RZ/T2L Group

RZ/T2L FuSa Reference Kit Startup Manual(PROFIsafe)

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Introduction

This document is the startup manual for operating PROFIsafe using the RZ/T2L Functional Safety Reference Board (hereinafter referred to as RZ/T2L FuSa Kit), which is equipped with two RZ/T2L MPUs manufactured by Renesas Electronics.

This document explains how to set up and connect the hardware, and the operating procedures for PROFIsafe communication.

Target Device

RZ/T2L Group

Contents

1. Overview

PROFIsafe is equipped on the RZ/T2L FuSa Reference Board manufactured by Renesas Electronics to perform PROFIsafe communication.

2. Hardware Configuration

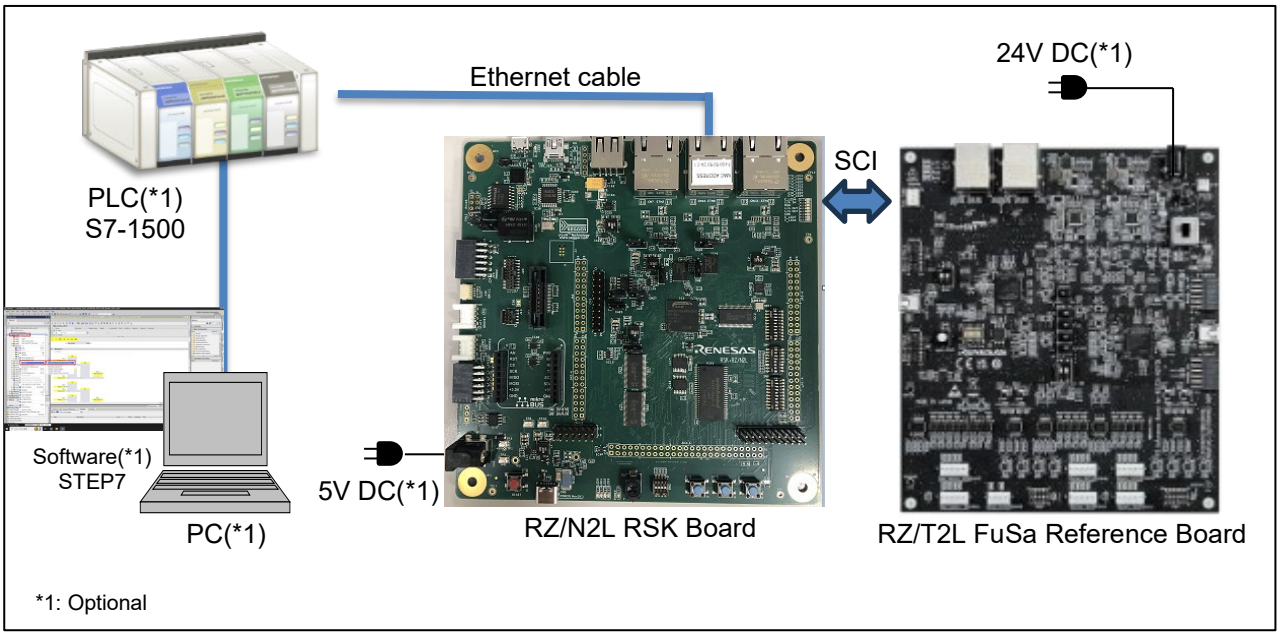


Figure 2-1 RZ/T2L FuSa Reference Kit Configuration

These boards can be purchased from the following URL.

RZ/N2L RSK Board: https://www.renesas.com/rzn2l-rsk
RZ/T2L FuSa Reference Board: https://www.renesas.com/rzt2l-safety-network

2.1 Operation Environment

■RZ/T2L FuSa Reference Kit

Item	Description
Board	RZ/T2L FuSa Reference Kit
MPU	RZ/T2L Group R9A07G074M04GBG x2 : 196pinFBGA
Operating frequency	CPU Core：800MHz（Arm® Cortex®-R52）
Operating voltage	3.3V/1.8V/1.1V
Operating mode	xSPI0 boot mode(x1 boot serial flash)
Device	Serial Flash ROM (64Mbyte) Renesas Electronics AT25SF128A
Integrated development environment	IAR Systems Embedded Workbench® for Arm Version 9.20.3(Functional Safety)
Emulator	IAR Systems I-jet
PROFIsafe Driver	Siemens PROFIsafe-StarterkitV3.5.2with PROFIsafeprofileV2.6 MU1

■RZ/N2L RSK Board

Item	Description
Board	RZ/N2L RSK Bard
MPU	RZ/N2L Group R9A07G084M04GBG: 225pinFBGA
Operating frequency	CPU Core：400MHz（Arm® Cortex®-R52）
Operating voltage	3.3V/1.8V/1.1V
Operating mode	xSPI0 boot mode(x1 boot serial flash)
Device	Serial Flash ROM (64Mbyte) Macronix MX25UR51245GMI00
Integrated development environment	IAR Systems Embedded Workbench® for Arm Version 9.50.1 (FSPv2.0.0) Renesas Electronics e² studio 2024-01 (FSPv2.0.0)
Emulator	IAR Systems I-jet Segger J-link OB

■Connecting Devices

Item	Description
PLC programming environment	STEP7 V18 Professional (Siemens)
	STEP7 SAFETYADVANCEDV18(Siemens)
PLC	S7-1500 (CPU 1516F-3 PN/DP V1.5, MLFB 6ES7516-3FN01-0AB0) (Siemens)
	Scalance X204IRT MLFB 6GK5204-0BA00-2BA3 (Siemens)(*1)
	S7, memory cards for S7-1x00 CPU/SINAMICS, 3, 3V Flash, 24 MB (Siemens)
CTT	Automated RT Tester (PROFIBUS and PROFINET International) (*1)

*1: Not used in this document.
*2: For how to get them, please contact each manufacturer.

2.2 RZ/T2L FuSa Reference Board Settings

Table 2-1 shows RZ/T2L FuSa Reference Board Switch Settings, and Table 2-2 shows RZ/T2L FuSa Reference Board Jumper Settings.

