MANUAL

Novolink™ – smart function and sensor modules for AF contactors

List of supported contactors

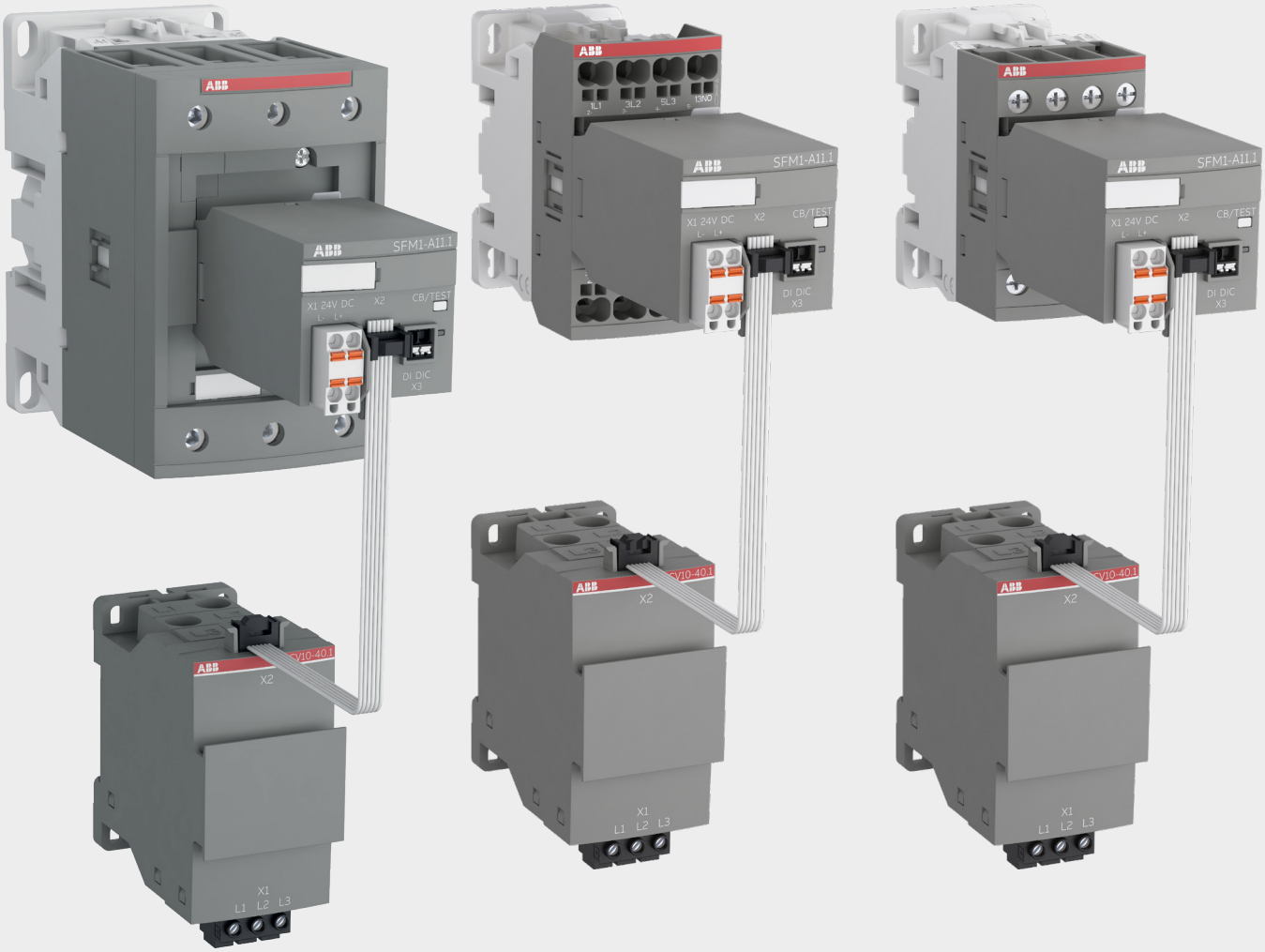


Table of contents

Purpose and basic description

This document lists all supported AF contactors that can be used in conjunction with the SFM1 smart function modules. How the SFM1 module can be used together with AF contactors is documented in related documents [1] at the end of this manual. The primary source for the technical data of the AF contactors is the associated catalog. In case of discrepancies, the catalog should be used as the source.

List of supported AF contactors

Note: Use the pull-in power data to select the right 24 V DC power supply out of the ABB CP-C.1 series of power supplies.

Product ID	Extended product type	Size	Poles	Connection	Range	Pull-in power	Holding power
1SBL136001R2101	AF09Z-30-01-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL136001R2110	AF09Z-30-10-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL136001R2122	AF09Z-30-22-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL136001R3001	AF09Z-30-01-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL136001R3010	AF09Z-30-10-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL136001R3022	AF09Z-30-22-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL136005R2101	AF09Z-30-01K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL136005R2110	AF09Z-30-10K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL136005R2132	AF09Z-30-32K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL136005R3001	AF09Z-30-01K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL136005R3010	AF09Z-30-10K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL136005R3032	AF09Z-30-32K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL136201R2100	AF09Z-40-00-21	1	4 N.O	Screw	Standard	16 W	1.7 W
1SBL136201R3000	AF09Z-40-00-30	1	4 N.O	Screw	Standard	6 W	1.7 W
1SBL136501R2100	AF09Z-22-00-21	1	2 N.O + 2 N.C	Screw	Standard	16 W	1.7 W
1SBL136501R3000	AF09Z-22-00-30	1	2 N.O + 2 N.C	Screw	Standard	6 W	1.7 W
1SBL137001R1101	AF09-30-01-11	1	3 N.O	Screw	Standard	50 W	2 W
1SBL137001R1110	AF09-30-10-11	1	3 N.O	Screw	Standard	50 W	2 W
1SBL137001R1122	AF09-30-22-11	1	3 N.O	Screw	Standard	50 W	2 W
1SBL137005R1101	AF09-30-01K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL137005R1110	AF09-30-10K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL137005R1132	AF09-30-32K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL137201R1100	AF09-40-00-11	1	4 N.O	Screw	Standard	50 W	2 W
1SBL137501R1100	AF09-22-00-11	1	2 N.O + 2 N.C	Screw	Standard	50 W	2 W
1SBL156001R2101	AF12Z-30-01-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL156001R2110	AF12Z-30-10-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL156001R2122	AF12Z-30-22-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL156001R3001	AF12Z-30-01-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL156001R3010	AF12Z-30-10-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL156001R3022	AF12Z-30-22-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL156005R2101	AF12Z-30-01K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL156005R2110	AF12Z-30-10K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL156005R2132	AF12Z-30-32K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL156005R3001	AF12Z-30-01K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL156005R3010	AF12Z-30-10K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL156005R3032	AF12Z-30-32K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL157001R1101	AF12-30-01-11	1	3 N.O	Screw	Standard	50 W	2 W
1SBL157001R1110	AF12-30-10-11	1	3 N.O	Screw	Standard	50 W	2 W

Product ID	Extended product type	Size	Poles	Connection	Range	Pull-in power	Holding power
1SBL157001R1122	AF12-30-22-11	1	3 N.O	Screw	Standard	50 W	2 W
1SBL157005R1101	AF12-30-01K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL157005R1110	AF12-30-10K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL157005R1132	AF12-30-32K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL176001R2101	AF16Z-30-01-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL176001R2110	AF16Z-30-10-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL176001R2122	AF16Z-30-22-21	1	3 N.O	Screw	Standard	16 W	1.7 W
1SBL176001R3001	AF16Z-30-01-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL176001R3010	AF16Z-30-10-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL176001R3022	AF16Z-30-22-30	1	3 N.O	Screw	Standard	6 W	1.7 W
1SBL176005R2101	AF16Z-30-01K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL176005R2110	AF16Z-30-10K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL176005R2132	AF16Z-30-32K-21	1	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL176005R3001	AF16Z-30-01K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL176005R3010	AF16Z-30-10K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL176005R3032	AF16Z-30-32K-30	1	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL176201R2100	AF16Z-40-00-21	1	4 N.O	Screw	Standard	16 W	1.7 W
1SBL176201R3000	AF16Z-40-00-30	1	4 N.O	Screw	Standard	6 W	1.7 W
1SBL176501R2100	AF16Z-22-00-21	1	2 N.O + 2 N.C	Screw	Standard	16 W	1.7 W
1SBL176501R3000	AF16Z-22-00-30	1	2 N.O + 2 N.C	Screw	Standard	6 W	1.7 W
1SBL177001R1101	AF16-30-01-11	1	3 N.O	Screw	Standard	50 W	2 W
1SBL177001R1110	AF16-30-10-11	1	3 N.O	Screw	Standard	50 W	2 W
1SBL177001R1122	AF16-30-22-11	1	3 N.O	Screw	Standard	50 W	2 W
1SBL177005R1101	AF16-30-01K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL177005R1110	AF16-30-10K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL177005R1132	AF16-30-32K-11	1	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL177201R1100	AF16-40-00-11	1	4 N.O	Screw	Standard	50 W	2 W
1SBL177501R1100	AF16-22-00-11	1	2 N.O + 2 N.C	Screw	Standard	50 W	2 W
1SBL236001R2100	AF26Z-30-00-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL236001R2111	AF26Z-30-11-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL236001R2122	AF26Z-30-22-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL236001R3000	AF26Z-30-00-30	2	3 N.O	Screw	Standard	6 W	1.7 W
1SBL236001R3011	AF26Z-30-11-30	2	3 N.O	Screw	Standard	6 W	1.7 W
1SBL236001R3022	AF26Z-30-22-30	2	3 N.O	Screw	Standard	6 W	1.7 W
1SBL236005R2100	AF26Z-30-00K-21	2	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL236005R2122	AF26Z-30-22K-21	2	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL236005R3000	AF26Z-30-00K-30	2	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL236005R3022	AF26Z-30-22K-30	2	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL236201R2100	AF26Z-40-00-21	2	4 N.O	Screw	Standard	16 W	1.7 W
1SBL236201R3000	AF26Z-40-00-30	2	4 N.O	Screw	Standard	6 W	1.7 W
1SBL236501R2100	AF26Z-22-00-21	2	2 N.O + 2 N.C	Screw	Standard	16 W	1.7 W
1SBL236501R3000	AF26Z-22-00-30	2	2 N.O + 2 N.C	Screw	Standard	6 W	1.7 W
1SBL237001R1100	AF26-30-00-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL237001R1111	AF26-30-11-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL237001R1122	AF26-30-22-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL237005R1100	AF26-30-00K-11	2	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL237005R1122	AF26-30-22K-11	2	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL237201R1100	AF26-40-00-11	2	4 N.O	Screw	Standard	50 W	2 W
1SBL237501R1100	AF26-22-00-11	2	2 N.O + 2 N.C	Screw	Standard	50 W	2 W
1SBL276001R2100	AF30Z-30-00-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL276001R2111	AF30Z-30-11-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL276001R2122	AF30Z-30-22-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL276001R3000	AF30Z-30-00-30	2	3 N.O	Screw	Standard	6 W	1.7 W
1SBL276001R3011	AF30Z-30-11-30	2	3 N.O	Screw	Standard	6 W	1.7 W

Product ID	Extended product type	Size	Poles	Connection	Range	Pull-in power	Holding power
1SBL276001R3022	AF30Z-30-22-30	2	3 N.O	Screw	Standard	6 W	1.7 W
1SBL276005R2100	AF30Z-30-00K-21	2	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL276005R2122	AF30Z-30-22K-21	2	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL276005R3000	AF30Z-30-00K-30	2	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL276005R3022	AF30Z-30-22K-30	2	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL277001R1100	AF30-30-00-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL277001R1111	AF30-30-11-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL277001R1122	AF30-30-22-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL277005R1100	AF30-30-00K-11	2	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL277005R1122	AF30-30-22K-11	2	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL296001R2100	AF38Z-30-00-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL296001R2111	AF38Z-30-11-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL296001R2122	AF38Z-30-22-21	2	3 N.O	Screw	Standard	16 W	1.7 W
1SBL296001R3000	AF38Z-30-00-30	2	3 N.O	Screw	Standard	6 W	1.7 W
1SBL296001R3011	AF38Z-30-11-30	2	3 N.O	Screw	Standard	6 W	1.7 W
1SBL296001R3022	AF38Z-30-22-30	2	3 N.O	Screw	Standard	6 W	1.7 W
1SBL296005R2100	AF38Z-30-00K-21	2	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL296005R2122	AF38Z-30-22K-21	2	3 N.O	Push-In Spring	Standard	16 W	1.7 W
1SBL296005R3000	AF38Z-30-00K-30	2	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL296005R3022	AF38Z-30-22K-30	2	3 N.O	Push-In Spring	Standard	6 W	1.7 W
1SBL296201R2100	AF38Z-40-00-21	2	4 N.O	Screw	Standard	16 W	1.7 W
1SBL296201R3000	AF38Z-40-00-30	2	4 N.O	Screw	Standard	6 W	1.7 W
1SBL296501R2100	AF38Z-22-00-21	2	2 N.O + 2 N.C	Screw	Standard	16 W	1.7 W
1SBL296501R3000	AF38Z-22-00-30	2	2 N.O + 2 N.C	Screw	Standard	6 W	1.7 W
1SBL297001R1100	AF38-30-00-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL297001R1111	AF38-30-11-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL297001R1122	AF38-30-22-11	2	3 N.O	Screw	Standard	50 W	2 W
1SBL297005R1100	AF38-30-00K-11	2	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL297005R1122	AF38-30-22K-11	2	3 N.O	Push-In Spring	Standard	50 W	2 W
1SBL297201R1100	AF38-40-00-11	2	4 N.O	Screw	Standard	50 W	2 W
1SBL297501R1100	AF38-22-00-11	2	2 N.O + 2 N.C	Screw	Standard	50 W	2 W
1SBL347001R1100	AF40-30-00-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL347001R1111	AF40-30-11-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL347001R1122	AF40-30-22-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL347201R1100	AF40-40-00-11	3	4 N.O	Screw	Standard	25 W	2 W
1SBL347501R1100	AF40-22-00-11	3	2 N.O + 2 N.C	Screw	Standard	25 W	2 W
1SBL367001R1100	AF52-30-00-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL367001R1111	AF52-30-11-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL367001R1122	AF52-30-22-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL367201R1100	AF52-40-00-11	3	4 N.O	Screw	Standard	25 W	2 W
1SBL387001R1100	AF65-30-00-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL387001R1111	AF65-30-11-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL387001R1122	AF65-30-22-11	3	3 N.O	Screw	Standard	25 W	2 W
1SBL397001R1100	AF80-30-00-11	3.5	3 N.O	Screw	Standard	40 W	2 W
1SBL397001R1111	AF80-30-11-11	3.5	3 N.O	Screw	Standard	40 W	2 W
1SBL397001R1122	AF80-30-22-11	3.5	3 N.O	Screw	Standard	40 W	2 W
1SBL397201R1100	AF80-40-00-11	3.5	4 N.O	Screw	Standard	40 W	2 W
1SBL397201R1111	AF80-40-11-11	3.5	4 N.O	Screw	Standard	40 W	2 W
1SBL397501R1100	AF80-22-00-11	3.5	2 N.O + 2 N.C	Screw	Standard	40 W	2 W
1SBL407001R1100	AF96-30-00-11	3.5	3 N.O	Screw	Standard	40 W	2 W
1SBL407001R1111	AF96-30-11-11	3.5	3 N.O	Screw	Standard	40 W	2 W
1SBL407001R1122	AF96-30-22-11	3.5	3 N.O	Screw	Standard	40 W	2 W
1SBL136001N2101	AF09N00Z-30-01-21	1	3 N.O	Screw	NEMA	16 W	1.7 W
1SBL136001N2110	AF09N00Z-30-10-21	1	3 N.O	Screw	NEMA	16 W	1.7 W

Product ID	Extended product type	Size	Poles	Connection	Range	Pull-in power	Holding power
1SBL137001N1101	AF09N00-30-01-11	1	3 N.O	Screw	NEMA	50 W	2 W
1SBL137001N1110	AF09N00-30-10-11	1	3 N.O	Screw	NEMA	50 W	2 W
1SBL156001N2101	AF12N0Z-30-01-21	1	3 N.O	Screw	NEMA	16 W	1.7 W
1SBL156001N2110	AF12N0Z-30-10-21	1	3 N.O	Screw	NEMA	16 W	1.7 W
1SBL157001N1101	AF12N0-30-01-11	1	3 N.O	Screw	NEMA	50 W	2 W
1SBL157001N1110	AF12N0-30-10-11	1	3 N.O	Screw	NEMA	50 W	2 W
1SBL236001N2100	AF26N1Z-30-00-21	2	3 N.O	Screw	NEMA	16 W	1.7 W
1SBL237001N1100	AF26N1-30-00-11	2	3 N.O	Screw	NEMA	50 W	2 W
1SBL237001N1111	AF26N1-30-11-11	2	3 N.O	Screw	NEMA	50 W	2 W
1SBL347001N1100	AF40N2-30-00-11	3	3 N.O	Screw	NEMA	25 W	2 W
1SBL347001N1111	AF40N2-30-11-11	3	3 N.O	Screw	NEMA	25 W	2 W
1SBL397001N1100	AF80N3-30-00-11	3.5	3 N.O	Screw	NEMA	40 W	2 W
1SBL397001N1111	AF80N3-30-11-11	3.5	3 N.O	Screw	NEMA	40 W	2 W
1SBL347287R1100	AF40-40-00-11LU	3	4 N.O	Screw	Lighting	25 W	2 W
1SBL367287R1100	AF52-40-00-11LU	3	4 N.O	Screw	Lighting	25 W	2 W

Additional information

Related documents

Ref #	Document Kind, Title	Document No.
1	Manual, Novolink™ – smart function and sensor modules for AF contactors	2CDC100017M0201

Revisions

Rev.	Page (P) Chapt. (C)	Description	Date Dept./Init.
A	All	Initial version	20.7.2021 / CPE

—
ABB STOTZ-KONTAKT GmbH
Electrification Products
Eppelheimer Strasse 82
69123 Heidelberg, Germany

You can find the address of your local sales organization on the ABB homepage

abb.com/lowvoltage

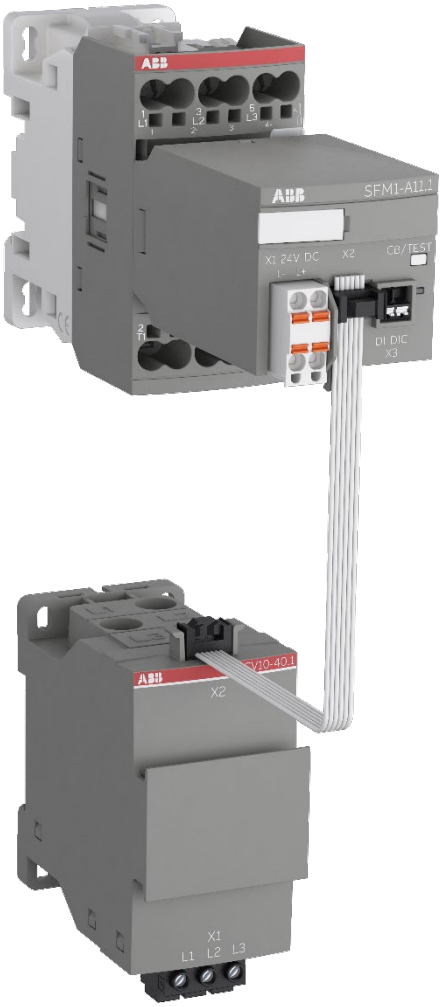
Additional information
We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB AG does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

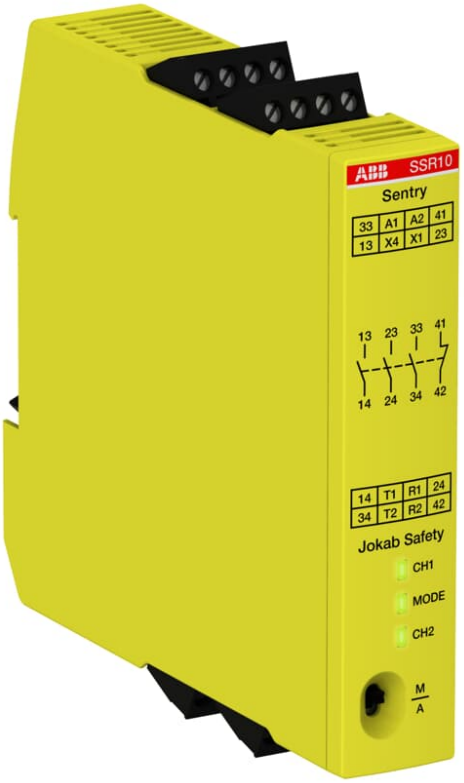
Document number 1SAC200142M0001 (08/2021)

APPLICATON NOTE

Novolink modules for AF contactors

Implement emergency stop with SSR10





PREPARED		STATUS	SECURITY LEVEL		
2021-01-20	DESTO	Approved	Internal		
APPROVED		DOCUMENT KIND			
2021-03-21	DESTO	Application example			
OWNING ORGANIZATION		DOCUMENT ID.	REV.	LANG.	PAGE
ABB STOTZ-KONTAKT GmbH		1SAC200123W0001	A	en	1/11

Contents

1. Important notice

Target group

This description is intended for use by trained specialists in electrical installation and control and automation engineering, who are familiar with the applicable national standards.

Safety requirements

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Symbols used in this application note:

	Symbol to indicate important information and conditions
	Symbol that indicated a potentially dangerous situation that can cause personal injury

Important notice

	Diagrams shown here are indicative examples. Relevant installation, design and safety calculations need to be completed specifically for each system implementation according to machinery safety standards (EN IEC 62061, EN ISO 13849-1, EN ISO 13850, EN IEC 61800-5-2, and EN IEC 60204-1) and local laws and regulations. ABB does not take any responsibility for the accuracy of the data used in this document and reserves the right to make changes without further notice. For detailed safety function implementation, please contact your local ABB representative.

2. Purpose and basic description

This document presents details on how an emergency stop, stop category 0, safety function can be designed and implemented using the Novolink devices together with AF contactors and an ABB safety relay. The safety function design is done according to EN ISO 13849-1 .

Necessary SIL/PL calculations are presented using ABB's functional safety design tool.

Safety functions are used in applications that require risk reduction from e.g. unexpected and hazardous movement. The aim is to design machines that are safe to use. This safety function example is presented for the new Novolink and safety relay SSR10.

	Note: It is expected that the reader is familiar with the used devices. Please read the related documentation if this is not the case before you go on reading.

3. Effective and reliable safe torque off for Novolink applications

3.1. Overview of the safety function

The STO function is the most common and basic safety function integrated. When STO is activated, the motor is no longer supplied with rotation or movement causing energy.

Requirements according to EN IEC 60204-1 and EN ISO 13850:

Safe torque off

- Safe Torque Off (STO) removes power to the electrical motor, preventing a torque of force to be generated.
- Leaving the STO state must not lead to an uncontrolled start of the electrical motor.
- The emergency stop function is a complementary protective measure and shall not be applied as a substitute for safeguarding measures and other functions or safety functions.

Stop category 0

- Stopping by immediate removal of power to the machine actuators.
- Mechanical disconnection between the hazardous elements and their machine actuators

Safe torque off, stop category 0 (figure 1), is used to immediately remove the power to the motor, causing the motor to coast to a stop (the motor stops due to inertia). Additional breaking can be necessary. The function can be used with applications where it is acceptable to allow movement to coast to a stop after the removal of the motor torque and/or the motor stops quickly due to heavy load.

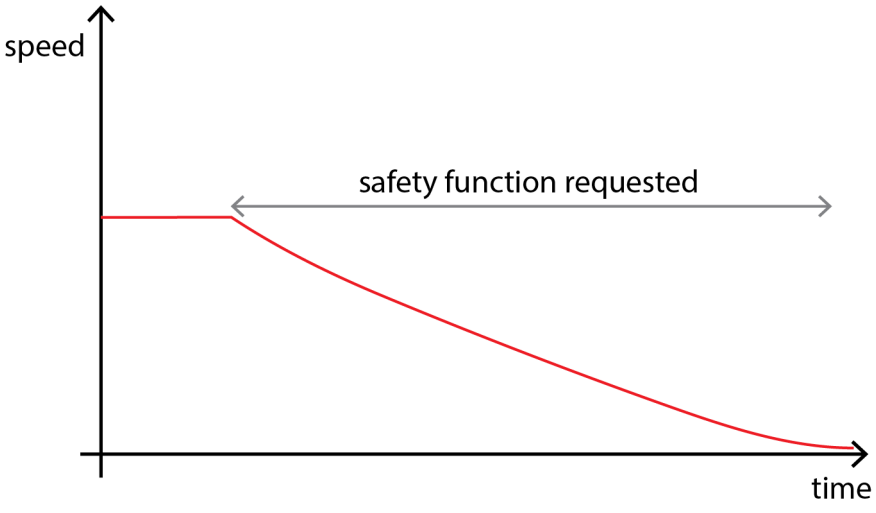


Figure 1: Typical motor speed with stop category 0 stop.

3.2. Design of the safety function for a single motor

The design of the safe torque off function, stop category 0, consists of an emergency stop button as an emergency power off switch, a safety relay as a logic unit and two contactors. The presented solution can be used up to PL e, category 4 according to EN ISO 13849-1.

Operation of the safety function

When the emergency stop button is pressed, the safety relay detects the signal from the button and opens its contacts to activate the STO safety function. After STO is activated, it de-energizes both contactors KS1 and K1. While contactor K1 is used for the regular operation of the motor, KS1 is only de-energized in case the safe function was activated.

The safety relay switches off the 24 V supply of the Novolink modules. In this case, a fault signal is sent to the PLC that the module is no longer operational.

To continue the motor operation after an emergency stop, the emergency stop button is disengaged (pulled up), which causes the contacts of the relay to close. This deactivates the STO safety function. When a new switch-on command is received from the PLC, the contactor K1 is released again.

A reset of the safety function is only possible when both contactors are in the off position. This detects if a contactor has welded and/or is stuck in its activated position. A reset button and a start command prevent unwanted starts. If there is a problem with a contactor and it is detected, a reset cannot be performed. SCV10 which is also in the mains path has no electrical connection to the motor wires and can be ignored in the safety evaluation.

Please note the following points:

Note 1: The number of operations of K1 must be on a level that MTTFd is achieved according to safety requirements in the application.

Note 2: The MTTFd will decrease if the number of annual “on-off” of K1 is high. The contactor must also be oversized according to well-proven safety principles.

Note 3: Some contactors have built-in mirror contacts. In this case CA401 is not needed and the contactor provided mirror contacts can be used.

See the circuit diagram (figure 2) for connection details.

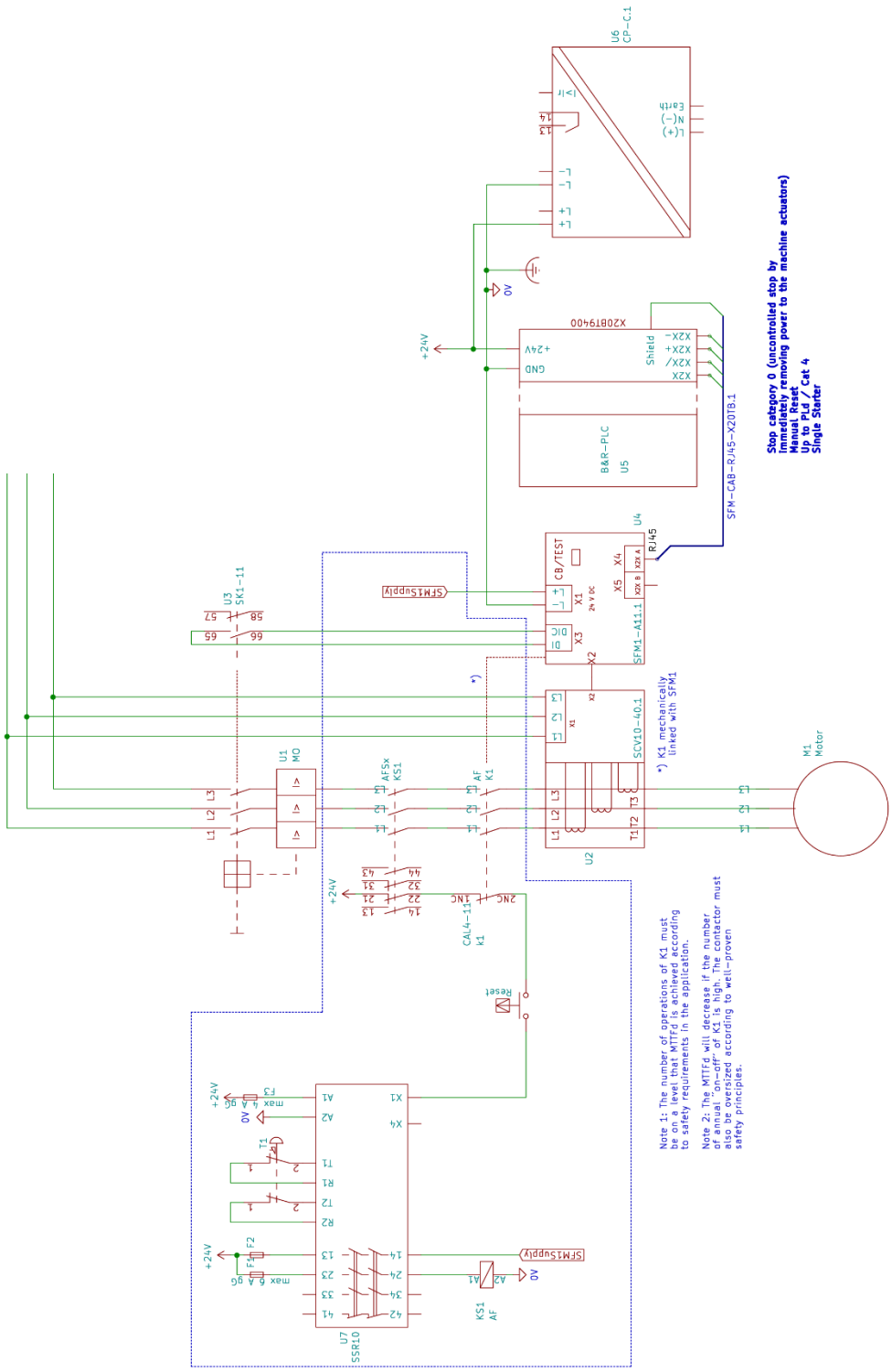


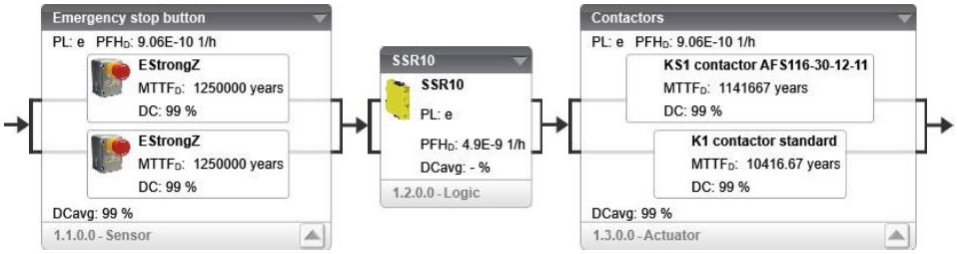
Figure 2: Circuit diagram of a motor feeder with safety function for a single motor.

3.3. Ensuring the required safety performance

In this design, two contactors are used in the actuator part of the safety function. KS1 is a contactor that is only broken when an emergency stop is initiated. K1 is a contactor that performs regular operations but is also used when an emergency stop is initiated.

