Demo Application for Sinamics S120

Demo Application; Sinamics S120 AC/AC, Simatic HMI, Simatic S7-200 PLC

Application Number: AXXXXXX-N00XXX-A0XXX
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- Trained or instructed according to the latest safety standards in the care and use of the appropriate safety equipment.
- Trained in rendering first aid.

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Reference regarding export codes

AL: N
ECCN: N
Foreword

Objective of the application
This application involves using “Basic Positioning” function in the Sinamics S120 AC/AC Drive with Simatic HMI and Simatic S7-200 PLC.

Knowledge base required
Basic know-how about STARTER or SIMOTION SCOUT, WINCC FLEXIBLE and STEP7 MICROWIN is required in order to understand this application example. You should also have knowledge in the area of basic positioning functionality.
Documentation structure

The documentation of this application is sub-divided into four parts:

**Application description**

**Application example as demonstration system**

The first section of the *application description* is intended for personnel that wish to obtain a fast overview. You do not have to read this section if you are knowledgeable in this area and you only wish to commission the application.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application description</td>
<td>You can read about everything you require obtaining an overview in Section A. You will learn about the components used (standard hardware and software components and the additional, developed software) and the principle of the technological core function.</td>
<td>This Section will allow you to transfer the technology to other applications.</td>
</tr>
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</table>

The second section – the *application example as demonstration system* – is intended for personnel that wish to use or present the examples supplied on a demonstration/presentation system.

<table>
<thead>
<tr>
<th>Part</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Application example as demonstration system</td>
<td>This Section navigates you step-by-step through the essential commissioning phases of the demonstration application. This Section then discusses how the demonstration application is used.</td>
<td></td>
</tr>
</tbody>
</table>
## Index

### Application description ........................................................................................................... 10

1. Basic information and data .................................................................................................... 10
   1.1 Prerequisites .................................................................................................................. 10
   1.1.1 Target group ............................................................................................................ 10
   1.1.2 Technical environment ............................................................................................. 10
   1.2 Objective and purpose of this standard application ....................................................... 10
   1.2.1 Task ........................................................................................................................ 10
   1.2.2 Solution using the standard application .................................................................... 12
   1.2.3 Advantages of the standard application ..................................................................... 12
   1.3 Components included in the standard application ......................................................... 12
   1.4 Typical areas of the application ...................................................................................... 12

2. Functions of the application ................................................................................................... 13

3. Automation solution ................................................................................................................. 14

### Application example as demonstration system ..................................................................... 15

4. Installing the hardware and software .................................................................................... 16
   4.1 Regarding your safety ..................................................................................................... 17
   4.1.1 Safety information and instructions .......................................................................... 14
   4.1.2 Responsibilities of the operator ................................................................................ 15
   4.2 Installation of Hardware ................................................................................................. 16
   4.3 Installation of Application Software ................................................................................ 16
   4.3.1 Configuration and parameter settings ....................................................................... 16

5. Using the application example ................................................................................................ 28
   5.1 Brief instructions to demonstrate .................................................................................... 28
   5.1.1 Overview of the structure .......................................................................................... 28
   5.2 OP77B HMI screen descriptions .................................................................................... 28
     5.2.1 Main screen ............................................................................................................ 27
     5.2.2 Home screen .......................................................................................................... 28
     5.2.3 Jog screen ............................................................................................................... 30
     5.2.4 MDI screen ............................................................................................................. 30
     5.2.5 Traversing block screen .......................................................................................... 31
     5.2.6 Limits screen .......................................................................................................... 31
     5.2.7 Parameter screen .................................................................................................... 32

### Appendix ............................................................................................................................... 34

6. General information on the application .................................................................................. 34
   6.1 Scope of supply .............................................................................................................. 34
Application description

Content

In Section “Application description” you’ll learn about everything to be able to obtain a complete overview. You will get to know the components used (standard hardware and software components and the additional, developed software) and the principle of function of the technological core function. Further, you will be provided with engineering information and instructions in order to select the suitable closed-loop control concept.

