (Scaler)

A SCALER function converts input data (0 to 100%) to the specified scale.

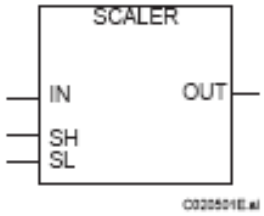


Figure SCALER

Arguments

Table Arguments of SCALER

IN/OUT	Arguments	Data type	Description
IN	IN	REAL	Input value (a value in the range from 0.0 to 100.0)
	SH	REAL	Scale high limit value (output value when input value = 100 [%])
	SL	REAL	Scale low limit value (output value when input value = 0 [%])
OUT	OUT	REAL	Output value

Description

The SCALER function converts input data (0 to 100%) to the specified scale.

The calculation formula of OUT is as follows:

$$OUT = IN \times \frac{(SH - SL)}{100.0} + SL$$

7.4.4 REPEATTIMER (Repeat Timer)

A REPEATTIMER is a function block of repeat timer.

Description

The REPEATTIMER function block executes a repeat timer function.

The REPEATTIMER function block outputs ON and OFF alternately as long as the output start switch (RUN) is TRUE. It outputs TRUE as the output value (Q) during the period specified by the ON period (ONT) and FALSE during the period specified by the OFF period (OFFT). The repeat interval is the value obtained by adding the ON period and OFF period (ONT + OFFT). If the output start switch (RUN) becomes FALSE, the output value (Q) is set to FALSE. If STF is TRUE, the timer starts from the OFF period. If STF is FALSE, the timer starts from the ON period.

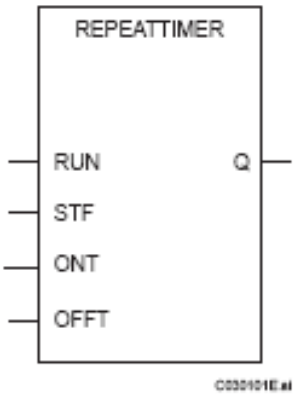


Figure REPEATTIMER

Arguments

Table Arguments of REPEATTIMER

IN/OUT	Arguments	Data type	Description
IN	RUN	BOOL	Output activation switch
	STF	BOOL	Start status flag TRUE: Start from OFF FALSE: Start from ON
	ONT	TIME	ON period (a multiple of the scan period)
	OFFT	TIME	OFF period (a multiple of the scan period)
OUT	Q	BOOL	Output value

7.4.5 ANLG1OO2D (1oo2D Analog Voter)

An ANLG1OO2D function block is a 2-input analog voter with diagnostics. It diagnoses the data status of two input values and determines the output value.

Description

The ANLG1OO2D function block is a 2-input analog voter with diagnostics. It receives two inputs with data status and determines the output value using the voting method of 1oo2D (one-out-oftwo with diagnostics). By using the ANLG1OO2D function block, it is possible to detect not only input module failures, but also input value errors.

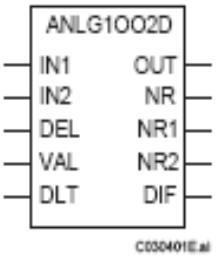


Figure ANLG1OO2D

Arguments

Table Arguments of ANLG1OO2D

IN/OUT	Arguments	Data type	Description
IN	IN1	IO_REAL	Input value 1 (with data status, 0 to 100%)
	IN2	IO_REAL	Input value 2 (with data status, 0 to 100%)
	DEL	REAL	Allowable range for difference. A range of allowable difference between two input values (DEL > 0; UNIT: %)
	VAL	REAL	Fail-safe value. The value output in case the input value is erroneous (-25.0 to 125%)
	DLT	TIME	Allowable time. The time to wait for the difference between the input values to converge to the allowable range (DEL) (an integral multiple of the scan period)
OUT	OUT	REAL	Output value (value selected with 1oo2D, 0 to 100%)
	NR	BOOL	Indicates whether or not the input value is normal TRUE: Normal FALSE: Abnormal (The fail-safe value is output.)
	NR1	BOOL	Indicates whether or not input value 1 (IN1) is normal TRUE: Normal FALSE: The data status is BAD or the difference between the input values is larger than the allowable range.
	NR2	BOOL	Indicates whether or not input value 2 (IN2) is normal TRUE: Normal FALSE: The data status is BAD or the difference between the input values is larger than the allowable range.
	DIF	REAL	Absolute value of the difference between the two input values

7.4.6 BOOLVOTER (IO_BOOL-Type BOOL Voter)

A BOOLVOTER function block is a 3-input BOOL voter. It receives three input values with data status and outputs a value selected from these input values or the fail-safe value

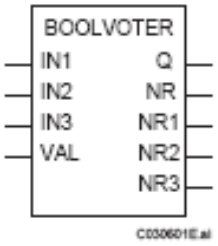


Figure BOOLVOTER

Arguments

Table Arguments of BOOLVOTER

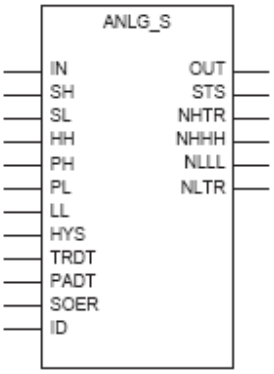
IN/OUT	Arguments	Data type	Description
IN	IN1	IO_BOOL	Input value 1 (with data status)
	IN2	IO_BOOL	Input value 2 (with data status)
	IN3	IO_BOOL	Input value 3 (with data status)
	VAL	BOOL	Fail-safe value. The value output in case the data status of input value is not GOOD.
OUT	Q	BOOL	Output value (value selected with 2oo3)
	NR	BOOL	Indicates whether or not output value is normal TRUE: Normal FALSE: Abnormal (The fail-safe value is output.)
	NR1	BOOL	Indicates whether or not input value 1 (IN1) is normal TRUE: Normal FALSE: The data status is BAD or the data value is different from the other input values.
	NR2	BOOL	Indicates whether or not input value 2 (IN2) is normal TRUE: Normal FALSE: The data status is BAD or the data value is different from the other input values.
	NR3	BOOL	Indicates whether or not input value 3 (IN3) is normal TRUE: Normal FALSE: The data status is BAD or the data value is different from the other input values.

Description

A BOOLVOTER function block is a 3-input BOOL voter. It receives three input values with data status and outputs one value selected as the value of at least two out of the three inputs (twoout-of three: 2oo3) via the output (Q). By using the BOOLVOTER function block, it is possible to detect not only input module failures, but also errors in input values INn {n = 1, 2 or 3} received from sensors.

7.4.7 ANLG_S (Analog Input Function Block with Data Status)

An ANLG_S function block converts the scale of the analog input (IN), and then outputs the converted analog output (OUT) and data status (STS) corresponding to the analog input (IN).



IN/OUT	Arguments	Data type	Description
IN	IN	IO_REAL	Analog input (data value: 0 to 100%)
	SH	REAL	Scale high limit (engineering data)
	SL	REAL	Scale low limit (engineering data)
	HH	REAL	Setting level of HI trip (engineering data)
	PH	REAL	Setting level of HI pre-alarm (engineering data)
	PL	REAL	Setting level of LO pre-alarm (engineering data)
	LL	REAL	Setting level of LO trip (engineering data)
	HYS	REAL	Hysteresis (HYS ≥ 0; unit is %). If HYS is set as HYS < 0, it acts as HYS = 0.
	TRDT	TIME	The minimum time period treated as trip occurrence (Must be an integer multiple of the scan period) If a trip event continues for the time period specified here, the trip "Occurred" is stored in NHTR and NLTR.
	PADT	TIME	The minimum time period treated as pre-alarm occurrence (Must be an integer multiple of the scan period) If a pre-alarm event continues for the time period specified here, the trip "Occurred" is stored in NHHH and NLLL.
	SOER	BOOL	SOER setting
	ID	STRING	Character string of up to 32 single-byte or 16 double-byte characters specified for SOER
OUT	OUT	REAL	Analog output (scale already converted)
	STS	BOOL	Data status (data status of IN) TRUE: GOOD FALSE: BAD
	NHTR	BOOL	HI trip occurrence flag TRUE: Normal FALSE: Occurred
	NHHH	BOOL	HI pre-alarm occurrence flag TRUE: Normal FALSE: Occurred
	NLLL	BOOL	LO pre-alarm occurrence flag TRUE: Normal FALSE: Occurred
	NLTR	BOOL	LO trip occurrence flag TRUE: Normal FALSE: Occurred

Description

An ANLG_S function block converts the scale of the analog input (IN), and then outputs the converted analog output (OUT) and data status (STS) corresponding to the analog input (IN). It compares this output value (OUT) with four types of threshold values (HH, PH, PL and LL) and outputs an alarm status

(NHTR, NHHH, NLLL or NLTR). Each alarm condition is only set as having occurred (FALSE) if the alarm condition continues for a specified period of time (TRDT or PADT) or longer. If TRUE is specified for SOER, an SOE event is generated when a trip/prealarm occurs or the system recovers from it.

It can be referenced using a tag name from CS 3000 by defining the tag name for the instance of the ANLG_S function block. If the data status (STS) becomes FALSE (BAD), an IOP process alarm is generated, which can be confirmed on an HIS.

7.4.8 ANLGI (Analog Input)

An ANLGI function block converts the scale of the input value (IN) and calculates the output value OUT).

Since the ANLG_S function block consists of the feature of this function block and other capabilities such as outputting data status, it is recommended to use ANLG_S instead of this function block.

7.4.9 VEL (Velocity Limit Alarm)

A VEL function block monitors the rate of change of the input value and judges whether or not the specified rate of change is exceeded.

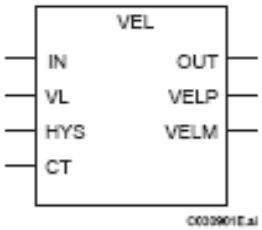


Figure VEL

Arguments

Table Arguments of VEL

IN/OUT	Arguments	Data type	Description
IN	IN	REAL	Input value (0 to 100%)
	VL	REAL	Velocity limit alarm setting level (VL > 0%)
	HYS	REAL	Hysteresis (HYS ≥ 0). If HYS is set as HYS < 0, it acts as HYS = 0.
	CT	TIME	Sampling interval
OUT	OUT	REAL	Output value
	VELP	BOOL	VEL + alarm occurrence flag TRUE: Occurring FALSE: Not occurred
	VELM	BOOL	VEL - alarm occurrence flag TRUE: Occurring FALSE: Not occurred

Description

The VEL function block monitors the rate of change of the input value and judges whether or not the specified rate of change is exceeded. Moreover, it can be referenced using a mapping block from CS 3000 by defining a tag name for the instance in question.

7.4.10 CTU (Count Up Counter)

A CTU function block counts up from 0 to the maximum counter value (PV) in increments of 1 as long as the count input (CU) is TRUE.

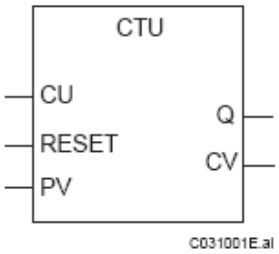


Figure CTU

Arguments

Table Arguments of CTU

IN/OUT	Arguments	Data type	Description
IN	CU	BOOL	Count input (count up while CU is TRUE)
	RESET	BOOL	Reset command (given higher priority than CU)
	PV	DINT	Maximum counter value
OUT	Q	BOOL	TRUE at overflow (CV ≥ PV)
	CV	DINT	Count result

Description

• The CTU function block counts up in increments of 1 at each scan from 0 to the maximum counter value (PV) as long as the count input (CU) is TRUE. The count result is output for CV and the default value is 0.

• When the counter reaches the maximum value (CV ≥ PV), the CTU function block stops counting up and outputs TRUE for Q.

• RESET is a reset command. If RESET becomes TRUE, the counter is reset, Q becomes FALSE and CV becomes 0. As long as RESET is TRUE, the CTU function block does not count up even if CU becomes TRUE.

7.4.11 CTD (Count Down Counter)

A CTD function block counts down in decrements of 1 at each scan from the initial counter value (PV) to 0 as long as the count input (CD) is TRUE.

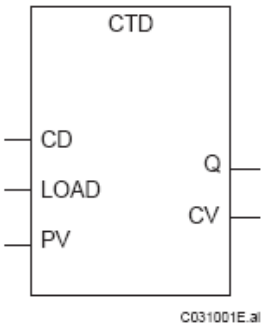


Figure CTD

Arguments

Table Arguments of CTD

IN/OUT	Arguments	Data type	Description
IN	CD	BOOL	Count input (count down while CD is TRUE)
	LOAD	BOOL	Load command (given higher priority than CD)
	PV	DINT	Initial counter value
OUT	Q	BOOL	TRUE at underflow (CV ≤ 0)
	CV	DINT	Count result

Description

• The CTD function block counts down in decrements of 1 at each scan from the initial counter value (PV) to 0 as long as the count input (CD) is TRUE. The count result is output for CV and the default value is the initial counter value (PV).