The safety function must fulfil the required safety performance determined by a risk assessment. ABB's Functional Safety Design Tool (FSDT-01) is used to account for the desired safety function. This is carried out according to the following steps:

1. Evaluate the risks often according to ISO 12100 and ISO/TR 14121-2 to establish the target safety performance (SIL/PL level) level for the safety function.
2. Design the safety function circuit and verify the achieved performance level according to EN ISO 13849-1, or safety integrity level according to EN IEC 62061.
3. Generate a report for the machine documentation. The report should contain all the calculation results as well as all assumptions made during the application design.



Target PL				e					
Achieved PL				e					
ID	Subsystem name	PL	PFH_D	Cat	$MTTF_D$	DCavg	Contr. to PFH_D	Lifetime	CCF
1.1.0.0	Emergency stop button	e	9.06E-10 1/h	4	2500 years	99 %	13.5 %	20 years	70
1.2.0.0	SSR10	e	4.9E-9 1/h	4	-	-	73 %	20 years	-
1.3.0.0	Contactors	e	9.06E-10 1/h	4	2500 years	99 %	13.5 %	20 years	70

Figure 3: Safety logical diagram and calculation results for a single motor feeder.

3.4. Design of the safety function for a group of motors

The design of the safe torque off function, stop category 0, consists of an emergency stop button as an emergency power off switch, a safety relay as a logic unit and two contactors. The presented solution can be used up to PL d, category 4 according to EN ISO 13849-1. In contrast to the example in the previous section, a group of motors can be stopped with a single safety relay. All motor relays must be in the OFF position before the safety function can be reset after an emergency power off.

Operation of the safety function

When the emergency stop button is pressed, the safety relay detects the signal from the button and opens its contacts to activate the STO safety function. After STO is activated, it de-energizes both contactors KS1 and KS2.

The contactors related to normal motor operation (e.g. K1) can be in any position.

To continue the motor operation after an emergency stop, the emergency stop button must be disengaged (pulled up), the reset button pressed and the condition of KS1 and KS2 being in their off state confirmed first. This deactivates the STO safety function by switching on the two contactors KS1 and KS2. New start commands will have now an effect again.

A reset of the safety function is only possible when all contactors (safety ones and operational ones) are in the off position. This prevents unwanted motor restarts. This is realized by adding auxiliary signals (CA401) into the reset path of the SSR10 relay. Having the work-contactor K1 within the reset signal chain is optional.

See the circuit diagram (figure 3) for connection details.

Please note that the Novolink devices do not play any role in the safety function and must not be considered in the safety design tool.

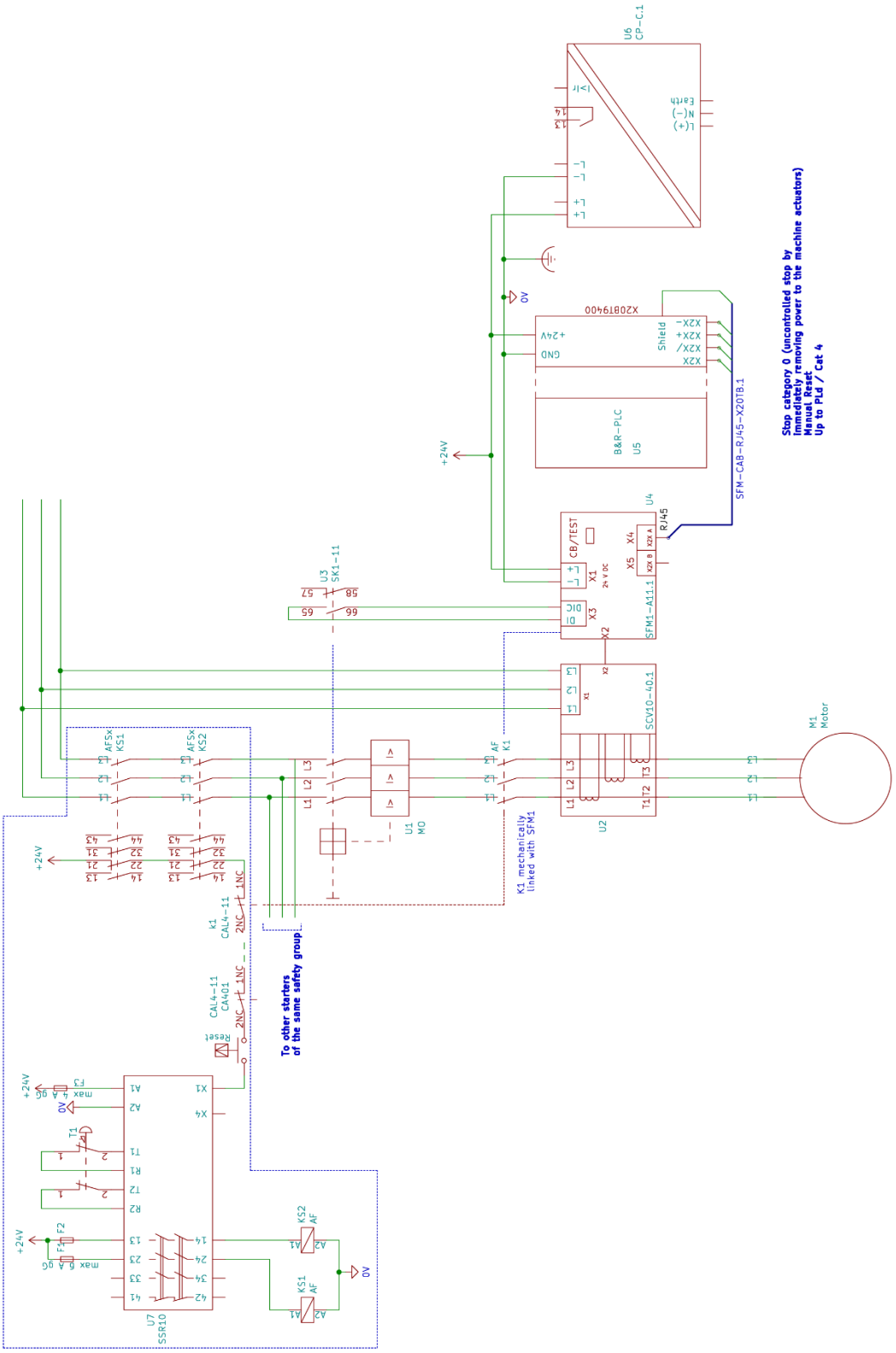


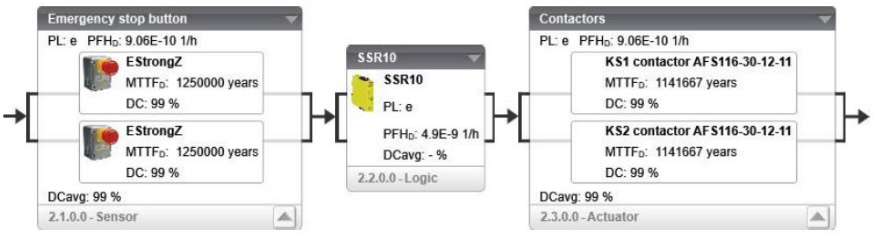
Figure 3: Circuit diagram for a group of motors with safety function.

3.5. Ensuring the required safety performance

In this example of an emergency stop function, two contactors are used in the actuator part of the safety function to switch off a group of motors.

The safety function must fulfil the required safety performance determined by a risk assessment. ABB's Functional Safety Design Tool (FSDT-01) is used to account for the desired safety function. This is carried out according to the following steps:

1. Evaluate the risks often according to ISO 12100 and ISO/TR 14121-2 to establish the target safety performance (SIL/PL level) level for the safety function.
2. Design the safety function circuit and verify the achieved performance level according to EN ISO 13849-1, or safety integrity level according to EN IEC 62061.
3. Generate a report for the machine documentation. The report should contain all the calculation results as well as all assumptions made during the application design.



Target PL				e					
Achieved PL				e					
ID	Subsystem name	PL	PFH_D	Cat	$MTTF_D$	DCavg	Contr. to PFH_D	Lifetime	CCF
2.1.0.0	Emergency stop button	e	9.06E-10 1/h	4	2500 years	99 %	13.5 %	20 years	70
2.2.0.0	SSR10	e	4.9E-9 1/h	4	-	-	73 %	20 years	-
2.3.0.0	Contactors	e	9.06E-10 1/h	4	2500 years	99 %	13.5 %	20 years	70

Figure 4: Safety logical diagram and calculation results for a group of motors.

3.6. General considerations

Achieving machinery safety requires a systematic approach beyond the physical implementation of a safety function. The overall machinery safety generally covers the following areas:

- Planning for and managing functional safety during the lifecycle of the machine
- Assuring compliance to local laws and requirements (such as the machinery directive and CE-marking in the European Union)
- Assessing machine risks (analysis and evaluation)
- Planning the risk reduction and establishing safety requirements
- Designing the safety functions
- Implementing and verifying the safety functions
- Validating the safety functions
- Documenting the implemented functions and results of risk assessment, verification and validation

4. Additional information

For more information concerning functional safety and the Functional safety design tool, see:

https://new.abb.com/low-voltage/products/safety-products

and ABB's technical guide no. 10.

4.1. Abbreviations

Term	References	Description
DC_{avg}	EN ISO 13849-1	Diagnostic coverage
$MTTF_d$	EN ISO 13849-1	Mean time to dangerous failure
PFH_d	EN/IEC 62061	Probability of dangerous failures per hour
PL	EN ISO 13849-1	Performance level: corresponds to SIL, Levels a-e
SIL	EN/IEC 62061	Safety integrity level

4.2. Related documents

Ref #	Document Kind, Title	Document No.
1	Novolink – smart function and sensor modules for AF contactors	2CDC100017M0201
2	Sentry safety relays	2TLC010002M0201
3	Functional Safety Design Tool, version 1.2.0.1	

5. Revisions

Rev.	Page (P) Chapt. (C)	Description	Date Dept./Init.
A	-	Initial version	19.03.2021

APPLICATION GUIDE

Novolink with Siemens PLC

Connecting Smart Gateway SGWX20-OUA to Siemens PLC using TIA Portal V17

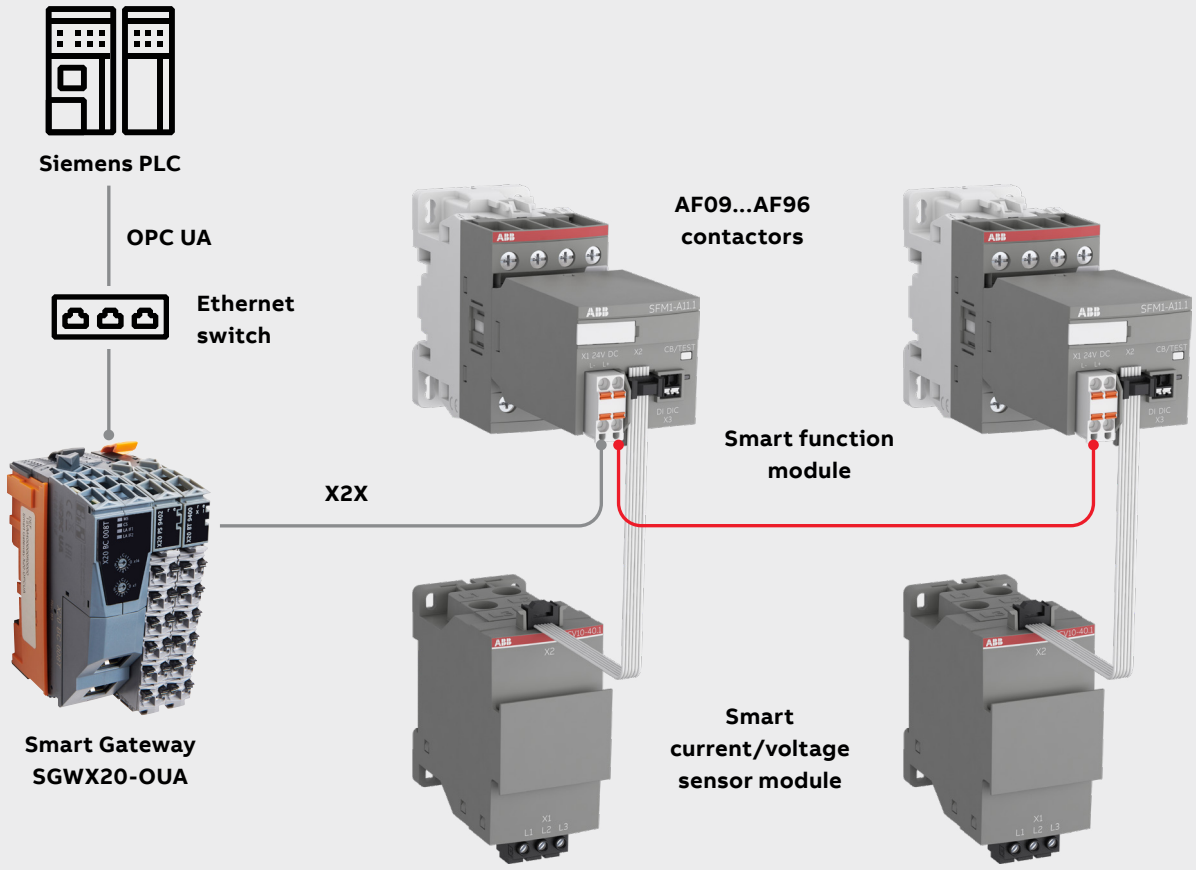


Table of contents

1. Purpose and basic description

This section describes the basic steps to set up the ABB Novolink modules with the Siemens PLC via Smart Gateway using OPC UA.

1.1. What is Novolink?

The ABB Novolink™ devices help digitalize motor starting solutions and gain insights into the connected loads. They‘re easy to design into existing wiring plans and connect to standard AF contactors. Installation is fast and simple, thanks to reduced wiring and fewer components, so engineering efforts are minimized. The Novolink devices enables predictive maintenance to reduce downtime, as well as increasing efficiencies and boosting cost savings. It’s fully integrated into the B&R automation system. And the possibilities open up even more as full remote access to your data creates new maintenance service and revenue opportunities.

2. Important disclaimers & recommendations

2.1. Cyber security legal disclaimer

The Smart Gateway and Novolink modules are designed to be connected in the ABB and 3rd party products and communicate information data via network interface. It is the user’s sole responsibility to provide and continuously ensure a secure connection between the product and the user’s network or any other. The user shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system, and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information. The data, examples and diagrams in this manual are included solely for the concept or product description and are not to be deemed as a statement of guaranteed properties. All people responsible for applying the equipment addressed in this manual must satisfy themselves that each intended application is suitable and acceptable, including that any applicable safety or other operational requirements are complied with. Any risks in applications where a system failure and/or product failure would create a risk for harm to property or persons (including but not limited to personal injuries or death) shall be the sole responsibility of the person or entity applying the equipment, and those so responsible are hereby requested to ensure that all measures are taken to exclude or mitigate such risks. This document has been carefully checked by ABB, but deviations cannot be completely ruled out. In case any errors are detected, the reader is kindly requested to notify the manufacturer. Other than under explicit contractual commitments, in no event shall ABB be responsible or liable for any loss or damage resulting from the use of this manual or the application of the equipment.

2.2. UaExpert

UaExpert is software, provided by Unified Automation. We suggest using this software for monitoring the data as described in chapter “UaExpert”.
Important: This software does not belong to ABB, and we do not take any responsibility on its functionality.

2.3. Making your networks more secure

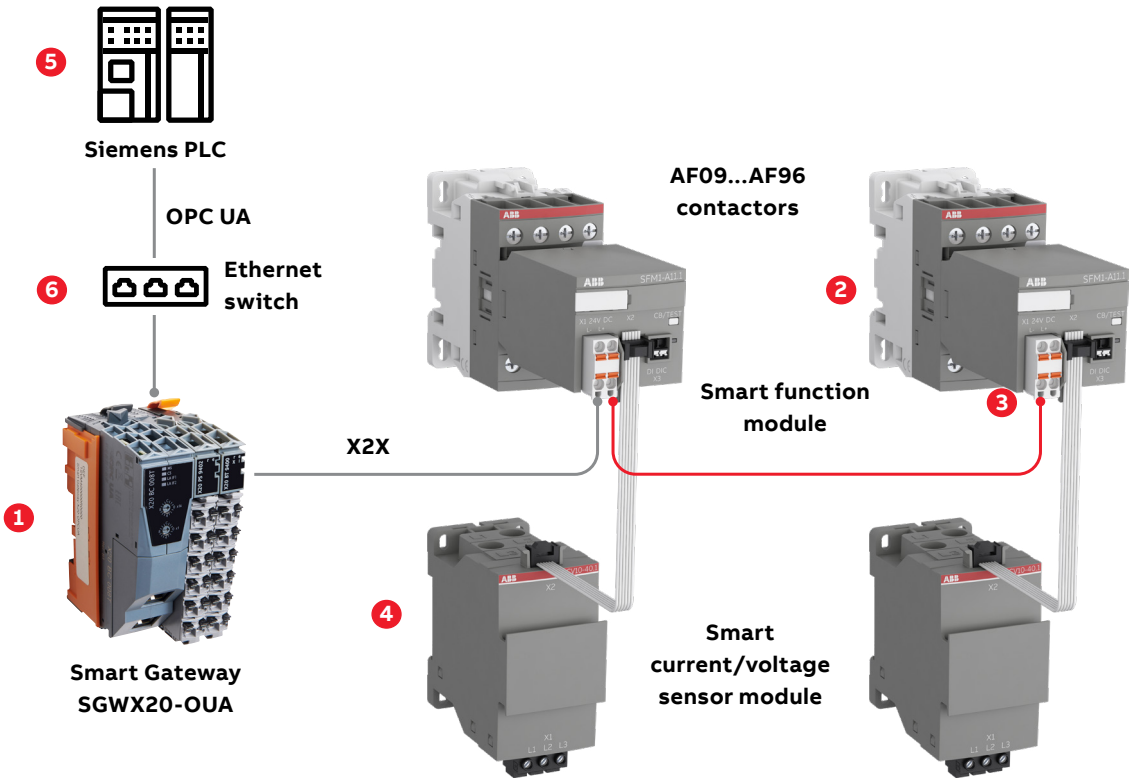
Following points are strongly recommended to make networks more secure:

- **Isolate your network** – separate the OT network (Operation Technology) from the IT network (Information Technology). This helps prevent any attack reaching the IT network from spreading to the OT network.
- **Use firewalls** – Implement firewalls to prevent unauthorized access to the OT network.
- **Use access control** – Implement access controls to restrict the human and device access to the OT/IT network and devices.
- **Keep software up to date** – Make sure all software/firmware of the devices are up to date to have the latest security updates installed.
- **Reduce attack surface on devices** – Disable device functions, services and ports not needed.
- **Replace default passwords** – Replace all default passwords of the devices to prevent attacker from getting access using default credentials.
- **Monitor network activity** – Monitor the OT network for any malicious activities that could be a sign of an attack. Example of network monitoring tool is intrusion detection system (IDS).
- **Train employees** – Train operators and service people on IT and OT security best practices.

3. Basic setup

This section describes basic steps required to set up the Smart Gateway SGWX20-OUA with Smart Function Module (SFM) and Smart Current/Voltage modules (SCM /SVM) connected to Siemens PLC over OPC UA.

The setup can be done as shown in the figure below:



The figure shows the main components and how they can be combined for complete motor starting solutions:

- Smart Gateway SGWX20-OUA (1) is connected to Siemens PLC (5) via ethernet switch (6).
- Smart Function Module SFM (3) should be mounted on AF contactors (2).
- SFM are connected to Smart Current/Voltage sensor module SCV (4) over X2X cable.
- All the SFMs are connected to Smart Gateway SGWX20-OUA (1) over X2X cable.

Note: Smart Gateway SGWX20-OUA can be an OPC UA server.

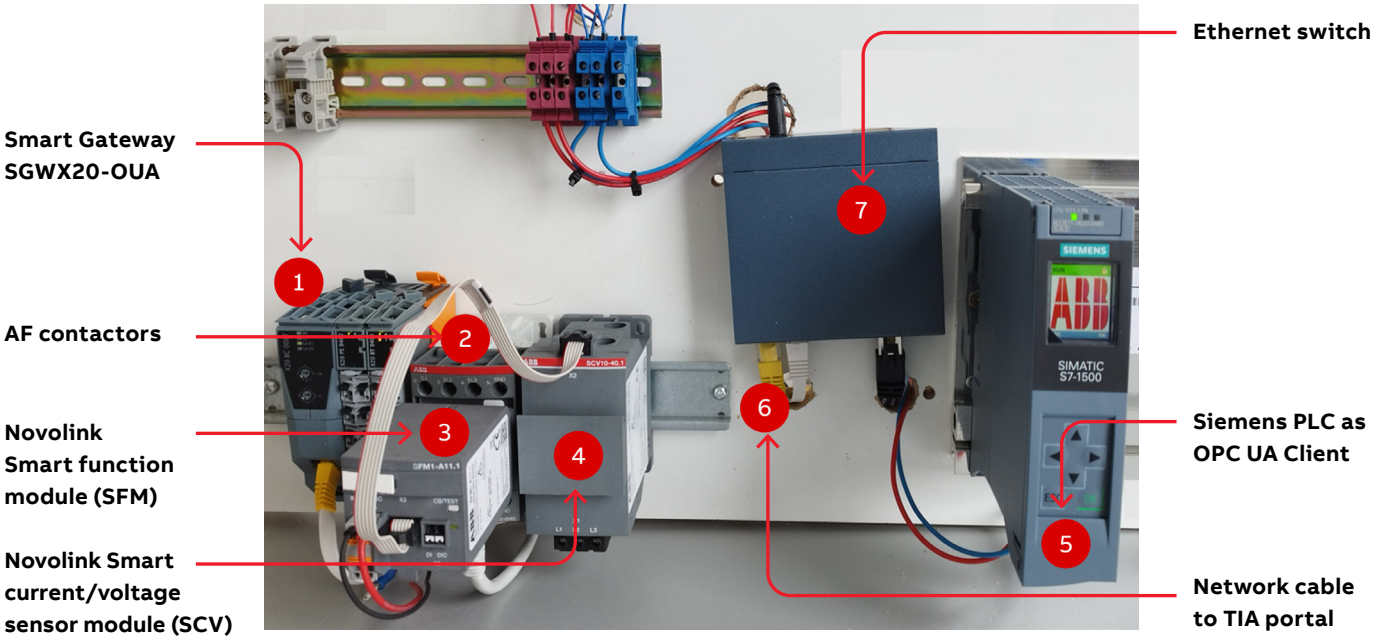
3.1. Hardware used

Following hardware are used.

	Device	Description	Part number	Quantity
Siemens	PLC	Siemens S7 1500 with firmware v2.6 or higher	1511-1PN - 6ES7 511-1AK02-0AB0 with firmware V2.9	1
Novolink	SFM-CAB-RJTB.1-500	Connection cable RJ45 - X20 Terminal block of X20BT9400	1SVM823000R0500	2
Novolink	SFM-CAB-S.1-50	Connection cable SFM to sensor 0.5 m	1SVM811000R0050	2
Novolink	SCV10-40.1	Smart current/voltage sensor	1SVM320010R0000	1
Novolink	SFM1-A11.1	Advanced function module with X2X	1SVM120012R0000	2
Contactor	AF09	Contactors	1SBL137001R1101 AF09-30-01-11	2
X2X OPC UA Gateway	X2X OPC UA Gateway	B&R controller	X20BT08T	1
X2X OPC UA Gateway	Power supply for the bus coupler	B&R controller	X20PS9400	1
X2X OPC UA Gateway	Power supply and interface of the X2X bus	B&R controller	X20BT9400	1
X2X OPC UA Gateway	Backplane module	B&R controller	X20BB80X	1

3.2. Architecture used

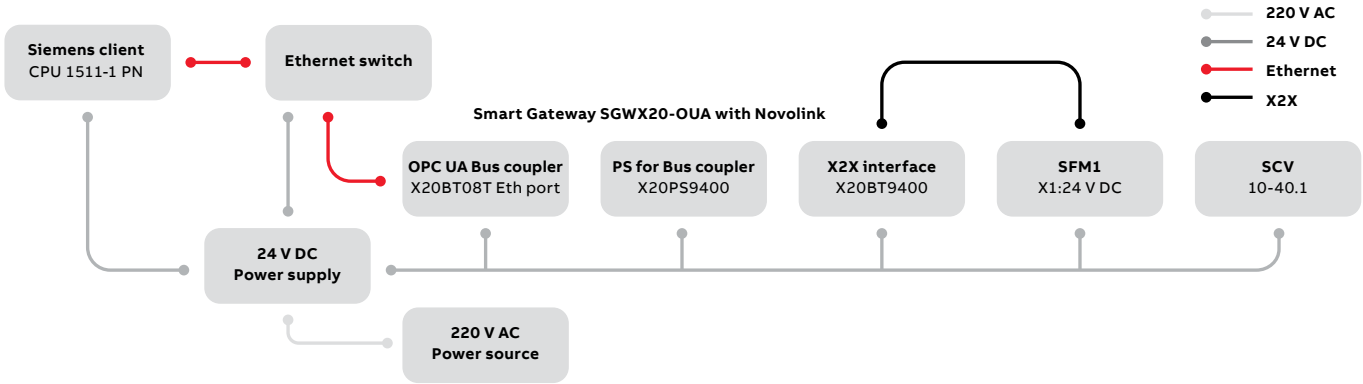
This section describes basic steps required to set up the Smart Gateway, Novolink modules with Siemens PLC.
The setup can be done as shown in the picture below:



Number	Description
1	Smart Gateway SGWX20-OUA
2	AF contactors
3	Novolink Smart function module (SFM)
4	Novolink Smart current/voltage sensor module (SCV)
5	Siemens PLC as OPC UA Client
6	Network cable to TIA Portal (install on a PC)
7	Ethernet switch

3.2.1. Wiring and power up

Refer to the architecture used, please ensure that all wiring is done, and devices are powered up using the schematic shown below.



24 V DC	24VDC is connected to the Smart Gateway, Novolink modules and PLCs
220 V AC	220 V AC is required for power supply. 220 VAC can also be used for power up contactors
OPC UA	For OPC UA: Connect the Smart Gateway and Siemens PLC to the ethernet switch
X2X	Connect Smart Gateway to SFM with cable “SFM-CAB-RJTB.1-500” Connect SFM to Sensors with cable “SFM-CAB-S.1-50”

3.2.2. Software configuration

Configuration of Siemens PLC	Following software are used to configure the Siemens PLC: • Siemens TIA Portal V17 or higher • Siemens OPC-UA license
Configuration of B&R Gateway	UaExpert
Reading/writing data from Novolink via B&R controller	UaExpert

4. Siemens client

4.1. Preparation and supplies

This section describes what you need to make the configuration in TIA V17.

- Novolink setup:
  see manual “SGWX20-OUA Smart Gateway X20 to OPC UA Connecting Novolink devices with OPC UA clients.”
- Siemens S7 1500 with firmware v2.6 or higher (example: 1511-1PN - 6ES7 511-1AK02-0AB0 with firmware V2.9)
- Siemens TIA Portal V17 or higher
- Siemens OPC-UA license
- The modules are wired to each other.
- IP-address of the server (example: 192.168.2.11)

This example will use the CPU 1511 with Firmware V2.9.