1 Basic information and data

1.1 Prerequisites

1.1.1 Target group

The demo application is intended for all programming engineers and users that want to easily and quickly implement basic positioning function using SINAMICS S120 AC/AC drive and SIMATIC S7-200 PLC.

1.1.2 Technical environment

This standard application can only be used – without having to make any changes – in conjunction with SIMATIC S7-200 and a SINAMICS S120 AC/AC demonstration case.

1.2 Objective and purpose of this standard application

1.2.1 Task

Due to the mentioned features, single-axis servo control applications can be realized easily. Except these features, it’s also possible to achieve a more effective usage by integrating other Siemens products. Two of the best examples for this are “Sinamics S120 AC/AC Unit + Siemens Operator panel” and “Sinamics S120 AC/AC Unit + Siemens Operator panel + Siemens S7 200 PLC” configurations, which are also illustrated in the graphics below.

Thanks to these configurations, you can increase your application’s functionality by changing position, speed, acceleration or several other parameters employed in Sinamics S120 AC/AC unit either via operator panel or through S7 200 PLC unit. So, it is possible to realize your application without making concessions from the features you wish and with reasonable costs.
Sinamics S120 AC/AC unit is comprised of three main parts, namely, CU (control unit), PM (Power module) and CF Card. CU unit and CF card can be used in all PM units with up to 90KW power rating. This provides to its user great advantages in inventory keeping, commissioning and modification.
1.2.2 Solution using the standard application

Thanks to these configurations, you can increase your application’s functionality by changing position, speed, acceleration or several other parameters employed in Sinamics S120 AC/AC unit either via operator panel or through S7 200 PLC unit. So, it is possible to realize your application without making concessions from the features you wish and with reasonable costs.

1.2.3 Advantages of the standard application

Sinamics S120 AC/AC unit, which can easily be distinguished by its technology and superior features among the systems especially used in implementation of single-axis applications requiring servo and vector control, will also increase your machine’s competition power both in domestic market and in export markets besides the technical advantages it adds to your machine.

1.3 Components included in the standard application

The standard “Sinamics S120” application is implemented as STARTER project.

The project can, at the same time, be used for a (demonstration) machine for a SINAMICS S120 AC/AC demonstration case.

The standard application fulfills the following tasks:
- SINAMICS S120 AC/AC Basic information.
- SINAMICS S120 AC/AC Commissioning notes and parameter setup.
- SIMATIC OP77B & TP177B Color, HMI pages and explanations of Demo Application.
- Communication setup on STARTER, WinCC Flexible, STEP 7 MICROWIN.

1.4 Typical areas of the application

This is a very low cost solution for the machines that includes servo or vector axis and have SIMATIC S7-200 PLC. As all servo axis functions (like basic positioning, torque control etc…) are done in the CU310 you can use S7-200 PLC only to produce the parameters that CU310 needs for functions like target position, speed, acceleration&deceleration ramps, etc.

Thanks to these features this demo application can be a basic for all applications that has one or has more than one independent axis.
2 Functions of the application

This Sinamics S120 AC/AC Demo Application has all basic positioning functions of an axis like:

- Homing,
- Axis limit settings,
- Positioning with MDI (Manual data input)
- Traversing Block Control
- Parameter watching and changing
- Alarm control
3 Automation solution

Readers will obtain an overview of the hardware components required in this Chapter.

3.1 Hardware components

A SINAMICS S120 drive combination is required. The application example has been designed for one axis SINAMICS S120 AC/AC demonstration case with firmware release V2.4. System are required for visualization and program control. A SIMATIC OP77B HMI and S7-200 CPU224 XP PLC is required.
Application example as demonstration system

Content

All of the steps necessary to commission the standard application as demonstration system are explained in this section.

4 Installing the hardware and software

4.1 Regarding your safety

4.1.1 Safety information and instructions

Pictograms, signal words and text

Every piece of safety information/instruction in this document is designated by text graphics – comprising pictogram and signal word, and supplemented by explanatory text. A clear classification according to the degree of the potential hazard is provided as a result of the combination of pictogram and signal word. Safety information/instructions are provided in front of the information regarding activities to be executed.

