Advance PLC Programming Course

SIEMENS S7-300 with Danfoss FC300 VFD

Based on Sitrain ST-PRO2

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-V 2019

Summary of Contents Chapter 1

Introduction to the S7 family of controllers and concepts of TIA Project creation and operation using Simatic Manager Hardware configuration of S7 300 systems

Programmable Logic Controllers Range of SIEMENS

SMALL	MEDIUM	MID-SIZED	LARGE	DCS-DISTRIBUTED CONTROL SYSTEM
LOGO!	S7-200	S5-115U	S5-155U	PCS7 PROCESS CONTROLLER
	S5-90U	**S7-300**	**S5-135U**	
	S7-1200	**S7-1500**	**S7-400**	

LEGEND:
OBSOLETE:
OBSOLETE SOON:
ACTIVE:

SIEMENS LOGO

LOGO! Basic Modules
The perfect choice as a fast, uncomplicated and space-saving solution for basic control tasks. LOGO! has long been a constant as an intelligent logic module for small automation projects.

LOGO! Expansion Modules
A wide range of expansion modules allows the user to set up a flexible LOGO! Configuration with a maximum of 24 digital inputs, 20 digital outputs, 8 analog inputs and 8 analog outputs possible.

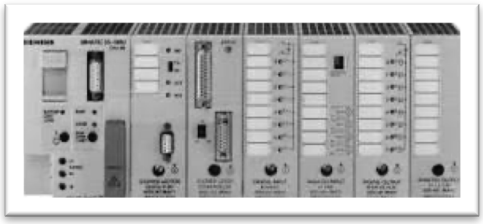
LOGO! Power
The mini power supply devices designed like LOGO! modules offer great performance in the smallest space: The excellent efficiency over the complete load range and the low performance loss during idle times guarantee efficient operation.

LOGO! Communication
The LOGO! family offers many communication options. In LOGO! 8, the connection to the communication modules is done via Ethernet. This means the entire address range of the inputs/outputs remains available for digital and analog signals.

Operator Devices
LOGO! TDE and SIMATIC Basic Panels offer simple operator control and monitoring possibilities.

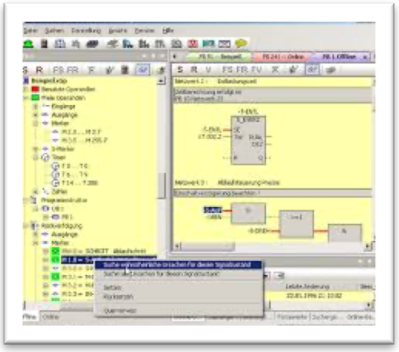
LOGO! Software
LOGO! Software supports small automation projects with simple and intuitive configuration and operation, from the engineering software LOGO! Soft Comfort, to the LOGO! Access Tool, and also the LOGO! Web Editor for the web server integrated into LOGO!

SIEMENS S5



The S5 line comes in the 90U, 95U, 101U, 100U, 105, 110, 115,115U, 135U, and 155U chassis styles. The higher the number (except for the 101U), the more sophisticated and more expensive the system. Within each chassis style, several CPUs are available, with varying speed, memory, and capabilities. Some systems provide redundant CPU operation for ultra-high-reliability control, as used in pharmaceutical manufacturing, for example.

Each chassis consists of a power supply, and a backplane with slots for the addition of various option boards. Available options include serial and Ethernet communications, digital input and output cards, analog signal processing boards, counter cards, and other specialized interface and function modules.



The S5 product line is usually programmed with a PC based software programming tool called *Step 5*. Step 5 is used for programming, testing, and commissioning, and for documentation of programs for S5 PLCs.

The original Step5 versions ran on the CP/M operating system. Later versions ran on MS-DOS, and then versions of Windows through Windows XP. The final version of Step 5 is version 7.2 (upgradable to version 7.23 Hotfix 1 with patches). No further development of this product line has occurred since that time, due to its announced obsolescence.

In addition to Step5, Siemens offered a proprietary State logic programming package called Graph5. Graph5 is a sequential programming language intended for use on machines that normally run through a series of discrete steps. It simulates a State machine on the S5 platform.

Several third-party programming environments have been released for the S5. Most closely emulate Step5, some adding macros and other minor enhancements, others functioning drastically differently from Step5. One allows Step5 programs to be cross-compiled to and from the C programming language and BASIC.

SIEMENS S7-200

The S7-200 series is a line of micro-programmable logic controllers (Micro PLCs) that can control a variety of automation applications. Compact design, low cost, and a powerful instruction set make the S7-200 controllers a perfect solution for controlling small applications. The wide variety of CPU sizes and voltages, and the windows-based programming tool, give you the flexibility you need to solve your automation problems. Programming was based on the easy to learn engineering software STEP 7 Micro/WIN. Maximum configurations 24 inputs / 16 outputs + 7 expansion modules max. 256 I/O max.

SIEMENS S7-1200

SIMATIC S7-1200 basic controllers impress with their comprehensive range of technological functions and integrated IOs as well their particularly compact space-efficient design. They are the intelligent choice for all everyday automation tasks with a small project scope. The S7-1200 CPUs with Safety Integrated handle standard and safety-related tasks – without additional hardware. You save on wiring workload and are much more flexible in adapting safety circuits and managing operating modes. Thanks to standardized Tele-control protocols, you can connect SIMATIC S7-1200 controllers directly to your control center without programming being required. All S7-1200 CPU's has IO process image size capable of handling 1024 inputs and 1024 outputs. Maximum hardware configurations are 3 communication modules, 1 signal board, and 8 signal modules.

A decisive advantage is the integration of the S7-1200 in the Totally Integrated Automation Portal (TIA Portal): SIMATIC controllers and SIMATIC panels thus access a common database, a uniform operating concept and central services. For you, this means significantly less engineering work. The user-friendly and innovative operability of the TIA Portal as well as the integrated system diagnostics contribute to efficient working.

SIEMENS S7-300

Powerful, compact and cost-effective

The SIMATIC S7-300 universal Controllers saves on installation space and features a modular design. A wide range of modules can be used to expand the system centrally or to create decentralized structures according to the task at hand,and facilitates a cost-effective stock of spare parts. SIMATIC is known for continuity and quality. Do you want to further utilize the investment into your machine or plant? The SIMATIC S7-300/ET 200M system families are part of our established product

range and will definitely be available until 2023. Upon publication of a product phase-out announcement, the respective product will be available as a spare part for a period of ten more years.

SIEMENS S7-1500

SIMATIC S7-1500 – The ultimate plus for productivity and efficiency

The SIMATIC S7-1500 Advanced Controllers convince with their ultimate power that provides maximum performance for medium-sized to high-end machines with high demands on performance, communication, flexibility, and technology functions.

Convincing functionalities

SIMATIC S7-1500 – probably the fastest controller worldwide

You'll achieve the highest productivity and product quality in your production process by using SIMATIC S7-1500 with its fast backplane bus, PROFINET performance, shortest reaction times, and a command processing time of up to 1 ns in the CPU.

Therefore, the PROFINET interface with deterministic time behavior provides reproducibility and precision in the µs timeframe.

Fast failure detection and correction

Thanks to a uniform display concept, the diagnostics functionality integrated into the SIMATIC S7-1500 system ensures that error messages in TIA Portal on the HMI, in the web server, and on the display of the CPU are visualized identically as plain text information. The configuration and the diagnostic reporting channels are integrated into the system in a user-friendly manner. The trace function is supported on all CPUs.

This makes it possible to run accurate diagnostics on user programs and motion

applications and optimize drives. If a fault occurs, the corresponding channel can be quickly identified and precisely assigned. That reduces downtimes and increases plant availability.

Easy handling and installation

The SIMATIC S7-1500 offers the easiest handling and the greatest level of user friendliness in numerous new details. Detailed plain text information offers full plant transparency. The standardized front connector provides simplified spare parts storage. Easy and practical assignment of clamp and label reduces wiring times and facilitates diagnostics in cases of failure.

Integrated potential bridges permit the simple and flexible formation of potential groups, and auxiliary components such as automatic circuit breakers and relays can be mounted quickly and easily. The shielding of analog signals ensures a high quality of signal reception and robustness with regard to external electromagnetic interference. Easy expandability, customized assembly, and upwards compatibility offer maximum cost efficiency and investment security.

Reliable protection of investments and expertise

The security concept of SIMATIC S7-1500 includes measures ranging from authorization stages and block protection to communication integrity. Security Integrated protects your investments, helps prevent the reproduction of machines, and helps to ensure a high level of plant availability.

On the SIMATIC memory card, individual blocks are linked to the serial numbers of the original memory card to prevent program copies. The controller detects modified engineering data or if data is being transmitted from an unauthorized source. Access protection safeguards against unauthorized configuration changes.

Fail-safe control for all functions

What is special about SIMATIC Safety Integrated: It is a system for standard and fail-safe applications. Fail-safe SIMATIC controllers offer the greatest possible integration: one controller, one communication, and one engineering for standard and fail-safe automation.

Safety Integrated applies to all SIMATIC S7-1500 controllers and provides for the simple connection of PROFIsafe devices Geräten via PROFIBUS and PROFINET. With SIMATIC STEP 7 Safety Advanced and in the TIA Portal, users create their programs using the same engineering and operating concept for standard as well as for fail-safe tasks. Data consistency functions automatically synchronize standard and fail-safe program components.

Optimally prepared for all technological tasks

The SIMATIC S7-1500 Advanced controllers are perfectly equipped for technological tasks. Motion Control, signal acquisition and output, and PID control are integrated and can be used in a broader scope with the T-CPUs. The TIA Portal offers support with the engineering of Motion Control tasks such as electronic drives or cam discs.

Siemens offers a coordinated package consisting of the SIMATIC S7-1500 Advanced Controller and the SINAMICS servo drive system, which can easily be linked through the integrated PROFINET interface. The controllers additionally contain compact controllers for continuous or discrete control processes (PID control) in order to provide for simple commissioning and an optimal control quality.

Efficient engineering in the TIA Portal

The Totally Integrated Automation Portal (TIA Portal) provides you with complete access to the entire digitalized automation system, from digital planning to integrated engineering to transparent operation. The new version decreases the time-to-market through a variety of measures including simulation tools, increases the productivity of your plant through additional diagnostic and energy management functions, and offers you greater flexibility thanks to a connection to the management level.

TIA Portal offers flexible cloud solutions, virtual commissioning with a digital twin, coordinated teamwork in interdisciplinary teams, greater transparency, and integrated energy management.

SIEMENS S7-400

There is a graded range of CPUs from the entry-level CPU right up to the high-performance CPU for configuring the controller. All CPUs control large quantity structures; several CPUs can work together in a multi-computing configuration to boost performance. Thanks to their high processing speed and deterministic response times, the CPUs enable short machine cycle times. The different CPUs are distinguished by, for example, work memory, address range, number of connections and execution time. As well as the standard CPUs, there are also two failsafe and three fault-tolerant CPUs available.

Applications

- The S7-400 is especially suitable for data-intensive tasks in the process industry. High processing speeds and deterministic response times guarantee short machine cycle times on high-speed machines in the manufacturing industry.
- The S7-400 is used preferably to coordinate overall plants and to control lower-level systems. This is guaranteed by the high communication power and the integral interfaces.
- Many of the S7-400 components are also available in a SIPLUS version for extreme environmental conditions.

S7-400 finds successful application here:

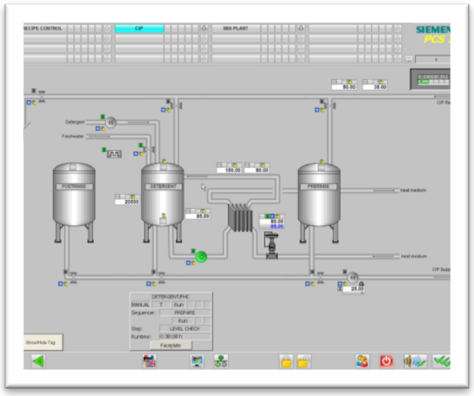
- Automotive industry
- Standard mechanical equipment manufacturing incl. custom mechanical equipment
- Warehousing systems
- Building engineering
- Steel industry
- Power generation and distribution

- Paper and printing industries
- Woodworking
- Textile manufacture
- Pharmaceuticals
- Food and beverages industries
- Process engineering, e.g. water and wastewater utilities
- Chemical industry and petrochemicals

SIEMENS PCS7 PROCESS CONTROLLER

The most powerful Automation System within SIMATIC

Superb communication capability and integrated interfaces make the SIMATIC S7-400 process controller ideal for larger tasks such as the coordination of entire systems. The graded range of CPUs enables scalable performance and the capacity for I/O periphery is virtually unlimited. What's more, process controller signal modules can be inserted and removed while the system is live (hot swapping), making it very easy to expand the system or replace modules.



Modular S7-410-Systems

The automation system AS 410 is the preferred system for new plants with SIMATIC PCS 7. Through the use of the innovative CPU 410-5H Process Automation the AS 410 covers the entire performance range of conventional SIMATIC S7-400 automation systems from AS 412 to AS 417. You can now adapt the performance of your controllers precisely to the task at hand at any time and without interruption – without having to allow for the usual safety reserves.

PROGRAMMING COMMUNICATION CABLES

PC ADAPTER USB A2

The PC adapter USB A2 enables the connection of PCs and notebooks with USB port to PROFIBUS and to the MPI interface of SIMATIC S7. It can be used with Windows XP SP2 and higher and supports all MPI and PROFIBUS baud rates. It is therefore a flexible solution for service and commissioning.

The **CP 5512** is used to connect programming devices and notebook computers with a PC card slot for CardBus (32-bit) to PROFIBUS and to the multi-point interface (MPI) of SIMATIC S7.

Communication services:

- PROFIBUS DP master Class 1 and 2 according to IEC 61158/IEC 61784 with SOFTNET DP software product
- PROFIBUS DP slave with the software product SOFTNET DP slave
- PG/OP communication with the STEP 5 or STEP 7 software product
- S7 communication with the SOFTNET S7 software product
- Open communication (SEND/RECEIVE) on basis of the FDL interface with the SOFTNET DP or SOFTNET S7 software product

PC card Type II (CardBus 32-bit); for programming device/PC with PC card slot and notebook computers Can be used with the following versions upwards:

- STEP 7 V5.2
- SOFTNET S7 V6.1
- SOFTNET DP, SOFTNET DP Slave V6.1
- STEP 7 Micro/WIN V3.2 SP4
- ProTool®, ProTool/Pro® V6.0 SP2
- NCM PC V5.2
- SIMATIC PDM V5.2 SP1

The appropriate OPC servers are included in the scope of supply of the respective communication software

SIMATIC NET CP 5711 is a USB V2.0 adapter for connecting SIMATIC PC/PGs or notebooks with a USB port to PROFIBUS up 12 Mbit/s. The SIMATIC NET CP 5711 expands the product range of PROFIBUS PC modules with another component in the area of mobile devices (such as notebooks).

to

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- PROFIBUS DP master Class 1 and 2 according to IEC 61158/IEC 61784 with SOFTNET DP software product
- PROFIBUS DP slave with the software product SOFTNET DP slave
- PG/OP communication with the STEP 5 or STEP 7 software product
- S7 communication with the SOFTNET S7 software product
- Open communication (SEND/RECEIVE on basis of the FDL interface) with the SOFTNET DP or SOFTNET S7 software product.

Can be used with:

- STEP 7 V5.4 and SP5
- SOFTNET S7 V7.1
- WinCC/WinCC flexible
- SOFTNET DP, DP Slave V7.1
- NCM PC V5.4 and SP5
- STEP 7/MicroWin

The new CP 5711 offers the complete functional scope which is already familiar from CP 5512. The following additional functions have also been integrated:

- Development of PG/PC slot technology for USB V2.0
- Functional compatibility with CP 5512 as well as PC Adapter USB
- + 5 V power supply from USB V2.0
- +24 V optional external power supply
- Mechanical USB locking on the housing of the CP 5711
- Diagnostics information via LEDs

- 35 mm standard rail mounting (with optional accessories)

  Applications for the CP 5512 can be used with the CP 5711 without changing the configuration or the user software.

