Training Manual for Integrated Automation Solutions

Totally Integrated Automation (TIA)

MODULE E12

VISION SENSOR Shape Checking

with SIMATIC S7-300F-2 PN/DP and VS120

This manual was prepared for training purposes by Siemens AG for the project *Siemens Automation Cooperates with Education* (SCE).
Siemens AG does not guarantee the contents of this document.

We wish to thank the Michael Dziallas Engineering corporation and the instructors of vocational schools as well as all those who provided support during the preparation of this manual.

PAGE

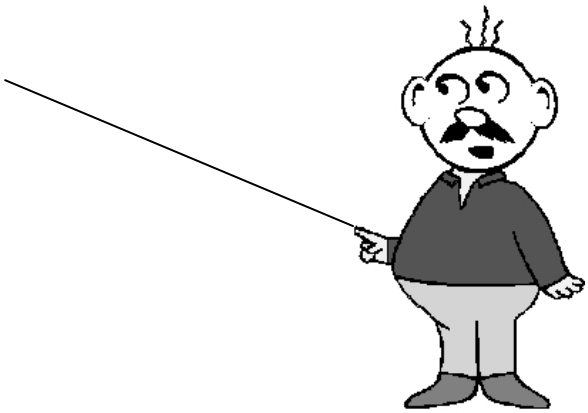
The following symbols serve as a guide through Module E12:

Information

Programming

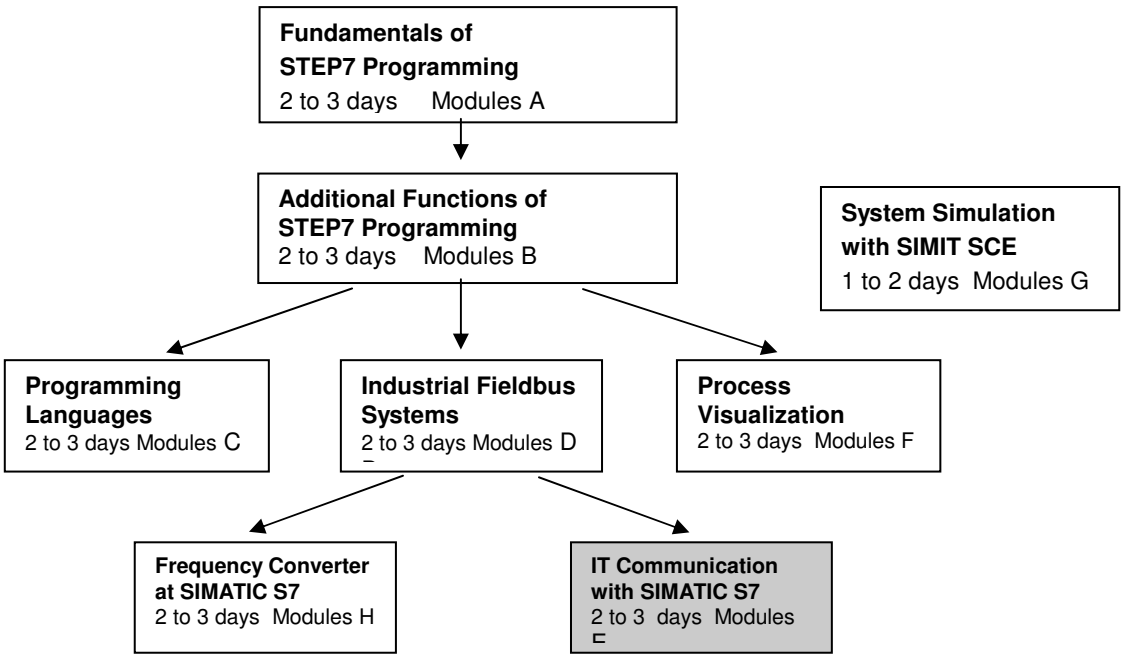
Sample Task

Notes



1 PREFACE

Regarding its content, Module E12 is part of the instruction unit '**IT Communication with S7**'.



Objective

In Module E12, the reader learns how networking and data exchange between PLCs and the vision sensor evaluation device VS120 is set up.
As PLC, the CPU 315F-2 PN/DP and as vision sensor evaluation device the VS120 system for the shape check are used. The SIMATIC VS120 components consist of an evaluation device with a sensor head and an LED ring lamp. PROFINET is used for networking between the PLC and the SIMATIC VS120.
Module E12 shows in principle the procedure for the startup, based on a brief example.
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Prerequisites

To successfully work through Module E12, the following knowledge is assumed:

- How to handle Windows
- Fundamentals of PLC programming with Step7 (for example, Module A3 'Startup' PLC Programming with STEP7)
- Fundamentals of network engineering (for example: Appendix V – Basics of Network Engineering)

Hardware and software required

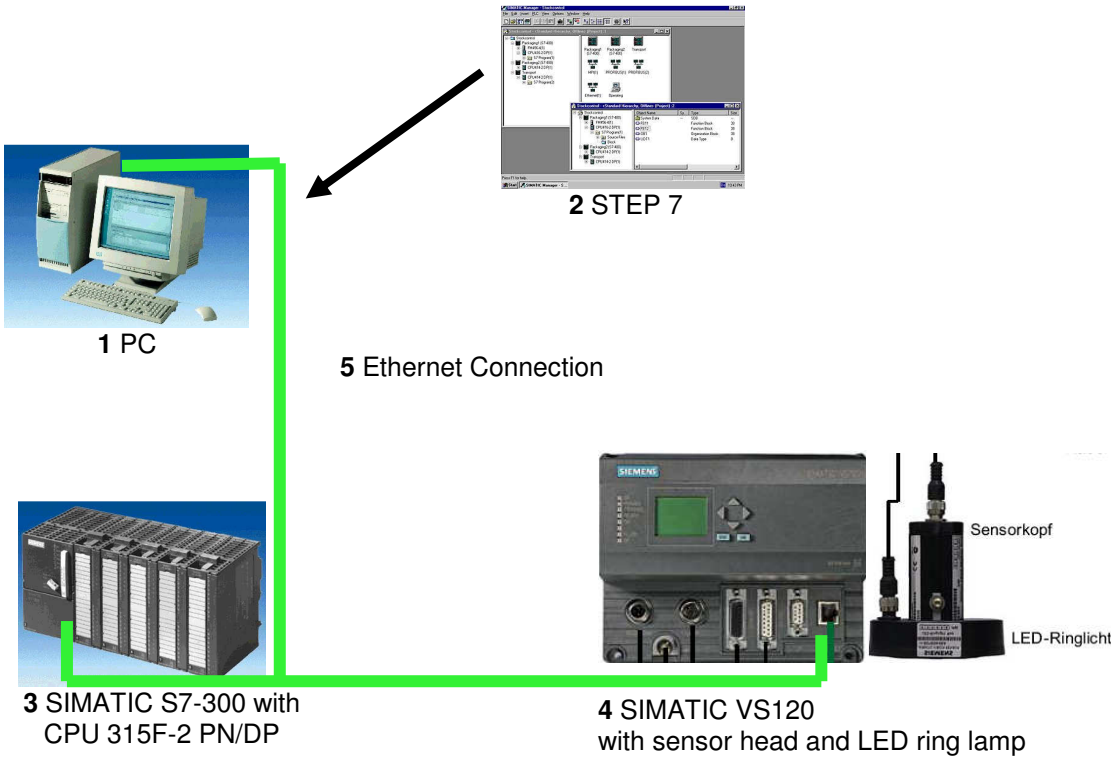
1 PC, operating system Windows XP Professional with SP2 or SP3/Vista 32 Bit Ultimate and Business/Server 2003 SP2 with 600MHz (only XP)/1 GHz and 512MB (only XP)/1 GB RAM, free disk storage approx. 650 to 900 MB, MS Internet Explorer 6.0 and network card

2 Software STEP 7 V 5.4

3 SPS SIMATIC S7300 with CPU 315F-2 PN/DP and at least one digital input and output module. Sample configuration:
- Power supply: PS 307 2A
- CPU: CPU 315F-2 PN/DP
- Digital inputs: DI 16x24VDC
- Digital outputs: DO 16x24VDC/0.5 A

4 SIMATIC VS120 evaluation device with sensor head and LED ring lamp

5 Ethernet connection between PC, CPU 315F-2 PN/DP and VS120



2 NOTES ON USING THE CPU 315F-2 PN/DP

The CPU 315F-2 PN/DP is a CPU that is shipped with 2 integrated interfaces.

- The first interface is a combined MPI/PROFIBUS DP interface that can be used at the PROFIBUS DP as master or slave to connect distributed IO/field devices with very fast reaction time.
  In addition, it is possible to program the CPU here by means of an MPI or PROFIBUS DP
- The second interface is an integrated PROFINET interface.
  This allows for using the CPU as PROFINET IO controller to operate distributed IO on PROFINET. The CPU can be programmed by means of this interface also!
- Moreover, it is possible to use fail-safe IO devices on both interfaces.

Notes:

- In module E12, the CPU 315F-2 PN/DP is used as the controller for the data exchange of a SIMATIC RFID system on the PROFINET.
- To run this CPU, a micro-memory card is required!
- The addresses of the input and output modules can be parameterized at this CPU.

3 NOTES ON THE SIMATIC VS120 COMPONENTS

3.1 Product Description

The vision sensor SIMATIC VS120 is used to optically recognize and check objects applying the incident light method. The vision sensor SIMATIC VS120 checks whether the object is the correct one, whether it is intact, and what its position is.

The vision sensor SIMATIC VS120 supplies the following recognition values for object recognition:

• x-coordinate
• y-coordinate
• angle
• Quality values of the object being checked, number of the parts found

This object recognition data is transmitted to evaluation units in automation systems. The data is then processed in the evaluation units of the automation systems.

The vision sensor SIMATIC VS120 is suitable for the following:

• Recognizing parts for sorting tasks
• Determining the position for Pick&Place applications
• Existence check and position check in manufacturing
• Position check for feed engineering; for example, for swing conveyors <<?>>, workpiece carriers, circulation systems and gripper units as well as robots
• Quality control of checked objects

3.2 Performance Features

- Incident light method with LED ring lamp
- Object recognition with object search and object check
- Startup by means of setup support at the PG/PC with installed Internet Explorer
- Up to 20 object checks per second
- Up to 64 objects to be checked can be stored
- To sort the objects to be checked, 2 digital outputs are provided: OK, N_OK
- Operator interface is completely Web-based
- Extensive operating and monitoring functions also in the evaluation mode
- Extensive diagnosis functions and logging functions
- Firmware update by means of the operator interface of the Web browser
- Control by means of digital I/O, PROFIBUS DP and PROFINET IO

Result output by means of

– PROFIBUS DP
– PROFINET IO
– RS232 interface of an RS232 Ethernet converter
– TCP/IP connection of the PC/PG

3.3 Function

Checking the properties of an object to be checked for correctness

64 models are provided to recognize objects to be checked. The SIMATIC VS120 checks whether the individual characteristics of the object to be checked are shaped as the trained model is.
When specifying the recognition and evaluation area, glossy areas on the objects to be tested are to be avoided.

Recognition principles of edges

To recognize image patterns, edges are used. These edges in the images are transitions from light to dark or vice versa. A model is generated from the sum of edges extracted in the picture, and from their arrangement.

Recognizing and localizing parts

The SIMATIC VS120 recognizes objects to be checked and determines the coordinates including the rotational position and forwards them -for example, by means PROFIBUS DP- to a control system like the S7.

Checking a model for completeness

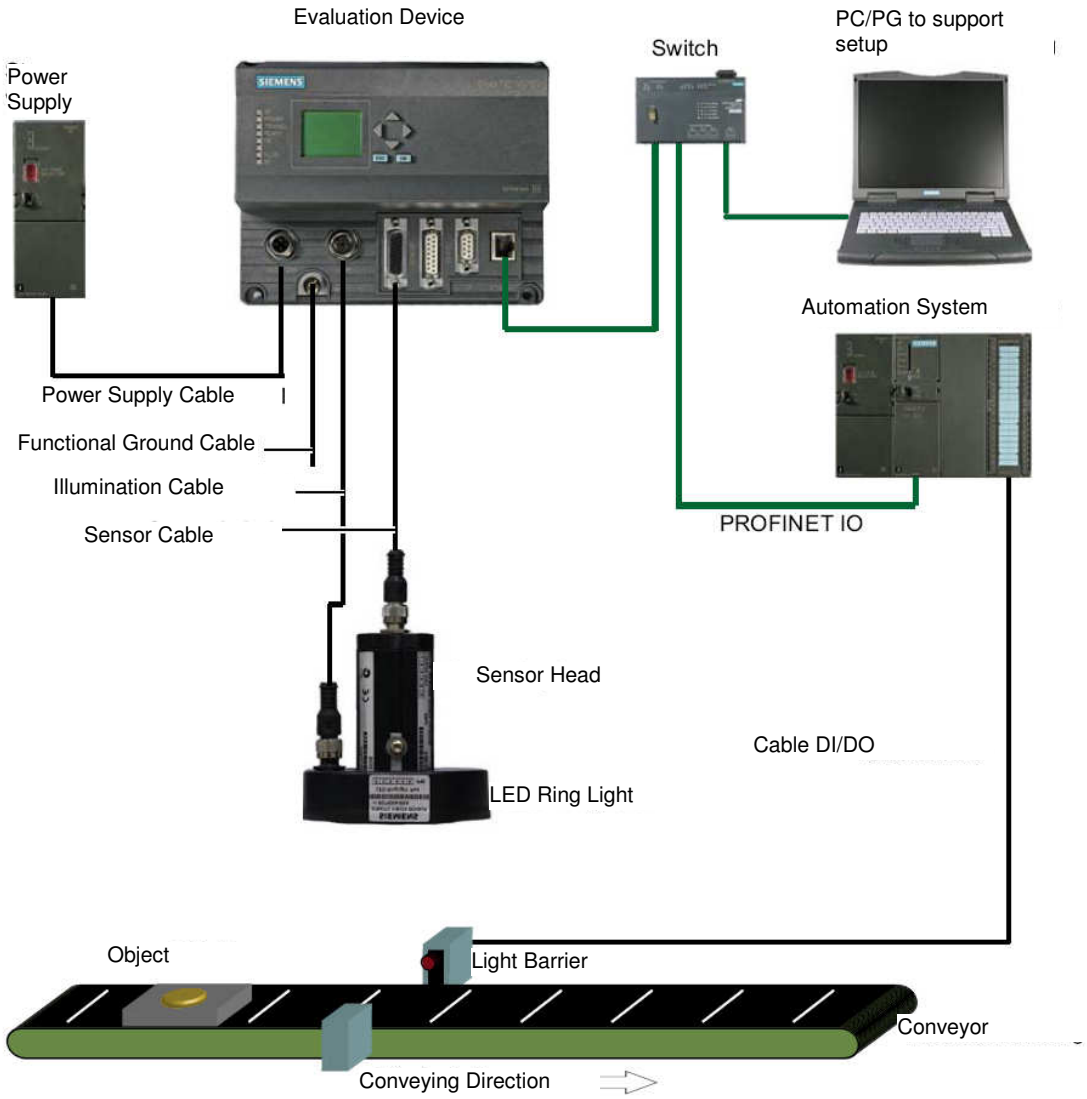
In addition, the SIMATIC VS120 checks the objects in question for completeness. Deviations from the trained model are detected, and the quality values of the evaluation are displayed.

Sorting functions of models in model sets

Depending on the importance of the application, it is possible to group and store 15 model sets for evaluation with 64 possible models. When evaluated with the SIMATIC VS120, the models are sorted -according to the application- with a control system.

3.4 Recording and Reading Out Recognition Values in a PROFINET IO Environment

- By means of the Ethernet (TCP/IP) and a switch, a PC/PG is connected that is used exclusive for the setup process.
- By means of the Ethernet and a switch, a connection exists to an automation systems with PROFINET IO capability.
- The SIMATIC VS120 is controlled by the automation system.
- The result of the objects to be checked is read out via PROFINET IO to the automation system



Additional information is provided in Chapter 3 of the operating instructions "Image Processing Systems Vision Sensor SIMATIC VS120".

3.5 Setting the Communication Interface of the VS120 to PROFINET

First, switch on the power supply of the evaluation device VS120 for the initial startup.

At the initial startup, "Factory Settings Used" appears on the LCD display.
Confirm with "**OK**".
The VS120 will then perform a self test:

• Checking the Ethernet connection
Press ESC

• Functional check of the sensor head
Press ESC

After completion of the self test, "Adjust" appears on the LCD display
Press OK to get to the main menu

At any additional start of the SIMATIC VS120, the evaluation device VS120 performs the following self test:

• Checking the stored settings and model data
• Checking the Ethernet connection
• If needed, checking the connection to PROFINET IO
• If needed, checking the Ethernet RS232 converter or TCP server and to the PC/PG <<?>>
• If needed, checking whether it is possible to exchange data from and to PROFIBUS DP
• Function check of the sensor head
• If needed, checking the connection for archiving the model data

If the self test ran without a fault, the following is indicated on the LCD display: the main menu, the display "Adjust", or the RUN menu, depending on the status at the last switch-off.

You may have to press ESC several times to get to the main menu

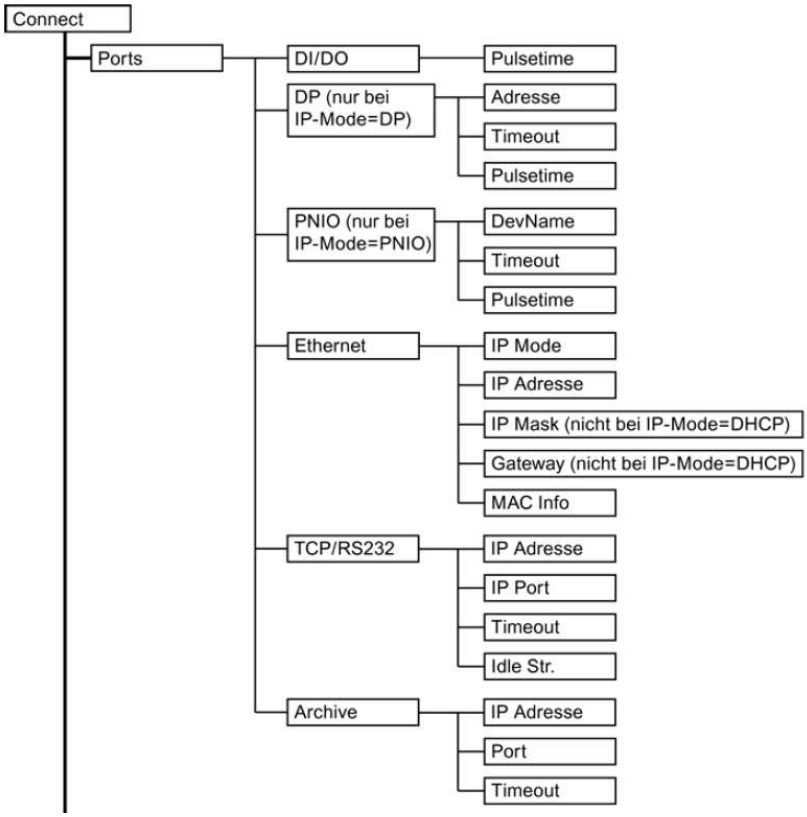
In addition, we navigate in the LCD display between the menus, and make entries.