• When the counter reaches 0 (CV ≤ 0), CTD stops counting down and outputs TRUE for Q.

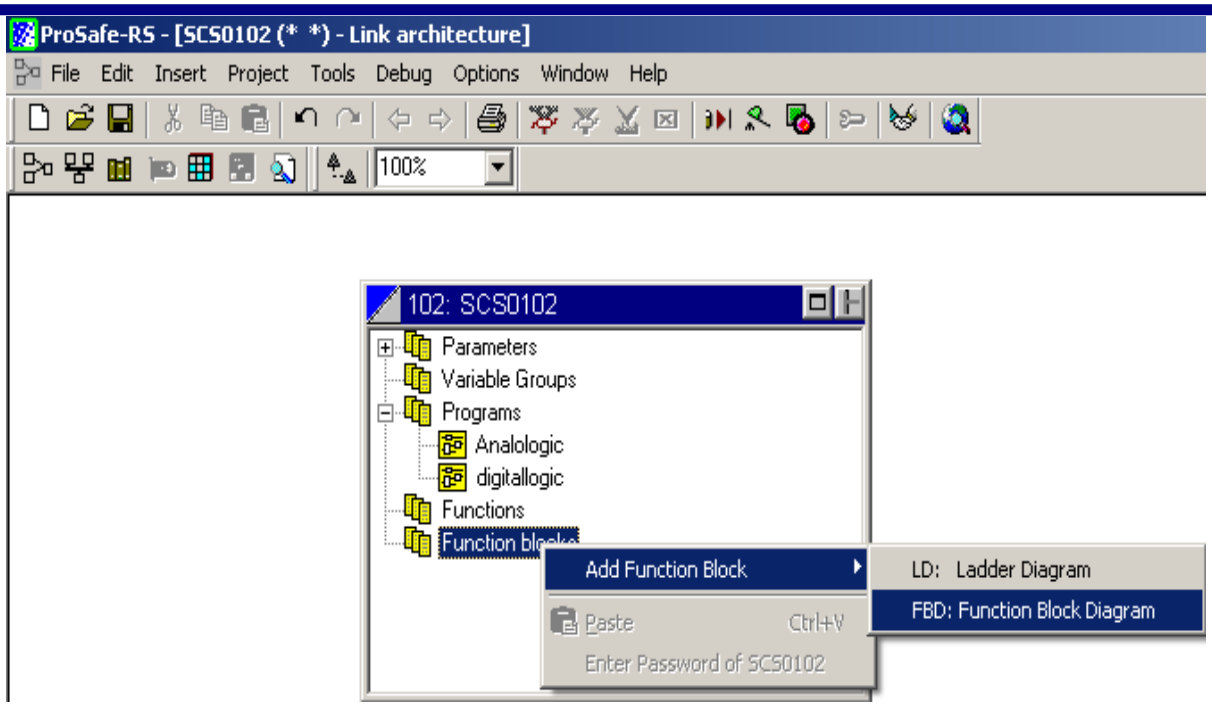
• LOAD is a load command. If LOAD becomes TRUE, the counter is loaded, Q becomes FALSE and CV is reset to PV. As long as LOAD is TRUE, the CTD function block does not count down even if CD becomes TRUE.

7.5 User Defined Function block

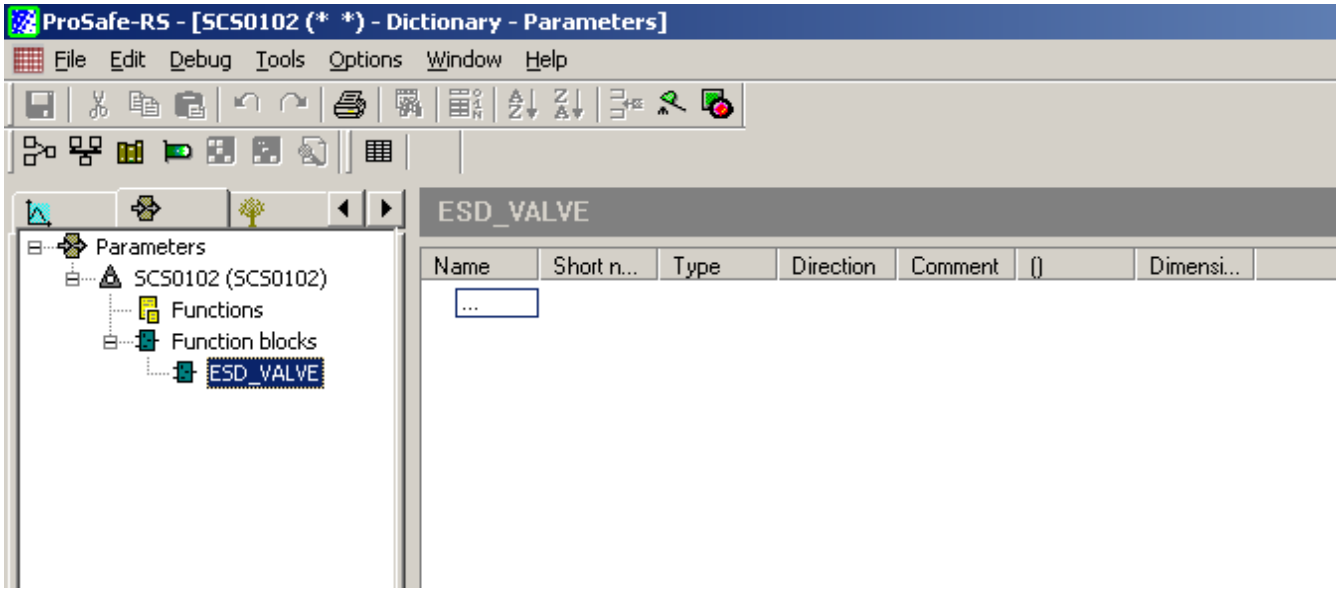
Prosafe-RS allows user to define unique FUs and FBs. These FUs and FBs are called "User defined FUs" and "User defined FBs," respectively. Frequently used FUs and FBs such as AND,OR, TON etc can be used by the user to write logics used commonly in applications as well. User defined FUs and FBs can be used in any programs.

Creation of a user defined function block.

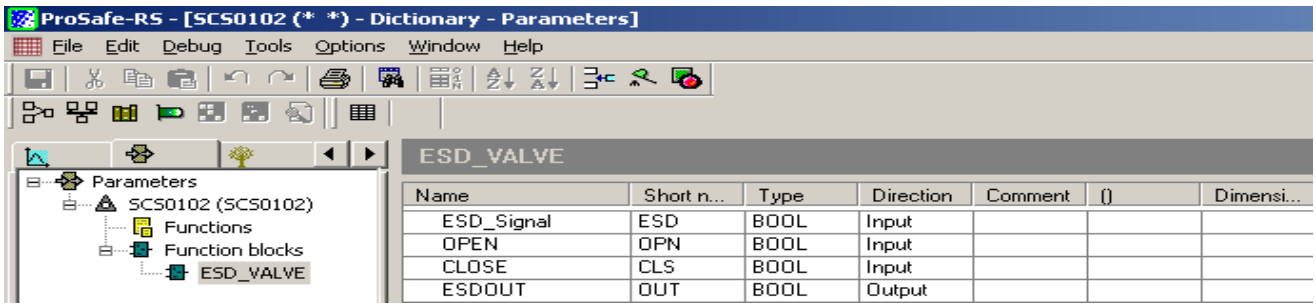
- **To Create a user defined function block, Right click 'Function blocks ' on the link architecture view, then select 'Add function block' option and the language FBD. Then name it as ESD_VALVE.**



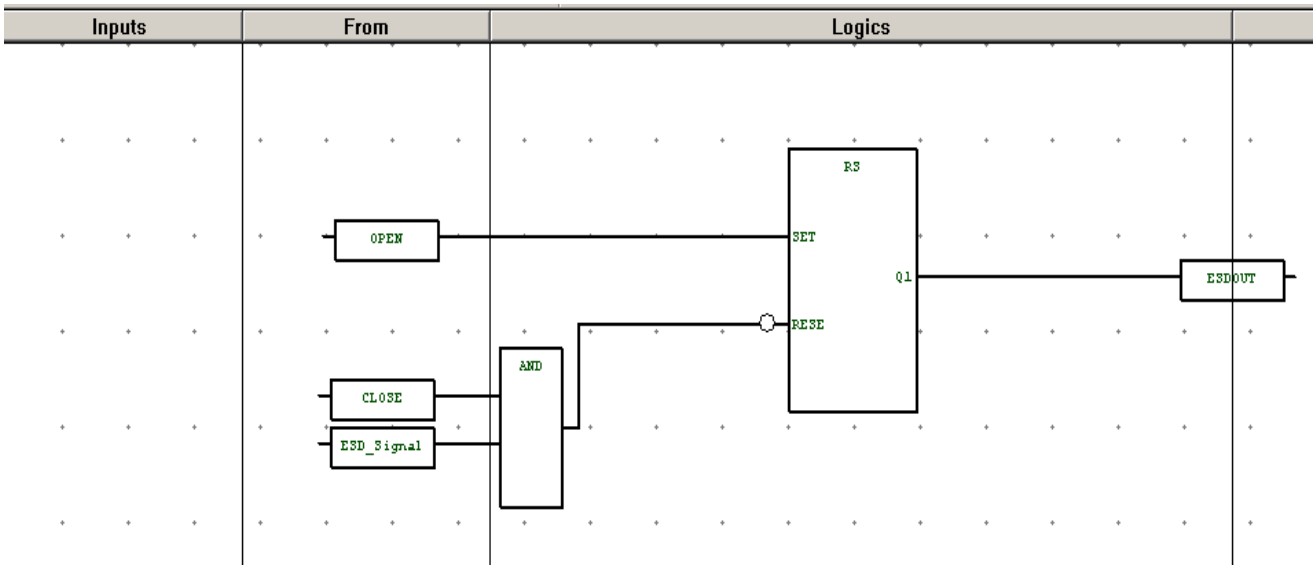
- **To define the parameters of the user defined function blocks, Open the Dictionary View . Then select the 'parameters' tree and click (+) on the tree view to select 'ESD_VALVE'.**



- **Define the following parameters in Dictionary.**



- **Double click on the 'ESD_VALVE' of a function block on the link architecture view. Edit the logic as shown in the following figure.**

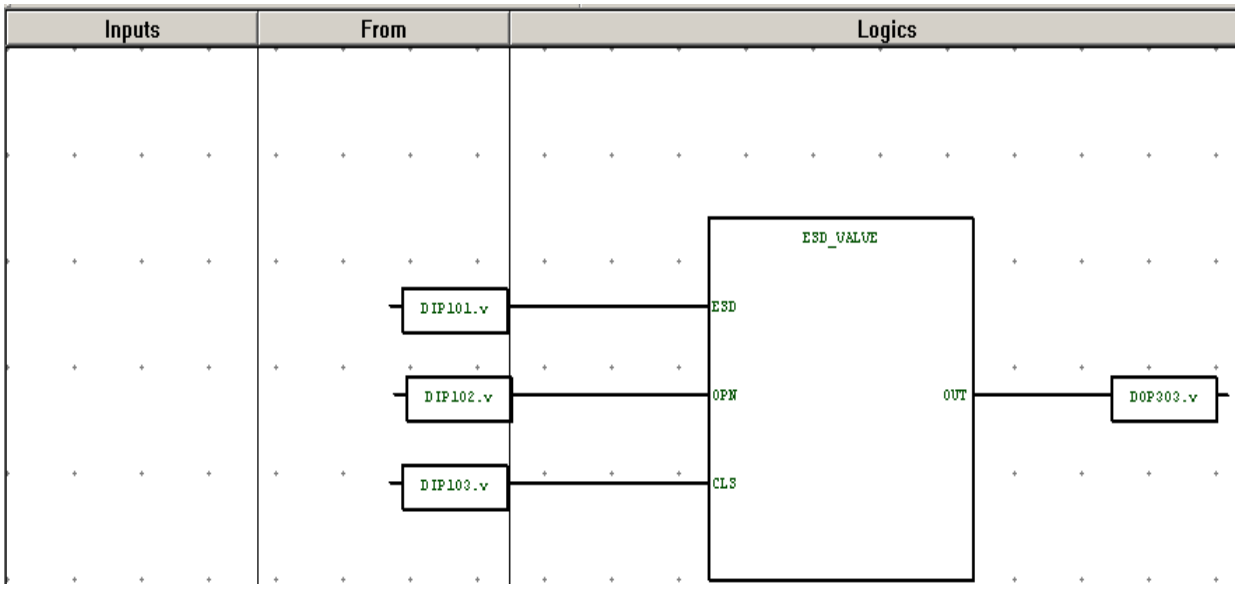


- **Execute the 'build program' and 'save'. Then close the multi-language editor.**

Creation of a program using User Defined function block.

Create a program for Valve-2 using 'ESD_VALVE' which is a User defined function block.