4.2. The properties of the CPU

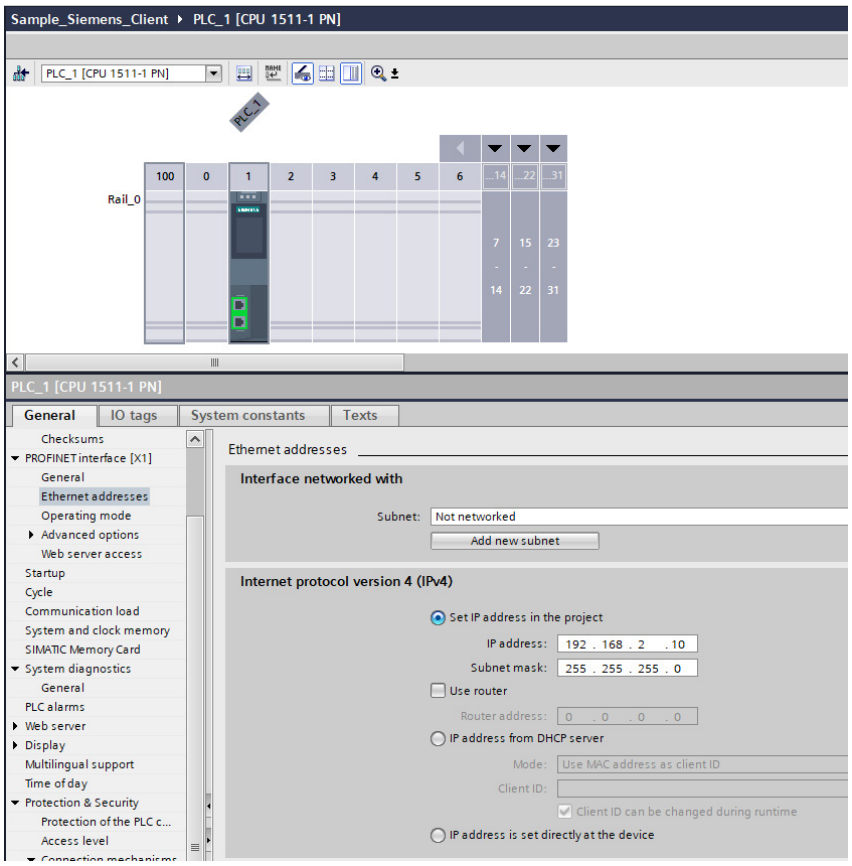
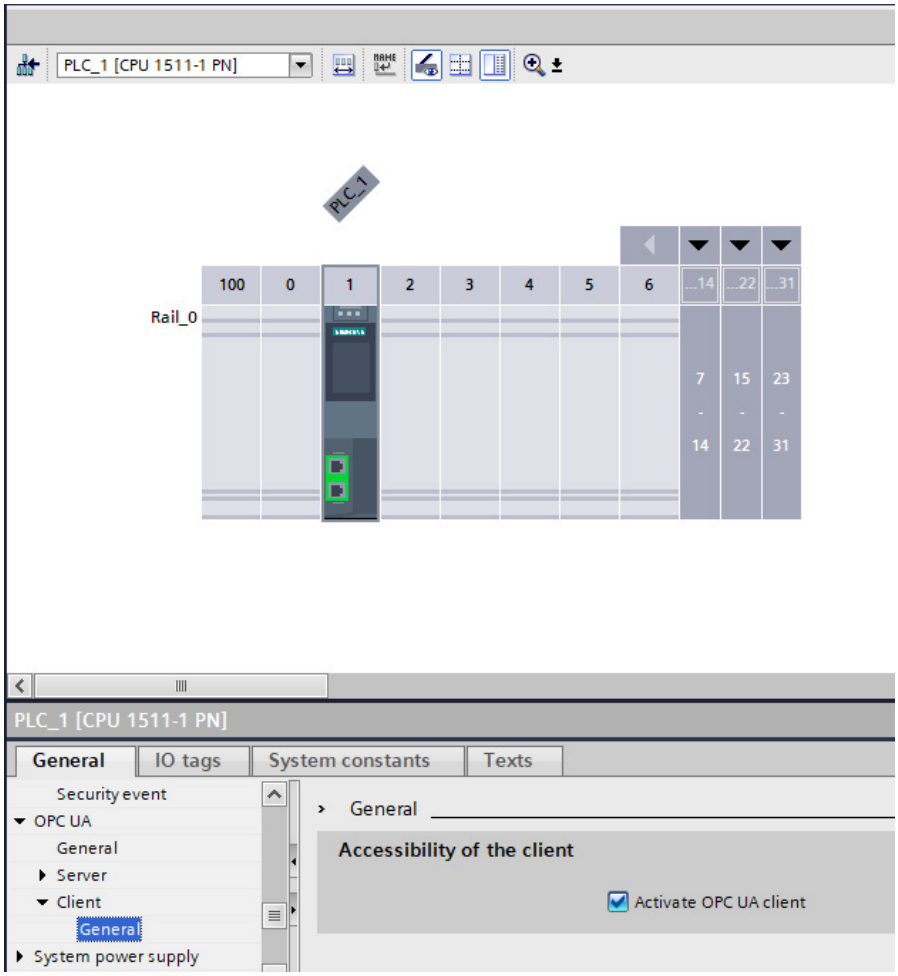


Figure 1: CPU_IP Address

- Make sure that the IP-address of the server and the client are in the same network



—
Figure 2: CPU_OPCUA_Client

- Enable the checkbox “Activate OPC UA Client”

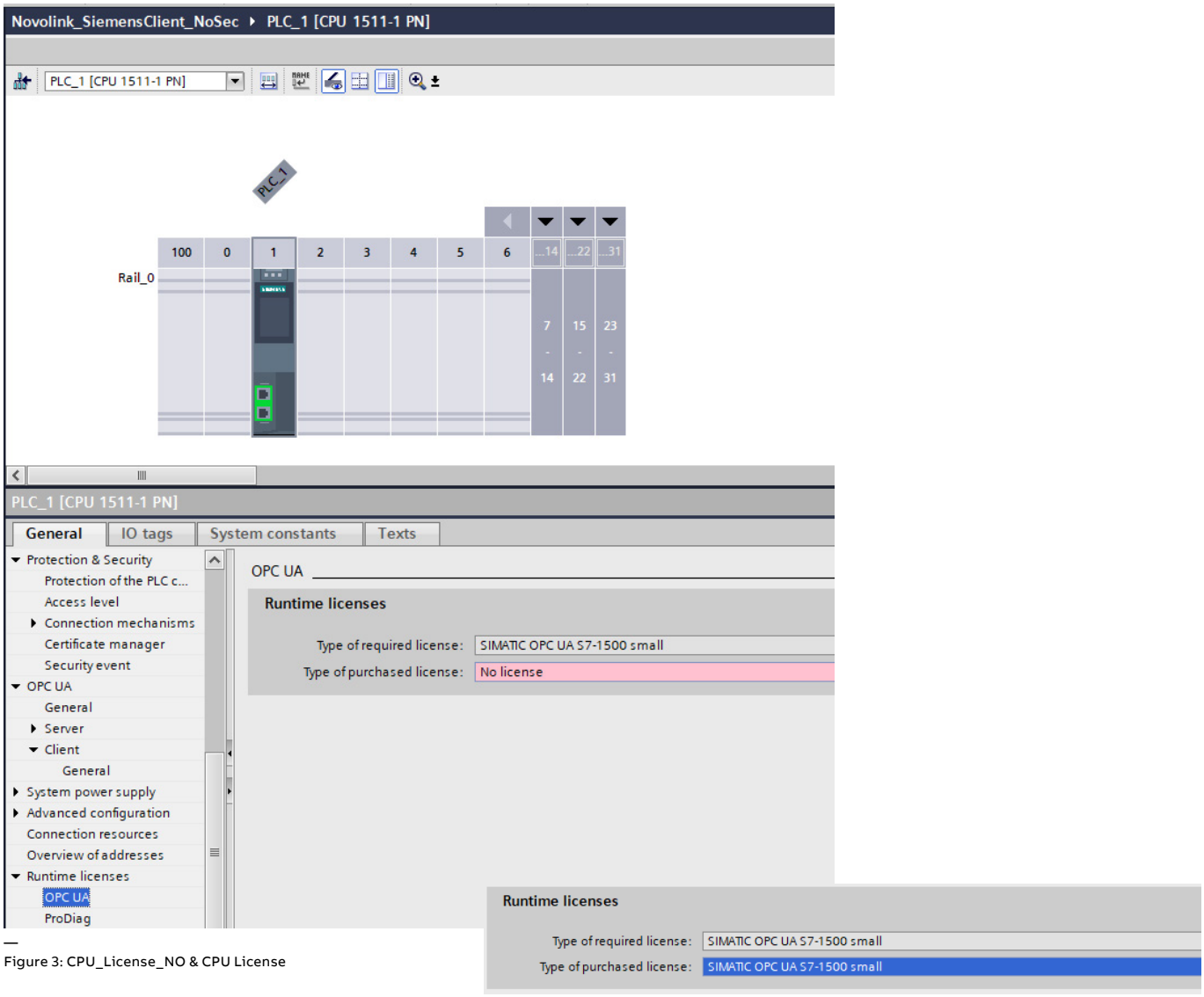


Figure 3: CPU_License_NO & CPU License

- Select the license, Siemens will inform what license you require

The license type is determined by the PLC that is used.

Licensing

An OPC UA Server or OPC UA Client is available on the target systems (CPUs) and is activated using runtime licenses. Runtime licenses are offered in three levels for different target systems:

Target system	OPC UA S7-1200 Basic	OPC UA S7-1500 Small	OPC UA S7-1500 Medium	OPC UA S7-1500 Large
S7-1200 CPUs	Yes	No	No	No
ET 200SP CPU 1510SP/1512SP/1515SP (Open Controller) S7-1500 CPU 1511/1513 CPU 1504D Drive Controller	No	Yes	Yes	Yes
ET 200pro CPU 1516pro S7-1500 CPU 1515/1516 PLC 1507S software	No	No	Yes	Yes
S7-1500 CPU 1517/1518/1508S CPU 1507D Drive Controller	No	No	No	Yes

The runtime license includes the certificate for OPC UA (Server and Client) and can be run on the respective target systems including F, C and T/TF as from firmware V2.0 (Client V2.6).

You can find more information on the Software Update Service, license types, Online Software Delivery and handling your SW licenses with the Automation License Manager under this link.

https://mall.industry.siemens.com/mall/en/WW/Catalog/Products/10315991

4.3. The client interface

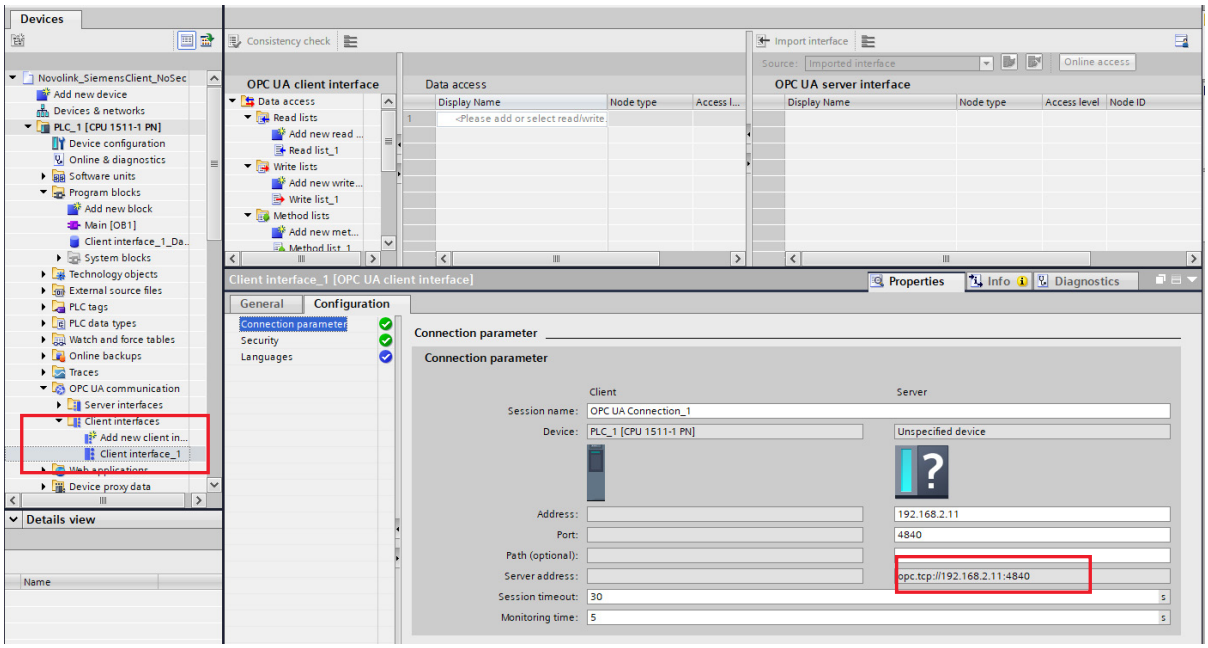


Figure 4: ClientInterface_ConnectParameter

- Add a new client interface
- Fill in the IP address of the server

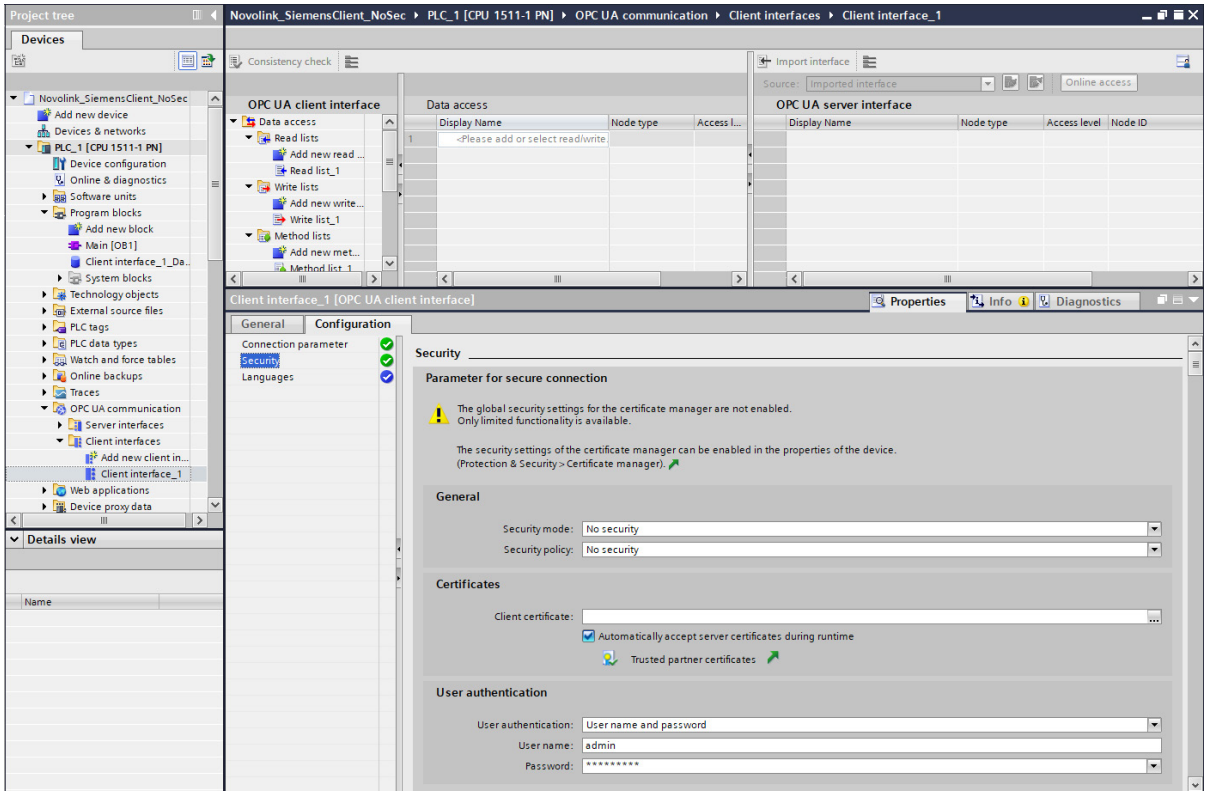


Figure 5: ClientInterface_Security

- Make sure “No security” is selected and that “automatically accept server certificates during runtime” is checked
- Fill in the username and the password of the server

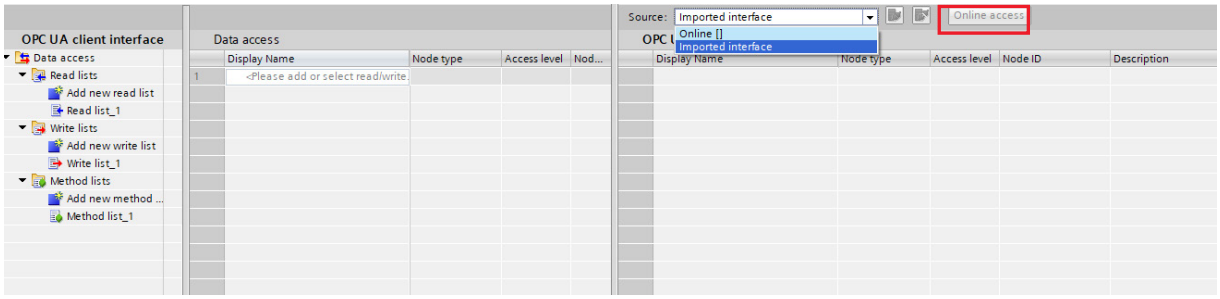


Figure 6: ClientInterface_OnlineAcces

On the topside of the client interface screen.

- Select “Online [ ]” behind source
- Click the “Online Access” button

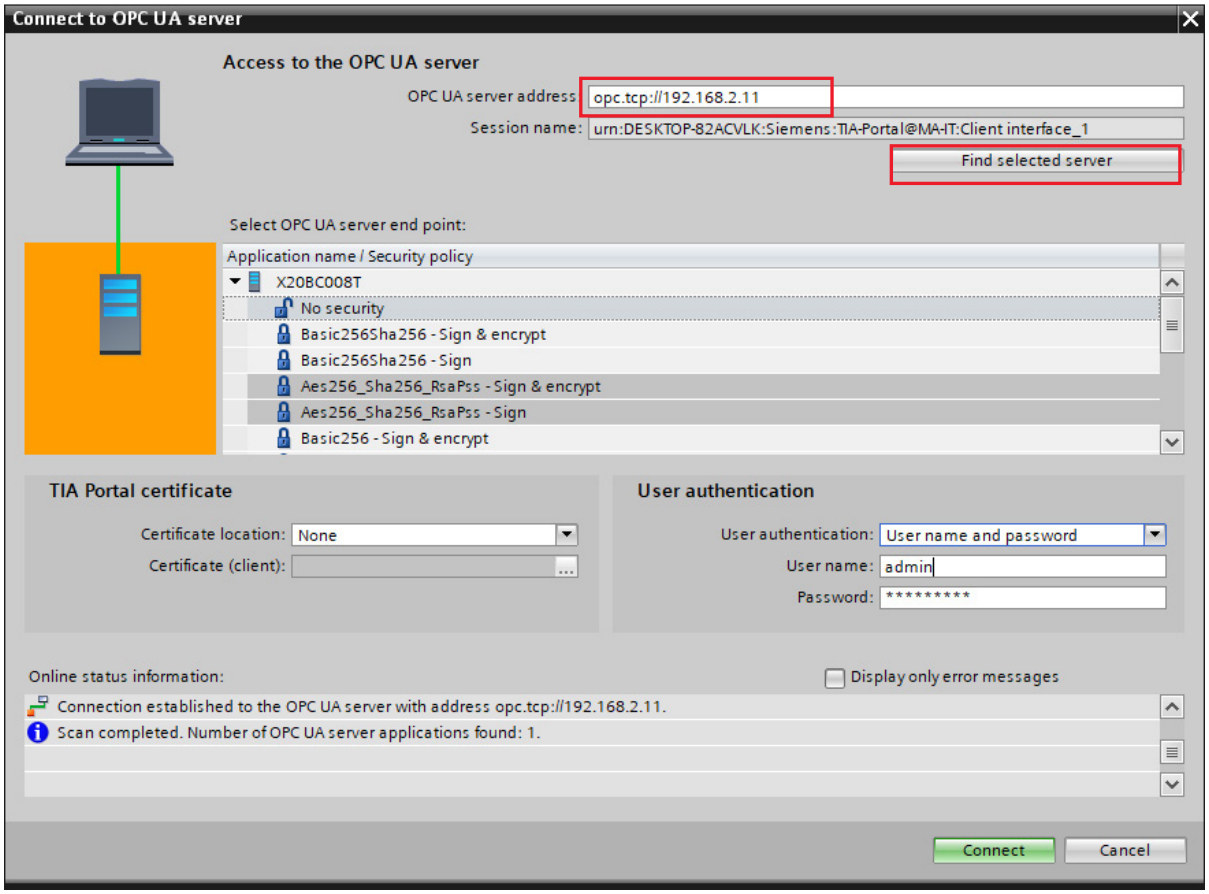


Figure 7: PopUp Online Access

The access pop-up popped up.

- Fill in the IP-address of the server
- Click the “Find Selected Server” button

Server with the security protocols will be shown

- Select “No Security”
- Select in User authorisation “User name and Password”
- Fill in the User name of the server
- Fill in the password of the server
- Click the button “Connect”

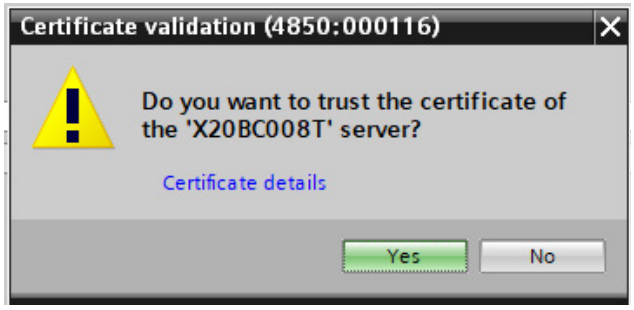


Figure 8: ClientInterface_ServerTrust

When asked if you trust the server certificate and you trust it.

- Click “yes”

On the right side of the screen, you will get the available objects of the server.

4.4. The Read list

4.4.1. Program read list

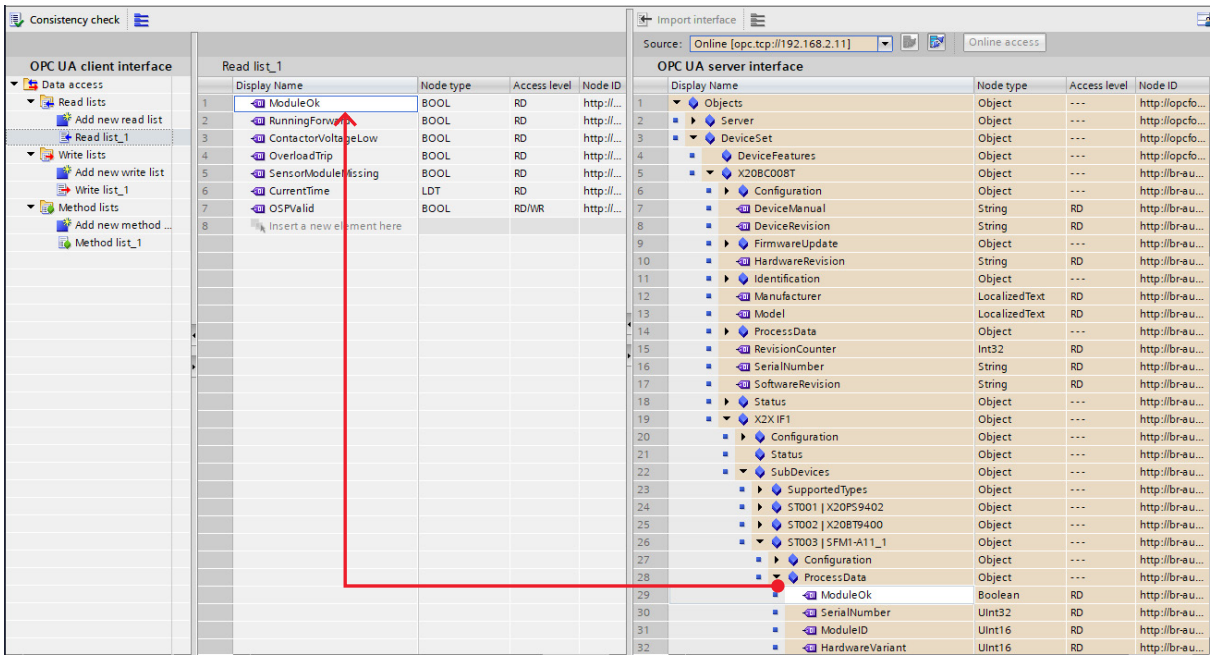


Figure 9: Read_list

- Add a new read-list.
- Select the variables you want to read and drag and drop the variables those you want to the left side into the read-list.
- Compile the software.

Note:
It is possible to add multiple read lists. For each read list you can use different reading intervals.

In this example we will use the next variables:

- ProcessData >> ModuleOk
- ProcessData >> RunningForward
- ProcessData >> ContactorVoltageLow
- ProcessData >> OverloadTrip
- ProcessData >> SensorModuleMissing
- ProcessData >> OSPValid

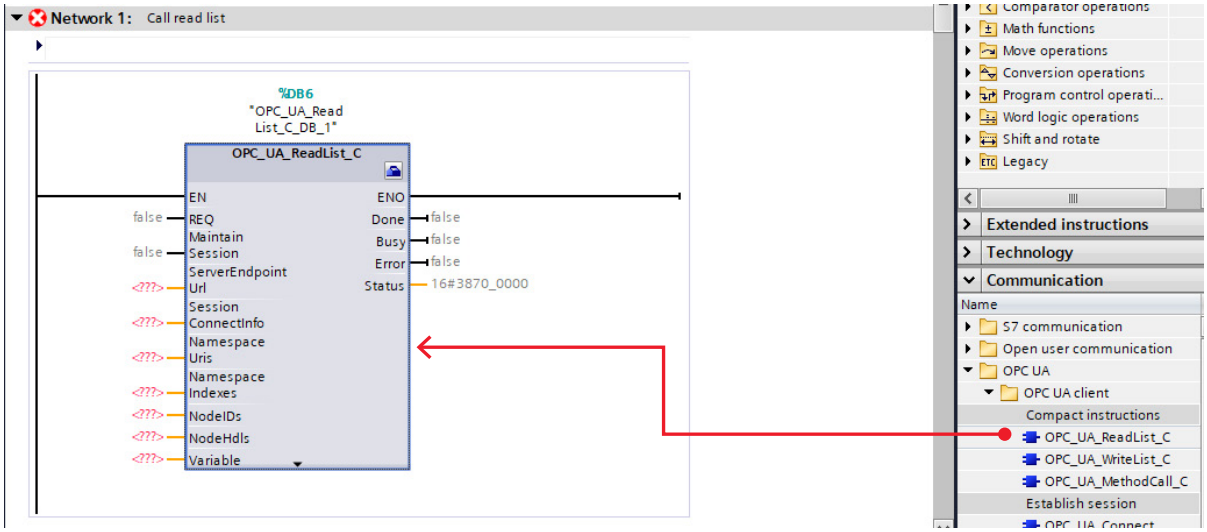


Figure 10: OB1_Readlist

- Drag and drop the OPC_UA_ReadList_C in OB1

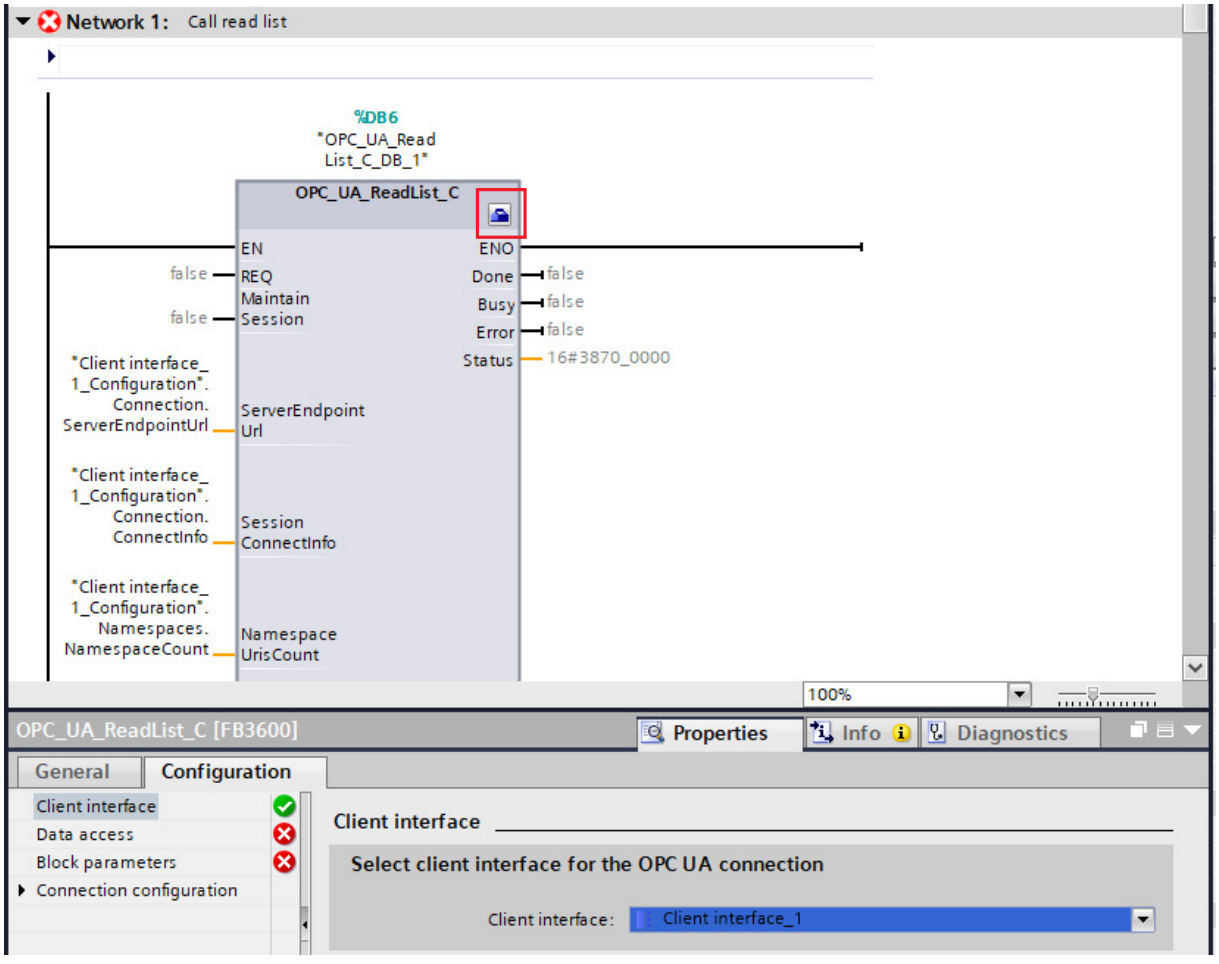


Figure 11: OB1_Readlist_ClientInterface

- Click on the toolbox icon in the upper right corner of the OPC_UA_ReadList_C block

The configuration of the OPC_UA_ReadList_C block will be shown below.

- Select the client interface that was made before.

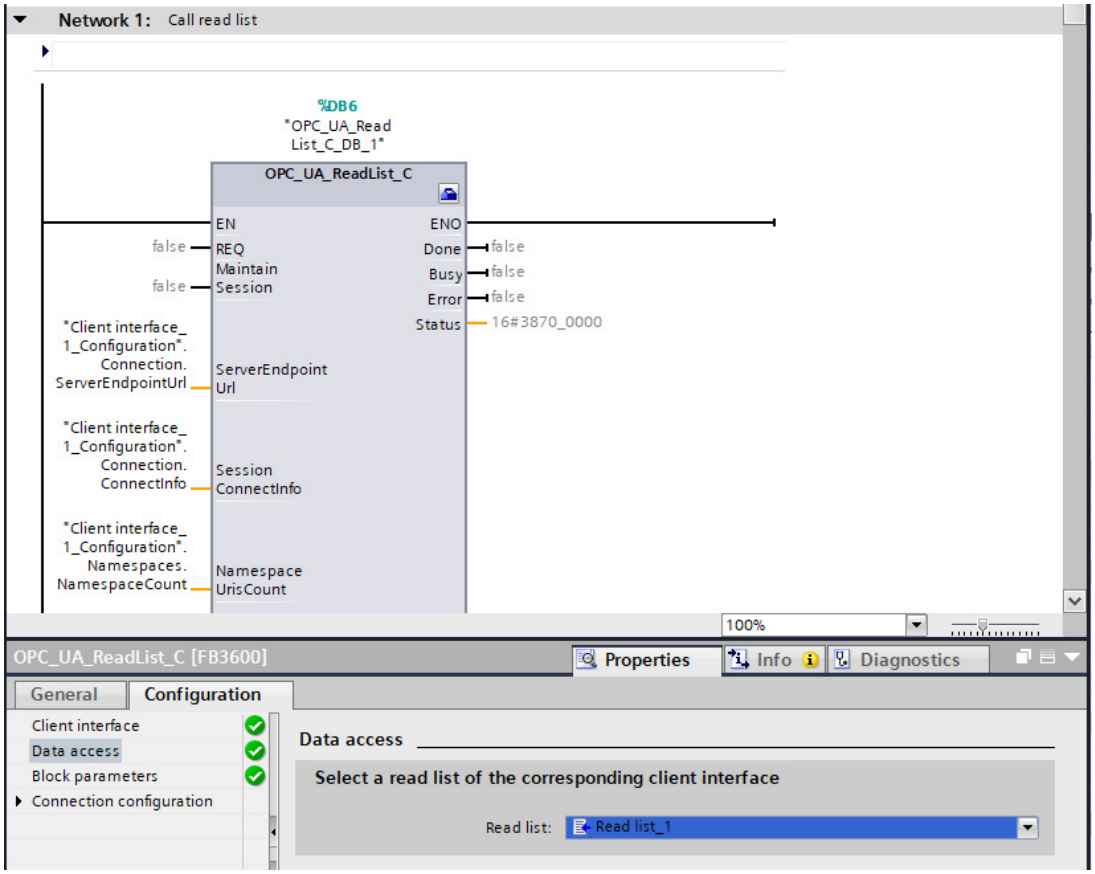


Figure 12: OB1_Readlist_DataAcces

- Select the read-list that was made before
- The rest of the parameters will be set automatically by Siemens

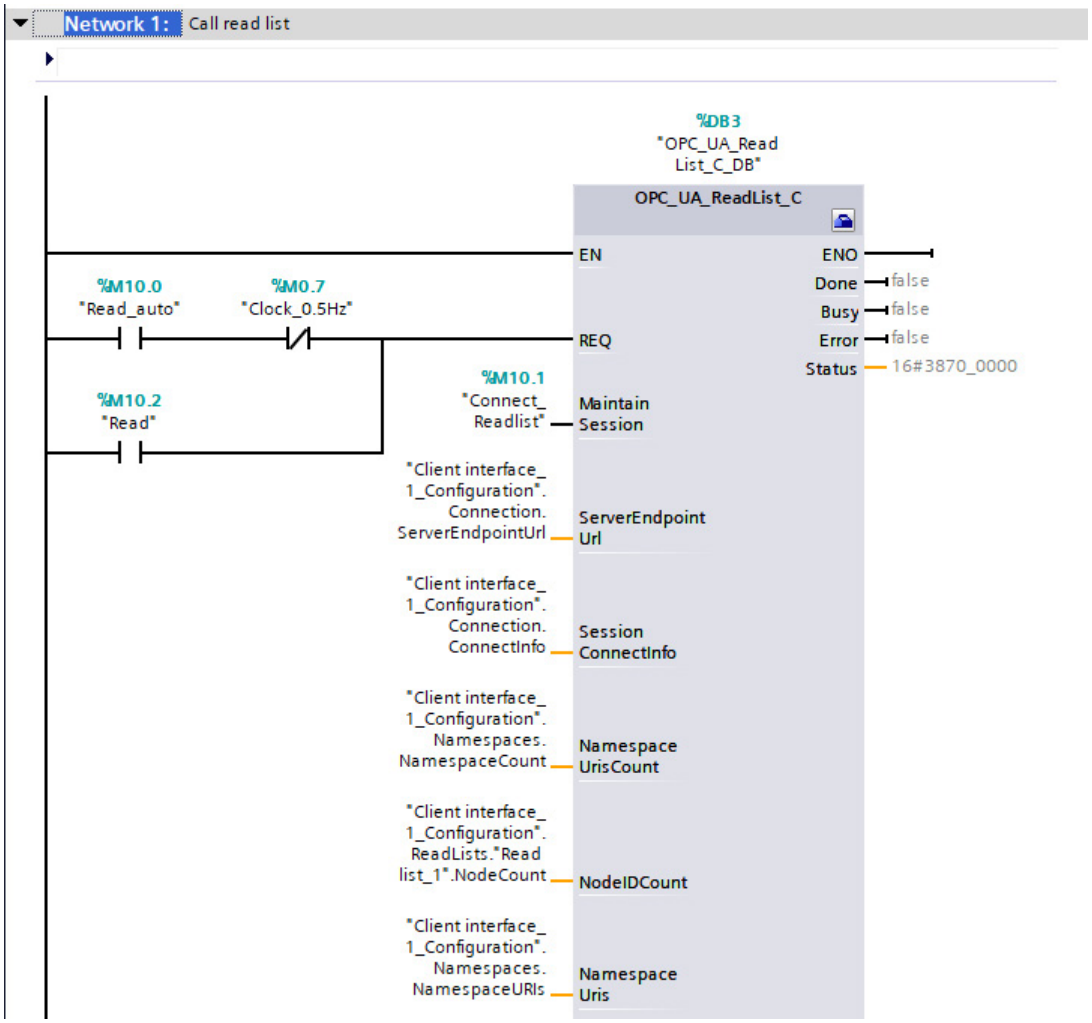


Figure 13: OB1_Readlist_Merkers

- Add a tag to the Request input (REQ). On every positive edge it will make connection with the server and the variables will read from the server
- Add a tag to the Maintain session
- Compile the project with a rebuild all for hardware and software
- Download “hardware configuration”
- Download “Software all”

Note:
The maintain session keeps the connection between server and client. It is not necessary to put this on true, but it will take less time to reconnect every time there is a positive edge on the REQ
When an error occurs it’s up to the user to disable the maintain and re-enable it to reconnect to the server.