"Main" Menu:

To set the VS120 to PROFINET, we have to get to the "**Connect**" menu.
Place the cursor in front of Connect, and press the OK key.

"Connect" Menu:

The Ethernet IP mode has to be set to PNIO.



Place the cursor in front of Ports and press the OK button
Place the cursor in front of Ethernet and press the OK button
Place the cursor in front of IP Mode and press the OK button
Place the cursor in front of PNIO and press the OK button

The evaluation device now requests a restart; press the OK button to confirm.
After the restart, the red bus error LED (BF) flashes until communication is established by means of PROFINET between a controller and the VS120.

ESC may have to be pressed several times to get to the main menu.

All additional information for operating the evaluation device is provided in chapters 8.3, 8.4 and 9.2 of the operating instructions
"Image Processing Systems Vision Sensor SIMATIC VS120".

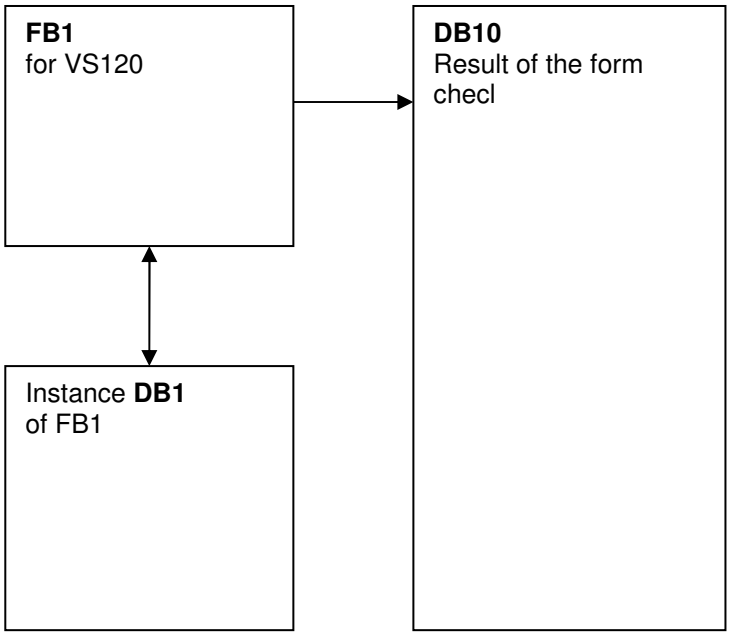
4 STARTING UP A PROJECT WITH CPU 315F-2 PN/DP AND VS120

Below, starting up the VS120 in a project is described.

As SIMATIC S7-300 Station, the CPU 315F-2 PN/DP is used.

In the CPU's control program, a data structure has to be generated by means of a function block call (FB1) with data block (DB10).

The data structure looks like this:

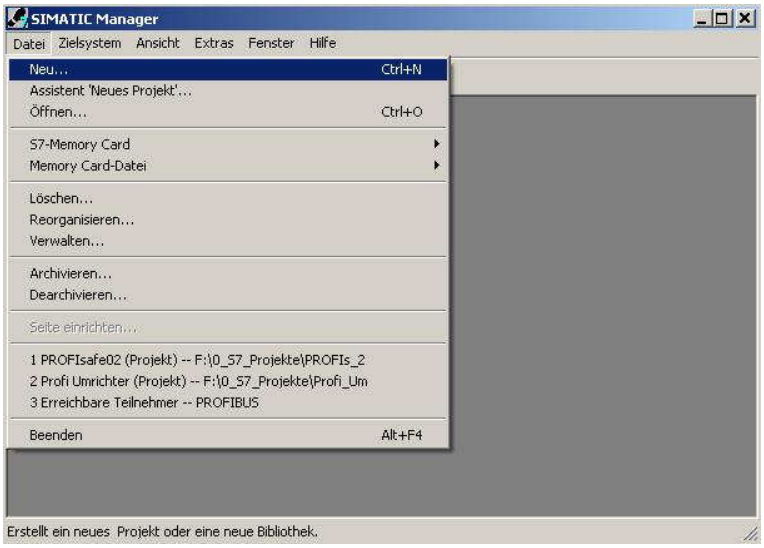


All additional information is provided in Chapter 10 of the operating instructions "Image Processing Systems Vision Sensor SIMATIC VS120".

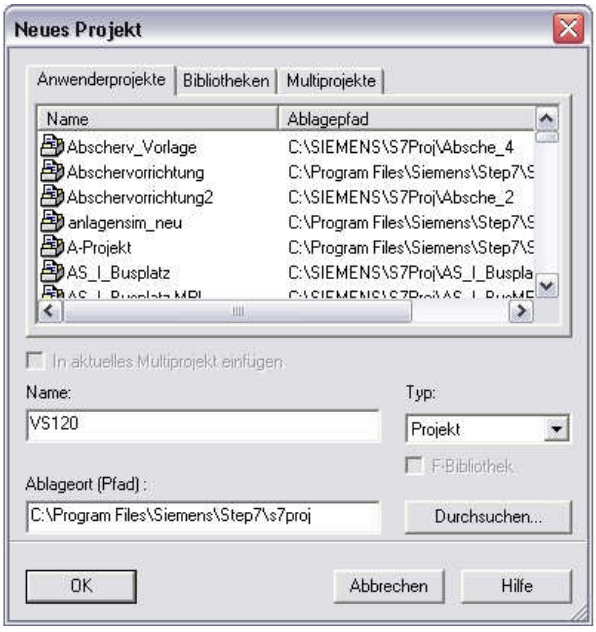
4.1 Setting Up a New Project

1. The central tool in STEP 7 is the **'SIMATIC Manager'**. It is called here with a double click (→ SIMATIC Manager)

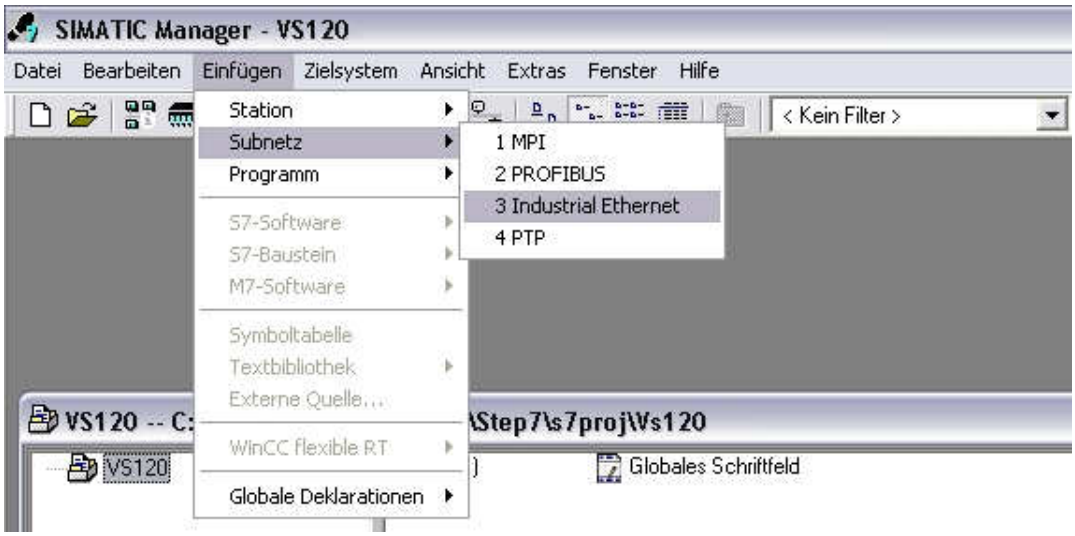
2. STEP7 programs are managed in projects. We are now setting up such a project (→ File → New)



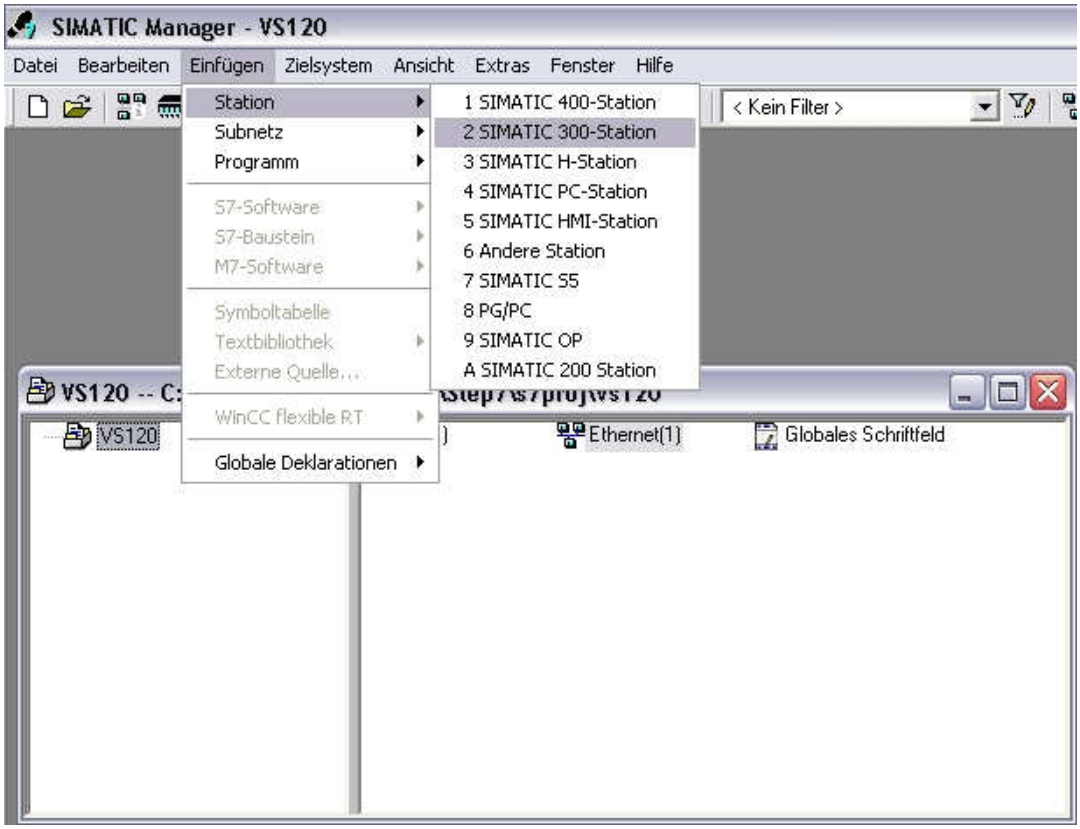
3. Now, the project is assigned the **'Name'** **'VS120'** (→ VS120 → OK)



4. Next, highlight your project and insert an '**Industrial Ethernet Subnet**'.
(→ VS120 → Insert → Subnet → Industrial Ethernet).

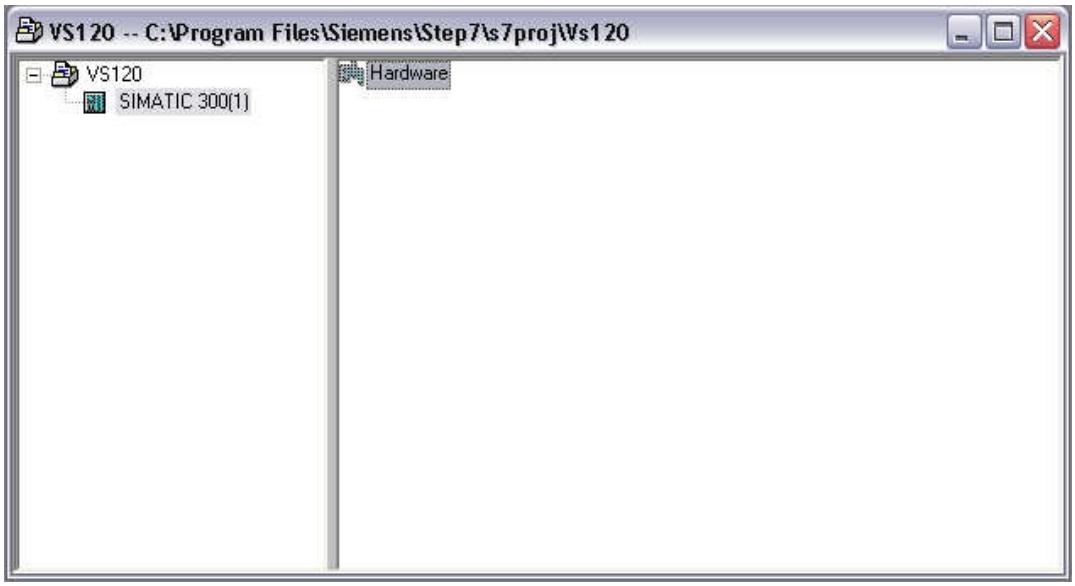


5. Now, a '**SIMATIC 300 Station**' is inserted (→ Insert → Station → SIMATIC300 Station)

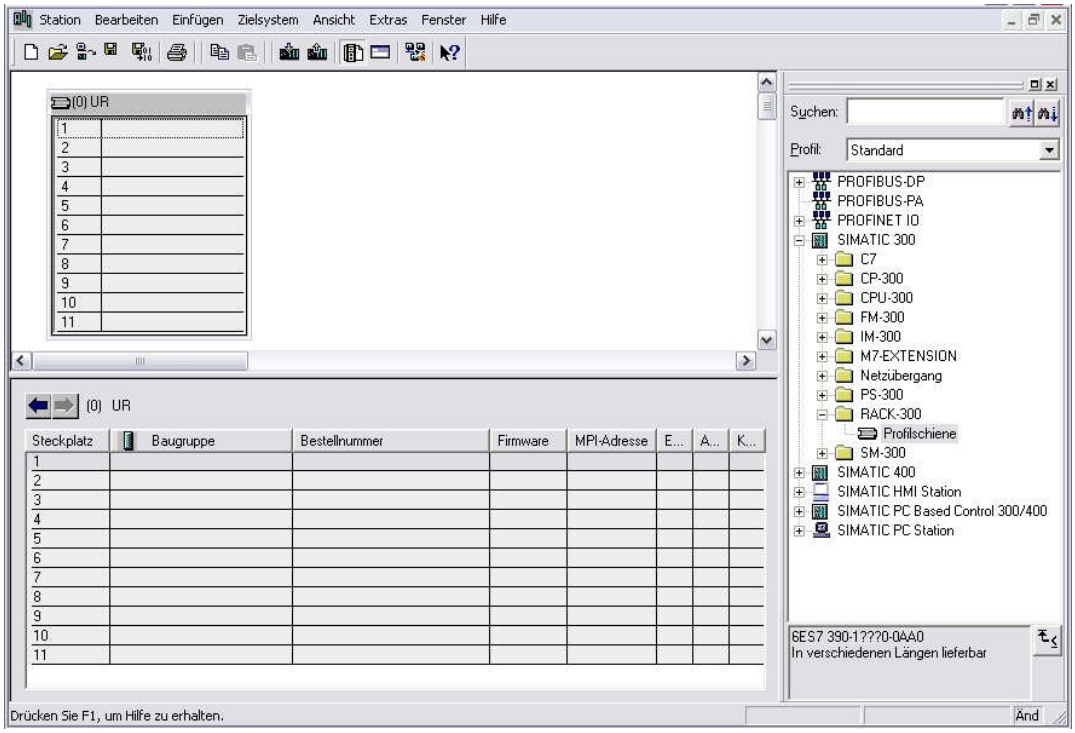


4.2 Configuring the Hardware

6. With a double click, open the configuration tool for the **'Hardware'**. (→ Hardware)

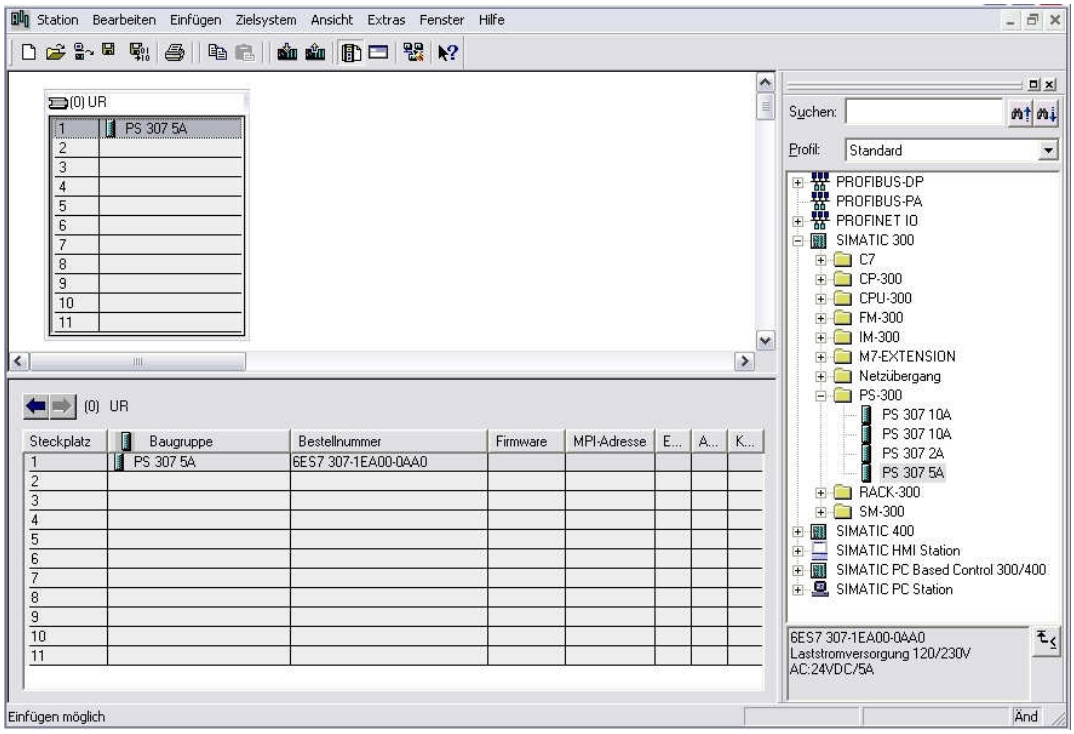


7. Open the hardware catalog by clicking on the symbol '  '. (→ )
Insert the **'Mounting Channel'** with a double click (→ SIMATIC 300 → RACK-300 → Mounting Channel).



