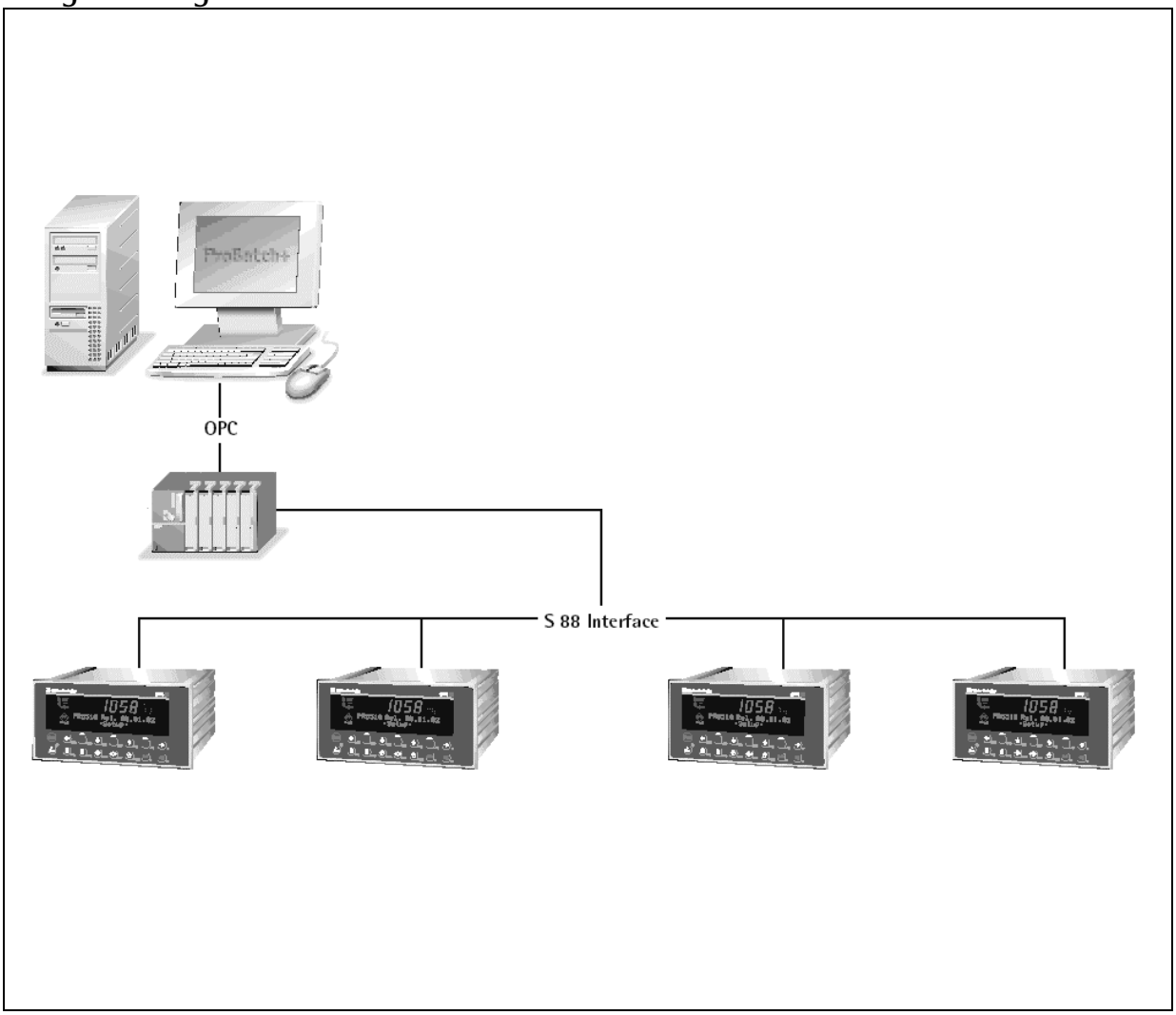
Example program for PLC control

Proxy Server

Programming manual



Programming manual for Proxy server	9499 050 84101 Release 1.0	Edition 1	01.07.2004

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Wichtig

Contents

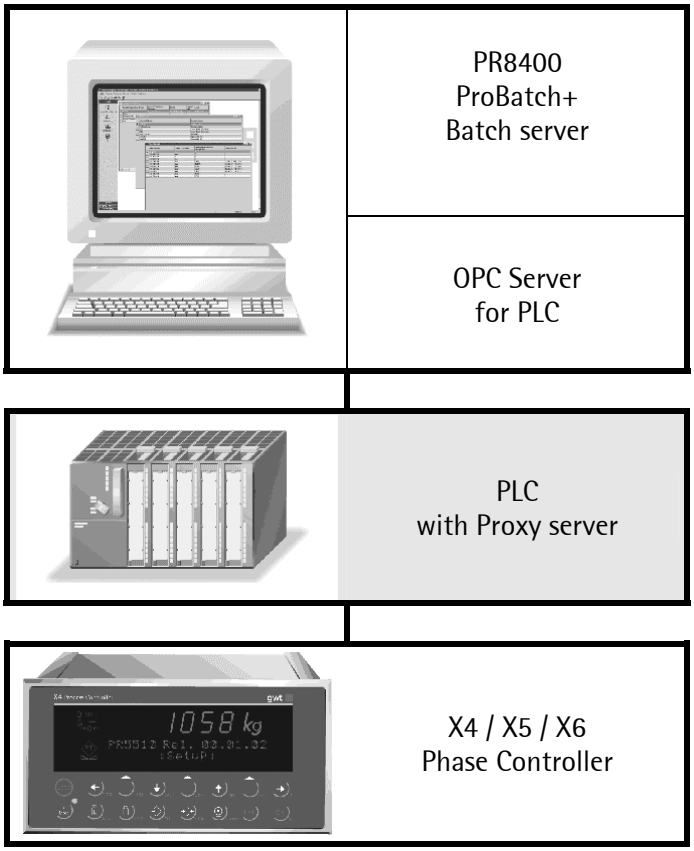
1. Introduction

1.1. Additional manuals

The use of the operation manual PR8400 ProBatch+ and the installation and operation manual of PR5510 for Phase-X4, PR5610 for Phase-X5 or PR5710 for Phase-X6 is required.

1.2. General

Whenever the X-Family batch controllers are connected indirectly to the recipe management system via a PLC, a considerable amount of programming work is usually required in the PLC for data transfer and synchronisation. In order to connect to a PLC controller more easily, a so-called Proxy server is provided. The proxy server is a program, which runs on the PLC and transfers parameter data between ProBatch+ and the batch controllers. The programming work on the PLC is considerably reduced with the proxy server. In this way, the process I/O's can be locked in the PLC. The advantage is that PLC functions can be easily synchronised with the pre-programmed batch functions of the controllers.