4.4.2. Check read list

For reading the data from the server:

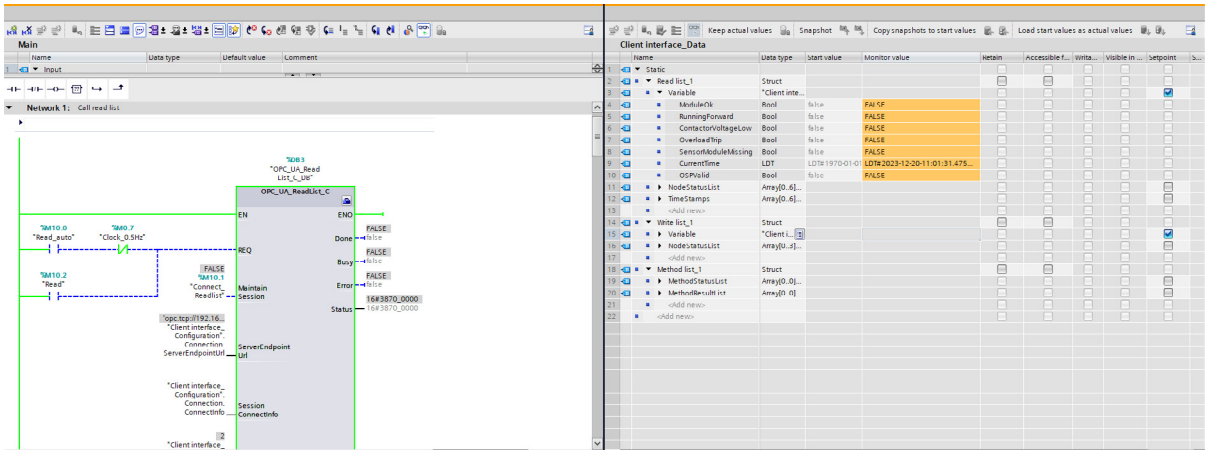


Figure 14: Online_setup_Reading

- Open “OB1” and “Client_Interface_Data” and put the screens next to each other
- Open the menu Readlist_1 >> Variable
- Monitor both screens

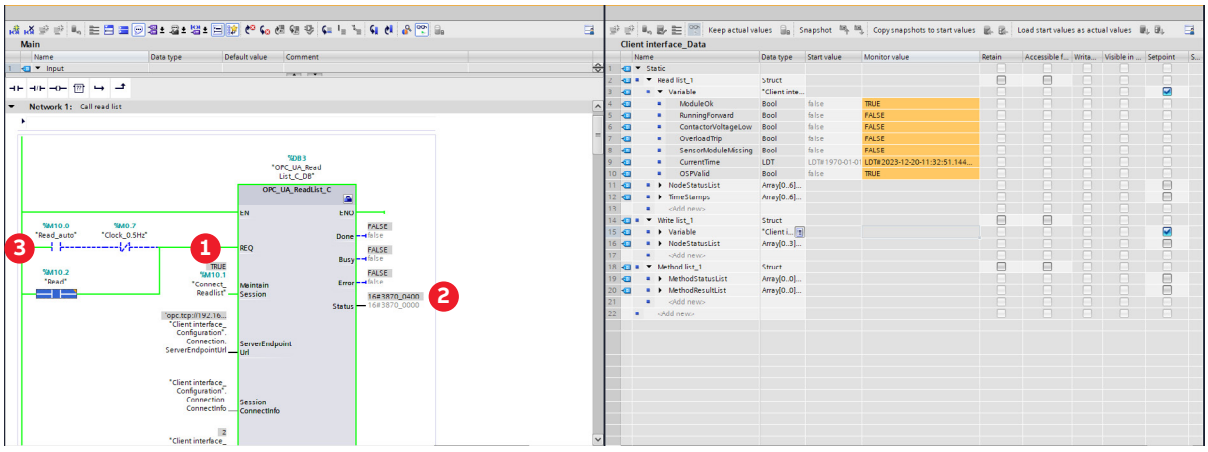


Figure 15: Online_Connect_Reading

- Connect to the server by set the tag “Connect_Readlist (Maintain Session)” on TRUE 1
- Check the status variable in OB1. The status should be return 16#3870_0400 2
- Read the values by setting the tag “Read”or “Read_auto” on TRUE. On Every positive edge of the REQ-signal the data will be reading from the server 3
- The variables on the “Client_Interface_Data” screen have now been read from the server

4.5. The write list

4.5.1. Program write list

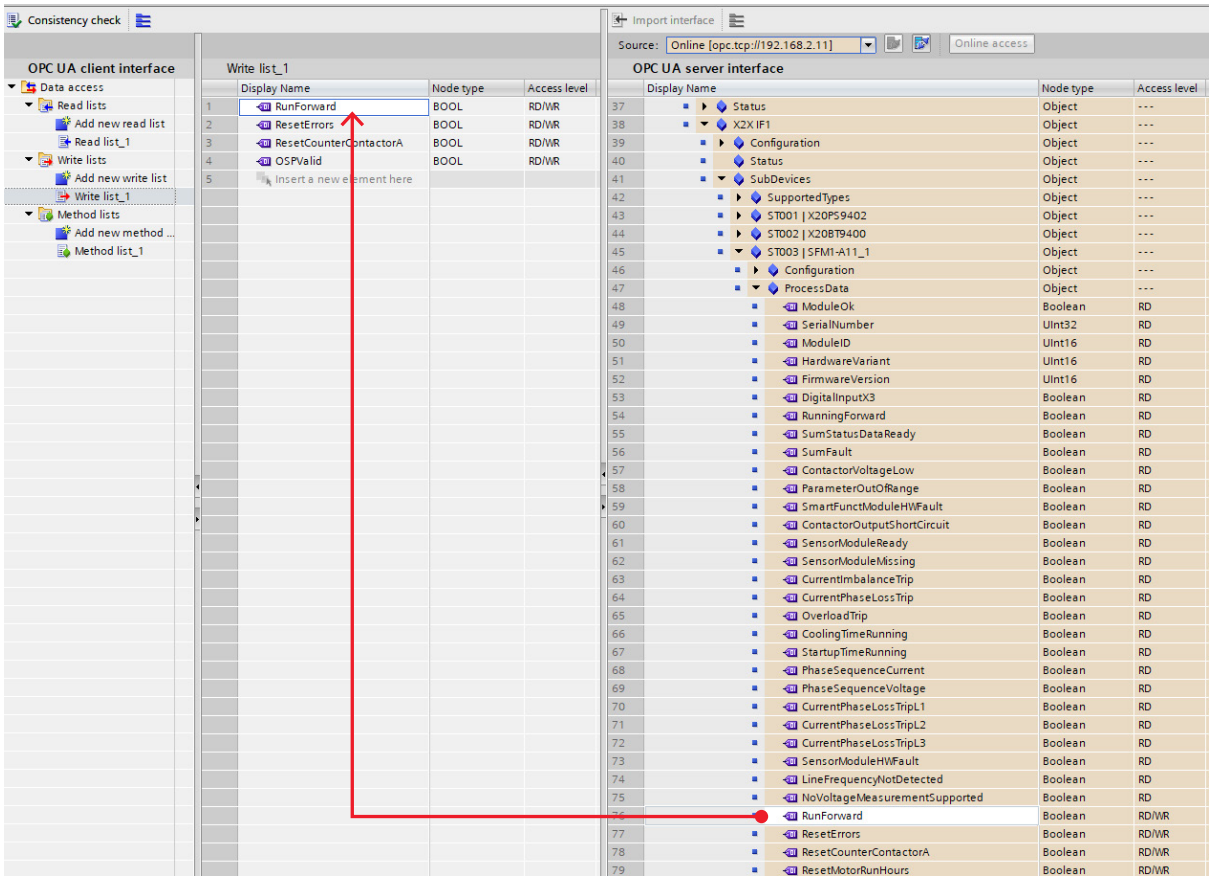


Figure 16: Write_list

- Add a new write-list
- Select the variables you want to write and drag and drop the variables those you want to the left side into the write-list
- Compile the software

Note: It is possible to add multiple write lists.

In this example we will use the next variables:

- ProcessData >> RunForward
- ProcessData >> ResetErrors
- ProcessData >> ResetCounterContactorA
- ProcessData >> OSPValid

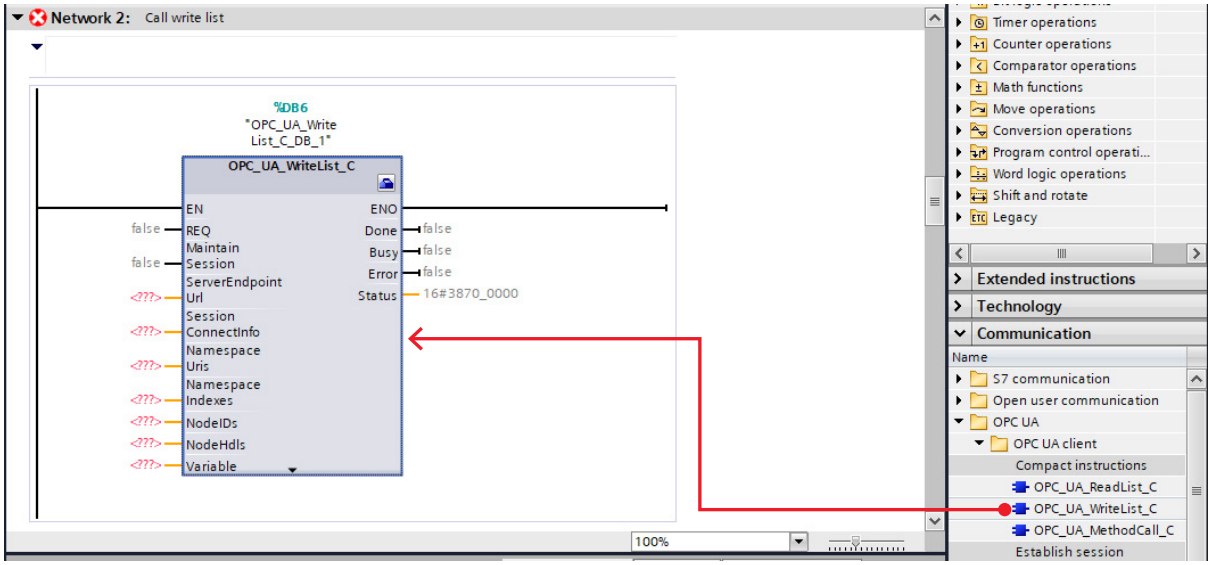


Figure 17: OB1_writelist

- Drag and drop the OPC_UA_WriteList_C in OB1

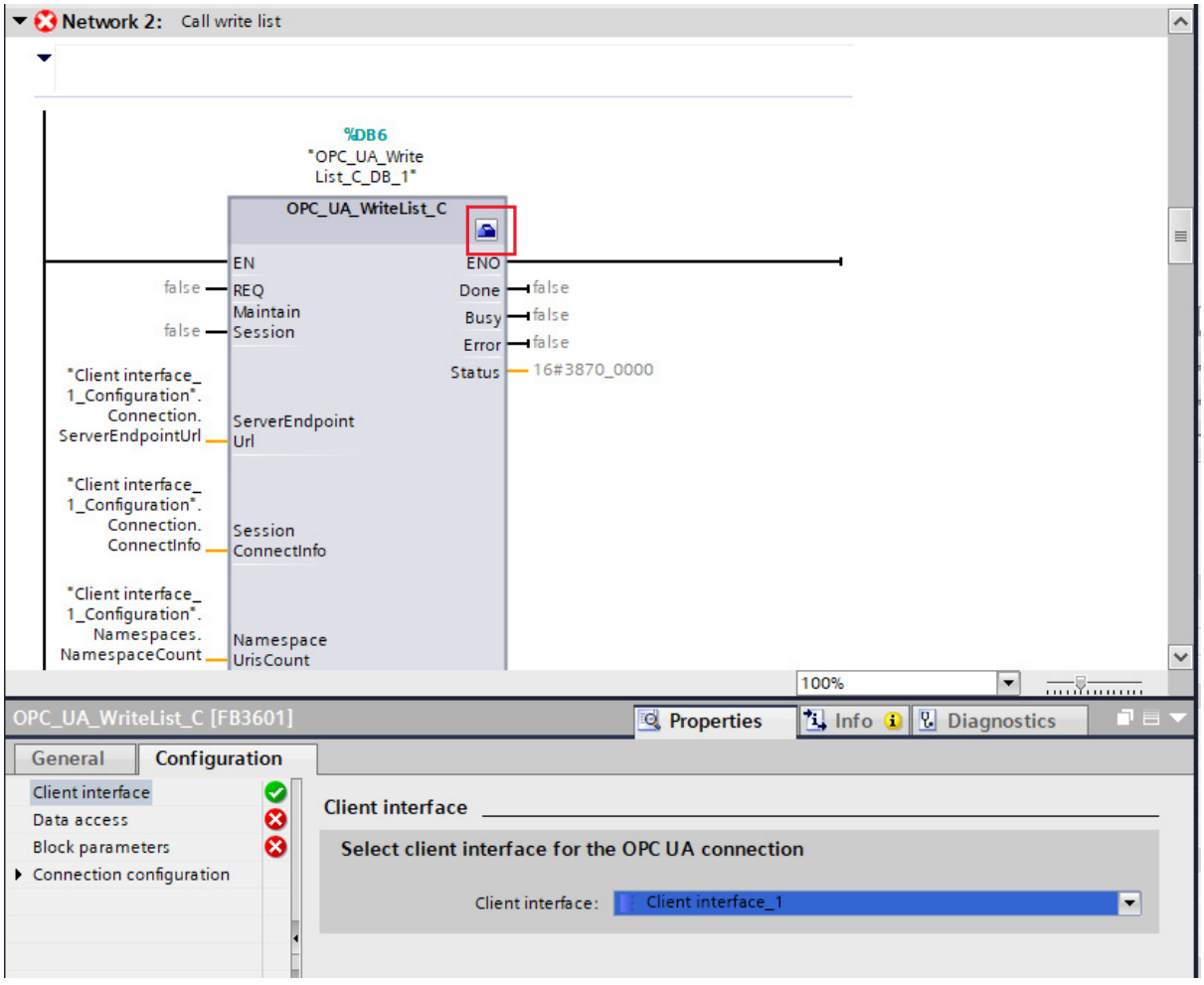


Figure 18: OB1_writelist_ClientInterface

- Click on the toolbox icon in the upper right corner of the OPC_UA_WriteList_C block

The configuration of the OPC_UA_WriteList_C block will be shown below.

- Select the client interface that was made before

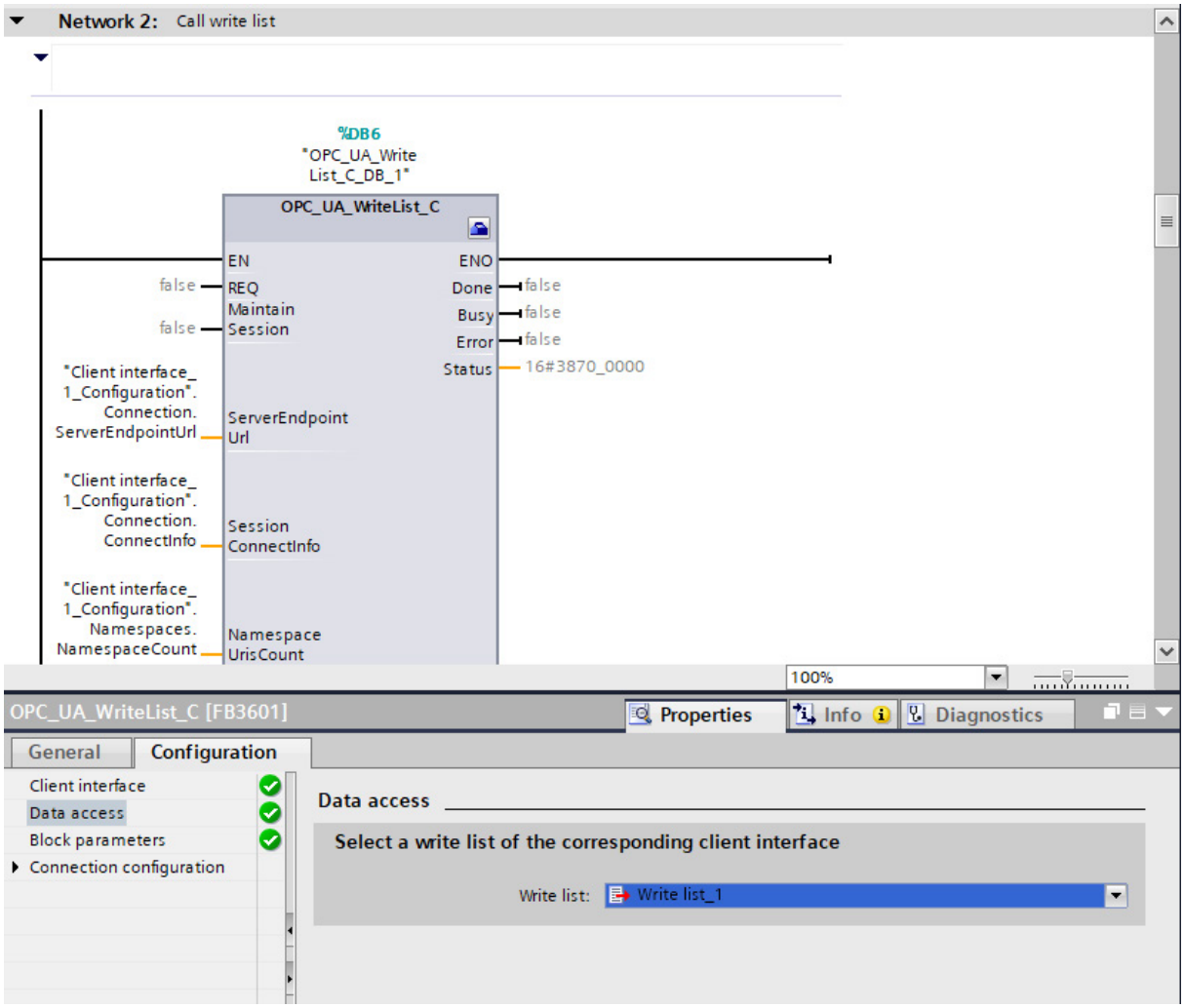


Figure 19: OB1_Writelist_DataAcces

- Select the write-list that was made before.
- The rest of the parameters will be set automatically by Siemens.

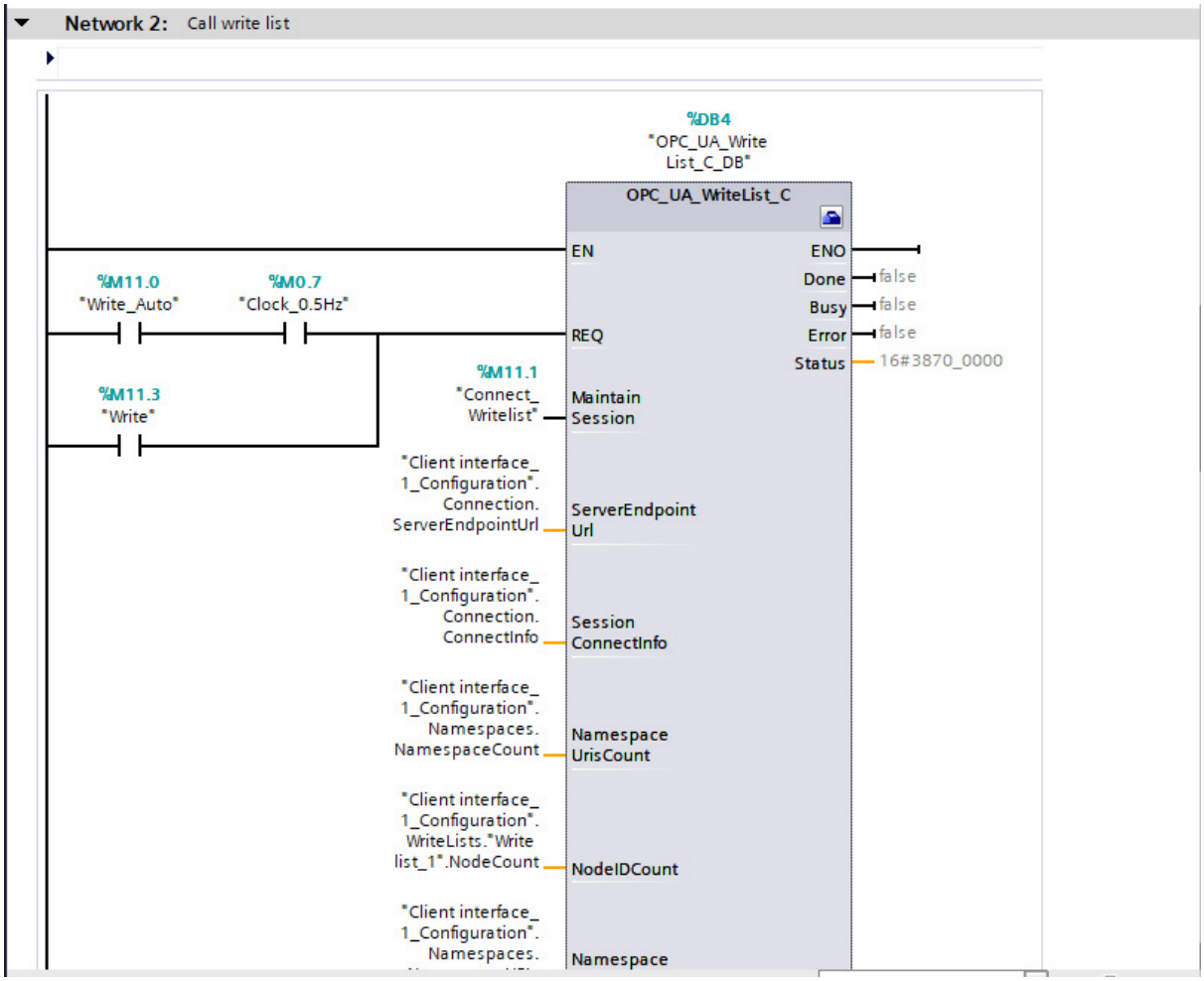


Figure 20: OB1_writelist_Merkers

- Add a tag to the Request input (REQ). On every positive edge it will make connection with the server and the variables will write to the server

Add a tag to the Maintain session.

- Compile the project with a rebuild all for hardware and software
- Download “hardware configuration”
- Download “Software all”

Note:
The maintain session keep the connection between server and client. It is not necessary to put this on true, but it will take less time to reconnect every time there is a positive edge on the REQ
When an error occurs it’s up to the user to disable the maintain and re-enable it to reconnect to the server.

4.5.2. Check write list

For writing the data in the server:

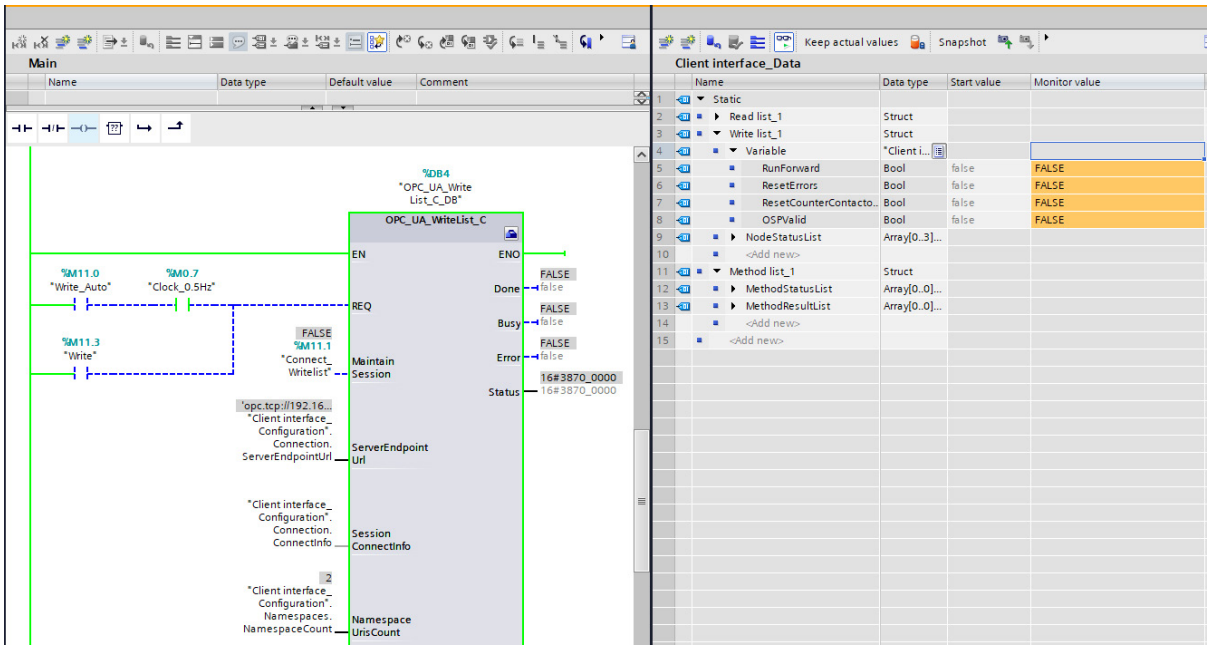


Figure 21: Online_setup_Writing

- Open “OB1” and “Client_Interface_Data” and put the screens next to each other
- Open the menu Writelist_1 >> Variable
- Monitor both screens.