Table 2-1 RZ/T2 L FuSa Reference Board Switch Setting

SW1

1	2	3	4	5	6	7	8
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

SW2

1	2	3	4	5	6
OFF	OFF	OFF	OFF	OFF	OFF

SW3

1	2
OFF	OFF

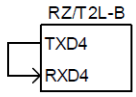
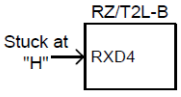
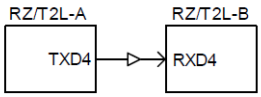
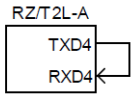
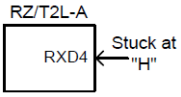
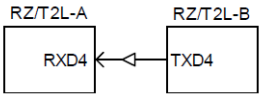
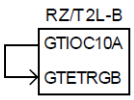
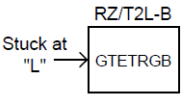
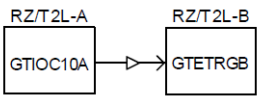
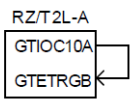
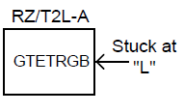
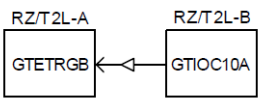
SW4

1	2	3	4	5	6	7	8
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

SW6

1	2
OFF	OFF

SW9-12

Switch	Left Silkscreen: "LP-B" Loop-back connection	Center Silkscreen: "F" Pseudo stuck-at fault	Right Silkscreen: "-" Normal connection
SW9			
SW10			
SW11			
SW12			

SW13

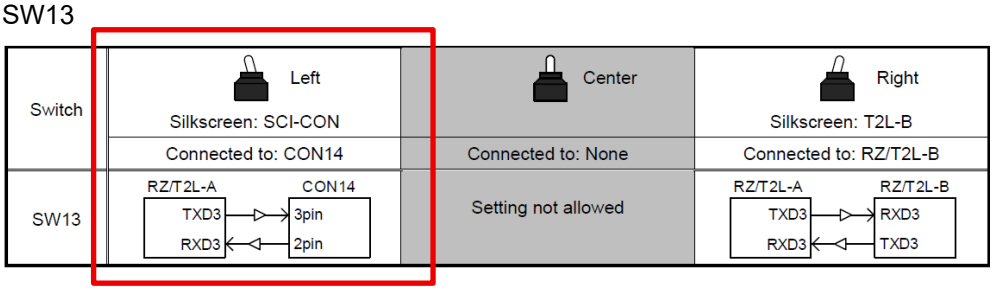


Table 2-2 RZ/T2L FuSa Reference Board Jumper Settings

No.	Jumper	Setting
1	JP1	1-4 Short

2.3 RZ/N2L RSK Board Settings

Table 2-3 shows RZ/N2L RSK Board Switch Settings and Table 2-4 shows RZN2L RSK Board Jumper Settings.

Table 2-3 RZ/N2L RSK Board Switch Settings

SW3

1	2	3	4
OFF	OFF	OFF	OFF

SW4

1	2	3	4	5	6	7	8
ON	ON	ON	ON	OFF	OFF	OFF	OFF

SW8

1	2	3	4	5	6	7	8	9	10
OFF	ON	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF

SW11

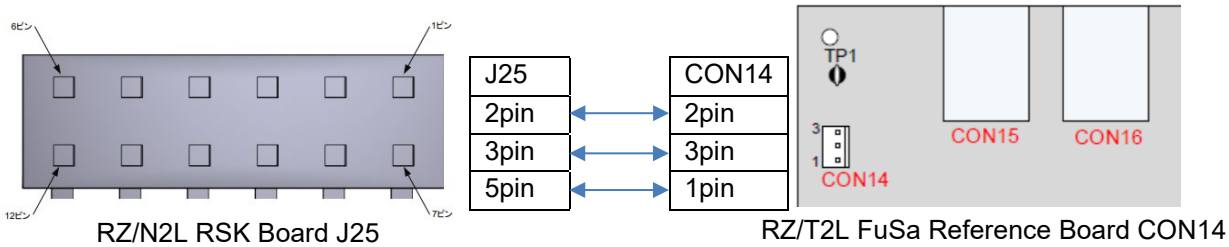
1	2	3	4	5	6	7	8	9	10
ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF

Table 2-4 RZ/N2L RSK Board Jumper Settings

No.	Jumper	Setting
1	JP9	Open
2	CN8	2-3 short
3	CN17	1-2 short
4	CN20	2-3 short
5	CN21	2-3 short
6	CN22	2-3 short
7	CN24	2-3 short
8	CN25	1-2 short
9	CN27	1-2 short
10	CN29	1-2 short
11	CN31	1-2 short
12	CN32	1-2 short

2.4 RZ/T2L FuSa Reference Board and RZ/N2L RSK Board Settings

Connecting with RZ/T2L FuSa Reference Board and RZ/N2L RSK Board is shown the below.

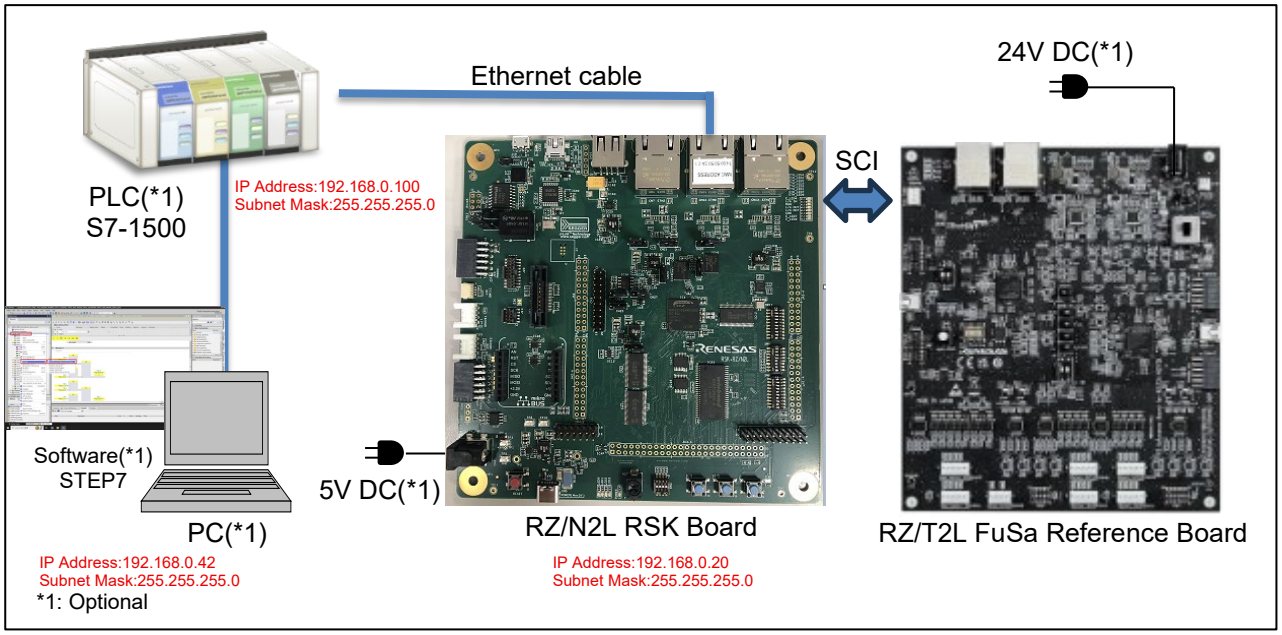


RZ/N2L RSK Board J25

RZ/T2L FuSa Reference Board CON14

3. Network Setting

Set the following IP address.