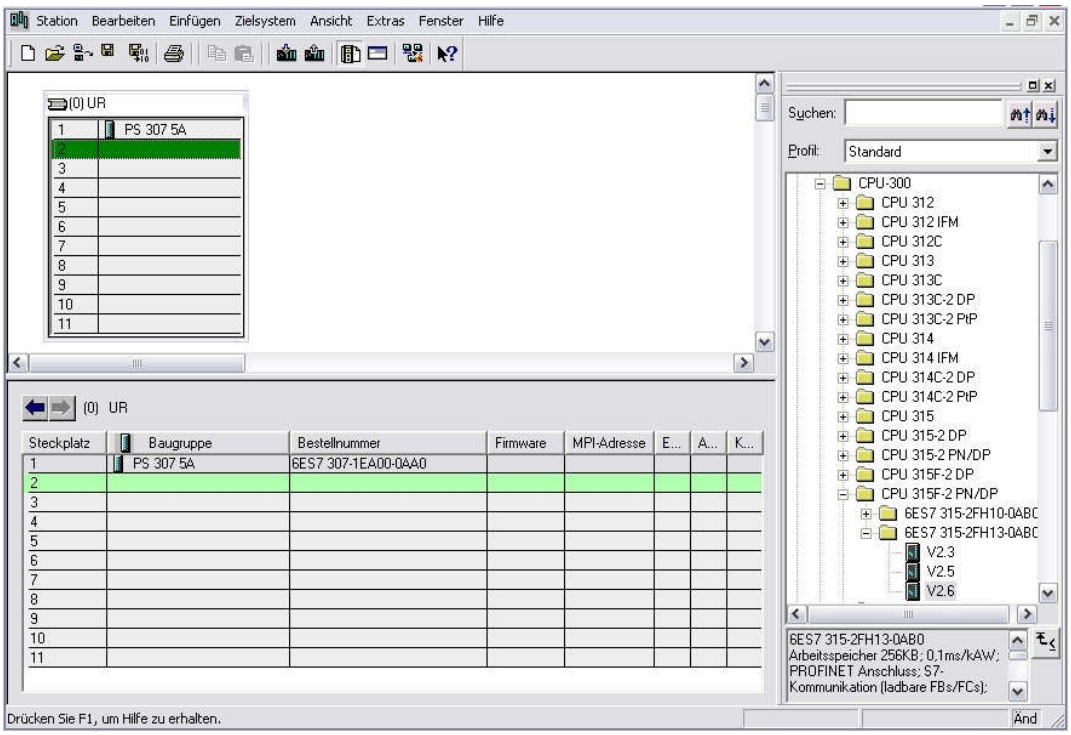
Note:
Then, a configuration table is displayed automatically for setting up Rack 0.

8. Now, from the hardware catalog select all modules that are also inserted in your actual rack and place them in the configuration table. To this end, click on the name of the respective module, hold the mouse key and drag it to a line in the configuration table.
   We start with the power supply **'PS 307 5A'** (→ SIMATIC 300 → PS-300 → PS 307 5A)

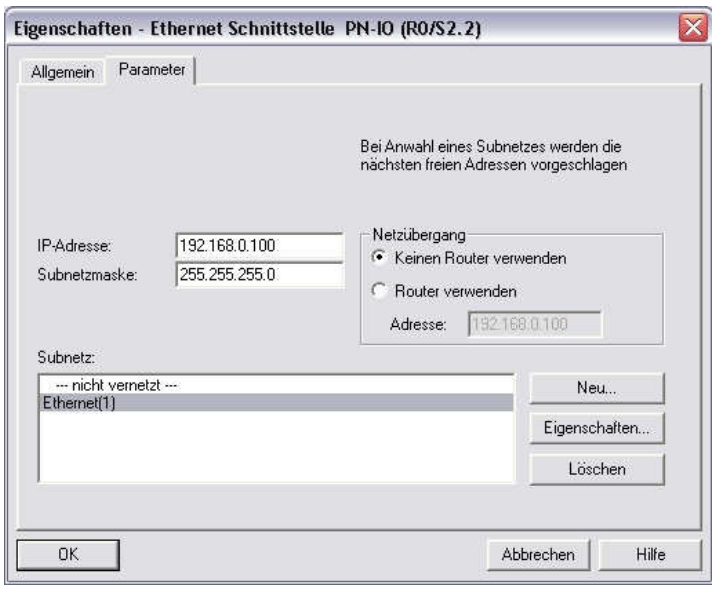


Note:
If your hardware differs from the one shown here, simply select the corresponding modules in the catalog and insert them in your rack. The order numbers of the individual modules that are also inscribed on the components, are shown in the footer of the catalog.

9. Next, we drag the '**CPU 315F-2 PN/DP**' to the second slot.
   The CPU's order number and the version are provided on the front of the CPU.
   (→ SIMATIC 300 → CPU-300 → CPU 315F-2 PN/DP → 6ES7 315-2FH13-0AB0 → V2.6)



10. When entering the CPU, the window below is displayed. In this window, do the following: assign to the CPU 315F-2 PN/DP an '**IP Address**', specify the '**Subnet screen form**' and select the '**Ethernet**' that is already set up. Optionally, a '**Router Address**' can be selected for network-overarching communication. Confirm your inputs with '**OK**' (→ IP Address: 192.168.0.100 → Subnet screen form: 255.255.255.0 → Ethernet(1) → Don't use a router→ OK)



Notes regarding networking on the Ethernet (additional information is provided in Appendix V of the training manual):

MAC address:
The MAC address consists of a permanent and a variable part. The permanent part ("Basic MAC address") identifies the manufacturer (Siemens, 3COM, ...). The variable part of the MAC address differentiates the different Ethernet stations and should be assigned globally unique. On each module, a MAC address specified by the factory is inscribed.

Value range for the IP address:
The IP address consists of 4 decimal numbers in the value range 0 to 255, separated by a period; for example: 141.80.0.16

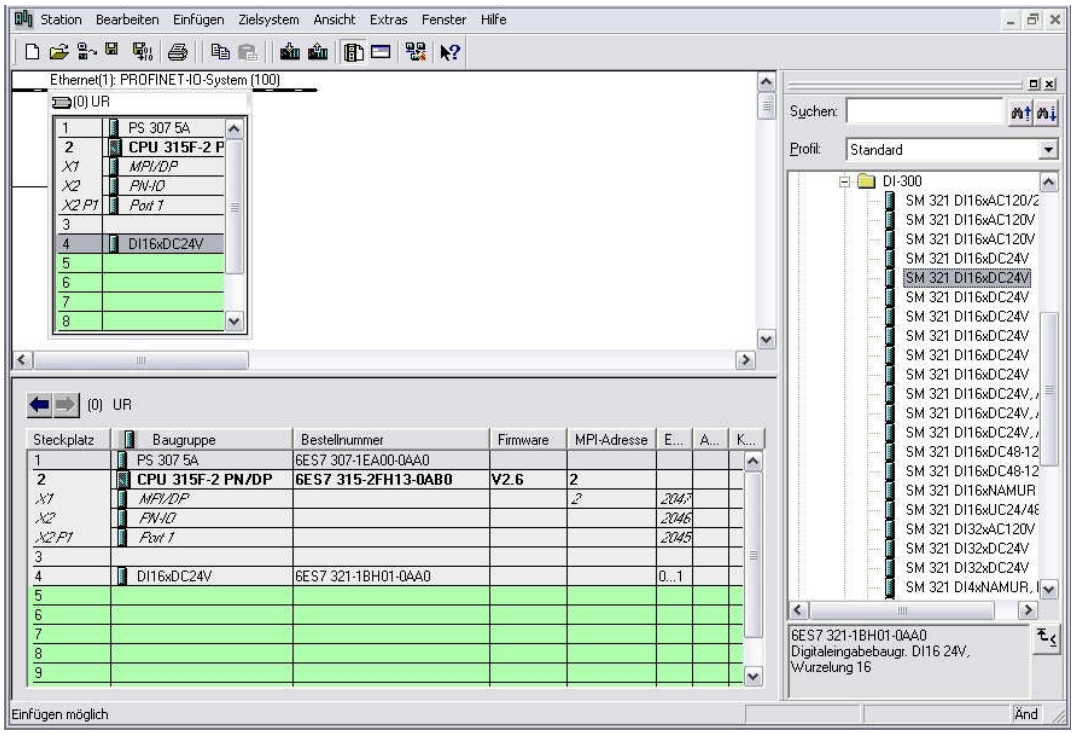
Value range for the subnet screen form:
This screen form is used to establish whether a station or its IP address belongs to the local subnet, or can be reached only by means of a router.
The subnet screen form consists of 4 decimal numbers in the value range 0 to 255, separated by a period; for example: 255.255.0.0
The 4 decimal numbers of the subnet screen form have to contain -in their binary representation- from the left a series of gapless values "1" and from the right a series of gapless values "0"..
The values "1" determine the area of the IP address for the network number. The values "0" determine the area of the IP address for the station address.
Example:

Correct values:	255.255.0.0 Decimal = 1111 1111.1111 1111.0000 0000.0000 0000 binary
	255.255.128.0 Decimal = 1111 1111.1111 1111.1000 0000.0000 0000 binary
	255.254.0.0 Decimal = 1111 1111.1111 1110.0000 0000.0000.0000 binary
Incorrect value:	255.255.1.0 Decimal = 1111 1111.1111 1111.0000 0001.0000 0000 binary

Value range for the address of the gateway (router):
The address consists of 4 decimal numbers in the value range 0 to 255 separated by a period; for example, 141.80.0.1.

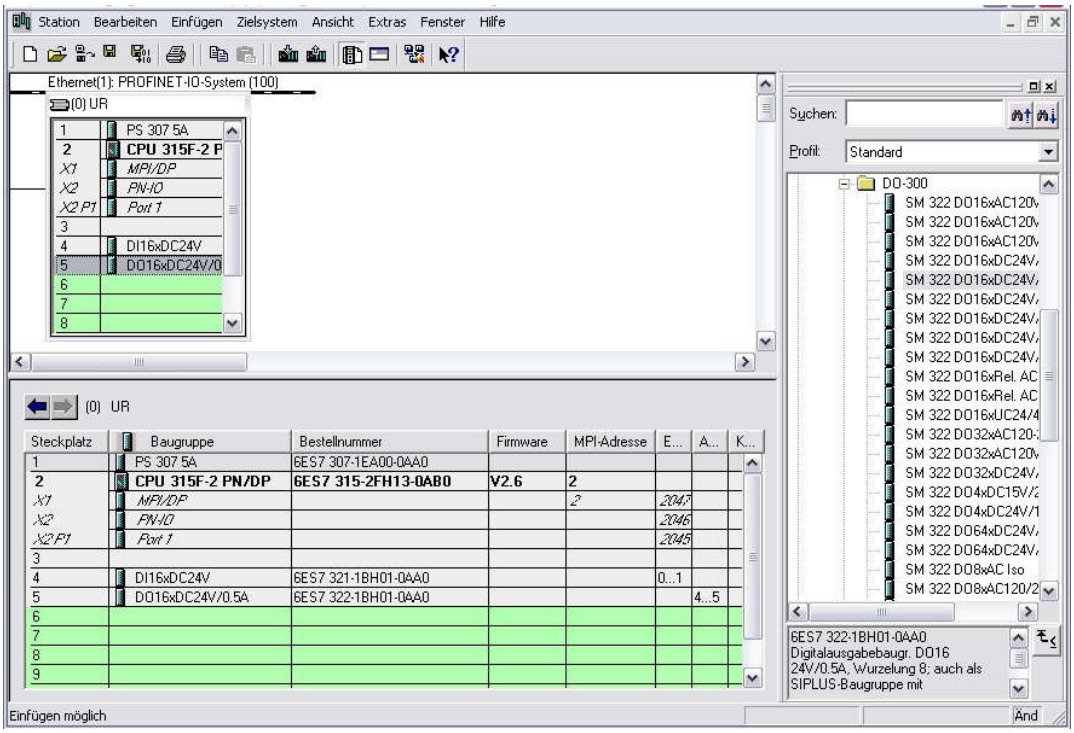
Relationship of the IP addresses, router address and subnet screen form:
The IP address and the gateway address must differ only at those positions where a "0" is shown in the subnet screen form.
Example:
You entered the following: for subnet screen form 255.255.255.0; for IP address 141.30.0.5 and for router address 141.30.128.1.
The value for the IP address and the gateway address is to differ only in the 4th decimal number. However, in the example, the 3rd position already differs.
In the example, we have to alternatively change:
- the subnet screen form to: 255.255.0.0 or
- the IP address to: 141.30.128.5 or
- the gateway address to: 141.30.0.1

11. Next, we drag the input module for 16 inputs to the 4th slot. The module's order number is inscribed on the front. (→ SIMATIC 300 → DI-300 → SM 321 DI16x24VDC).



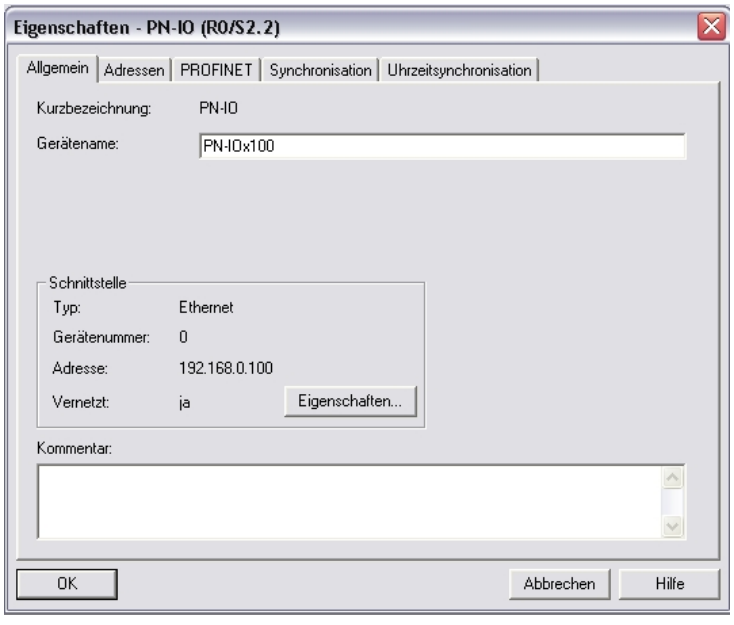
Note:
Slot 3 is reserved for interface modules and remains empty for that reason. The module's order number is shown in the footer of the catalog.

12. Then, we drag the output module for the 16 outputs to the 5th slot. The module's order number is inscribed on the front. (→ SIMATIC-300 → DO-300 → SM 322 DO16x24VDC/0.5A).

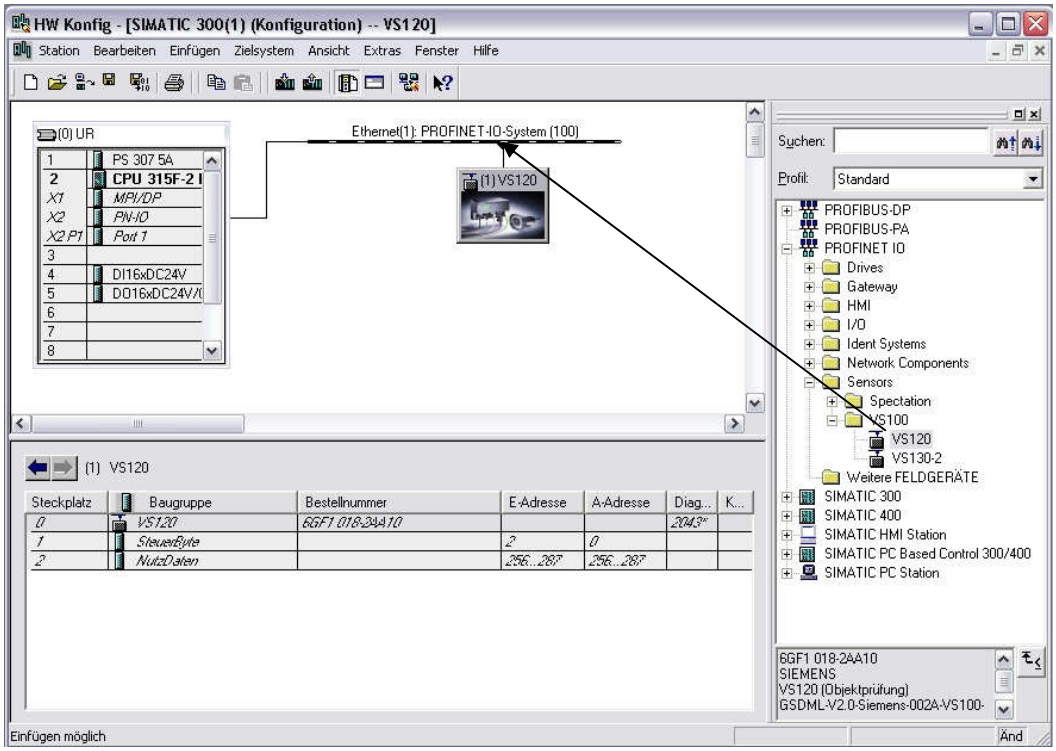


Note:
The module's order number is shown in the footer of the catalog.

