Training document for the company-wide automation solution Totally Integrated Automation (T I A)

MODULE D4

PROFIBUS DP with

Master CPU 315-2DP / Slave ET 200M

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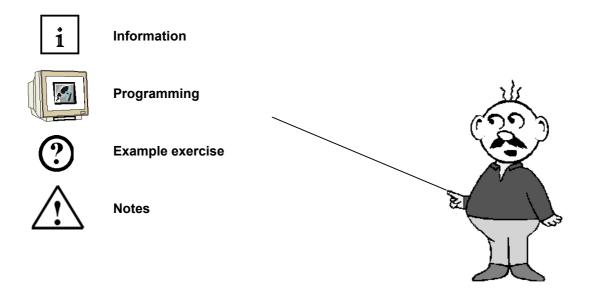
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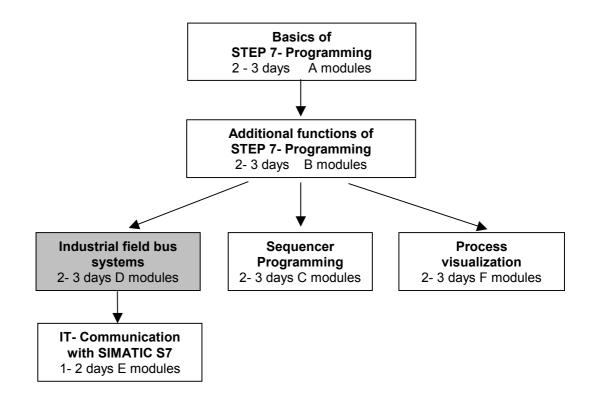
The following symbols stand for the specified modules:



1. FORWARD

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The module D4 is assigned content wise to Industrial field bus systems.



Learning goal:

In this module, the reader should learn how the PROFIBUS DP is taken into operation with the CPU 315-2DP as a master and the ET 200M as a slave. The module shows the principle procedure by means of a short example.

Requirements:

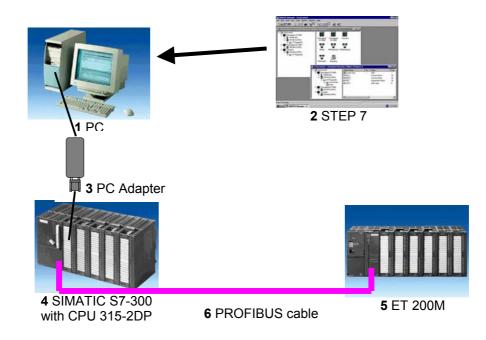
For the successful use of this module, the following knowledge is assumed:

- Knowledge in the use of Windows 95/98/2000/ME/NT4.0
- Basics of PLC- Programming with STEP 7 (e.g. Module A3 'Startup' PLC programming with STEP 7)
- Basics of the PROFIBUS DP (e.g. Appendix IV Basics of field bus systems with SIMATIC S7-300)

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Required hardware and software

- 1 PC, Operating system Windows 95/98/2000/ME/NT4.0 with
 - Minimal: 133MHz and 64MB RAM, approx. 65 MB free hard disk space
 - Optimal: 500MHz and 128MB RAM, approx. 65 MB free hard disk space
- 2 Software STEP 7 V 5.x
- 3 MPI- Interface for the PC (e.g. PC- Adapter)
- 4 PLC SIMATIC S7-300 with the CPU 315-2DP
 - Example configuration:
 - Network: PS 307 2A
 - CPU: CPU 315-2DP
- **5** Distributed I/O ET 200M with at least one digital in- and output. Example configuration:
 - Power supply: PS 307 2A
 - PROFIBUS terminal: IM 153-1
 - Digital inputs: DI 16x DC24V
 - Digital outputs: DO 16x DC24V / 0.5 A
- 6 PROFIBUS cable with 2 PROFIBUS slots



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2. NOTES FOR THE OPERATION OF THE CPU 315-2DP

The CPU 315-2DP is a CPU that is made available with an integrated PROFIBUS DP interface. For the CPU 315-2DP, the following PROFIBUS protocol profiles are available at your disposal:

DP- Interface as a master or slave in accordance with EN 50170. PROFIBUS-DP (Distributed I/O) is the protocol profile for the connection of distributed I/O/Field equipment with fast reaction time.