Benefits

- Connection of PROFIBUS field devices to PC systems with USB interface
- Optimal support of PROFIBUS commissioning and analysis tools
- Connection for portable PCs (e.g. for diagnostics and commissioning)
- Stable USB connection thanks to mechanical locking of the USB connector on the CP 5711 enclosure
- Active PROFIBUS termination is ensured by an external 24 V DC supply even if the USB cable is disconnected
- LEDs for signaling operating states and fault conditions
- Easy installation and startup
- Optimally attuned to SOFTNET PROFIBUS

PROFINET CABLE

PLC SOFTWARE

SOFTWARE	LATEST VERSION	COMPATIBLE CONTROLLERS
LOGO SOFT COMFORT	V8	LOGO
STEP 5	7.2	S5
Step7 Micro/WIN	V4.0 SP9	S7-200
STEP 7 SIMATIC MANAGER	5.6	S7-300/400
TIA PORTAL	15	S7-1200/1500/300/400
PCS7	V9	S7-400 PROCESS CONTROLLER
PCS7	Neo	S7-400 PROCESS CONTROLLER

Programming Devices
Siemens Field PG

Latest generation of high-performance programming devices in a semi ruggedized notebook design

The SIMATIC Field PG with its robust magnesium housing is well prepared for mobile applications in harsh environments: Shocks and vibrations, but also electromagnetic disturbances in machine-oriented industrial environments do not affect the device. Equipped with all important automation interfaces, the connection to machines and systems is possible via PROFIBUS as well as via two fast PROFINET interfaces. Serial connections are also supported. The SIMATIC memory cards can be deleted and programmed directly in the corresponding slots. The pre-installed engineering software makes the SIMATIC Field PG ready for immediate use. The TIA Portal simplifies fast and efficient configuring, commissioning, service and maintenance. The SIMATIC Field PG is available in two performance choices: Comfort and Advanced

Interfaces:

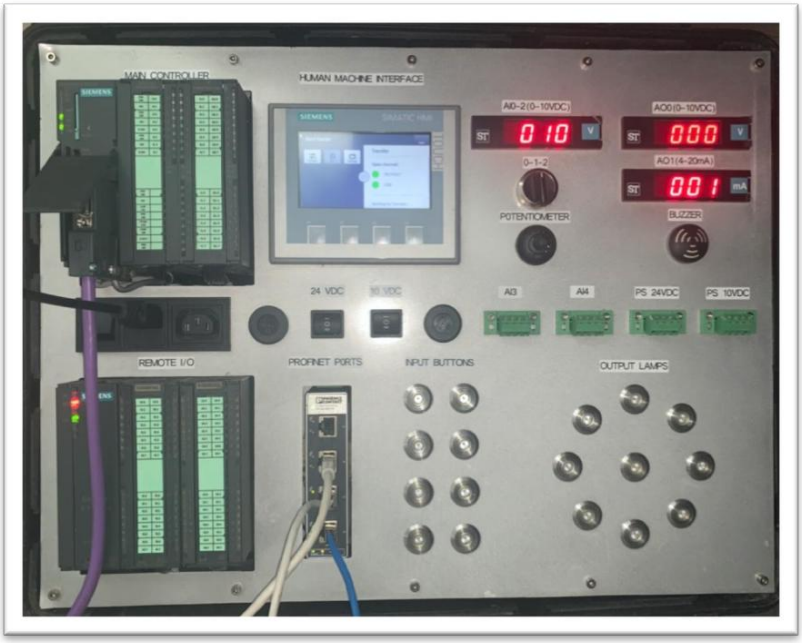
2 x Gigabit Ethernet (10 / 100 / 1000 MBit) / PROFINET
1 x MPI/PROFIBUS
2 x USB 3.0 Type A (1 x 1.5 A charging feature while power off),
2 x USB 3.1 Gen2 Type A / Type C
1 x COM 1
1 x SIMATIC Memory Card, 1 x SIMATIC Multimedia Card
1 x Smart card slot (ID card)
1 x Universal audio jack (in/out)
1 x Card-Reader (SD, SDHC UHS-II, MMC)
1 x DP Display Port (for external monitors or projectors, max. 4096 x 2304 Pixel)
1 x DVI-I (for external monitors or projectors)

SIMATIC Field PG - Promotional Package
SIMATIC Field PG M6 + TIA Portal + TIA Portal Options

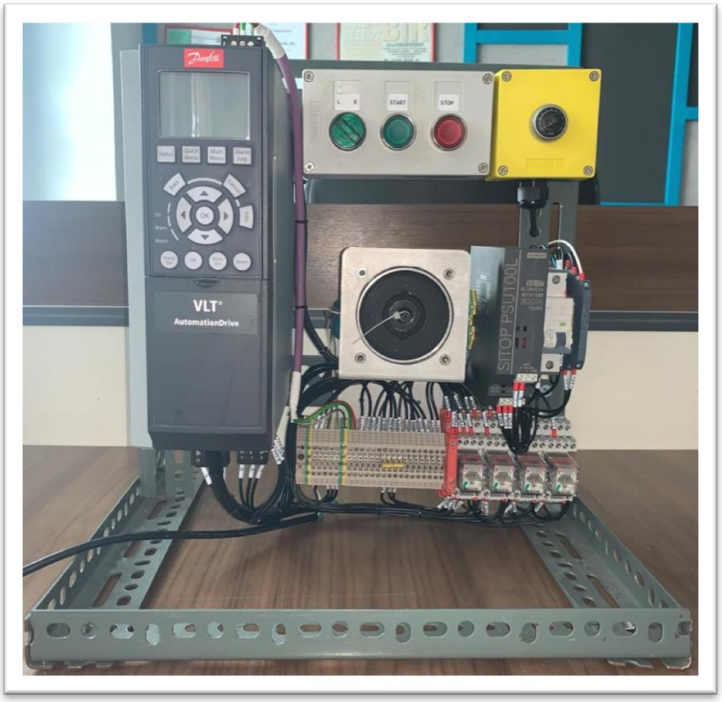
- You need the TIA Portal engineering for SIMATIC Controllers, HMI Panels and you have to deal with safety related applications?
- At the same time you have to maintain and service older machines and plants?
- You want to go with the flow, and test your project without PLC hardware?
- The offer to save engineering time by automatically generating HMI images also appeals to you.
- You and your co-worker share the same project?
- You also want to take action for the environment and better control your energy consumption.

Then we have a special offer for you for a limited period of time

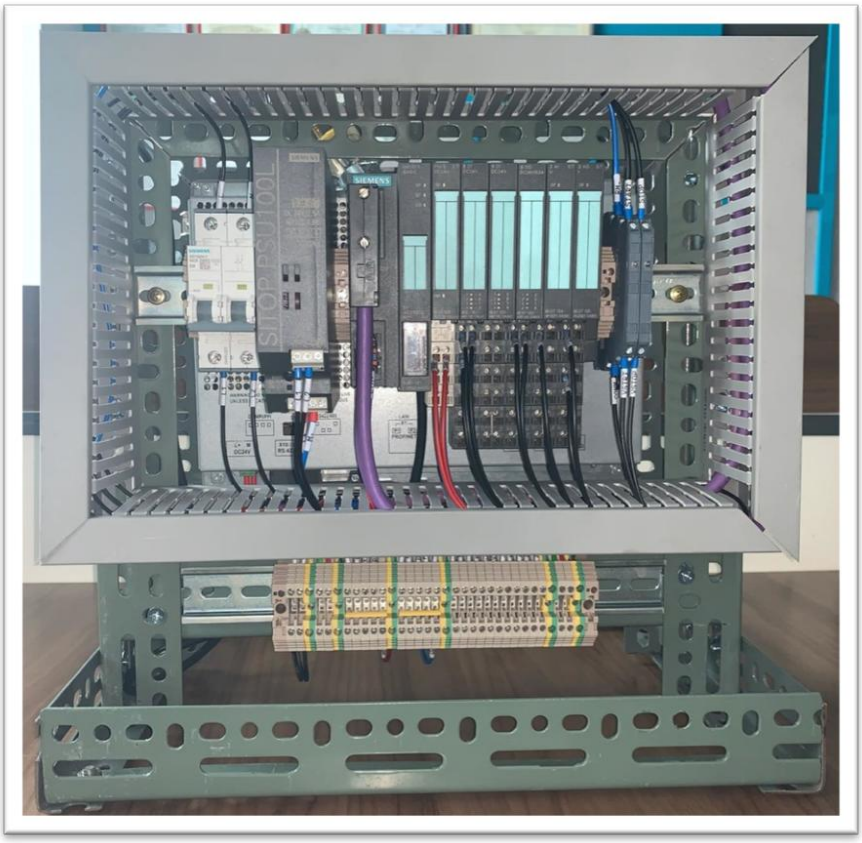
The Training Kit
Main PLC - Siemens S7-300 CPU314c-2 PN/DP
RIO – Siemens ET200M



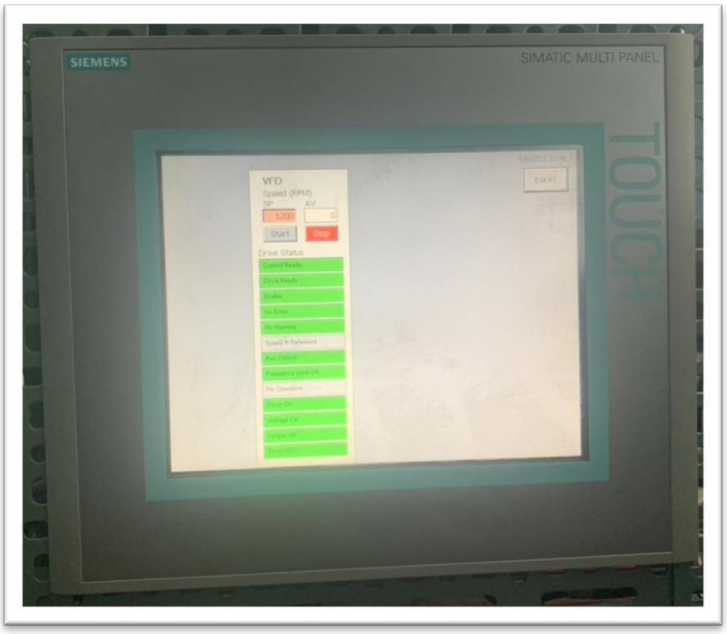
Danfoss VFD – FC300 SERIES



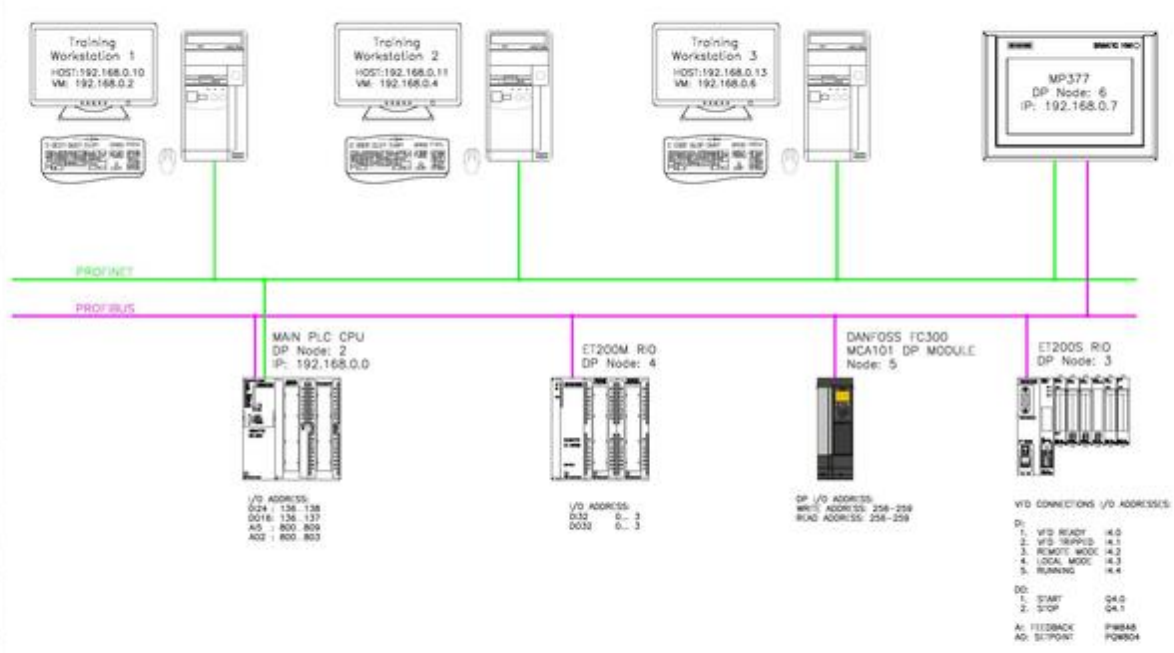
Remote I/O – Siemens ET200s



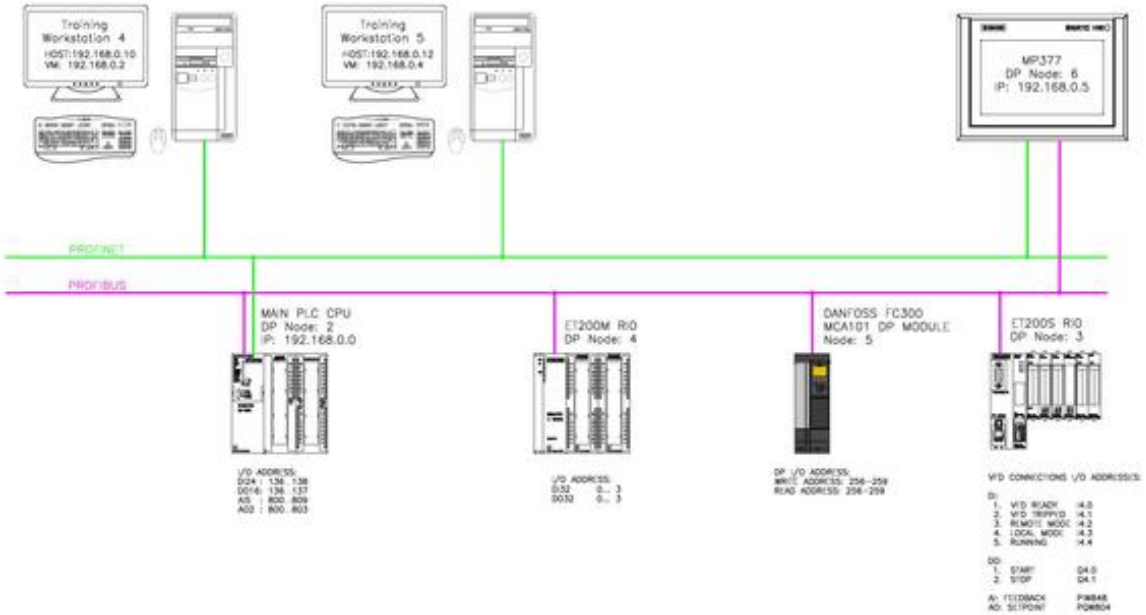
Touch Screen HMI – Siemens MP377
Order Code: 6AV6 643-0CD01-1AX1



GROUP 1 TRAINING STATION SYSTEM ARCHITECTURE



GROUP 2 TRAINING STATION SYSTEM ARCHITECTURE



PROFIBUS

Profibus – (Process Field Bus) is a standard for fieldbus communication in automation technology and was first promoted in 1989 by BMBF (German Department of Education and Research) and then used by Siemens. PROFIBUS is openly published as part of IEC 61158.

History

PROFIBUS goes back to a publicly promoted plan for an association which started in Germany in **1986** and for which 21 companies and institutes devised a master project plan called "*fieldbus*". The goal was to implement and spread the use of a bit-serial field bus based on the basic requirements of the field device interfaces. For this purpose, member companies agreed to support a common technical concept for production (i.e. discrete or factory automation) and process automation. First, the complex communication protocol Profibus FMS (Field bus Message Specification), which was tailored for demanding communication tasks, was specified. Subsequently, in **1993**, the specification for the simpler and thus considerably faster protocol **PROFIBUS DP** (Decentralized Peripherals) was completed. **Profibus FMS** is used for (non-deterministic) communication of data between Profibus Masters. Profibus DP is a protocol made for (deterministic) communication between Profibus masters and their remote I/O slaves.

There are two variations of PROFIBUS in use today; the most commonly used PROFIBUS DP, and the lesser used, application specific, PROFIBUS PA:

- **PROFIBUS DP** (Decentralized Peripherals) is used to operate sensors and actuators via a centralized controller in production (factory) automation applications. There are many standard diagnostic options, in particular, are focused in here.
- **PROFIBUS PA** (Process Automation) is used to monitor measuring equipment via a process control system in process automation applications. This variant is designed for use in explosion/hazardous areas (Ex-zone 0 and 1). The Physical Layer (i.e. the cable) conforms to IEC 61158-2, which allows power to be delivered over the bus to field instruments, while limiting current flows so that explosive conditions are not created, even if a malfunction occurs. The number of devices attached to a PA segment is limited by this feature. PA has a data transmission rate of 31.25 kbps. However, PA uses the same protocol as DP, and can be linked to a DP network using a coupler device. The much faster DP acts as a backbone network for transmitting process signals to the controller. This means that DP and PA can work tightly together, especially in hybrid applications where process and factory automation networks operate side by side.

FACTS: In excess of 30 million PROFIBUS nodes were installed by the end of 2009. Five (5) Millions of these are in the process industries.

What is PROFIBUS DP?

PROFIBUS has two variants: PROFIBUS DP and PROFIBUS PA. The PROFIBUS DP is one of the 2 variants that is used most frequently. For this reason it is regarded by many experts as the standard PROFIBUS.

Your advantage with PROFIBUS DP:

- Most applied fieldbus in production environments worldwide
- Quick data transfer: at 12 Mbps faster than 1ms
- Plug-and-play

Turn-key networking solution

The application area of **PROFIBUS DP** (Decentralized Periphery) is the complete production automation whereby high data speed, low connection costs and plug-and-play are central. The applications within production automation are usually realized by creating a network made up of remote I/O, frequency converters, sensors and actuators. If power supply and cabling are not issues, then reliable installations can easily be realized in this environment.

Because PROFIBUS is so versatile, it serves as an ideal solution for automation challenges. Other bus systems only work in limited application areas which means the user is forced to apply a second technology to accommodate it.

Furthermore, PROFIBUS DP is standardized under **IEC 61158**, which guarantees compatibility with devices from various manufacturers.

How fast is PROFIBUS DP?

The user can select transmission speeds between **9.6 kbps** and **12 Mbps.** These are configured in the master. Because the master processes slaves cyclically by writing the outputs of the device with a command and reading the inputs sent back, the cycle is highly optimal and constant.

Saving on cabling and installation costs

PROFIBUS is essentially a data communication system that allows a relatively large number of components to share a two-core copper cable (bus system). This saves enormously in cabling and installation costs compared to conventional non-digital systems. The optimal cable offers even more advantages such as:

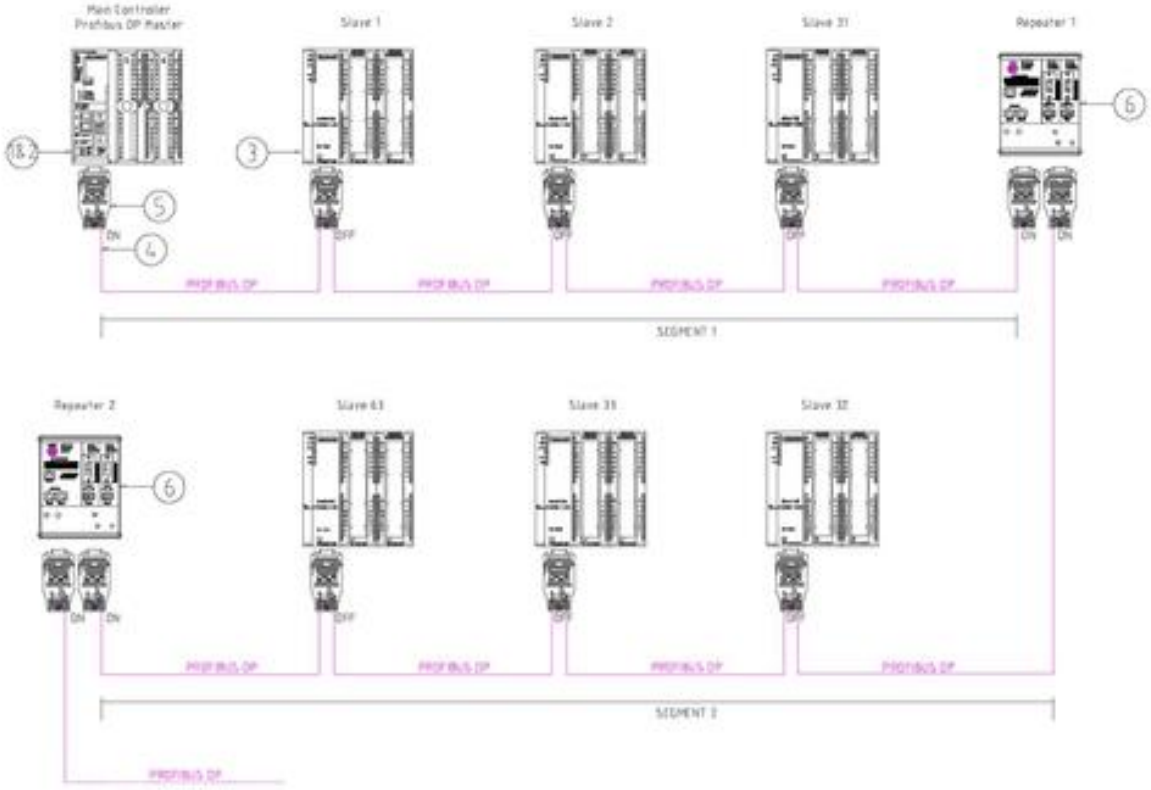
- Minimizing of components.
- Simpler designs.
- Shorter testing and purchasing period.
- Simpler maintenance.