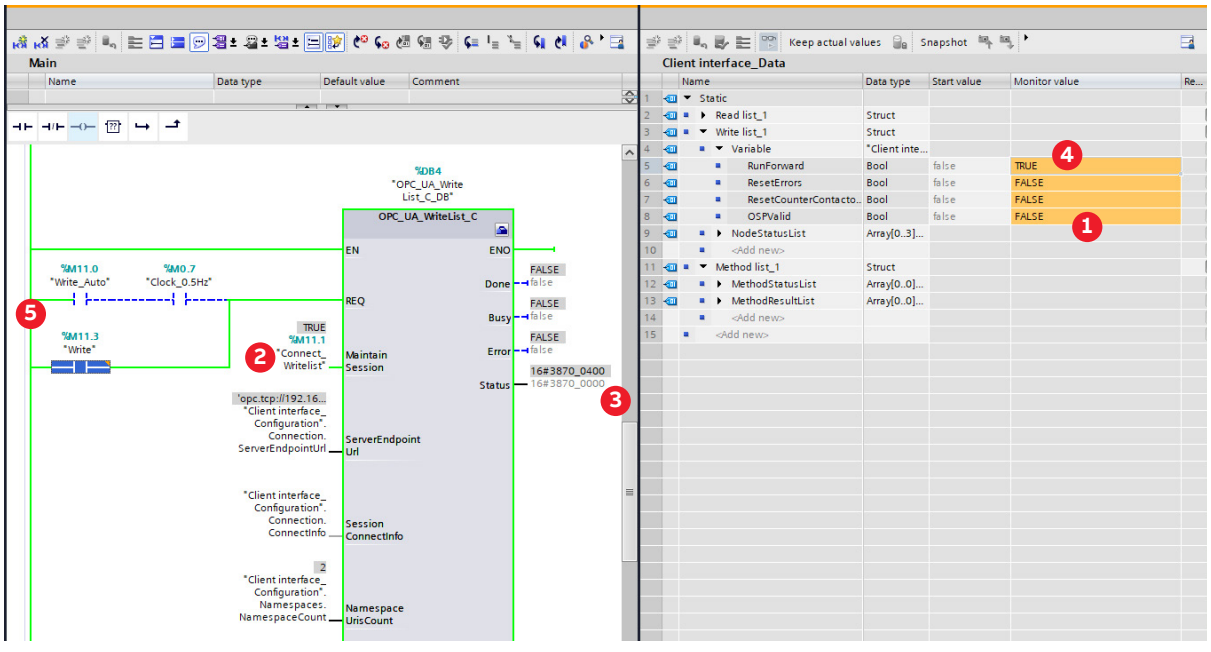


Figure 22: Online_Connect_Writing

- Check if “OSPValid” is True in the read variable else put the “OSPValid” variable on TRUE in the write list 1
- Connect to the server by set the tag “Connect_Writelist (Maintain Session)” on TRUE 2
- Check the status variable in OB1. The status should be return 16#3870_0400 3
- Change a value in the “Client_Interface_Data” screen, for example “RunForward” on TRUE 4
- Write the values by setting the tag “Write”or “Write_auto” on TRUE. On Every positive edge of the REQ-signal the data will be written to the server 5
- Check if the contactor makes a click sound

4.6. The method list

4.6.1. Program method list

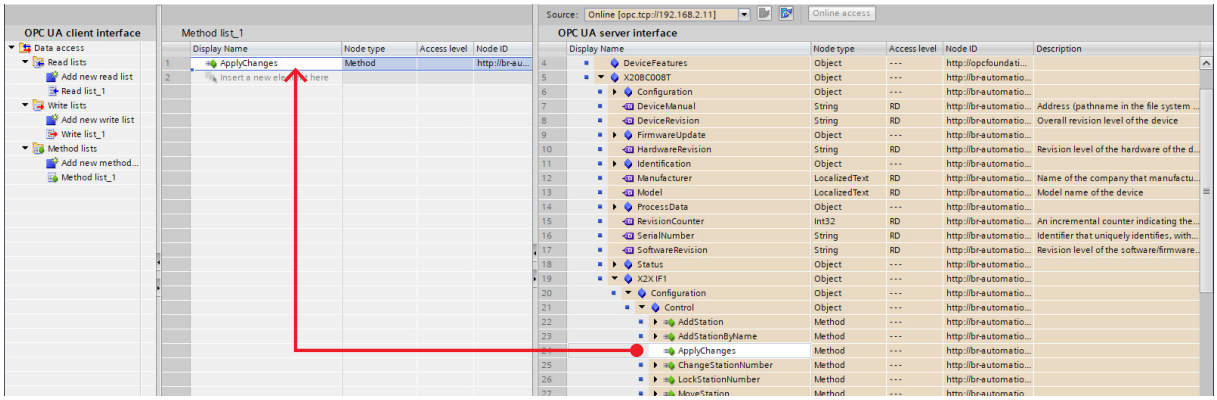


Figure 23: Method_list

- Add a new Method-list
- Select ApplyChanges and drag and drop the variable to the left side into the Method-list
- Compile the software

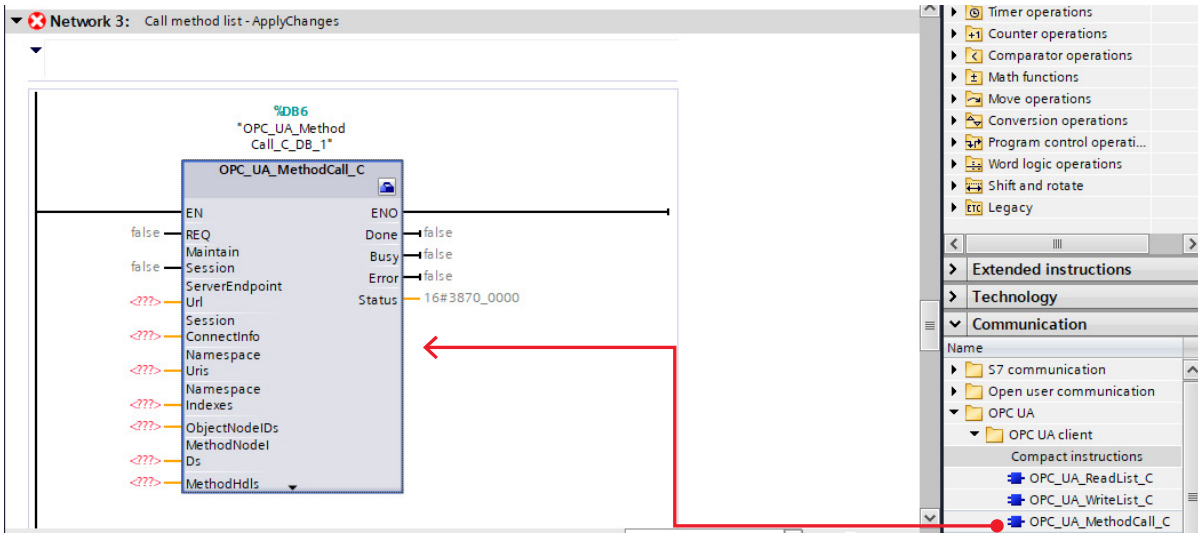


Figure 24: OB1_Methodlist

- Drag and drop the OPC_UA_MethodCall_C in OB1

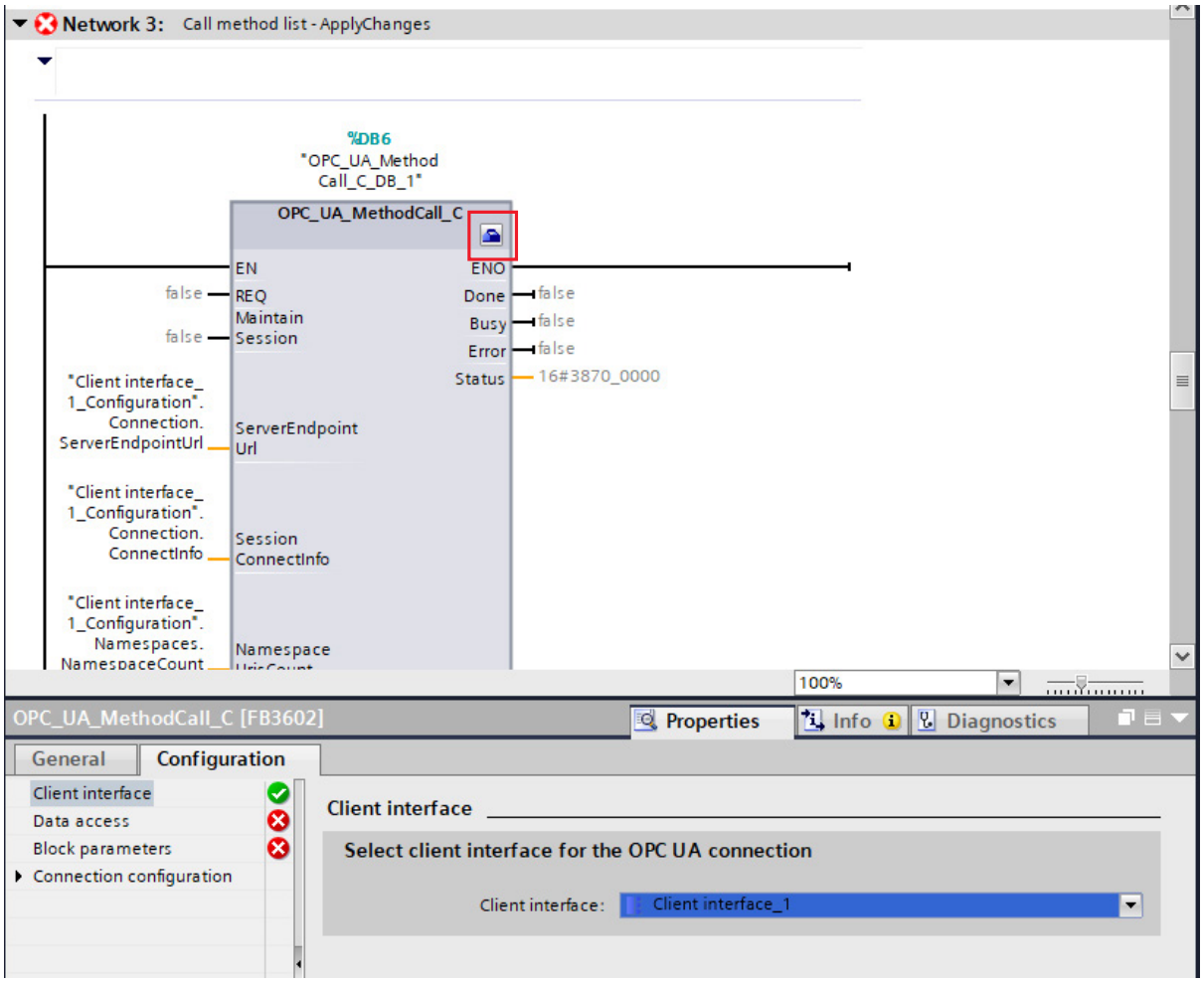
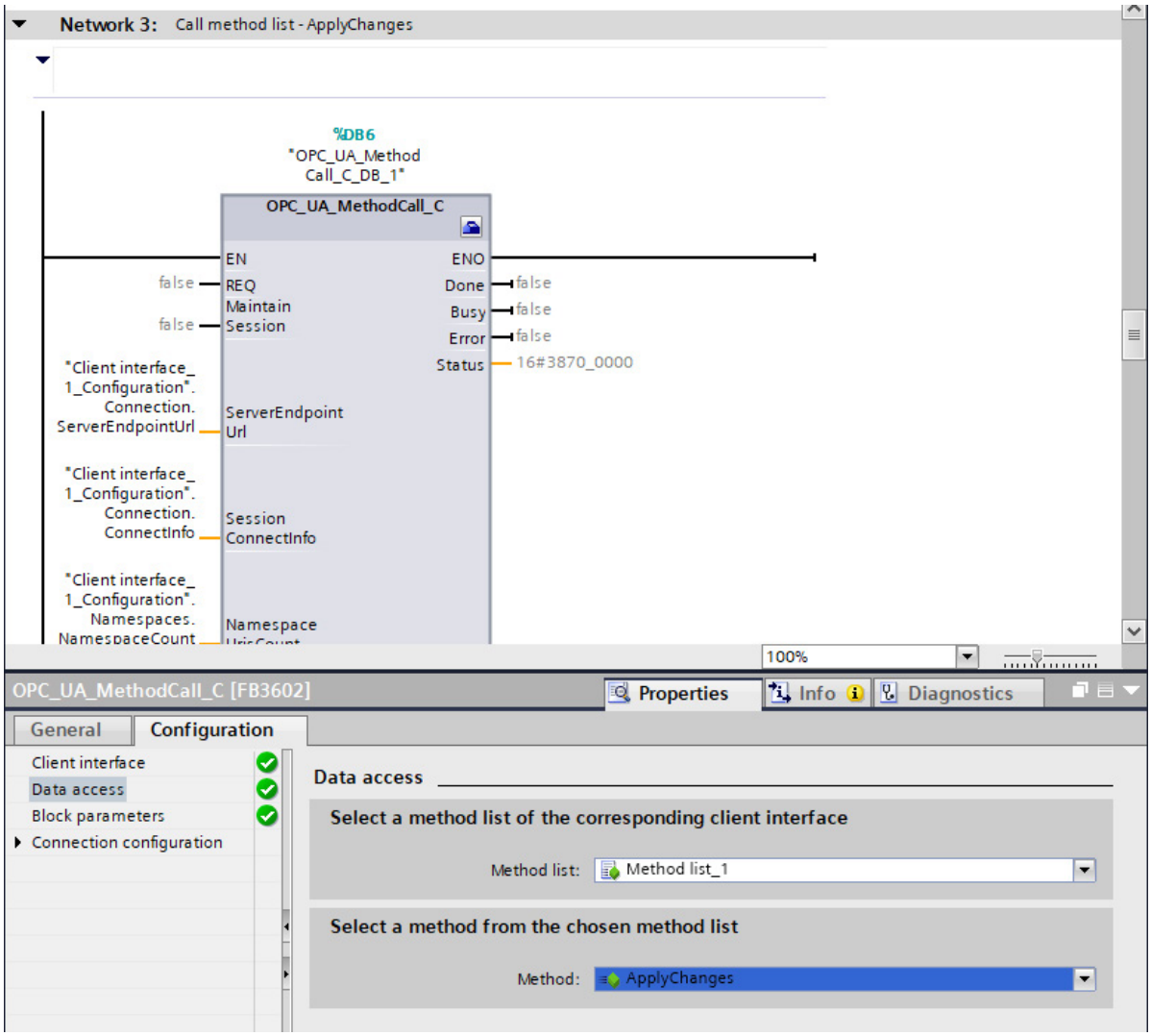


Figure 25: OB1_Methodlist_ClientInterface

- Click on the toolbox icon in the upper right corner of the OPC_UA_MethodCall_C block

The configuration of the OPC_UA_MethodCall_C block will be shown below.

- Select the client interface that was made before



—
Figure 26: OB1_Methodelist_DataAcces_AC

- Select the Method-list that was made before
- Select the method “ApplyChanges”
- The rest of the parameters will be set automatically by Siemens

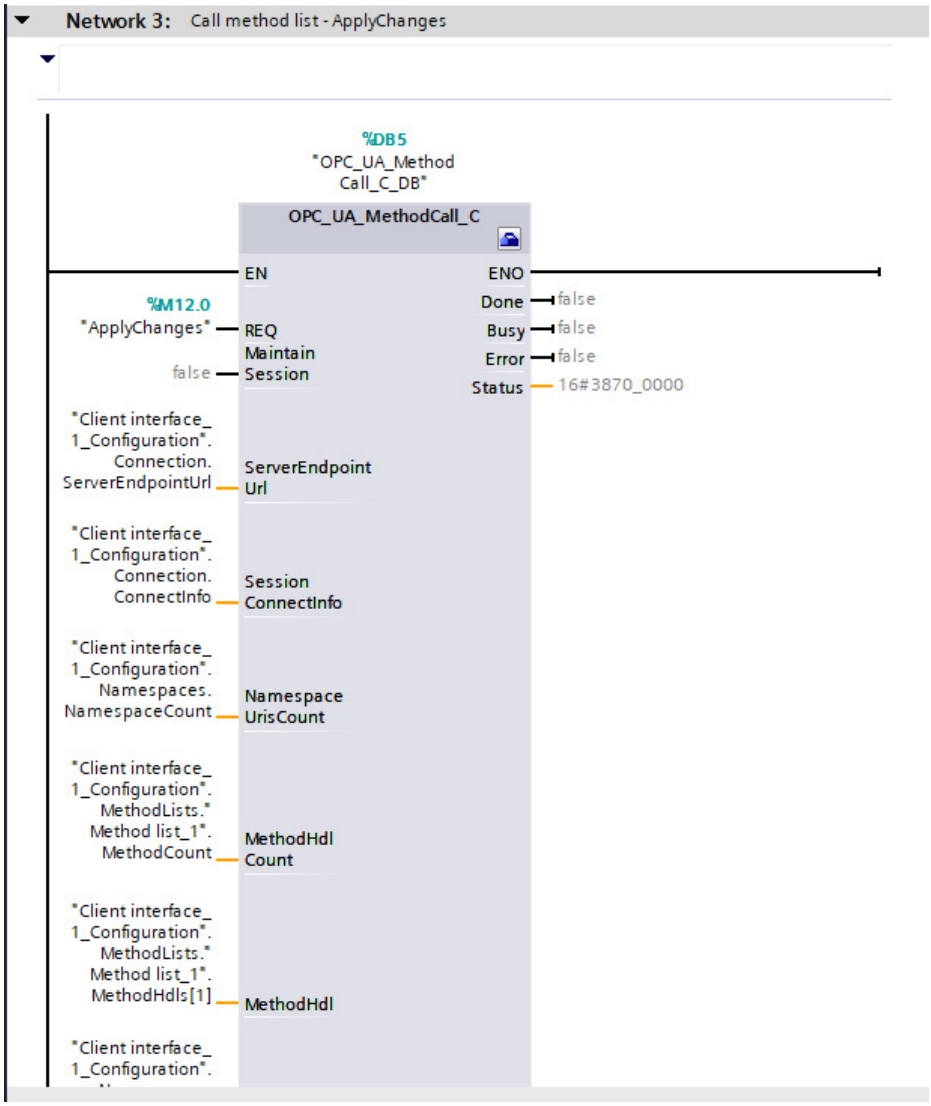


Figure 27: OB1_Methodlist_Merkers_AC

- Add a tag to the Request input (REQ). Every positive edge it will make connection with the server and apply the changes to the server
- Compile the project with a rebuild all for hardware and software
- Download “hardware configuration”
- Download “Software all”

4.7. Set parameters

To adjust the parameter value you must use the method-list.

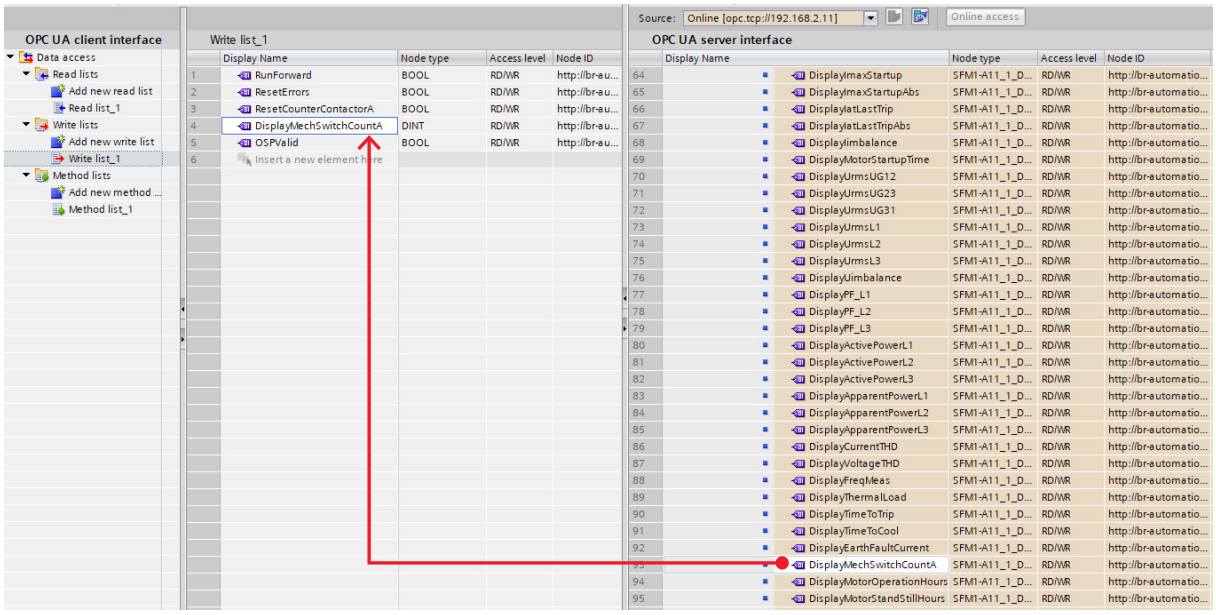


Figure 28:Online_Set_Parameter_Writelist

- Drag and drop the parameter in the write list
- Compile the software

In this example we want to know how many time the contactor switched.
To be able to do this, we have to perform the following steps:

- Set the parameter “DisplayMechSwitchCountA” to TRUE
- Write the parameter to the server
- Use the Method “Apply Changes”
- Read the variable in the readlist
- ParameterSet >> DisplayMechSwitchCountA

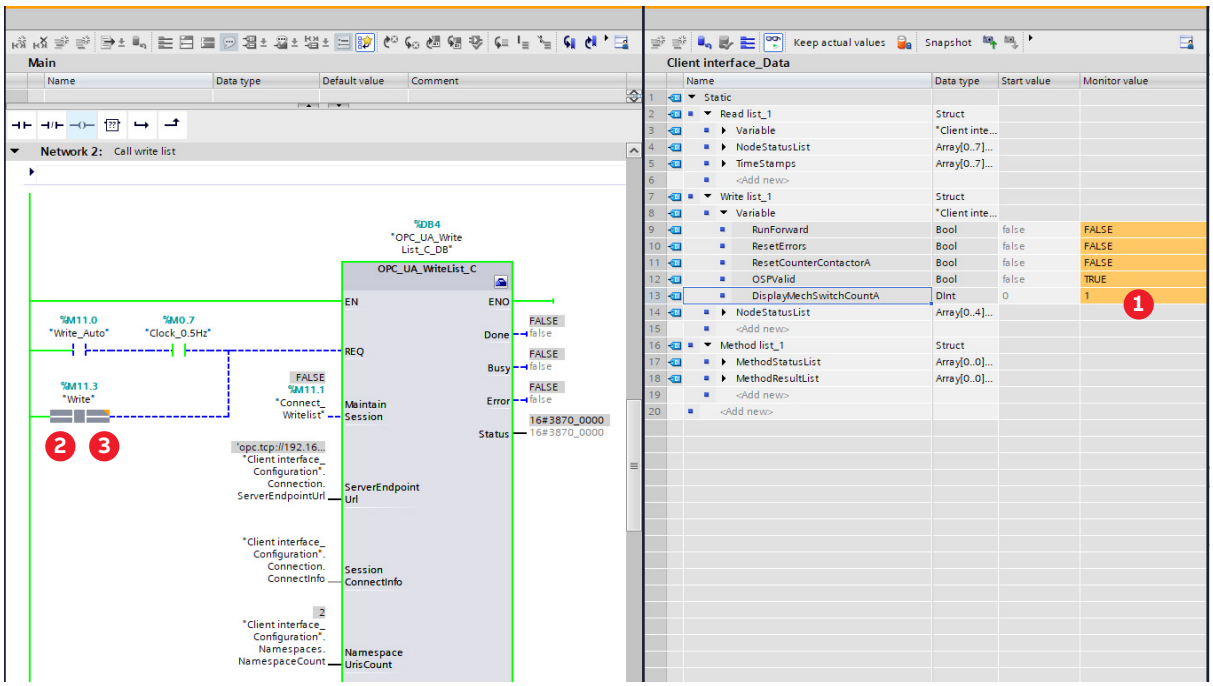


Figure 29: Online_Set_Parameter_Set

- Open “OB1” and “Client_Interface_Data” and put the screens next to each other
- Open the menu Writelist_1 >> Variable
- Monitor both screens
- Set “DisplayMechSwitchCountA” op 1 (1)
- Activate the write tag (2)
- Deactivate the write tag (3)

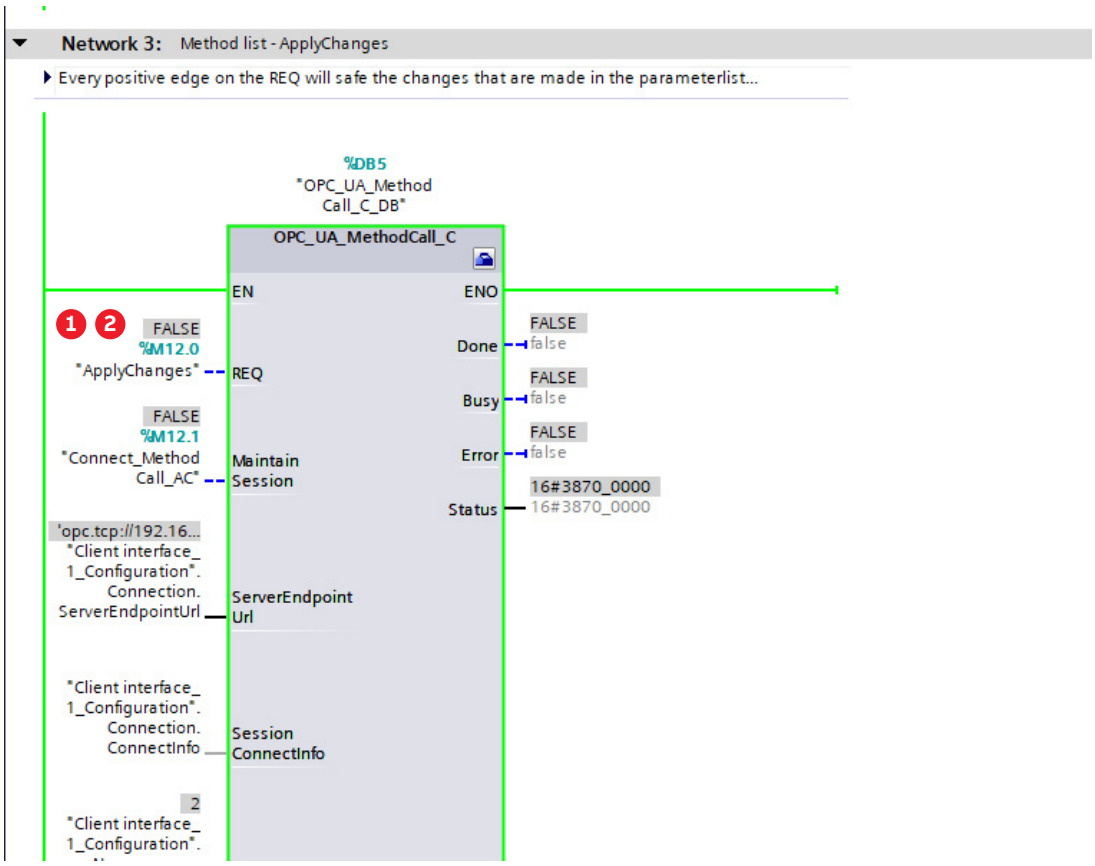


Figure 30: Online_Set_Parameter_ApplyChanges

- Activate the ApplyChanges (REQ) (1)
- Deactivate the Applychanges (REQ) (2)

After disconnecting and connect the server again, the variable should be available in the processData of the client interface.

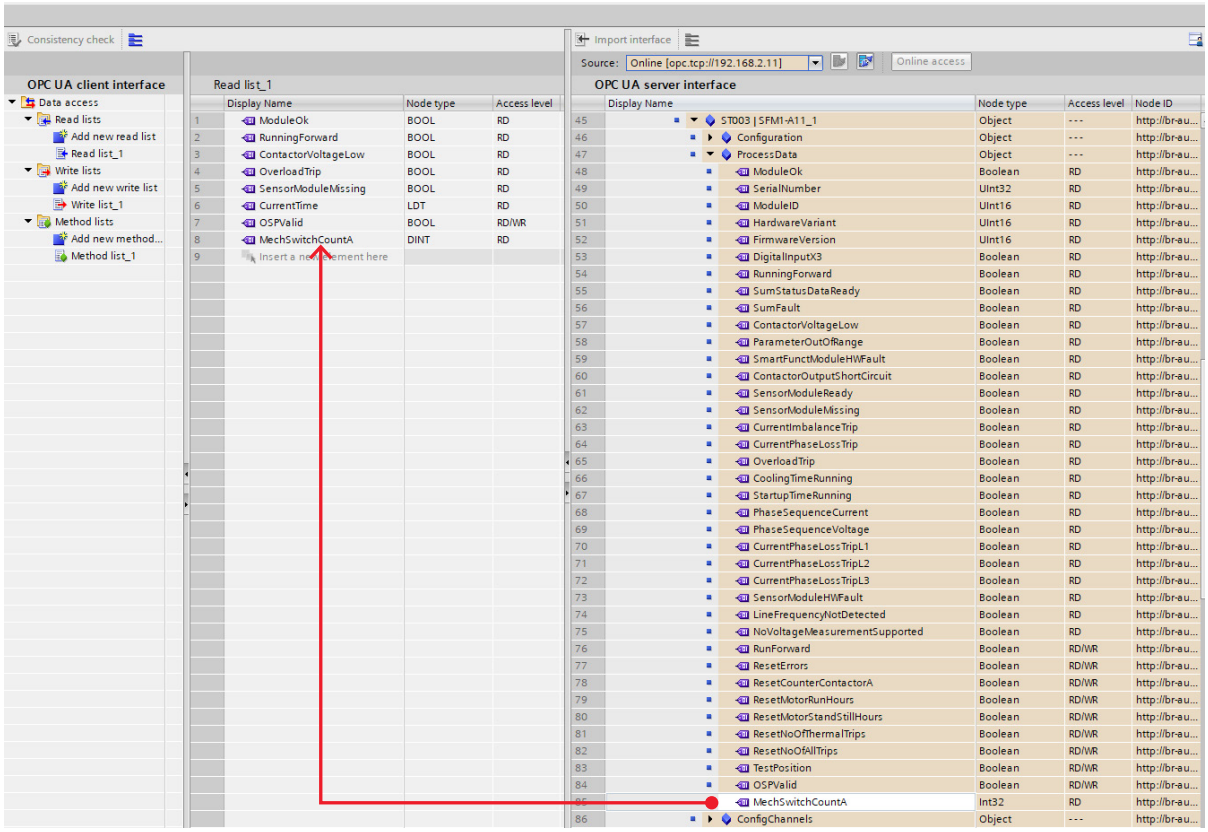


Figure 31: Online_Set_Parameter_Result

Example:

- ProcessData >> MechSwitchCountA

5. Configuring Novolink with Smart Gateway

Please use following documents to configure Novolink with Smart Gateway

Document type	Document number	Link
SFM1 Manual	2CDC100017M0201	link
User manual for Novolink	1SAC200230M0001	link

6. Troubleshooting

6.1. No OPC UA Sever application Found

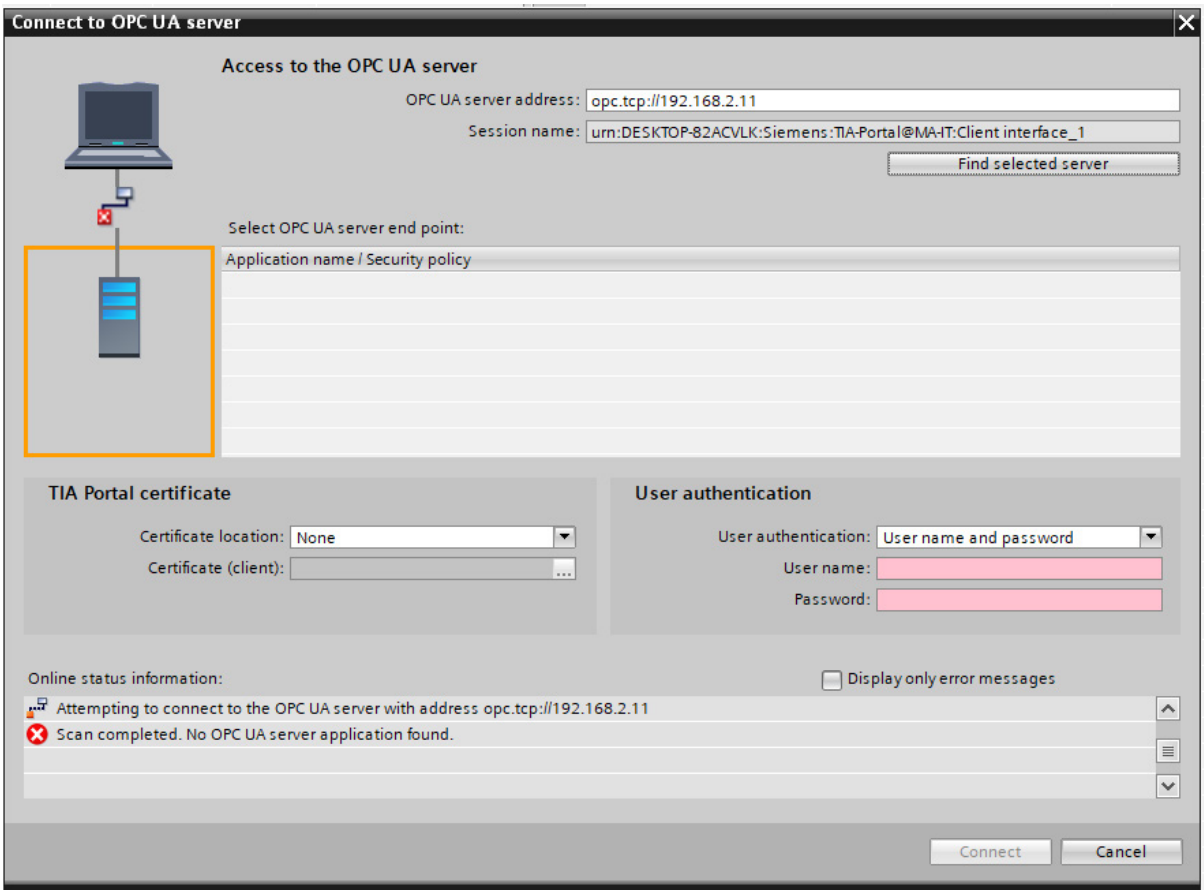


Figure 32: PopUp No_Online Access

- Verify TIA Portal is able to reach the smart-gateway
- Check the IP-address of the server
- Check the IP-address of your Client (TIA Portal)
- Check that you can reach the server using ping
- Reboot the server

6.2. Status 16#3870_0600

Activate the connection and the status is 3870_0600 check the next part:

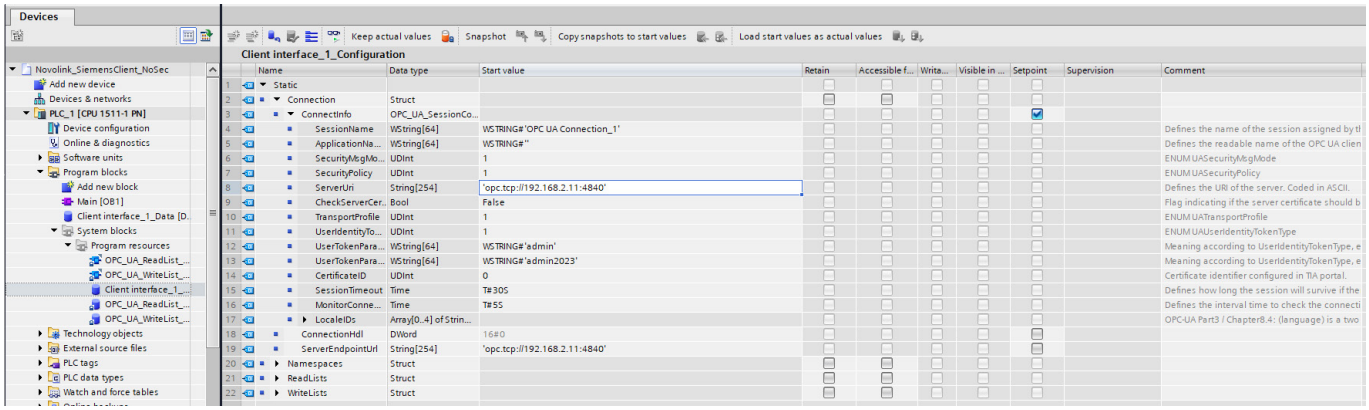


Figure 33: ClientInterface_Configuration

- Open the Client interface configuration data block
- Check if the ServerEndpointUrl" and "ServerUri" start values are the same
  - If this is not?

