SIEMENS

CMS X-Tools

User Manual - ION SIMATIC S7 PN

English

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Safety Guidelines

This document contains notices which you should observe to ensure your own personal safety as well as to avoid property damage. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring to property damage only have no safety alert symbol.

Danger

indicates an **imminently** hazardous situation which, if not avoided, will result in death or serious injury.

Warning

indicates a **potentially** hazardous situation which, if not avoided, could result in death or serious injury.

Caution

used with the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Caution

used without safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Notice

used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state.

When several danger levels apply, the notices of the highest level (lower number) are always displayed. If a notice refers to personal damages with the safety alert symbol, then another notice may be added warning of property damage.

Qualified Personnel

The device/system may only be set up and operated in conjunction with this documentation. Only qualified personnel should be allowed to install and work on the equipment. Qualified persons are defined as persons who are authorized to commission, to earth, and to tag circuits, equipment and systems in accordance with established safety practices and standards.

Intended Use

Please note the following:

Warning

This device and its components may only be used for the applications described in the catalog or technical description, and only in connection with devices or components from other manufacturers approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up and installed correctly, and operated and maintained as recommended.

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Disclaimer of Liability

We have checked the contents of this document for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in the manual are reviewed regularly, and any necessary corrections will be included in subsequent editions. Suggestions for improvement are welcomed.

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1   Preface

1.1   Purpose of this Document

This document provides an introduction and supports you when commissioning and using the software

- ION SIMATIC S7 PN

of the CMS X-Tools product line.

1.2   Basic Knowledge required

In order to understand this manual, general knowledge of automation technology and software packages CMS X-Tools (in the following, *X-Tools*), STEP 7, S7-SCL, S7-CFC is required.

In addition, you must be familiar with network technology (UDP/IP) and with using computers with Windows.

1.3   Validity of this Document

This document is valid for the following software:

- CMS X-Tools ION SIMATIC S7 PN V 01.03

During the following pages, this software will be referred to by the term *ION SIMATIC S7 PN*.

1.4   Terms

The following terms are used within this document:

Definition	Description
CP	Communication Processor
DB	Data Block
FB	Function Block
ION	I/O-Node
OB	Organization Block
UIK	Universal Identification Key
SW	Software

2   Scope of Delivery

2.1   Scope of Delivery

What is shipped?

- CD

  CMS X-Tools ION SIMATIC S7 PN - Software & Documentation

2.2   Unpacking and checking

After unpacking, please check

- the packet for completeness and
- all parts for transport damage.

Caution
Do not use any content / parts that show evidence of damage!

3   Product Characteristics

3.1   What is CMS X-Tools?

CMS *X-Tools* is an industrial-suited Condition Monitoring System for technical and technological services in industrial plants. *X-Tools* is a modular, scalable analysis and diagnosis system. It is optimized for reaction less measurement of analog, binary and numerical data. *X-Tools* can be integrated in existing and new industrial plants.

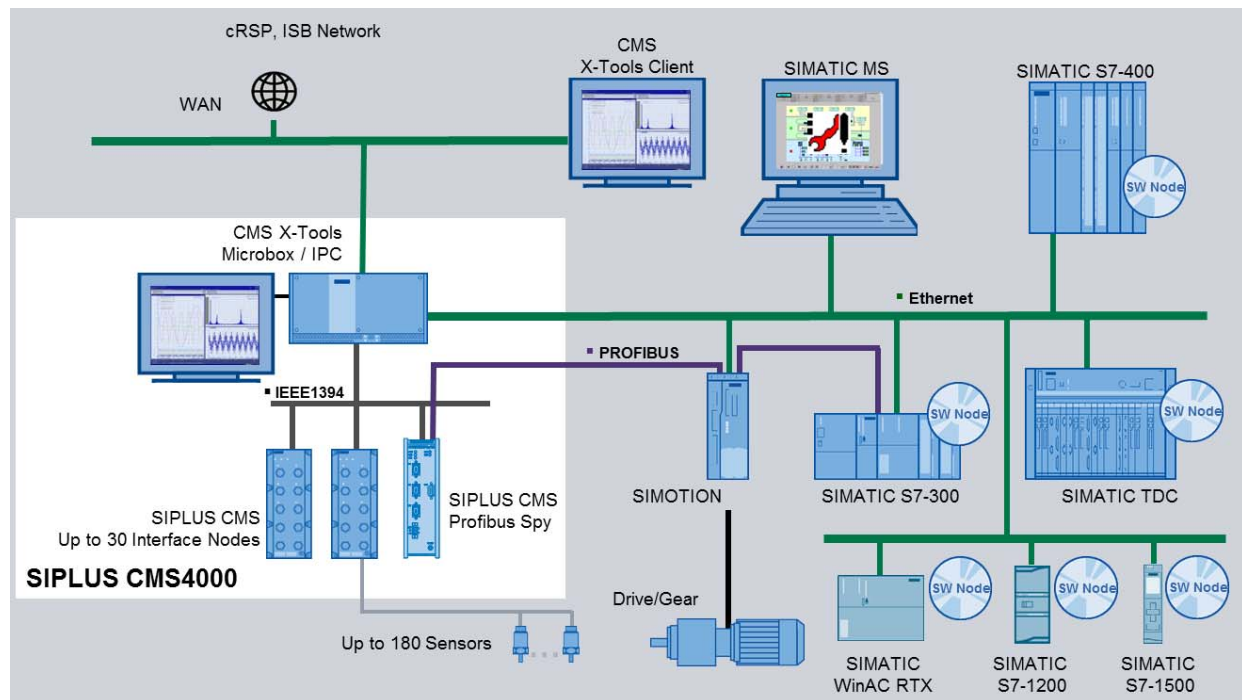*X-Tools* can be integrated into the TIA-Architecture:

Figure 1: Overview of the Components of X-Tools

3.2   Introduction

The *ION SIMATIC S7 PN* is used in order to acquire data from a SIMATIC S7 PN controller (S7-300, S7-400, or WinAC) and to transmit the recorded data via Ethernet (UDP) to a superior industrial PC. After the engineering, the *ION SIMATIC S7 PN* is used for the transmission of measurement data to *X-Tools*.