1.3. Disclaimer

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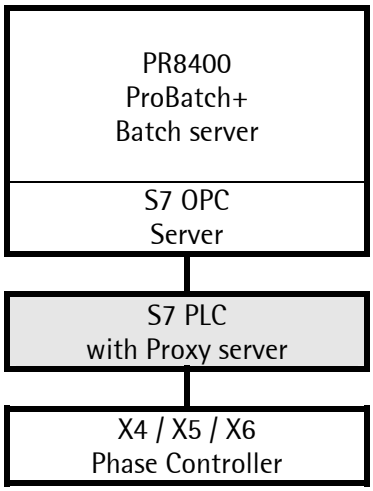
1.4. Updates

Updates for this program can be found on our Website www.sartorius-mechatronics.com

2. S7 Proxy

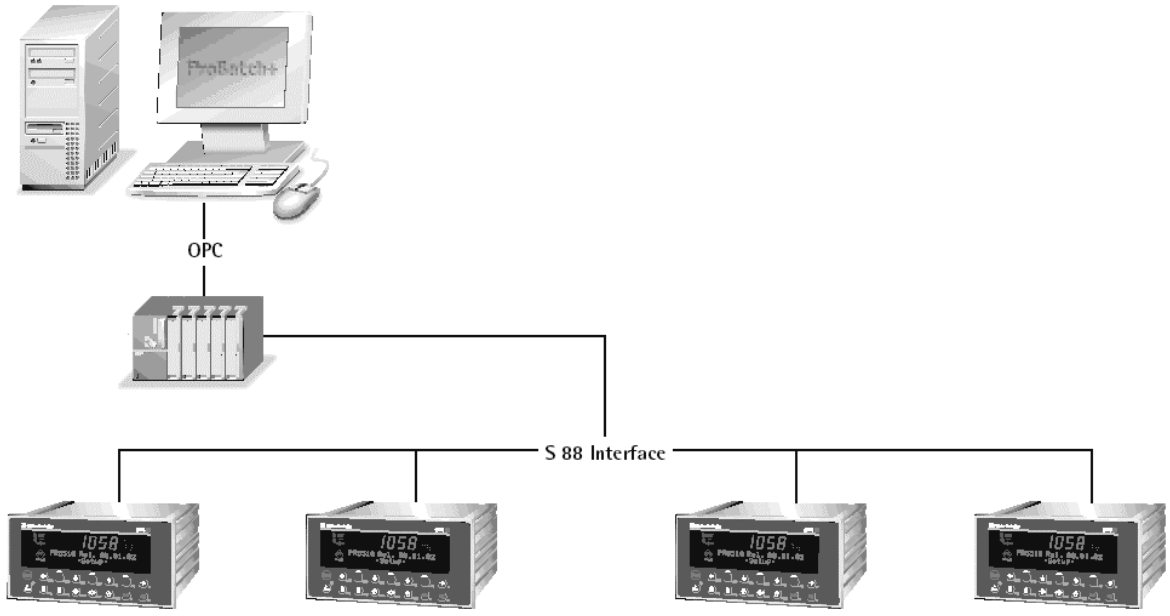
2.1. Overview

The proxy interface is S7 application code providing a transport layer between ProBatch+ (with underlying S7-OPC Servers) and Sartorius batching devices such as X4 / X5 / X6.
Actually there are two modes how this can be accomplished:
S7 just provides communication paths already present.
S7 actively intercepts the process by switching valves, checking material paths etc.
This document deals with information on how to set up a basic configuration, combine the proxy code together with other S7 application code and how to interact with ProBatch+ batching actions.



A minimum system using the S7 proxy is made up of

- a PC running the ProBatch+ with Batch Server and S7 OPC communication server,
- an S7 connected to the PC and having a Profibus interface running the S7 Proxy code,
- an X4 / X5 / X6 device with a Profibus interface board connected to the S7



2.1.1. Requirements

- PC running ProBatch+
- Simatic Step 7 development environment (only during installation)
- Simatic S7 PLC
- Simatic Net from V6.0 or higher. (Simatic OPC Server, Simatic Industrial Ethernet or Simatic Profibus S7 type depending on connection type used).
- Sartorius X4/X5 device with Phasecontroller software/license

2.1.2. Configuration

A Step 7 development PC running the Simatic Manager software is required to

- configure S7 hard- and software components
- combine the S7 Proxy code with an application program (SCL or STL)
- download the code to the S7 and to the Simatic Net Station Manager
- start the S7 application

The development PC is not necessarily the same one that later runs the ProBatch+ application. Step 7 also allows to define and configure a PC different from the development PC which will then run the S7 OPC server. For further information see the Simatic Net manuals.

2.1.3. Operation

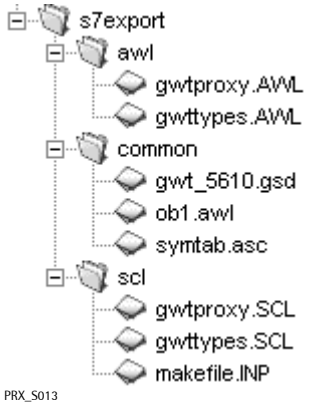
After the S7 has been connected and configured, the application code is loaded into the S7 along with the proxy server. The user is responsible, that for the proxy server function block is called with a correct parameter set and within resonably short time intervals.

2.2. Installation

2.2.1. S7 Proxy Installation

Installing the S7 Proxy to your project means importing serveral source files to your Step 7 project. Run the S7 Proxy Server Kit Setup on the Simatic Step 7 development PC. It copies an archived tree of source files into the selected folder. No executable program is installed.

Unpack the file tree from the archive to any suitable location on disk, this results in the following file tree:



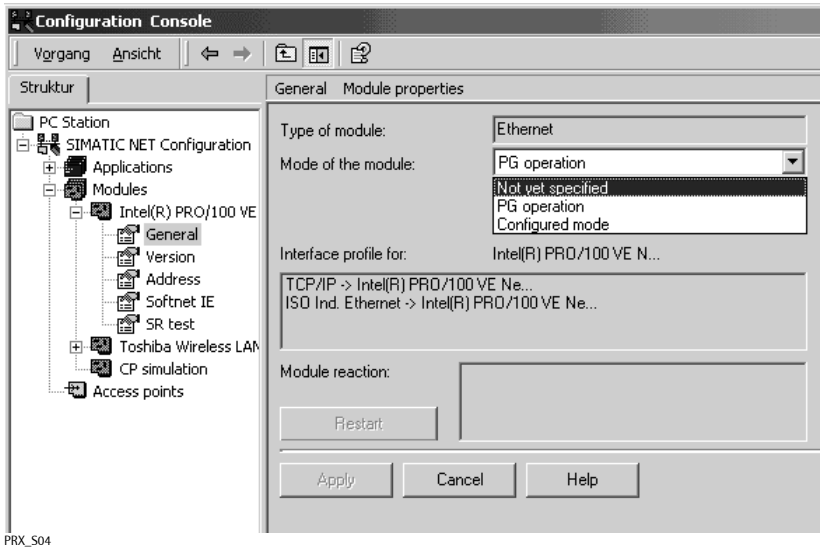
PRX_S013

The files contain

- sample S7 code. Sources are provided for STL and SCL programming languages.
- the GSD file for 'PR1721/xx Profibus Extended' that you will need during the Hardware configuration of your project.
- Symbol table and the sources for the S7 Proxy server

2.2.2. Configure Simatic Net

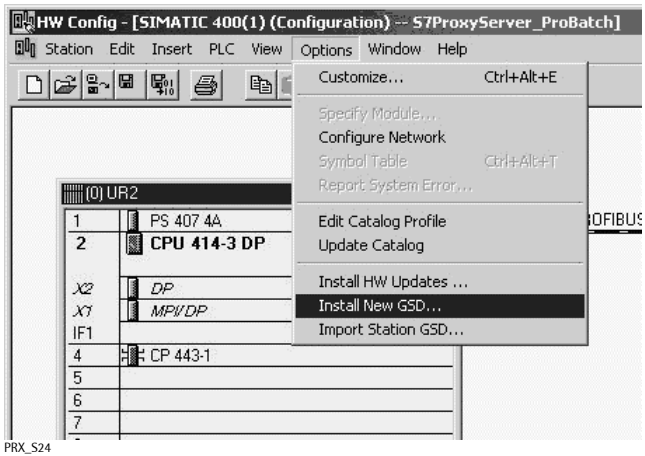
Open the 'Configuration Console' of Simatic Net. Change 'Mode of the module' of your network card to 'Not yet specified'. After that, start the 'Commissioning Wizard'.