Classification

There are three different stages regarding safety information/instructions. These are designated by the same pictogram. They differ by the signal word.

⚠️ Danger

This safety information/instruction indicates an immediate hazard. If the information/instruction is not carefully followed, this results in severe bodily injury or even death.

⚠️ Warning

This safety information/instruction indicates a potential hazard. If the information/instruction is not carefully followed, this can result in severe bodily injury or even death.

⚠️ Caution

This safety information/instruction indicates a potentially hazardous situation, which can result in slight to average bodily injury. This pictogram/text word can also warn about potential material damage.
4.1.2 Responsibilities of the operator

Correct use

The correct use of the application components exclusively relates to the open-loop and closed-loop control of test set-ups that were adapted to the power/performance of the application components. In order that the application functions perfectly, the required standard SIMATIC components as well as also the necessary hardware and software components must be installed.

Misuse

The following are considered to be misuse:

- Inadmissible loads applied to the application components.
- Any application deviating from the use specified above, or applications that go beyond the specified use.
- Non-observance of the safety information and instructions.
- If faults that could have a negative impact on the safety are not immediately resolved/removed.
- Any changes/modifications to equipment/devices that are used to ensure perfect function and operation, unrestricted use as well as active or passive safety.
- If recommended hardware and software components are not used.
- If the application components are not in a perfect technical condition are not operated conscious of safety and hazards, and not taking into account all of the instructions provided in the documentation.

The manufacturer assumes no liability for incorrect use (misuse).

Responsible for monitoring

The company or person operating the system is responsible in continually monitoring the overall technical status of the application components (defects and damage that can be externally identified as well as changes in the operating behavior). The company/person operating the system is responsible in ensuring that the application is only operated in a perfect state. He must check the state of the application components before they are used and must ensure that any defect is removed before commissioning.

Qualification of personnel

The operating company/person may only deploy trained, authorized and reliable personnel. In so doing, all safety regulations must be carefully observed.

Personnel must receive special instructions regarding the hazards/dangers that can occur.
4.2 Installation of Hardware

Table 4-1

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Note</th>
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<tbody>
<tr>
<td>1.</td>
<td>Install xy on...</td>
<td>for example explanatory screenshot</td>
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<tr>
<td>2.</td>
<td></td>
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<tr>
<td>3.</td>
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</table>

Note

4.3 Installation of Standard Software

4.3.1 Configuration and parameter settings

After system power-up, required settings can be made by communicating via PG/PC and profibus and through STARTER or SIMOTION SCOUT programs.

During the initial commissioning of the drive, profibus address should be set on CU310DP “Profibus address switch” as the same address to be assigned to the drive in STARTER program in order to ensure communication between PG/PC and Profibus. Address is set using binary coding. As an example, to set the “address 3”, bit 0=1, bit 1=1 other bits =0; to set the “address 5” bit 0=1, bit1=0, bit2=1 and other bits =0, etc.

Then click on “Project” button from the program menu of STARTER program and select “New” in the dropdown menu to open a new window, where you can enter the name of the prepared project in “Name” box and click OK button to complete the process.
The program then creates the following screen. You should make “Insert single drive unit” selection on this screen.

Click to this button and after that click on the topic on the page that you need help, then the help page that includes help about that topic opens.
Sections on this screen can be selected as shown below and clicking OK button will complete the selection made. Bus address should have the same value with the address value set on “profibus address switch” as mentioned before.

STARTER program will automatically set required program infrastructure for SINAMICS_S120_CU310_DP according to the selected specifications and the following screen opens.
If the hardware for profibus communication between drive and PG/PC is ready and communication cable is already connected to "BUS X121" on the drive, initiate the communication by clicking on the yellow (connect to target system) button which is marked in red on the previous screen. When communication starts, "Online mode" message will be shown on the lower right of the program screen and this part will turn into yellow background color.
Then you can double-click the “**Automatic configuration**” icon shown below to start the automatic configuration process. Automatic configuration process will start.
In the window opened, select “Servo” for servo application and click “Finish” button. System continues the automatic configuration process and finally the message “Automatic configuration completed” is shown on the screen. By clicking “Close” button at this stage the automatic configuration process will be completed.