A further characteristic is that the addresses of the in- and output modules can be parameterized by this CPU.

The CPU capability is given with the following data:

- 16K Statements. 48Kbyte RAM (integrated) 80Kbyte RAM
- 1024 Byte DI/DO
- 128 Byte Al/AO
- 0.3 ms / 1K Instructions
- 64 Counters
- 128 Timers
- 2048 Memory bits



Note: The CPU 315-2DP is appointed here on the PROFIBUS as a master.

3. NOTES TO THE OPERATION OF THE ET 200M



The ET 200M is a distributed I/O system with a small, compact configuration. The modules are identical with the standard modules of the SIMATIC S7-300. By the actuators of the CPU, there is only one interface module (e.g. IM153-1) that functions as a slave on the PROFIBUS DP. The PROFIBUS address is adjusted by a binary coded DIL- switch block.

Another possible adjustment of the PROFIBUS address is with the power recovery. Therefore, the ET 200M must be turned off and then back on.

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COMMISSIONING THE PROFIBUS (MASTER CPU315-2DP / SLAVE ET200M) 4.



In the following example, the commissioning of a mono master system with the CPU315-2DP as a master and an ET 200M as a slave is described.

For the testing of the configuration, a program will be written in which a display lamp H1 is triggered by the simultaneous activation of two buttons S0 and S1.

Assignment	list:
------------	-------

10.0	S0	Button selection 1
10.1	S1	Button selection 2
Q0.0	H1	Display lamp



1. The central tool in STEP 7 is the SIMATIC Manager, which is opened here with a double click (\rightarrow SIMATIC Manager).





2. STEP 7- Programs are administered in projects . Such a project will be created (\rightarrow File \rightarrow New).

SIMATIC Manager		
<u>File</u> PLC <u>View</u> <u>Options</u> <u>W</u> indow <u>H</u> elp		I
New Project' Wigard	Ctrl+N	
<u>Open</u>	Ctrl+O	
Open Versjon 1 Project		
S7 Memory Card Memory Card <u>F</u> ile		
<u>D</u> elete R <u>e</u> organize		
Manage		
Archive Retrieve		
Page Setup		
Labeling fields		
P <u>r</u> int Setup		
1 tester (Project) C:\Siemens\Step7\S7proj\tester 2 Convert (Project) C:\Siemens\Step7\S7proj\Convert		
3 Testproject_FB (Project) C:\Siemens\Step7\S7proj\Testpr_1		
4 Testproject_DB (Project) C:\Siemens\Step7\S7proj\Testproj		
E <u>x</u> it	Alt+F4	
Creates a new project or a new library.		and and a second se

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3. Give the Name ET200M to the project (\rightarrow ET200M \rightarrow OK).

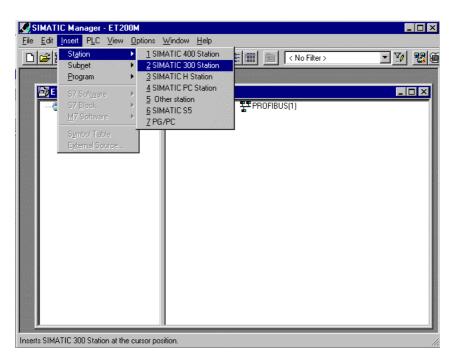
New		×
User projects Librar	ies	
Name	Storage path	
Abschervorrichtung Convert Cutting apparatus Cutting apparatus Cutting apparatus ET200L startup tester Testproject_FB	C:\Siemens\Step7\S7proj\AB C:\Siemens\Step7\S7proj\Cor C:\Siemens\Step7\S7proj\Cut C:\Siemens\Step7\S7proj\Cut C:\Siemens\Step7\S7proj\Cut C:\Siemens\Step7\S7proj\Et2 C:\Siemens\Step7\S7proj\test C:\Siemens\Step7\S7proj\test	nvert ting_2 test 00I ARTUP
 Na <u>m</u> e:		
ET200M		Project 💌
Storage location (path) C:\Siemens\Step7\S7		<u>B</u> rowse
ОК	Cance	Help

4. Highlight your project and insert a **PROFIBUS Subnet** (\rightarrow ET200M \rightarrow Insert \rightarrow Subnet \rightarrow PROFIBUS).