PRX_S04

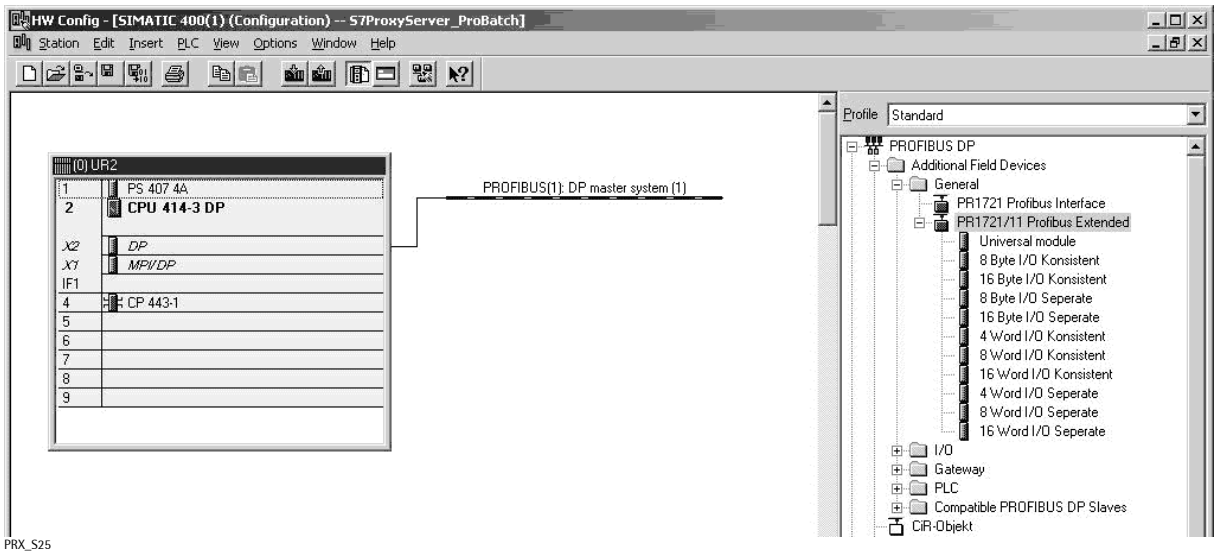
2.2.3. S7 hardware configuration

Start 'Simatic Manager' on the development PC and open the new created project.
Open the hardware configuration for your S7 PLC.
Configure your hardware (CPU, CP, etc.) and the Profibus master-system for a connection to the X4/X5.
Then open the hardware catalog. Expand the 'Profibus DP' tree downto 'Additional Field Devices \ General \ PR1721/xx Profibus Extended'. If your Step 7 development environment does not have the PR1721/xx entry, you need to import the GSD file from the S7 Proxy server kit installation folder.



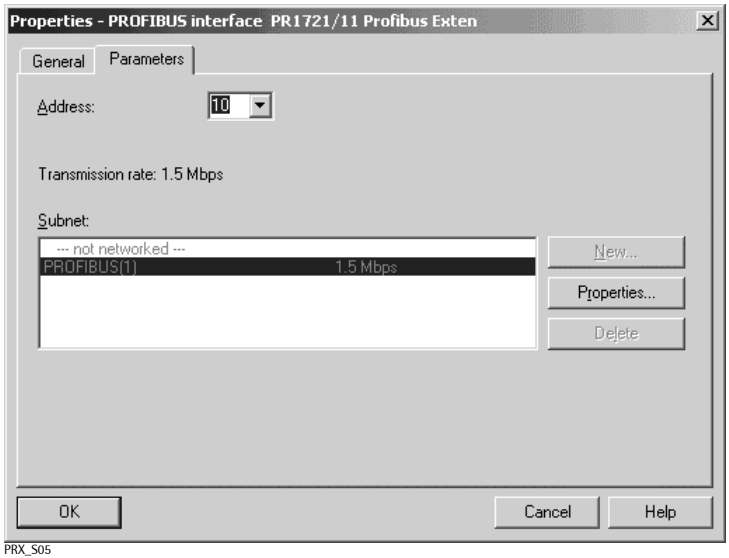
PRX_S24

Locate the Profibus rail to which the Sartorius device is connected. Drag a PR1721 module and drop it onto the 'Profibus (x): DP-Mastersystem(y)'.



PRX_S25

The HW Config opens a dialog to enter the Profibus address of the rack just dropped onto the bus line.



PRX_S05

It also suggests an unused Profibus device address for each PR1721/xx added to the bus.


PRX_S06

The Profibus device address entered here **must** match the address assigned to the corresponding X4/X5 device.

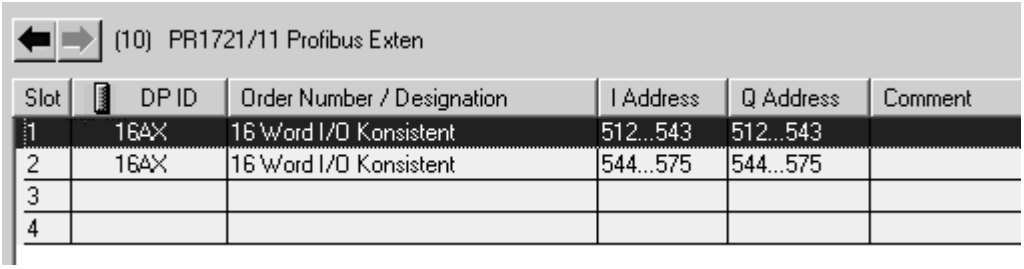
Clicking on the Profibus rail displays it's hardware rack in the lower pane. From the hardware catalog drag a "16 Word Konsistent" element to the Profibus rack pane. For a second weighing point in the same X4 / X5 device drag another "16 Word Konsistent" element to the next slot of the rack.

A total of 2 '16 Word I/O Konsistent' elements may be dragged to the PR1721 rack – one for each weighing point of the device.

The associated memory IO addresses (input and output) for the PR1721/xx are automatically assigned by STEP7 – you may overwrite them as long as no overlap with other devices occurs.


PRX_S06

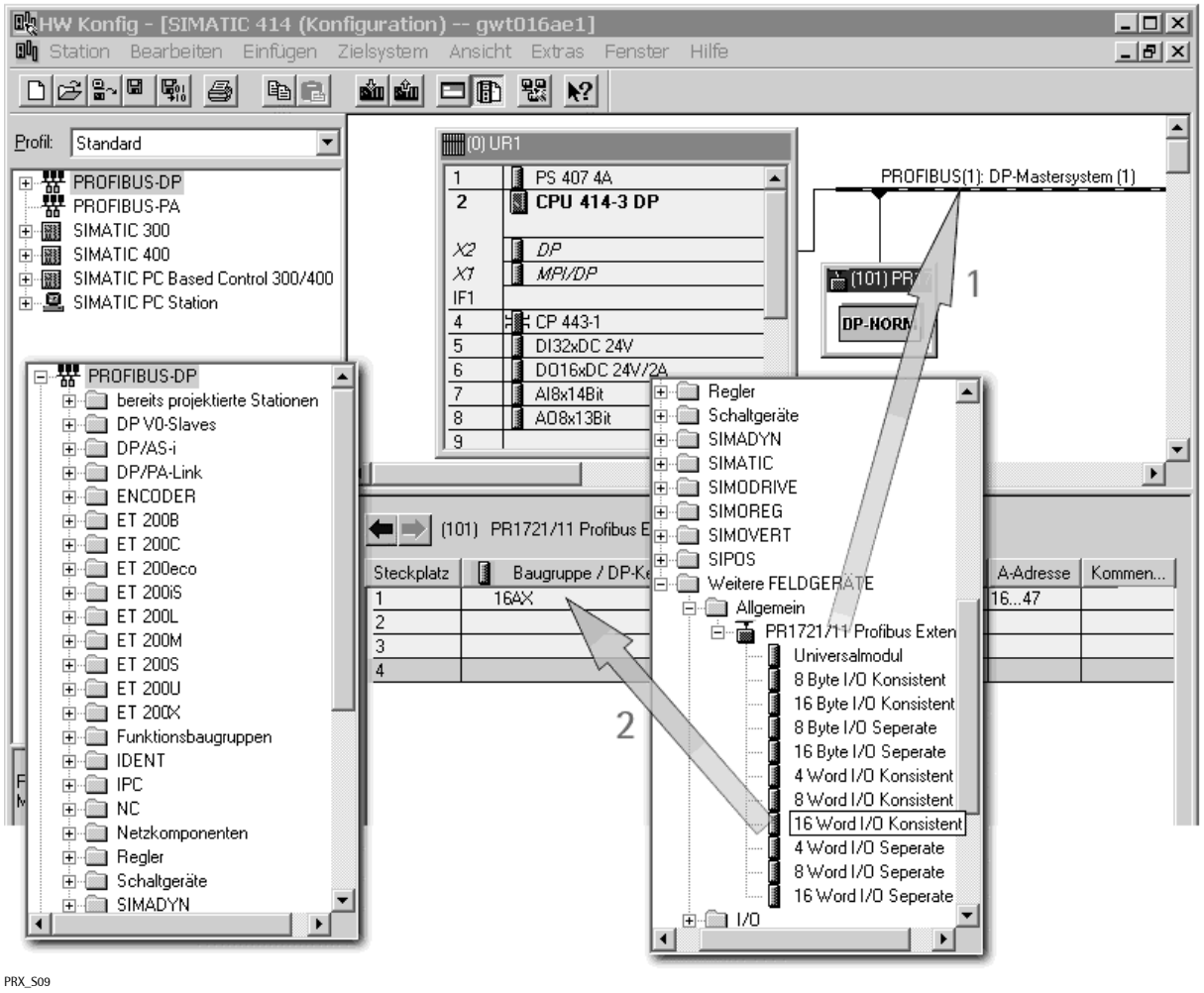
Take note of the memory IO addresses assigned to the PR1721/xx devices as you will need to enter them later into the code when calling the Proxy FB.