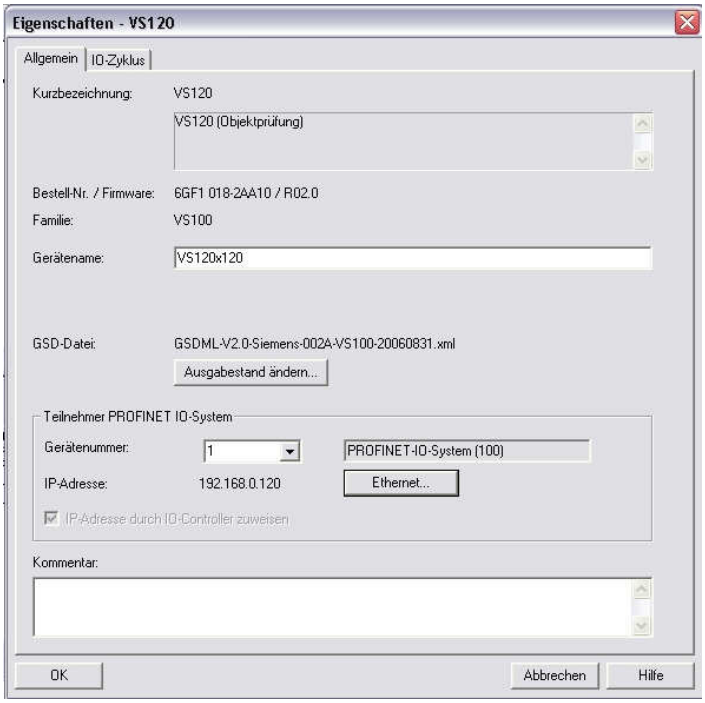
13. Now, we have to change the PROFINET device name to PN-IOx100.
Select '**PN-IO**' with a double click (→ PN-IO,→ PN-IOx100,→ OK)



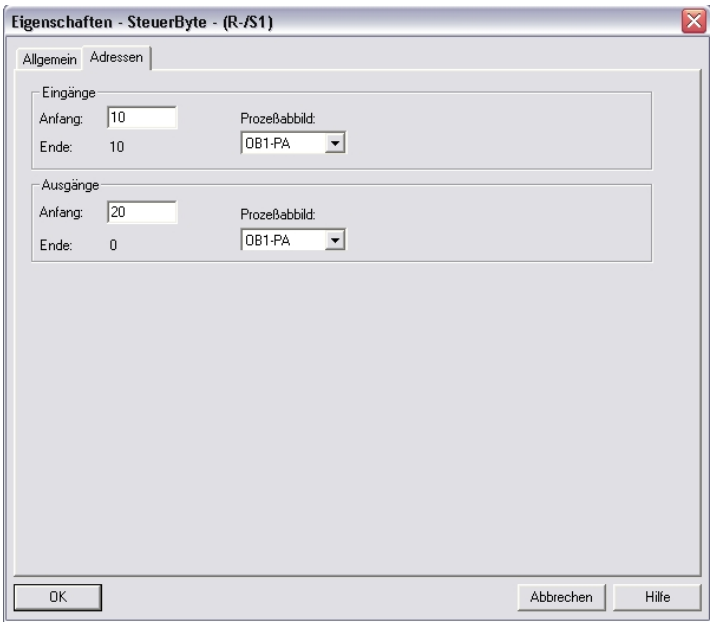
14. Then, drag the PROFINET IO System (100) module tier <<?>> toward the right, and from the folder PROFINET IO add the SIMATIC VS100 module VS120 by dragging it to the tier.
If module VS120 should not be available for selection, it has to be added by a data carrier by means of the menu “Options“ Install GSD files.



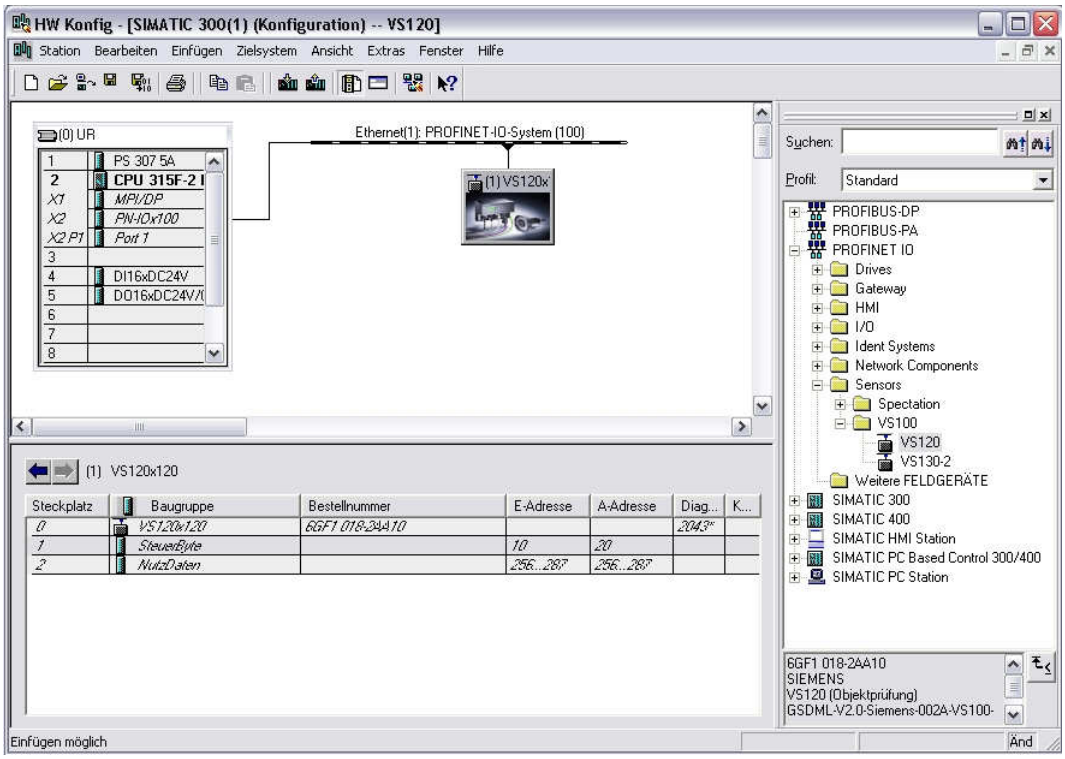
15. Double click on the inserted module and change the device name to VS120x120 and the IP address to 192.168.0.120.



16. Now double click on the control byte of the inserted module and change the address of the inputs to 10 and of the outputs to 20.



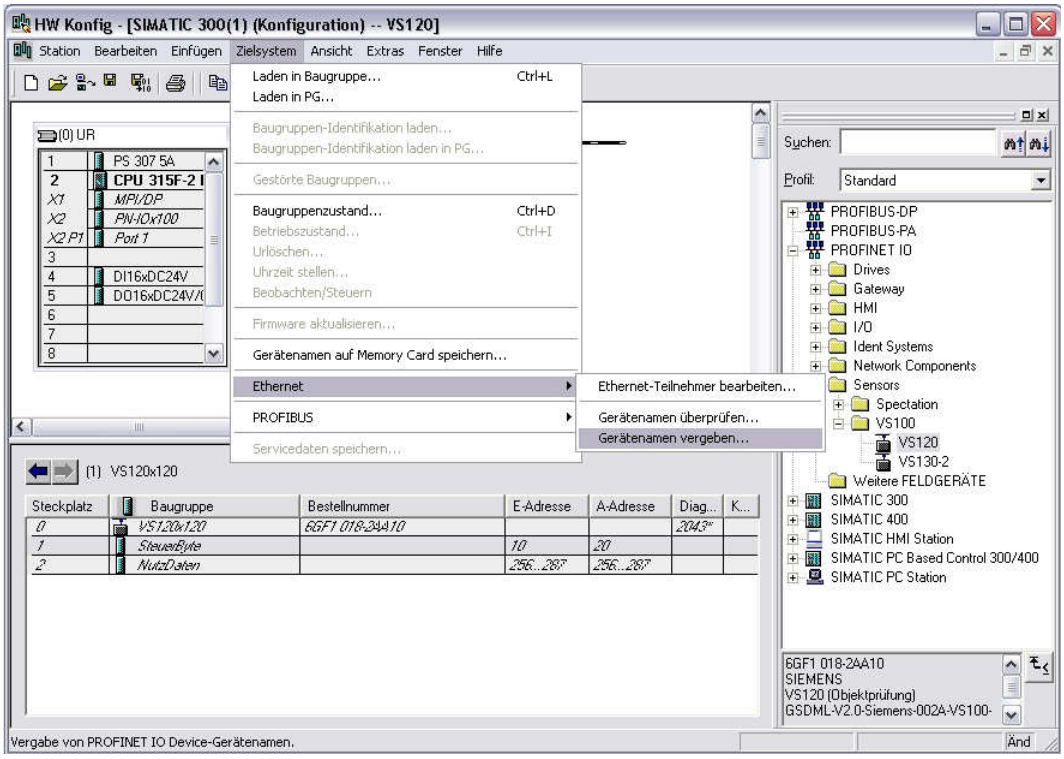
Hardware View



17. By clicking on '  ', the hardware configuration is stored and compiled.

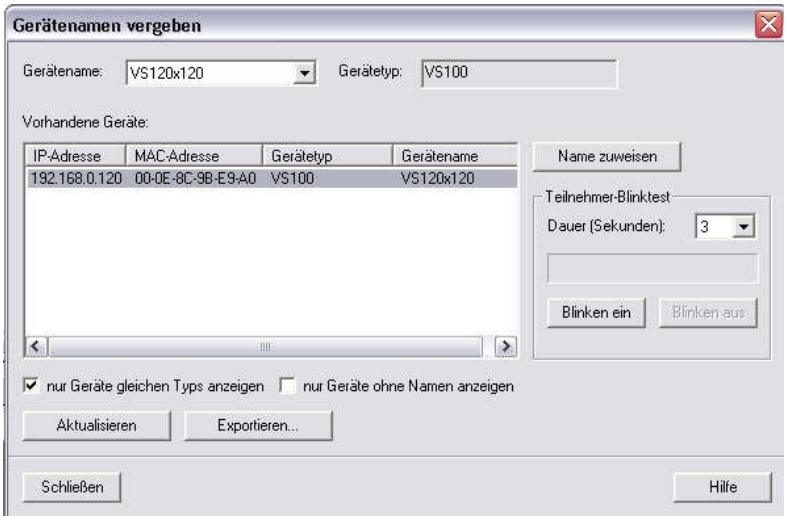
4.3 Assigning the Device Name

18. Highlight module VS120 and then select, via the menu “Destination system“, at Ethernet ’**Assign device name**’.

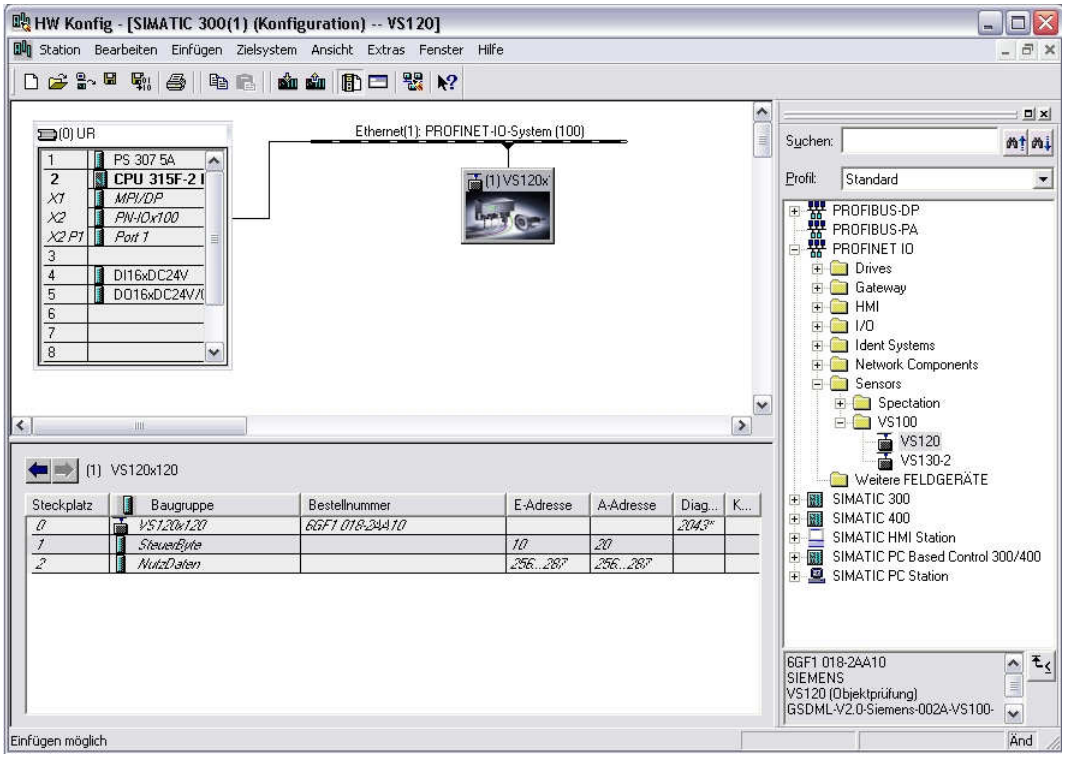


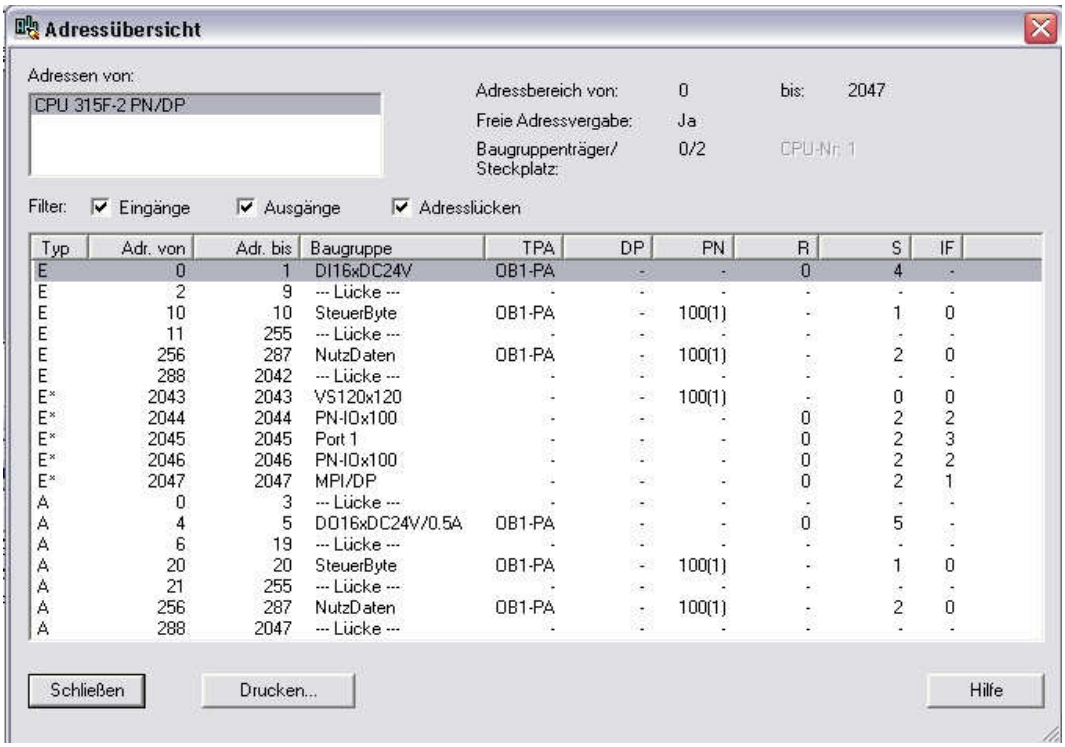
Note:
A precondition for this is that the PG/PC interface is set to TCP/IP and the network card for the PC is configured correctly. For example, IP address 192.168.0.99, subnet 255.255.255.0 and router address -.-.-.- (refer to Module E02).

19. Highlight the VS100 module and then click on the button “Assign name“. Close the window.



20. By clicking on '  ', we can now load the hardware configuration into the PLC. The operating mode switch should be on Stop! (→ ).





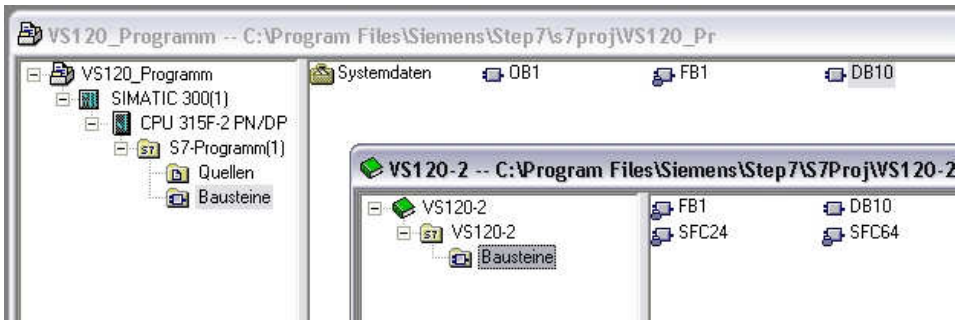
(After the hardware is loaded into the CPU, the red BF LED on the VS120 goes out)

21. Close the hardware configuration.

4.4 Inserting Blocks and FB1 and DB10 into the Project

From the template directory or from the Image Processing System SIMATIC VS120 V2.1 CD from the directory "Function Blocks“, de-archive and open the library **VS120-2**.

Add **FB1** and **DB10** to the block folder of the project.
Close the library.



Note:
Instead of library **VS120-2**, we can also de-archive the example program **VS120_Examples**. The file **Vs120_Examples.zip** is located on the Image Processing System SIMATIC VS120 V2.1 CD in the directory “Examples“, subdirectory "SIMATIC“

4.5 Function Block FB1

For a simpler handling of the functions of Vision Sensor SIMATIC VS12, the function block FB1 is provided for IO operations.
FB1 facilitates software-engineering integration into the control program.