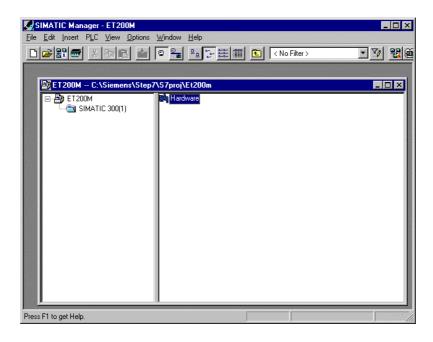
SIMATI	C Manager - ET2	00 M		_ 🗆 ×
<u>F</u> ile <u>E</u> dit	<u>Insert</u> P <u>L</u> C ⊻iew	<u>O</u> ptions <u>W</u> indow <u>H</u> elp		
	St <u>a</u> tion Sub <u>n</u> et Program		No Filter >	<u>y</u> 80
	Erogram 97 Software 97 Block M7 Software Symbol Table Egternal Source	3 Industrial Ethernet 4 PTP		
Inserts PROF	FIBUS at the cursor p	position.		

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5. Then insert a **SIMATIC 300-Station** (\rightarrow Insert \rightarrow Station \rightarrow SIMATIC 300-Station).



6. Open the configuration tool for the **Hardware** with a double click (\rightarrow Hardware).



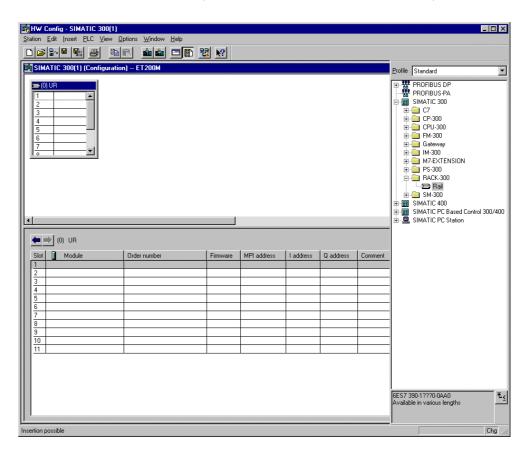
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7. Open the hardware catalog with a click on the symbol $(\rightarrow \mathbb{D})$. There you will see the directories are divided into the following:

- PROFIBUS-DP, SIMATIC 300, SIMATIC 400 and SIMATIC PC Based Control, all module racks, modules and interface modules for the configuration of your hardware configuration are made available.

Insert a **Rail** with a double click(\rightarrow SIMATIC 300 \rightarrow RACK-300 \rightarrow Rail).



After the insert, a configurations table for the configuration of the Rack 0 appears automatically.

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8. Now all modules can be chosen out of the hardware catalog and inserted into the configuration table and are also inserted into your rack.

To insert, you must click on the name of the respective module, hold the mouse button and Drag & Drop the module into a line of the configurations table. We will begin with the power supply **PS 307 2A** (\rightarrow SIMATIC 300 \rightarrow PS-300 \rightarrow PS 307 2A).

		Config - SIMATIC 300(1) Edit Insert <u>P</u> LC View I	Options Window Help						
	נ 😂	<u> </u>		2					
	SIM.	ATIC 300(1) (Configuration	on) ET200M						Profile Standard
1	-	JUR ■ PS 307 2A ▲ ■							
	Slot		Order number	Firmware	MPI address	I address	Q address	Comment	
	1 2	PS 307 2A	6ES7 307-1BA00-0AA0						1
	3								
	4 5			_					
	6			-					•
100	7								
	89								
	10								
	11								
									EES7 307-1BA00-0AA0 Load supply voltage 120/230 VAC: 24 VDC / 2 A
Ins	ertion p	oossible							Chg //



Note: If your hardware differs from what is shown above, then you must select the appropriate modules from the catalog and insert them into the rack. The part numbers of the individual modules, which are found on the components, are indicated in the footer of the catalog.