Slot	DP ID	Order Number / Designation	I Address	Q Address	Comment
1	16AX	16 Word I/O Konsistent	512...543	512...543	
2	16AX	16 Word I/O Konsistent	544...575	544...575	
3					
4					

PRX_S08

The configuration in summary:

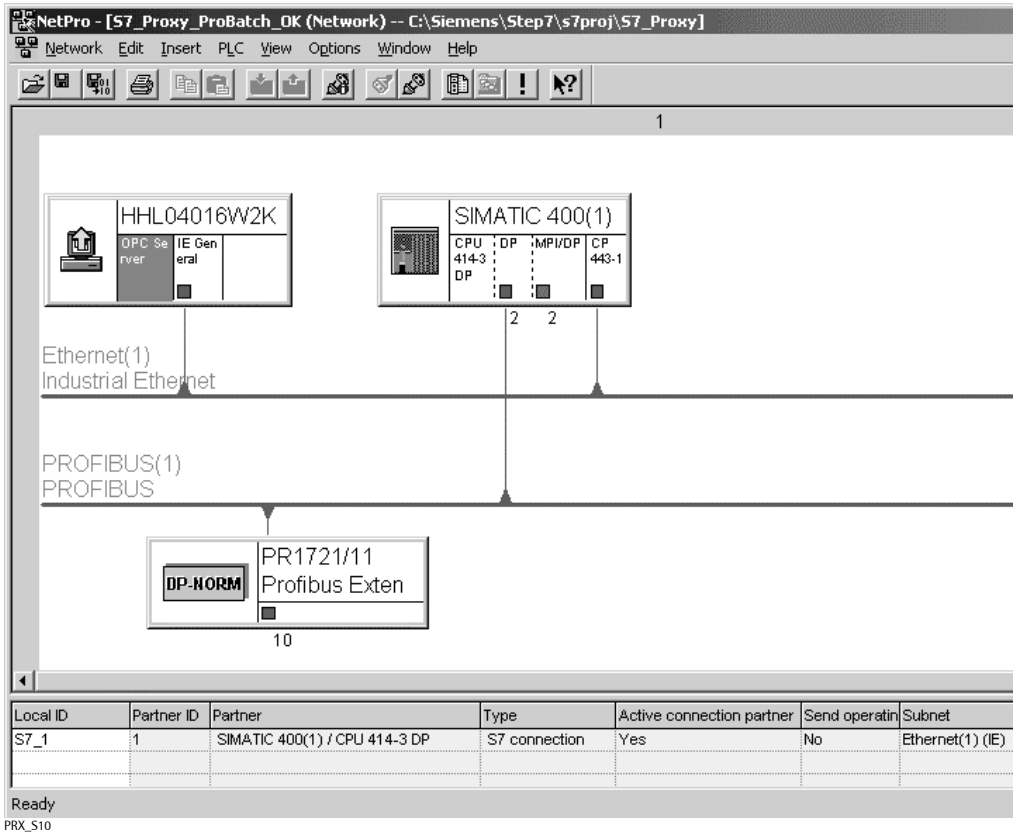


PRX_S09

2.2.4. Configure NetPro

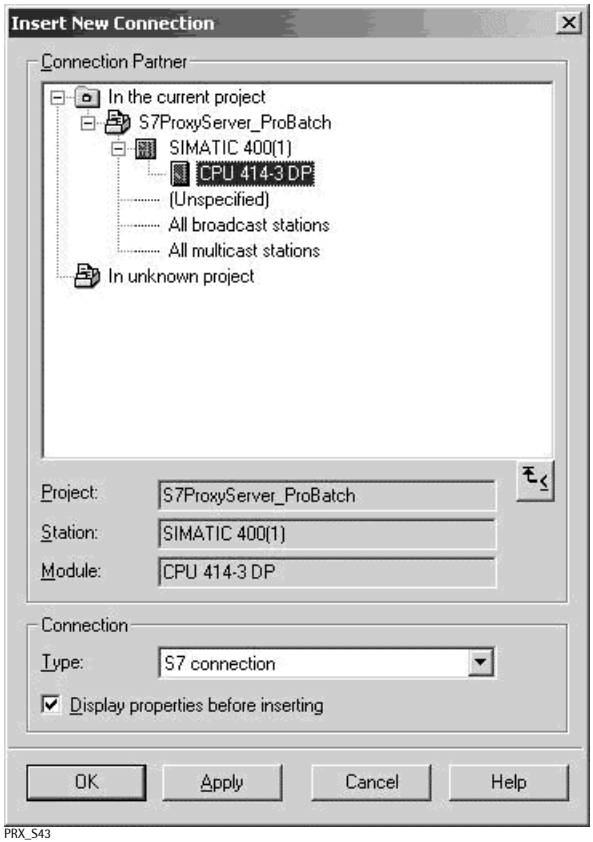
Using NetPro set up the communication connections of the configuration. Very important is to add an OPC server to the PC station where ProBatch+ is installed. (Already done in the 'Commissioning Wizard')
You should take note of the name given to the connection from OPC Server on the PC station to the Simatic S7 ('S7_1' in the image below; "Local ID"). The connection name is needed later.

Note:
The configuration shown below may differ from your configuration.



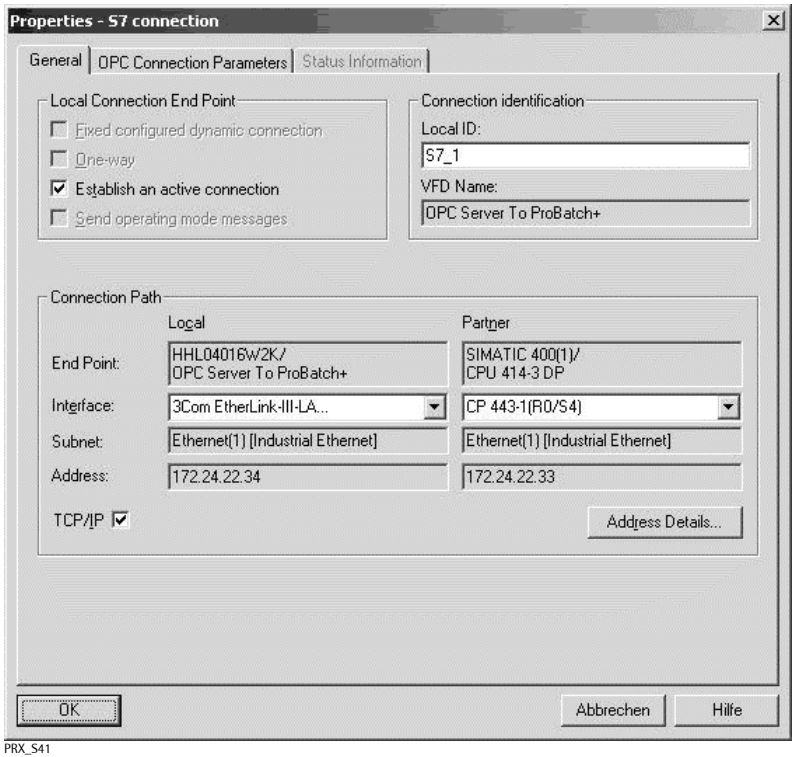
PRX_S10

To insert a new S7 connection, double click in the connection table, and choose the connection partners.