Trend

PROFIBUS DP shares the market with Ethernet protocols that have also found their way in the world of production automation. The growth of PROFIBUS DP is unrelenting. In the long term, the purchasing of devices will be based primarily on maintenance. Network components and diagnostic tools will become much more widely used.

Basic Components of a Profibus DP network

1. Main Controller
2. Profibus DP Master
3. Profibus DP remote I/O (slave) Coupler
4. Profibus DP communication cable
5. Profibus DP connector
6. Repeater`



- There are maximum of 126 slaves per one master
- In a single segment, a maximum of 32 devices are allowed before a repeater is needed
- Speed versus length specifications are as follows; applicable to class A cables only,

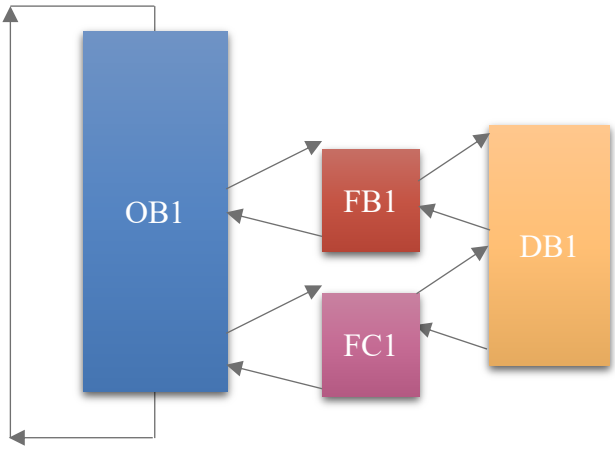
Baud Rate	Maximum Cable Length
9.6, 19.2, 31.25, and 45.45 kbps	1200 m (3940 ft)
93.75 and 187.5 kbps	1000 m (3280 ft)
500 kbps	400 m (1310 ft)
1500 kbps	200 m (656 ft)
3000, 6000, and 12000 kbps	100 m (328 ft)

Structured way of programming Siemens PLC's

Components of a basic Structured PLC Program

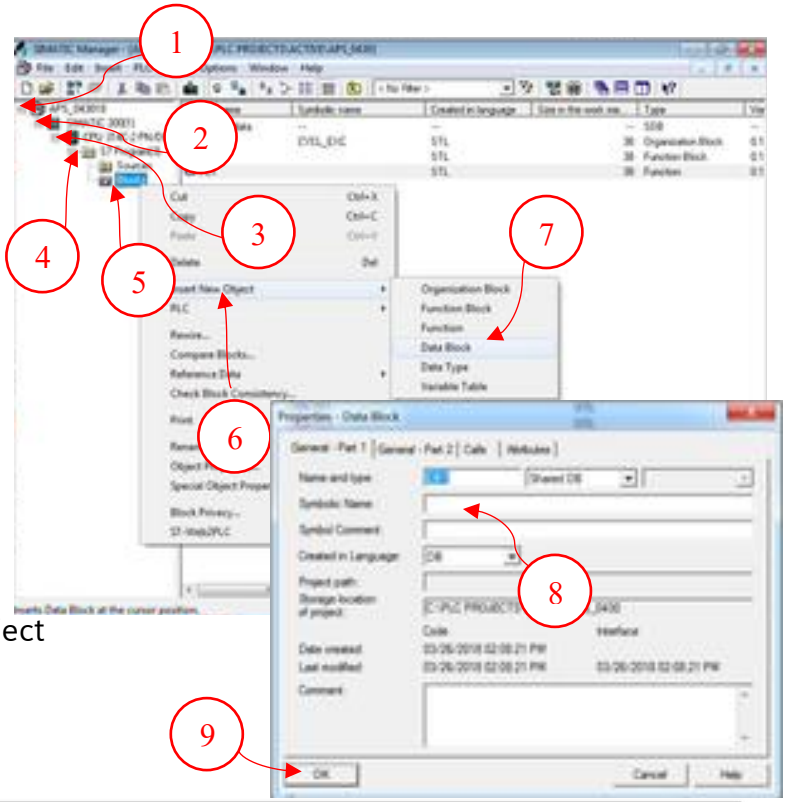
- **OB1** – *Organization Block 1*, is a plc block wherein FC's are called to be executed. Entire PLC Ladder Program can be freely written in OB1 in a linear programming way. OB1 is already configured during project creation from scratch.
- **FC** – *Function*, a specific code or sequence logic as per your machine or process requirements
- **FB** – *Function Block*, a pre-program specific function or logic that can be use multiple times within your project and always requires an instance data block for storage of process data
- **DB** – *Data block*, simply a storage of data for the PLC program project

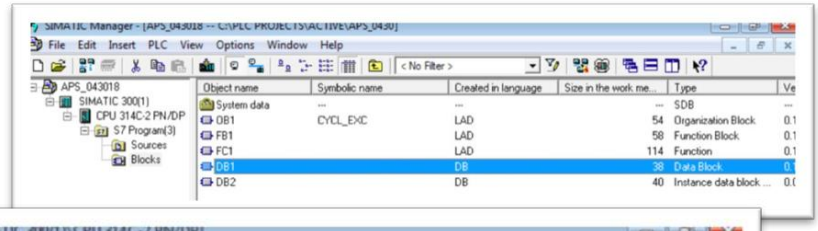
MAIN PROGRAM CYCLE

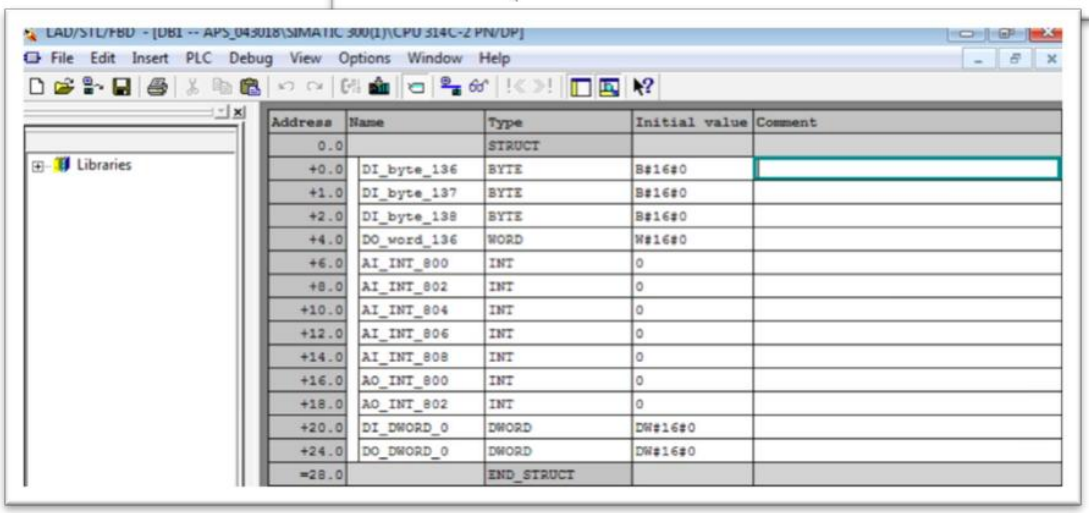


Creating DB1
Follow steps below;

1. Click + icon on the left of the printer icon
2. Click + icon on the left of the PLC icon SIMATIC 300 (1)
3. Click + icon on the left of the PLC icon CPU 314C-2PN/DP
4. Click S7 Program (3)
5. Right click Blocks
6. Click insert new object
7. Click Data Block
8. Enter DB1
9. Click OK







Transferring I/O data to Data Block

Data Block addressing scheme;

For bits addressing, we take example using Data Block 1, and taking address at starting byte 0, so the addressing are as follows;

DB1.DBX0.0

DB1 – Data block Number
DB – Always DB which stands for Data Block
X – use to signify bits addressing
0.0 – Series number of the bit address

For byte addressing, we take example using Data Block 1, and taking address at starting byte 0, so the addressing are as follows;

DB1.DBB0

DB1 – Data block Number
DB – Always DB which stands for Data Block
X – use to signify byte addressing
0 – Series number of the byte address

For word addressing, we take example using Data Block 1, and taking address at starting byte 0, so the addressing are as follows;

DB1.DBW0

DB1 – Data block Number
DB – Always DB which stands for Data Block
W – use to signify word addressing
0 – Series number of the word address, Word 0 means byte 0~1, 16 bits

For double word addressing, we take example using Data Block 1, and taking address at starting byte 0, so the addressing are as follows;

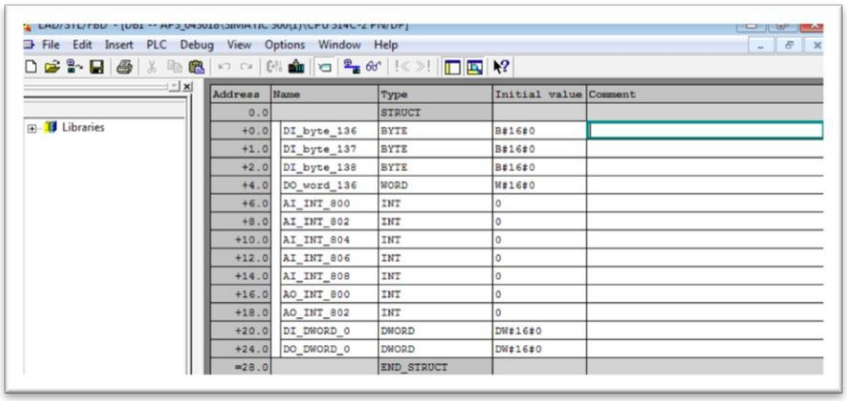
DB1.DBD0

DB1 – Data block Number
DB – Always DB which stands for Data Block
D – use to signify double word addressing
0 – Series number of the word address, Double Word 0 means byte 0~3, 32 bits

Note: Always consider the same data length when transferring data to Data Blocks Memory

Preparing DB1 for the I/O transfer

Configure and encode to DB1



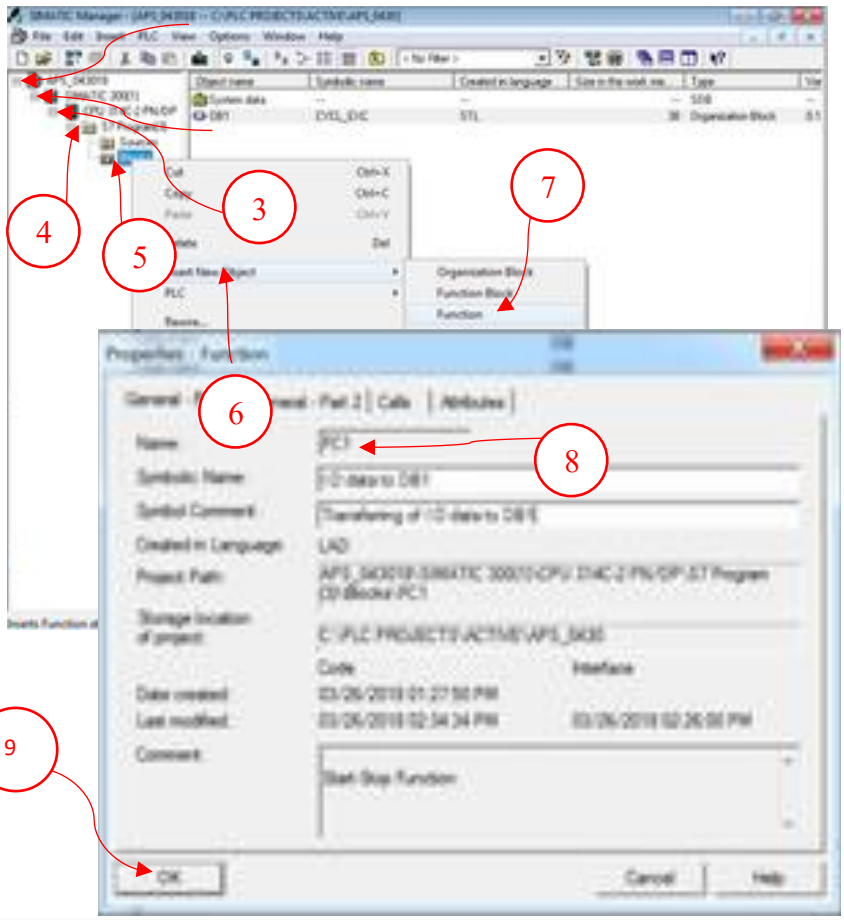
DI Byte 136	DB1.DBB0
DI Byte 137	DB1.DBB1
DI Byte 138	DB1.DBB2
DO Byte 136	DB1.DBB4
AI INT 800	DB1.DBW6
AI INT 802	DB1.DBW8
AI INT 804	DB1.DBW10
AI INT 806	DB1.DBW12
AI INT 808	DB1.DBW14
AO INT 800	DB1.DBW16
AO INT 802	DB1.DBW18
DI DWORD 0	DB1.DBD20
DO DWORD 0	DB1.DBD24

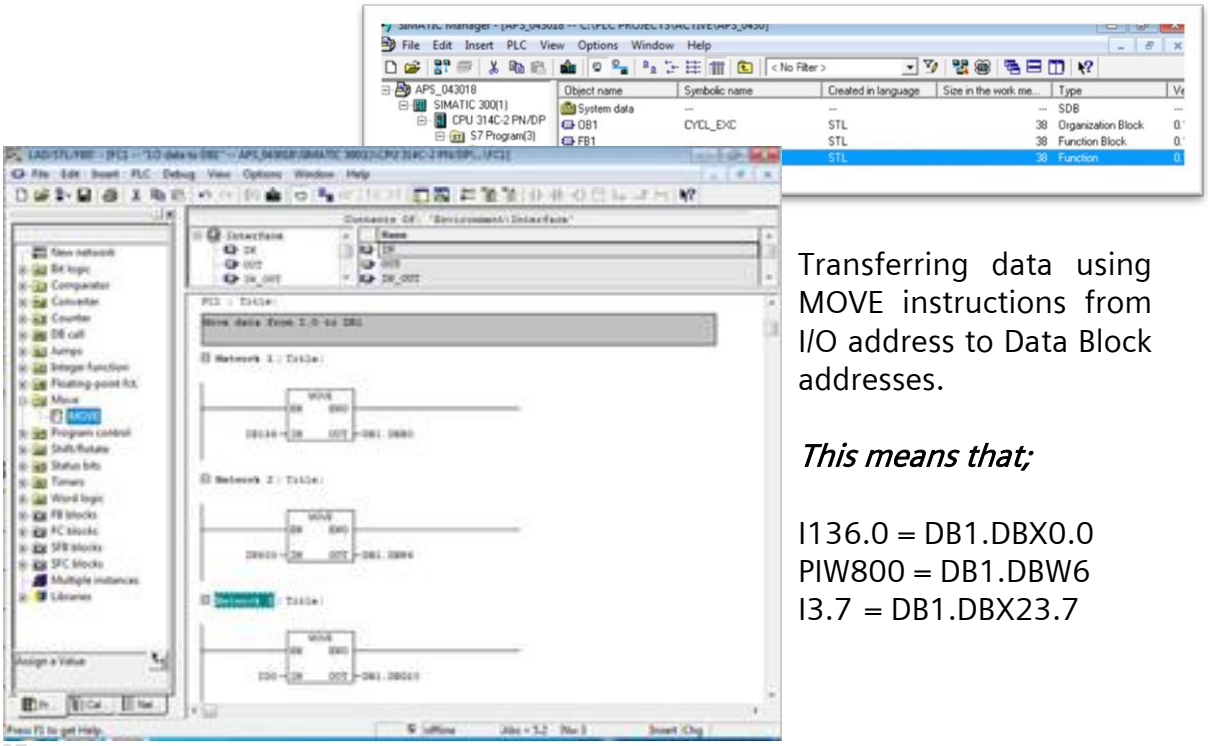
Transferring of the I/O data can be done by using MOVE instructions from I/O address to Data Block Addresses.

We will use FC1 as a transfer FUNCTION to Move data from Project I/O's to Data Block Address.

Creating FC1
Follow steps below;

1. Click + icon on the left of the printer icon
2. Click + icon on the left of the PLC icon SIMATIC 300 (1)
3. Click + icon on the left of the PLC icon CPU 314C-2PN/DP
4. Click S7 Program (3)
5. Right click Blocks
6. Click insert new object
7. Click Function
8. Enter FC1
9. Click OK.