4. How to Write Program

4.1 RZ/N2L RSK Board

RZ/N2L RSK Board For more information on how to write a program to the RZ/N2L RSK Board, see "6. Running the Sample Application" of "Quick Start Guide: Renesas PROFINET IRT DEVKIT (R01AN7819)"

The Application Name is "Debug_App5_FAILSAFE_PSD" or "Debug_App5_FAILSAFE_PSD_hram".

Application Name	Description	Core Support
Debug_App1_STANDARD	Standard Application (Use SDRAM)	Single, Dual
Debug_App1_STANDARD_hram	Standard Application (Use HyperRAM)	Single, Dual
Debug_App3_ IsoApp	Isochronous Application (Use SDRAM)	Single, Dual
Debug_App3_IsoApp_hram	Isochronous Application (Use HyperRAM)	Single, Dual
Debug_App5_FAILSAFE_PSD	PROFIsafe Application (Use SDRAM)	Single, Dual
Debug_App5_FAILSAFE_PSD_hram	PROFIsafe Application (Use HyperRAM)	Single, Dual
Debug_App6_SharedMemory	Shared Memory Application (Use SDRAM)	Dual
Debug_App6_SharedMemory_hram	Shared Memory Application (Use HyperRAM)	Dual
Debug_App44_PROFIdrive	PROFIdrive Application (Use SDRAM)	Single, Dual
Debug_App44_PROFIdrive_hram	PROFIdrive Application (Use HyperRAM)	Single, Dual

4.2 RZ/T2L FuSa Reference Board

Refer to the RZ PROFIsafe Reference Software Development Handbook (R30UZ0216) in the RZ/T2L PROFIsafe Reference Software package.

4.3 S7-1500

The IP Address and Subnet Mask settings of the PC where the S7-1500 (PLC) and STEP7 are installed are set in advance. This document is explained in the following IP Address and Subnet Mask. For information on how to configure the IP Address and Subnet Mask of the S7-1500, refer to the manual for the S7-1500. For information on how to set the IP Address and Subnet Mask of PC in STEP 7, refer to "6.1 PC Network Setting".

■S7-1500

IP Address:192.168.0.100

Subnet Mask:255.255.255.0

■PC of STEP7

IP Address:192.168.0.42

Subnet Mask:255.255.255.0

Download the latest TIA Portal (RZN2L_PROFI_Safe_Renesas_Demo_ap16.zip) from the following URL

https://www.renesas.com/rzt2l-safety-network

1. Connect RZ/N2L RSK Board and RZ/T2L FuSa Reference Board.
   For how to connect, refer to “2.4 RZ/T2L FuSa Reference Board and RZ/N2L RSK Board Settings ”.

2. Connect RZ/N2L RSK Board (ETH0) and S7-1500(X1P1) via ethernet cable.

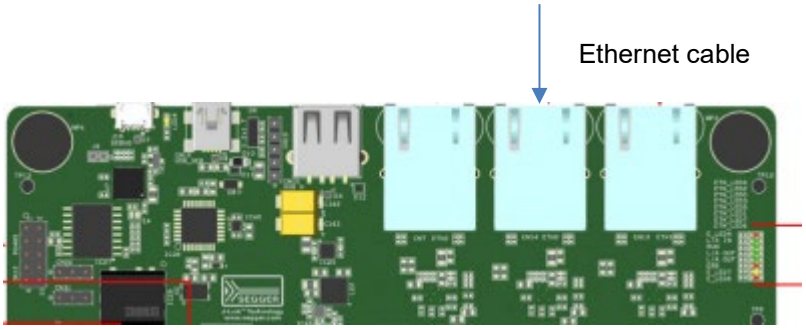


Figure 4-1 RZ/N2L RSK Board

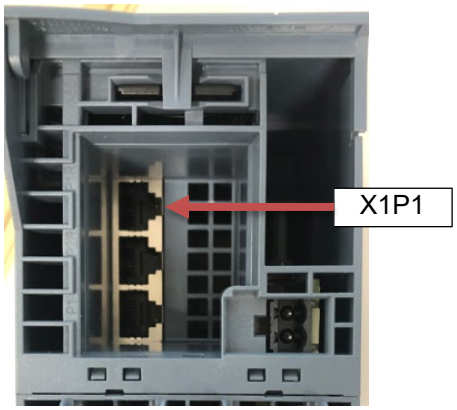


Figure 4-2 S7-1500 (X1P1)

3. Connect the S7-1500 (X1P2) to the PC via ethernet cable.

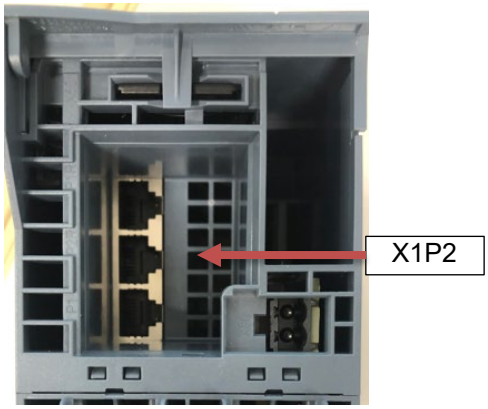
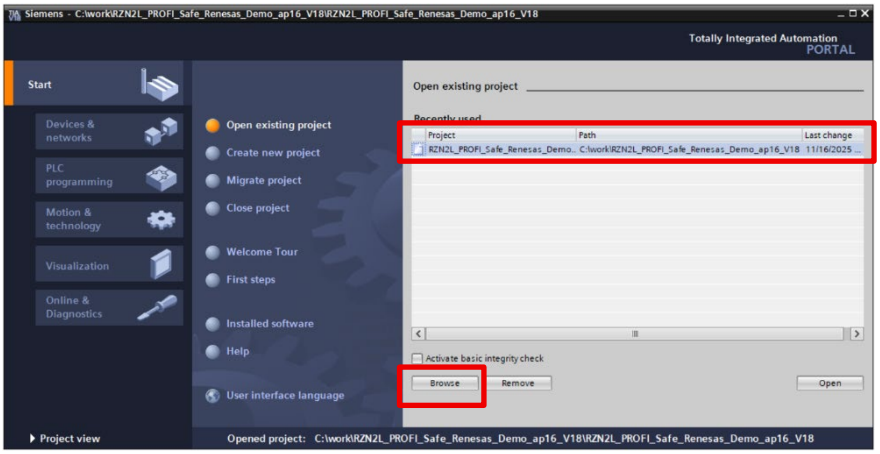


Figure 4-3 S7-1500 (X1P2)

4. Apply a power supply of 24VDC to the RZ/T2L FuSa Reference Board. Push RESET SW (SW5).
5. Apply a power supply of 5 VDC to the RZ/N2L RSK Board and press RESET SW (S3).
6. Insert an SD card (S7, memory cards) into the S7-1500. Apply a power supply of 24VDC.
7. Open STEP7(TIA Portal V18).
8. If STEP7 is started for the first time, need to register a license for "STEP7 Professional" and "Safety Advanced". For how to register licenses for "STEP7 Professional" and "Safety Advanced", refer to "6.2 How to Register Licenses of ”STEP7 Professional” and ”Safety Advanced””.
9. Unzip the following to any folder. This book explains in the c:\work folder.