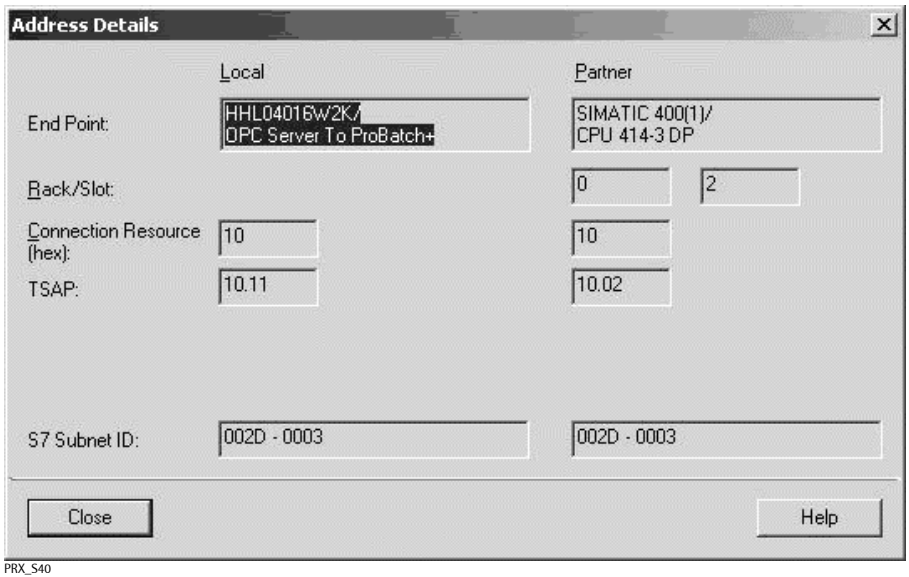


PRX_S43

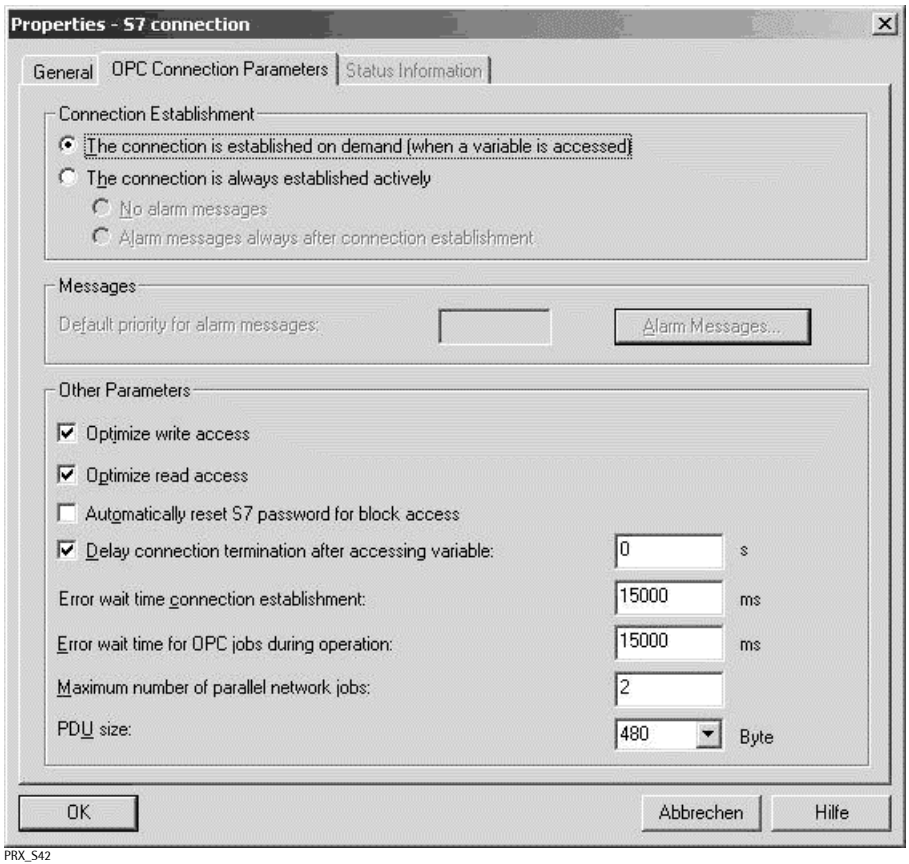
Set a new name for your connection at 'Connection identification'. The name e.g. 'S7_1' is used in configuration of ProBatch+.



PRX_S41



PRX_S40



PRX_S42

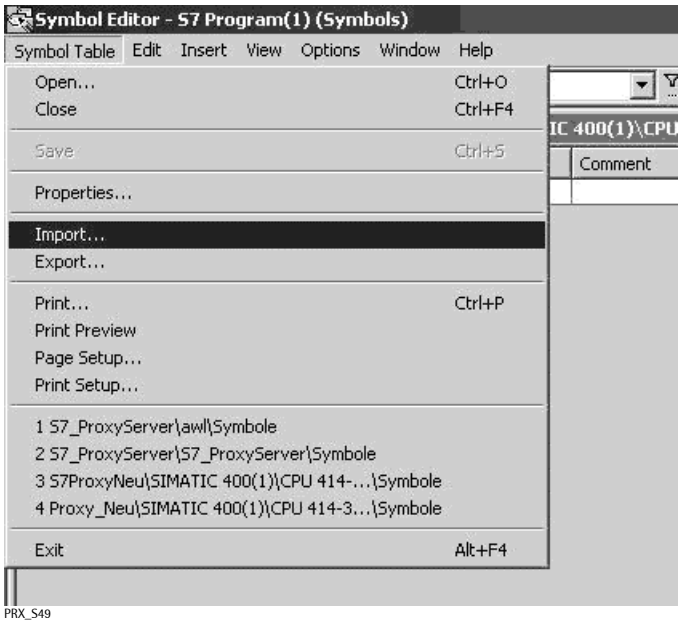
After setup of the connection configuration, the configuration must be downloaded to the S7 PLC and Station manager on your PC.

Note:
Therefore the PG/PC-Interface has to be set to 'PC-internal (local)'.

2.2.5. Loading S7 Code into Project

2.2.5.1. Import Symbol Table

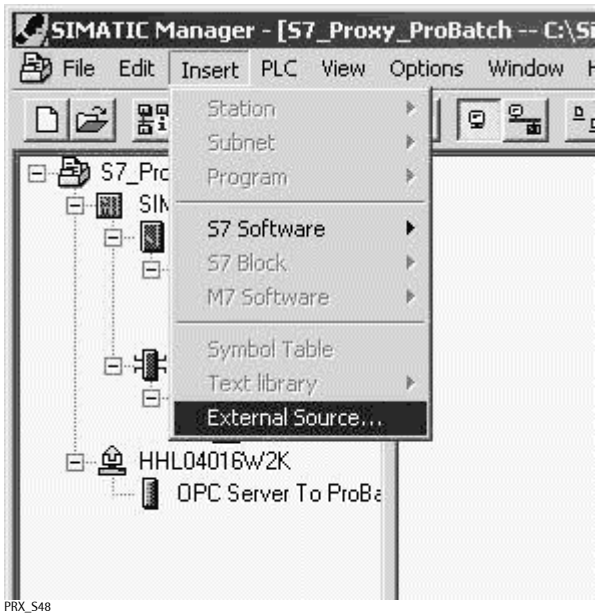
First import the Symbol Table file '**symtab.asc**' from the 'Common' Folder into the project. It define symbols used by symbolic programming. If the project already used any of the symbols just imported you must resolve any conflicts.