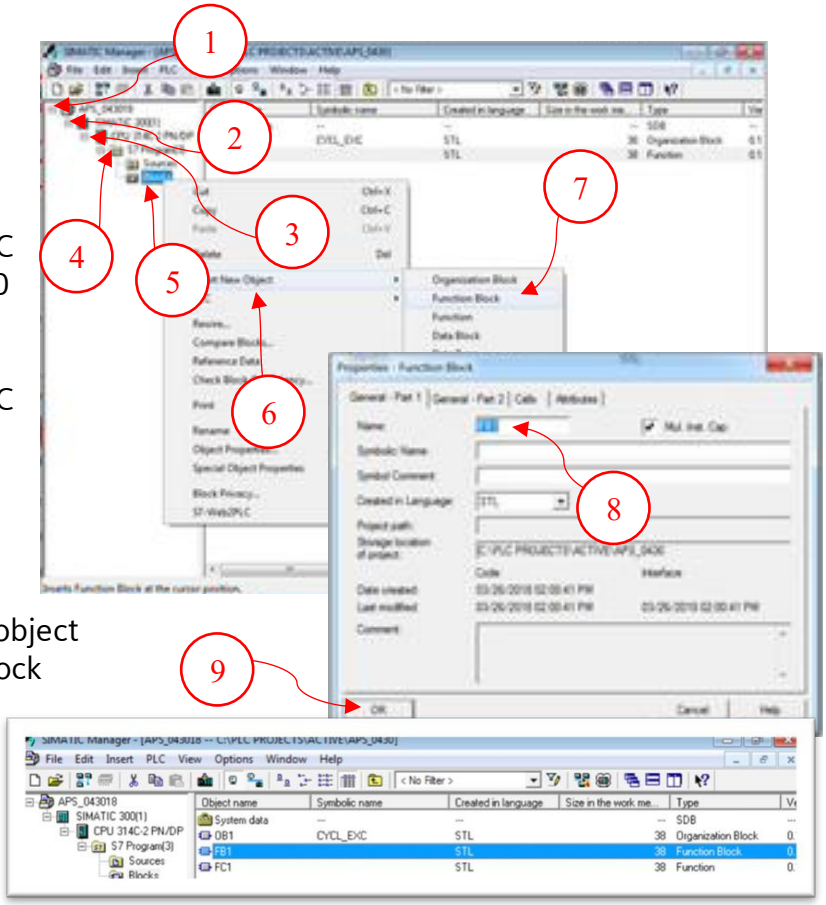
Transferring data using MOVE instructions from I/O address to Data Block addresses.

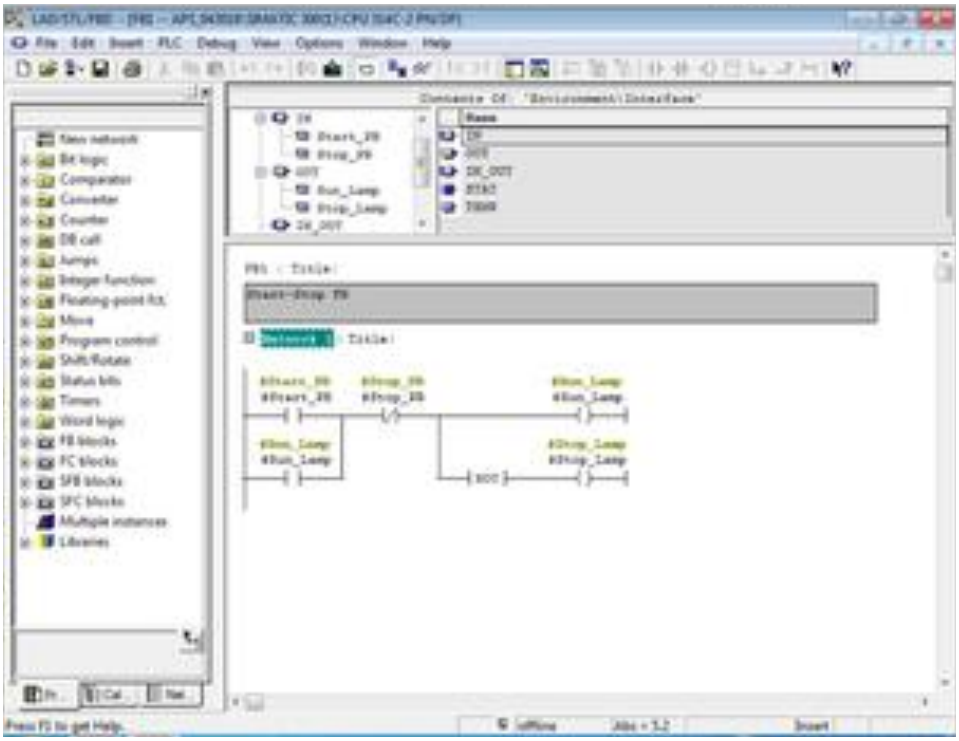
This means that;

I136.0 = DB1.DBX0.0
PIW800 = DB1.DBW6
I3.7 = DB1.DBX23.7

Creating FB1
Follow steps below;

1. Click + icon on the left of the printer icon
2. Click + icon on the left of the PLC icon SIMATIC 300 (1)
3. Click + icon on the left of the PLC icon CPU 314C-2PN/DP
4. Click S7 Program (3)
5. Right click Blocks
6. Click insert new object
7. Click Function Block
8. Enter FB1
9. Click OK.





Function (FC) and Function Block (FB) Similarities/Differences in Siemens PLC-S7 programming:

Similarities:

- We can define TEMP variable in both FB and FC.
- In FBD/LAD, you will see an ENO as the result of the FB/FC execution. If it is a logical one, it means that FB/FC has been run with no problem.
- You can activate EN as enable for the FC/FB in LAD or FBD to make a conditional execution.
- The possibility of using all Formal Parameters, IN, OUT, IN_OUT.
- There is always a limitation for the number of Nesting Depth in FBs and FCs, refer to the CPU data sheet. They are usually 16 for the new S7-300 processors.

Differences:

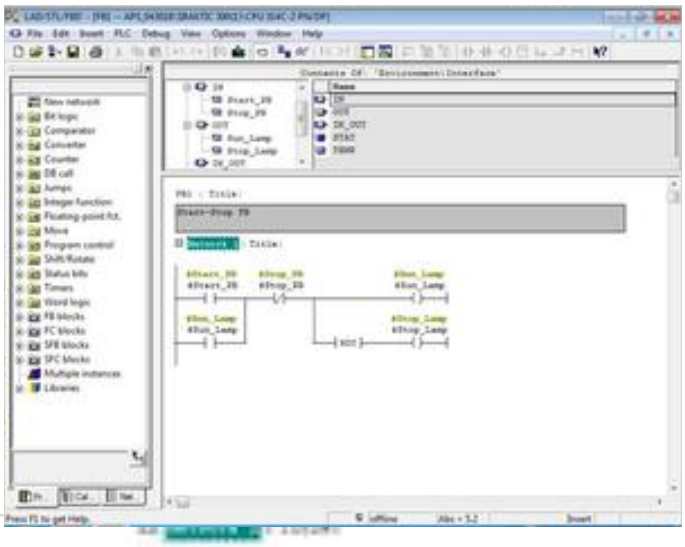
- Memory: FC has no instance memory, while FB has an Instance Data Block (IDB). This IDB saves all IN, OUT, IN_OUT and STAT parameters. They are accessible even after execution of the relevant FB.
- Programming Language: You can program FC or FB with FBD, LAD, STL and SCL programing languages, while just FB has the capability to be programed in GRAPH.
- Calling: FB call should be along with its instance data block. Otherwise, there will be question mark "?" at the top the FB with no possibility to save or download to the processor. There is not such a necessity in FC.
- Filling Actual Parameters: If there is an FC call, all Actual Parameters should be filled in with an address, since all Formal Parameters in FC do not save in any memory and as a result there are no initial values assigned to them. In FB, you can leave any of the Actual Parameters with no address. If you do not fill out all FC addresses, there is no possibility to save or download the program.

Note:

In FC programming, if you do not want to use the results of the FC subroutines outside of it, it is always a good idea to use TEMP variables, instead of Memory Bits (M) or Data Blocks (DB). This is because of the possibility to call those M or DB addresses outside of the FC, results in an inaccurate execution for the FC.
Overall, programmers do their best not to use Global variables in FC's.

Using Function Blocks multiple times in FC's

If you are programming an example of 199 units motor start-stop logics, you can use FB to do an identical logic control and use it in your FC.



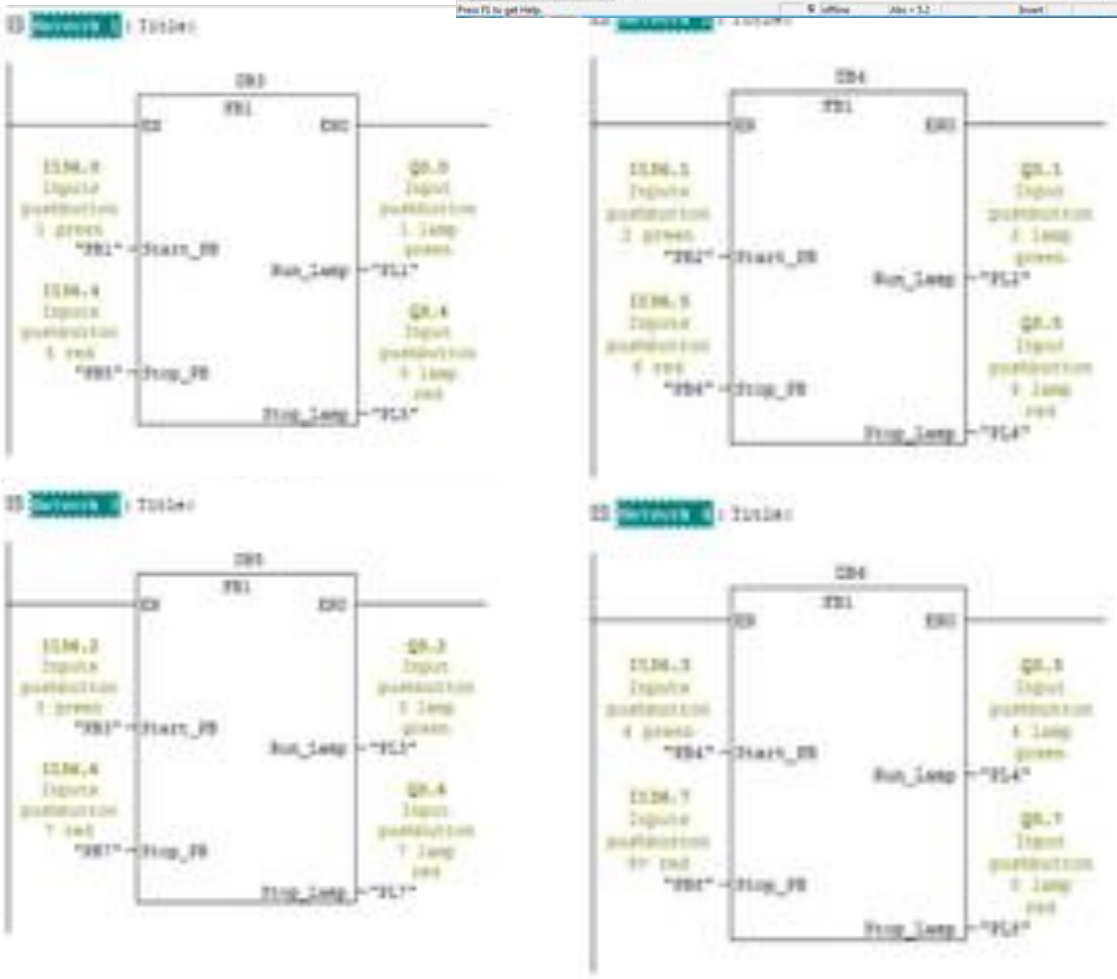
Example; FB1,
INPUT PARAMETERS:

- Start_PB
- Stop_PB

OUTPUT PARAMETERS:

- Run_Lamp
- Stop_Lamp

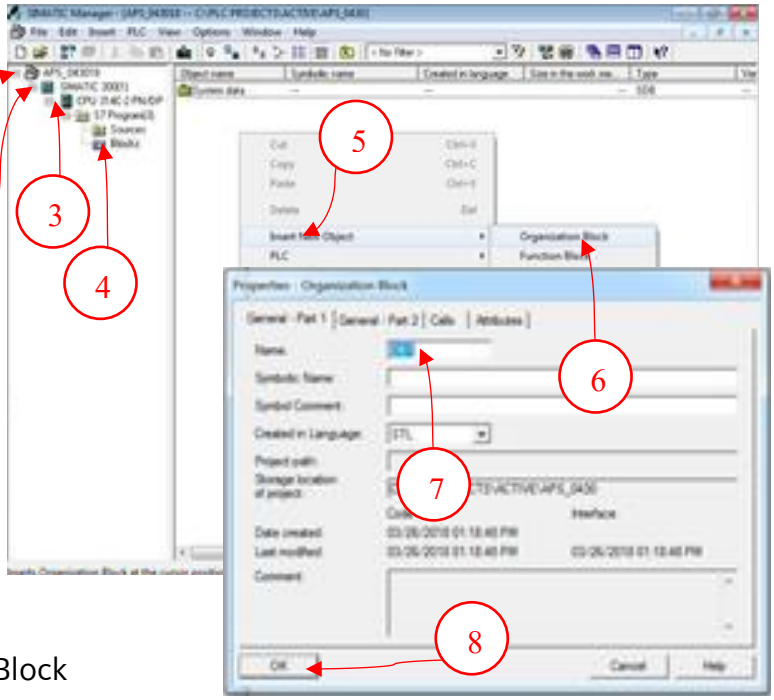
Instead of doing this logic 199 times, we will create FB1 and use these 199 times in our FC2.

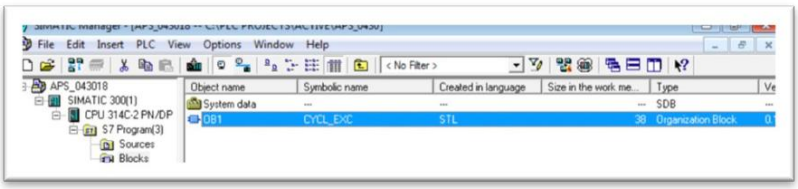


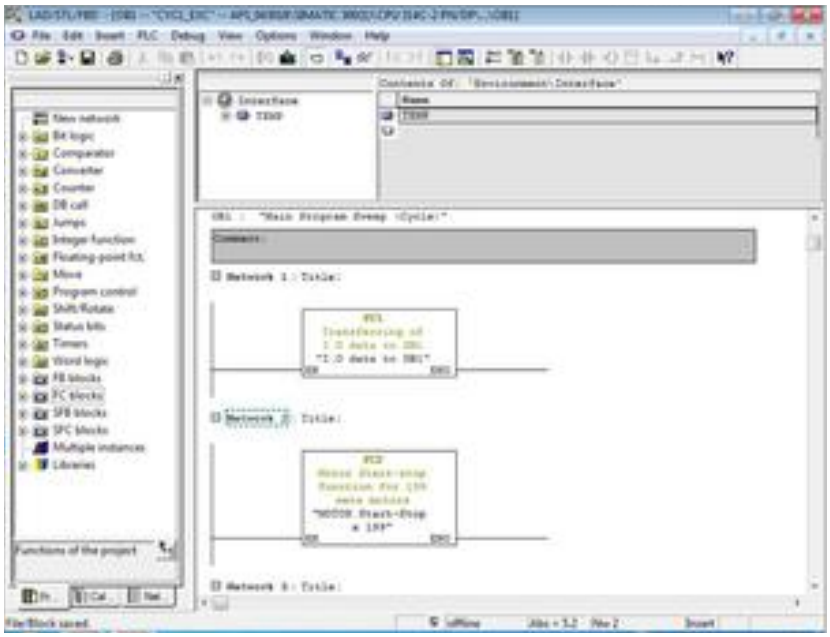
Creating OB1

In case that OB1 is not configure in your Simatic Manager Project, follow steps below:

1. Click + icon on the left of the printer icon
2. Click + icon on the left of the PLC icon SIMATIC 300 (1)
3. Click + icon on the left of the PLC icon CPU 314C-2PN/DP
4. Click S7 Program (3)
5. Right click Blocks
6. Click insert new object
7. Click Organizational Block
8. Enter desired OB1
9. Click OK.







Programming using the LADDER Editor

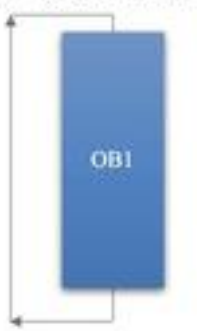
In organizing a PLC program, there are two common types;

1. Linear – You can write your entire user program in OB1. This is only advisable with simple programs written for the S7-300 CPU and requiring little memory.

2. Structured – Complex automation tasks can be controlled more easily by dividing them into smaller tasks reflecting the technological functions of the process or that can be used more than once. These tasks are represented by corresponding program sections, known as the blocks.

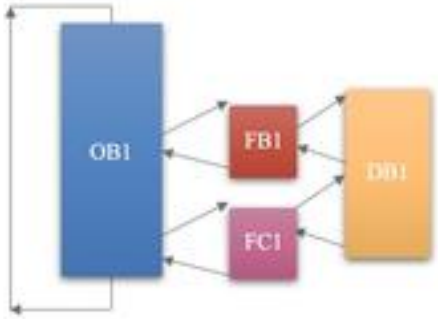
Linear Programming

Main Program



Structured Programming

Main Program



Organization blocks and program structures

Organization blocks (OBs) represent the interface between the operating system and the user program. Called by the operating system, they control cyclic and interrupt driven program execution, startup behavior of the PLC and error handling. You can program the organization blocks to determine CPU behavior.

Organization Block Priority

Organization blocks determine the sequence (start events) by which individual program sections are executed. An OB call can interrupt the execution of another OB. Which OB is allowed to interrupt another OB depends on its priority. Higher priority OBs can interrupt lower priority OBs. The background OB has the lowest priority.