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In the next step, we drop the CPU 315-2DP into the second card location. This allows for the part number and version of the CPU to be read off. (→ SIMATIC 300 → CPU-300 → CPU 315-2DP → 6ES7 315-2AF03-0AB0 → V1.1).

	IW Config - SIMATIC 300(1)							
Sta	ion <u>E</u> dit Insert <u>P</u> LC ⊻iew <u>O</u>	ptions <u>W</u> indow <u>H</u> elp						
Ľ	🗲 🐂 🖣 📑	8 111 - 6	R?					
	SIMATIC 300(1) (Configuration	n) ET200M						Profile Standard
	(0) UR 1 1 P PS 307 2A 2 3 3 4 5 5 7 7 0							B ■ PROFIBUS PA ■ ■ PROFIBUS PA ■ ■ 15.7 ■ ■ CPU ■ □ CPU
								😟 🧰 CPU 314C-2 DP
•								
	4 5 m							EPU 315 EPU 315-2 DP
	🛑 動 (0) UR							ES7 315-2AF00-0AB
	Slot Module	Order number	Firmware	MPI address	I address	Q address	Comment	- 🔂 6ES7 315-2AF01-0AB
11 1	1 S 307 2A	6ES7 307-1BA00-0AA0						- 🚺 6ES7 315-2AF02-0AB
	2							6ES7 315-2AF03-0AB
	3							
	4							V1.2
	5							ES7 315-24F82-04B
	7							🗄 🛅 6ES7 315-2AF83-0AB
	8							6ES7 315-2AG10-0AB
	9							🕀 🧰 CPU 315F-2 DP
	10							E CPU 316
	11							EPU 318-2 DP
								E CPU 614
								📄 💼 СРИ М7 🔤
								64 KB work memory; 0.3 ms/1000
								instructions; MPI+ DP connection
Ľ								(DP master or DP slave); multi-tier
Pres	s F1 to get Help.							Chg //

By the entering of the CPU, the following window appears, in which you assign a PROFIBUS address to the CPU 315-2DP and must already choose the first PROFIBUS net. When you want to alter the parameter of the PROFIBUS net, you must highlight it and then click on **Properties** (→ Properties).

Properties - PROFIBUS interface DP (R0/S2.1)	×
General Parameters	
Address:	
Highest address: 126	
Transmission rate: 1.5 Mbps	
<u>S</u> ubnet:	
not networked PROFIBUS(1) 1.5 Mbps	<u>N</u> ew
	P <u>r</u> operties
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11. Now you can choose the **Highest PROFIBUS Address** (here \rightarrow 126), the **Transmission Rate** (here \rightarrow 1,5 Mbit/s) and the **Profile** (here \rightarrow DP). (\rightarrow OK).

Properties - PROFIBUS		X
General Network Settings		×
Highest PROFIBUS Address:	126 🔽 🗖 🖸	Options
<u>I</u> ransmission Rate:	45.45 (31.25) Kbps 93.75 Kbps 187.5 Kbps 500 Kbps 1.5 Mbps 3 Mbps	
Profile:	DP Standard Universal (DP/FMS) User-Defined	<u>B</u> us Parameters
OK		Abbrechen Hilfe

12. Then a bar chart for the Master system is shown to the right of the CPU315-2DP, in which you can arrange the PROFIBUS. This happens by clicking the desired module (Here the IM 153-1, an ET 200M interface module) from the hardware catalog in the path PROFIBUS-DP. By Drag & Drop click with the mouse, it can be dropped into the master system. (→ PROFIBUS DP → ET 200M → IM 153-1→ 6ES7 153-1AA83-0XB0).