PRX_S49

2.2.5.2. Import sources

Copy the source data into the S7 folder 'Sources'.



PRX_S48

The STL or SCL sources are located in the installation path of the S7 Proxy Server Kit.
C:\ ... \S7ProxyServerKit\AWL ('AWL' for 'STL'-language) or
C:\ ... \S7ProxyServerKit\SCL (if available)

First the source 'gwttypes' has to be compiled. A number of UDTs will be created.
After that the source 'gwtproxy' is compiled. You will get:

- FB100, gwtproxyfb

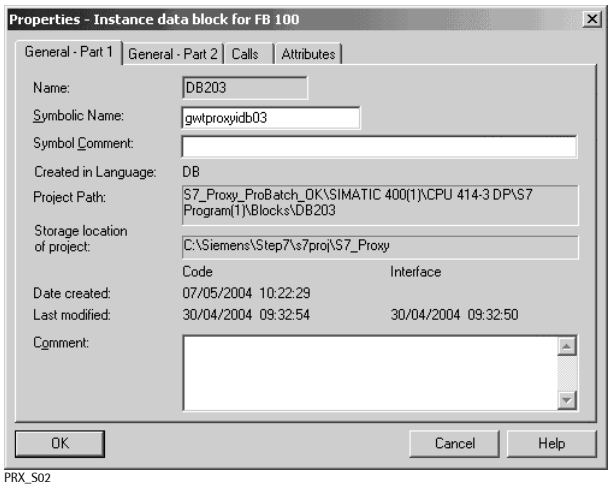
- FC101, Profi_IO
- FC102, byte_to_int
- DB201, gwtproxyidb01, data block for weighing point A from Phase Controller 1
- DB202, gwtproxyidb02, data block for weighing point B from Phase Controller 1
- DB300

If the programing language SCL is installed, the SCL-compile control file 'makefile' can be used for automatic compiling.

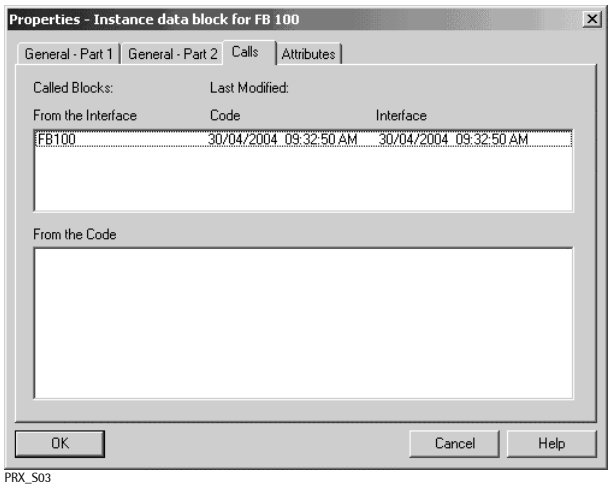
2.2.6. Adding Devices

For each X4/X5 that is being connected to the S7 Profibus and used by ProBatch+ one instance DB of type 'gwtproxyfb' must be instantiated.
Simply mark the data block 'gwtproxyidb01'. Copy and paste it for each additional weighing point. Rename the newly created instances e.g. 'gwtproxyidb03', 'gwtproxyidb04', etc.

An example is shown below:



PRX_S02



PRX_S03

2.2.7. Proxy Calling Sequence

The application programmer has to ensure that the Proxy is called often enough (cyclic) to be able to handle all data transport.

Since the Proxy is a function block, it may be called with different instance DBs as actual call paramters to realize several different weighing points. An example call sequence in STL is contained in the installation folder (C:\ ... \S7 Proxy Server Kit \ Common) in the file 'ob1.AWL'. Here's an excerpt:

```
// Start Proxy calling code:

// profibus addresses mentioned here are NOT device addresses but
// mapping addresses assigned to device by hardware-config

       L      W#16#10;               // profibus IN-address of X5
       T      gwtproxyidb01.dp_in;
       L      W#16#10;               // profibus OUT-adress of X5
       T      gwtproxyidb01.dp_out;
       L      0;                     // ASK param for later proxy-
extensions
       T      gwtproxyidb01.ask;
       L      300;                   // message DB number
       T      gwtproxyidb01.lData;
      CALL   gwtproxyfb, gwtproxyidb01;
```

WP specific data is copied to the instance DB (here it is 'gwtproxyidb01') and then the proxy is called with that DB as instance DB.

2.2.8. S7 Resources Used

The Proxy uses one DB of 224 bytes per Simatic S7 to route asynchronous messages from weighing points (WP) to batch manager and one DB of 426 Bytes per connected weighing point. The DB for asynchronous messages is private storage area of the Proxy whereas some areas of the weighing point DBs are of interest for the S7 application to watch the process and/or even intercept it.

DB of 426 Bytes per connected WP

Address		
0 319	Phase parameter	For PLC-Controller for reading
320 383	Profibus image	
384 391	SPM_in	For PLC-Controller for reading
392 399	SPM_out	For PLC-Controller for writing
400 425	private proxy variable	

The Phase parameters area contains structure, variables and their content as outlined in the 'Phase Controller' documentation accompanying this document.
The 'SPM_out' and 'SPM_in' areas (384 ... 396) are part of the virtual SPM of the Phase Controller, which is automatically exchanged by the Proxy. Their content may e.g. be used to synchronize S7 actions to a phase start.

All variables of the 426 Byte structure of one weighing point. For additional information see the Phase Controller operation manual.

	variable	Data type	comment
0.0	iCommand	BYTE	"SINT; (* command for phase status *)"
1.0	oStatus	BYTE	"SINT; (* current phase status *)"
2.0	iMsgStatus	BOOL	Message transfer status flags
2.1	oMsgStatus	BOOL	Message transfer status flags
2.2	bTextStatus	BOOL	asynchronuous message transfer request
2.3	lPowerFail	BOOL	powerfail occurred
2.4	tb08	BOOL	reserved
2.5	tb04	BOOL	reserved
2.6	tb02	BOOL	reserved
2.7	tb01	BOOL	reserved
3.0	oUnit	BYTE	"SINT; (* = ENUM_TO_INT(WEIGHT_UNIT(wgt)) *)"
4.0	oExpo	BYTE	"SINT; (* = WEIGHT_EXPO(wgt) *)"
5.0	oStep	BYTE	"SINT; (* = WEIGHT_VALUE(GET_WEIGHT(WGT_TYP#STEP)) *)"
6.0	oPhaseError	BYTE	"USINT;(* errorcodes *)"
7.0	oWPError	BYTE	"USINT;(* same on display *)"
8.0	oWPFlags	BYTE	weighing point status
9.0	oPhaseFlags	BYTE	state of phase. Coarse- or fine stream active, alarm, ...
10.0	iRecipeLine	WORD	"UINT; (* line number in recipe *)"
12.0	iSPMin	INT	"UINT; (* number of enable bit for material *)"
14.0	iSPMout	INT	"UINT; (* component output bit *)"
16.0	iRstMode	WORD	"UINT; (* restart mode *)"