Types of Interrupt and Priority Classes

Start events triggering an OB call are known as interrupts. The following table shows the types of interrupt in STEP 7 and the priority of the organization blocks assigned to them.
The following table of OB's are applicable only to Siemens CPU314C-2 PN/DP

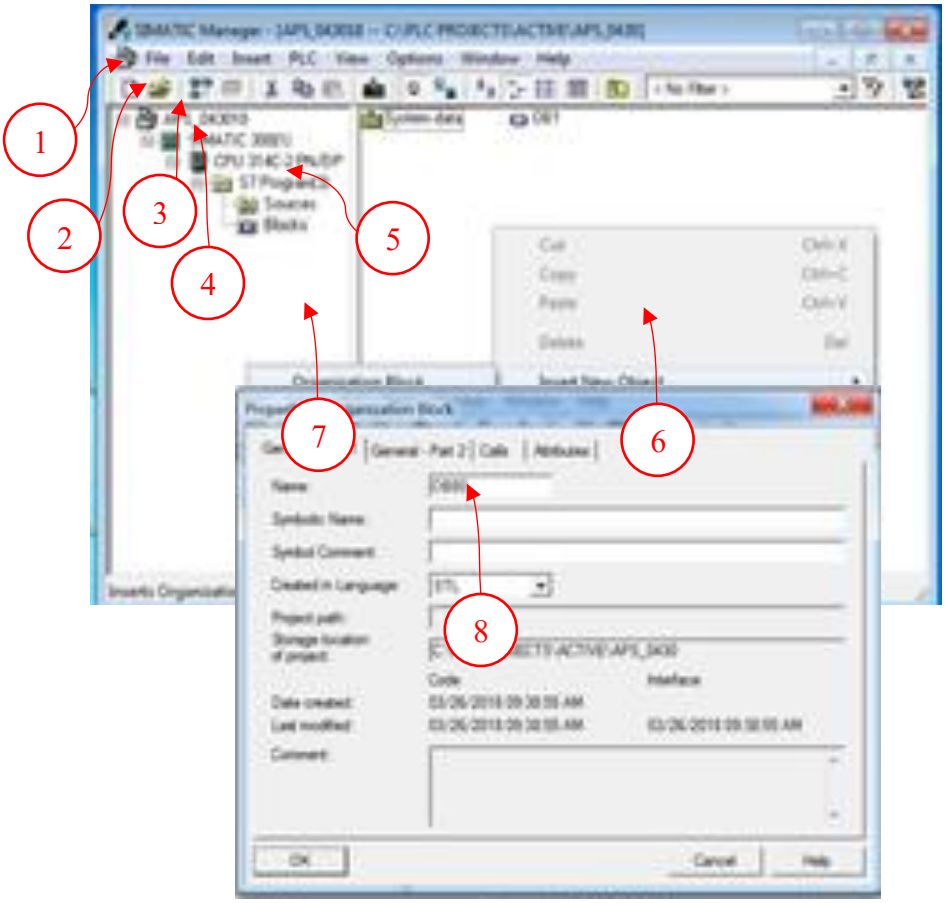
Main program scan	**OB1**	**1**	**Organization Block for Cyclic Program Processing (OB1)**
Time-of-day interrupts	OB10	2	Time-of-Day Interrupt Organization Blocks (OB10 to OB17)
Time-delay interrupts	OB20	3	Time-Delay Interrupt Organization Blocks (OB20 to OB23)
	OB21	4	
	OB32	9	
	OB33	10	
	OB34	11	
	OB35	12	
Hardware interrupts	OB40	16	Hardware Interrupt Organization Blocks (OB40 to OB47)
DPV1 interrupts	OB 55	2	Programming DPV1 Devices
	OB 56	2	
	OB 57	2	

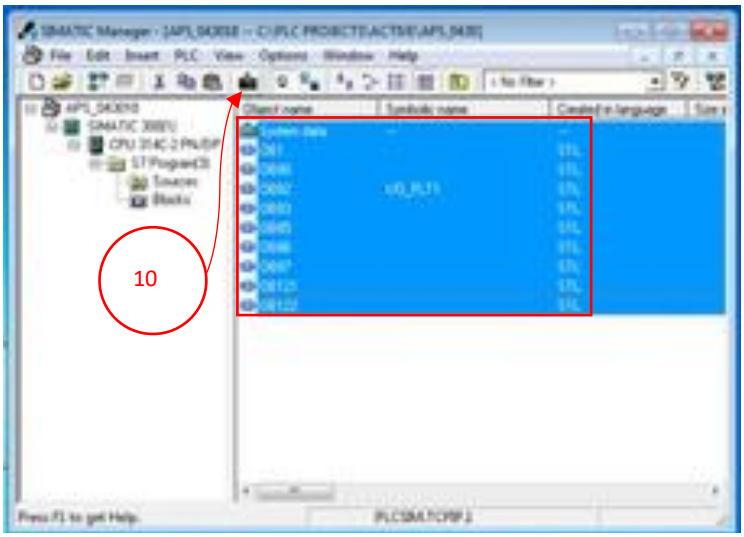
Synchronous cycle interrupt	OB 61	25	Configuring Short and Equal-Length Process Reaction Times on PROFIBUS-DP

Asynchronous errors	OB80 Time Error	25	Error Handling Organization Blocks (OB70 to OB87 / OB121 to OB122)
	OB82 Diagnostic Interrupt		
	OB83 Insert/Remove Module Interrupt		
	OB 85 Program Cycle Error		
	OB86 Rack Failure		
	OB87 Communication Error		
Startup	OB100 Restart	27	Startup Organization Blocks (OB100/OB101/OB102)
Synchronous errors	**OB121 Programming Error**	**Priority of the OB that caused the error**	**Error Handling Organization Blocks (OB70 to OB87 / OB121 to OB122)**
Synchronous errors	**OB122 Access Error**		

1) The priority class 29 corresponds to priority 0.29. The background cycle has a lower priority than the free cycle.

Programming Asynchronous and Synchronous errors OB's





To program Error OB's, follow steps below;

1. Click + icon on the left of the printer icon
2. Click + icon on the left of the PLC icon SIMATIC 300 (1)
3. Click + icon on the left of the PLC icon CPU 314C-2PN/DP
4. Click S7 Program (3)
5. Right click Blocks
6. Click insert new object
7. Click Organizational Block
8. Inter desired OB No.
9. Repeat procedure to program OB82, OB83, OB85, OB96, OB87, OB121, and OB122
10. No need to program any code on each OB's. You only need to download the OB's to the PLC CPU.

Review on Number Systems used by Siemens

1 byte = 8 bits
1 word = 2 bytes = 16 bits
1 INT = 2 bytes = 16 bits
1 DWORD = 2 words = 4 bytes = 32 bits
1 DINT = 2 words = 4 bytes = 32 bits
1 REAL = 2 words = 4 bytes = 32 bits

Going back to the Hardware configurations addresses;
At Rack 0,
I/O Default addresses:
DI24 : 136...138 = 24 bits
DO16 : 136...137 = 16 bits
AI5 : 800...809 = 5 words = 10 bytes = 80 bits
AO2 : 800...803 = 2 words = 4 bytes = 32 bits

This means;

For Digital Inputs
DI24 = I136.0 ~ I138.7 = 24 bits
- I136.0 ~ I136.7 = 8 bits
- I137.0 ~ I137.7 = 8 bits
- I138.0 ~ I138.7 = 8 bits

For Digital Outputs
DO16 = Q136.0 ~Q137.7 = 16 bits
- Q136.0 ~ Q136.7 = 8 bits
- Q137.0 ~ Q137.7 = 8 bits

For Analog Inputs
AI5 = PIW800 ~PIW808
- PIW800 = 1 word = byte 800-801 = 16 bits
- PIW802 = 1 word = byte 802-804 = 16 bits
- PIW804 = 1 word = byte 804-805 = 16 bits
- PIW806 = 1 word = byte 806-807 = 16 bits
- PIW808 = 1 word = byte 808-809 = 16 bits

For Analog Outputs
AO2 = PQW800 ~PQW802
- PQW800 = 1 word = byte 800-801 = 16 bits
- PQW802 = 1 word = byte 802-804 = 16 bits

At Remote ET200M I/O Rack, DP Address 4;

Default addresses;
DI32 : 0...3
DO32 : 0...3

This means;
For Digital Inputs
DI32 = I0.0 ~I3.7 = 32 bits
- I0.0 ~ I0.7 = 8 bits
- I1.0 ~ I1.7 = 8 bits
- I2.0 ~ I2.7 = 8 bits
- I3.0 ~ I3.7 = 8 bits

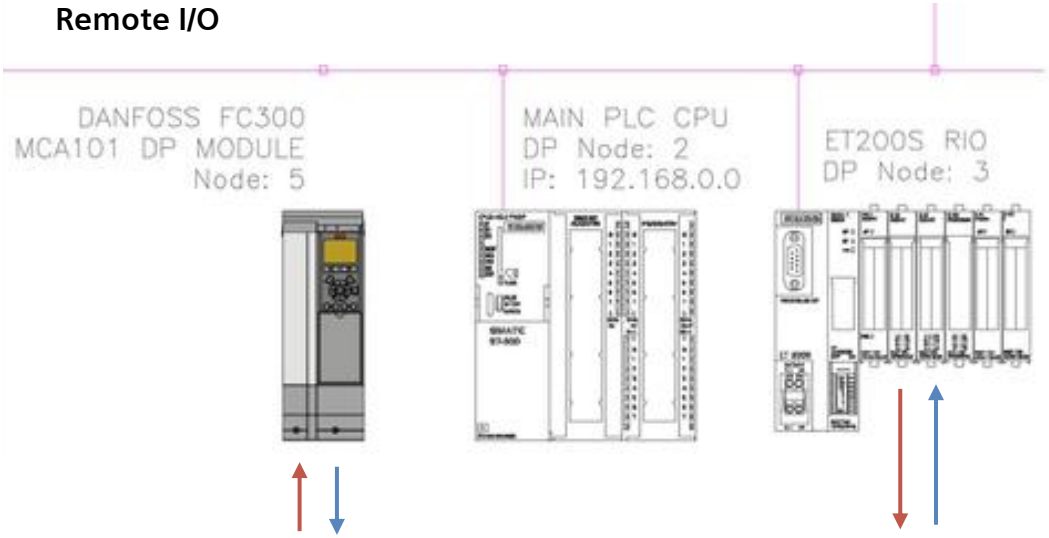
For Digital Outputs
DO32 = Q0.0 ~Q3.7 = 32 bits
- Q0.0 ~ Q0.7 = 8 bits
- Q1.0 ~ Q1.7 = 8 bits
- Q2.0 ~ Q2.7 = 8 bits
- Q3.0 ~ Q3.7 = 8 bits

At Remote ET200S I/O Rack, DP Address 3;
Default addresses;
DI8 : 4
DI8 : 5
DO8 : 4
AI2 :848
AO2 :804

This means;
For Digital Inputs
DI8 = I4.0 ~I4.7 = 8 bits
DI8 = I5.0 ~I5.7 = 8 bits
For Digital Outputs
DO8 = Q4.0 ~Q4.7 = 8 bits
For Analog Inputs
AI2 = PIW848 ~PIW851
- PIW848 = 1 word = byte 848-849 = 16 bits
- PIW850 = 1 word = byte 850-851 = 16 bits

For Analog Outputs
AO2 = PQW804 ~PQW807
- PQW804= 1 word = byte 804-805 = 16 bits
- PQW806= 1 word = byte 806-807 = 16 bits

Conventional wiring integrations of Danfoss FC300 VFD to Siemens ET200s Remote I/O



Danfoss I/O:
Digital Input terminals:
18 : Start
19 : Coast inverse

Digital Output terminals:
27 : VFD Ready
Relay 2 : VFD Tripped
Selector switch: Remote Mode
Selector switch: Local Mode
Relay 1 : Running status

Analog Input terminal:
53 : (+) 4-20mA
55 : (-) 4-20mA

Analog Output terminal:
42 : (+) 4-20mA
39 : (-) 4-20mA

ET200s Remote I/O:
Digital Output terminals:
Q4.0 : Start
Q4.1 : Coast inverse

Digital Input terminals:
I4.0 : VFD Ready status
I4.1 : VFD tripped status
I4.2 : Remote mode
I4.3 : Local mode
I4.4 : VFD running

Analog Output terminal:
AI1 : (+) 4-20mA
(PIW848) : (-) 4-20mA

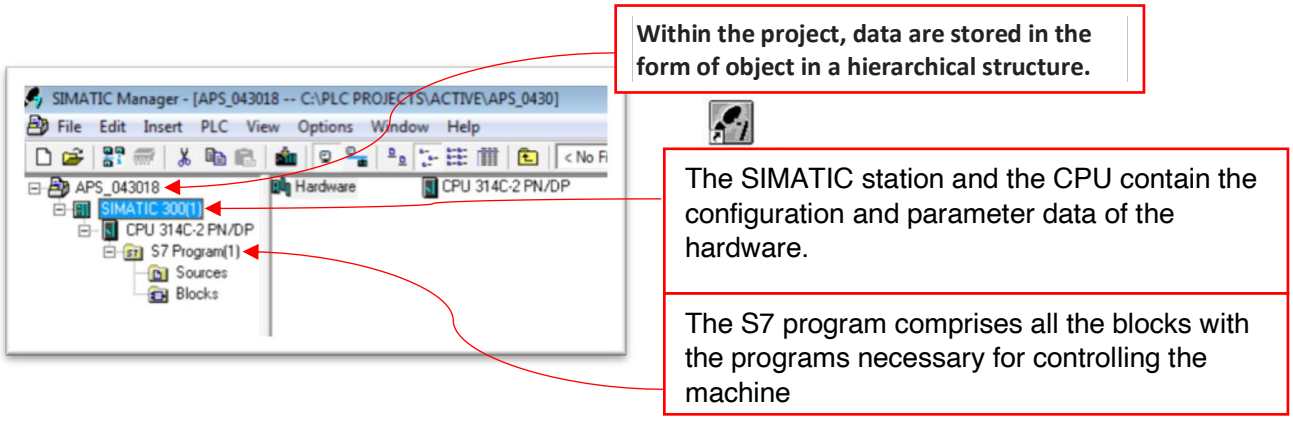
Analog Input terminal:
AO1 : (+) 4-20mA
(PQW804) : (-) 4-20mA

Hardware Configurations:

The SIMATIC Manager

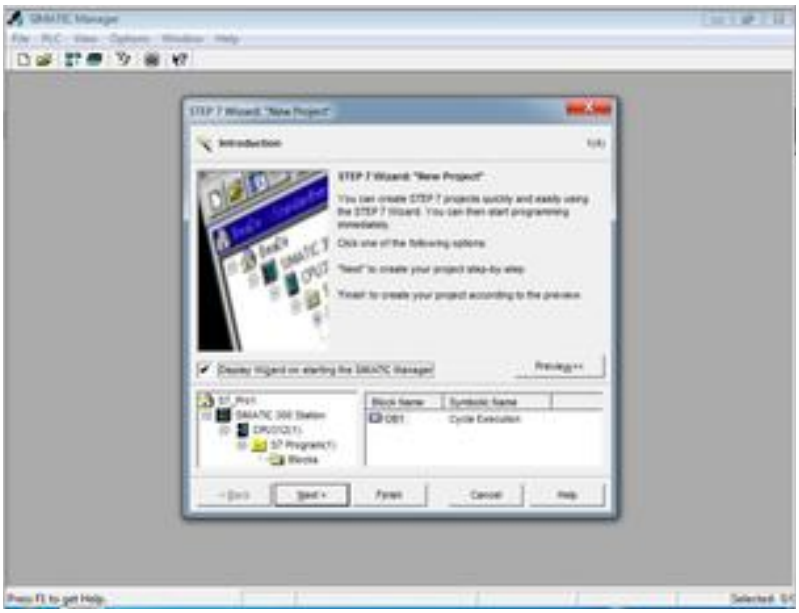
Starting the SIMATIC Manager and Creating a Project

The SIMATIC Manager is the central window which becomes active when STEP 7 is started. The default setting starts the STEP 7 Wizard, which supports you when creating a STEP 7 project. The project structure is used to store and arrange all the data and programs in order.



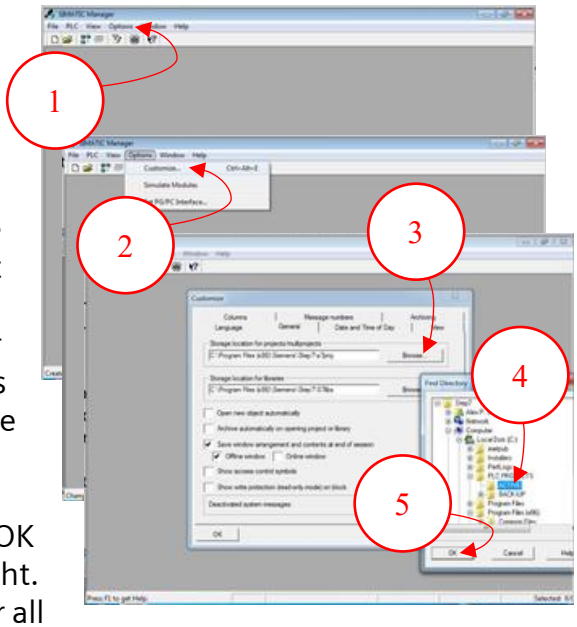
Double-click the **SIMATIC Manager** icon. The STEP 7 Wizard is activated.

Click, **Cancel.**



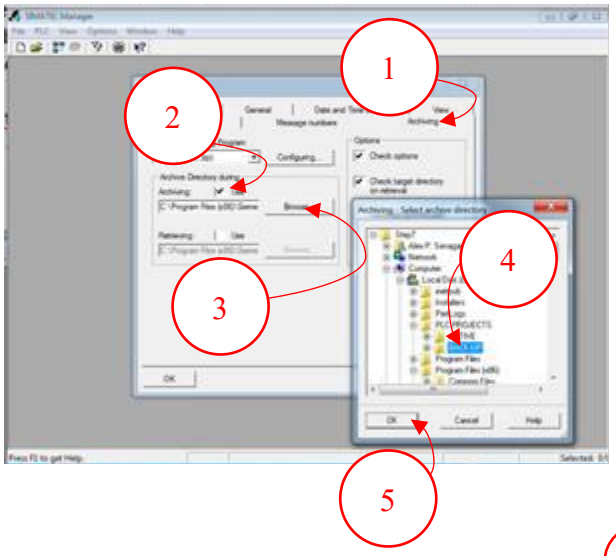
On your PC, create a new folder under Drive E or D, and named it **PLC Projects**.

Warning! ***Please do not create on Drive C.***

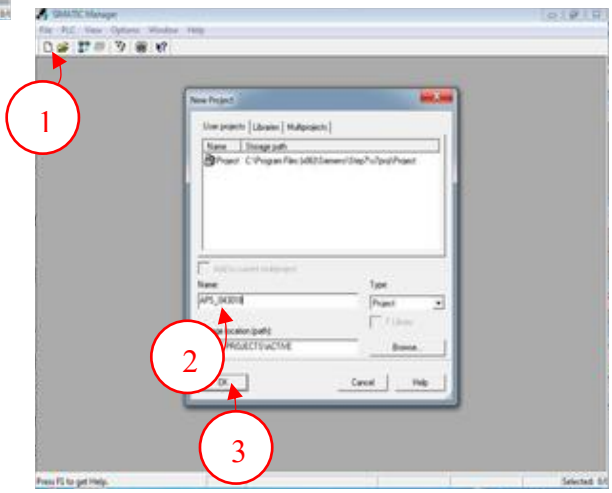


Under the PLC Projects folder, create another two sub-folders and named it **Active** and **Back-up.**
This will prepare our PG's default folder for all Step 7 projects in the future. This procedure can be done only once especially if you are formatting a new PC.

Click Options\ Customize\ Browse\ Active\ OK as illustrated on the screens on the right. This will enable a central folder storage for all active Step 7 projects.



Click Archiving\Check Archiving\ Browse\ Back-up\ OK as illustrated on the screens on the right. This will enable a central folder storage for Back-up copies on all Step 7 projects.