- Define I/O variables on the Dictionary view and wire them with I/O channels on the I/O wiring builder.
  1. Digital inputs:
     ESD switch signal from operator console: DIP101 NC input
     Open operation for Valve-2 from local operation box: DIP102 NO input.
     Close operation for Valve-2 from local operation box: DIP103 NC input.
  2. Digital outputs:
     Open command for Valve-2 : DOP303 DTS output
- Create new program choosing FBD as the language, and then name it 'Valve2' on the link architecture view.
- Double-click the 'Valve2' to open the editor and edit the logic as shown in the following figure.



- **Execute ‘Save’ and ‘Build Program'. Then close the multi-Language editor.**

8. INTEGRATION

Table of contents

8.1 Overview of CS 3000 Integration

The CS 3000 Integration Function of the ProSafe-RS provides a communication interface for accessing SCS of ProSafe-RS from HIS and FCS of CENTUM CS 3000 system (hereinafter referred to as “CS 3000”). By this function, you can operate and monitor SCS from HIS using the same interfaces (windows) for operating and monitoring FCS. You can also access SCS data from FCS using the same interface (tag names) used by an FCS to access other FCS.

8.2 Overview of Operation and Monitoring from HIS.

In the CS 3000 integration, the following operations are possible from HIS to SCS:

• To use tag names to operate and monitor SCS data via the same interface used to monitor FCS data.

• To monitor the status of process alarms and annunciators generated on SCSs in HIS’s Process Alarm window.

• To monitor the system alarms generated on SCS in HIS’s System Alarm window.

• To display the status of each SCS in HIS’s SCS Status Display window.

• To override the application logic variables.

• To set output of the application logics.

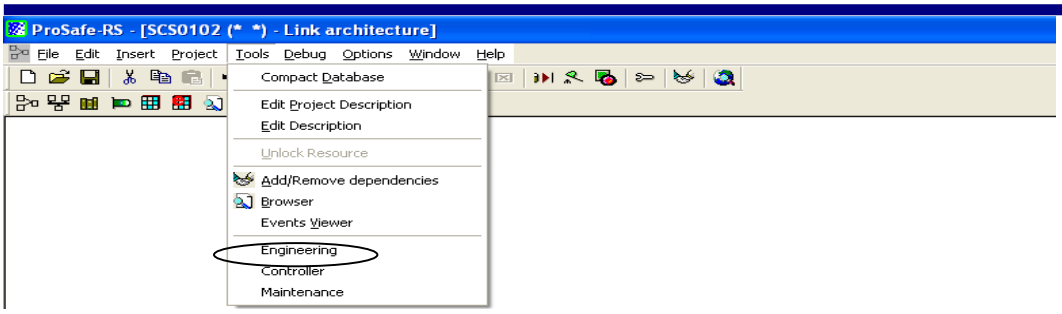
8.3 Engineering on the SENG Side

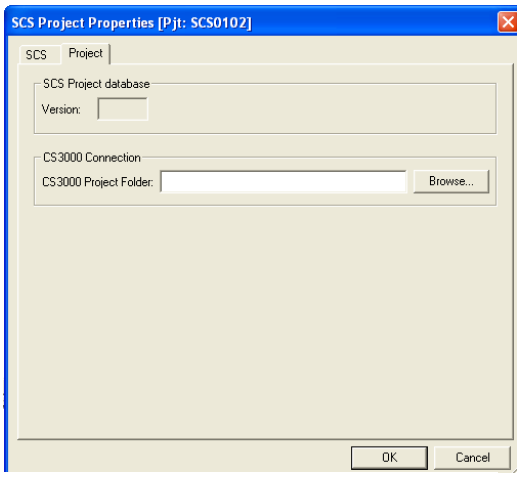
This section describes the engineering tasks performed on the SENG side, among the tasks required to connect an SCS project and a CS 3000 project.

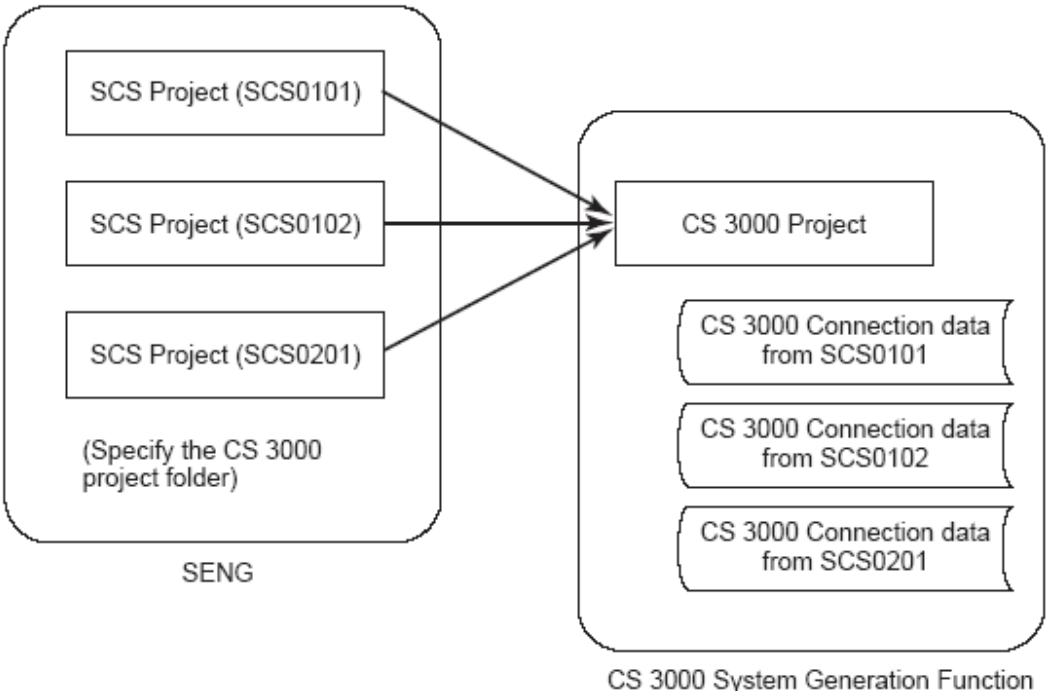
Setting of SCS Project Property

An SCS project and a CS 3000 project can be connected using SCS Project Properties in SCS manager. In SCS Project Properties, specify the folder of the CS 3000 project you want to connect to the SCS project. The information for CS 3000 integration that has been set in the SCS project can be copied to the CS 3000 project folder.

The connection of an SCS project and a CS 3000 project is set only in one direction: from the SCS project to the CS 3000 project.


ProSafe-RS - [SCS0102 (* *) - Link architecture]
File Edit Insert Project Tools Debug Options Window Help
Compact Database
Edit Project Description
Edit Description
Unlock Resource
Add/Remove dependencies
Browser
Events Viewer
Engineering
Controller
Maintenance


SCS Project Properties [Pjt: SCS0102]
SCS
Project
SCS Project database
Version:
CS3000 Connection
CS3000 Project Folder:
Browse...
OK
Cancel


SCS Project (SCS0101)
SCS Project (SCS0102)
SCS Project (SCS0201)
(Specify the CS 3000 project folder)
SENG
CS 3000 Project
CS 3000 Connection data from SCS0101
CS 3000 Connection data from SCS0102
CS 3000 Connection data from SCS0201
CS 3000 System Generation Function

8.4 Engineering on the CS 3000 Side

This section describes engineering tasks performed on the CS 3000 side, among those tasks required to connect an SCS project and a CS 3000 project.

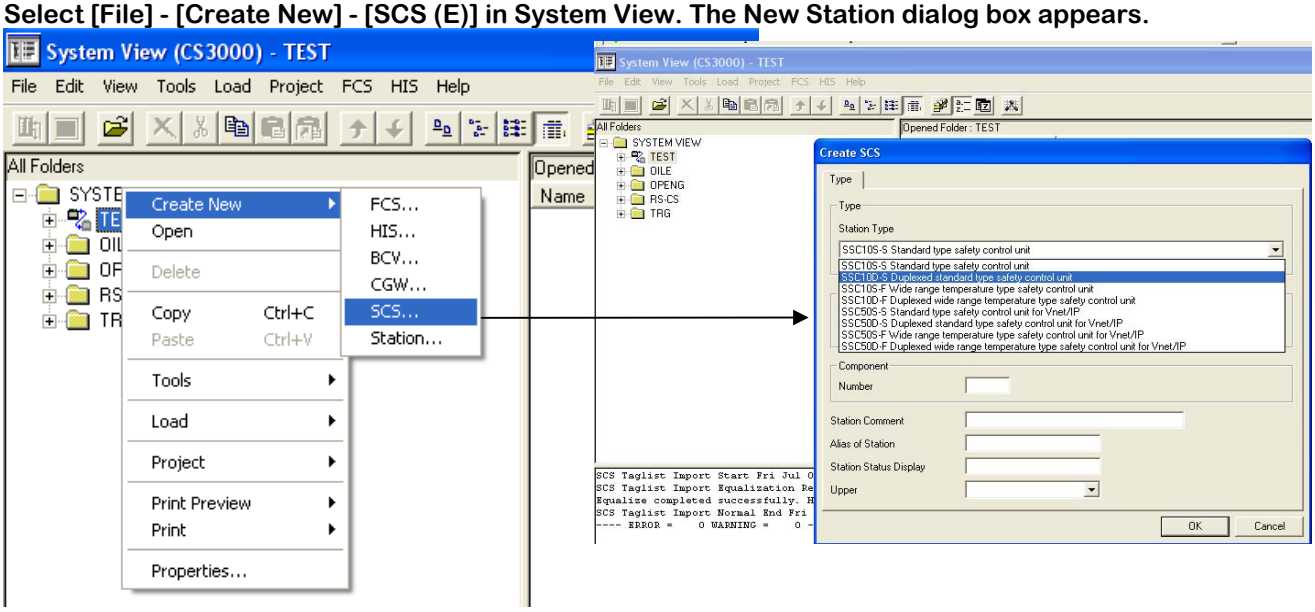
SCS Creation

To connect each SCS project to a CS 3000 project, a corresponding SCS must be created in CS 3000 System View first.

Creating an SCS

SCSs are created in CS 3000 System View. The procedure is explained below:

Select [File] - [Create New] - [SCS (E)] in System View. The New Station dialog box appears.



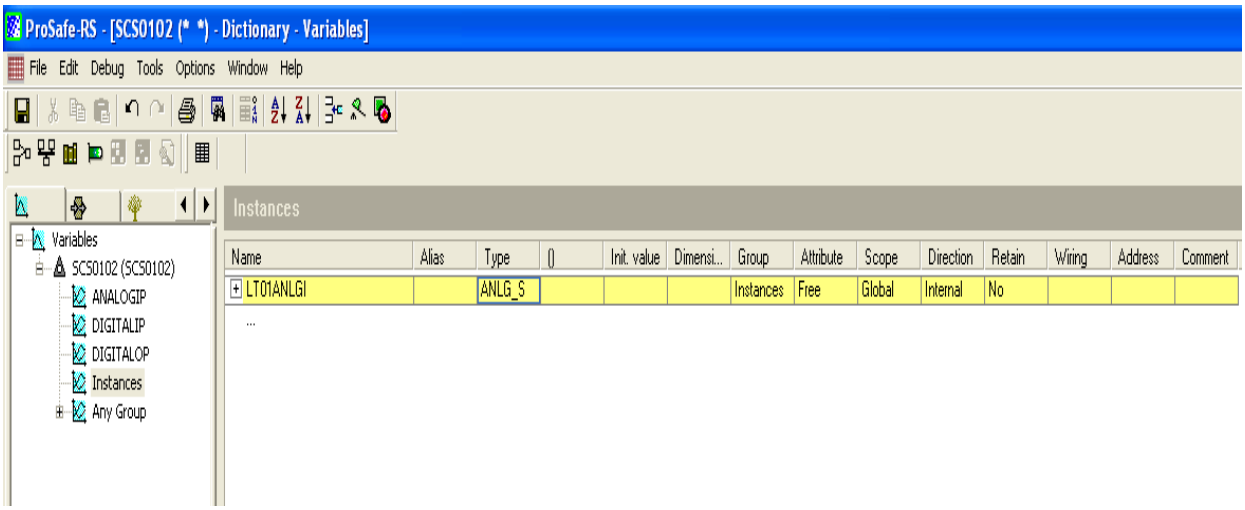
8.5 Integration of ANLG_S with CS3000

There are number of function blocks that makes the integration with Centum CS3000 an easy job. By using these block in Prosafe-RS and exporting them to CS3000 configuration, Faceplates on the HIS are generated automatically.