The usage of an *ION SIMATIC S7 PN* allows transmitting up to 712 byte of data. The data is divided into 178 channels and each channel consists of 32 bit (DWORD), where several signals can be merged to a channel.

The *ION SIMATIC S7 PN* consists of a function block which must be engineered into a SIMATIC S7 PN controller with an integrated PROFINET interface.

3.3   Hard- and Software Requirements

Hardware

- PC
  - o   the hardware demands of the PC are dependent to the used software
- SIMATIC Controller with integrated Ethernet / PROFINET interface
  - o   CPU 41x-3 PN/DP

- o CPU 31x-2 PN/DP

- o CPU 319-3 PN/DP

- o 41x-5H PN/DP

- o WinAC RTX

- Ethernet connecting cables

Software

- CMS X-Tools Professional (V 03.01 SP1 or higher)

- STEP7 (using V 5.4 + SP5 or higher)

3.4   Ordering Numbers

Article	Ordering Number (MLFB)
CMS X-Tools Professional V 04.02	9AE4160-1AB00

Further information is obtained from your local Siemens office and from the homepage
http://www.siemens.com/siplus-cms.

4   Block Description

4.1   Function

The **ION SIMATIC S7 PN** is used in order to acquire data from a SIMATIC S7 PN controller and to transmit the recorded data via Ethernet (UDP/IP) to a superior industrial PC. The **ION SIMATIC S7 PN** consists of a function block (FB) which must be engineered into a SIMATIC S7 PN controller with an integrated PROFINET interface. The communication protocol is UDP/IP.

The FB is called in a cyclic interrupt (e.g. OB35) and allows transmission of up to 712 byte of data each cycle. The data is divided into 178 channels and each channel consists of 32 bit (DWORD). The channels are filled with data in the S7 program. It is possible to merge several signals into one channel (e.g. two WORD signals).

A relative timestamp is automatically added to the transmitted data. Two different ways for the internal timestamp generation are possible. These can be selected by the input TIME_BASE. When using the system clock-based timestamp generation, the timestamp is directly calculated by reading the clock of the S7-CPU. In contrast to that, the timestamp is calculated out of the cycle time CYCLE_T in case of the counter-based time base.

Whenever the clock of the S7-CPU is synchronized (e.g. by NTP), the counter-based time base is recommended to avoid errors in the time domain check of X-Tools.

The FB is called in startup OB (OB100, OB101, OB102) for initialization. Therefore the parameter COM_RST is set to TRUE. During initialization the number of active channels is written, the cycle time is set and some other calculations for service are done.

Afterwards a phase begins, in which the FB runs along passive in the program. Only after **X-Tools** attempts to connect the FB is activated and it takes place data exchange with **X-Tools**. Details for engineering in **X-Tools** you can find in the user manual of **X-Tools**.

When data transmission is started the signals are transmitted to **X-Tools**. Therefore the signals are buffered in two buffers. Each buffer can store 712 bytes. With 178 active channels one buffer is transmission buffer and one is the buffer for the current data. The buffers are alternating written and transmitted. If not all channels are active more cycles can be buffered. With 89 active channels each buffer can buffer two measurement cycles, the transmission is initialized after each two cycles. The communication load can be reduced.

4.2   Parameters

Parameter	Declaration	Data type	Description
COM_RST	INPUT	BOOL	With ‚True' on this signal a reset of the FB is forced. During runtime it should be ‚False'. The FB remains in initializing routine as long as COM_RST is set to ‚True'.
CYCLE_T	INPUT	INT	Cycle time of calling alert in ms.
COMMAND_ID	INPUT	INT	ID for command connection (0x0001 … 0x0FFF).
DATA_ID	INPUT	INT	ID for data connection (0x0001 … 0x0FFF).
COMMAND_PORT	INPUT	WORD	Local UDP port for command connection (0x07D0 … 0x1388).
DATA_PORT	INPUT	WORD	Local UDP port for data connection (0x07D0 … 0x1388).
DEV_ID	INPUT	BYTE	Identifier for CPU type.
CURRENT_CHANNELS	INPUT	INT	Number of channels which are transmitted to X-Tools each cycle (1 … 178).
CHANNEL	INPUT	ARRAY[0..177] OF DWORD	Array, which defines the channels which shall be transmitted to X-Tools. A reading of peripherals is not possible.

Parameter	Declara-tion	Data type	Description
UIK0..UIK7	INPUT	BYTE	UIK of the **ION SIMATIC S7 PN**. See point 6.4 for details.
TIME_BASE	INPUT	BYTE	Time base for timestamp generation (0=system clock-based; 1=counter-based)
STATUS_CMD_TCON	OUTPUT	WORD	Status word of TCON function for command communication
STATUS_DATA_TCON	OUTPUT	WORD	Status word of TCON function for data communication

4.3 Conditions

During projecting of the *ION SIMATIC S7 PN* the conditions of all used components have to be respected. The *ION SIMATIC S7 PN* must not be called in OB1.

The minimum cycle time of the calling OB as the number of channels which can be transmitted properly in this time are specific for each project and hardly depending on SIMATIC CPU type and network usage. The used configuration has to be checked for stability and must not operate at the limit, because in case of errors (e.g. BUS errors) a higher CPU load must be expected.

Notice

Wrong project engineering can lead to errors or stop of the CPU.