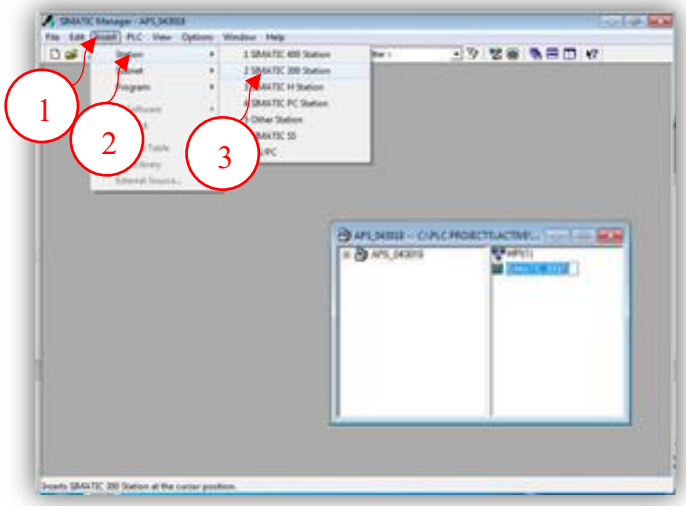
Creating a New Project
Click New\ Project File Name\ OK.

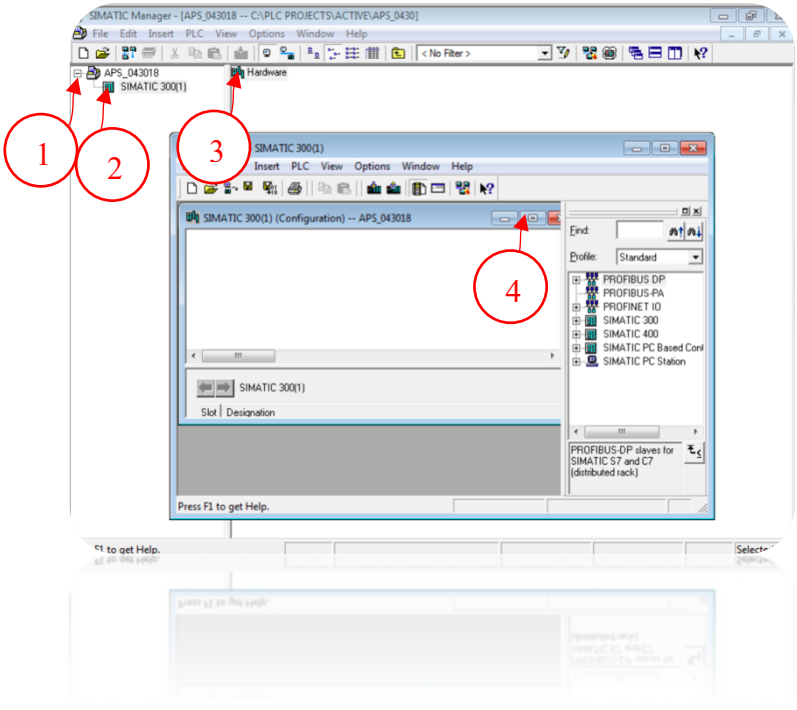
This will create your first project with a filename on your **INITIAL_PRESENT DATE.**

Inserting a new station,
Follow the steps below;

1. Click Insert Menu
2. Select Station
3. Click SIMATIC 300 Station

This will insert a new Simatic 300 PLC station which is ready for further hardware configurations.





Hardware configurations
To do your first hardware configurations, please follow the steps;

1. Click + icon on the left of the printer icon
2. Click PLC icon on the left of the SIMATIC 300(1)
3. Double click PLC icon on the left of Hardware
4. Click Hardware Configuration Maximize icon

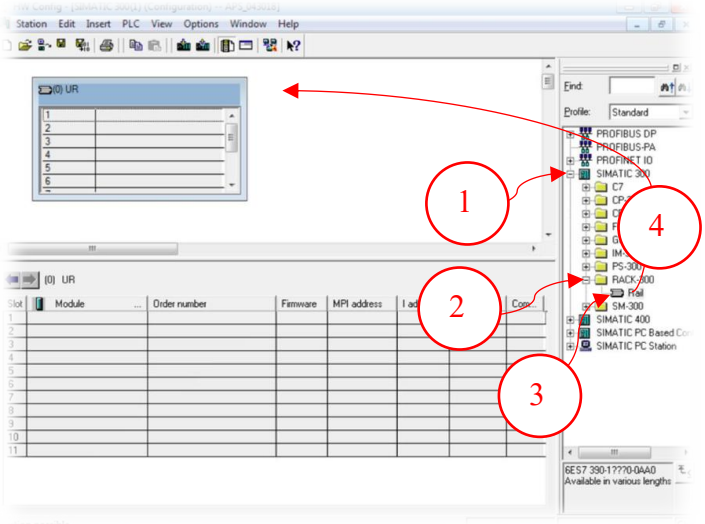
This will prepare the Hardware configuration screen for your project.

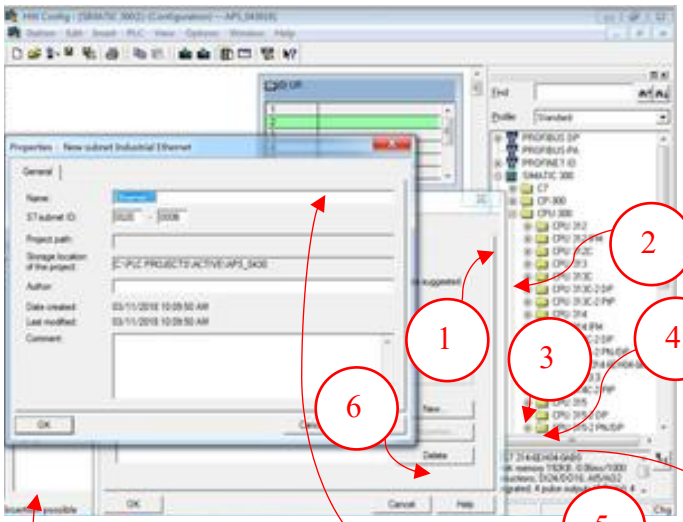
Configuration of Simatic Rail

Follow the steps below;

1. Click + icon on the left of Simatic 300
2. Click + icon on the left of RACK-300
3. Click the rail icon
4. Drag to the empty white window on the top

This will configure your Simatic rail for your S7-300 PLC CPU rack which is called rack 0.





Inserting the S7-300 PLC hardware

Follow the steps below;

1. Click + icon at the left of SIMATIC 300
2. Click + icon at the left of CPU-300
3. Click + icon on the left of CPU 314C-2 PN/DP
4. Click + icon on the left of 6ES&314-6EH04-0AB0
5. Drag the PLC icon to the Rack 0 (0) UR

Simatic rail

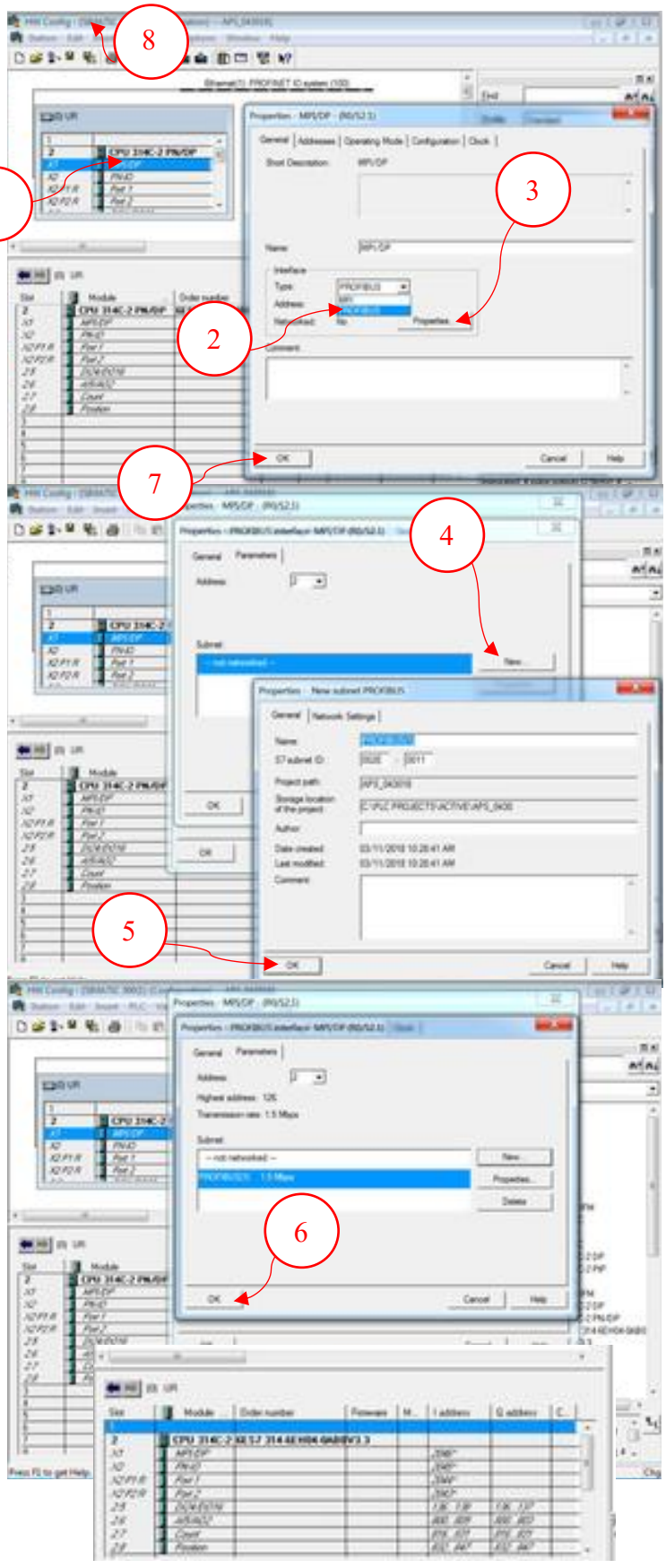
6. Click new
7. Click OK
8. Click OK

This will configure your PLC CPU to the Simatic Rail Rack 0 with default I/O address for it DI/DO/AI/AO and Profinet network configurations 192.168.0.1

Setting Profibus Master configurations

Follow steps below;

1. Double click MPI/DP
2. Select Profibus
3. Click Properties
4. Click New
5. Click OK
6. Click OK
7. Click OK
8. Click Save & Compile



This procedure will configure your S7-300 PLC as a Profibus master with Profibus DP node address of 2 at a baudrate of 1.5Mbps.

I/O Default addresses:

DI24 : 136...138
DO16 : 136...137
AI5 : 800...809
AO2 : 800...803

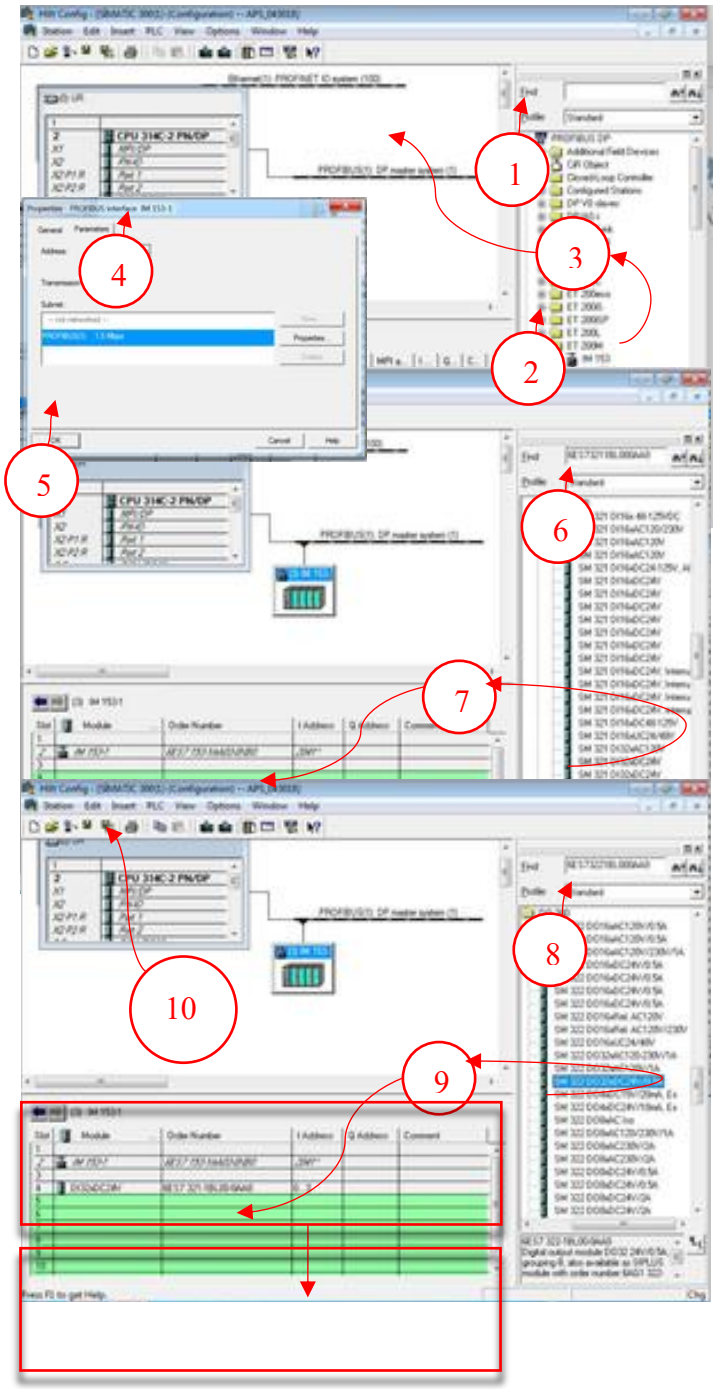
This means;

DI24 = I136.0 ~ I138.7
DO16 = Q136.0 ~Q137.7
AI5 = PIW800 ~PIW808
AO2 = PQW800 ~PQW802

Inserting ET200M Remote I/O station:

Follow steps below;

1. Click + icon on the left of PROFIBUS DP Hardware library
2. Click + icon on the left of ET 200M
3. Drag and drop the second icon of ET200M-1 from the ET200M Family
4. Configure Profibus Slave DP address No. 3
5. Click OK
6. Type the Order code on the actual hardware 6ES73211BL000AA0
7. Drag and drop SM321 DI32xDC24V to slot 4
8. Type the Order code on the actual hardware 6ES73221BL000AA0
9. Drag and drop SM322 DO32xDC24V/0.5A to slot 5
10. Click Save and Compile



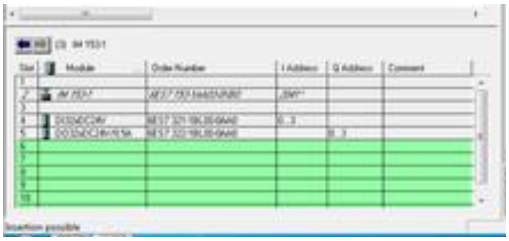
This will configure the actual hardware on the training and simulation station. The input and output addresses can be change whatever you want as long as it within the address range of the Profibus network I/O and available on the hardware itself.

Default addresses;

DI32 : 0...3
DO32 : 0...3

This means;

DI32 = I0.0 ~I3.7
DO32 = Q0.0 ~Q3.7



Inserting ET200s remote I/O modules:

Follow steps below;

11. Click + icon on the left of PROFIBUS DP Hardware library
12. Click + icon on the left of ET 200s
13. Drag and drop the IM151-1 Basic from the ET200s Family
14. Configure Profibus Slave DP address No. 4
15. Click OK
16. Insert the PM/DI/DO/AI/AO modules to the ET200s RIO rack
17. Insert PM Order Code: 6ES7138-4CA00-0AA0 to slot 1 of the EET200s rack
18. Insert 2 pcs DI8 Order Code: 6ES7131 4BF00-0AA0 to slot 2 and 3 of the ET200s rack
19. Insert 1 pc DO8 Order Code: 6ES7132 4BF00-0AA0 to slot 4 of the ET200s rack
20. Insert 1 pc AI2 Order Code: 6ES7134 4GB11-0AB0 to slot 5 of the ET200s rack
21. Insert 1 pc AO2 Order Code: 6ES7 135-4GB01-0AB0 to slot 6 of the ET200s rack
22. Click Save and Compile

This will configure the actual hardware on the training and simulation station. The input and output addresses can be change whatever you want as long as it within the address range of the Profibus network I/O and available on the hardware itself.