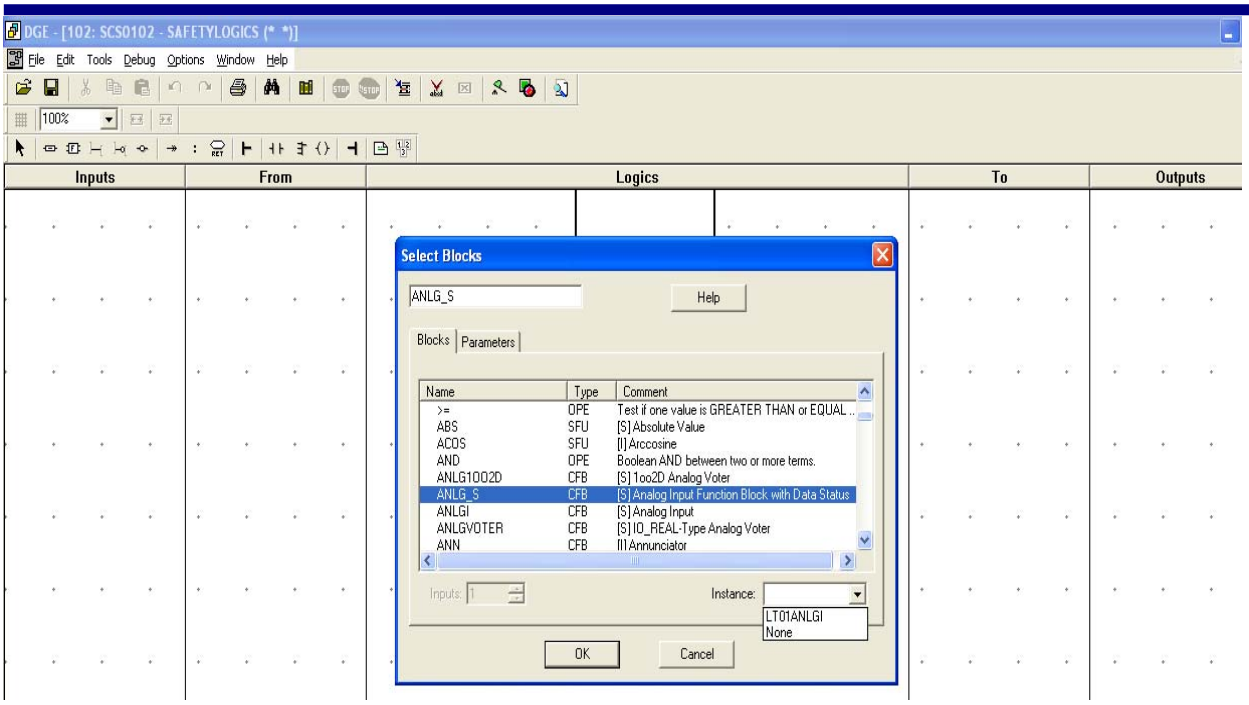
The blocks are mentioned below.

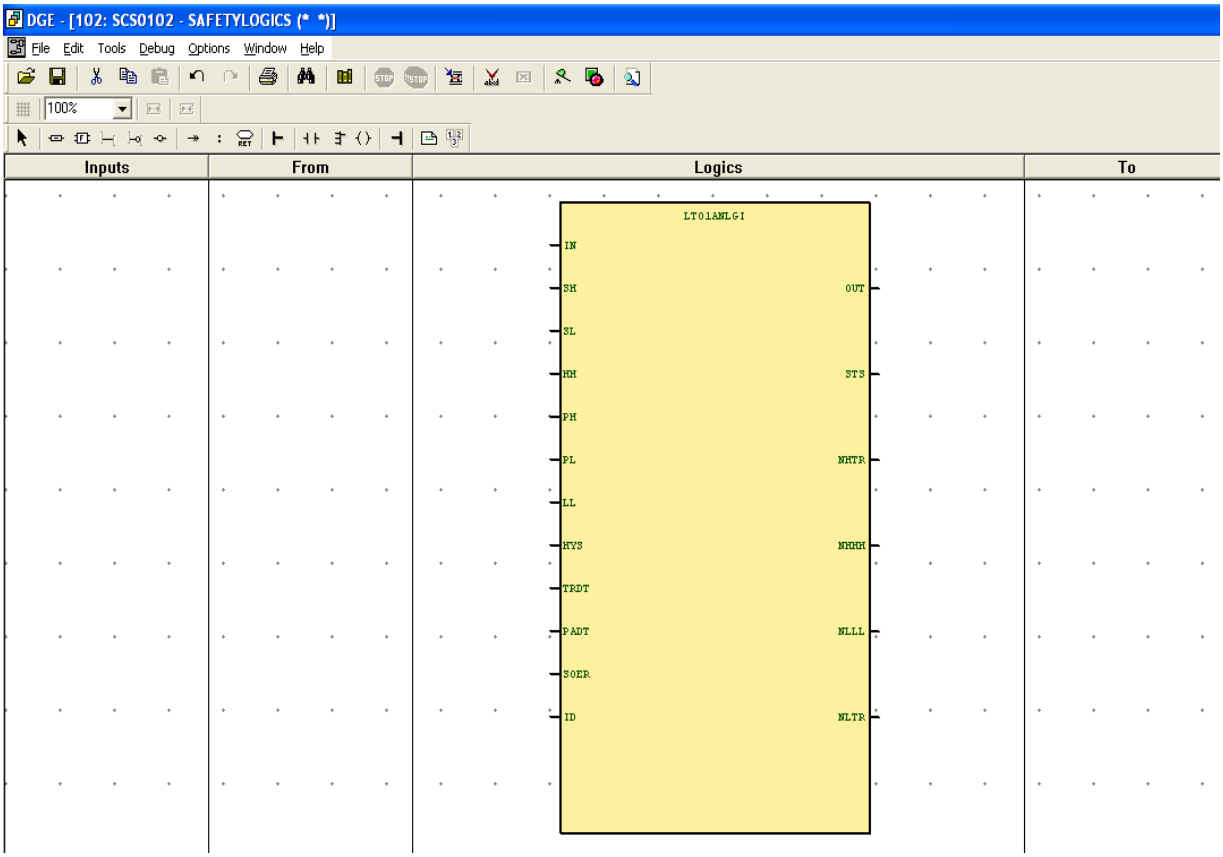
- **It is necessary to assign instance name to the blocks. This should be done in dictionary.**

BLOCK	Description
ANLGI	Analog input block
OVR	Override function block
PASSWD	Password block
VEL	Velocity limit alarm block
SCI/SCO	Subsystem communication block
MOB	BOOL-Type Data Manual Operation Function Block with Answerback
MOA	Analog-Type Data Manual Operation
MOB_RS	Auto-Reset BOOL-Type Data Manual Operation.

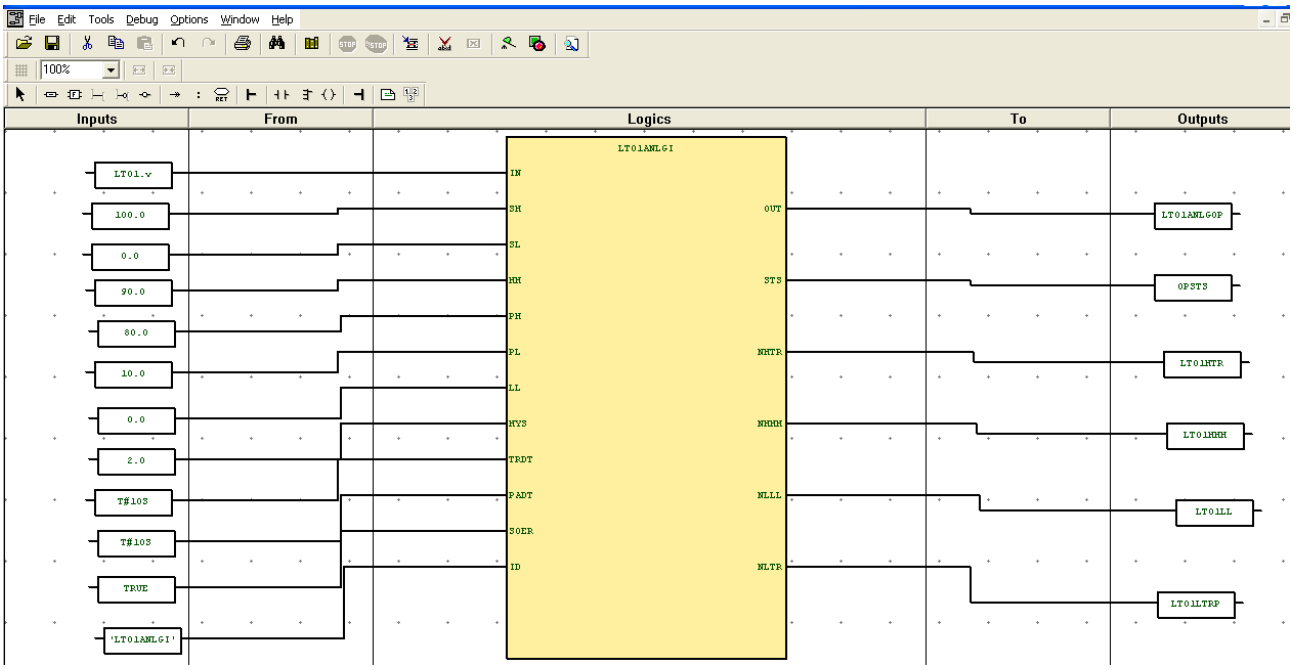


- **After the instance names are set the blocks can be placed in the drawing or if the blocks where already drawn instance name should be attached.**

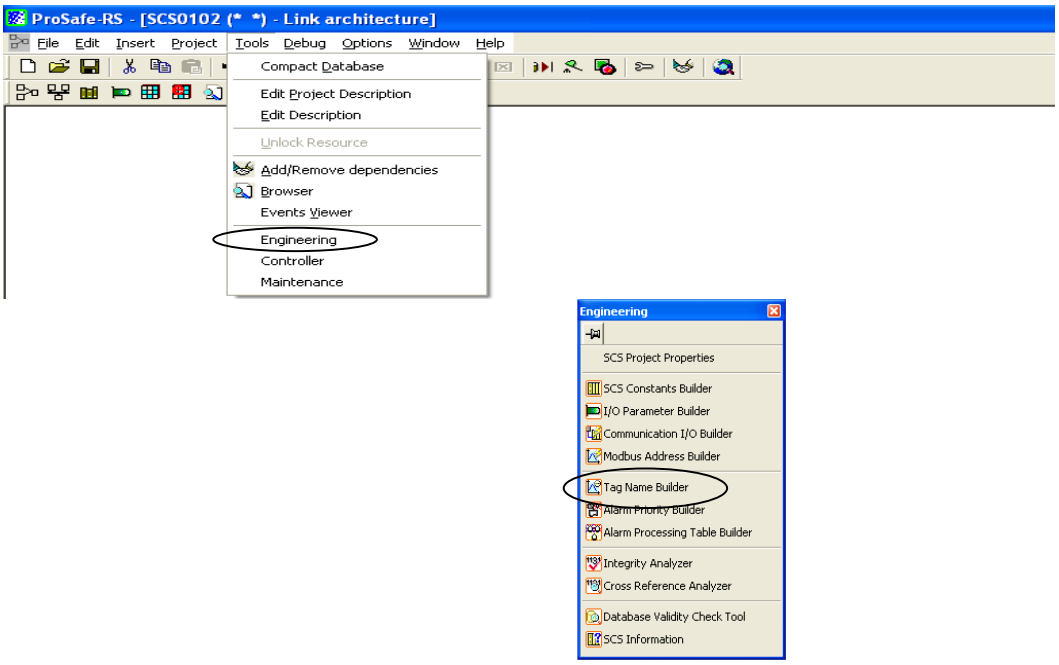

DGE - [102: SCS0102 - SAFETYLOGICS (* *)]
File Edit Tools Debug Options Window Help
100%
Inputs
From
Logics
To
Outputs
Select Blocks
ANLG_S
Help
Blocks
Parameters
Name
Type
Comment
>=
OPE
Test if one value is GREATER THAN or EQUAL ..
ABS
SFU
[S] Absolute Value
ACOS
SFU
[I] Arccosine
AND
OPE
Boolean AND between two or more terms.
ANLG1OO2D
CFB
[S] 1oo2D Analog Voter
ANLG_S
CFB
[S] Analog Input Function Block with Data Status
ANLGI
CFB
[S] Analog Input
ANLGVOTER
CFB
[S] IO_REAL-Type Analog Voter
ANN
CFB
[I] Annunciator
Inputs:
Instance:
LT01ANLGI
None
OK
Cancel


DGE - [102: SCS0102 - SAFETYLOGICS (* *)]
File Edit Tools Debug Options Window Help
100%
Inputs
From
Logics
To
LT01ANLGI
IN
SH
SL
HH
PH
PL
LL
HYS
TRDT
PADT
SOER
ID
OUT
STS
NHTR
NHHH
NLLL
NLTR