  Copy the "ServerEndpointUrl" to "ServerUri"
- Compile the project with a rebuild all for hardware and software
- Download "hardware configuration"
- Download "Software all"

7. List of related documents/links

Document type	Document number	Link
SFM1 Manual	2CDC100017M0201	link
User manual for Novolink	1SAC200230M0001	link
Siemens Licenses		link
Siemens PLCs		link

—
ABB STOTZ-KONTAKT GmbH
Eppelheimer Strasse 82
69123 Heidelberg, Germany

You can find the address of your local sales organization on the ABB homepage

abb.com/lowvoltage

Additional information
We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB AG does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

Document number 1SAC200372W0001 - Rev. A (02/2024)

APPLICATION GUIDE

Novolink with ABB AC500 PLC

Users' manual for connecting Smart Gateway SGWX20-OUA to AC500 PLC using Automation Builder

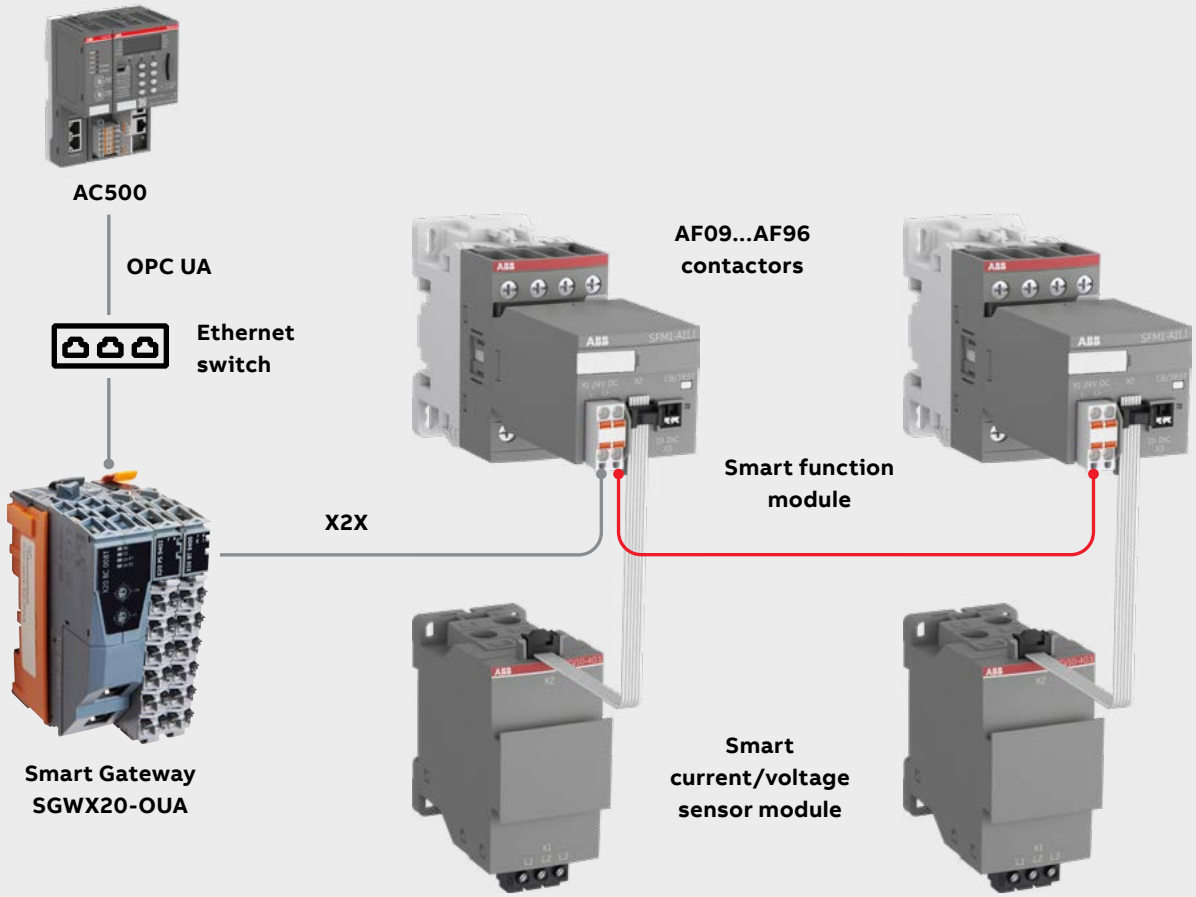


Table of contents

1. Purpose and basic description

This section describes the basic steps to set up the ABB Novolink modules with the AC500 PLC via Smart Gateway using OPC UA.

1.1. What is Novolink?

The all-new ABB Novolink™ devices help digitalize motor starting solutions and gain insights into the connected loads. They're easy to design into existing wiring plans and connect to standard AF contactors. Installation is fast and simple, thanks to reduced wiring and fewer components, so engineering efforts are minimized. The Novolink devices enables predic-tive maintenance to reduce downtime, as well as increasing efficiencies and boosting cost savings. It's fully integrated into the AC500 and B&R automation system. And the possibilities open up even more as full remote access to your data creates new maintenance service and revenue opportunities.

2. Important disclaimers & recommendations

2.1. Cyber security legal disclaimer

The Smart Gateway and Novolink modules are designed to be connected in the ABB and 3rd party products and communicate information data via network interface. It is the user's sole responsibility to provide and continuously ensure a secure connection between the product and the user's network or any other. The user shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system, and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information. The data, examples and diagrams in this manual are included solely for the concept or product description and are not to be deemed as a statement of guaranteed properties. All people responsible for applying the equipment addressed in this manual must satisfy themselves that each intended application is suitable and acceptable, including that any applicable safety or other operational requirements are complied with. Any risks in applications where a system failure and/or product failure would create a risk for harm to property or persons (including but not limited to personal injuries or death) shall be the sole responsibility of the person or entity applying the equipment, and those so responsible are hereby requested to ensure that all measures are taken to exclude or mitigate such risks. This document has been carefully checked by ABB, but deviations cannot be completely ruled out. In case any errors are detected, the reader is kindly requested to notify the manufacturer. Other than under explicit contractual commitments, in no event shall ABB be responsible or liable for any loss or damage resulting from the use of this manual or the application of the equipment.

2.2. UaExpert

UaExpert is software, provided by Unified Automation. We suggest using this software for monitoring the data as described in chapter "UaExpert".
Important: This software does not belong to ABB, and we done take any responsibility on its functionality.

2.3. Making your networks more secure

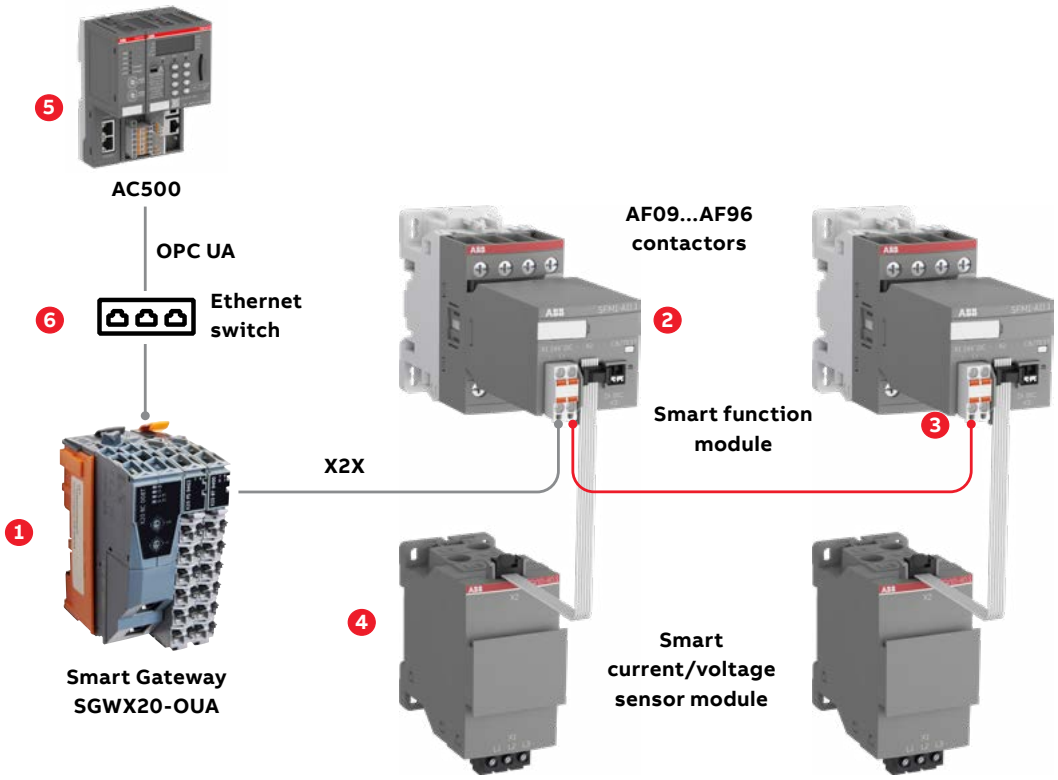
Following points are strongly recommended to make networks more secure:

- **Isolate your network** – separate the OT network (Operation Technology) from the IT network (Information Technology). This helps prevent any attack reaching the IT network from spreading to the OT network.
- **Use firewalls** – Implement firewalls to prevent unauthorized access to the OT network.
- **Use access control** – Implement access controls to restrict the human and device access to the OT/IT network and devices.
- **Keep software up to date** – Make sure all software/firmware of the devices are up to date to have the latest security updates installed.
- **Reduce attack surface on devices** – Disable device functions, services and ports not needed.
- **Replace default passwords** – Replace all default passwords of the devices to prevent attacker from getting access using default credentials.
- **Monitor network activity** – Monitor the OT network for any malicious activities that could be a sign of an attack. Example of network monitoring tool is intrusion detection system (IDS).
- **Train employees** – Train operators and service people on IT and OT security best practices.

3. Basic setup

This section describes basic steps required to set up the Smart Gateway SGWX20-OUA with Smart function module (SFM) and Smart current/Voltage modules (SCM/SVM) connected to AC500 PLC over OPC UA.

The setup can be done as shown in the figure below:



The figure shows that:

- Smart Gateway SGWX20-OUA (1) is connected to AC500 PLC(5) via ethernet switch (6).
- SFM (3) should be inserted on AF contactors (3).
- SFM are connected to SCV (4) over X2X cable.
- All the SFMs are connected to Smart Gateway SGWX20-OUA (1) over X2X cable.

Note: Smart Gateway SGWX20-OUA can be a OPC UA server.

The figure below shows the main components and how they can be combined for complete motor starting solutions.

3.1. Hardware used

Following hardware are used.

	Device	Description	Part number	Quantity
OPC UA Client	PM5670-2ETH or PM5650-2ETH	2 x Ethernet with configurable protocol Ethernet/IP (2), 1 x serial, 1x CAN interface	1SAP151000R0278 or 1SAP141000R0278	1
	TA521	Lithium battery	1SAP180300R0001	1
Novolink	SFM-CAB-RJTB.1-500	Connection cable RJ45 - X20 Terminal block of X20BT9400, 5 m	1SVM823000R0500	1
Novolink	SFM-CAB-S.1-50	Connection cable SFM to sensor 0.5 m	1SVM811000R0050	1
Novolink	SCV10-40.1	Current/Voltage sensor	1SVM320010R0000	1
Novolink	SFM1-A11.1	Advanced function module with X2X	1SVM120012R0000	2
Contactor	AF09	Contactors	1SBL137001R1101 AF09-30-01-11	2
X2X OPC UA Gateway	X2X OPC UA Gateway	B&R controller	X20BT08T	1
X2X OPC UA Gateway	OPC UA bus coupler	B&R controller	X20BT08T	1
X2X OPC UA Gateway	Power supply for the bus coupler	B&R controller	X20PS9400	1
X2X OPC UA Gateway	Power supply and interface of the X2X bus	B&R controller	X20BT9400	1
X2X OPC UA Gateway	Backplane module	B&R controller	X20BB80X	1

Important: JSON files are provided as examples on how data can be retrieved from the devices.

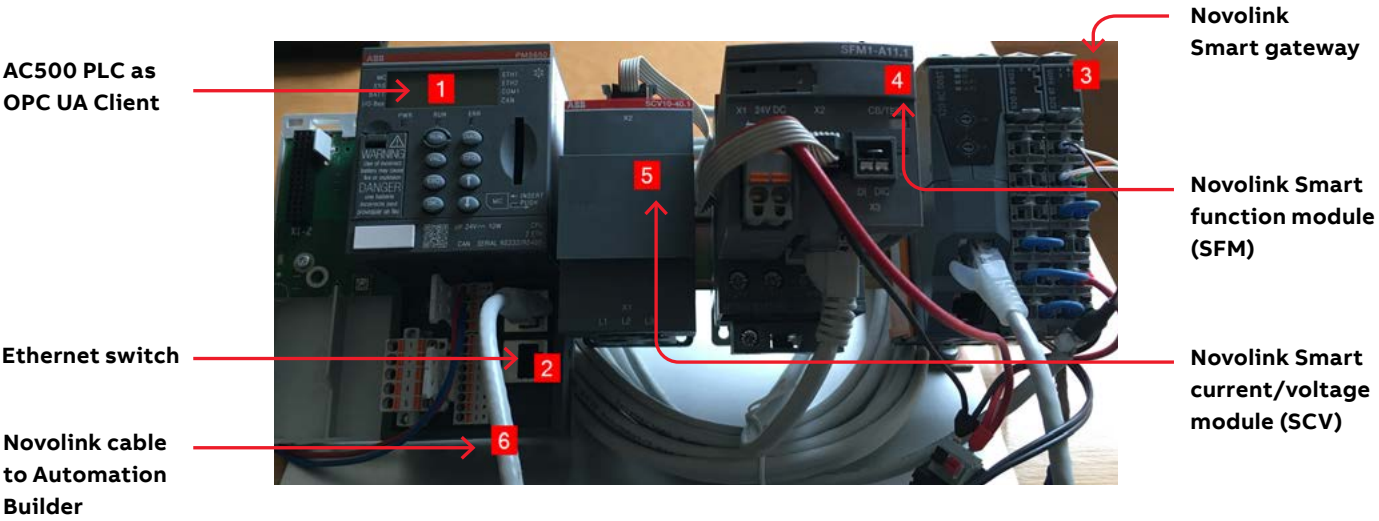
3.2. Software used

Following software are used.

- Automation Builder version 2.7 or newer (download link: https://new.abb.com/plc/automationbuilder/platform/software)
- SGWX20-OUA FW V2.00 or newer

3.3. Architecture used

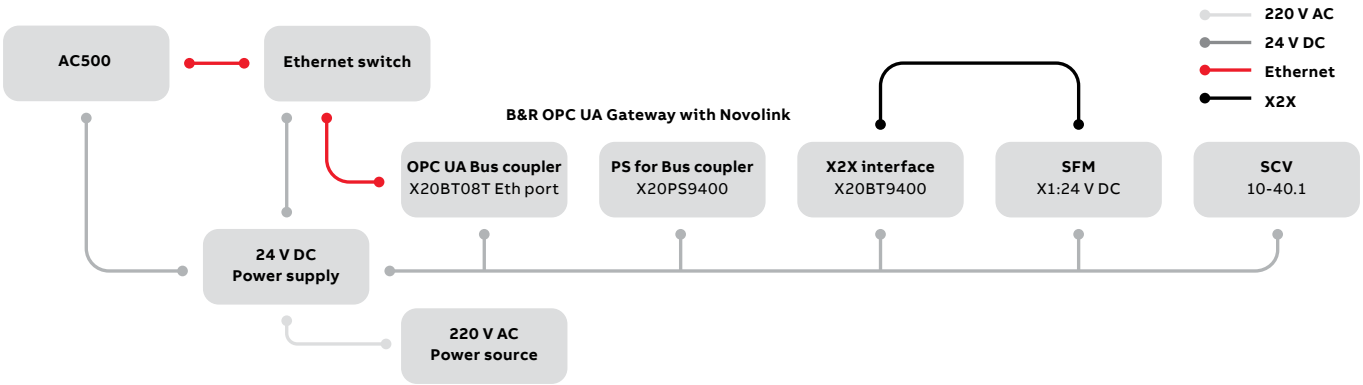
This section describes basic steps required to set up the Smart Gateway, Novolink modules with ABB AC500 PLC. .
The setup can be done as shown in the picture below:



Number	Description
1	AC500 PLC as OPC UA Client
2	Ethernet Switch
3	Novolink Smart gateway
4	Novolink Smart function module (SFM)
5	Novolink Smart current voltage module (SCV)
6	Network cable to Automation Builder

3.3.1. Wiring and power up

Refer to the architecture used, please ensure that all wiring is done, and devices are powered up using the schematic shown below.



24 V DC	24VDC is connected to the Smart Gateway, Novolink modules and PLCs.
220 V AC	220 VAC is required for power supply. 220 VAC can also be used for power up contactors
OPC UA	For OPC UA: Connect the Smart Gateway and AC500 PLC to the ethernet switch.
X2X	Connect Smart Gateway to SFM with cable “SFM-CAB-RJTB.1-500”. Use cable “SFM-CAB-S.1-50 “ to connect Sensors to the SFM

3.3.2. Software configuration

Configuration of AC500 PLC	Following software are used to configure the AC500 PLC: Automation builder V2.7 or newer
Configuration of Smart Gateway	UaExpert
Reading /writing data from Novolink via Smart Gateway	UaExpert

4. Basic configuration of the OPCUA Server Novolink

The bus controller is delivered with the factory settings. This means that neither device settings nor security settings are configured.

In the following example , the OPC UA “UaExpert” client software is used for configuration. Other similar tools can also be used.

The following minimum version should be used:

- UaExpert version 1.6 or later

Download here: https://www.unified-automation.com

This document assumes that you already have a basic knowledge of OPC UA in general and the X20BT08T bus coupler in particular.

Note: Please visit the data sheet of X20BC008T for the detailed steps.

4.1. Setting the network address

A DHCP server is not required for this method. The static IP address (in this example ‘192.168.1.1’) is suggested to be established for the connection.

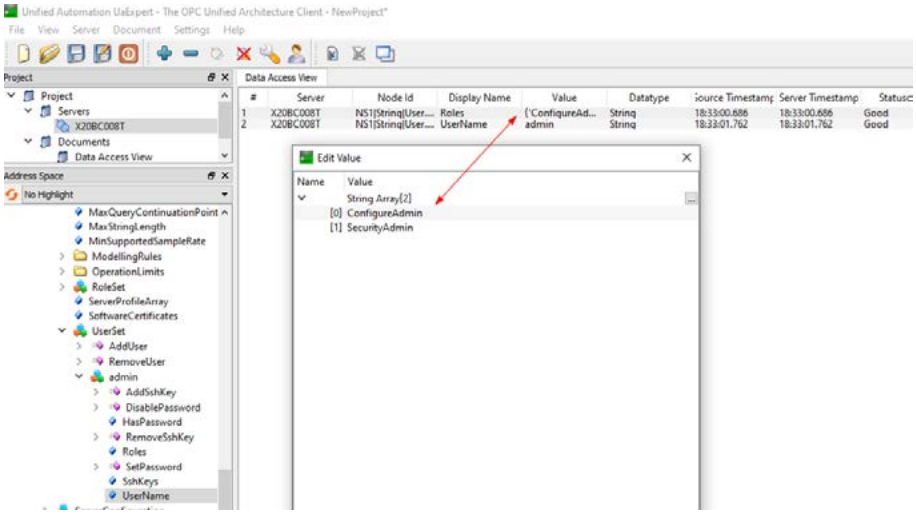
The following’Endpoint URL’can be used in UaExpert/AC500 to establish the connection

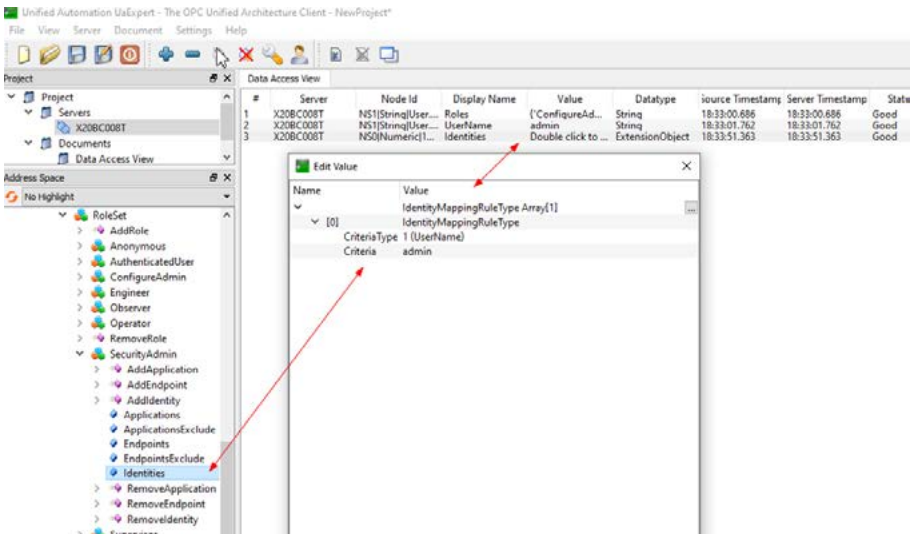
Opc.tcp://192.168.1.1:4840

Or opc.tcp://<Product ID>-<MAC address>:4840

4.2. Creating user accounts

Creating the first user, setting the password and assignment to role SecurityAdmin.



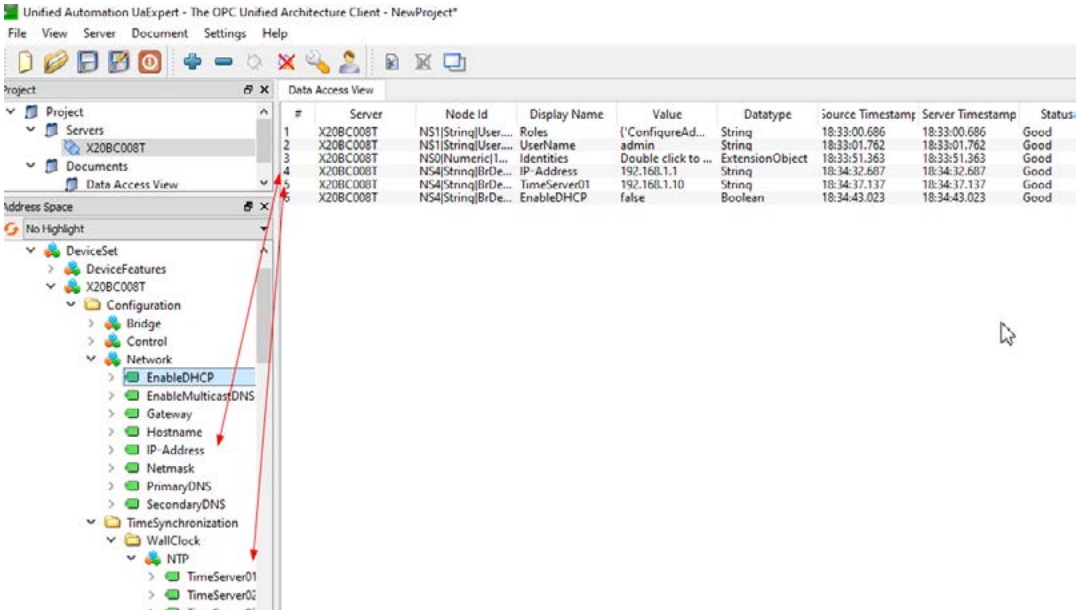


Note: A user must be created, otherwise, no further configuration can be performed.

4.3. Time Synchronization

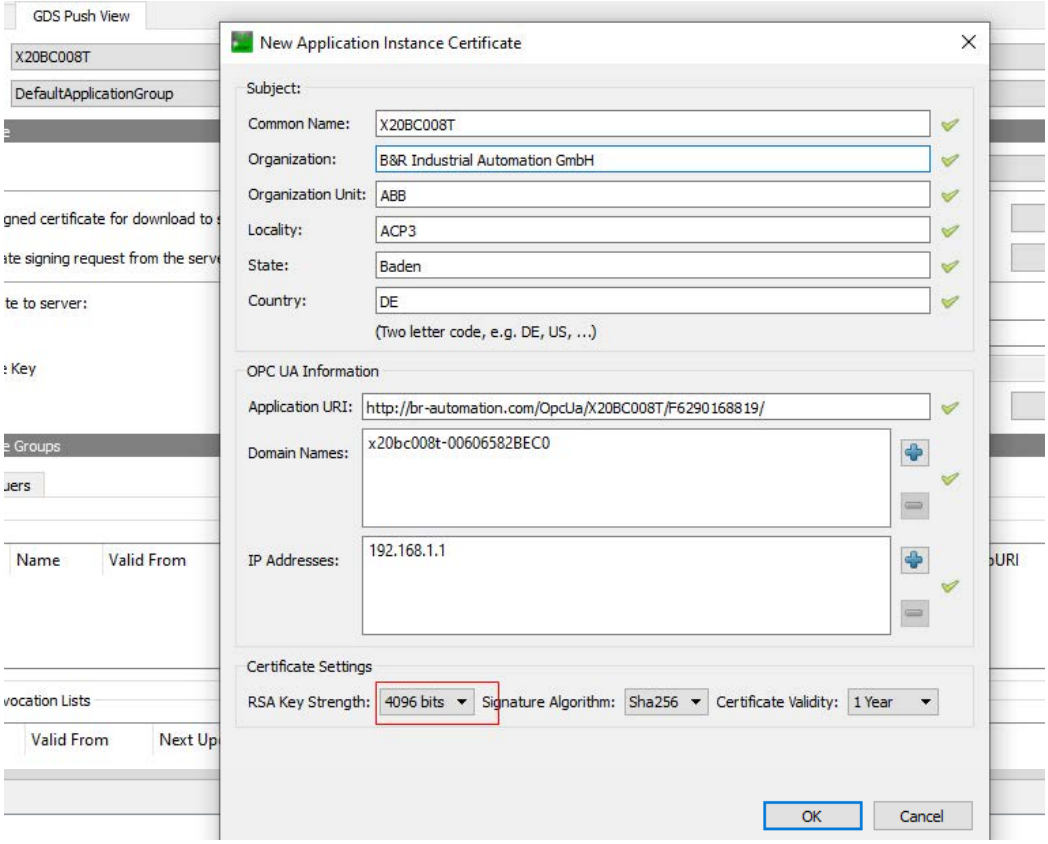
Information about the current time is required in order for the bus controller to operate. This is mainly needed to process digital certificates correctly and to correctly set the timestamps of OPC UA vales.

The following description shows how to configure „WallClock“ to enable synchronization over the Network Time Protocol (NTP). We are using ABB AC500 PLC as NTP server in this example (e.g. TimeServer01: ‘192.168.1.10’).



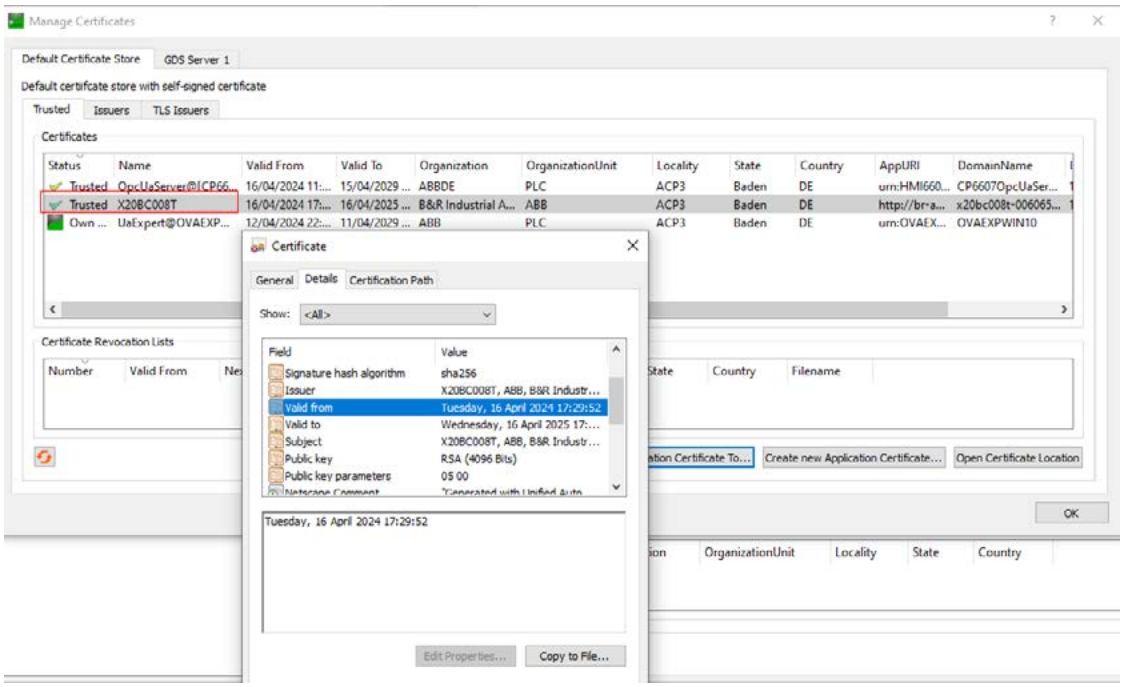
4.4. Updating the self-signed certificate using UaExpert

The bus controller has a method in the information model that can be used to easily generate a new self-signed certificate that contains necessary application-specific information. However, UaExpert contains tools(GDS Push View) that make it easier to update certificates.



Calling method ApplyChanges disconnects all connected clients. A new connection is only possible when the new certificate is trusted.

After that, please accept the new Server certificate in UaExpert and save the certificate file on your PC.



5. AC500 OPC UA Client

The standard installation of Automation Builder not only includes an OPC UA server but also for OPC UA Client. You can use it to access the variable interface of the AC500 PLC via a client. The OPC UA server communicates with connected OPC UA clients over a separate TCP connection. The AC500 OPC UA Client can be used to connect to any OPC UA servers and exchange data with them, in which the connection can be established via a data source OPC UA Client of AC500.