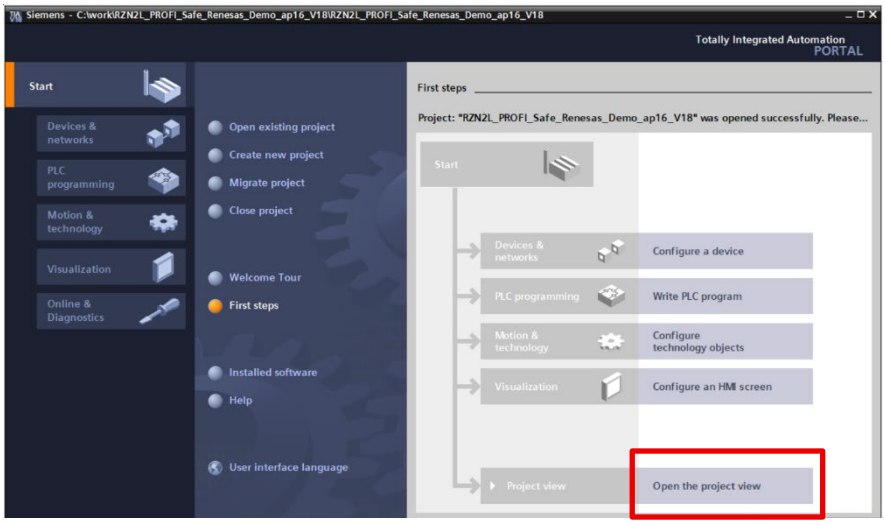
   RZN2L_PROFI_Safe_Renesas_Demo_ap16.zip
10. Push the "Browse" button in STEP 7 and specify the following:

    C:\work\RZN2L_PROFI_Safe_Renesas_Demo_ap16\RZN2L_PROFI_Safe_Renesas_Demo_ap16.ap16

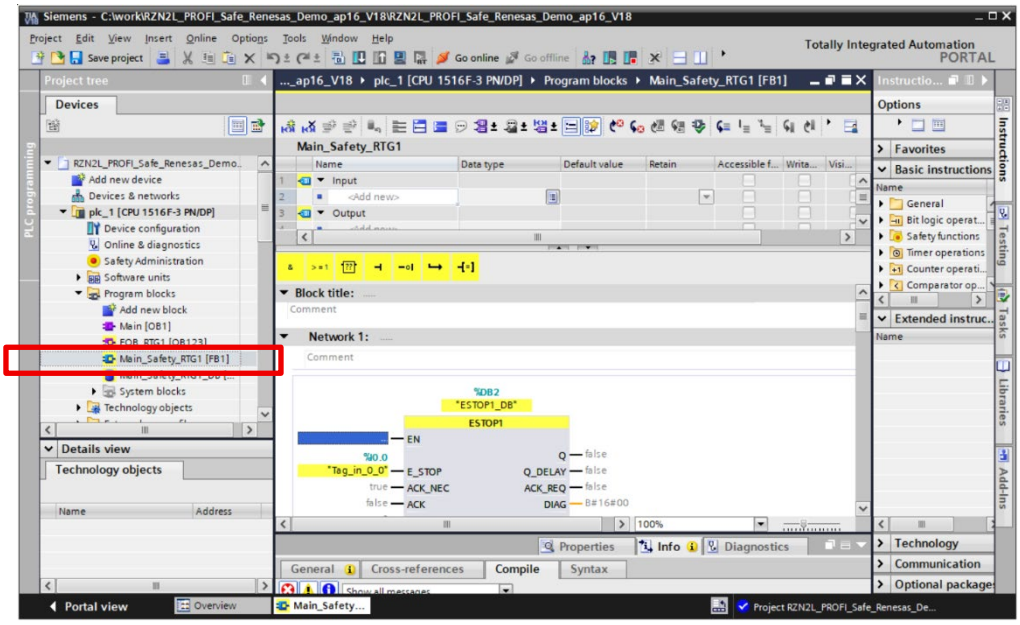


   It is displayed in "Recently Used"

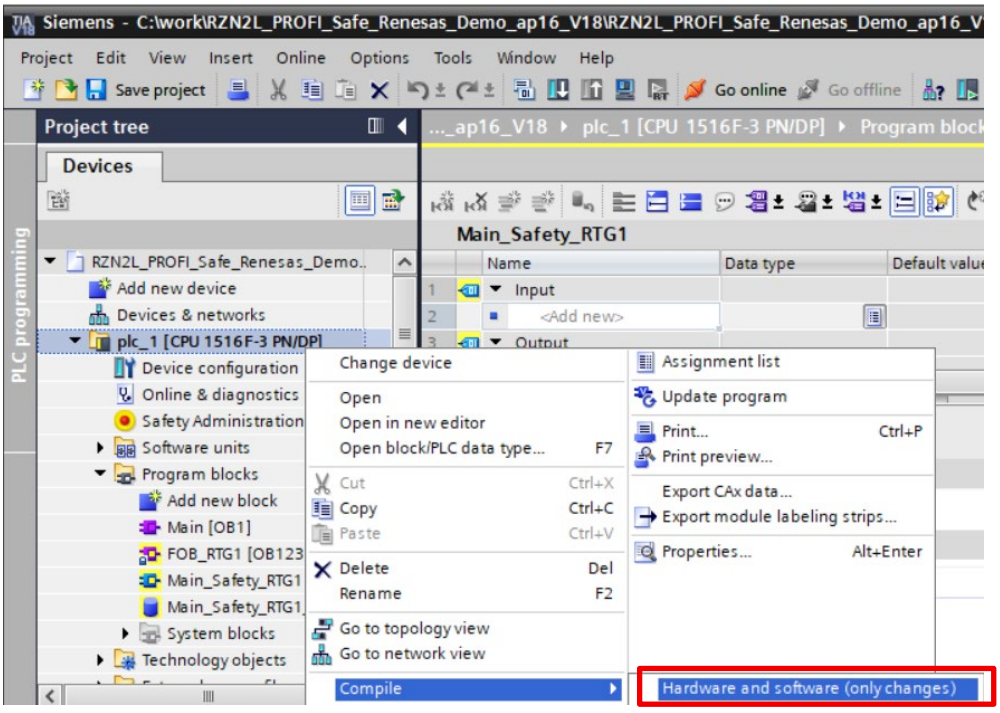
11. Push the "Browse" button in STEP 7 and specify the following:

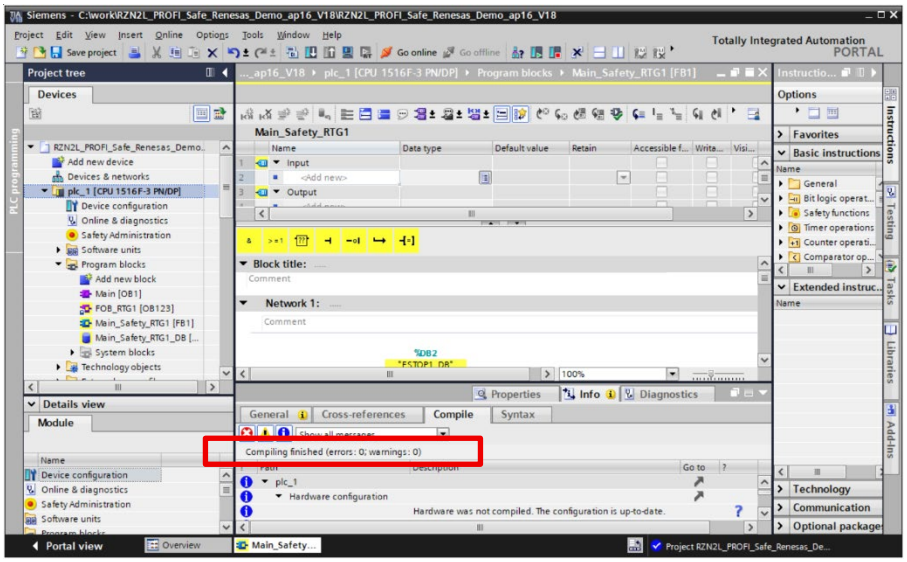


12. Select the "Devices" window - > plc_1 "CPU 1516F-3 PN/DP" - "Program blocks" - [Main_Safety_RTG1] [FB1].



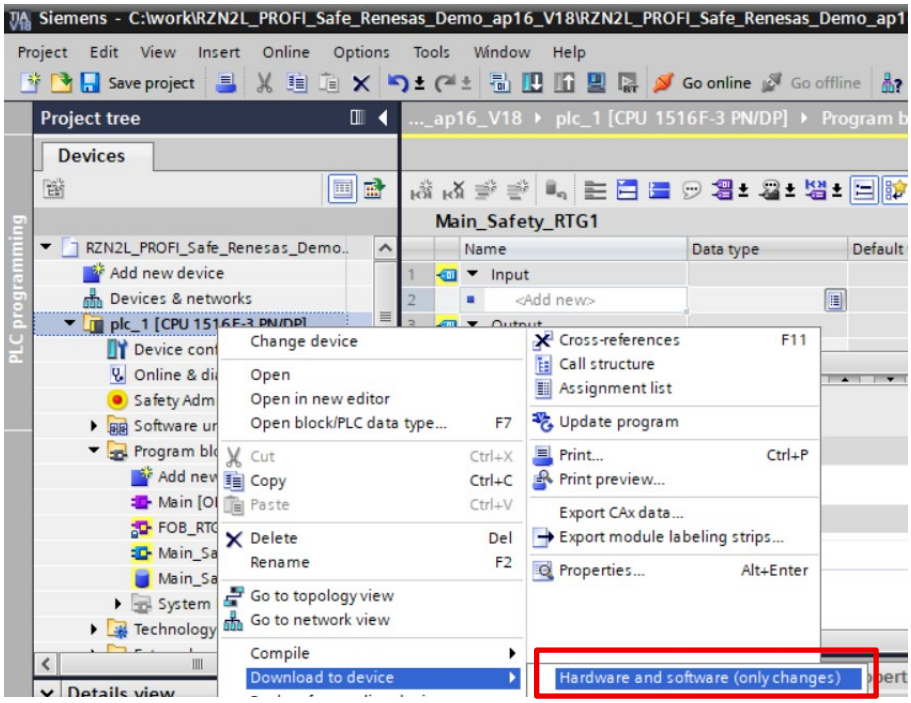
13. Right-click on the [plc_1 CPU 1516F-3 PN/DP] and select [Compile - Hardware and software (Only change)] to compile.





If compile finishes successfully, the "Compile" window is displayed "errors:0".

14. Right-click on "plc_1 CPU 1516F-3 PN/DP" and select [Download to Device] – [Hardware and software (Only change)], and download program.



5. Operating Procedure

5.1 S7-1500 Connecting Procedure

1. Insert an SD card (S7, memory cards) into the PLC (S7-1500) and apply power of PLC.
   (Do not connect the PLC to the RZ/N2L RSK Board.)
2. Push the STOP button on the PLC.
3. Connect RZ/N2L RSK Board and RZ/T2L FuSa Reference Board.
   For how to connect, refer to “2.4 RZ/T2L FuSa Reference Board and RZ/N2L RSK Board Settings ”.
4. Connect RZ/N2L RSK Board (ETH0) and S7-1500(X1P1) via ethernet cable.

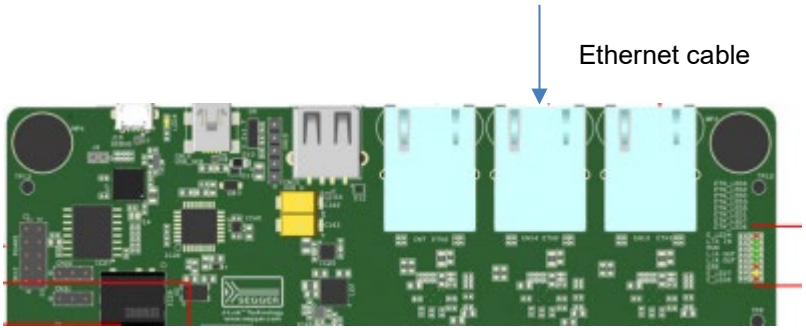


Figure 5-1 RZ/N2L RSK Board

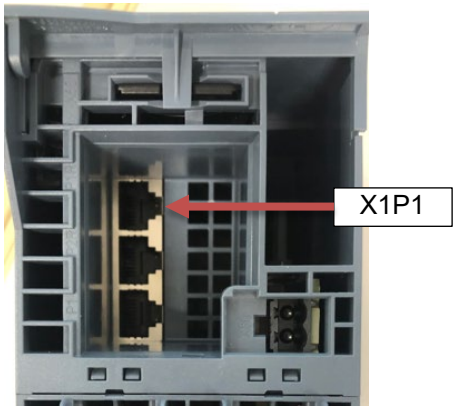


Figure 5-2 S7-1500 (X1P1)