5   Installation

5.1   Installation of the Library

Insert the product-CD "CMS X-Tools" into the drive of your PC. Start the SIMATIC Manager and open via **File > Retrieve...** the dialog for de-archiving of projects and libraries. Choose the path to your CD-drive and open the archive file "CMS X-Tools ION SIMATIC S7 PN V 01.03.zip" from the product CD. Finally choose the target directory and the storage path for the **ION SIMATIC S7 PN** library and confirm with OK.
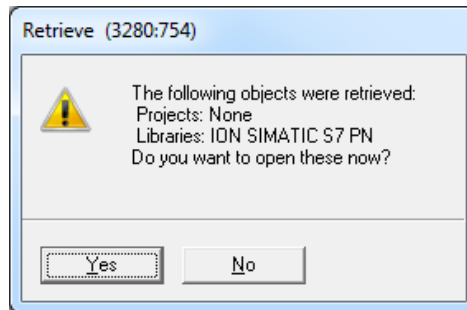

Figure 2: De-Archiving Dialog

When de-archiving is finished apply the shown dialog on "Yes" to open the library. The library is installed properly. After successful installation, the engineering can begin.
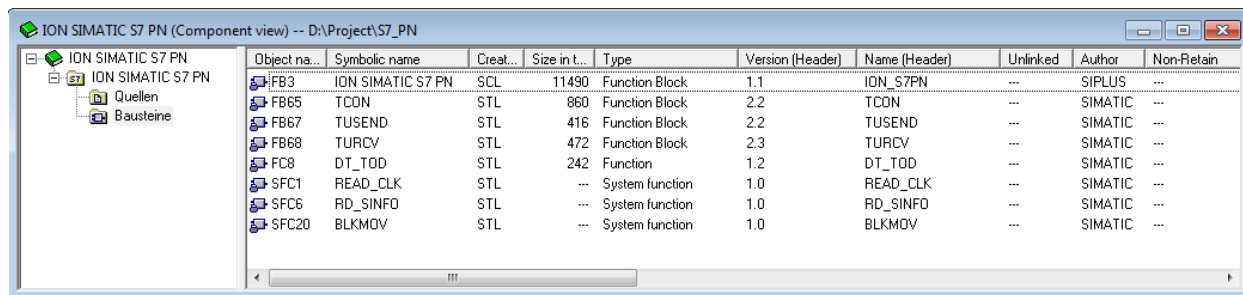

*Figure 3: The **ION SIMATIC S7 PN** Library after the Installation*

6 Engineering in AWL

6.1 Copying the necessary SW Components

Opening of the Library

If the library was not opened automatically, go to the SIMATIC Manager and choose **File > Open**. In the next dialog select the tab Libraries and choose the library "ION SIMATIC S7 PN". Afterwards confirm in the dialog with the "OK" button.
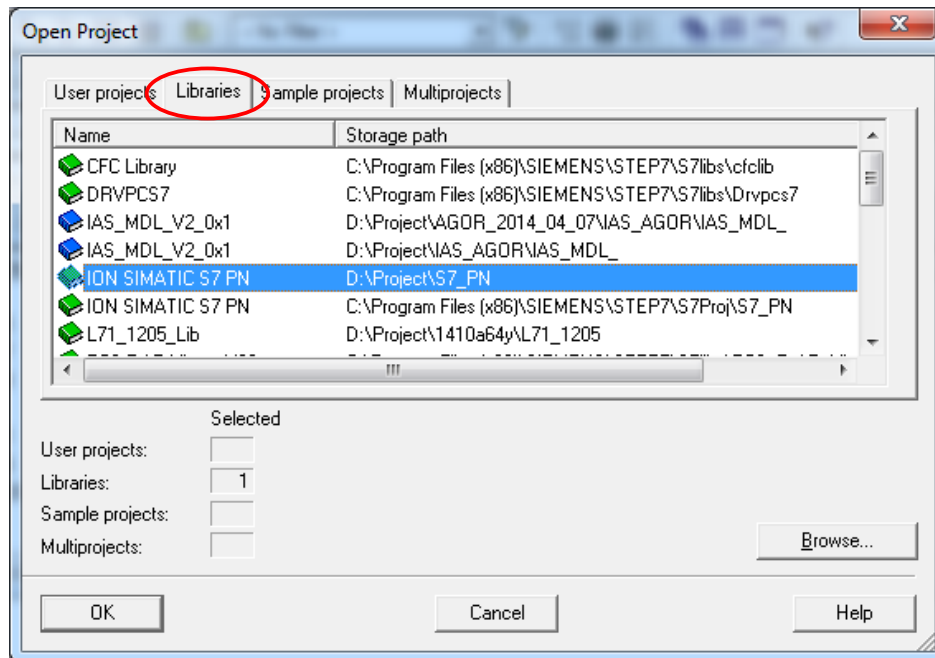

*Figure 4: Opening of the **ION SIMATIC S7 PN** Library*

To copy the necessary Components

Copy all SW components of the **ION SIMATIC S7 PN**. The SW components FB65, FB67, FB68, FC8, SFC6 and SFC20 originate from the library "Standard Library" and can be copied from this source.
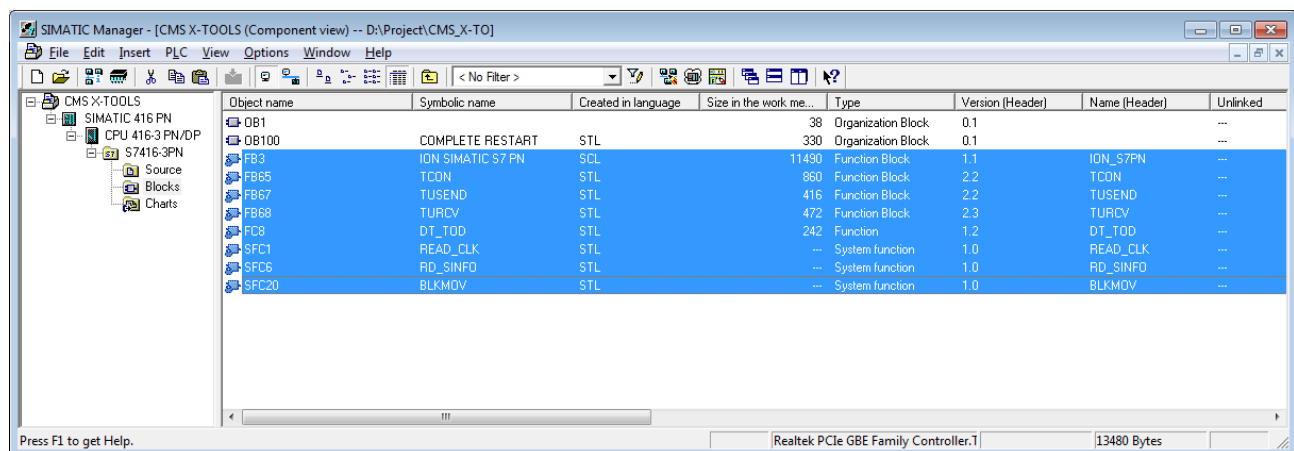

*Figure 5: The Components of the **ION SIMATIC S7 PN***

6.2   Calling the Function Block - Startup OBs (OB100, OB101 and OB102)

Description

The component *ION SIMATIC S7 PN* must be connected in the Startup OBs, to allow a system restart when the CPU initiates the restart.