18.0	iCalTime	WORD	"UINT; (* calming time in 100 ms *)"
20.0	oSig	DINT	Signature of device
24.0	oFSD	REAL	Full scale deflection
28.0	oGross	REAL	actual gross value of scale
32.0	oActual	REAL	actual net value during dosing
36.0	bSetpoint	REAL	setpoint for dosing
40.0	iPreset	REAL	presetpoint parameter
44.0	bOvershoot	REAL	overshoot parameter
48.0	iNegTol	REAL	range for negative tolerance parameter
52.0	iPosTol	REAL	range for positive tolerance parameter
56.0	iFlowRate	REAL	minimum flow rate
60.0	iMinScale	REAL	value for analogue output
64.0	iMaxScale	REAL	value for analogue output
68.0	lStatus	BYTE	actual state of the phase
69.0	iPLineID	BYTE	Production line ID
70.0	iRecipeID	STRING[20]	name of recipe
92.0	iMatID	STRING[20]	name of material
114.0	iBatchMode	STRING[20]	Batching mode: e.g. 'B1'
136.0	bTextpar	STRING[160]	Text parameter
289.0	lData	INT	
300.0	oLicense	BYTE	state of license
301.0	oMsgActive	BYTE	message is active
302.0	fillerb	BYTE	
304.0	filler	ARRAY[0..15] BYTE	
320.0	rd_data	ARRAY[0..31] BYTE	buffer for storing last read profibus message
352.0	wr_data	ARRAY[0..31] BYTE	buffer for assembling a write profibus message
384.0	oSpm_0	DWORD	8 byte data range copied from Phase Controller to PLC.
388.0	oSpm_1	DWORD	
392.0	iSpm_0	DWORD	8 byte data range copied from PLC to Phase Controller.
396.0	iSpm_1	DWORD	
400.0	pb_stat	WORD	Last S7 profibus system call result
402.0	ask	INT	reserved for future extension, defined for compatibilty
404.0	idb_nr	INT	own instance DB number
406.0	dp_in	WORD	Stored profibus I/O memory address for this instance (=PR1721 Mapping)
408.0	dp_out	WORD	
410.0	state	INT	State of Proxy's internal Profibus tranfer state machine
412.0	last_ans	BYTE	last answered message atom ident
414.0	change_ctr	INT	timeout counter to recogbnize whether WP is alive on profibus or not
416.0	init_ctr	INT	cyclic use of tele 2/3 instead of 0/1 to track FSD etc.
418.0	fast_init	BOOL	make second Profibus-cycle use tele 2/3 to get FSD quickly
418.1	sema_set	BOOL	remember whether this instance has set the asynchronuous msg buffer flag
420.0	msgstate	INT	remember asynchronuous message transfer states
422.0	lstMsgActive	BYTE	last profibus transferred message atom ident
423.0	icmd_latch	BYTE	latched OPC iCommand

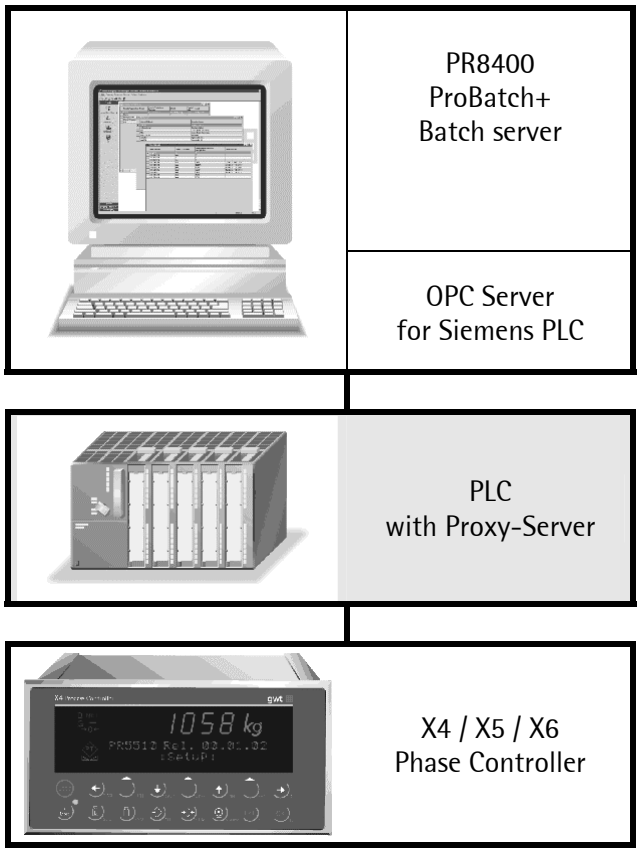
2.3. Setup ProBatch+ and Phase Controller

To run the S7 Proxy with ProBatch+ the following steps are necessary:

- Hardware setup of X4 / X5 /X6 devices
- X4 / X5 / X6 Software Setup
- S7 Software Setup (see chapter Installation)

2.3.1. Hardware Setup

In order to communicate via OPC a hardware connection between the PC running ProBatch+ and the S7 is required. Usually this is either a TCP/IP network connection or a Profibus connection. Any connection is suitable for which a Simatic OPC server is available.
The second connection is a Profibus DP between S7 and an X4/X5/X6 device. The S7 must have at least one Profibus device adress available and the X4/X5 must be equipped with a PR1721/xx Profibus DP interface board. S7 and X4/X5 must be connected via Profibus cable.