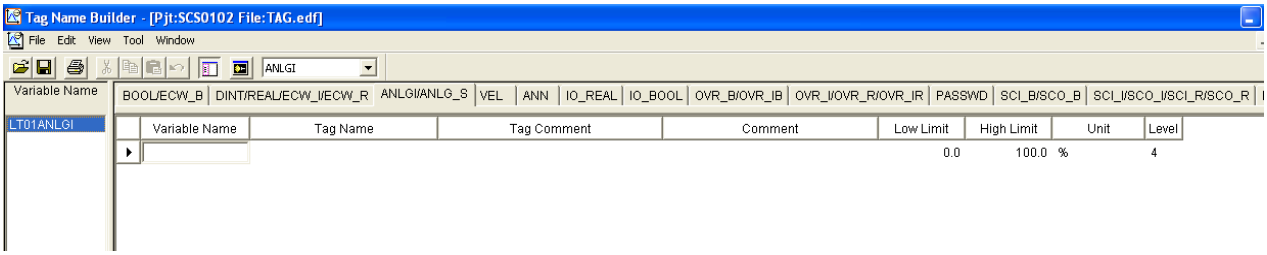
- **Set the right input output variable.**



- **Once the tags and instances are assigned in the dictionary it is necessary to start the tag list generation and assign the tag names as they should appear in HIS. This should be done by the tag name builder.**



- **Use Tag name builder to assign Centum CS3000 tag names to SCS Tags. Double click on the SCS tag name in the left panel. By doing this name will move to the list on right. The different types of SCS tags will show up under the tabs with the same name, e.g. the tags assigned to ANLG_S block will show up under the tab.**

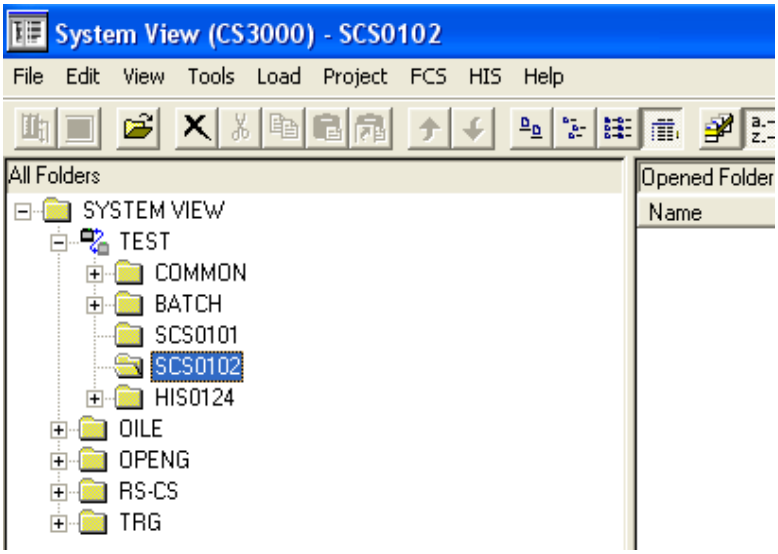


- **Assign a centum CS3000 tag name in the "Tag Name" Column.**

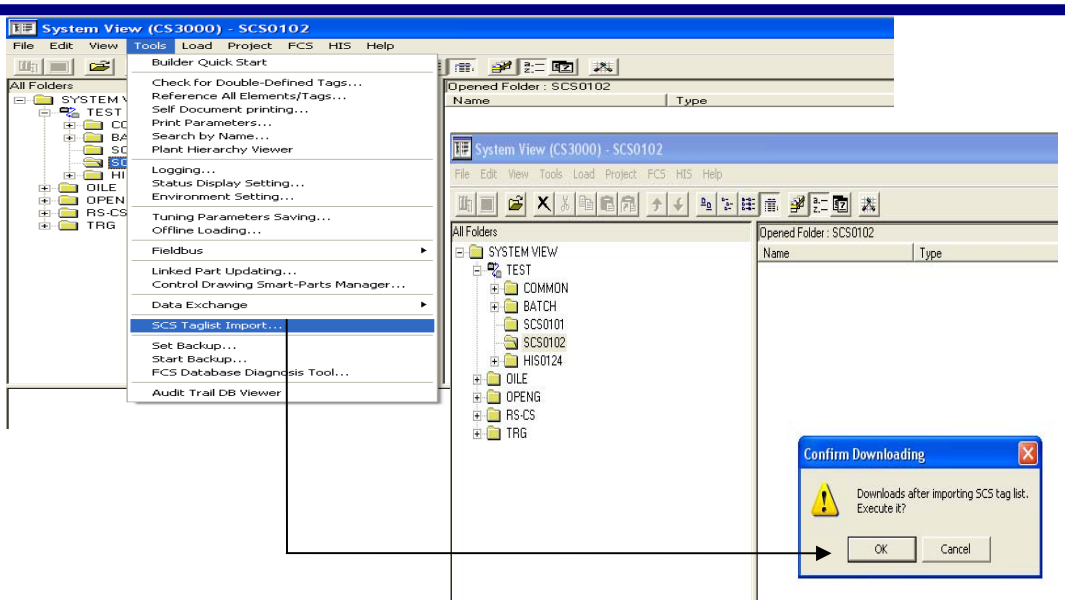
- **The next step is to make the data available for Centum CS3000. Therefore make sure where that workbench software is provided with the path for centum CS3000 project.**

- **As mentioned earlier each SCS must be created in CS3000 system view.**

- **Launch Taglist builder from System view. In System view, select the SCS you want to generate a taglist for.**



- **Select the [TOOLS]-[SCS Taglist import] from the menu. An HIS tag list will be generated.**

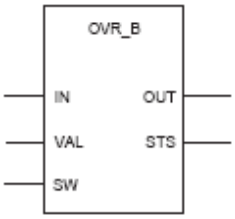


8.6 Function blocks for integration with CS3000

8.6.1 Override Function Blocks

Override function blocks (override FBs) override variables of an application logic. Blocks vary according to the data type of the overridden variables.

- OVR_B (BOOL-Type Data Override)
- OVR_I (INTEGER-Type Data Override)
- OVR_R (REAL-Type Data Override)
- OVR_IB (IO_BOOL-Type Data Override)
- OVR_IR (IO_REAL-Type Data Override)



Types of Override Function Blocks

There are five types of override function blocks, one for each data type, as shown in the table below. Arguments other than input parameter IN, output parameter OUT and input parameter VAL are common for all of the function blocks regardless of the data type.

FB type	Data type of IN and OUT	Data type of VAL	Remark
OVR_B	BOOL	BOOL	
OVR_I	DINT	DINT	
OVR_R	REAL	REAL	
OVR_IB	IO_BOOL	BOOL	The data status of output parameter OUT during override is GOOD.
OVR_IR	IO_REAL	REAL	

Arguments

IN/OUT	Arguments	Data type	Description
IN	IN	(*1)	Input
	VAL	(*1)	Override value
	SW	BOOL	TRUE: Override allowed. Override releasable FALSE: Override not allowed. Override not releasable
OUT	OUT	(*1)	Output
	STS	BOOL	TRUE: Overridden and OUT outputs the value specified in VAL FALSE: Not overridden and OUT outputs data input to IN

Description

The override function blocks output the data input from input parameter IN as is via output parameter OUT as long as no overriding operation is performed. If an override instruction is set from an HIS, on the other hand, the override function blocks output the data specified in input parameter VAL via output parameter OUT. In short, data is fixed to the value defined in input parameter VAL in advance. If the override operation is canceled from the HIS, the override function blocks resume outputting data input from input parameter IN via output parameter OUT.

8.6.2 PASSWD (Password)

The PASSWD function block sets the output value to either TRUE or FALSE upon examination of the password character string sent from an HIS.

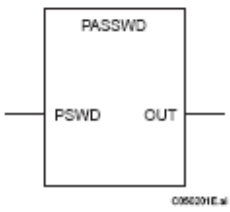


Figure PASSWD

Arguments

Table Arguments of PASSWD

IN/OUT	Arguments	Data type	Description
IN	PSWD	Character Constant	Password character string (up to 16 single-byte characters)
OUT	OUT	BOOL	TRUE: TRUE is set via a mapping block FALSE: FALSE is set via a mapping block

Description

A password character string entered on the faceplate of an HIS is transmitted to the PASSWD function block via a mapping block. If this character string matches with the character string specified for the input parameter PSWD, a data value set to TRUE, the PASSWD function block outputs the same value to its output parameter OUT.

The default value of output parameter OUT of the PASSWD function block is FALSE. Make sure to configure the PASSWD function block such that it outputs FALSE under normal circumstances and TRUE when data requiring password authentication is set from an HIS.

8.6.3 ANN (Annunciator)

An ANN function blockis used to generate annunciator messages if a CS 3000 HIS is connected.

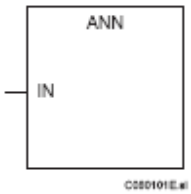


Figure ANN

Arguments

Table Arguments of ANN

IN/OUT	Arguments	Data type	Description
IN	IN	BOOL	Input value

Description

ANN block generates an annunciator message notifying that an alarm has been generated if the input value (IN) changes from FALSE to TRUE. If the input value (IN) changes from TRUE to FALSE, it generates an annunciator message notifying that the function block has recovered from the alarm. Message character strings are specified in Tag Name Builder. The default value for IN when starting an SCS is FALSE.

8.7 Inter SCS communication

An SCS is able to perform Safety Communication with another SCS in same domain and in different domains.i.e an user can create a safety loops covering two SCS.
The specifications of inter-SCS safety Communication are discussed below:

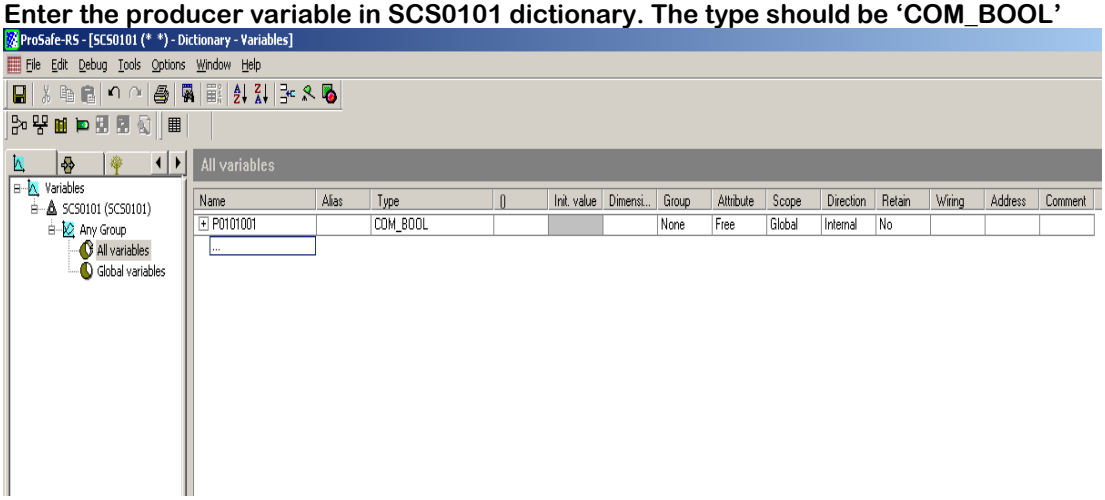
- One SCS can Communicate with 16 SCS.
- One SCS can send up to 200 data values.
- One SCs can receive up to 200 data values.
- Communication data sent at the same time is never divided into multiple scans and received.

An application logic that shows the fail safe communication between SCS0101 and SCS0102.

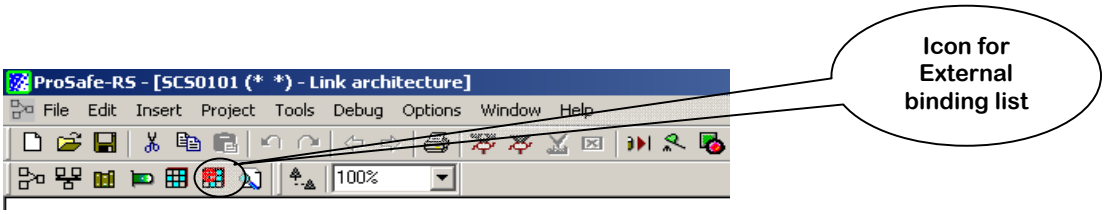
SCS0101 sends a variable called P0101001 (P=Producer Variable, 0101=ddss, 001=index of the variable) to the SCS0102.Last SCS will put this variable called C0101001(C=Consumer Variable, 0101=ddss, 001=index number).