Tasks of FB1

- Selecting a model or model set
- Reading the result data and storing it in DB10
  (DB10 is included in the documentation package)
- Operating the control and status interface (triggering, result bits, ...)
- Transmitting the delay time of the trigger
- Reading out error indications

FB1 Input Parameters

Parameter	Declaration	Data Type	Description
LADDR_ CONTROL	INPUT	INT	Address of the control byte in the SIMATIC VS120 interface that is entered under the Connection Control. This parameter has to be wired.
LADDR_ STATUS	INPUT	INT	Address of the status byte of the SIMATIC VS120 interface that is entered under Connection Control
LADDR_ RECV	INPUT	INT	Start address of the user data interface "Send“ of the SIMATIC VS120/"Receive“ of the PLC
LADDR_ SEND	INPUT	INT	Start address of the user data interface "Receive“ of the SIMATIC VS120/ "Send“ of the PLC
MODEL	INPUT	BYTE	Model number 1 to 15. **Note**: For model changes, the DISA bit has to be set
DISA	INPUT	BOOL	Disable: disables manual key operation
RESET	INPUT	BOOL	Reset: Reset error evaluation device or FB error. **Note**: Works also without setting the DISA bit
TRG	INPUT	BOOL	Trigger: Image pickup and starting the evaluation
DELAY	INPUT	DINT	Delay time: transfer of the trigger delay time to the SIMATIC VS120 in us (value range: 0 to 9.999.999us). **Note**: The delay value is a multiple of 50us with rounding off limits of 0us or 50us. For example, 49us becomes 0us, 65us becomes 50us..
RECV	INPUT	ANY	Receive: Receive area for the result values Permissible are only data block areas and the data type BYTE. This parameter has to be wired and the data block has to be at least as large as the maximum result to be expected.

Notes

FB1 Output Parameters

Parameter	Deklaration	Datentyp	Beschreibung
IN_OP	OUTPUT	BOOL	In Operation: • 0 = Fehlermeldung wird angezeigt • 1 = SIMATIC VS120 funktionsfähig, kein Fehler
TRD	OUTPUT	BOOL	Trained: • 0 = Modell / Modellset ist nicht ablauffähig • 1 = Modell / Modellset ist ablauffähig
RDY	OUTPUT	BOOL	Ready: • 0 = Anlauf des Geräts oder SIMATIC VS120 im Stopp • 1 = SIMATIC VS120 im Auswertebetrieb (Run)
OK	OUTPUT	BOOL	Objekt wurde erkannt: 1 = OK während der eingestellten Pulszeit
N_OK	OUTPUT	BOOL	Objekt wurde nicht erkannt 1 = N_OK während der eingestellten Pulszeit
NDR	OUTPUT	BOOL	New Data Received: Neue Daten empfangen **Hinweis:** Dieser Parameter steht nur einen CPU-Zyklus lang zur Verfügung.
ERROR	OUTPUT	BOOL	Es ist ein Fehler aufgetreten.
ERRCODE	OUTPUT	WORD	Tritt während der Bearbeitung der Funktion ein Fehler auf, enthält der Rückgabewert einen Fehlercode: • W#16#0000: kein Fehler • W#16#1xyz: FB1-interner Fehler • W#16#2xyz: Fehler des Auswertegeräts • W#16#8xyz: Fehlermeldungen interner SFCs.
MODEL_OUT	OUTPUT	BYTE	Nummer des aktuell angewählten Modells
LENGTH	OUTPUT	INT	Länge des Ergebnisses in Bytes

Notes

4.6 Operating FB1

Model Selection

- To select a model, the DISA bit has to be set to 1.
- The desired model number is set up at FB1 input MODEL.
- The model change is completed when the TRD and RDY bit changes from FALSE to TRUE. The model number that was set up is placed on output MODEL_OUT.
- As long as no model was transmitted, 0 is read out at output MODEL_OUT.
- The output MODEL_OUT changes to 0 as soon as the DISA bit is reset.
- If MODEL = 0, the model that was selected last is retained. 0 is read out at output MODEL_OUT.

Reset

- When errors are reset, SIMATIC VS120 module errors (IN_OP = 0) and the FB1 transmission errors are reset.

Triggering

- With the trigger input at FB1, image evaluation with the SIMATIC VS120 can be activated.
- For mixed operation "Controlling by means of PROFIBUS DP and triggering by means of DI/DO“ the trigger signal can be connected directly to the evaluation device VS120. The FB1 parameter TRG remains free in this case.

Transmitting Delay Time

- The time delay for hardware oriented trigger delays is set up at the FB1 parameter DELAY. With the delay time parameter, the value for the hardware oriented trigger supply can be specified.

Reading and transmitting result data

- The FB1 is always ready to receive.
- After an OK or N_OK evaluation, the result data is read out.
- The data is valid when bit NDR changes from 0 to 1.
- With the setup support under "Connections - Register Output" we are setting how many Sub-ROIs (regions of interest) are transmitted.

4.7 FB1 Error Information

If an error occurs, **ERROR = 1** is set.
The exact cause for the error is indicated in ERRCODE.

Error information

- 0000: No error
- 1xyz: Internal FB1error
- 2xyz: Evaluation device error
- 8xyz: Error indications of internal SFCs

ERRCODE (W#16#)	ERROR	Explanation
0000	0	No error
1001	1	Impermissible model number (parameter model). The values 1 to 15 are permissible
1002	1	Impermissible reveive area. Only data type BYTE is permissible
1003	1	Impermissible data area. Only data blocks are permissble
1004	1	The receive area does not exist (data block not available)
1005	1	The receive area is too short
1006	1	The receive area is write protected
1007	1	The delay value is outside the permissible range of 0 to 9.999.999us
2001	1	Selected model number is not trained
80xx	1	Transfer of SFC14 and SFC 15 error indications
8090	1	No module is configured for the specified logical base address
80A0	1	An access error was detected during the access to the IO
80C0	1	System error at the external PROFIBUS DP interface

4.8 Data Block DB10

Tasks of DB10

DB10 is laid out for the structured acceptance/storage of the data from one Main ROI and a maximum of 16 Sub-ROIs. In the setup support, the number of Sub-ROIs is set in Connections – Register Output.

.

Structure of the DB10

Adresse	Name	Typ	Anfangswert	Kommentar
0.0		STRUCT		
+0.0	Main_ROI	STRUCT		
+0.0	Reserve_0	BYTE	B#16#0	
+1.0	Warn	BYTE	B#16#0	First byte of "Receive" area
+2.0	Result	BYTE	B#16#0	
+3.0	Quality	BYTE	B#16#0	
+4.0	xPos	REAL	0.000000e+000	
+8.0	yPos	REAL	0.000000e+000	
+12.0	Angle	REAL	0.000000e+000	
+16.0	Model	BYTE	B#16#0	
+17.0	Quality_MainSubROI	BYTE	B#16#0	
+18.0	Number_of_SubROIs	BYTE	B#16#0	
+20.0	Reserve	WORD	W#16#0	
=22.0		END_STRUCT		
+22.0	SubROI_01	STRUCT		
+0.0	Result	BYTE	B#16#0	
+1.0	Quality	BYTE	B#16#0	
+2.0	xPos	REAL	0.000000e+000	
+6.0	yPos	REAL	0.000000e+000	
+10.0	Angle	REAL	0.000000e+000	
=14.0		END_STRUCT		
+36.0	SubROI_02	STRUCT		
+0.0	Result	BYTE	B#16#0	
+1.0	Quality	BYTE	B#16#0	
+2.0	xPos	REAL	0.000000e+000	
+6.0	yPos	REAL	0.000000e+000	
+10.0	Angle	REAL	0.000000e+000	
=14.0		END_STRUCT		
+50.0	SubROI_03	STRUCT		
+0.0	Result	BYTE	B#16#0	
+1.0	Quality	BYTE	B#16#0	
+2.0	xPos	REAL	0.000000e+000	
+6.0	yPos	REAL	0.000000e+000	
+10.0	Angle	REAL	0.000000e+000	
=14.0		END_STRUCT		
+64.0	SubROI_04	STRUCT		
+0.0	Result	BYTE	B#16#0	
+1.0	Quality	BYTE	B#16#0	
+2.0	xPos	REAL	0.000000e+000	
+6.0	yPos	REAL	0.000000e+000	
+10.0	Angle	REAL	0.000000e+000	
=14.0		END_STRUCT		
+78.0	SubROI_05	STRUCT		
+0.0	Result	BYTE	B#16#0	
+1.0	Quality	BYTE	B#16#0	
+2.0	xPos	REAL	0.000000e+000	
+232.0	SubROI_16	STRUCT		
+0.0	Result	BYTE	B#16#0	
+1.0	Quality	BYTE	B#16#0	
+2.0	xPos	REAL	0.000000e+000	
+6.0	yPos	REAL	0.000000e+000	
+10.0	Angle	REAL	0.000000e+000	
=14.0		END_STRUCT		
=246.0		END_STRUCT		

(DB10 has a size of 246 bytes and can accommodate 16 SubROIs)

4.9 Supplementing the Symbol Table

Open the symbol table and enter the following symbol assignments.

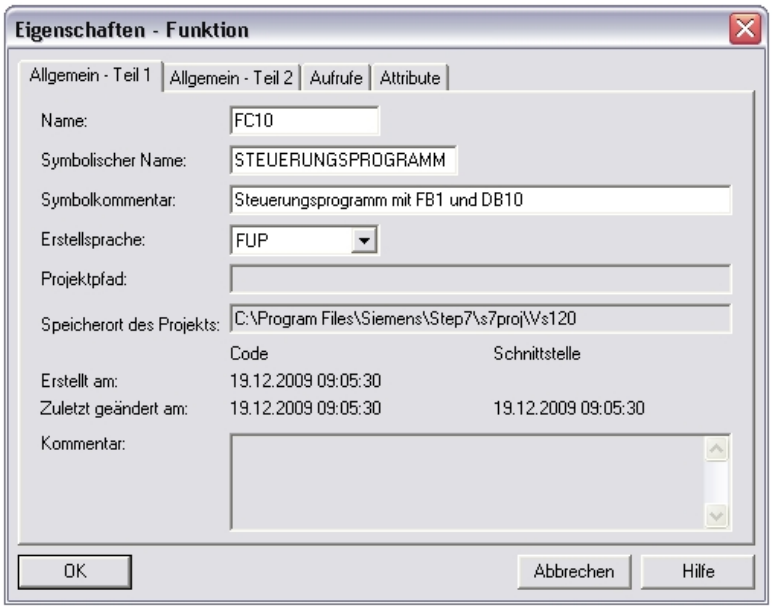
Symbol	Adresse	Datentyp	Kommentar
VS120_Funktion_OK	A 4.0	BOOL	1 = SIMATIC VS120 funktionsfähig, kein Fehler
VS120_Modellset_OK	A 4.1	BOOL	1 = Modell / Modellset ist ablauffähig
VS120_RUN	A 4.2	BOOL	1 = SIMATIC VS120 im Auswertebetrieb (Run)
VS120_Modell_OK	A 4.3	BOOL	1 = Objekt wurde erkannt, Teil OK
VS120_Modell_N_OK	A 4.4	BOOL	1 = Objekt wurde nicht erkannt, Teil nicht OK
VS120_NDR	A 4.5	BOOL	Neue Daten empfangen. Steht nur 1 Zyklus an
VS120_Fehler	A 4.6	BOOL	Es ist ein Fehler aufgetreten.
START	E 0.0	BOOL	Bildaufnahme und Auswertung starten
RESET	E 0.1	BOOL	Auswertegerät oder FB-Fehler rücksetzen
DISA	E 0.2	BOOL	Sperren der manuellen Tastenbedienung

Save and close the symbol table.

4.10 FC10 Control Program

In FC10, we now generate the control program for the Vision Sensor Module VS120.

Generate FC10.

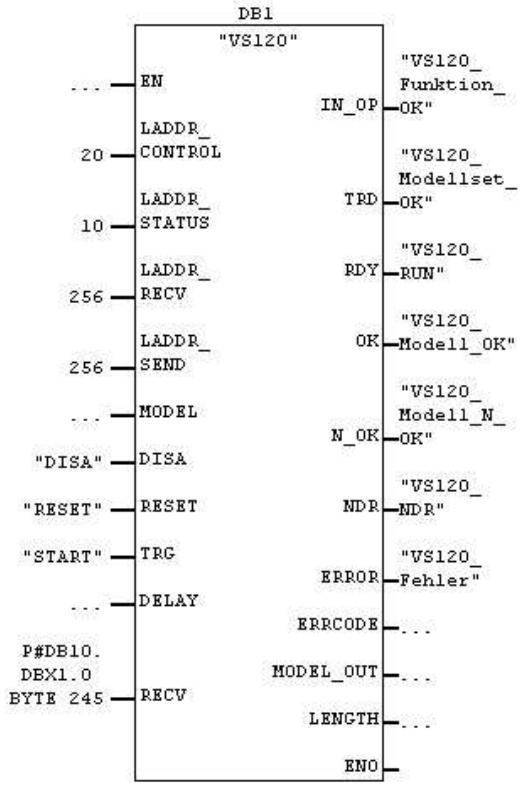


The input/output addresses of the VS120 (hardware) have to be entered at the first four input parameters of FB1.
With input I0.0, the command for image pickup and for starting the evaluation is executed.
With input I0.1, the error is reset if there is an error.
With input I0.2, operating the VS120 manually is disabled.

At input parameter RECV, DB10 is specified as ANY P#DB10.DBX1.0 BYTE 245.
In DB10, data is entered starting with Byte 1.
By means of the inputs Q4.0 to Q4.6, the VS120 status information is displayed.

FB1 is called on Network 1

```
FC10 : Steuerungsprogramm VS120
Netzwerk 1: Funktionsbaustein FB1 aufrufen
```



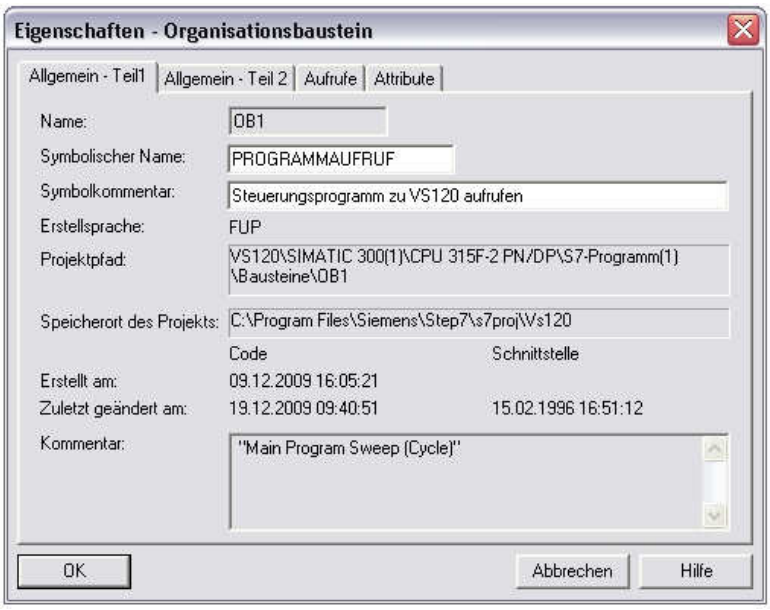
Symbolinformation:

```
VS120                   FB1     -- VS120-Communication via PROFIBUS-DP S7-300/400
DISA                    E0.2    -- Sperren der manuellen Tastenbedienung
RESET                   E0.1    -- Auswertegerät oder FB-Fehler rücksetzen
START                   E0.0    -- Bildaufnahme und Auswertung starten
VS120_Funktion_OK       A4.0    -- 1 = SIMATIC VS120 funktionsfähig, kein Fehler
VS120_Modellset_OK      A4.1    -- 1 = Modell / Modellset ist ablauffähig
VS120_RUN               A4.2    -- 1 = SIMATIC VS120 im Auswertebetrieb (Run)
VS120_Modell_OK         A4.3    -- 1 = Objekt wurde erkannt, Teil OK
VS120_Modell_N_OK       A4.4    -- 1 = Objekt wurde nicht erkannt, Teil nicht OK
VS120_NDR               A4.5    -- Neue Daten empfangen. Steht nur 1 Zyklus an
VS120_Fehler            A4.6    -- Es ist ein Fehler aufgetreten.
```

Additional information is provided in Chapter 10.6 of the operating instructions "Image Processing System Vision Sensor SIMATIC VS120".

4.11 Calling FC10 in OB1

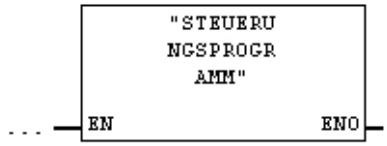
Double click on OB1.
Enter symbolic name and symbol comment.



Confirm with OK

Enter Network 1.

```
OB1 :  "Main Program Sweep (Cycle)"
Netzwerk 1: Steuerungsprogramm VS120 aufrufen
```




```
Symbolinformation:
 STEUERUNGSPROGRAMM       FC10                -- Steuerungsprogramm mit FB1 und DB10
```

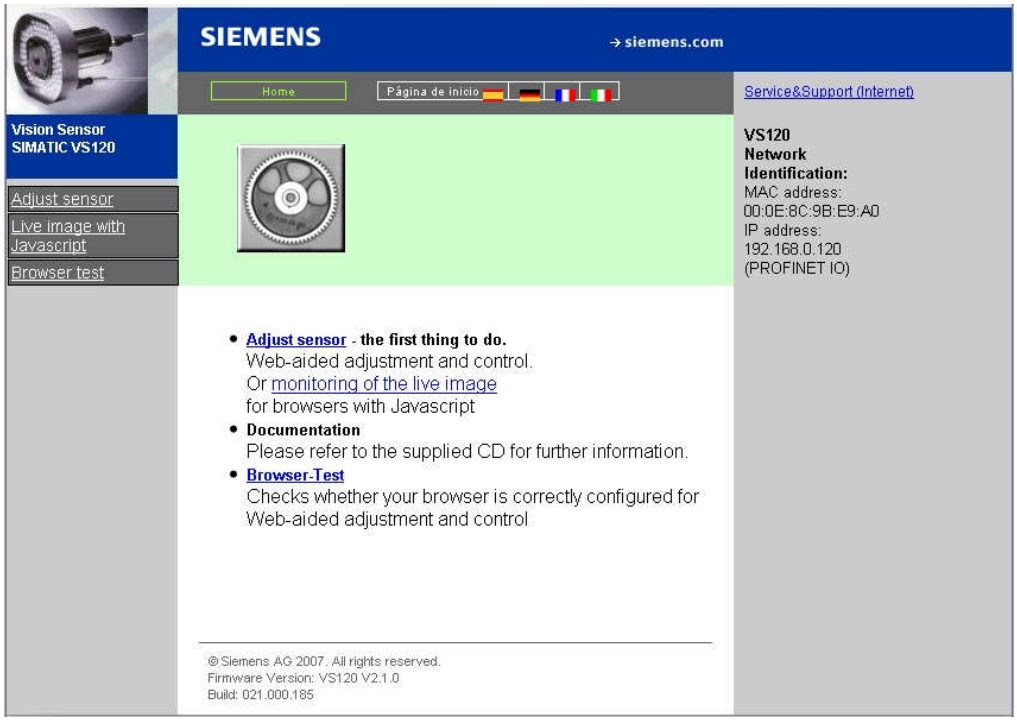
Save and close OB1.