As the result of the process, a servo axis, shown as “SERVO_02” on the left pane of the following screen will be created. Under this icon, sections covering all features of this axis are available.
At this point, our drive is able to move the servo motor by means of hardware. The selections and settings after this stage will be application oriented. If required, drive can be activated via PG/PC and servo motor can be moved for test purposes. To achieve this, enter to “Control Panel” module shown and click “Assume control priority” button, click “Accept” button in the opened box and select “Enables” icon, respectively. At this point, Green and Yellow buttons are shown. Green button activates and Red button de-activates the drive. The motor can be moved for test purposes only, according to the speed entered in the next box “n =       ” in revolution/minute.

More detailed information on modules can be obtained from STARTER or SIMOTION SCOUT program Help files. Information given here aimed to orientate first users of the system. Therefore, some basic features and instructions on using them are emphasized.

If servo axis is to be used for positioning, “Device configuration” should be changed and “Basic positioner” feature should be selected. Next figure shows the order of this procedure.

To realize this procedure, drive should be in “Offline Mode”. To achieve this condition, use “Disconnect from target system” button on the upper part of the program marked in the diagram.
Then, following the sequence in the drawing, “Configuration–SINAMICS S120 CU310DP Control structure” mode will be opened. This module contains values determined by automatic configuration process of the system. Same values can also be entered manually. If automatic configuration is already carried out, you do not need to change these values. Therefore, after selecting “Basic positioner” feature, close this module without making any changes, by clicking “next” buttons and close “device configuration” module using “close” button. Since these changes are made in “Offline Mode”, they should be sent to drive. Therefore “Online Mode” will be selected again.

Whenever STARTER program establishes communication with the system, first it compares the program in PG/PC with the program in drive and shows “Online/offline comparison” module to inform the user. On this screen, user can transfer the program saved in PG, that is computer, to the drive (with “Download”), or program saved in the drive to the computer (with “Load to PG”) by using “Download” and “Load to PG” buttons.

At this point, click “Download” button to send changes made on PG/PC to the drive and by doing it, selected “Basic positioner” feature have been activated on the drive.

To enable automatic set-up of “BICO transformer” settings we need to load “Script” file prepared based on example application. Therefore, before proceeding, make sure that “SinamicsS120_Script.txt” file exists in your computer. Then right-click on “SERVO_02” axis on the left column of the
screen. Select “Expert” and “insert script folder” from the menu opened and finally a folder “SCRIPTS” is created at the bottom of the “SERVO_02” axis menu.

Right-click on this folder, and select “ASCII Import” from the menu opened. Then select “SinamicsS120_Script.txt” file from the new pane. After this procedure, a script named SinamicsS120_Script has been created under “SCRIPTS” folder. When you right-click on this file, a menu opens. Here select “Accept and execute” option. After you confirmed opened screens, procedure will be completed.
After all these procedures, Sinamics S120 AC/AC unit is ready for example application. In order to maintain these settings and parameters in case of a power cut, apply "Copy RAM to ROM" function to copy data in RAM into ROM, as shown in the following figure either from the screen shown when switching to Offline Mode, or when in Online mode. Then, drive is ready for running as set whenever powered-up. As a result of this procedure, drive will be ready for example HMI application operation. After these steps carried on in Online mode, select "Load to PG" to transfer the changes to the program running on PC from the screen appearing when switching into the Offline mode. Save your project, and the procedure is completed.
4.3.2 Digital Input and Input/Output settings

To configure Digital Inputs and Input/Outputs open the configuration screen from the window-like section shown in red circle on the above figure. In this screen you can assign parameters to inputs or outputs you wish. Parameter assignment can be achieved by selecting them from the related section as shown.
5 Using the application example

5.1 Brief instructions to demonstrate

5.1.1 Overview of the structure

5.2 OP77B HMI screen descriptions

5.2.1 Main Screen

This page employs buttons for switching to function screens of the sample application functions. These screens and their summarized contents are as follows:

HOME PAGE: Switches to the screen where referencing or homing function is implemented to determine absolute position of the axis.