The following table shows the available Startup OB types:

Type of Startup	Corresponding OB
Hot restart	OB 101
Warm restart	OB 100
Cold restart	OB 102

Check which Startup OBs are used by your CPU and which Startup OBs your application needs for proper initialization in all states. Maybe you need to implement more than one Startup OB. In the following part the implementation of OB100 is shown as example.

Function Block call

If the OB100 is not available jet you must insert it into your program. For this, right Mouse click on the component folder and select **Insert new Object > Organization Block**.
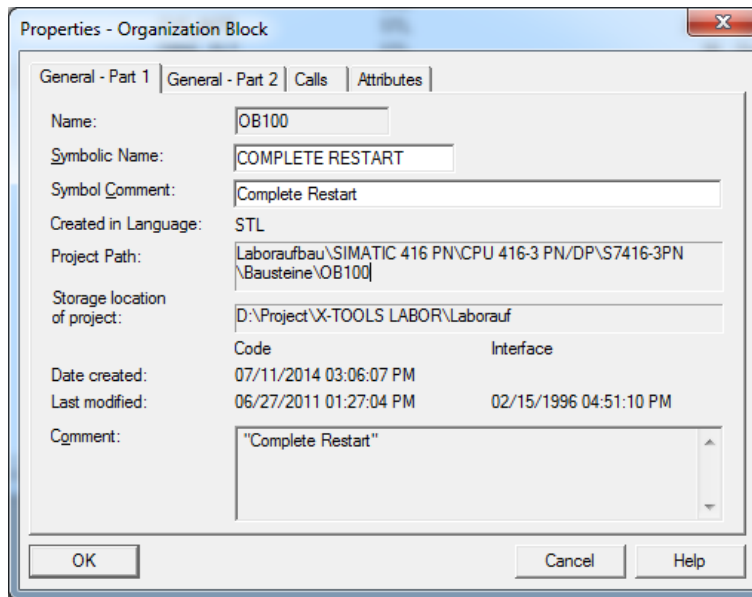

Figure 6: Insert a new Organization Block

Open the OB100 via a double click and add a call of FB3. The assigned instance database can be freely selected (select any free number, in the example DB31). Afterwards confirm in the dialog with the "Yes" button and the DB is automatically generated by the SIMATIC manager.
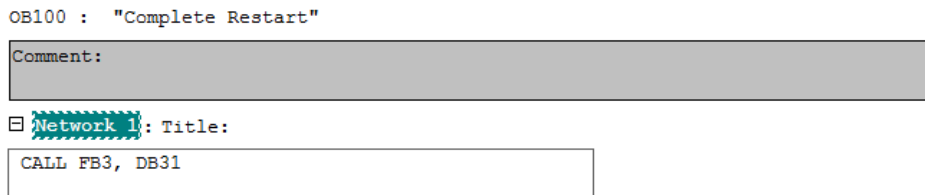

Figure 7: Calling of FB3 in the OB100

Now you must set the parameter COM_RST with TRUE to initialize the **ION SIMATIC S7 PN**. For the parameter DEV_ID you must insert the identifier for your CPU according to the following table:

WinAC RTX IF1	B#16#01
315-2 PN/DP, 317-2 PN/DP	B#16#02
319-3 PN/DP	B#16#03
414-3 PN/DP, 416-3 PN/DP, 41x-5H PN/DP (Rack0)	B#16#05
WinAC RTX IF2	B#16#06
WinAC RTX IF3	B#16#0B
WinAC RTX IF4	B#16#0F
41x-5H PN/DP (Rack1)	B#16#15

Afterwards save and close the component.

```
CALL  "ION SIMATIC S7 PN" , "DB_S7PN_01"    FB3 / DB31
 COM_RST           :=TRUE
 CYCLE_T           :=
 COMMAND_ID        :=
 DATA_ID           :=
 COMMAND_PORT      :=
 DATA_PORT         :=
 DEV_ID            :=B#16#5
 CURRENT_CHANNELS:=
 CHANNEL           :=
 UIK0              :=
 UIK1              :=
 UIK2              :=
 UIK3              :=
 UIK4              :=
 UIK5              :=
 UIK6              :=
 UIK7              :=
 TIME_BASE         :=
 STATUS_CMD_TCON :=
 STATUS_DATA_TCON:=
```

*Figure 8: Initialized Parameter List of the **ION SIMATIC S7 PN** in the OB100*

6.3   Calling the Function Block - OB3x Cyclic Interrupts

Description

The acquisition and transmission of measurement data is done via a function call in a cyclic interrupt (OB3x). The sample time matches the cycle time of this OB. It can be configured in HW Config. It is recommended to use a cycle time between 10ms and 100ms.

Write data into the Transmission Channel

Insert new cyclic interrupt-OB into your program, or work on an existing one in your program. In the following example OB35 is used.

The channels which can be observed will be supplied. There exists of up to 178 channels each having 4 bytes per channel for a total of 712 bytes. The up to 178 channels are sent cyclically to the PC after *X-Tools* has connected with the *ION SIMATIC S7 PN*. The current measuring data is determined by the configuration of these up to 178 channels. For the beginning you must fill the data block. Therefore you have two options:

a) Load the data and transfer it directly into the destination channel in the DB. The editor produces the database addresses automatically via input of the channel numbering in the format "DB3.CHANNEL [*index*].

b) All data can be written into an array which can be set to the input CHANNEL of the FB3 during block call.