5.1. Preparation and supplies

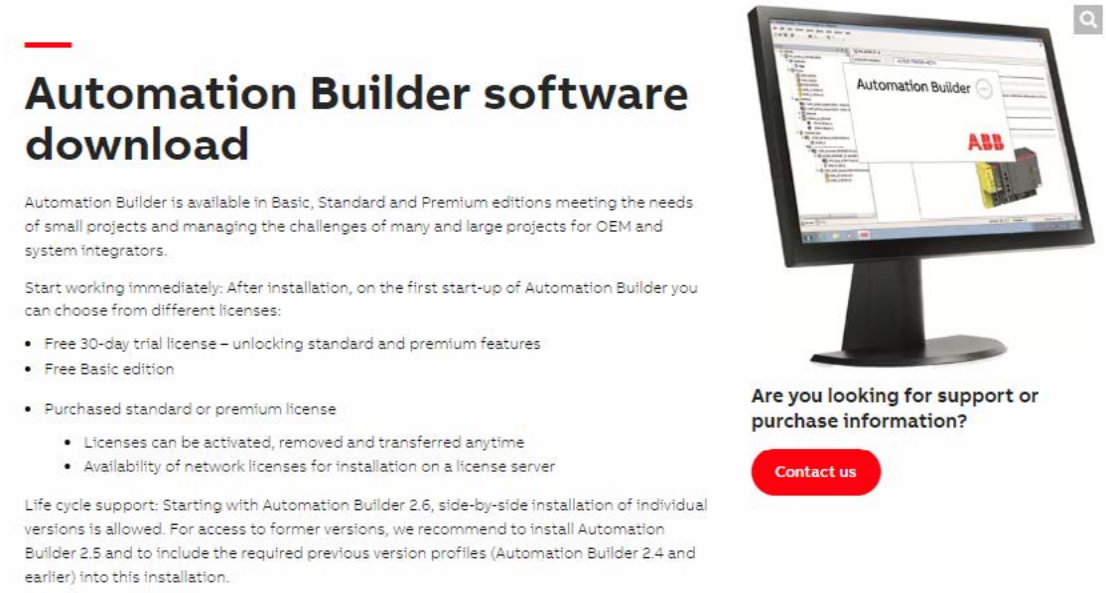
In this section will describe what you need to make the configuration in Automation Builder.

a. An OPC UA Server Novolink is available,please see the above chapter 4 . For the description of the Novolink setup which is included in the manual “SGWX20-OUA Smart Gateway X20 to OPC UA Connecting Novolink devices with OPC UA clients.”
b. AC500 PLC - PM5670-2ETH or PM5650-2ETH.
c. Automation builder V2.7 or newer
d. PS5616-UACli - AC500 V3 OPC UA Client Runtime License
e. Battery TA521 is installed.
f. The modules are wired to each other.
g. IP-address of the OPC UA server (example: 192.168.1.1)

This example uses AC500 CPU PM5650-2ETH as OPCUA Client to communicate with an OPC UA Server Novolink.

5.2. Installation Automation Builder

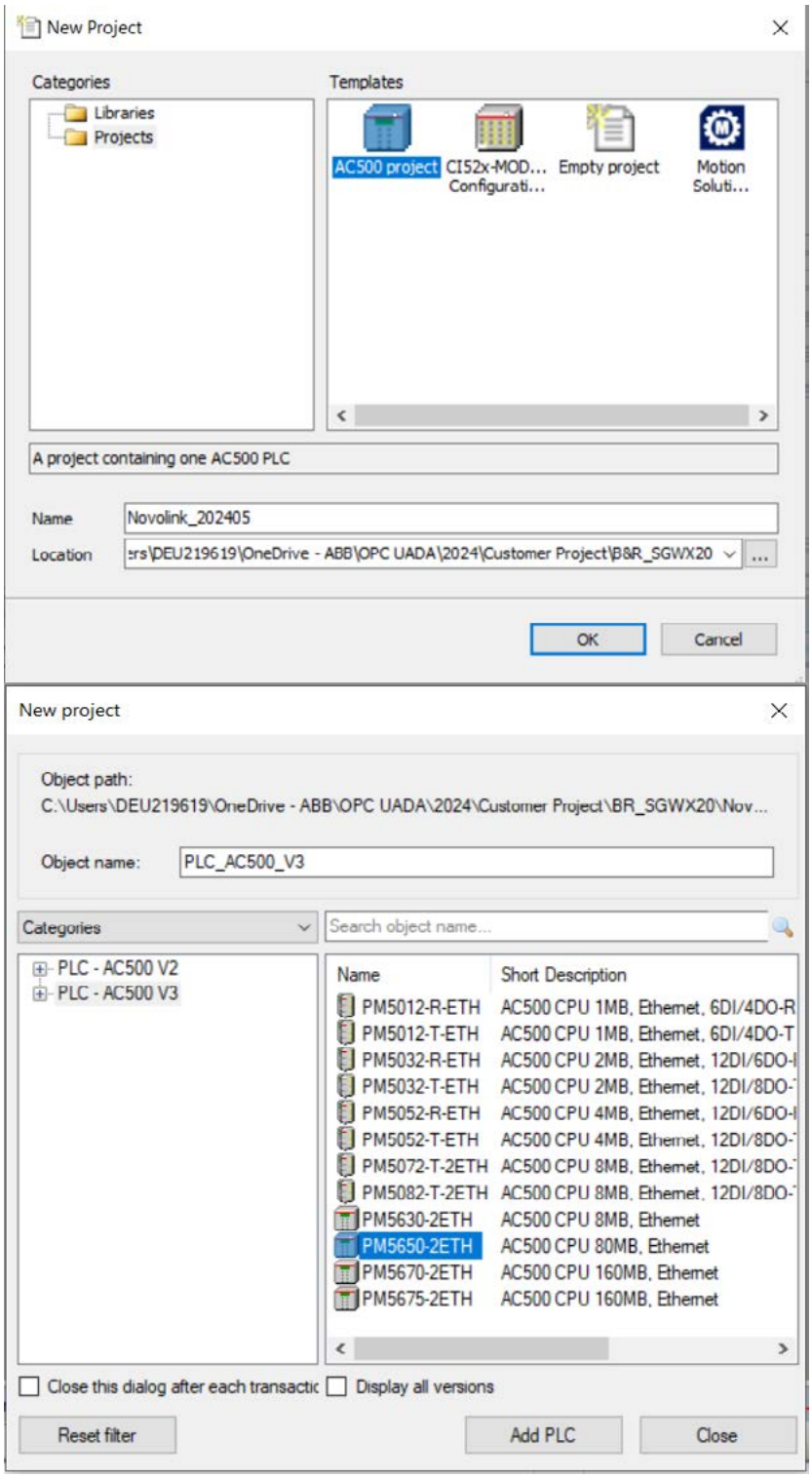
Install Automation builder V2.7 or newer version, you can download the installation package from website https://new.abb.com/plc/automationbuilder/platform/software.



5.3. Protocol Configuration in Automation Builder

5.3.1. Create new project

Select the 'New project…' from the Menu> Files in Automation Builder. At the New Project dialog, select the 'AC500 project 'and name your project file. e.g. Novolink_202405

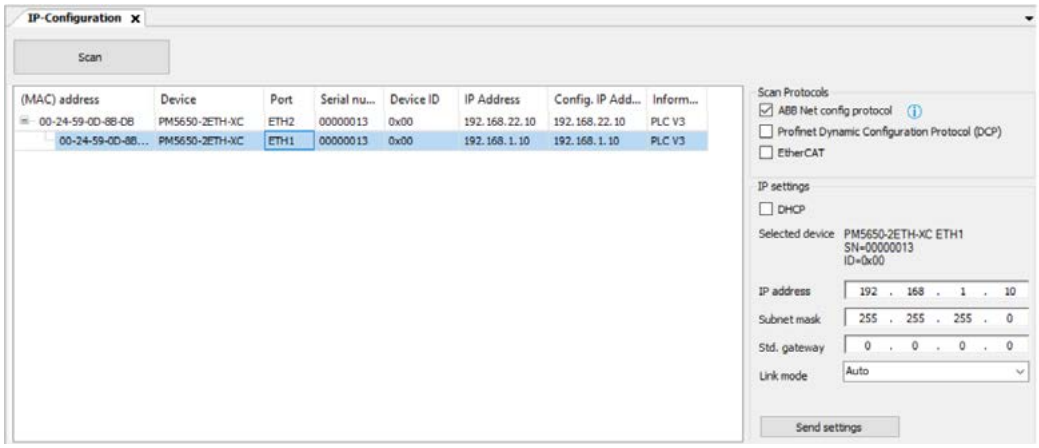


Click OK to continue and choose the AC500 CPU according to your equipment and click 'Add PLC' to proceed.

5.3.2. Scan Network for Devices

AC500 PLC must be given a fix IP address,the CPU must have different IP address ranges on ETH1 and ETH2 (different subnet configured on ETH1 and ETH2) e.g.: OPCUA Client AC500 PLC : ETH1-192.168.1.10 , ETH2-192.168.22.10

With the 'IP-Configuration' from the menu 'Tools' in Automation Builder, Users can set the IP address of each ETH ports as below. e.g.:



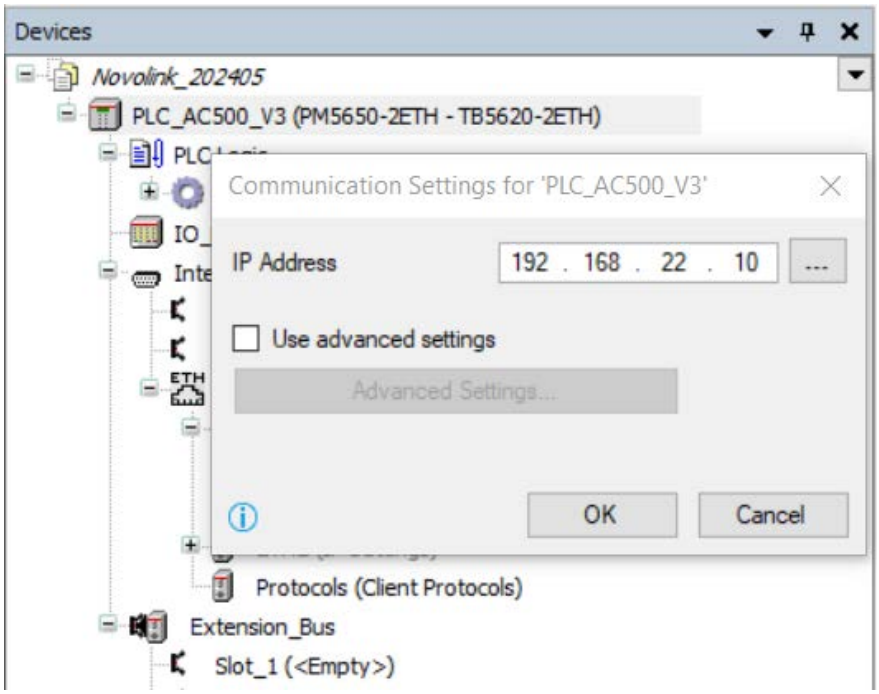
In the above picture setting, connections are made in the following combination:

- ETH1 port of PLC PM5650-2ETH is used for connecting OPC UA Server Smart Gateway SGWX20-OUA (IP address:192.168.1.1).
- ETH2 port of PLC PM5650-2ETH is used for Automation builder, PC connection(PC IP address:192.168.22.80 for example).

Note: Make sure that the IP-address of the OPC UA server and the OPC UA client are in the same network.

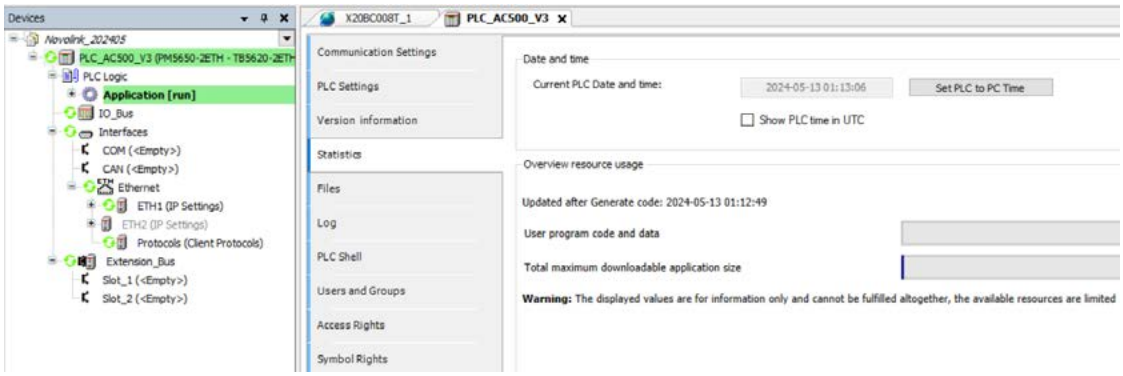
5.3.3. Online to the PLC

Right-click on the "PLC_AC500_V3" and select 'Communication Settings'.



The IP address for ETH2 is "192.168.22.10". Click "Ok" button to continue.
If your PLC have different IP Address, click the '…' button beside the IP address to launch the network scanning tool to search the CPU IP address.

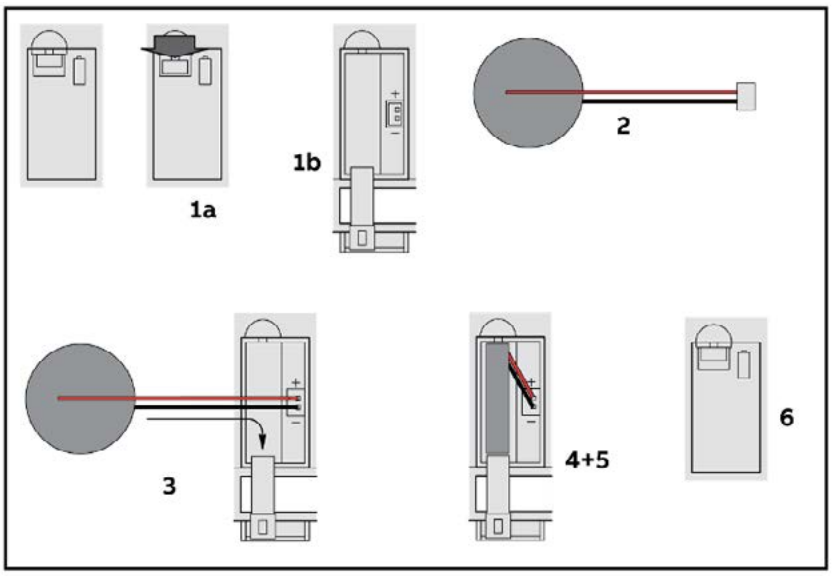
You now ready to go online with the PLC by choosing 'Login' from the 'Online' menu. After downloading completed, go offline and reboot the PLC.



5.3.4. NTP Server

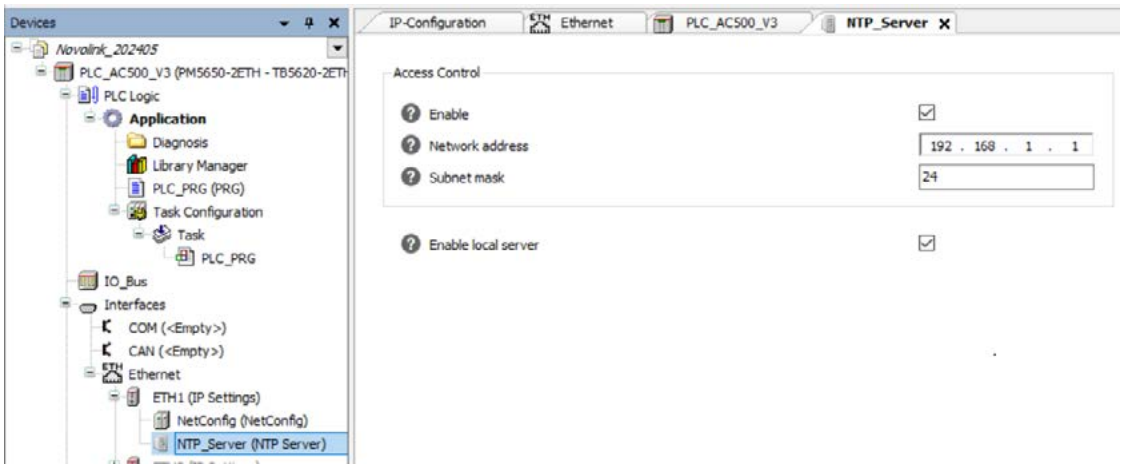
See previous chapter 4.4, Time Synchronization will be executed by NTP server from AC500 PLC.

The prerequisite is that battery is inserted, and clock is set to actual time.



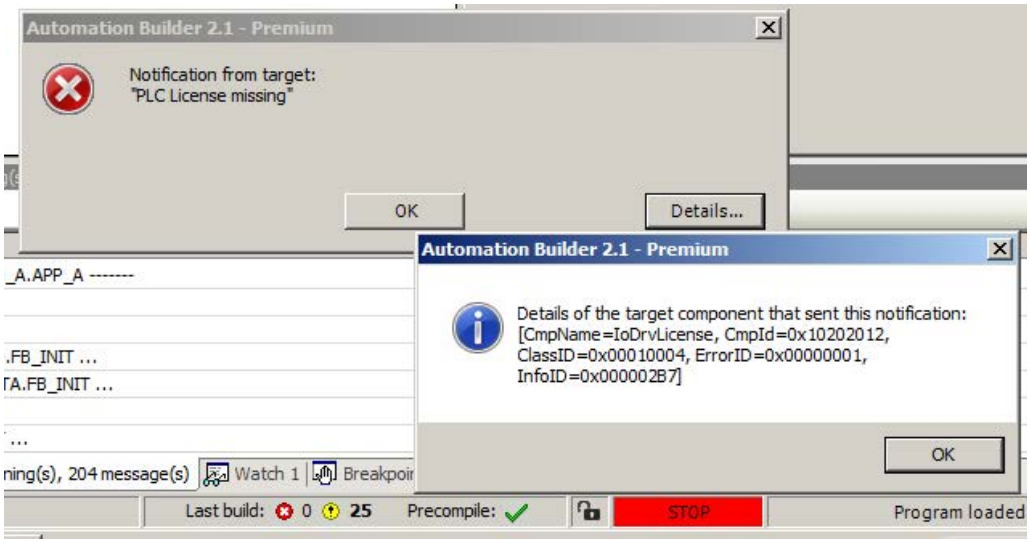
Login the PLC and push the ‘Set PLC to PC Time ‘button from option Statistics to set time with PC time.

Add protocol NTP Server on ETH1 port and input the OPC UA server IP address in Access Control settings.



5.3.5. Install OPC UA Client Runtime license

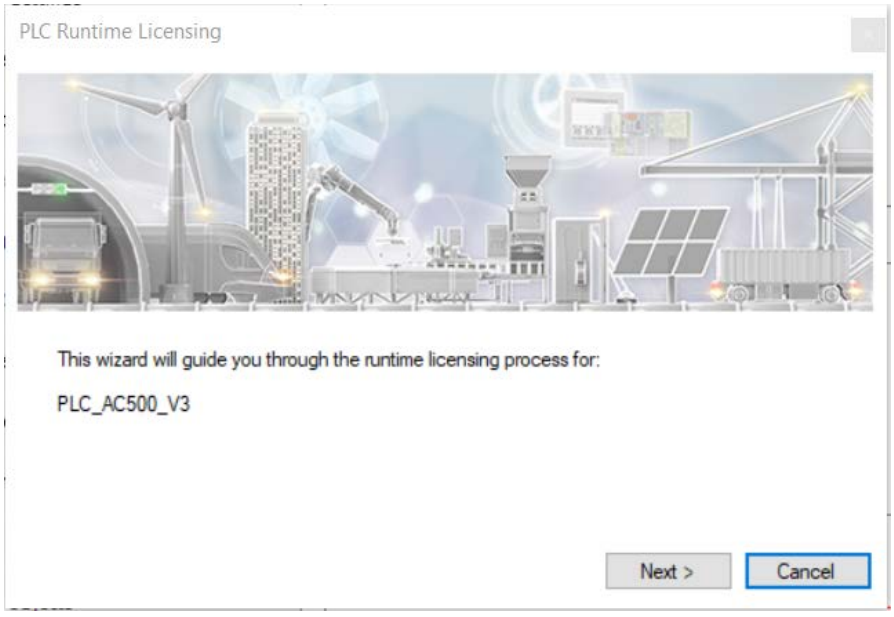
The use of OPC UA Client require the V3 CPU to have a Runtime license. Otherwise, the CPU cannot go to Run mode with below notification when you try to login the CPU.



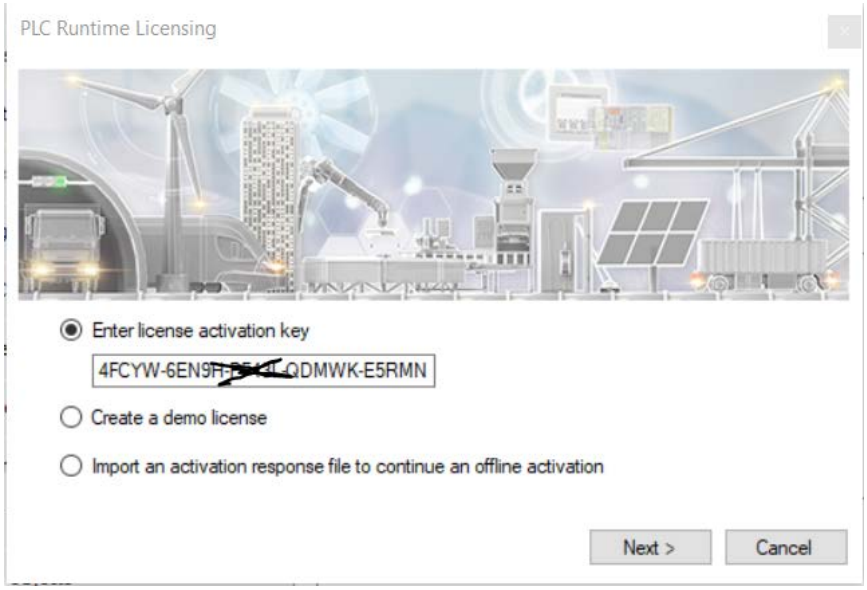
To activate OPC UA Client runtime license on a PC with internet connection. Following steps are necessary:

1. Login the PLC

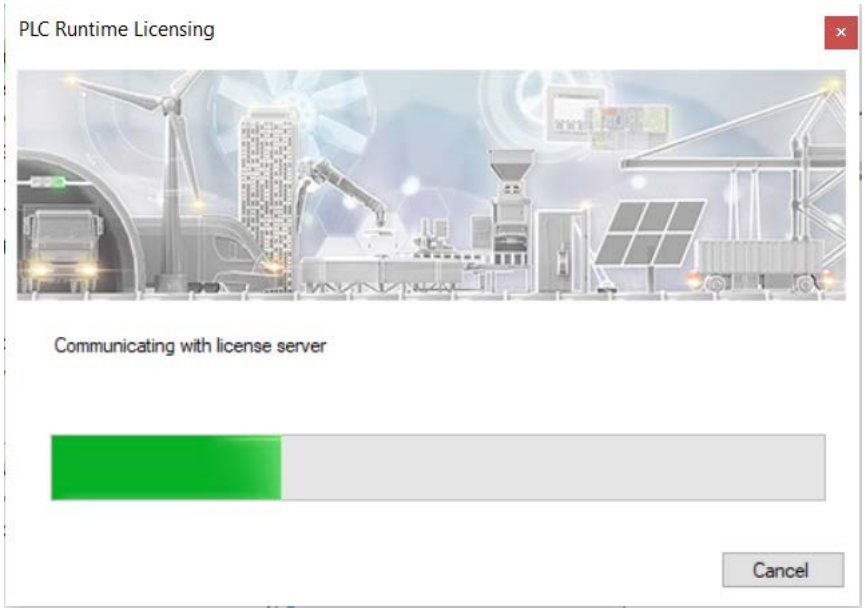
2. Right-click on the PLC node and select 'PLC runtime licensing 'from the 'Runtime Licensing 'menu, the a wizard is started, This wizard will guide you through the runtime licensing process.



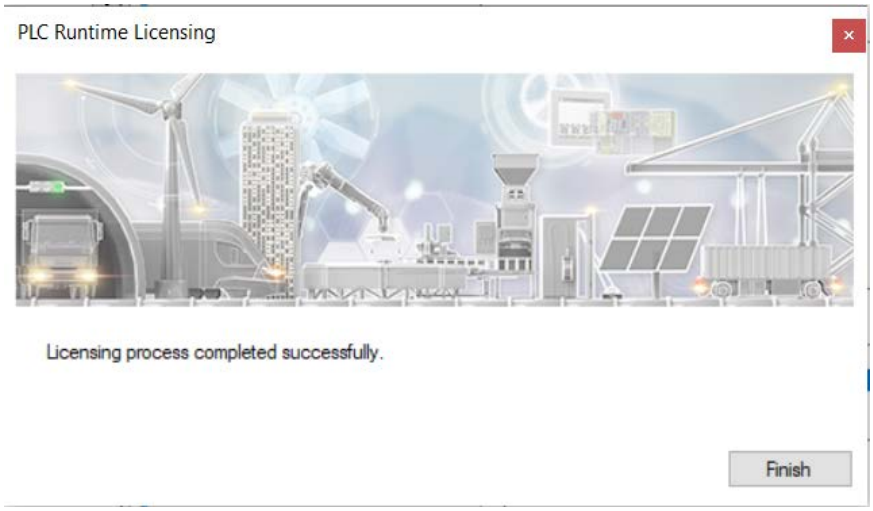
3. Enter the license activation key and click ‘Next’ to finish the licensing procedure.



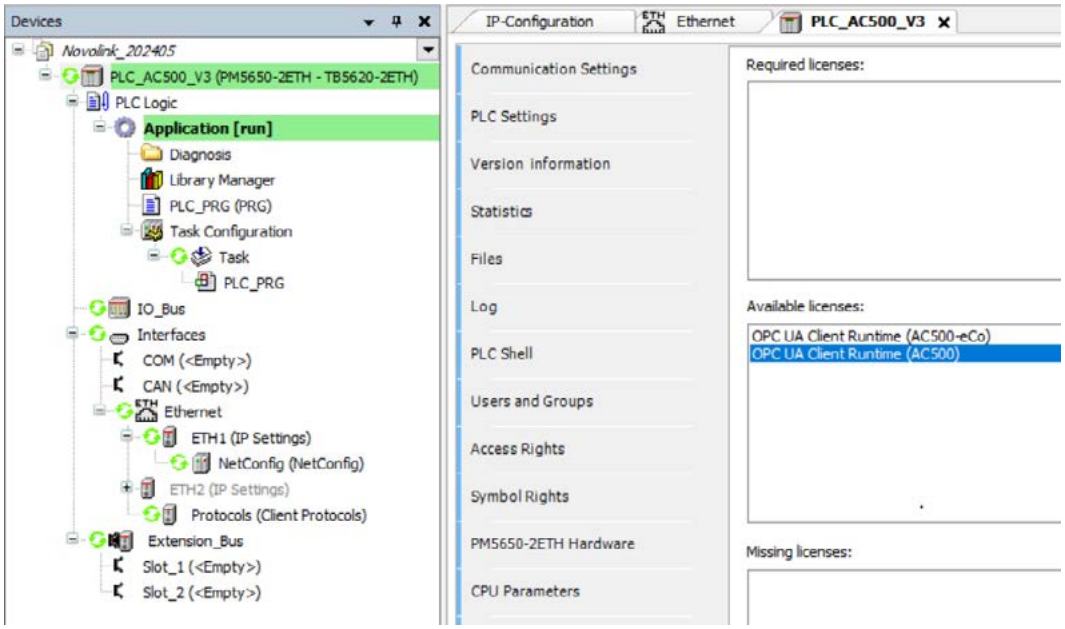
4. The License is validated by the ABB license server and afterwards activated on the PLC device.



5. Finish the activation successfully.



The license status of PLC can be displayed by license information.

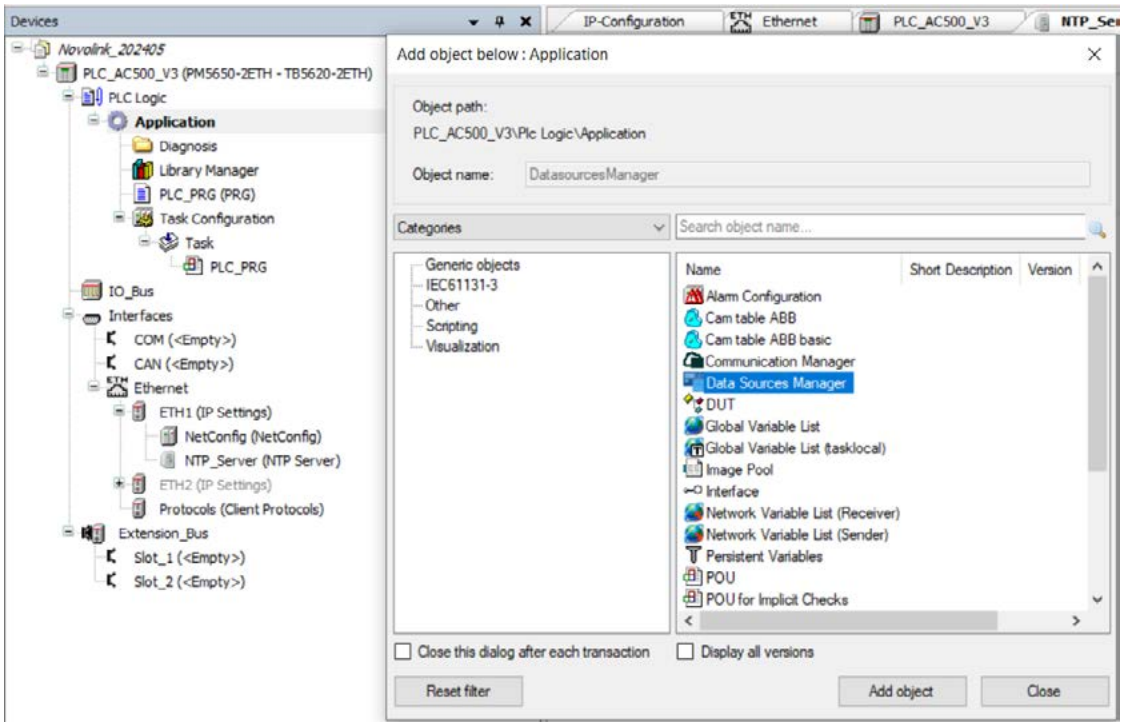


5.3.6. Add OPC UA Client

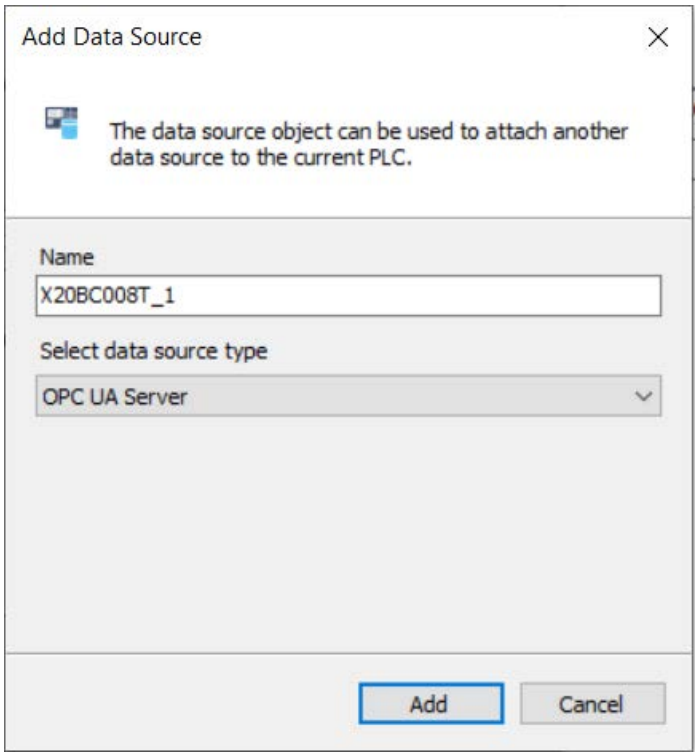
Since a user is created on the OPC UA server, a login with username and password is required for a connection from the client to the OPC UA server. In the case that the communication is established via a data source, see the Username setting below Authentication in the data source editor.