5. Connect the S7-1500 (X1P2) to the PC via ethernet cable.

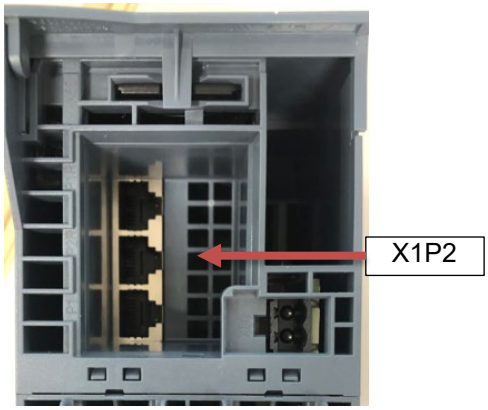
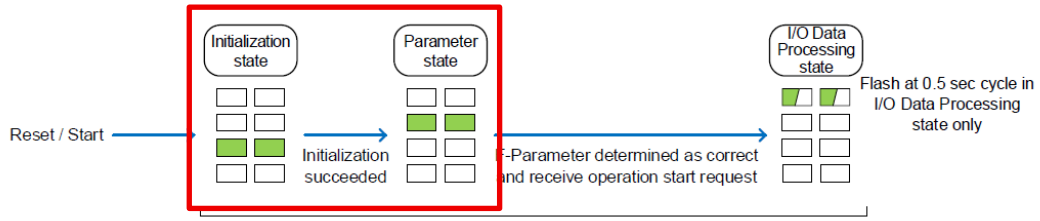


Figure 5-3 S7-1500 (X1P2)

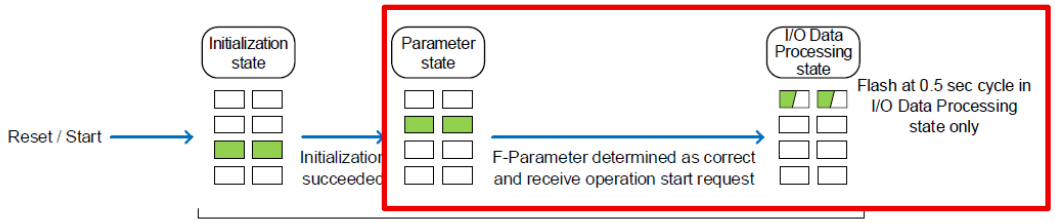
6. Apply a power supply of 24VDC to the RZ/T2L FuSa Reference Board.
7. Push RESET SW (SW5). Apply a power supply of 5 VDC to the RZ/N2L RSK Board and press RESET SW (S3).
8. Push the RUN button on the PLC.

The LED on the RZ/T2L FuSa Reference Board changes from Initialization state to Parameter state.



9. Turn on “RUN” button of PLC

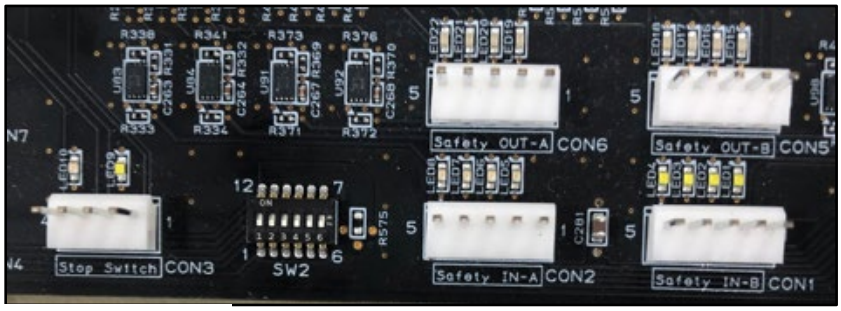
   The LED on the RZ/T2L FuSa Reference Board changes from Parameter state to I/O Data Processing state.

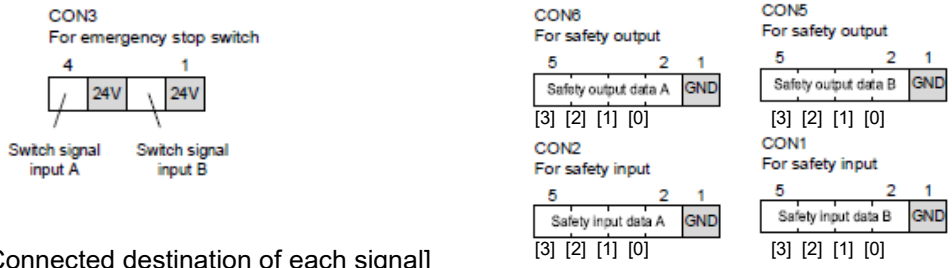


PROFIsafe communication is established.

5.2 Confirmation of operation

CON2: 2 pin ~ 5 pin of the RZ/T2L FuSa Reference Board are assigned Safety Input data A [0~3], and the CON1:2 pin ~ 5 pin are assigned Safety Input data B [0~3].
Switch signal input A is assigned to CON3: 4 pin, and Switch signal input B is assigned to CON3: 2 pin.
CON6: 2 pin ~ 5 pin are assigned Safety Output data A[0~3], and CON5: 2pin ~ 5-pin are assigned Safety Output data B [0~3].
The RZ/T2L_A/B connection destination for each signal is shown below.