Figure 9: Filling of the Data

Write Data into the Transmission Channel

When the channels are filled with data you can add an additional network and project your **ION SIMATIC S7 PN** as follows:

```
CALL  "ION SIMATIC S7 PN" , "DB_S7PN_01"      FB3 / DB31
  COM_RST          :="Reset S7 PN"           M0.3
  CYCLE_T          :=#OB35_EXC_FREQ           #OB35_EXC_FREQ
  COMMAND_ID       :=31
  DATA_ID          :=32
  COMMAND_PORT     :=W#16#7D0
  DATA_PORT        :=W#16#7D1
  DEV_ID           :=B#16#5
  CURRENT_CHANNELS:=178
  CHANNEL          :=#Datenkanal              #Datenkanal
  UIK0             :=B#16#22
  UIK1             :=B#16#67
  UIK2             :=B#16#42
  UIK3             :=B#16#0
  UIK4             :=B#16#0
  UIK5             :=B#16#0
  UIK6             :=B#16#0
  UIK7             :=B#16#1
  TIME_BASE        :=B#16#1
  STATUS_CMD_TCON :=
  STATUS_DATA_TCON:=
```

Figure 10: Component Call in the OB35

In the cyclic interrupt COM_RST must be set to FALSE during runtime of the block. Enter for the parameter CYCLE_T the temporary component variable OB3x_EXC_FREQ. This setting defines the cycle time of the interrupt OB3x.

For the communication you need to specify connection IDs and port numbers. Enter for the parameter COMMAND_ID a connection ID for the command connection (0x0001…0x0FFF) and for the parameter DATA_ID a connection ID for the data link (0x0001…0x0FFF). Enter for the parameter COMMAND_PORT a UDP port for the command connection (0x07D0…0x1388). As in the example port 2048 which can be selected freely. Enter for the parameter DATA_PORT a UDP port for the data link (0x07D0…0x1388). As in the example port 2049 which can be selected freely.

Enter for the parameter DEV_ID the identifier for your SIMATIC S7 CPU according to the following list:

WinAC RTX IF1	B#16#01
315-2 PN/DP, 317-2 PN/DP	B#16#02
319-3 PN/DP	B#16#03
414-3 PN/DP, 416-3 PN/DP, 41x-5H PN/DP (Rack0)	B#16#05
WinAC RTX IF2	B#16#06
WinAC RTX IF3	B#16#0B
WinAC RTX IF4	B#16#0F
41x-5H PN/DP (Rack1)	B#16#15

Enter for the parameter CURRENT_CHANNELS the channels to be transmitted per cycle (1…178). Attention, also empty channels are transmitted.

For the parameter CHANNEL it is optional to enter a field which contains the measurement data. This is valid only for 178 channels.

For the last inputs you have to configure the UIK of the **ION SIMATIC S7 PN**. Regard the following chapter for details.

6.4   UIK

Description

Each *ION SIMATIC S7 PN* must possess a unique number, the UIK. The UIK is used by *X-Tools* for the clear identification of the *ION SIMATIC S7 PN*. The device name, which is shown by default in *X-Tools*, consists of the device type and the UIK. Example:

- ION SIMATIC S7 PN (000008-00-06010000).

The user can defined is own unique rule.

Assigning the UIK

It is formed via the MAC address of the hardware (6 bytes) and 2 user-defined bytes.

The parameters UIK0 and UIK1 can contain a zero byte (B#16#0) in case there shall be only one *ION SIMATIC S7 PN* under the specified MAC address. Enter the MAC address (must be in hexadecimal representation) for UIK2 … UIK7. In the following example the MAC address 08-00-06-01-00-00 is used.
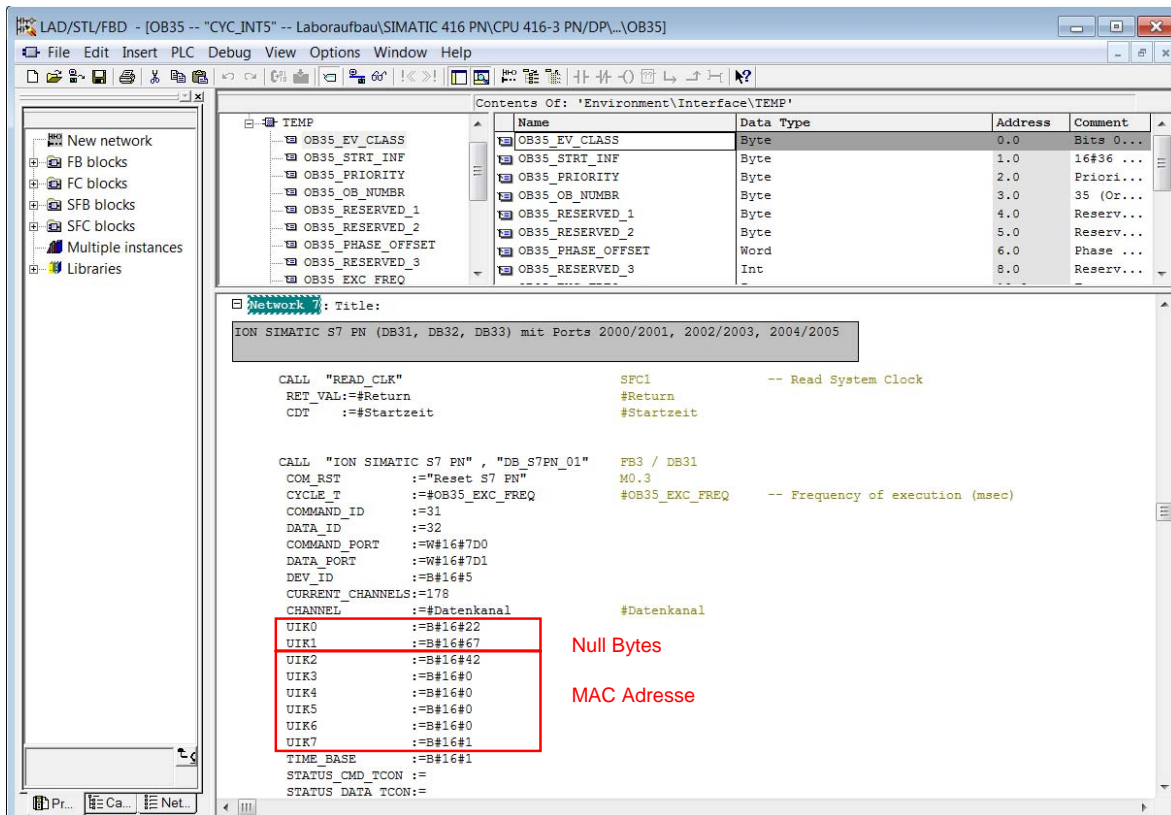

Figure 11: Assignment of the UIK

If multiple *ION SIMATIC S7 PN* are to be operated on a single hardware unit (over the same MAC address), it must be ensured that each UIK is unique. Therefore, the 2 user-defined bytes can be used in order to give different values to each operated instances.

