

Example program for PLC control

Proxy Server

Programming manual



Programming manual for Proxy server

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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.



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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:



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 •

Configure Simatic Net 2.2.2.

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'.



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.

	ait insert	FLC VIEV		Wind0W	noip	
28	日日。	5 B	Custon	nize	Ctrl+Alt+E	_
			Specify Configu Symbol	v Module. ure Netwo I Table	ork Ctrl+Alt+T	
iiii (0) U	R2		Report	System B	Error,	
1/2	PS 407	4A 14-3 DP	Edit Ca Update	italog Proi e Catalog	file	IOF
x	DP		Install	HW Updal	tes	
XT	MPI/D	P	Install	New GSD.		
IF1			Import	Station G	SD	
4	H CP 443	PT)				_
5	- 1 -					
6						
7						

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)'.



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

Properties - PROFIBUS interface PR1721/11 Profibus Exten		×
General Parameters		
Address:		
Transmission rate: 1.5 Mbps		
<u>S</u> ubnet:		
not networked PROFIBUS(1) 1.5 Mbos	1	<u>1</u> ew
	P <u>r</u> o	perties
	[Dejete
ОК	Cancel	Help

PRX_S05

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



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.



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.

(10) PR1721/11 Profibus Exten							
Slot	🛽 DP ID	Order Number / Designation	I Address	Q Address	Comment		
1	16AX	16 Word I/O Konsistent	512543	512543			
2	16AX	16 Word I/O Konsistent	544575	544575			
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.



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

sert New Co	nnection	I
<u>Connection</u>	Partner	-
	he current project S7ProxyServer_ProBatch SIMATIC 400(1) (Unspecified) All broadcast stations All multicast stations inknown project	
Project:	S7ProxyServer_ProBatch	
		<u> </u>
<u>Station:</u>	SIMATIC 400(1)	<u> </u>
<u>S</u> tation: <u>M</u> odule:	SIMATIC 400(1) CPU 414-3 DP	<u>{</u>
<u>S</u> tation: <u>M</u> odule: - Connection	SIMATIC 400(1) CPU 414-3 DP	<u> </u>
<u>S</u> tation: <u>M</u> odule: Connection <u>T</u> ype:	SIMATIC 400(1) CPU 414-3 DP	<u></u>
Station: <u>M</u> odule: -Connection <u>T</u> ype: <u>D</u> isplay p	SIMATIC 400(1) CPU 414-3 DP S7 connection T oroperties before inserting	<u></u>
Station: Module: Connection Lype: Display	SIMATIC 400(1) CPU 414-3 DP S7 connection roperties before inserting	<u>_</u>
<u>S</u> tation: <u>M</u> odule: -Connection <u>I</u> ype: I♥ <u>D</u> isplay OK	SIMATIC 400(1) CPU 414-3 DP S7 connection T Apply Cancel Help	<u></u>

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

Local Connec	tion End Point	Local ID:		
 		S7_1 VFD Name:		
🔽 Establish a	an active connection			
Send oper	rating mode messages	OPC Server To ProBatch+		
Connection P	ath			
	Lo <u>c</u> al	Part <u>n</u> er		
End Point:	HHL04016W2K/ OPC Server To ProBatch+	SIMATIC 400(1)/ CPU 414-3 DP		
Int <u>e</u> rface:	3Com EtherLink-III-LA	CP 443-1(R0/S4)		
Subnet:	Ethernet(1) [Industrial Ethernet]	t] Ethernet(1) [Industrial Ethernet]		
Address:	172.24.22.34	172.24.22.33		
TCP/IP 🔽		Add <u>r</u> ess Details		

PRX_S41

	Local	<u>P</u> artner
End Point:	HHL04016W2K/ OPC Server To ProBatch+	SIMATIC 400(1)/ CPU 414-3 DP
<u>B</u> ack/Slot:		0 2
Connection Resource (hex):	10	10
TSAP:	10.11	10.02
67 C. b	0020 - 0003	

• The connection is established on demand (when a variable	is accessed)	
C The connection is always established actively C No alarm messages		
C Alarm messages always after connection establishment	4	
Messages		
Default priority for alarm messages:	Alarm M	essages
Automatically reset S7 password for block access Delay connection termination after accessing variable:	0	S
Error wait time <u>c</u> onnection establishment:	15000	ms
Error wait time for OPC jobs during operation:	15000	ms
End wak and for of clobs during operation.	2	
Maximum number of parallel network jobs:	1 m m	