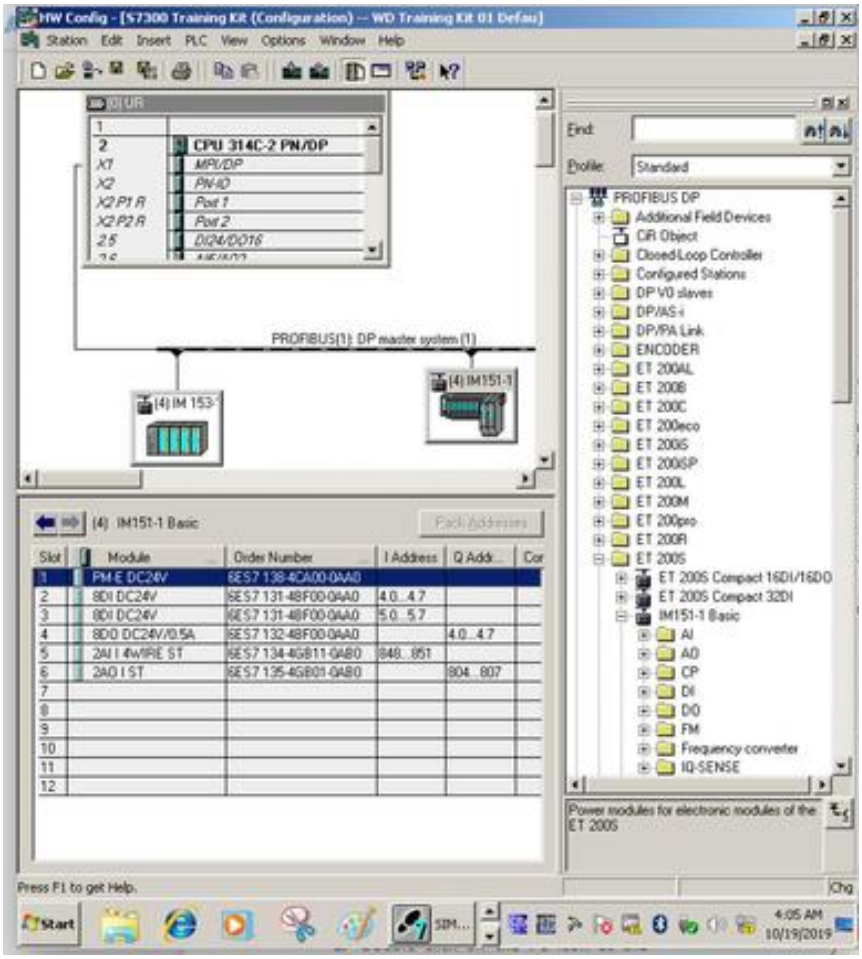
Default addresses;
DI8 : 4...5
DO8 : 4
AI2 : 848
AO2 : 804

This means;
DI8 : 4...5
I4.0~I4.7
I5.0~I5.7

DO8 : 4
Q4.0~Q4.7

AI2 : 848
PIW848
PIW850

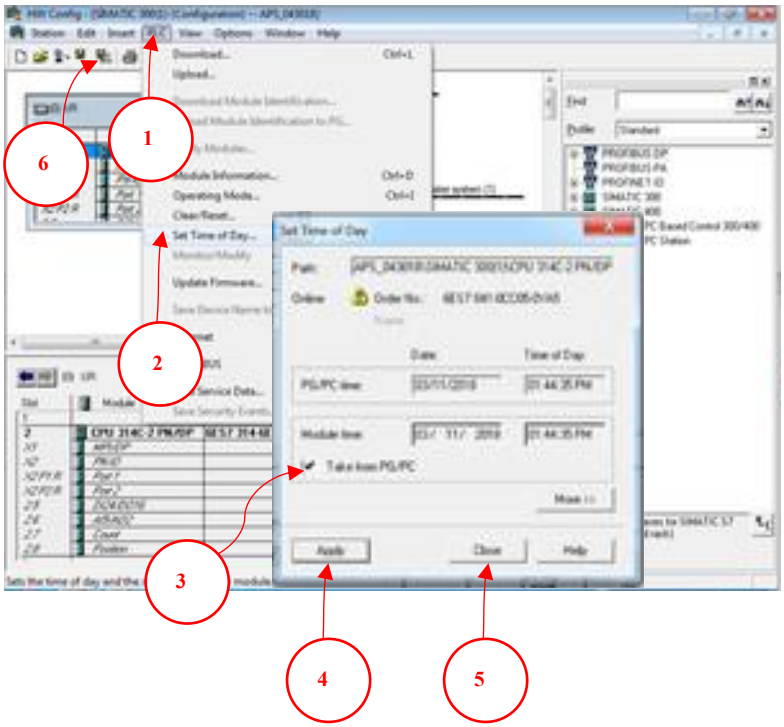
AO2 : 804
PQW804
PQW806



Setting PLC CPU Clock

Follow steps below;

1. Click PLC MENU
2. Select and click Set Time of Day
3. Check Take from PG/PC
4. Click Apply
5. Click Close
6. Click Save and Compile

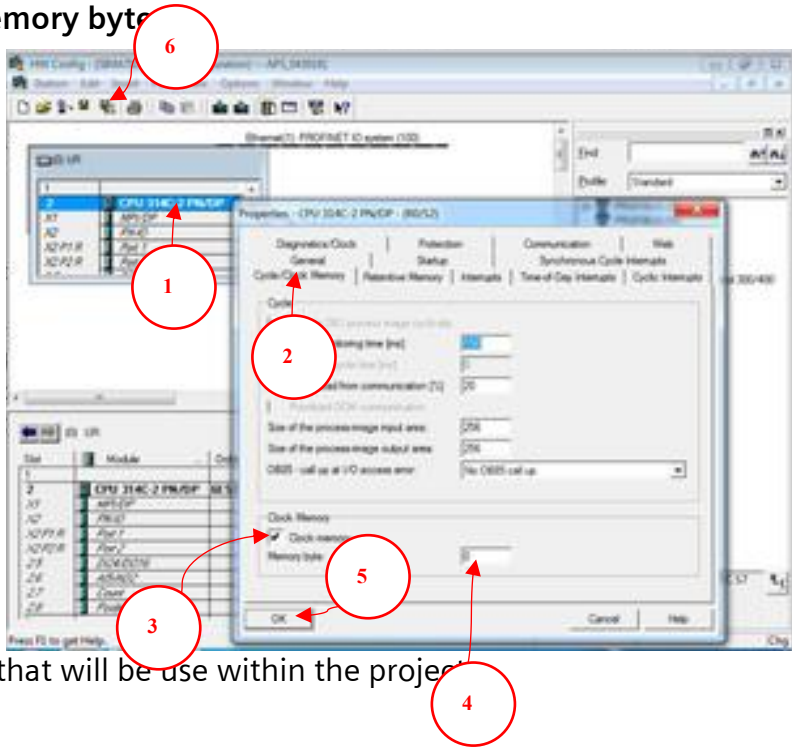


This procedure will set your PLC Hardware clock which is very important to diagnostics time stamping.

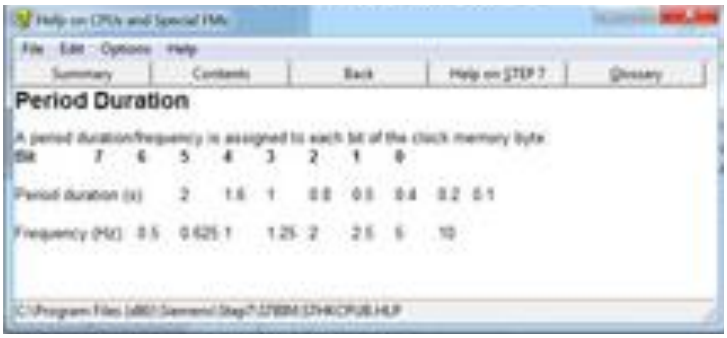
Activating CPU Clock Memory byte

Follow steps below;

1. Double click CPU 314C-2 PN/DP Simatic Rail Rack 0
2. Click Cycle/Clock Memory
3. Check Clock Memory
4. Assign Memory Byte 0
5. Click OK
6. Click Save and Compile



This procedure will enable clock memory byte activation which can be a very useful byte that will be use within the projec

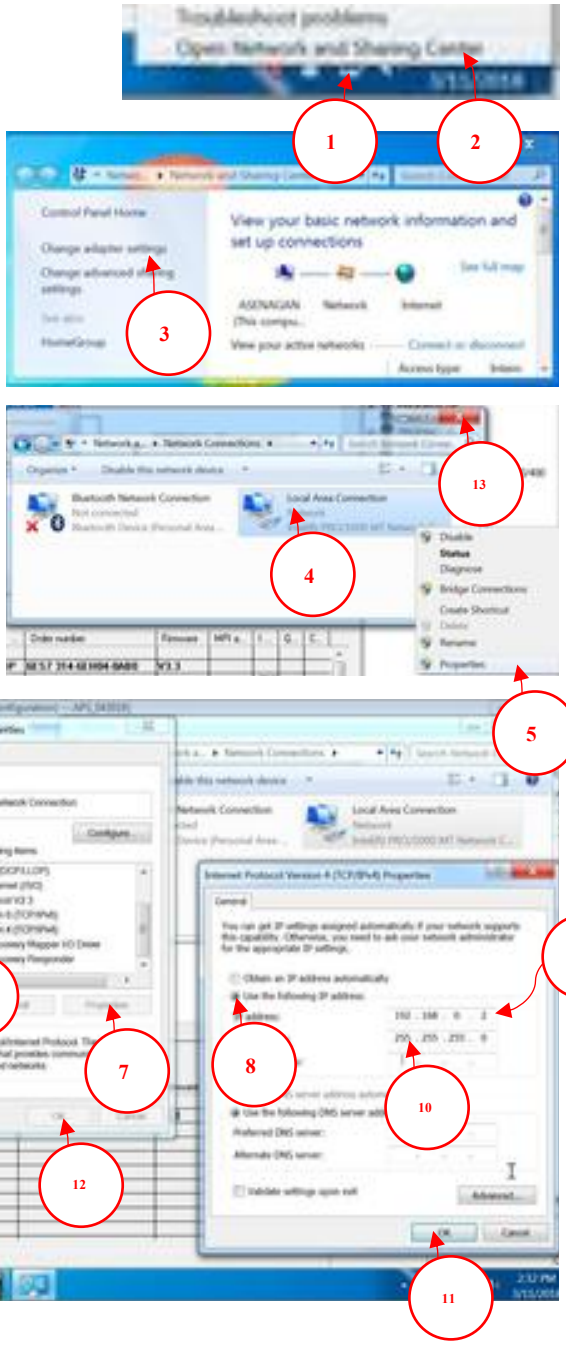


When Memory byte 0 is enable, MB0 is already occupied and cannot be used anymore within the project addresses M0.0 up to M0.7 for standard flags.
Please see on the left special usage of MB0 as a result of the activation process.

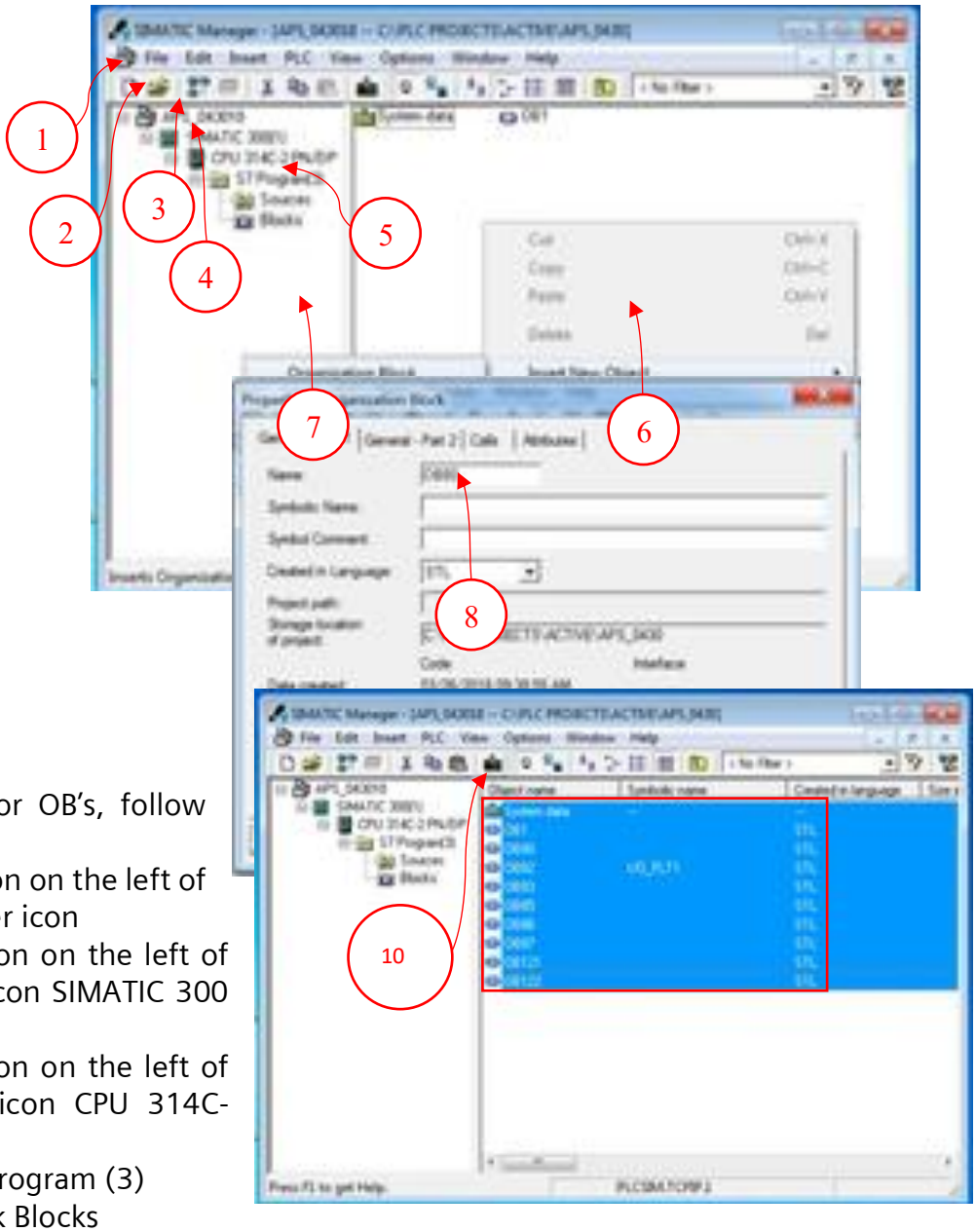
Setting up your PG/PC IP Address
Follow steps below;

1. Double click on the PC icon at the bottom right portion of the Windows task bar
2. Click Open Network and Sharing Center
3. Click Change Adapter settings
4. Right click on active Local Area Connection
5. Select Properties
6. Click Internet Protocol Version 4 (TCP/IPv4)
7. Click Properties
8. Select Use the following IP address
9. Encode IP Address: 192.168.0.2
10. Click on the Subnet Mask field to obtain automatic subnet mask 255.255.255.0
11. Click OK
12. Click Close
13. Click Exit window

This procedure will align your PG/PC IP address in preparation for communication to the PLC CPU.



Programming Asynchronous and Synchronous errors OB's



To program Error OB's, follow steps below;

1. Click + icon on the left of the printer icon
2. Click + icon on the left of the PLC icon SIMATIC 300 (1)
3. Click + icon on the left of the PLC icon CPU 314C-2PN/DP
4. Click S7 Program (3)
5. Right click Blocks
6. Click insert new object
7. Click Organizational Block
8. Inter desired OB No.
9. Repeat procedure to program OB82, OB83, OB85, OB86, OB87, OB121, and OB122
10. No need to program any code on each OB's. You only need to download the OB's to the PLC CPU.

Creation of symbol table for the ET200s Remote I/O's

Create Symbol table parameters as follows;

S7 Program(1) (Symbols) -- WD Training Kit 01 Defau\S7300 Training Kit\CPU 314C-2 PN/DP

	Status	Symbol	Address	Data type	Comment
1		VFD_Ready_Stat	I 4.0	BOOL	
2		VFD_Tripped_Stat	I 4.1	BOOL	
3		VFD_Remote_Mode	I 4.2	BOOL	
4		VFD_Local_Mode	I 4.3	BOOL	
5		VFD_Running_Stat	I 4.4	BOOL	
6		Spare_DI5	I 4.5	BOOL	
7		Spare_DI6	I 4.6	BOOL	
8		Spare_DI7	I 4.7	BOOL	
9		VFD_Start	Q 4.0	BOOL	
10		VFD_Stop	Q 4.1	BOOL	
11		Spare_DO2	Q 4.2	BOOL	
12		Spare_DO3	Q 4.3	BOOL	
13		Spare_DO4	Q 4.4	BOOL	
14		Spare_DO5	Q 4.5	BOOL	
15		Spare_DO6	Q 4.6	BOOL	
16		Spare_DO7	Q 4.7	BOOL	
17		VFD_RPM	PIW 848	INT	
18		Spare_AI2	PIW 850	INT	
19		VFD_Setpoint	PQW 804	INT	
20		Spare_AO2	PQW 806	INT	

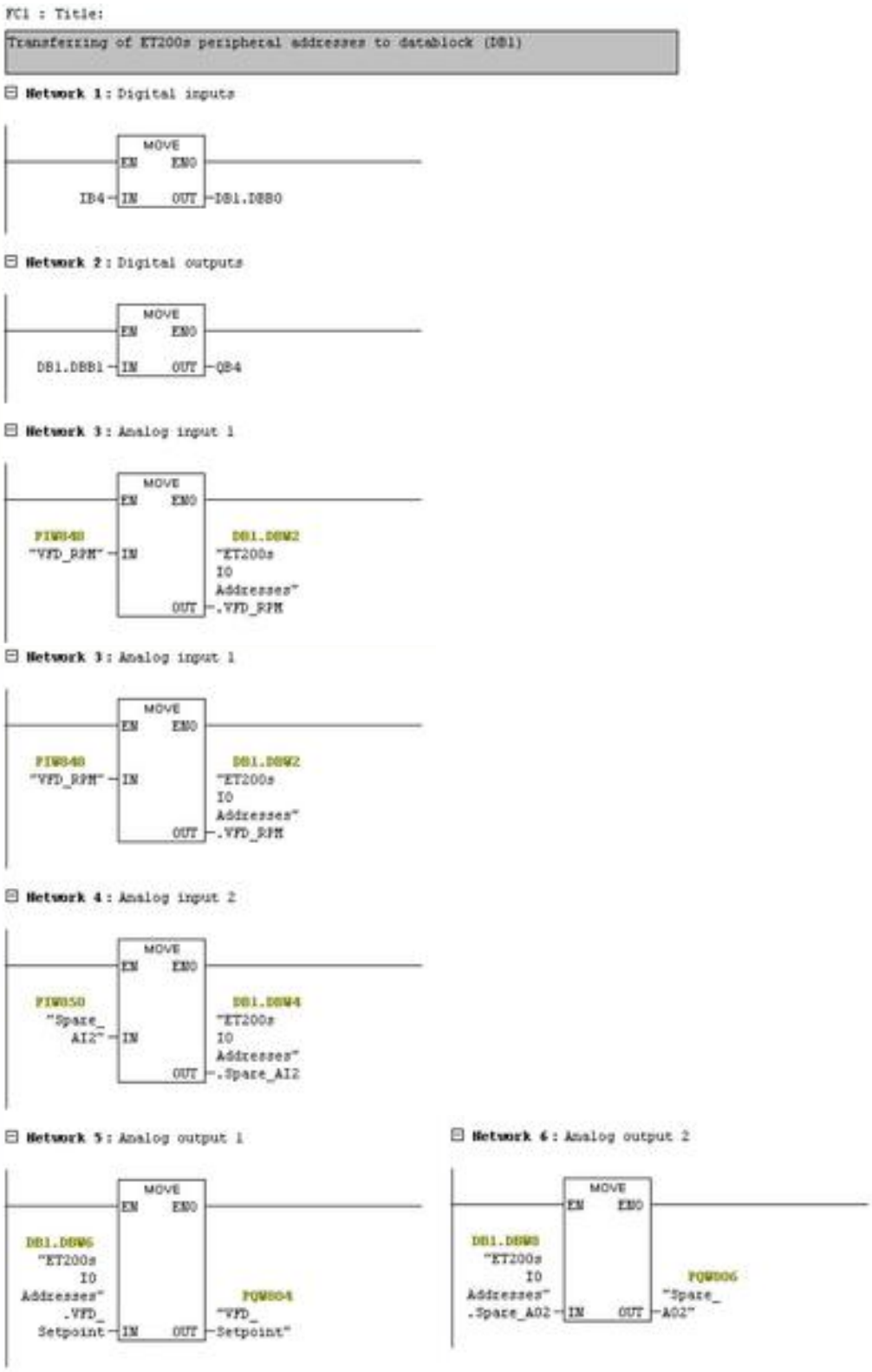
Creation of Data Block (DB1) for ET200s Remote I/O's