We now can load the program into the CPU.

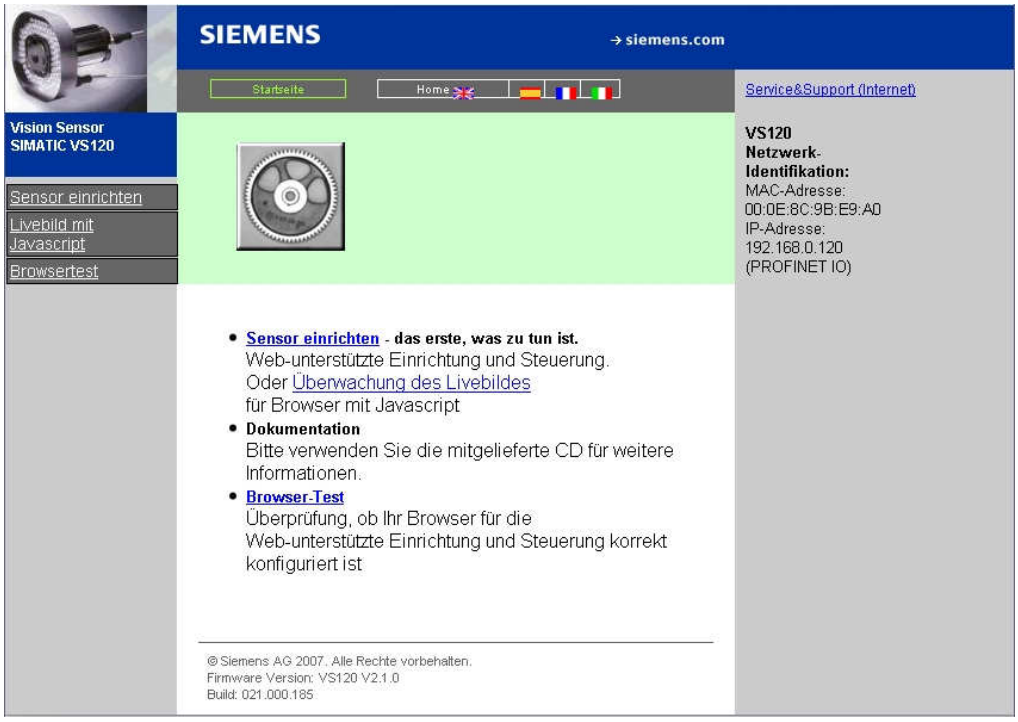
5. WEB SERVER BASED OPERATOR INTERFACE OF VS120

5.1 Setting Up and Evaluating the Model

Open the Internet browser.
As link, enter the IP address 192.168.0.120 of the VS120.



To set the language, click on the German flag.



Click on **Set up Sensor**.

On the left of the interface, you will see a selection of tasks in the form of buttons. Activate the desired task with a mouse click on the corresponding button. The associated dialog will then be displayed on the right side of the interface.

The Web server based interface for Vision Sensor SIMATIC VS120 provides the following dialog fields for image evaluation:

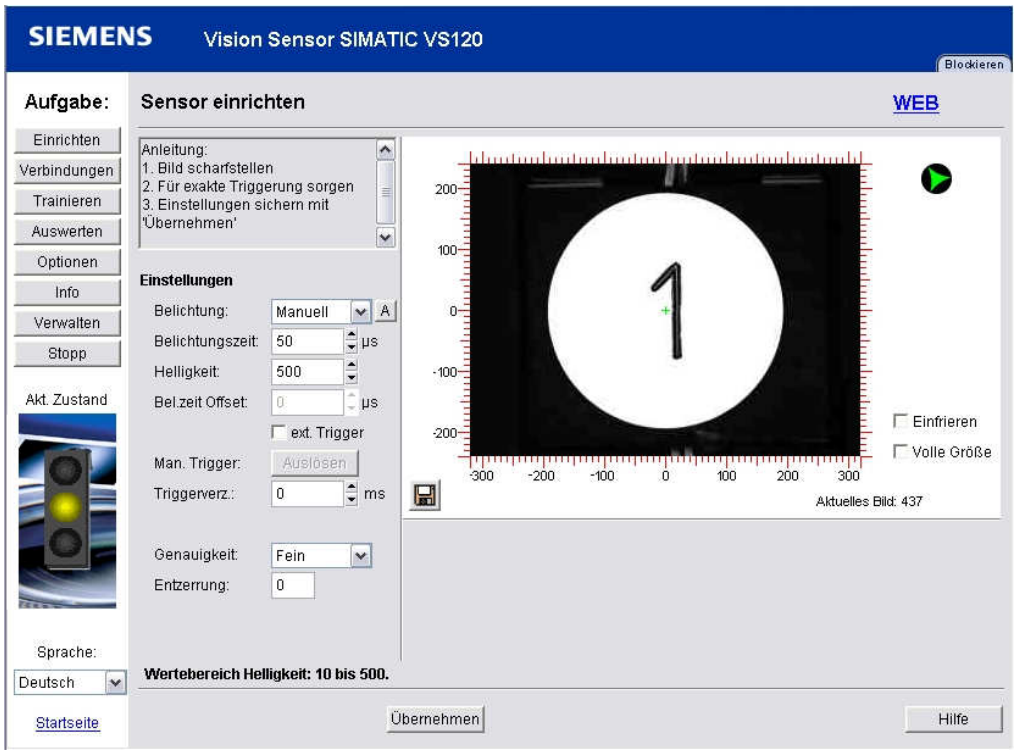
- Set up
- Connections
- Training
- Evaluating
- Options
- Info
- Managing
- Stop

A traffic light is located below the task buttons that shows you at a glance the current operating mode of the evaluation device VS120.

The traffic light can display the following states:

- Green: Evaluation mode VS120 with result output
- Yellow: STOP including setup and training
- Red: Error

Click on the button **Set up**.



Here, we specify the parameters for image pickup and image evaluation.

To create patterns that can be recognized, edges -that is, the transition from light to dark or vice versa- of the image are used. Although the algorithm extracts the edges automatically, the user has to provide for an image rich in contrasts through optimum exposure; i.e., to generate models that are recognizable, creating an image that is rich in contrasts through optimum exposure is a precondition.

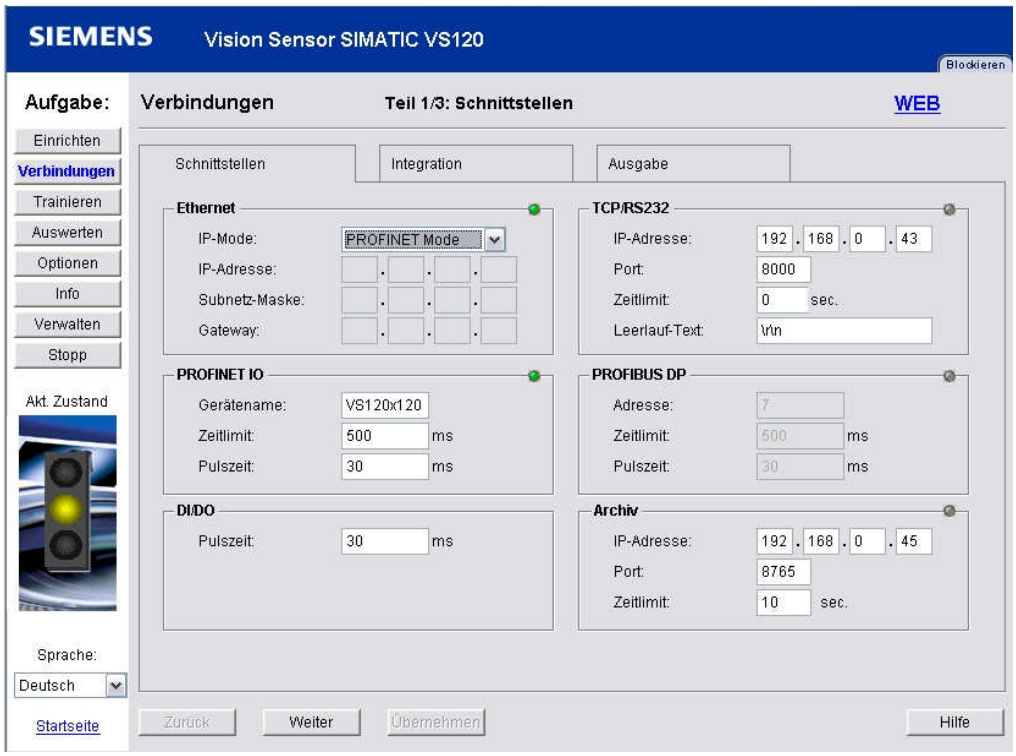
Automatic exposure time should be selected only if the object to be checked is not moving.

Selecting the accuracy is based on the size of the search ranges and on the detectable changes of the object to be checked. Parts in the image are searched for pyramidically.
We start with a rough search with low resolution, and conclude with a detail search with a high resolution.
The accuracy influences the rough and detailed search.

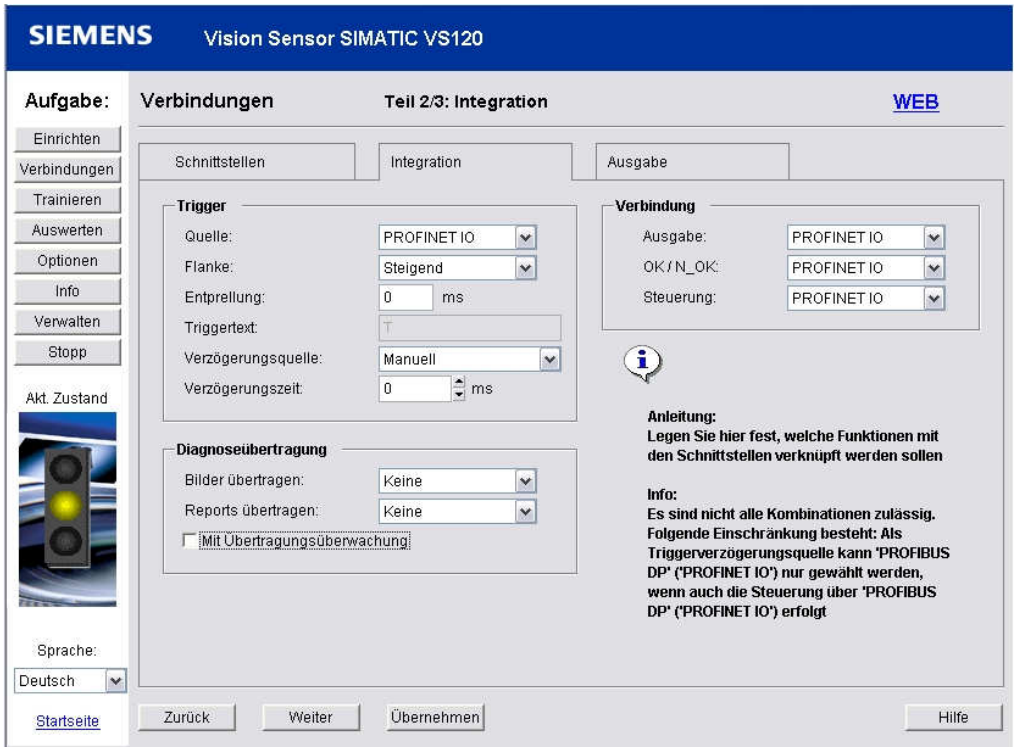
The higher the checking accuracy, the longer the evaluation takes.

Additional information is provided in Chapter 4 of the operating instructions "Image Processing System Vision Sensor SIMATIC VS120".

Now click on the button **Connections**.

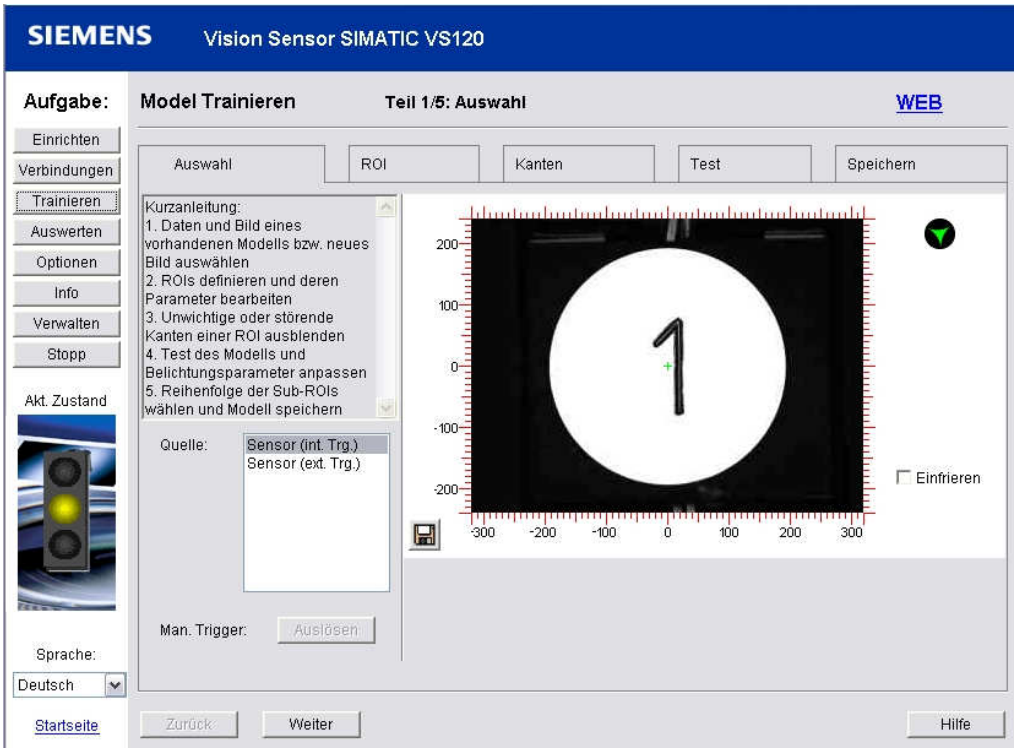


Then click on the tab **Integration** or on the button **Continue**.

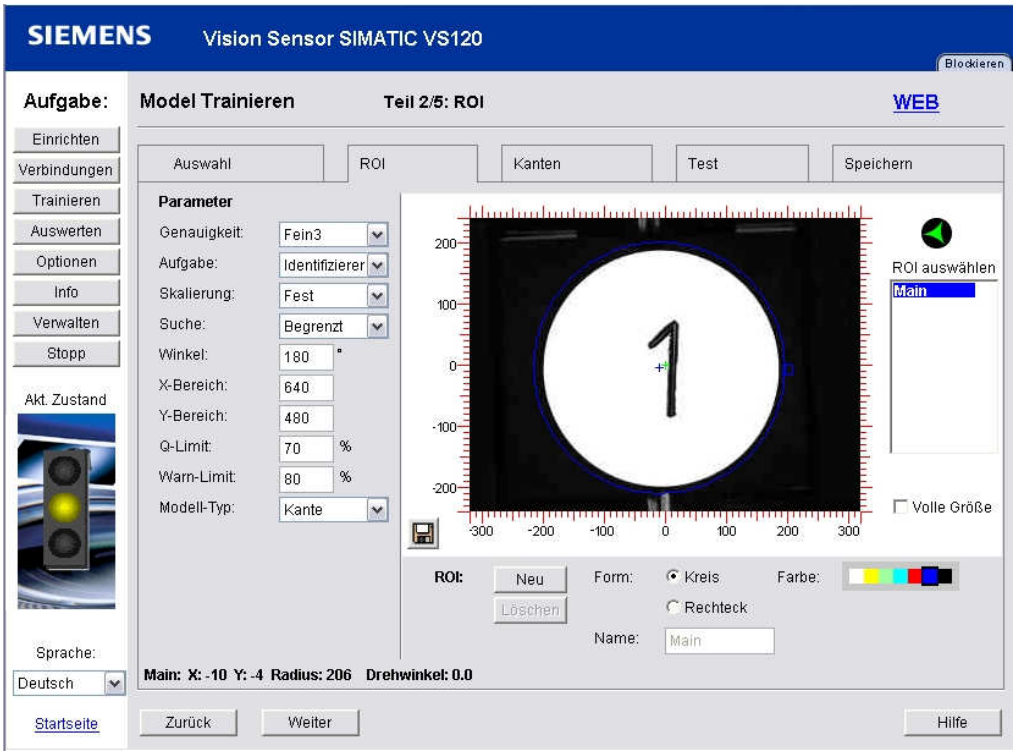


As **Trigger**, set the source PROFINET IO.
At **Connection**, set the output, OK/N_OK, and controller PROFINET IO.
Click on **Accept**.

Next, click on the button **Training**.



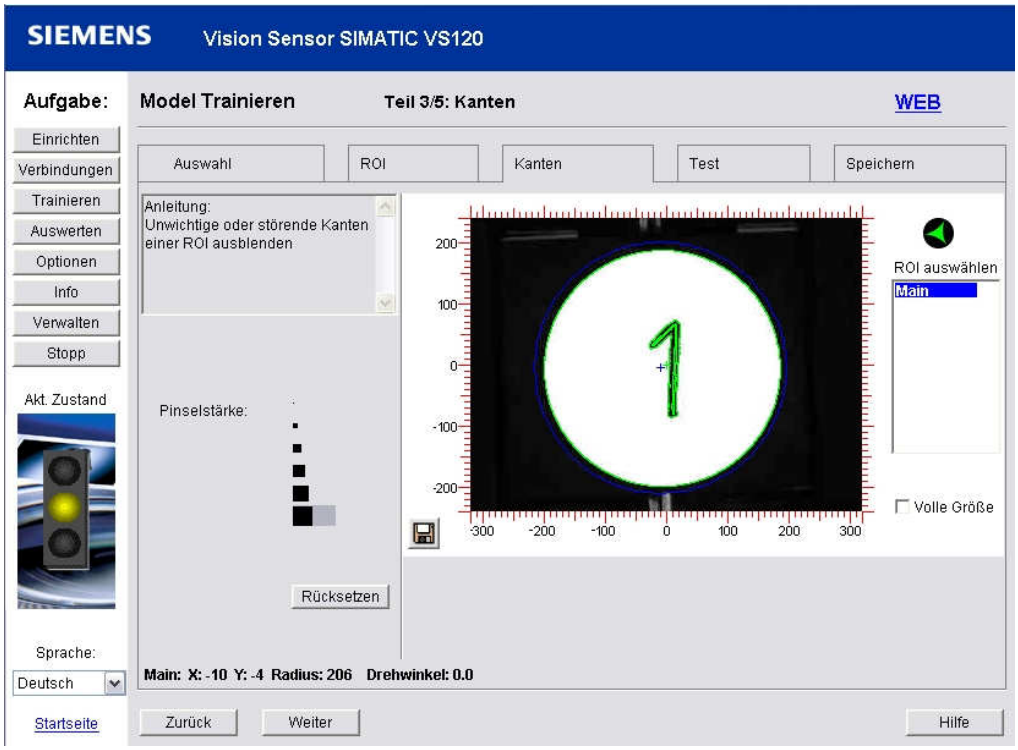
Then click on the button **Continue**, set the parameters and draw a circular ROI (Region of Interest) around the part.