HW Config - SIMATIC 300(1)								_ 🗆 🛛
Station Edit Insert PLC View		and the l						
		🐮 🕅						
SIMATIC 300(1) (Configurati	on) ET200M						Erofile Standard	
2 GUR 1 PS 307 2A 2 GCPU 3152 U 2 GCPU 3152 U 3 4 5 5 6 - 7 -		8US(1) DP m	aster system (1)	_			W PROFILIS DP B: Additional Field Devices P: Dioed-loop Contribute D: Configured Stations D: O VO States D: D PANS+ D: D PANS+ <td< td=""><td>1</td></td<>	1
I							😐 🚡 🖬 153-1	- 18
(0) UR							 B → M 153-1 B → M 153-1, Release 1 B → M 153-1, Release 1 	
Slot Module	Order number	Firmware	MPI address	I address	Q address	Comment		5
1 PS 307 2A	6ES7 307-18A00-0AA0						B- 1 IM 153-1, Release 7	·
2 CPU 315-2 DP	6ES7 315-2AF03-0AB0	V1.1	2				in 153-2 in 153-2	
X2 DP		-		1023*			E-≧ IM 153-2	
3 4								
5		+	+	+				
6		-		-	-		🐵 🚡 IM 153-2 FO	
7		-					😟 🚡 IM 153-2 FO	
8							i⊞-∰ IM 153-3	
9							🖻 – 🚰 IM 153-3	
10							 Image: Bit 200S Image: Bit 200U 	
11							ET 2005	
							E- Function Modules	
11								u NË
							6ES7 153-1AA83-0/080 Bus interface for S7-300 SMs.	_ ₹<
11							extended environmental conditions	
P							FM 350 to FM 352, FM 355, CP 340	-
Press E1 to get Help								Cha /

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13. By the entering of the slave, the following window is displayed in which you must assign a PROFIBUS address to the slave. This address must be identical with the address that you created in the rotary switch of the IM 153-1 ($\rightarrow 5 \rightarrow OK$).

Properties - PROFIBUS interface IM 153-1	l l
General Parameters	
Address:	
Transmission rate: 1.5 Mbps	
<u>S</u> ubnet:	
PROFIBUS(1) 1.5 Mbps	<u>N</u> ew
	P <u>r</u> operties
	Dejete
	·
OK	orechen Hilfe

14. In the next step we see the input module for 16 inputs on fourth slot place of the ET 200M. There the order number of the module is read off the front (→ PROFIBUS DP → ET 200M → IM 153-1 → DI-300 → SM 321 DI16xDC24V).

Big HW Config - SIMATIC 300(1)	
Station Edit Insert PLC View Options Window Help	
SIMATIC 300(1) (Configuration) ET200M	Profile Standard 💌
	NCODER
(∋(I) UR	T 200B
1 PS 307 2A PROFIBUS(1): DP master system (1)	T 200C T 200eco
2 S CPU 315-2 DP X2 DP	T 2006C0
	T 200L
	T 200M M 153
	IM 153-1
	H A0-300
	- CP-300
	- DI-300
	- SM 321 DI16x 48-125VDC
	- SM 321 DI16xAC120/230V - SM 321 DI16xAC120/
(5) IM 153-1	🚺 SM 321 DI16xAC120V
	- SM 321 DI16xDC24V - SM 321 DI16xDC24V
Slot Module Order Number I Address Q Address Comment D116xDC24V 6ES7 321-78H80-0480 01	SM 321 DI16xDC24V
5	- SM 321 DI16xDC24V - SM 321 DI16xDC24V
	- SM 321 D116xDC24V
8	
9 10	- SM 321 DI16xUC24/48V - SM 321 DI32xAC120V
	🚺 SM 321 DI32xDC24V
	- SM 321 DI32xDC24V - SM 321 DI4xNAMUR, Ex
	🚺 SM 321 DI8xAC120/230V
	- SM 321 DI8xAC120/230V - SM 321 DI8xAC230V
	- SM 321 DI8xAC230V
	6ES7 321-78H80-0AB0 E.
	hardware and diagnostic interrupts,
	extended environmental conditions
Insertion possible	Cha

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15. In the next step we see the output module for 16 outputs on fifth slot place of the ET 200M. There the order number of the module is read off the front (→ PROFIBUS DP → ET 200M → IM 153-1 → DO-300 → SM 322 DO16xDC24V/0.5A).