[Connected destination of each signal]

Usage		Connector		Corresponding port RZ/T2L (Main)	Corresponding port RZ/T2L (Sub)
Non-safety	Out	CON7	5 pin - 2 pin	P14_3 - P14_0	-
	In	CON4	5 pin - 2 pin	P00_3 - P00_0	-
Emergency stop switch input		CON3	4 pin 2 pin	P15_6 P15_5	P15_5 P15_6
Safety	Out	CON6	5 pin - 2 pin	P22_3 - P22_0	-
		CON5	5 pin - 2 pin	-	P22_3 - P22_0
	In	CON2	5 pin - 2 pin	P01_3 - P01_0	P01_7 - P01_4
		CON1	5 pin - 2 pin	P01_7 - P01_4	P01_3 - P01_0

The program of the Safety PLC is reflected in CON5 and CON6 with the AND of (1) and (2).
(1) Safety Input data B[0～3] of CON1 AND Switch signal input B of CON3：2pin
(2) Safety Input data A[0～3] of CON2 AND Switch signal input A of CON3：4pin

[Safety PLC Program]

Safety Output data A/B[0]=(Safety Input data B[0]& Switch signal input B) &
(Safety Input data A[0]& Switch signal input A)

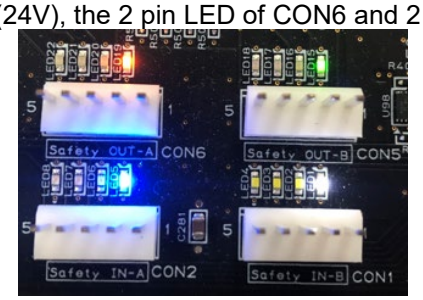
Safety Output data A/B[1]=(Safety Input data B[1]& Switch signal input B) &
(Safety Input data A[1]& Switch signal input A)

Safety Output data A/B[2]=(Safety Input data B[2]& Switch signal input B) &
(Safety Input data A[2]& Switch signal input A)

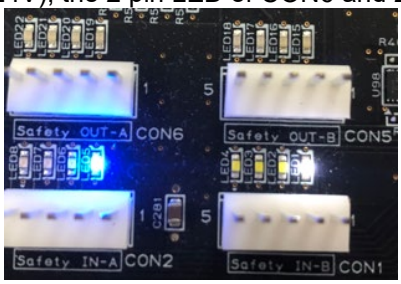
Safety Output data A/B[3]=(Safety Input data B[3]& Switch signal input B) &
(Safety Input data A[3]& Switch signal input A)

For example:

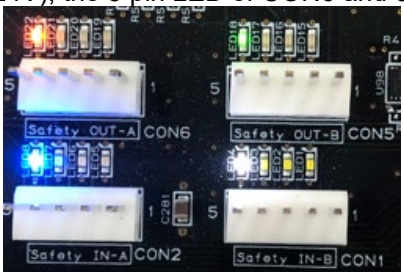
Example 1: When Switch signal input A and Switch signal input B are High (24V) and Safety Input data B[0] and Safety Input data A[0] are High (24V), the 2 pin LED of CON6 and 2 pin of CON5 turn on.



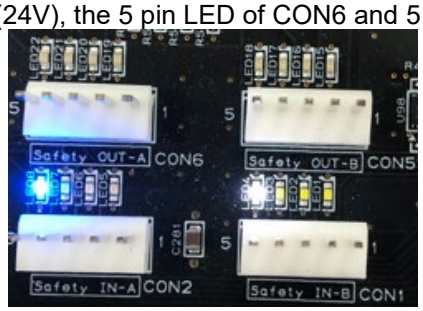
Example 2: When Switch signal input A and Switch signal input B are Low (0V) and Safety Input data B[0] and Safety Input data A[0] are High (24V), the 2 pin LED of CON6 and 2 pin of CON5 turn off.



Example 3: When Switch signal input A and Switch signal input B are High (24V) and Safety Input data B[3] and Safety Input data A[3] are High (24V), the 5 pin LED of CON6 and 5 pin of CON5 turn on.

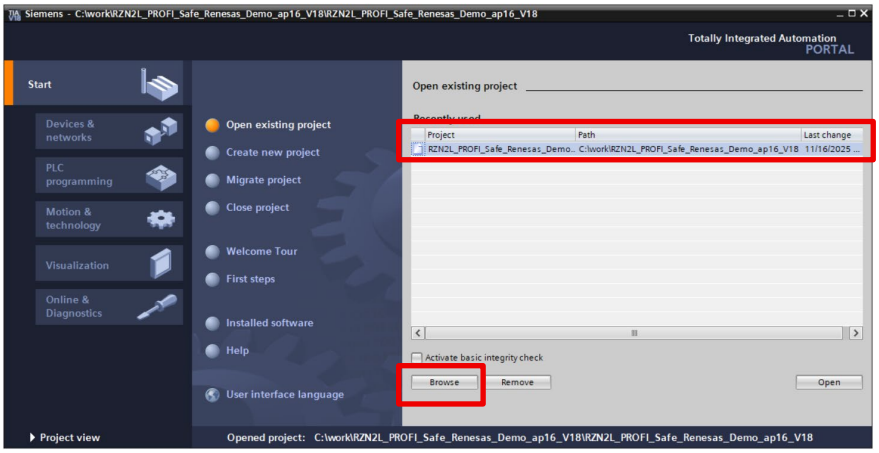


Example 4: When Switch signal input A and Switch signal input B are Low (0V) and Safety Input data B[3] and Safety Input data A[3] are High (24V), the 5 pin LED of CON6 and 5 pin of CON5 turn off.



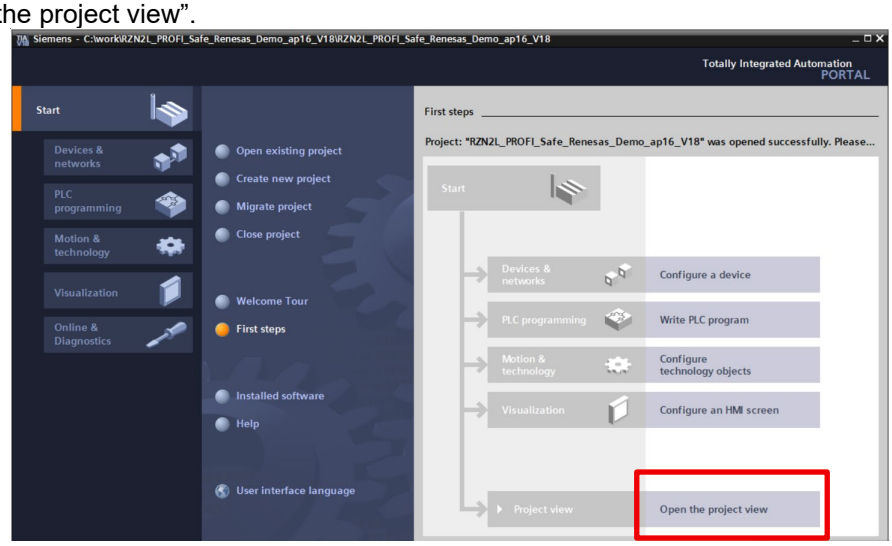
[How to check in STEP 7]

1. Start STEP7 (TIA Portal V18).
2. Push the "Browse" button in STEP 7 and specify the following:
   C:\work\RZN2L_PROFI_Safe_Renesas_Demo_ap16\RZN2L_PROFI_Safe_Renesas_Demo_ap16.ap16