- **Creation of the producer variable.**

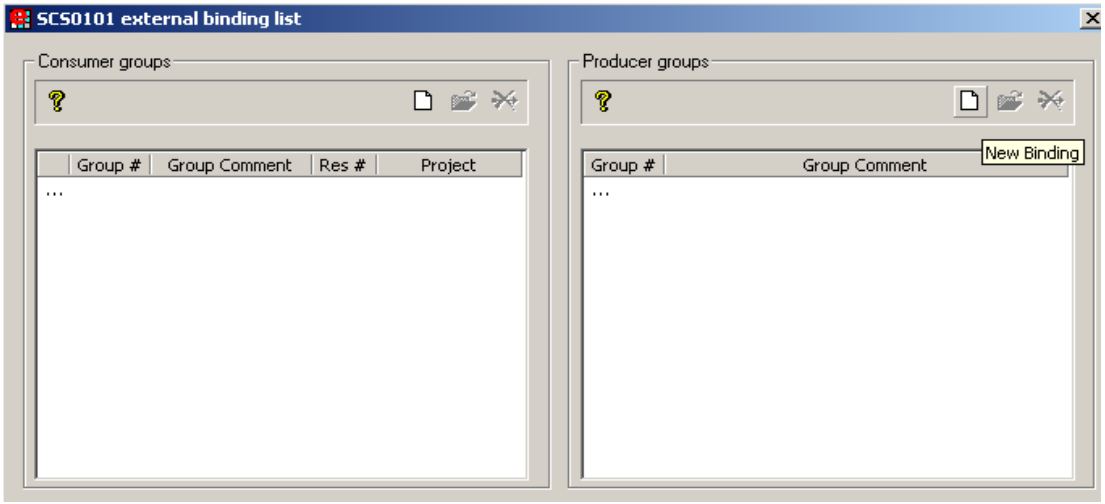
Enter the producer variable in SCS0101 dictionary. The type should be 'COM_BOOL'



- **Select from Link Architecture the external binding list.**

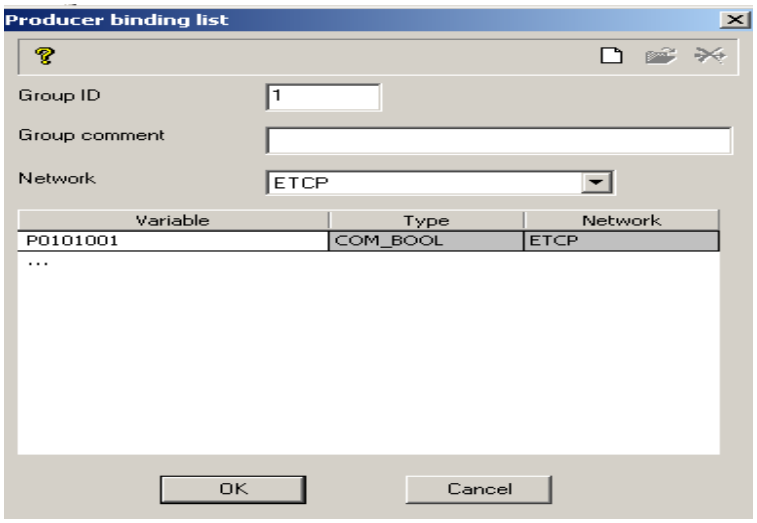


- Select new binding option from this Form



- **After you have selected the option new binding the next figure appears. Select New binding option to select the variables. Select the variable P0101001.**

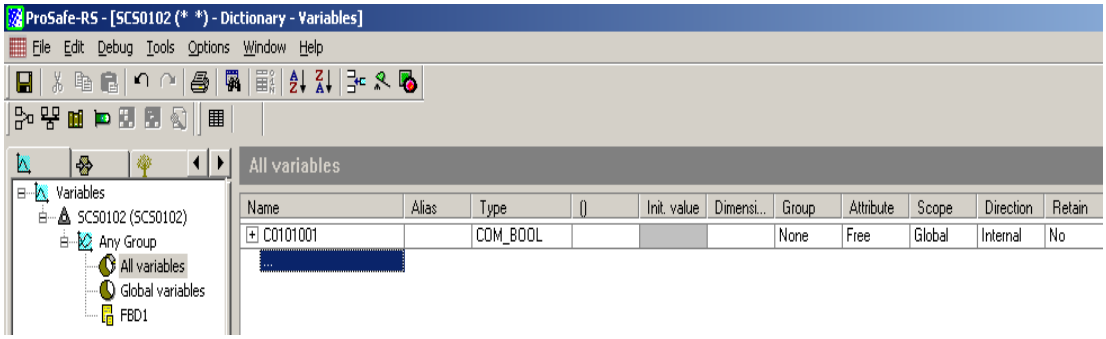
- **If everything has been defined the right way, the result should look like the next figure.**



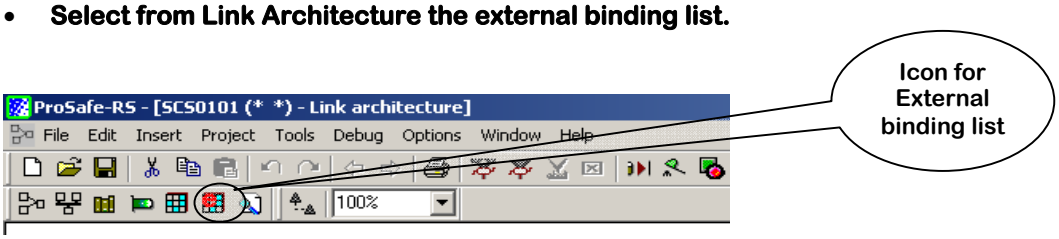
- **Define the right variable into the right function block for producer variable.**

- **Perform Offline download.**

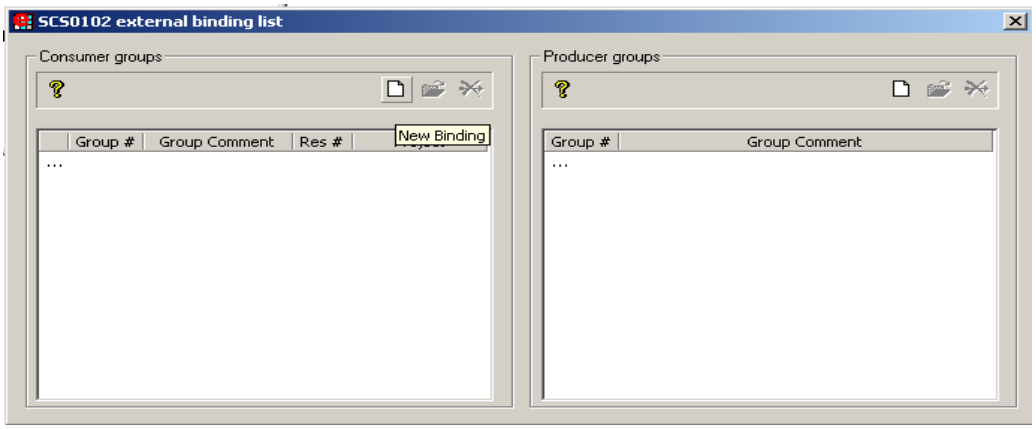
- **Creation of the Consumer variable.**
  Enter a consumer variable in SCS0102 dictionary. The type should be COM_BOOL.



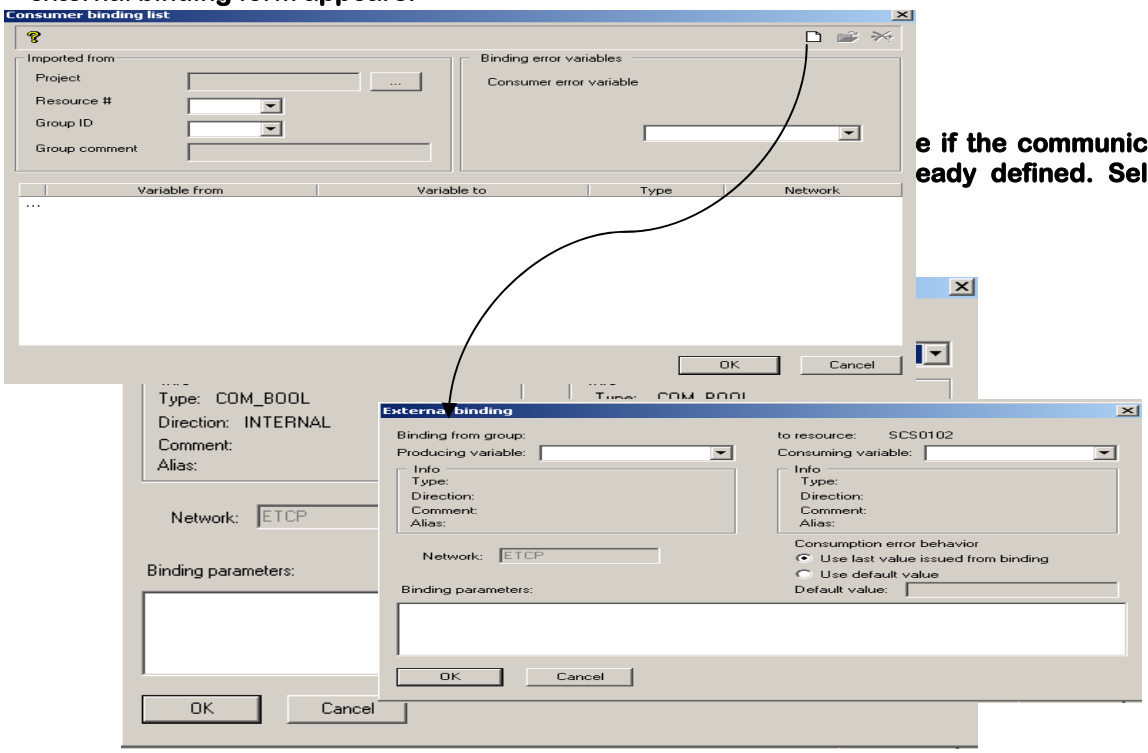
- **Select from Link Architecture the external binding list.**



- **Select new binding option from this Form.**

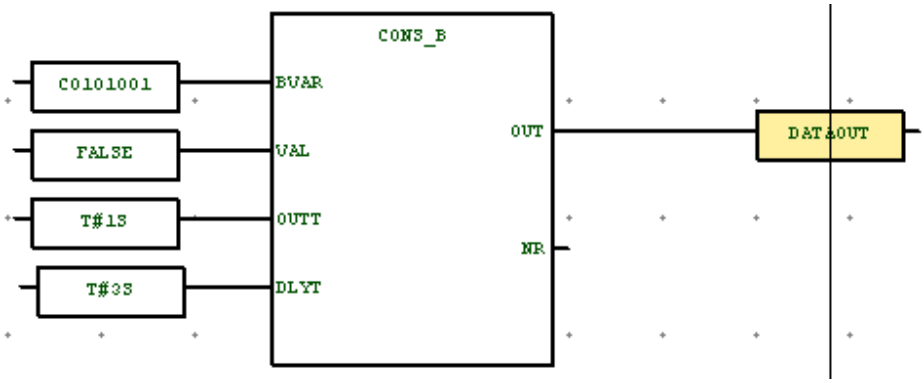


- **In this form one can enter the variables by selecting the new binding symbol. At that moment external binding form appears.**



- **e if the communication is eady defined. Select the**

- **Define the right variable into the right function block for consumer variable.**



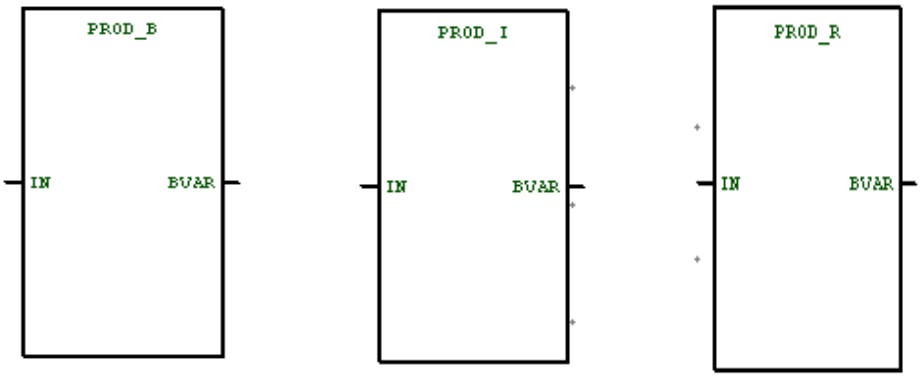
- **Perform Offline download. Also perform Output enable operation on the producer side.**

8.7.1 Function Blocks details for Inter-SCS Communication:

The Following function Blocks are provided for Inter-SCS Communication:

- Production function blocks.
- Consumer function blocks.

Production function blocks:

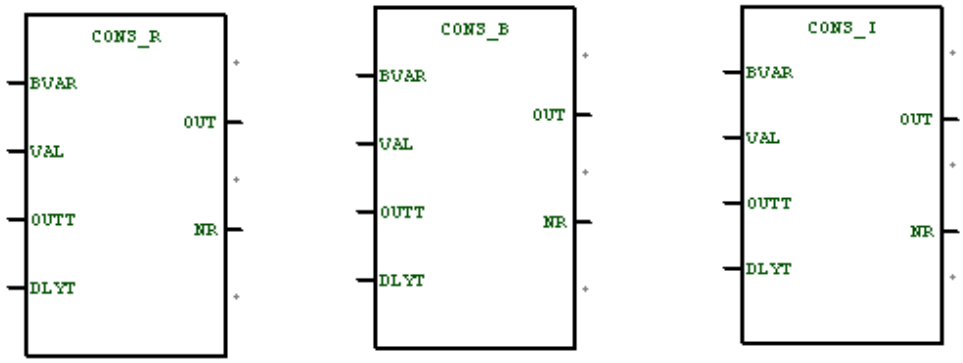


The function blocks have same input and output parameters, but the data type corresponds with the type of function blocks.