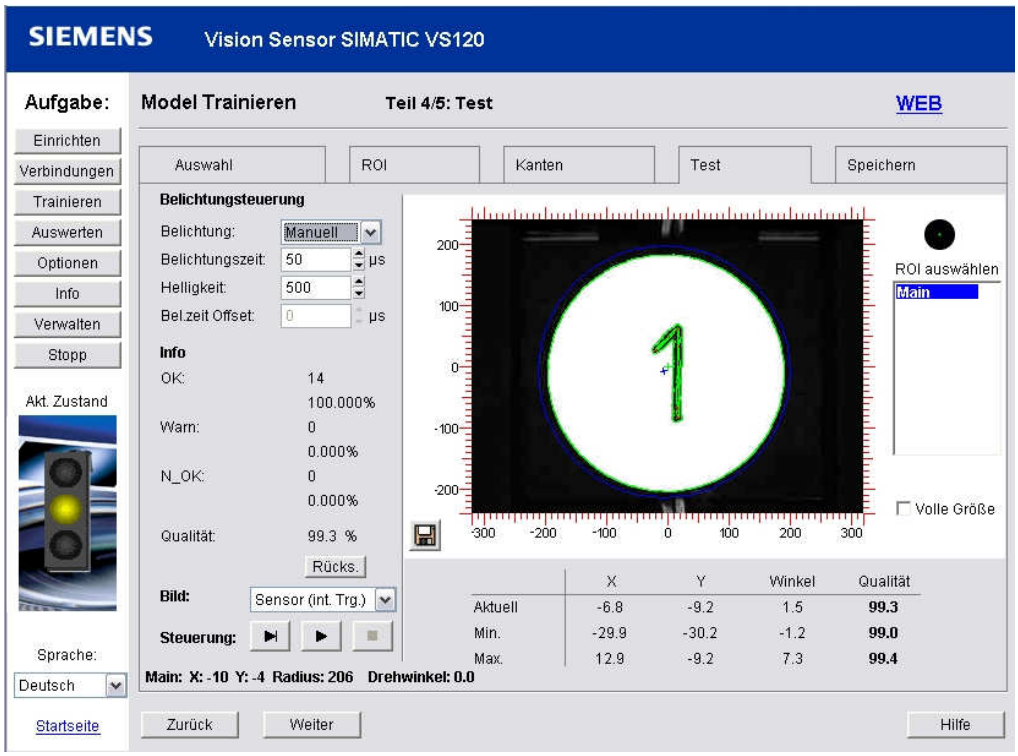
Click on the button **Continue**

Additional information about the parameters is provided in Chapter 4.3 of the operating instructions "Image Processing System Vision Sensor SIMATIC VS120".

Under the tab **Edges**, interfering or unimportant edges can be removed.

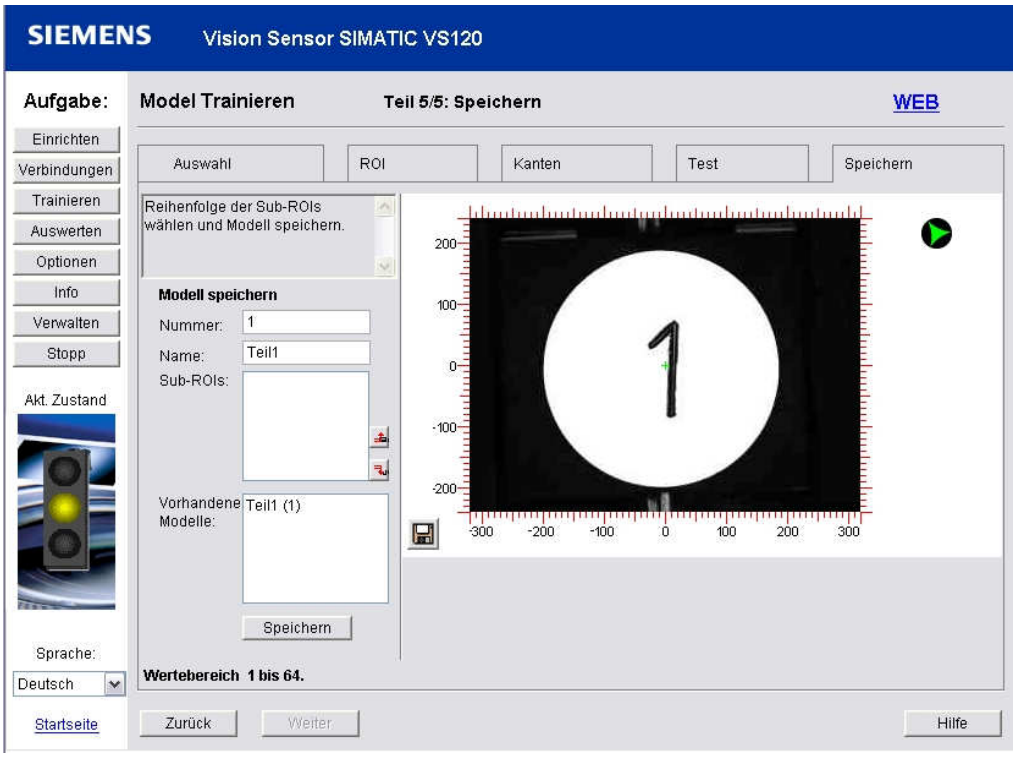


Under the tab **Test**, the trained part is tested.

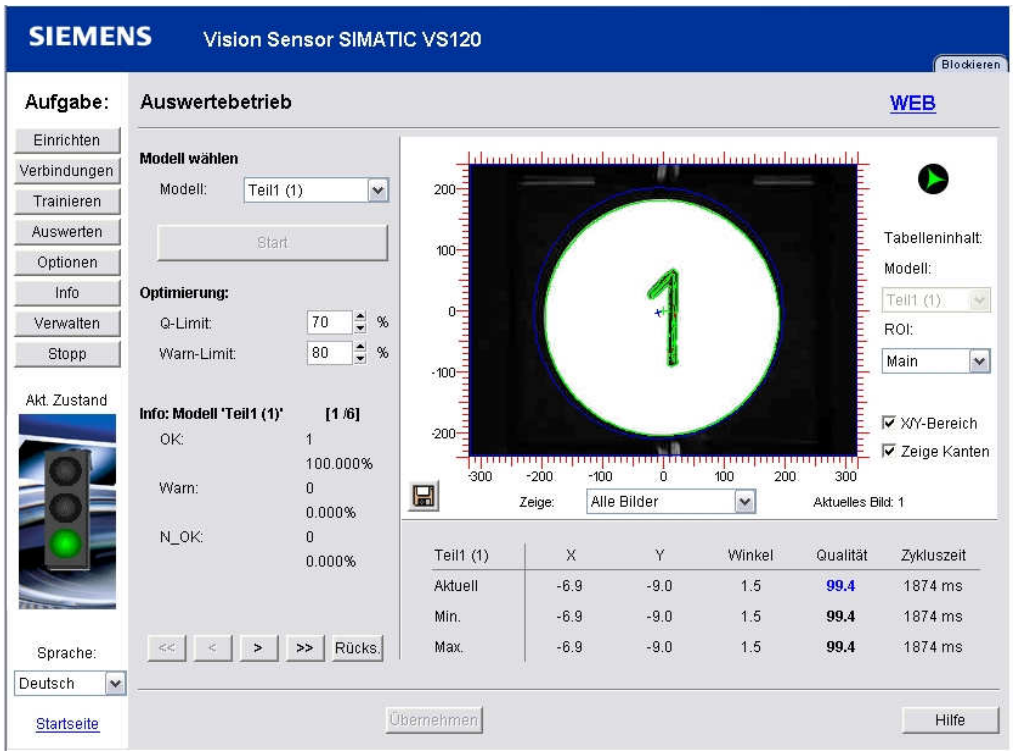


Click on the button **Continue**.

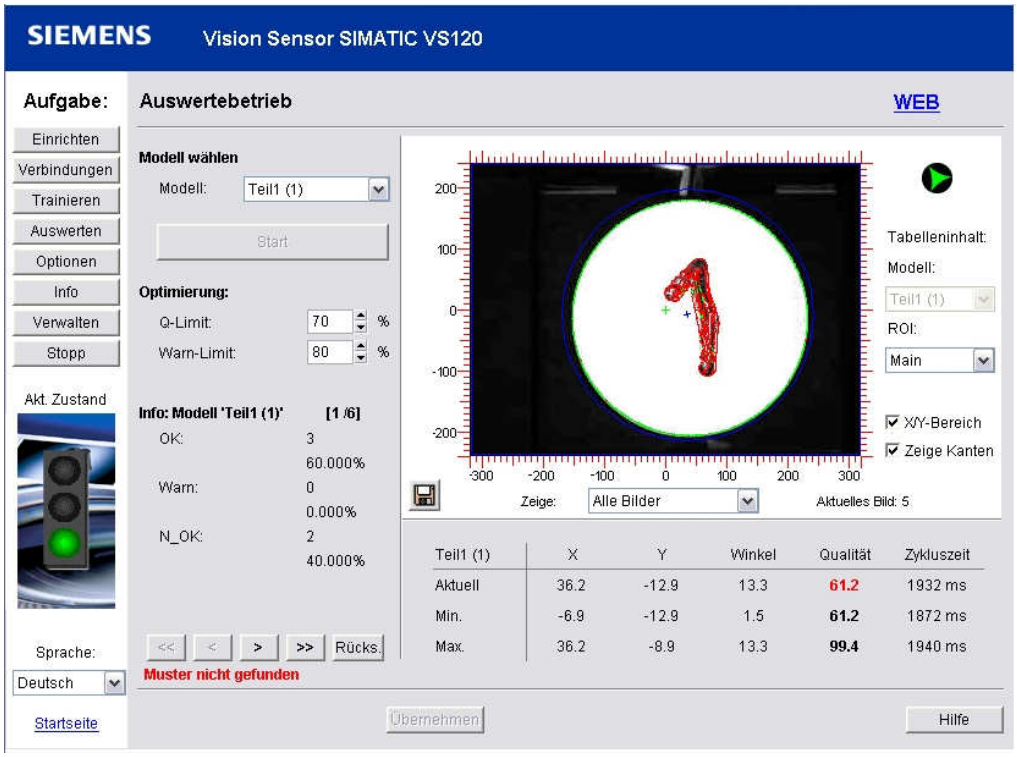
Under the tab **Save**, save the model with the name Part1.



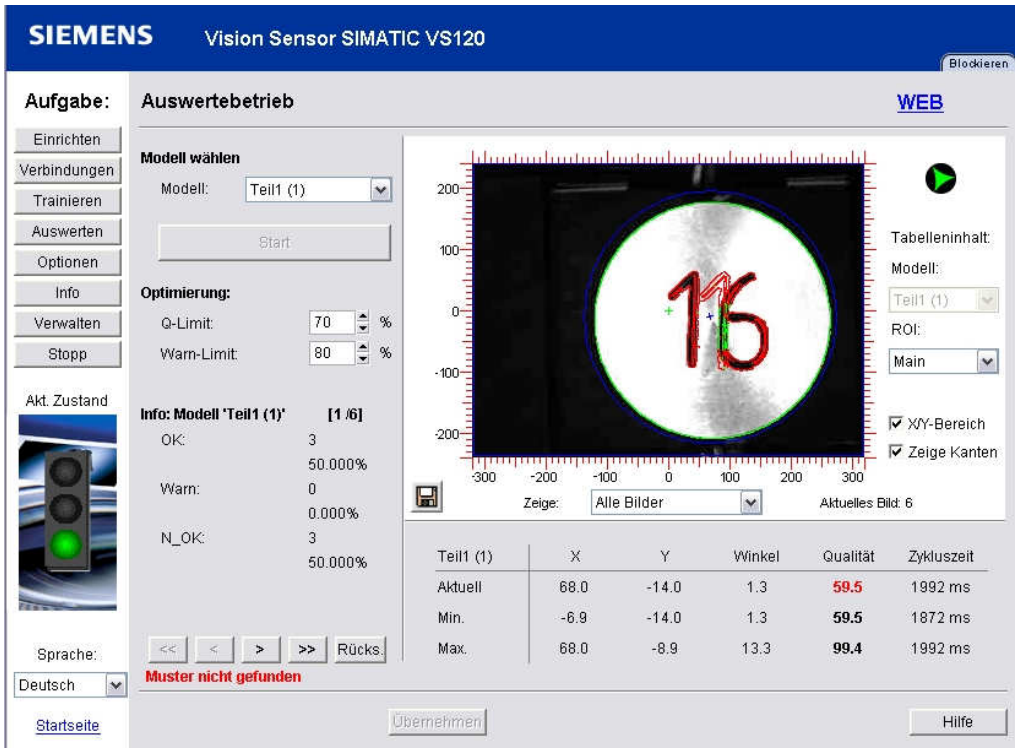
Now click on the button **Evaluate** and start the evaluation mode.
Set the CPU to **Run** and start the image evaluation with "**Start**“ (I0.0).



Evaluation result: Faulty part with the Number 1 is too large and milling is crooked.



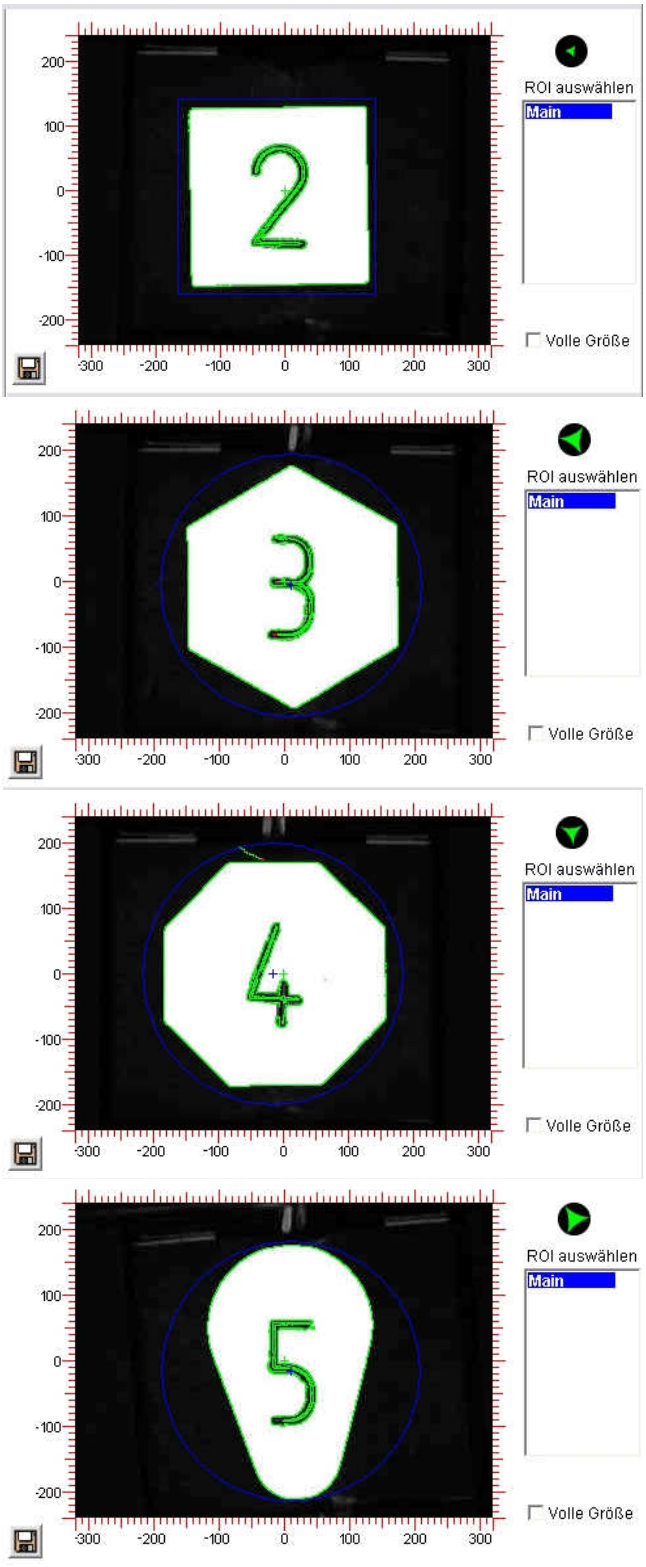
Evaluation result: Faulty part with Number 16 instead of Number 1



5.2 Setting Up the Model Set and Evaluating the Model Number

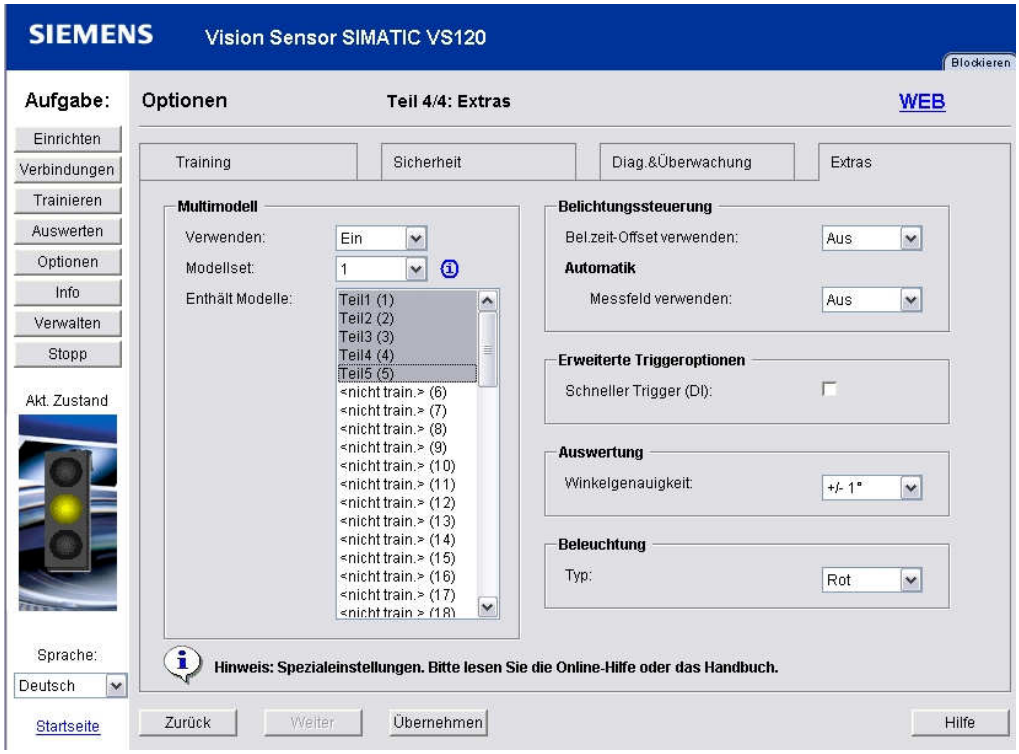
Several models are to be trained and combined into a set.