JOG PAGE: Switches to the screen where manual control based on direction definitions like “forward” or “backward” for linear axis; for circular axis “clockwise” or “counterclockwise” for circular axis, depending to the physical axis.
design

MDI PAGE : Switches to the MDI (Manual Data Input) screen where axis positioning commands can be given by directly entering position, speed and ramp values.

TRV BLOCKS : Switches to the screen where Travers Block lines previously prepared in the drive can be enabled, stopped or cancelled.

LIMITS : Switches to the screen where axis can be limited by either software or via logical inputs by hardware.

PARAMETERS : Switches to the screen where parameters sent by drive to operator panel can be monitored.

5.2.2. Home Page

This screen is prepared to implement axis’ referencing. First of all, to ensure that drive is active, press F1 button shown as Dr.On/off. It can be found on top of each screens line monitoring section as standard.

Using this section you can monitor axis’ current status, mode and alarm number, if any.

By clicking F1 button drive will switch into activf mode and start controlling the motor. After this point, it’s important not to touch to motor shaft or mechanical systems. Otherwise accidents may occur.

F2 button shown as Home start will start search process. Sinamics S120 employs three separate reference search modes. You can select the most suitable one for your mechanical system and application. This function is executed by related part of Starter software.

In our sample application, “Homing out cam and encoder zero mark” reference searching method has been used among these modes, which is also shown in the figure below.
In this method, axis starts moving with search speed (Home Search Speed1) and stops when sees the homing sensor. Then it starts to search C encoder signal in the opposite direction with the speed shown as "to the zero mark" in the figure (Home Search Speed2). Encoder C signal is a signal per 1 revolution of the motor except special cases * . That means, reverse motion of the motor will end in maximum one revolution. If desired, axis can also be sent to another waiting point (with Home Search Speed3 ). All these function will be executed with a single command. For further information, please refer to related Starter program or Sinamics S120 documentation.

Homing function is a feature needed and used especially in applications employing position control. In a regular application, homing parameters whether or not shown on this screen should be included in password-protected “Homing Settings” screens, since these are parameters which are not needed to be changed during automatic operation. Generally, they do not need to be changed, once set when the machine is commissioned.
5.2.3. Jog Screen

This screen shows parameters and commands to move the axis manually. These are labeled as “Jog Speed1” and “Jog Speed2”. Below them, axis’ instantaneous speed and position values are shown for monitoring purposes.

5.2.4. MDI Screen

This screen includes commands and parameters for activating MDI mode, which basically serves for position and speed data entry and axis’ positioning. Similarly, ramps can also be adjusted.

In this mode, both absolute or incremental positioning is possible. P.Type button can be used for this selection.

Set Point Tr.(F3) function activates entered task and carries out positioning process.
5.2.5. Traversing Block Screen

In this screen, traversing blocks previously prepared in drive can be activated and axis movement based on these commands are ensured. If needed, operation can be stopped or cancelled.

5.2.6. Limits Screen

In Limit1 screen, Positive limit and Negative limit software limits of Sinamics S120 limiting features are shown. At the bottom of the screen, instantaneous speed and position data are also monitored. In Limit2 screen speed, acceleration and deceleration ramps of the axis are shown.
5.2.7. Parameter Screen

In this screen, parameters used for system control and status monitoring such as Control Word and Status Word can be monitored.

This sample application has been arranged to display Basic Positioning feature, on of the Servo Control features of Sinamics S120 AC unit, and almost all features needed in a single-axis servo control application included.
Appendix

6 General information on the application

6.1 Scope of supply

The package „---“ comprises the following:

- Program
- Documentation

6.2 Revision/Authors

Table 6-1: Revision/Authors

<table>
<thead>
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<th>Version</th>
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<th>Author</th>
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<tr>
<td>V 0.1</td>
<td>08.12.2006 First edition</td>
<td>S.YILDIRIM</td>
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</tbody>
</table>
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