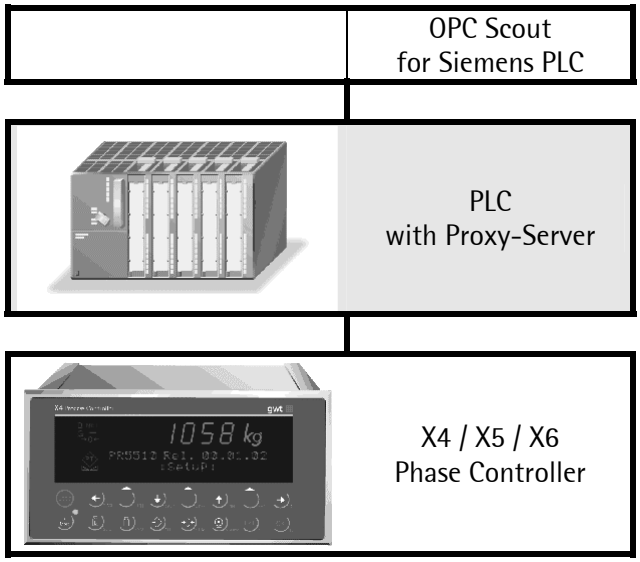


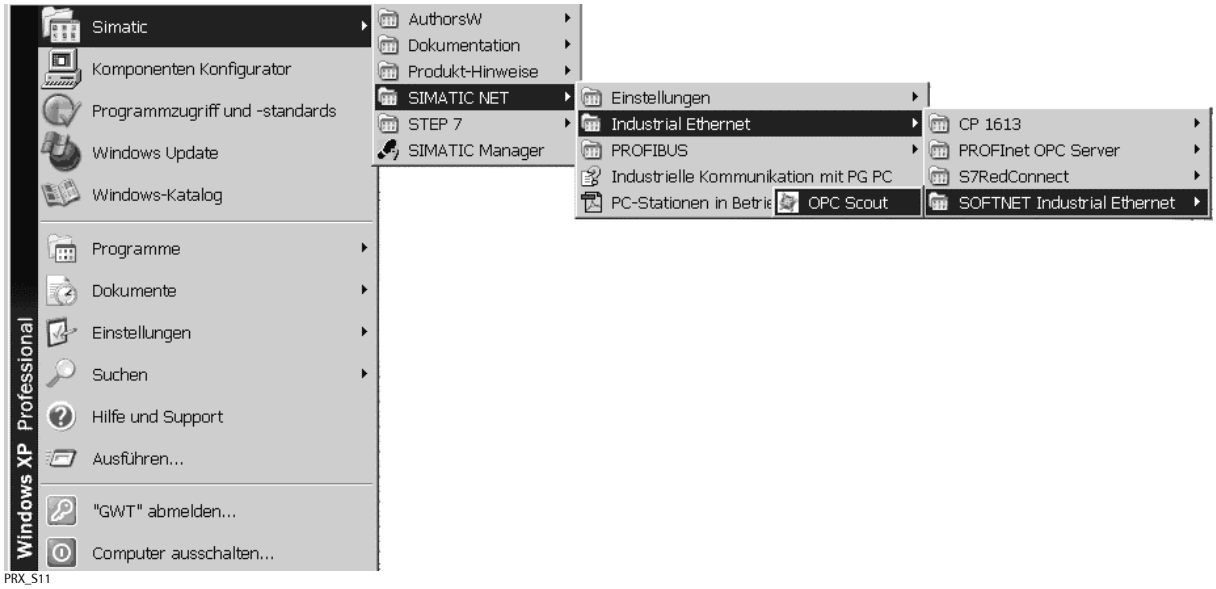
2.3.2. X4 / X5 / X6 Software Setup

In the Phase Controller the appropriate Bios, Firmware as well as the Phase Controller Application is already flashed. The Phase Controller license is enabled.
Via the 'Setup' menue the 'Fieldbus Parameter' must be set to either '32 Byte I/O' or '64 Byte I/O' depending on the number of weighingpoints this device is going to have. A unique 'Profibus-DP address' must be entered. And the parameter 'Scale-interface' at the 'Fieldbus parameter' **must** be disabled!
For further information see Phase Controller manual.

2.3.3. Testing the communication

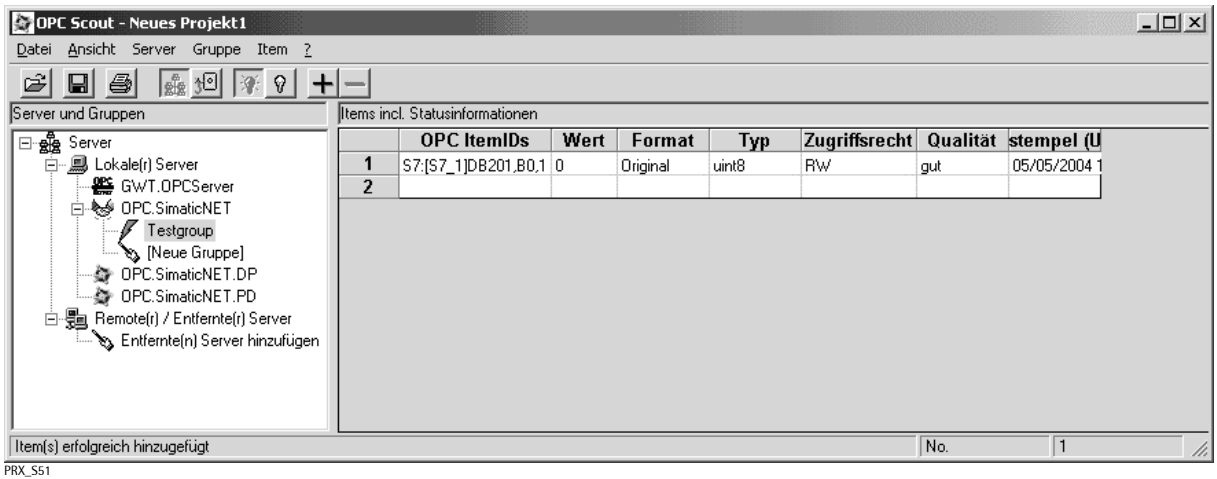
After saving, compiling and loading the configuration to all stations you should start the Simatic OPC Scout matching your connection between PC station and Simatic S7 station.





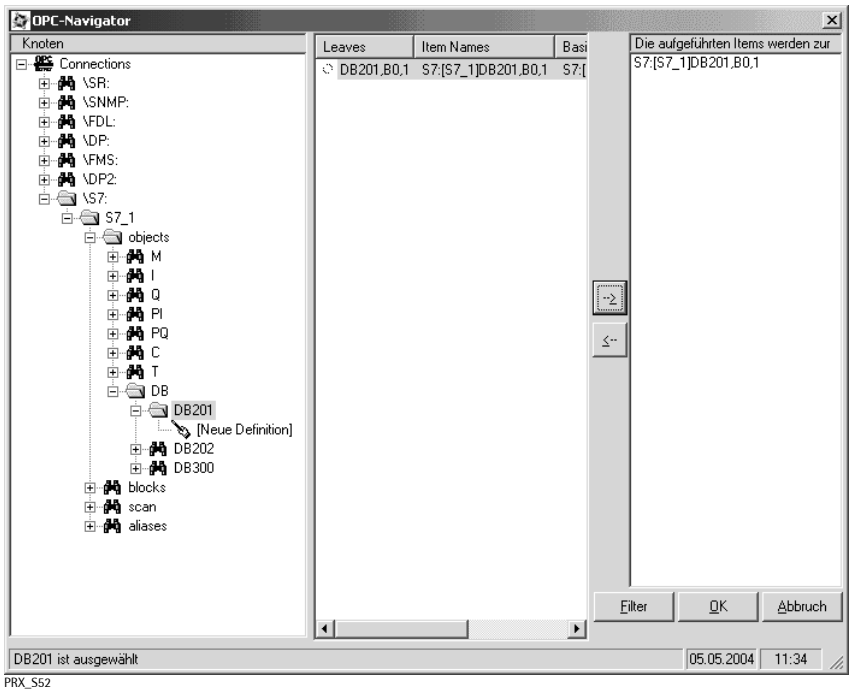
PRX_S11

Add some existing (!) variables, to check their quality is 'good' and they are 'alive'.



PRX_S51

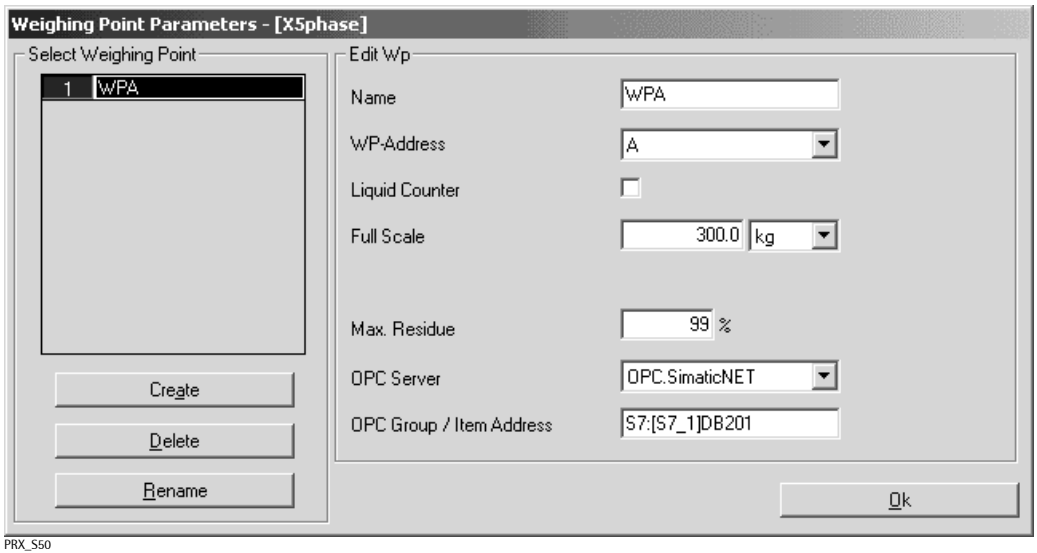
Example, how to add a new item:



PRX_S52

2.3.4. Weighing point configuration in ProBatch+

Finaly setup the weighing point in the ProBatch+ configuration.



PRX_S50

In field OPC Group / Item Address:

The symbolic name [S7_1] was set in the NetPro configuriation.

DB201 is the instance data block for weighing point A. See chapter 2.2.5.2

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