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:

Properties - Instance da	ata block for FB 100	×	Propert	ies - Instance data b	lock for FB 100		×
General - Part 1 Genera	I - Part 2 Calls Attributes		Gener	al - Part 1 General - Pa	rt 2 Calls Attributes		
Name:	DB203		Calle	d Blocks:	Last Modified:		
Symbolic Name:	gwtproxyidb03		From	the Interface	Code	Interface	
Symbol Comment:			FB1	00	30/04/2004 09:32:50 AM	30/04/2004 09:32:50 AM	
Created in Language:	DB						
Project Path:	S7_Proxy_ProBatch_OK\SIMATIC Program(1)\Blocks\DB203	400(1)\CPU 414-3 DP\S7					
Storage location of project:	itorage location of project: C:\Siemens\Step7\s7proj\S7_Proxy		From	i the Code			_
Date created: Last modified:	Code 07/05/2004 10:22:29 30/04/2004 09:32:54	Interface 30/04/2004 09:32:50					
Comment:		× 					
OK		Cancel Help	0	К		Cancel	Help
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
       Т
               gwtproxyidb01.dp in;
               W#16#10;
                                       // profibus OUT-adress of X5
       L
       Т
               gwtproxyidb01.dp out;
                                       // ASK param for later proxy-
       L
               0;
extensions
       Т
               gwtproxyidb01.ask;
       L
               300;
                                       // message DB number
       Т
               gwtproxyidb01.1Data;
       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.

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

DB of 426 Bytes	per	connected	WP
-----------------	-----	-----------	----

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	IPowerFail	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	оЕхро	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	IData	INT	
300.0	oLicense	BYTE	state of license
301.0	oMsgActive	BYTE	message is active
302.0	fillerb	BYTE	
304.0	filler	ARRAY[015] BYTE	
320.0	rd_data	ARRAY[031] BYTE	buffer for storing last read profibus message
352.0	wr_data	ARRAY[031] 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
408.0	dp_out	WORD	(=PR1721 Mapping)
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	IstMsgActive	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.

Testing the communication 2.3.3.

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.



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

OPC Scout	- Neues Projekt1									- 🗆 🗙
<u>D</u> atei <u>A</u> nsicht	: Server Gruppe Item <u>?</u>									
B	🗿 🚠 🖭 🐺 🛛 🛨									
Server und Grup	open	Items inc	cl. Statusinformationen							
🖃 🙀 Server			OPC ItemIDs	Wert	Format	Тур	Zugriffsrecht	Qualität	stempel (U	
📃 🚊 Loł	kale(r) Server	1	S7:[S7_1]DB201,B0,1	0	Original	uint8	BW	gut	05/05/2004 1	
OPC	GWT.0PCServer	2								
0	OPC.SimaticNET									
	Testgroup									
	Neue Gruppe]									
2	OPC.SimatioNET.DP									
	mote(r) / Entfernte(r) Server									
	Entfernte(n) Server binzufügen									
×	Environ Ko(n) Conton hinzaragon									
<u> </u>										
Item(s) erfolgrei	ch hinzugefügt							No.]1	11.

PRX_S51

ЧX

Example, how to add a new item:

💱 OPC-Navigator						×
Knoten	Leaves	Item Names	Basi	Die auf	geführten Items	werden zur
□ ♣ A \SR: ● ♣ \SR: ● ♠ \SR: ● ♠	○ D8201.80,1	\$7:[\$7_1]DB201,B0,1	[\$7.[\$7	_1]DB201,B0,1	Abbush
	•		Ð			
DB201 ist ausgewählt					05.05.2004	11:34 //.

PRX_S52

2.3.4. Weighing point configuration in ProBatch+

Finaly setup the weighing point in the ProBatch+ configuration.

Weighing Point Parameters - [X5ph	ase]		
CSelect Weighing Point	Edit Wp		
1 WPA	Name	WPA	
	WP-Address	A	•
	Liquid Counter		
	Full Scale	300.0 kg	•
	Max. Residue	99 %	
Create	OPC Server	OPC.SimaticNET	•
	OPC Group / Item Address	S7:[S7_1]DB201	
<u> </u>			
<u>R</u> ename			<u>0</u> k
DDV STO			
LUV_200			

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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