6.5   Loading of Components

When you have finished you implementation mark / highlight all blocks of your project. Then select in the menu **PLC > Download** or click on the appropriate symbol to load the marked / highlighted components into the CPU. Then the CPU must be restarted (STOP →RUN) to initialize the *ION SIMATIC S7 PN*. Now the connection to *X-Tools* can be initiated.
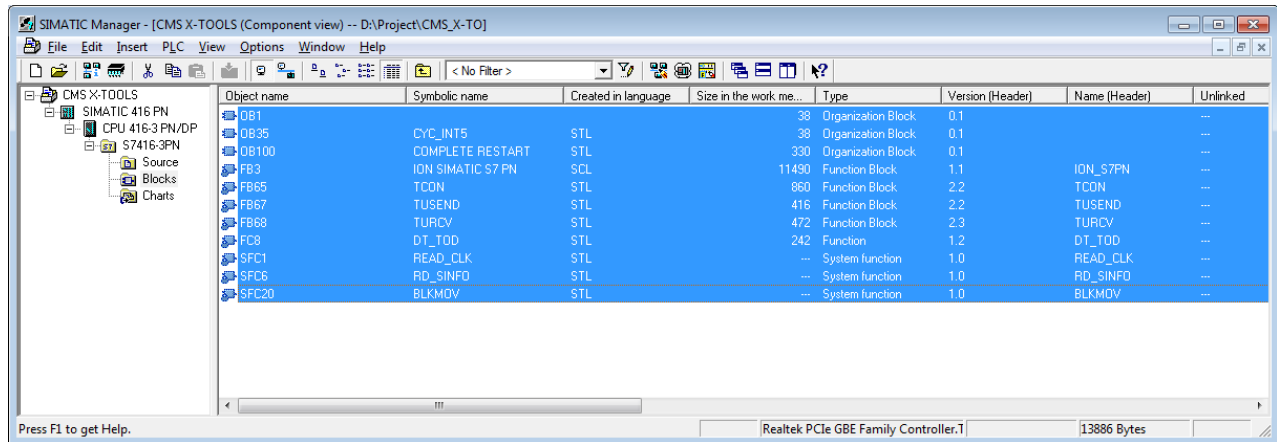

Figure 12: Loading of Components

7   Engineering in CFC

7.1   Modification of the ION_PN

Description

The component *ION SIMATIC S7 PN* cannot be directly placed in a CFC-plan. Instead a covering block ION_PN (FB600) is placed in the CFC-plan and therefore calls the component *ION SIMATIC S7 PN* internally. The SCL source of the ION_PN is delivered as a component of the library. Thus making it possible to project-specifically adapt the interface to the transmitted data.

Modifying the SCL File

Open the library of the *ION SIMATIC S7 PN* and select in the folder Sources the SCL-Source ION_PN. Open the SCL source per double click.

Figure 13: Opening of the ION_PN

Modifying the SCL Code

1. The initial parameter DUMMY may not be changed, deleted, shifted or renamed.

2. Behind the initial parameter DUMMY are the initial parameters for the values which can be transferred. Designations and data types of the variables may be project-specifically adapted. It is highly recommended in this case to provide the initial parameters with comments for the PCS7 attributes (e.g. to assign *S7_visible = ,false')*.

3. Make sure that the parameters projected behind the input variable DUMMY occupy a storage area at least by CURRENT_CHANNELS x 4 byte per channel. CURRENT_CHANNELS can be changed for the instance. Since the max. number of channels amounts to 178, the initial parameters should occupy 712 byte.

The remaining SCL code should not be changed!

Translate the Block

Translate the component in the SCL editor over file → translating.

Notice

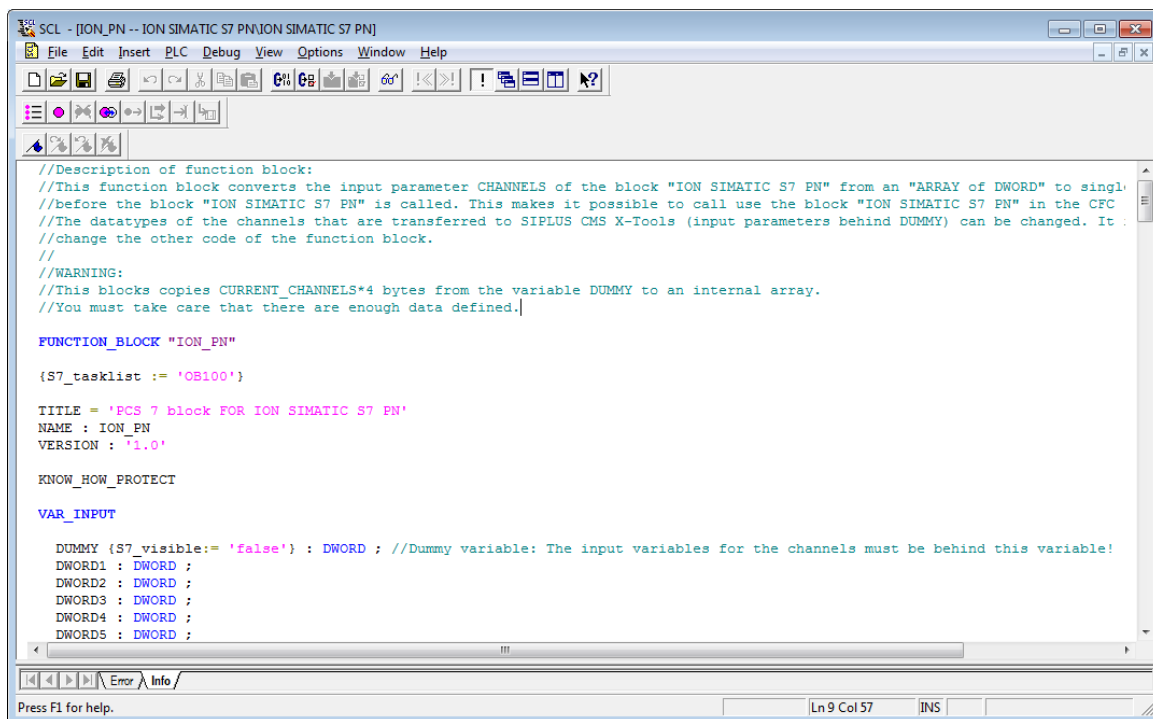If it is not possible to translate the CFC block check whether FB600 is listed in symbols as "ION_PN".