HW Contig - SIMATIC 300(1) Station Edit Insert PLC View Options Window Help		_ 🗆 ×
Zeanou For Lines Erre Alex Allonus Munon Tela Zeanou For Lines Erre Alex Allonus Munon Telab		
R SIMATIC 300(1) (Configuration) ET200M	Profile Standard	-
PROFIBUS(1): DP master system (1)	Al-300 Al/A0-300 Al/A0-300 CP-300 D/20-300 D/20-300 D/20-300 SM 322 D016wAC120//01 SM 322 D016wAC120//01 SM 322 D016wAC120//02 SM 322 D016wAC120//02	5A OV/0,5A A A V V/230V
(5) IM 153-1	 SM 322 D04xDC15V/20m/ SM 322 D04xDC15V/20m/ SM 322 D04xDC24V/10m/ SM 322 D08xAC Iso 	
Std Module ID ride Number I Address Q Address Comment 4 D116x0C24V/0.5A EES7 321-78H80-0&B0 01	SM 322 DUBAC 180 SM 322 DUBAC 20230/ SM 322 DUBAC 20230/ SM 322 DUBAC 20230/2A SM 322 DUBAC 230/2A SM 322 DUBAC 230/2A SM 322 DUBAC 24/V3 5A SM 322 DUBAC 24/V3 5A SM 322 DUBAC 24/V3 5A SM 322 DUBAC 24/V3 SM 322 DUBAC 24/V3	1.5A /8A /8A



Note: The order number of the module is displayed in the footer of the catalog.

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16. The addresses of the I/O modules can now be modified.

This happens by a double click on the corresponding input and output modules in the ET 200M and is adjusted in the register **Address**.

In any case these addresses should be required. An automatic address allocation takes place in the sequence similar to how the slaves are entered (\rightarrow DO 16xDC24V/0,5A \rightarrow Adresses \rightarrow OK).

Prop	perties	: - DI16xD(C24V - (R-	/\$4]			×
Ge	eneral	Addresses	Inputs				
Г	Inputs	s					
	<u>S</u> tart:	E		Process image:			
	End:	1		OB1 PI	~		
	OK					Cancel	Help
	211						

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17. The configuration table should first be saved and compiled with a click on \square and then downloaded into the PLC with \square . The mode switch on the CPU must be on STOP! (\rightarrow \square \rightarrow

HW Config - SIMATIC 300(1)	2 NZ L 11 L							Ξ	
Station Edit Insert PLC View Op									
	8 🛍 🖬 🗖 🖪	×							
SIMATIC 300(1) (Configuration) ET200M						Profile	Standard	-
			aster system (1)	-			NCODE T 2008 T 200C T 200c T 200is T 2	3 33 331 330 1/40-300 0-300 0-300 0-300 1-300 1-300 1-300 1-300	
Slot Module	Order number	Firmware	MPL address	Laddress	0 address	Comment		SM 321 DI16xDC24V SM 321 DI16xDC24V	
	6ES7 307-1BA00-0AA0	1 million	ini i dadicoo	1 333/000	0 0001000	Common	- I	SM 321 DI16xDC24V	
	6ES7 315-2AF03-0AB0	¥1.1	2					SM 321 DI16xDC24V	
X2 DP				1023*				SM 321 DI16xDC24V	
3								SM 321 DI16xDC24V	
4								SM 321 DI16xDC24V SM 321 DI16xUC24/48V	
5								SM 321 D132xAC120V	
6 7								SM 321 DI32xDC24V	
							· · · · ·	SM 321 DI32xDC24V	
9			-				· · · · [SM 321 DI4xNAMUR, Ex	
10								SM 321 DI8xAC120/230V	
11								SM 321 DI8xAC120/230V	
								SM 321 DI8xAC230V SM 321 DI8xAC230V	
							0.00	UD 0, 000	ل
							4		Ŀ.
							Digital i hardwa	I21-7BH80-0AB0 input module DI 16x24 VDC, wit ire and diagnostic interrupts, ed environmental conditions	h <u>₹</u>
Insertion possible								[Chg //