	PROD_B	PROD_I	PROD_R	Description
IN	BOOL	DINT	REAL	Data to be transmitted.
BVAR	COM_BOOL	COM_BOOL	COM_REAL	Binding Variable for sending data.

Consumer function blocks:

Consumer function block receives the data sent from the production function block in other SCS and, if there is no error, outputs the data.



The consumer function blocks have input and output with the same name, but the data type corresponds to the type of the function block.

	PROD_B	PROD_I	PROD_R	Description
BVAR	COM_BOOL	COM_DINT	COM_REAL	Binding Variable for receiving data.
VAL	BOOL	DINT	REAL	Fail Safe value. Output on error occurrence.
OUTT	TIME	TIME	TIME	Reception interval time out value: 100ms-30s If a value outside the range is specified it is treated as 100ms or 30s,whichever is closer. Generates a communication error if OUTT becomes smaller than the reception interval
DLYT	TIME	TIME	TIME	Transmission delay timeout value. Generates a communication error if DLYT becomes smaller than transmission delay. Transmission delay is not checked if DLYT is set to 0
OUT	BOOL	DINT	REAL	Output value.
NR	BOOL	BOOL	BOOL	The communication status is output. TRUE: Normal FALSE: Abnormal

09. SEQUENCE OF EVENT RECORDER

Table of contents

9.1 SOER Collection Definition

Sequence of Events Recorder (SOER) is a function that collects and stores events occurred in an SCS. The SOER collection definition defines which events to collect. It also specifies the time synchronization method related to event collection time (time stamp). By using SOE Viewer, it is possible to analyze collected events and save them in files.

9.2 Event Collection

The setting method of event collection definition varies depending on the object. Events can be collected either from a discrete input/output module or an application logic.

9.2.1 Objects of Event Collection

The following types of events can be collected for SCSs.

• Signal changes of discrete input modules.

It is possible to collect events from discrete input modules according to the changes of data input from individual channels. Specify whether or not to collect events for each channel.

• Signal changes of discrete output data

It is possible to collect events according to the changes of data output to individual discrete output channels. Specify whether or not to collect events for each channel.

• Alarms on Analog input data and Recovery

It is possible to collect events by comparing the output values with the settings of alarm level set to the analog input block.

• Variation of Analog output data

It is possible to collect events based on the variation of output variable. Take the settings of the output variable into SOE_R, and specify the conditions of event generation.

• Changes of internal variable of an application logic

It is possible to collect events according to the changes of an internal variable of an application logic. Specify the object internal variable and conditions of event generation.

9.2.2 Event Saving

• There is no need to prepare a PC for saving events or keep the power supply to an SENG on at all times, because event information is saved in the SCS.

• The maximum number of event information records that can be saved in an SCS is 15,000.

• It is possible to ensure that particularly important event information, i.e., records acquired before and after a trip signal was generated, can be notified to users without fail by separating the storage location.

9.2.3 Event Targets

An SCS can save the following data as event information by user specification. Events related to discrete inputs (DI) are collected by the input modules; other events are collectedby the CPU.

9.2.3.1 Events of Discrete Inputs (DI)

• Discrete input modules detect changes in the input signals input to each channel (FALSE to TRUE or TRUE to FALSE) and collect events.

• Users can specify whether or not to collect SOE event information for each channel.

• If discrete input modules are placed in redundant configuration, the active module collects events.

• The each comment text applied to the variable corresponding to DI is added to the event (acharacter string of up to 32 single-byte characters or 16 double-byte characters). The user needs to define the variables corresponding to the contact inputs on the Workbench Dictionary View as the comments so as to identify the whereabouts of the occurred events.

9.2.3.2 Events of Discrete Outputs (DO)

• The CPU detects changes in the output value set to a discrete output module and collects events.

• Users can specify whether or not to collect SOE event information for each channel.

• For dual-redundantly configured contact output modules, the signals output from the active module are gathered as the events.

• If the output channel is abnormal (data status is BAD), the events will not be gathered.

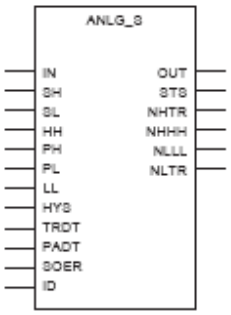
• Each event is attached with a comment text assigned as a variable to the contact output (a character string of up to 32 single-byte characters or 16 double-byte characters). The user needs to define the variables corresponding to the contact outputs on the Workbench Dictionary View as the comments so as to identify the events.

9.2.3.3 Events of Analog Inputs (AI)

• The ANLG_S function block outputs alarms by judging analog input values, so it is able to collect events by making appropriate application. It performs magnitude correlation comparison of set values and analog output values (OUT) and collects events by using a change in OUT as a trigger.

• Events are collected when the SOER input terminal is set to TRUE.

• At event collection, a character string set to the ID input (a character string of up to 32 single-byte characters or 16 double-byte characters) is stored along with the event data.



An ANLG_S function block collects events when the following outputs change their status from FALSE to TRUE, or from TRUE to FALSE

- **NHTR (HI trip flag)**
- **NHHH (HI pre-alarm flag)**
- **NLLL (LO pre-alarm flag)**
- **NLTR (LO trip flag)**

When the event occurred can be checked in the ID field of the SOE Viewer.

Table ANLG_S Event IDs

ID in SOE Viewer	Occurrence timing of event
EVT_TRUE	When an alarm recovered (when output status change from FALSE to TRUE).
EVT_FALSE	When an alarm generated (when output status change from TRUE to FALSE).

9.2.3.4 Events of internal variables

SOE_B (BOOL-Type Data SOER)

An SOE_B function block collects SOE data of BOOL type.

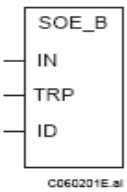


Figure SOE_B

Arguments

Table Arguments of SOE_B

IN/OUT	Arguments	Data type	Description
IN	IN	BOOL	Input value
	TRP	DINT	Trip signal specification TRIP_NONE: Do not regard as a trip signal TRIP_OFF: Regard as a trip signal if IN changes from TRUE to FALSE TRIP_ON: Regard as a trip signal if IN changes from FALSE to TRUE
	ID	STRING	Event identification character string constant (constant of up to 32 single-byte or 16 double-byte characters)

Description

The SOE_B function block collects SOE data of BOOL type.

The SOE_B function block collects events at the timing when input value IN changes. If the trip signal specification is set to a value other than TRIP_NONE, events collected with the SOE_B function block are treated as trip signals. ID is event identification information and displayed in SOE Viewer. Specify a character string (up to 32 single-byte or 16 double-byte characters) in order to identify the event.

SOE_I (INTEGER-Type Data SOER)

An SOE_I function block collects SOE data of integer type.

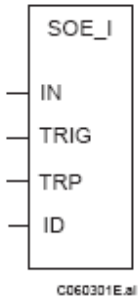


Figure SOE_I

Table Arguments of SOE_I

IN/OUT	Arguments	Data type	Description
IN	IN	DINT	Input value
	TRIG	BOOL	Trigger signal
	TRP	DINT	Trip signal specification TRIP_NONE: Do not regard as a trip signal TRIP_OFF: Triggers a trip signal when TRIG changes from TRUE to FALSE. TRIP_ON: Triggers a trip signal when TRIG changes from FALSE to TRUE
	ID	STRING	Event identification character string constant (constant of up to 32 single-byte or 16 double-byte characters)

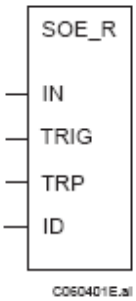
Description

The SOE_I function block collects SOE data of integer type.

The SOE_I function block collects events at the timing when the trigger signal value changes. If the trip signal specification is set to TRIP_ON or TRIP_OFF, events collected with the SOE_I function block are treated as trip signals. ID is event identification information and displayed on SOE Viewer. Specify a character string (up to 32 single-byte or 16 double-byte characters) in order to identify the event.

SOE_R (REAL-Type Data SOER)

An SOE_R function block collects SOE data of real number type.



Arguments

Table Arguments of SOE_R

IN/OUT	Arguments	Data type	Description
IN	IN	REAL	Input value
	TRIG	BOOL	Trigger signal
	TRP	DINT	Trip signal specification TRIP_NONE: Do not regard as a trip signal TRIP_OFF: Triggers a trip signal when TRIG changes from TRUE to FALSE. TRIP_ON: Triggers a trip signal when TRIG changes from FALSE to TRUE.
	ID	STRING	Event identification character string constant (constant of up to 32 single-byte or 16 double-byte characters)

Description

The SOE_R function block collects SOE data of real number type.

The SOE_R function block collects events at the timing when the trigger signal value changes. If the trip signal specification is set to TRIP_ON or TRIP_OFF, events collected with the SOE_R function block are treated as trip signals. ID is event identification information and displayed on SOE Viewer. Specify a character string (up to 32 single-byte or 16 double-byte characters) in order to identify the event.

9.3 Event Storage

Event information is stored in the SOER event information storage memory of an SCS. There are two types of files in which event information can be stored: an event log file and trip signal files. An event log file stores the latest event information. In the trip signal file, events before and after each trip signal are saved.

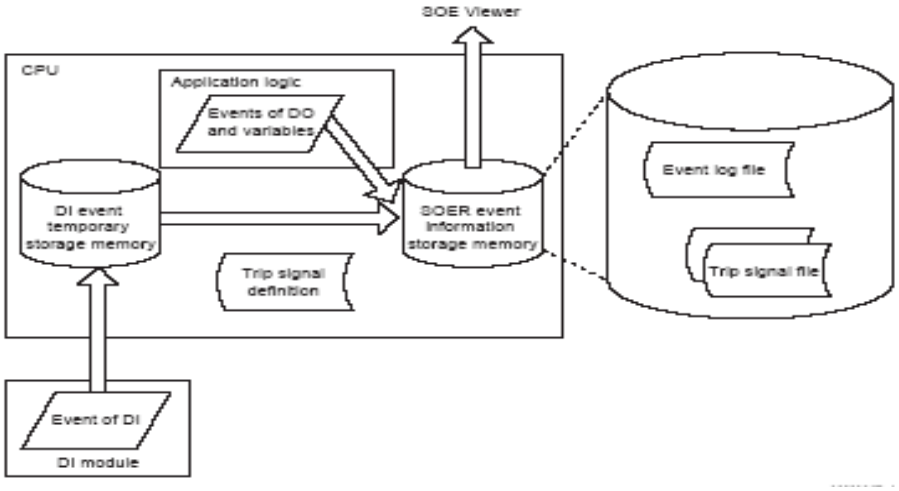
9.3.1 Saving Event Data

• An SCS saves event data using two types of files: an event log file, which stores event information in the order of data collection, and trip signal files, which store events generated before and after the trip signal specified by the user. There are two trip signal files.

• Event information saved in an SCS is not deleted when read by an SENG and HIS. It is thus possible to reference the information from multiple SOE Viewers.

9.3.2 Flow of Event Storage

The figure below illustrates the flow according to which event information is stored in an SCS.



Since event information from a discrete input (DI) module is automatically stored in the DI event temporary storage memory of the CPU, both the DI event in this memory and event information collected in the application logic are stored in the SOER event information storage memory.

9.3.3 Specification of Event Log Files

• An event log file stores the latest event information and one event log file is saved per SCS.

• Up to 15,000 events can be saved in the event log file.
• If the number of events saved exceeds the maximum number, events are deleted and overwritten by new events from the oldest one.

• Whenever an SCS has saved 12,000 events in the event log file, it sends a diagnostic information message to prompt the user to upload to the SENG.

9.3.4 Trip Signal

• Trip signals are particularly important events in the plant. Since they are key events when engineers attempt to analyze the causes of tripping, they must be securely stored in the SCS together with the events generated before and after them.

• Either ON edge or OFF edge can be specified as the trip signal. However, both edges can be specified as ignored.

• Users can specify trip signals in input/output definitions or in function blocks for SOE. There is no restriction on the number of trip signals that can be specified, but it is necessary to examine trip signal settings thoroughly in order to record useful event information.

9.3.5 Specification of Trip Signal Files

Trip signal files store events generated before and after a trip signal specified by the user.

• An SCS stores events generated before and after the trip signal in a trip signal file.

• A trip signal file stores 1,500 events in total: the last 500 events generated before tripping including the trip signal and the 1,000 events generated after tripping.

• Up to two trip signal files can be stored in an SCS. No more trip signal files are saved even if more trip signals are generated. If two trips occur in a short period of time, the data in the two trip signal files may overlap.

• If less than 500 events are collected prior a trip event occurs, the number of the events before the trip event will be less than 500.