Notice

If the FB600 should be already present, before translating the existing FB600 must be deleted from the library *ION SIMATIC S7 PN* and the symbolic name ION_PN must be assigned to a free module number. Secure the changed SCL source ION_PN from *ION SIMATIC S7 PN* for later adjustments.

Figure 14: SCL Source of the covering Block

7.2 Projecting of the covering Component in the CFC

Project the adapted component ION_PN in the CFC-Plan and insert the ION_PN in a cyclic interrupt (OB3x). The installation of the component into the OB100 takes place automatically; likewise the supply of the entrance SAMPLE_T with the cycle time of the used cyclic interrupt is necessary.

Configure the inputs COMMAND_ID, DATA_ID, COMMAND_PORT, DATA_PORT and CURRENT_CHANNELS of the ION_PN. Configure the inputs UIK0..UIK7 in CFC.

Finally the CPU must once be restarted (STOP, →RUN) thereby that *ION SIMATIC S7 PN* is initialized and a connection to *X-Tools* can be established.
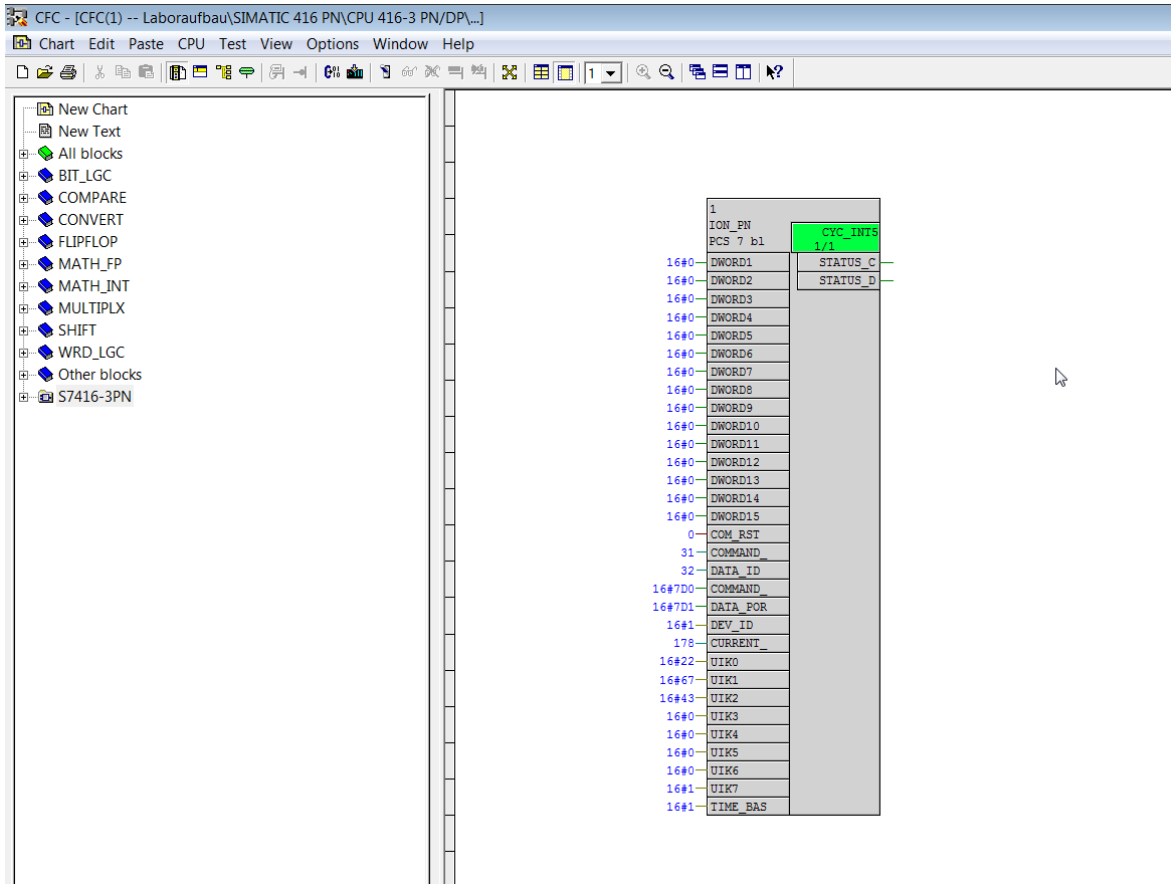

Figure 15: Call of the adapted CFC Block ION_PN in CFC

8 Tips and Tricks

8.1 Reset the Function Block

The **ION SIMATIC S7 PN** can be reset by COM_RST. This input can be connected to a bit memory which makes it possible to reset the **ION SIMATIC S7 PN** at any moment easily.

8.2 Engineering during Runtime

Because of the possibility to initialize the **ION SIMATIC S7 PN** via input COM_RST you can add it to you project during runtime. There is no STOP → RUN of the CPU necessary.

8.3 Changing the Number of the Function Block

The number of **ION SIMATIC S7 PN** (FB3) can be changed. It is just necessary to adapt the Symbol Table. It is possible to change the numbers of FB65/FB67/FB68 by STEP 7 option "Rewire". When you plan to rewire the blocks it is recommended to do this in an empty project and add just the rewired blocks into you working project.