18. The CPU 315-2DP is then activated as the target module for the download activity (\rightarrow OK).

Select Target Module			×
Target Modules:			
Module	Racks	Slot	
CPU 315-2 DP	0	2	
1			
Select <u>A</u> ll			
OK	Cance	el 📔	Help

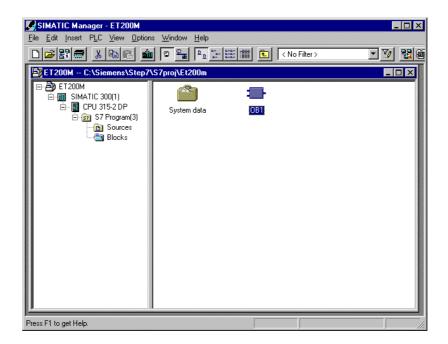
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19. The station address of the CPU in the MPI net is then chosen. You are only connected with the CPU so you can accept with **OK** (\rightarrow OK).

Select Station	Address X
Over which sta	tion address is the programming device connected to the module CPU 315-2 DP?
<u>R</u> ack: <u>S</u> lot:	
Target Station:	 Local Can be reached by means of gateway
Connecti	on to target station
Туре	Address
MPI	2
ОК	Cancel Help

20. From the SIMATIC Manager, you can open the block OB1 with a double click in the editor LAD, STL, FBD: Program blocks (\rightarrow OB1).



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21. Optional: Enter the properties of the OB1 for documentation and accept with OK (\rightarrow OK).

Properties - Organizatio	n Block			×
General - Part 1 General	- Part 2 Calls Attributes			
<u>N</u> ame:	OB1			
<u>S</u> ymbolic Name:				
Symbol <u>C</u> omment:				
Created in Language:	FBD			
Project path:				
Storage location of project:	C:\Siemens\Step7\S7proj\Et200n	1		
	Code	Interface		
Date created: Last modified:	26/09/2002 10:28:45 07/02/2001 03:03:43	15/02/1996 04:51:	12	
C <u>o</u> mment:	"Main Program Sweep (Cycle)"		<u>^</u>	
]		~	
OK			Cancel	Help

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21. With LAD, STL, FBD: Program blocks, you now have an editor which gives you the possibility to generate your STEP 7- Program. Here the organization block OB1 was already opened with the first network. In order to generate your first logical operation, you must highlight the first network. Now you can write your first STEP 7- Program. Several programs can usually be divided into

networks. Open a new network by clicking on the network symbol **...** The STEP 7- Program to be tested can now be downloaded into the PLC.

In our case, the OB1 is the only block. Save the organization block with \square and click on download \square . The mode switch of the CPU must be on STOP! ($\rightarrow \square \rightarrow \square$)

KAD/STL/FBD - 0B1		
File Edit Insert PLC Debug View Options Window H	elp	
		e e e e e e e e e e e e e e e e e e e
B0B1 ET200M\SIMATIC 300(1)\CPU 315-2 DP		New network
OB1 : "Main Program Sweep (Cycle)" Comment:		
Network 1/: Title:		i⊞r <mark>ien</mark> Jumps i∎rienn Integer fot.
Comment:		Floating-point fct. Move Forgram control
I0.0 - & Q0.0 I0.1		Britt/Rotate Status bits Go Timers Go Timers Go FB blocks FC blocks
	¥ Þ //	SFB blocks
1: Error 2: Info	-	
Press F1 to get Help.	🗣 offline	Abs Nw 1

22. Through the switching of the mode switch to RUN, the program is started and after a click on the symbol for for monitoring, the program in the **OB1** can be monitored (\rightarrow for).

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