Create DB1 parameters as follows;

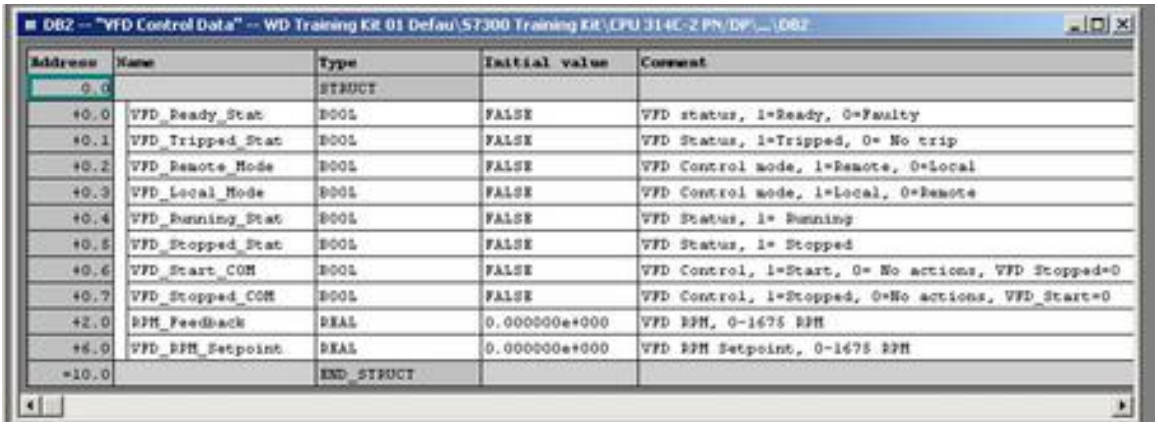
DB1 -- WD Training Kit 01 Defau\S7300 Training Kit\CPU 314C-2 PN/DP

Address	Name	Type	Initial value	Comment
0.0		STRUCT		
+0.0	VFD_Ready_Stat	BOOL	FALSE	
+0.1	VFD_Tripped_Stat	BOOL	FALSE	
+0.2	VFD_Remote_Mode	BOOL	FALSE	
+0.3	VFD_Local_Mode	BOOL	FALSE	
+0.4	VFD_Running_Stat	BOOL	FALSE	
+0.5	Spare_DI5	BOOL	FALSE	
+0.6	Spare_DI6	BOOL	FALSE	
+0.7	Spare_DI7	BOOL	FALSE	
+1.0	VFD_Start	BOOL	FALSE	
+1.1	VFD_Stop	BOOL	FALSE	
+1.2	Spare_DO2	BOOL	FALSE	
+1.3	Spare_DO3	BOOL	FALSE	
+1.4	Spare_DO4	BOOL	FALSE	
+1.5	Spare_DO5	BOOL	FALSE	
+1.6	Spare_DO6	BOOL	FALSE	
+1.7	Spare_DO7	BOOL	FALSE	
+2.0	VFD_RPM	INT	0	
+4.0	Spare_AI2	INT	0	
+6.0	VFD_Setpoint	INT	0	
+8.0	Spare_AO2	INT	0	

Transfer ET200s Remote I/O Address to Data Block 1 using FC1



Creation of Data Block (DB2) for VFD Control Data

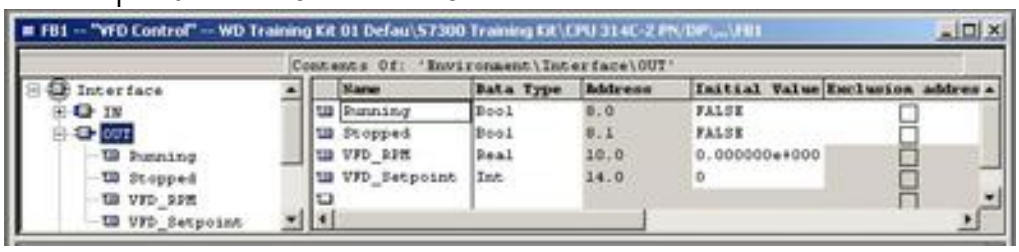


Address	Name	Type	Initial value	Comment
0.0		STRUCT		
+0.0	VFD_Ready_Stat	BOOL	FALSE	VFD status, 1=Ready, 0=Faulty
+0.1	VFD_Tripped_Stat	BOOL	FALSE	VFD Status, 1=Tripped, 0= No trip
+0.2	VFD_Remote_Mode	BOOL	FALSE	VFD Control mode, 1=Remote, 0=Local
+0.3	VFD_Local_Mode	BOOL	FALSE	VFD Control mode, 1=Local, 0=Remote
+0.4	VFD_Running_Stat	BOOL	FALSE	VFD Status, 1= Running
+0.5	VFD_Stopped_Stat	BOOL	FALSE	VFD Status, 1= Stopped
+0.6	VFD_Start_COM	BOOL	FALSE	VFD Control, 1=Start, 0= No actions, VFD Stopped=0
+0.7	VFD_Stopped_COM	BOOL	FALSE	VFD Control, 1=Stopped, 0=No actions, VFD_Start=0
+2.0	RPM_Feedback	REAL	0.000000e+000	VFD RPM, 0-1675 RPM
+6.0	VFD_RPM_Setpoint	REAL	0.000000e+000	VFD RPM Setpoint, 0-1675 RPM
+10.0		END_STRUCT		

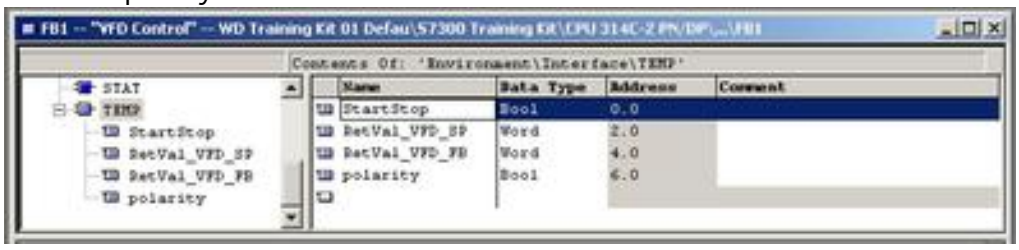
Creation of Function block (FB1) for VFD Control

FB1 Input declaration variables;

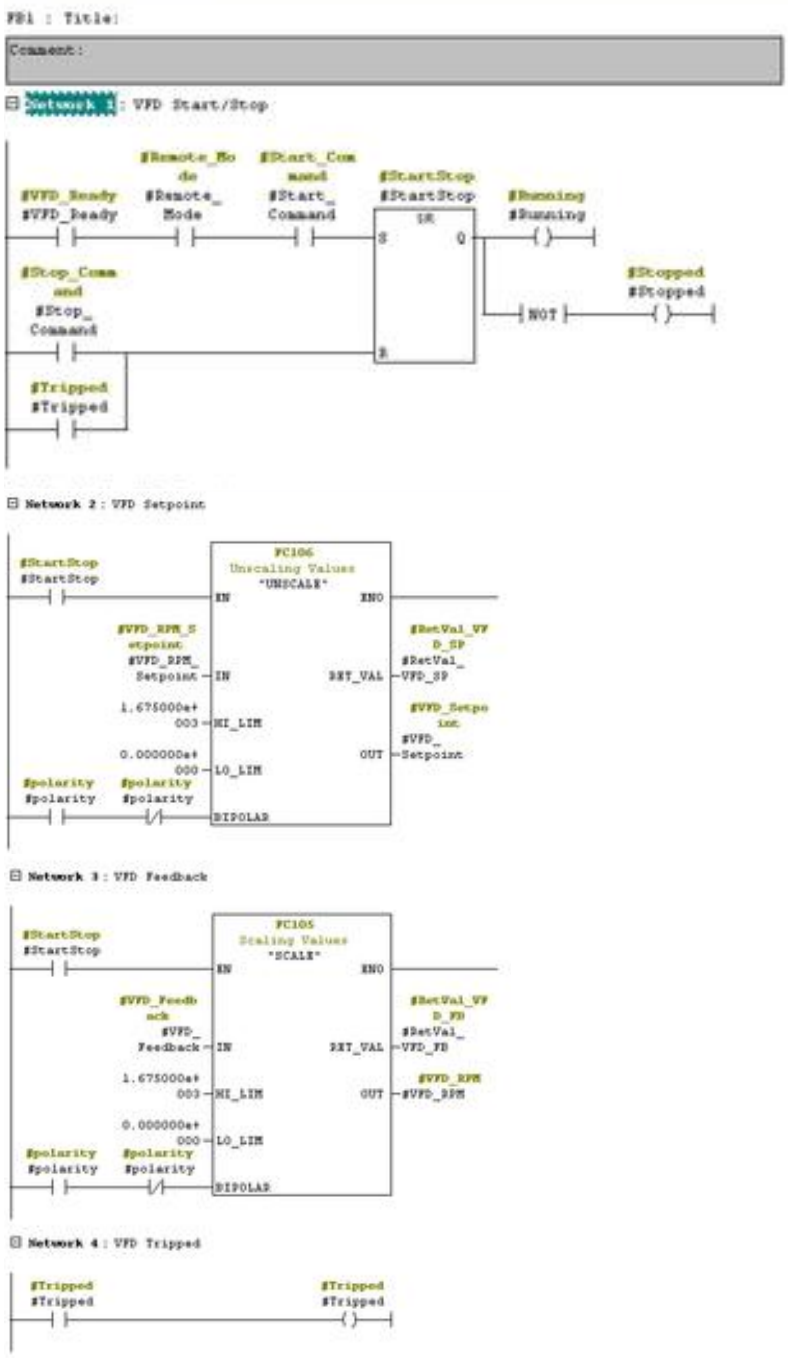
FB1 Output declaration variables



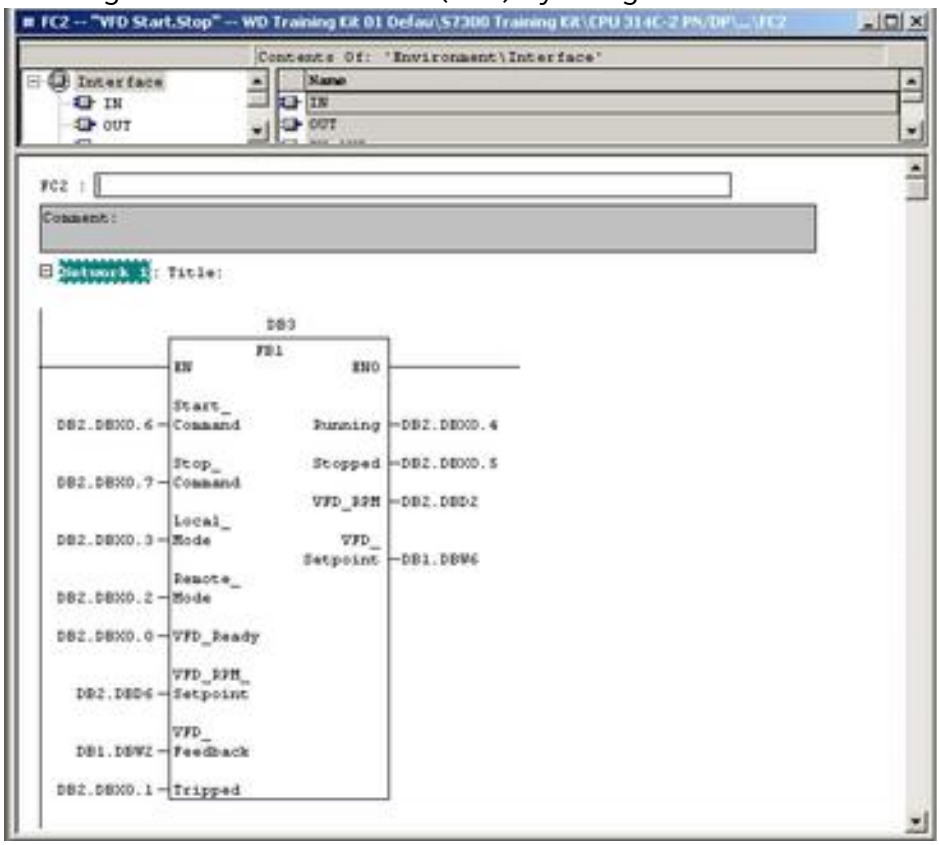
FB1 Temporary declaration variables



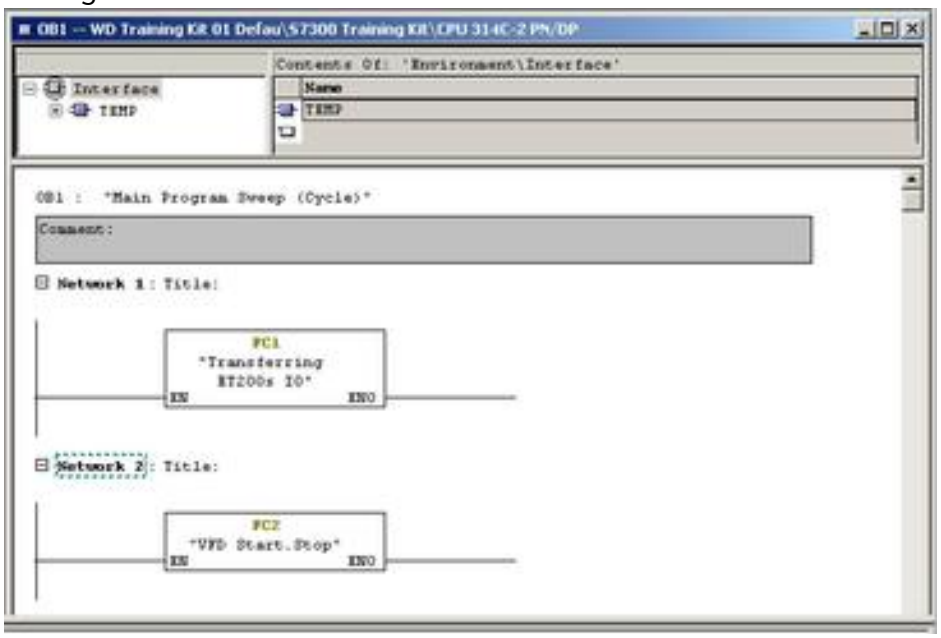
FB1 Control Logics



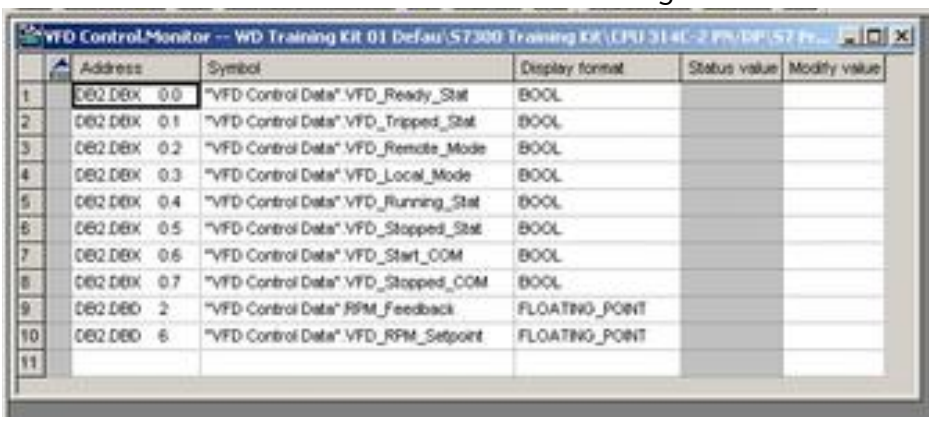
Creating VFD Control Function (FC2) by using the created Function Block



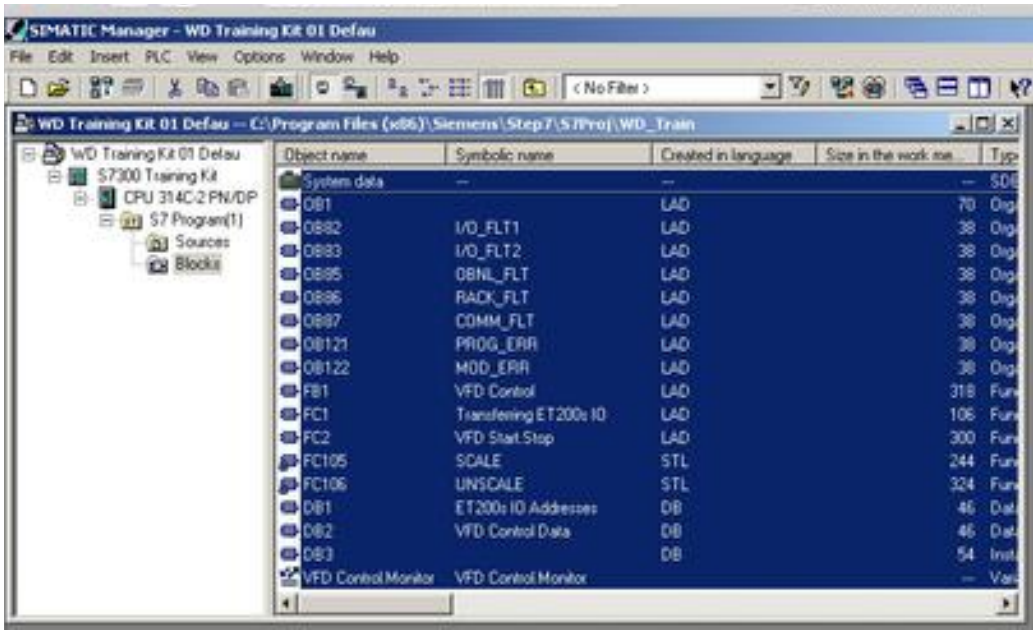
Calling Functions in OB1



Creation of Variable Table for Online Monitoring and Control via Simatic Manager



Downloading the Entire PLC Program



Testing and commissioning

Steps:

1. Checking of the Profibus DP node addressing
2. Running the VFD by Local Control
3. I/O checking from field terminals to Software
4. Checking of the peripheral I/O addressing transfer function to Data Block
5. Checking of the VFD Start.Stop Function
6. Controlling and monitoring the VFD via Variable Table