8.4 Analyzing of Connection Problems

If the interface is not able to transmit all data (OB-cycle to fast or communication too high) the variable "Dummy1" in the corresponding DB is rising. This can be supervised via the variable table or it can be transmitted to **X-Tools** via the **ION SIMATIC S7 PN**.

8.5 Multi-Instancing of the ION SIMATIC S7 PN

It is possible to call multiple instances of the **ION SIMATIC S7 PN** in one SIMATIC CPU. This is necessary when the required amount of data is more than 712 Byte per cycle.

Each instance of the **ION SIMATIC S7 PN** must be called in OB100 with COM_RST = TRUE to initialize the FB. For each instance a separate data block and a dedicated connection pair (command and data connection) is required. The connections are identified by COMMAND_ID, DATA_ID, COMMAND_PORT und DATA_PORT. The parameters COMMAND_ID and DATA_ID can be taken from 0x0001 to 0x0FFF. Each ID must be used for one connection only.

The UIK must be unique for each **ION SIMATIC S7 PN**. The bytes UIK2...UIK7 shall be set to the MAC address of the used PROFINET interface. To keep unique UIKs for each **ION SIMATIC S7 PN** the bytes UIK0 and UIK1 can be numbered sequential.

The number of usable instances is limited by the capacity of the CPU. If multiple instances are called in one controller the memory usage and cycle time of the CPU have to be checked.

8.6 Error code from TCON

If the communication is not set up the output called STATUS_CMD_TCON / STATUS_DATA_TCON from ION PN TIA 1200/1500 FB give back the error code from TCON block.

- STATUS_CMD_TCON is used in order to set up the communication between X-Tools and the PLC in both directions. (Declaration, exchange of command)
- STATUS_DATA_TCON is used in order to send the data from PLC to X-Tools.

For diagnostic refer to online help from TCON (Standard Library\Communication Blocks) in order to get the meaning of the error code.

8.7   Configuration of the Windows Firewall

If the firewall does not allow *X-Tools* then the communication can not start between the automation system and *X-Tools*. Please verify the configuration as follow.

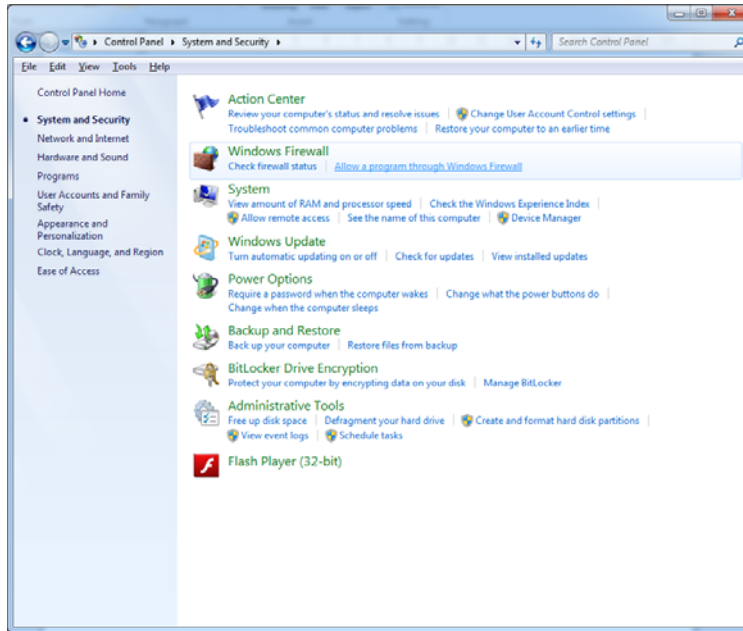1. Open „Allow a program through Windows Firewall" from the "Control Panel\System and Security" window.

Figure 16: Control Panel - System and Security

2. Allow a program through Windows Firewall
   a. Add "X-Tools Server Pro.exe" in the list of exception in order to allow *X-Tools* through Windows Firewall for public and Home/Work(Private) Networks
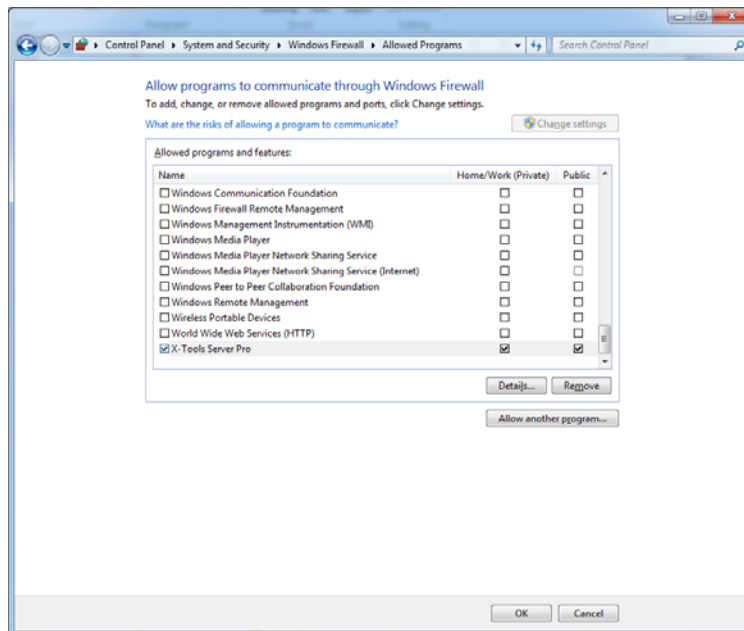

*Figure 17: Allow **X-Tools** to communicate through Windows Firewall*

9   References

9.1   Other Documentation

- CMS X-Tools - User Manual
- SIMATIC System Software for S7-300/400 System and Standard Functions
- SIMATIC Programming with STEP 7
- http://www.siemens.com/siplus-cms

10 Contact Information

Should you have any questions concerning the software application, please refer to the Industry Sector Technical Support.

Department

Siemens AG

Industry Sector

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Internet

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Thank you for using one of the above mentioned contacts to ensure your inquiry is registered and can be processed.