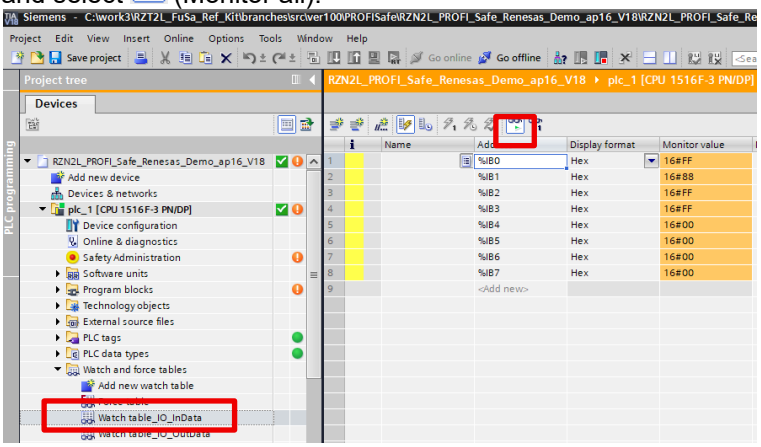


It is displayed in "Recently Used".

3. Select “Open the project view”.



4. "Devices" window - select > [plc_1 "CPU 1516F-3 PN/DP"] - [Watch and force tables] - [Watch table_IO_InData], and select (Monitor all).

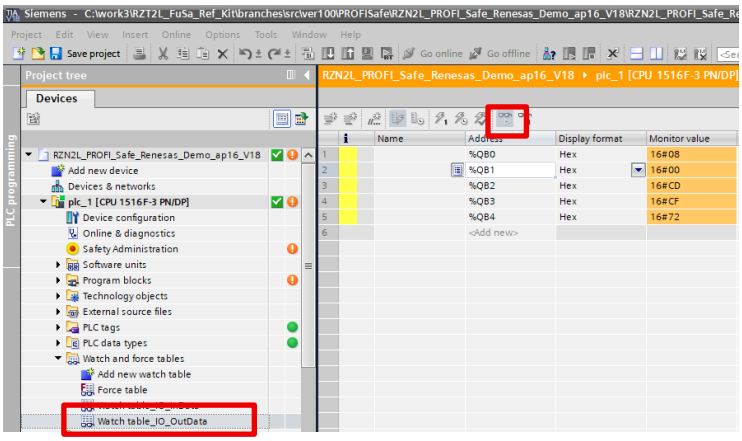


Bit 0 of the first byte is assigned Switch signal input B, and bit 4 of the first byte is assigned Switch signal input A.
Bottom 4 bits of the second byte are assigned Safety Input data B[0]~[3], and top 4 bits are assigned Safety Input data A[0]~[3].

For example, if the value of the first byte shows 0xFF, it means that Switch signal input B and Switch signal input A are High (24V).

Also, if the second byte shows 0x88, the Safety Input data B[3] and Safety Input data A[3] are High (24V) and the others are Low (0V).

5. "Devices" window - select > [plc_1 "CPU 1516F-3 PN/DP"] - [Watch and force tables] - [Watch table_IO_OutData], and select (Monitor all).

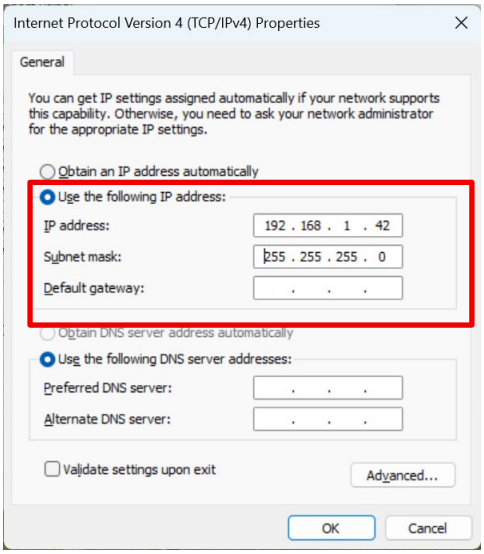


Bottom 4 bits of the first byte are assigned Safety Output data A/B [0~3].
For example, if the value of the first byte shows 0x8, Safety Output data A/B[3] is High (24V).

6. Appendix

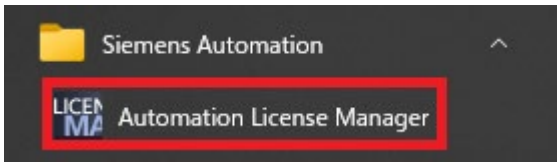
6.1 PC Network Setting

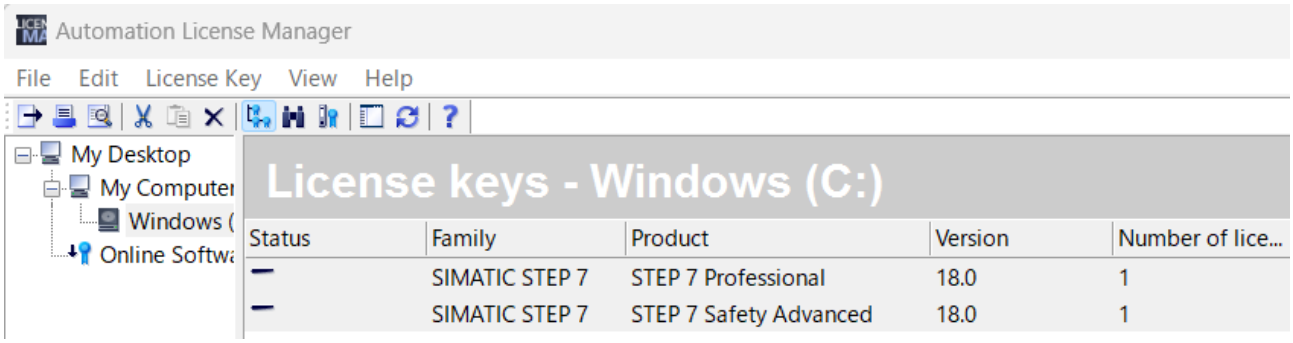
Open the IP address settings screen (below) and set the IP Address and Subnet Mask in the red frame.



6.2 How to Register Licenses of ”STEP7 Professional” and ”Safety Advanced”

Connect the USB memory containing the "STEP7 Professional" and "Safety Advanced" licenses to PC. Open Automation License Manager and move the "STEP7 Professional" and "Safety Advanced" licenses from the LICENCE KEY to the local disk.





Revision History

Rev.	Date	Description	
		Page	Summary
0.90	Jun.13, 2025	-	Preliminary
1.00	Nov.28, 2025	P.10	Add how to write Safety PLC program
		P.17	Add how to operate Safety PLC program

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products
   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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