Train parts 2 to 5.



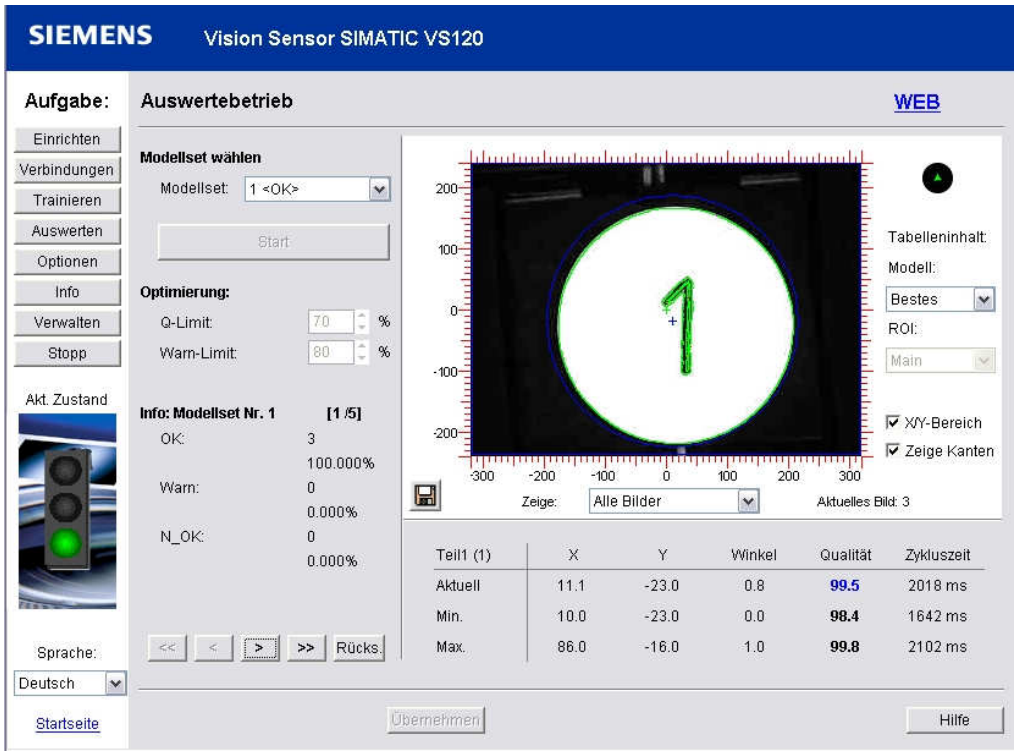
Parts 1 to 5 are to be combined into one model set.

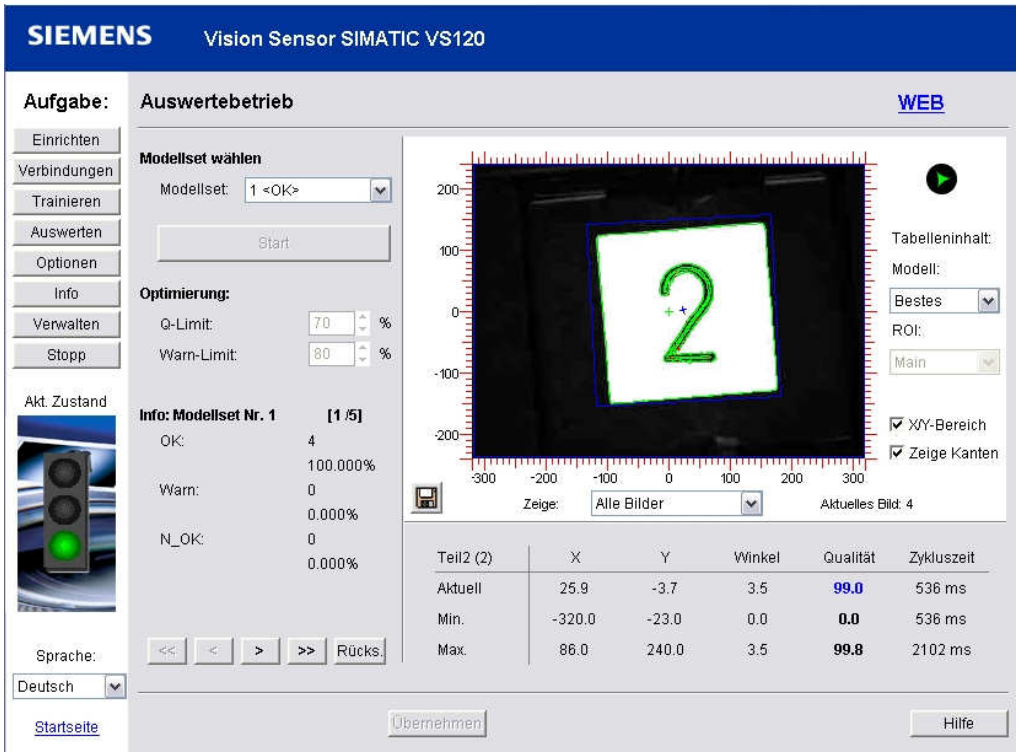
Click on the button **Options**.
In the tab **Extras** under **Multi-Model** Use: select **ON**.
Highlight Part1 to Part5.
Save Part1 with the names
Click on the button **Accept**.



All additional information about operating the Web server based interface is provided in Chapter 9.3 of the operating instructions "Image Processing System Vision Sensor SIMATIC VS120".

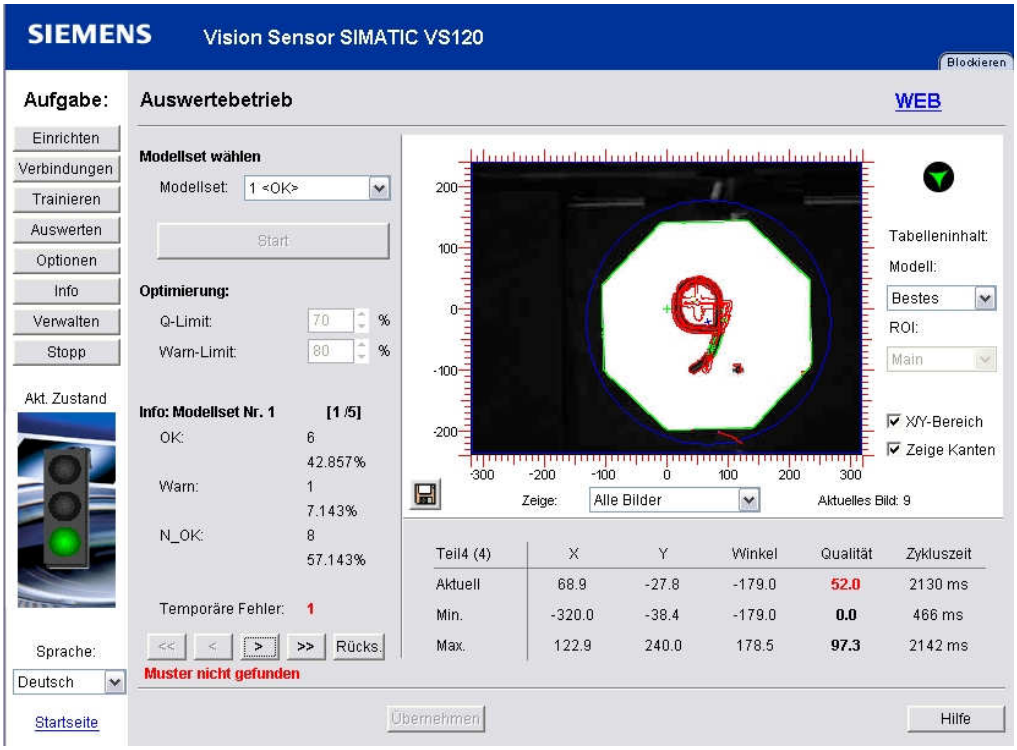
Now click on the button **Evaluate** and start the evaluation mode.
Set the CPU to **Run** and start image evaluation with "**Start**" (I0.0).

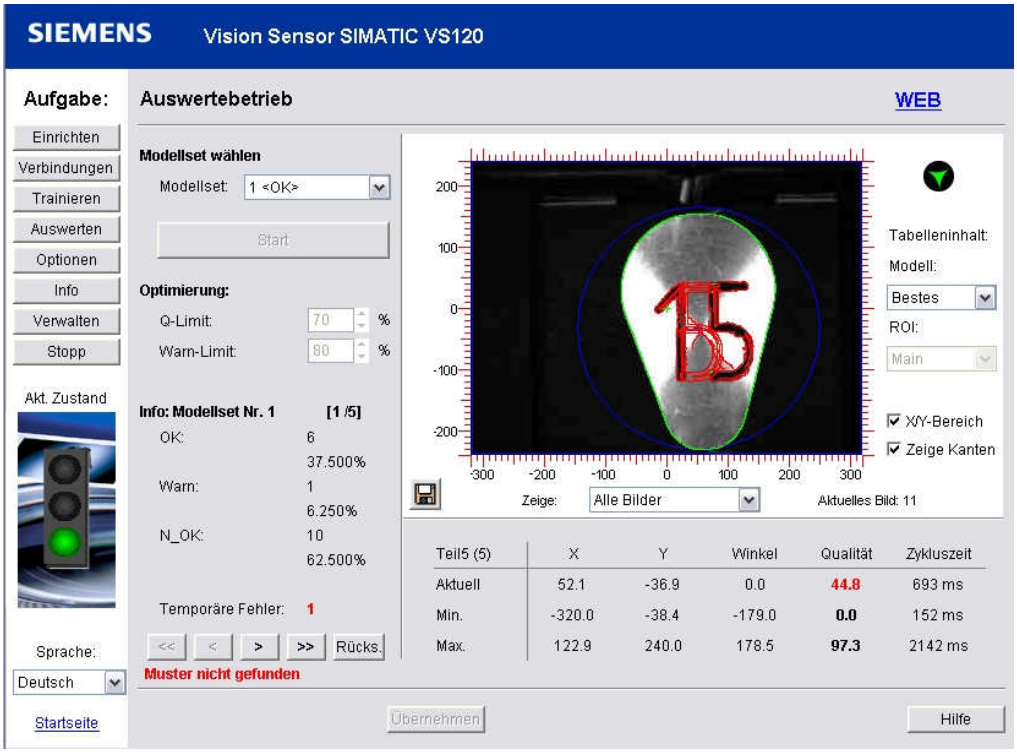




The work pieces are recognized.

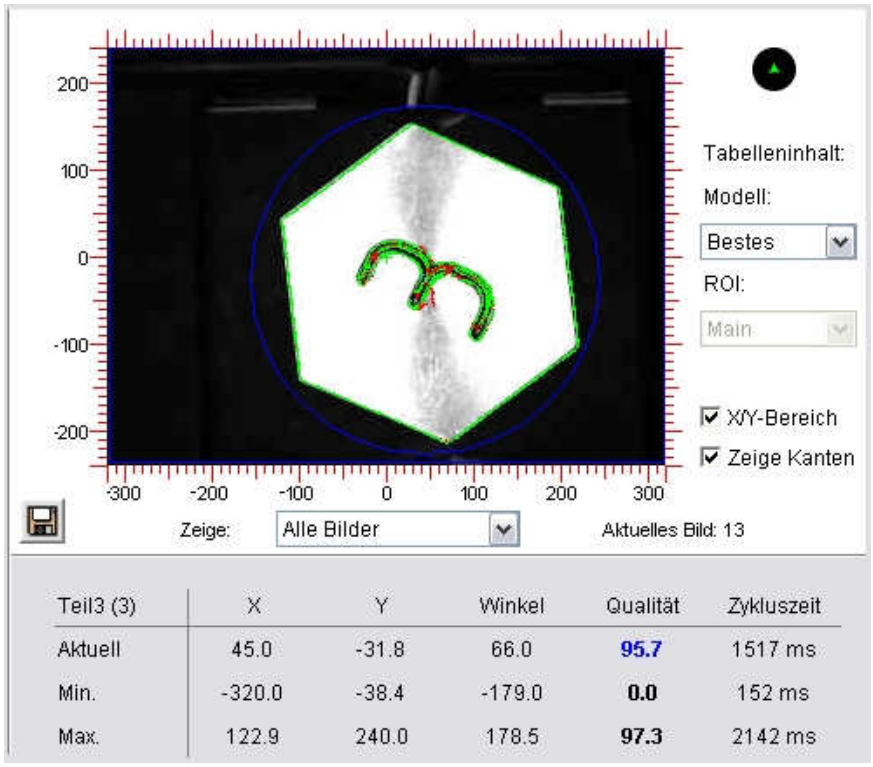
Even if the number is faulty, a parts assignment is still made by means of the shape.





6 RESULTS OF IMAGE EVALUATION IN THE CPU

6.1 Web View of the Evaluation



Teil3 (3)	X	Y	Winkel	Qualität	Zykluszeit
Aktuell	45.0	-31.8	66.0	**95.7**	1517 ms
Min.	-320.0	-38.4	-179.0	**0.0**	152 ms
Max.	122.9	240.0	178.5	**97.3**	2142 ms

6.2 DB10 Data View

The result of the image evaluation is stored in DB10

Adresse	Name	Typ	Anfangswert	Aktualwert
0.0	Main_ROI.Reserve_0	BYTE	B#16#0	B#16#00
1.0	Main_ROI.Warn	BYTE	B#16#0	B#16#00
2.0	Main_ROI.Result	BYTE	B#16#0	B#16#01
3.0	Main_ROI.Quality	BYTE	B#16#0	B#16#60
4.0	Main_ROI.xPos	REAL	0.000000e+0	45.0
8.0	Main_ROI.yPos	REAL	0.000000e+0	-31.8
12.0	Main_ROI.Angle	REAL	0.000000e+0	66.0
16.0	Main_ROI.Model	BYTE	B#16#0	B#16#03
17.0	Main_ROI.Quality_MainSubROI	BYTE	B#16#0	B#16#60
18.0	Main_ROI.Number_of_SubROIs	BYTE	B#16#0	B#16#00
20.0	Main_ROI.Reserve	WORD	W#16#0	W#16#0000

6.3 Variable Table DB_Values

DB_Werte -- @VS120\SIMATIC 300(1)\CPU 315F-2 PN/DP\S7-Programm(1) O

	Operand	Symbol	Anzeigeformat	Statuswert	Steuerwert
1	DB10.DBB 0	"DB-Result".Main_ROI.Reserve_0	DEZ	0	
2	DB10.DBB 1	"DB-Result".Main_ROI.Warn	DEZ	0	
3	DB10.DBB 2	"DB-Result".Main_ROI.Result	DEZ	1	
4	DB10.DBB 3	"DB-Result".Main_ROI.Quality	DEZ	96	
5	DB10.DBD 4	"DB-Result".Main_ROI.xPos	GLEITPUNKT	45.0	
6	DB10.DBD 8	"DB-Result".Main_ROI.yPos	GLEITPUNKT	-31.8	
7	DB10.DBD 12	"DB-Result".Main_ROI.Angle	GLEITPUNKT	66.0	
8	DB10.DBB 23	"DB-Result".SubROI_01.Quality	DEZ	0	
9	DB10.DBB 16	"DB-Result".Main_ROI.Model	DEZ	3	
10	A 4.0	"VS120_Funktion_OK"	BOOL	true	
11	A 4.1	"VS120_Modellset_OK"	BOOL	true	
12	A 4.2	"VS120_RUN"	BOOL	true	
13	A 4.3	"VS120_Modell_OK"	BOOL	false	
14	A 4.4	"VS120_Modell_N_OK"	BOOL	false	
15	A 4.5	"VS120_NDR"	BOOL	false	
16	A 4.6	"VS120_Fehler"	BOOL	false	

6.4 Symbol Table

Symbol	Adresse	Datentyp	Kommentar
VS120_Funktion_OK	A 4.0	BOOL	1 = SIMATIC VS120 funktionsfähig, kein Fehler
VS120_Modellset_OK	A 4.1	BOOL	1 = Modell / Modellset ist ablauffähig
VS120_RUN	A 4.2	BOOL	1 = SIMATIC VS120 im Auswertebetrieb (Run)
VS120_Modell_OK	A 4.3	BOOL	1 = Objekt wurde erkannt, Teil OK
VS120_Modell_N_OK	A 4.4	BOOL	1 = Objekt wurde nicht erkannt, Teil nicht OK
VS120_NDR	A 4.5	BOOL	Neue Daten empfangen. Steht nur 1 Zyklus an
VS120_Fehler	A 4.6	BOOL	Es ist ein Fehler aufgetreten.
DB-Result	DB 10	DB 10	DB Result
START	E 0.0	BOOL	Bildaufnahme und Auswertung starten
RESET	E 0.1	BOOL	Auswertegerät oder FB-Fehler rücksetzen
DISA	E 0.2	BOOL	Sperren der manuellen Tastenbedienung
VS120	FB 1	FB 1	VS120-Communication via PROFIBUS-DP S7-300/400
STEUERUNGSPROGRAMM	FC 10	FC 10	Steuerungsprogramm mit FB1 und DB10
PROGRAMMAUFRUF	OB 1	OB 1	Steuerungsprogramm zu VS120 aufrufen
DB_Werte	VAT 1		