Following steps are necessary:

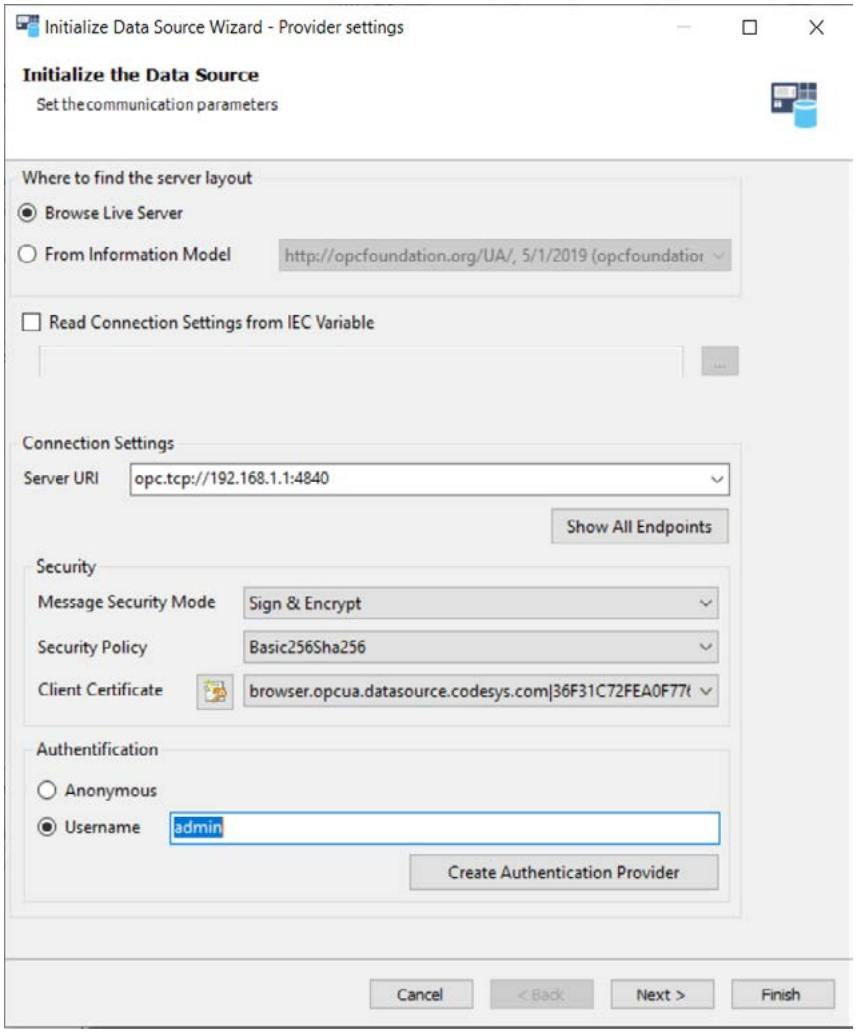
1. Add a Data Sources Manager object to the application.



2. Add a Data Source OPC UA Server to the Data Sources manager, The Datasource dialog opens.



3. In the Initialize Data Source dialog, configure the data source for communication in the following.



The settings from this dialog are reflected accordingly on the Communication tab of the data source manager:

- For Where to find the server layout, define how the information about the existing variables and types should be detected. When you select the Browse Live Server option, the OPC UA Client connects to the OPC UA Server for this purpose and reads the information there. When you select From Information Model, the client reads the same information from an installed information model and does not require a running OPC UA Server to do this.

- For Server URL, specify the URL of the started OPC UA Server.

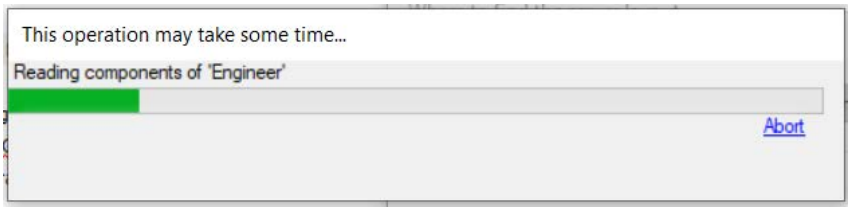
- Click the Show All Endpoints button to open the Available Endpoints dialog.

- Select an endpoint which defines an Encrypt & Sign message security mode and a corresponding security strategy. After the dialog is closed, these settings are transferred to the Security section of the Initialize Data Source dialog.

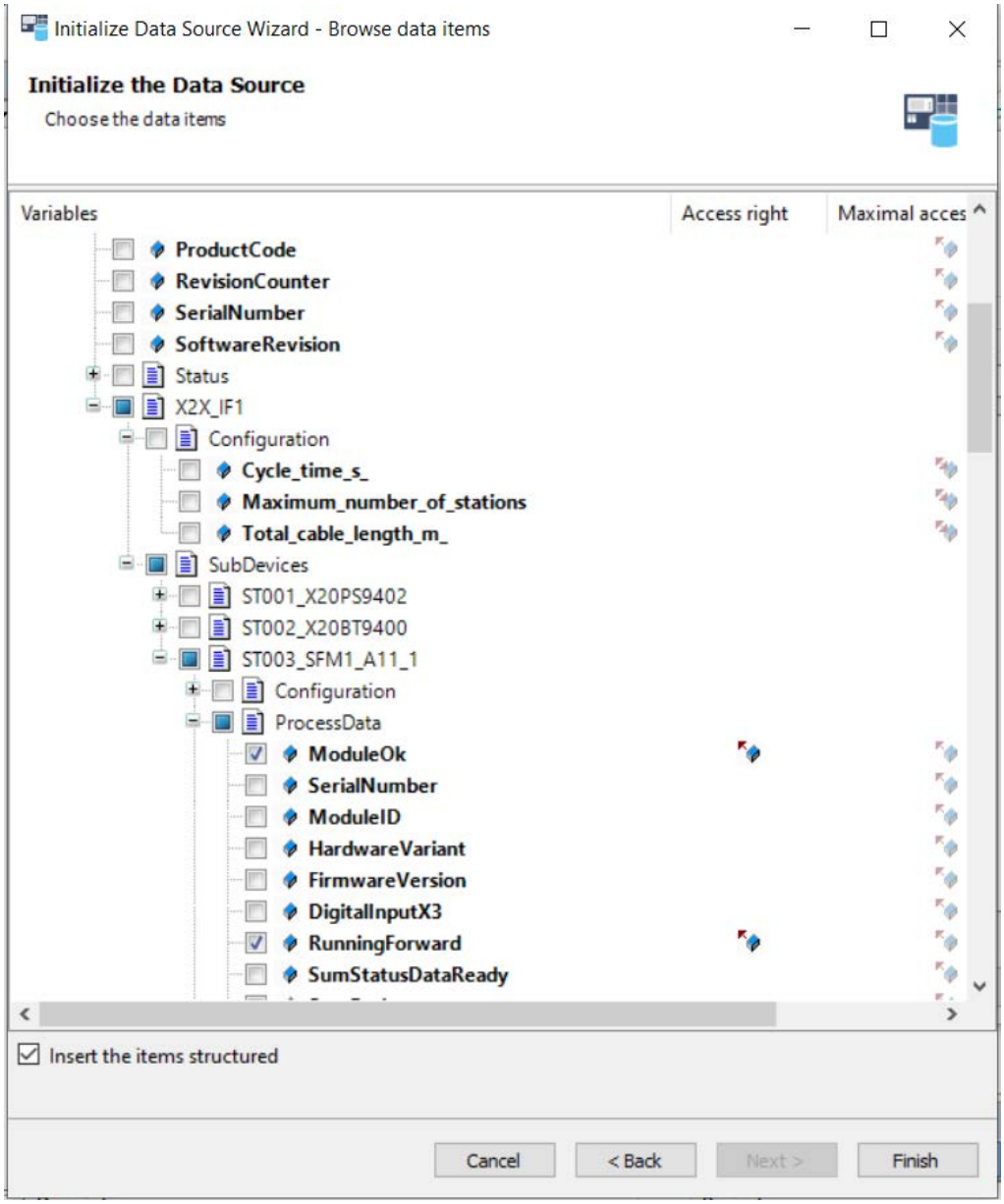
- Choose a suitable Client certificate to access the server for browsing purposes. If a certificate is not available for selection yet, then you can have one generated immediately. To do this, click the button to open the Generate self-signed certificate dialog. Define a password for your private key and a file name for the certificate. When you click OK, the certificate is generated and automatically entered into the certificate store. The *.cer and *.pfx certificate files are stored with the project file. As a result, you can „give“ the certificate with the public key (*.cer) to the server so that it „knows“ the certificate. You can also share the private key (*.pfx) to make the project usable on another machine (for browsing).

Note: This certificate can be used only for browsing the server for variables and data types. An additional certificate is required for data exchange in online mode. Its creation is described below.

4. Click Next. Now the client scans the OPC UA Server to find the variables and types of the OPC UA Server. The OPC UA Server must be in online mode to do this.



5. Now select one or more variables. These variables can be exchanged later via encrypted communication between the OPC UA Client and the OPC UA Server. For the variables, components are created in the Automation Builder devices view, in the DataSources_Objects folder. The variables can be used in the application.



Note: In this example we will use the next variables:

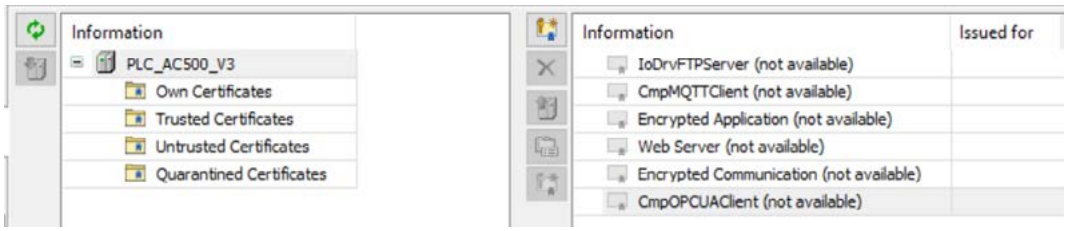
- ProcessData >> ModuleOk
- ProcessData >> RunningForward
- ProcessData >> ContactorVoltageLow
- ProcessData >> OverloadTrip
- ProcessData >> SensorModuleMissing
- ProcessData >> OSPValid
- ProcessData >> RunForward
- ProcessData >> ResetErrors
- ProcessData >> ResetCounterContactorA

6. In the next steps, you create a certificate for the encrypted communication from the OPC UA Client to the OPC UA Server.

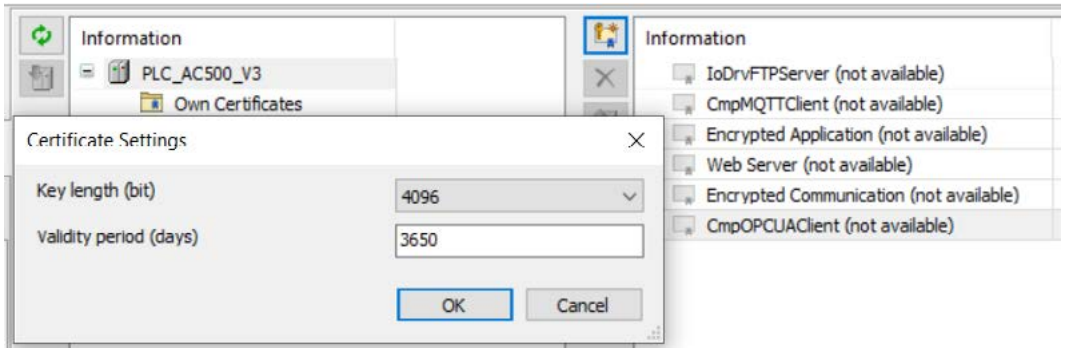
7. Click View → Security Screen, then switch to the Devices tab.
   In the view on the left, select the controller.

8. In the right view, all services of the controller are displayed which require a certificate.

9. Select the service CmpOPCUAClient.

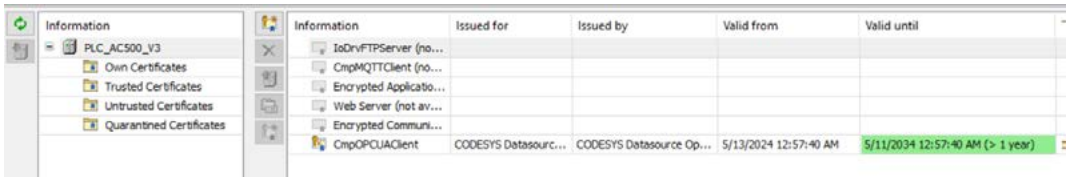


10. Create a new certificate for the device. To do this, click the  icon. The data required for the certificate are entered in the following dialog box.



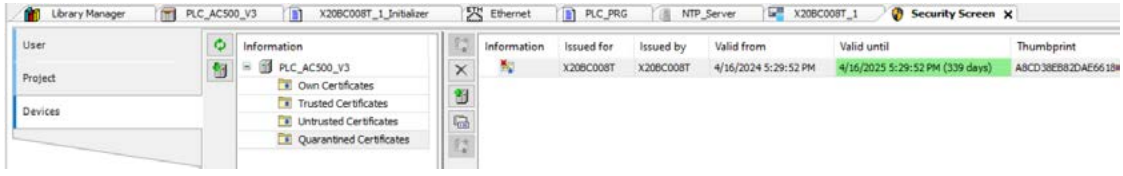
11. Define the certificate parameters and click OK to close the dialog.

The certificate is created on the controller.



12. Click the  button and save the certificate to the local file directory of the OPC UA Server, in the certs folder.

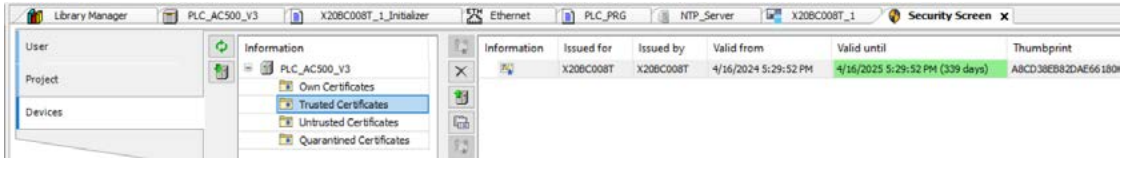
Now when you restart the OPC UA Server, it will recognize the client certificate. The server sends its certificate to the client.



In the following steps, this certificate will be made „trusted“ to the client.

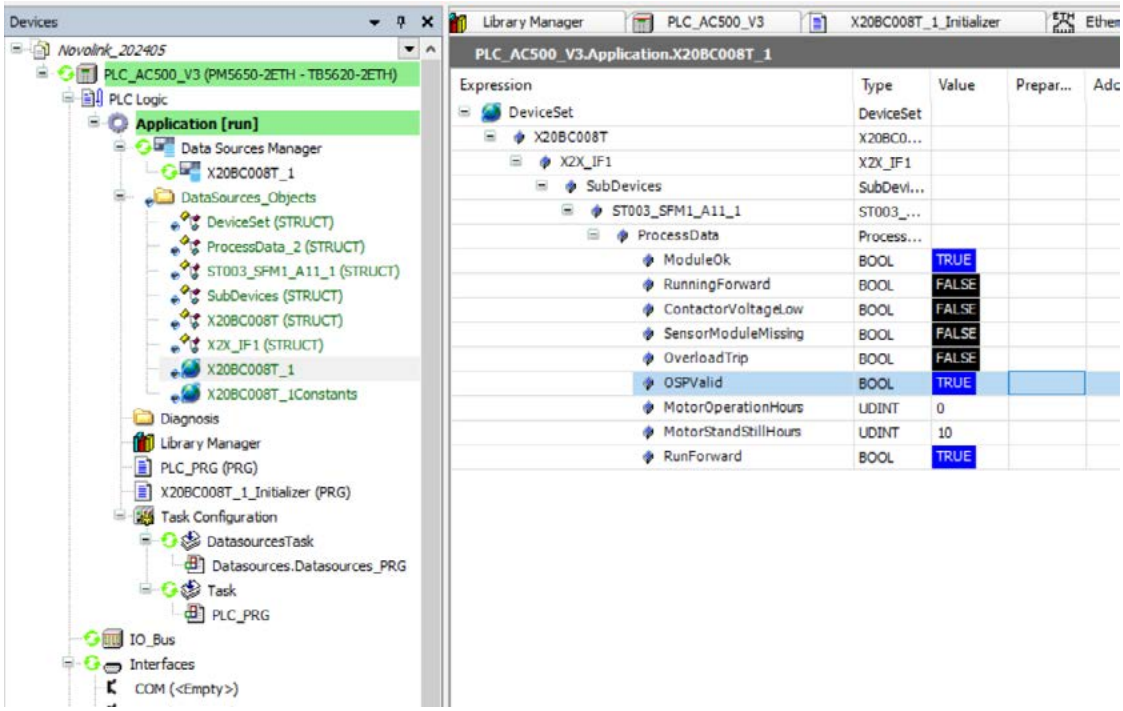
13. To do this, in the Security Screen view, on the Devices tab, click the Certificates in Quarantine folder in the left area. The certificate is displayed in the right area.

14. Drag this certificate to the Trusted Certificates folder.



Now the server certificate is „trusted“ by the client.

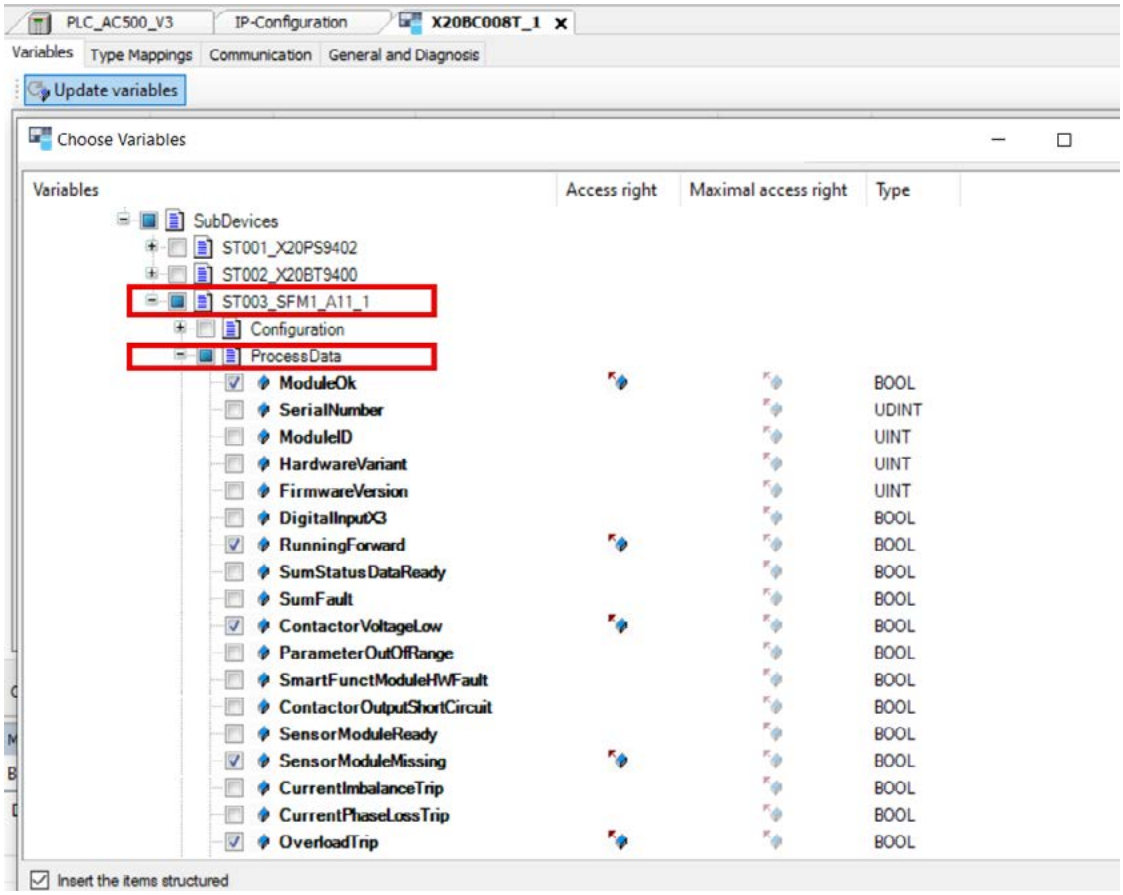
15. Now when you connect to the controller and the application starts, the data source variables of the OPC UA Client can be exchanged with the OPC UA Server via the encrypted connection.



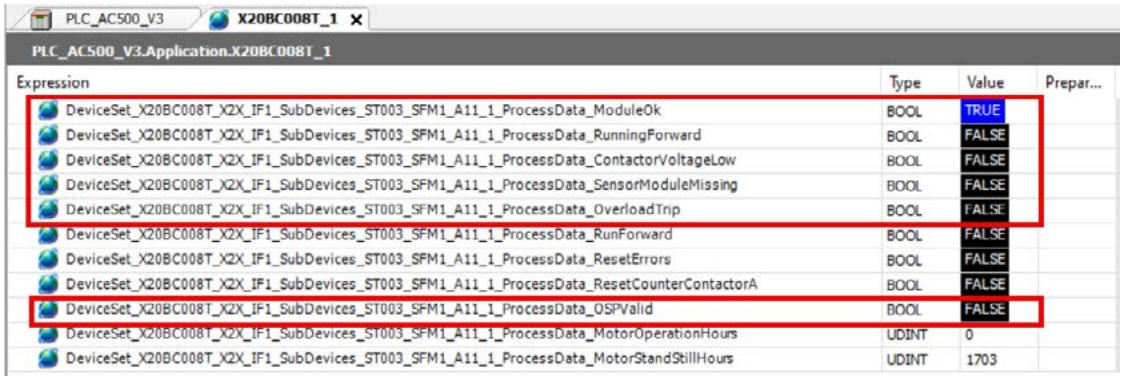
Finally, these variables can be used in the application according to the logic requirement.
Some key functions are descripted in the following chapters which you often need.

5.4. The Read list

For reading the data from the server:



The variables on the “X20BC008T_1” screen have now been read from the server.

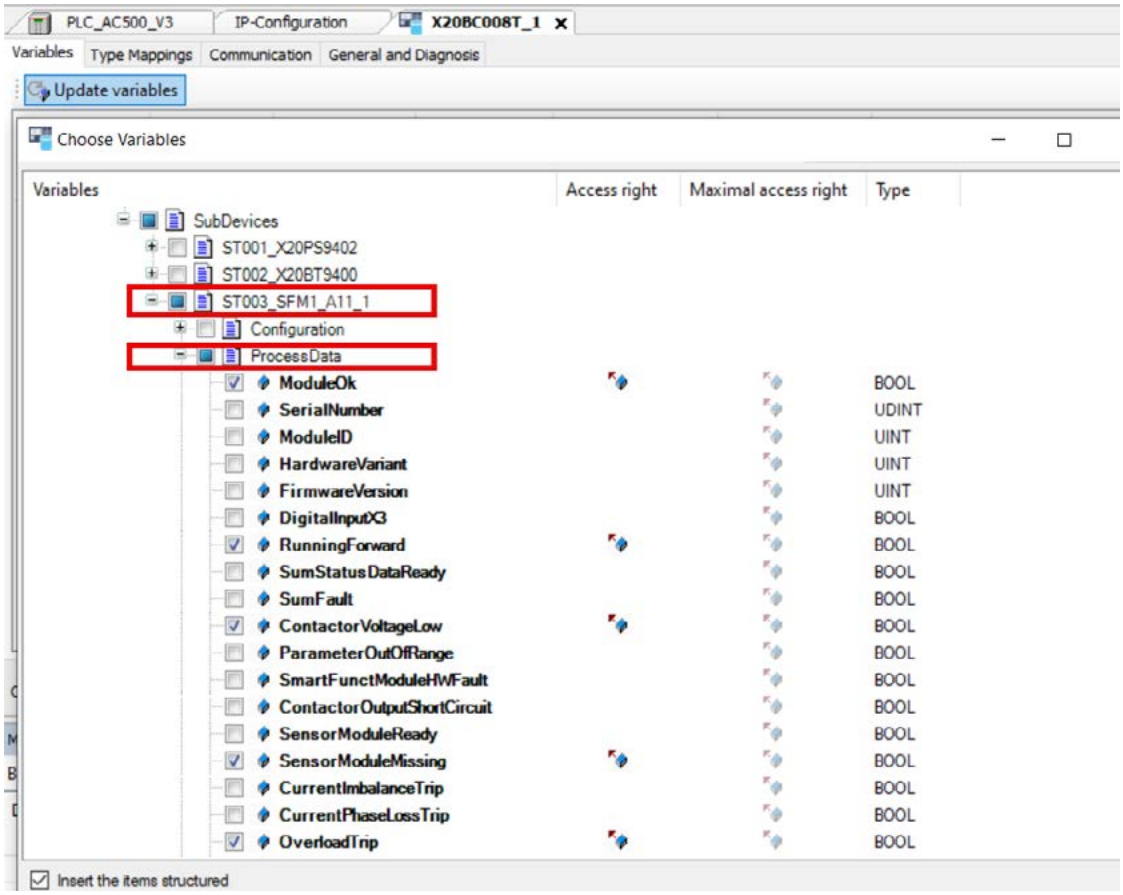


Note: In this example we will use the next variables:

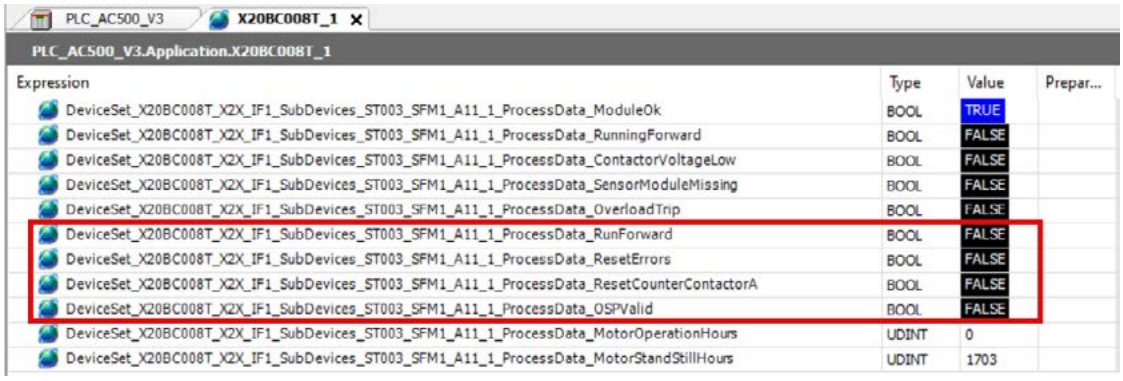
- ProcessData >> ModuleOk
- ProcessData >> RunningForward
- ProcessData >> ContactorVoltageLow
- ProcessData >> OverloadTrip
- ProcessData >> SensorModuleMissing
- ProcessData >> OSPValid

5.5. The write list

For writing the data in the server:



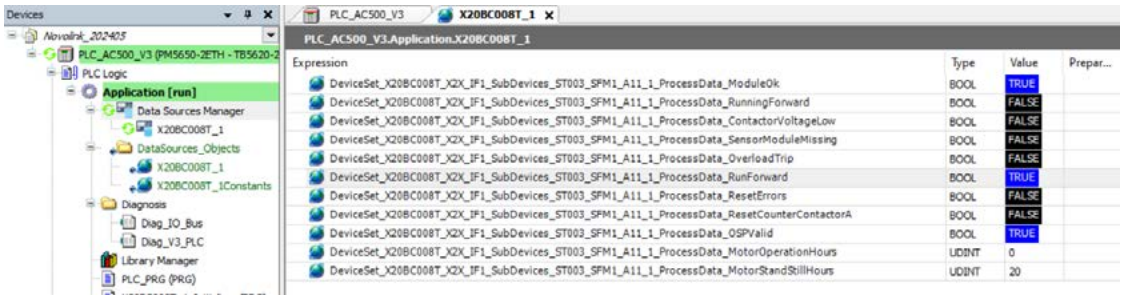
The variables on the “X20BC008T_1” screen have now been written to the server.



Note: In this example we will use the next variables:

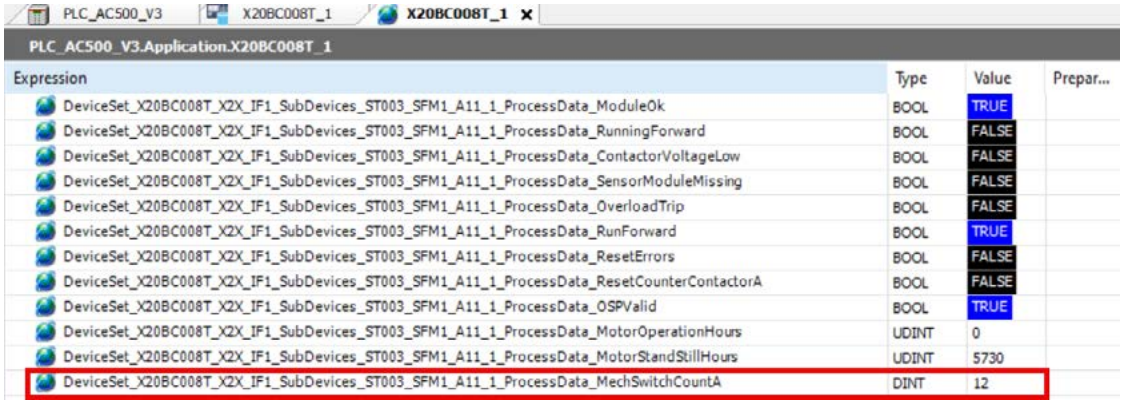
- ProcessData >> OSPValid
- ProcessData >> RunForward
- ProcessData >> ResetErrors
- ProcessData >> ResetCounterContactorA

- Check if “OSPValid” is True in the read variable else put the “OSPValid” variable on TRUE in the write list.
- Change variable “RunForward” on TRUE.
- Check if the contactor makes a click sound.



5.6. The parameters list

In this example we want to know how many time the contactor switched.



Note: In this example we will use the next variable:

- ProcessData >> MechSwitchCountA

6. Configuring Novolink with Smart Gateway

Please use following documents to configure Novolink with Smart Gateway

Document type	Document number	Link
SFM1 Manual	2CDC100017M0201	link
User manual for Novolink	1SAC200230M0001	link

7. Troubleshooting

7.1. No OPC UA Sever application Found

- Verify Automation Builder is able to reach the smart gateway.
- Check the IP-address of the OPC UA server.
- Check the IP-address of your Client (IP configuration Tool)
- Check that you can reach the server using ping.
- Reboot the server.

8. List of related documents/links

Document type	Document number	Link
SFM1 Manual	2CDC100017M0201	link
User manual for Novolink	1SAC200230M0001	link
Automation Builder 2.7.0	3ADR010583	link
AC500 PLC	3ADR020077C0204	link

ABB STOTZ-KONTAKT GmbH
Eppelheimer Strasse 82
69123 Heidelberg, Germany

You can find the address of your local sales organization on the ABB homepage

abb.com/lowvoltage

Additional information
We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB AG does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

Document number 1SBC100156C027 - Rev. A (05/2024)