• The file will be closed when 1000 events are collected after the trip event. However,if the number of events after 30 minutes of the trip event is less than 1000, the file will be closed anyway with less events.

• An SCS sends a diagnostic information message when saving of a trip signal file is completed.

• Trip signal files are not automatically initialized by the system. These files can be initialized only via operation from the SENG.

9.4 Management of Event Information when SCS is Unsteady

An SCS is considered to be unsteady if it is in one of the following conditions:

• A power failure occurs in the SCS

• During startup of the SCS

• Input/output variables are locked

If a power failure occurs in an SCS, event information is saved in a memory backed up by a battery. The SCS restores the event information at startup; it is thus possible to check the event information before the SCS was stopped.

9.4.1 Protection of Event Information at Power Failure

Under normal circumstances, event information is stored in the main memory of an SCS. If a power failure occurs in the CPU, the data saved in the main memory is lost. Therefore, the SCS saves the most recent events recorded immediately before the power failure to a different memory backed up by a battery. Although all the events cannot be protected, it is possible to analyze events that occurred immediately before the power failure by protecting them in this way.

9.4.2 SCS Startup Operation

An SCS restores the event information that was saved before it was stopped when it starts up at restarting or after off-line download.

9.4.3 Lock Status by the Forcing Function

If input/output variables are locked by the forcing function, event collection is performed in the following ways when the values of the input/output variables change.

9.5 SOE Viewer

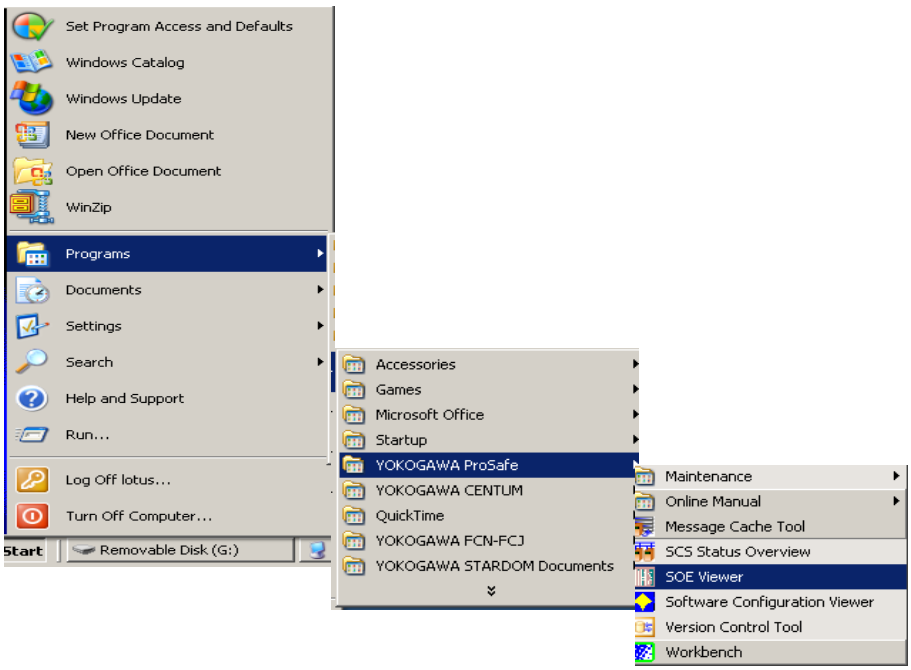
SOE Viewer allows the user to analyze events detected by SCS. It uploads event logs from the specified SCS and displays them as event messages.

9.5.1 SOE Viewer Window

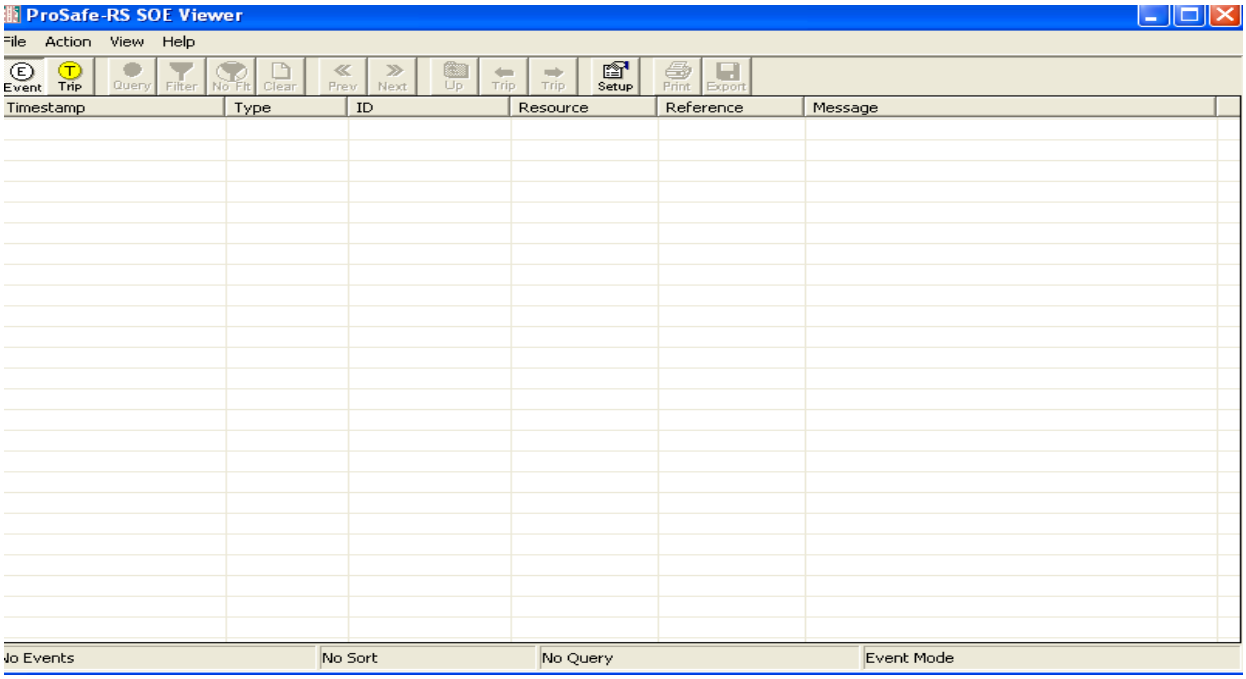
The information managed by SOE Viewer is displayed in either the event mode or the trip mode. The window structure used in the event and trip modes is the same.

9.5.2 Displaying SOE Viewer

Select [All Programs], [YOKOGAWA ProSafe] and [SOE Viewer] from the [Start] menu of Windows. SOE Viewer is displayed in the event mode.



- After starting the SOE Viewer, no event message is displayed in the message record list since no data source is specified. The event messages are displayed only after specifying the data source and running the query.



9.5.3 Event Mode Operation

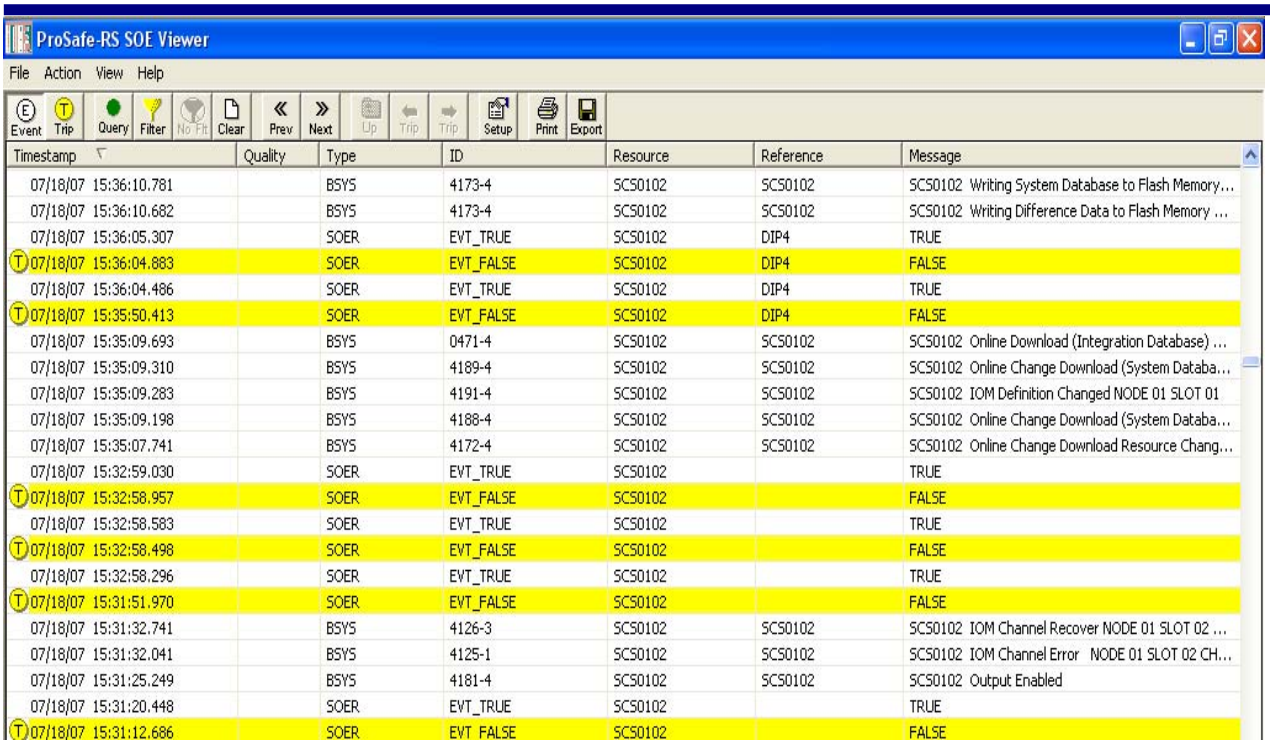
In this mode, SOE Viewer displays event messages of an SCS in a list format. This allows analyzing events from relevant information using filtering.

9.5.4 Activating the Event Mode

When you start SOE Viewer, the event mode is automatically activated. When you start up SOE Viewer for the first time, no data source is setup. Specify one or more data sources in the SOE Viewer Properties dialog box.

9.5.5 Data Source Query

If a query is executed, event messages matching the date/time and the data source parameters specified in the SOE Viewer Properties dialog box are acquired, up to the maximum number of records. The event messages are displayed in the message record list of SOE Viewer.



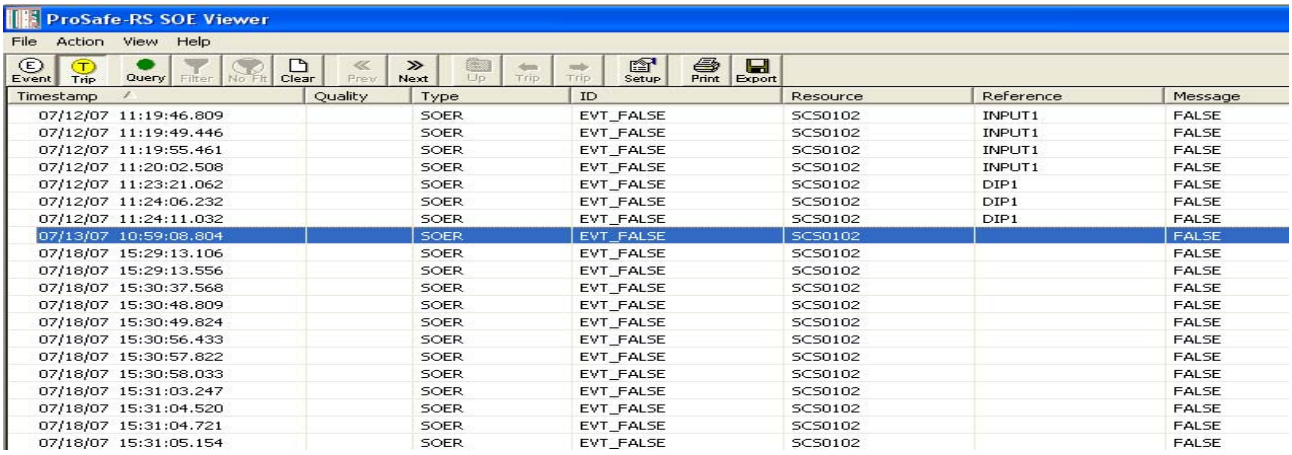
9.5.6 Trip Mode Operation

In this mode, SOE Viewer displays only trip trigger events specified as trip signals in a list format. It also displays detailed information generated near a specified trip trigger event for analysis. This section provides an overview of the trip mode of SOE Viewer and information displayed in the trip detail display.

9.5.7 Activating the Trip Mode

Click “Trip Mode” button on the toolbar or select [Trip Mode] in the [View] menu. SOE Viewer switches to the trip mode.

The trip trigger event list is blank until a query is executed. Once a query is executed, trip signals in the specified date range are uploaded from the specified data source and the trip trigger events are displayed in the trip trigger event list. This data is displayed again when the trip mode is activated again.



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