SIMATIC S7-1200 Workshop
Modular Controller Positioning
- New Gen Controllers S7-1200/1500

S7-1500: Advanced Control
- Balance of control for machines or plants
- Complex automation architectures that require Many HMI’s, Drives and other field devices
- Customized mass production control
- Perfect for when machine to machine controls are required for an entire production process

S7-1200: Basic Control
- Perfect for stand-alone simple machine control
- Material handling & packaging
- Vertical form, fill and seal

Performance

Application Requirements
SIMATIC S7-1200 positioning
- Siemens Modular Controller Overview

Advanced
- SIMATIC S7-400
- SIMATIC S7-1500

Basic
- SIMATIC S7-300

Micro
- SIMATIC S7-200
- SIMATIC S7-1200

LOGO!
…“Programmable Relay”

Logic module for switching and controlling solutions in low-end standalone automation
SIMATIC S7-1200 Compact Controller

Modular space-saving controller for small automation systems that require either simple or advanced functionality for logic, HMI, and networking.

- Perfect for stand-alone simple machines and basic automation systems
- Easily implemented in networked systems and systems that require one or more HMIs
- Even advanced functionality for small motion control systems and small process applications
SIMATIC S7-1200: Three Areas of Innovation


1. System Architecture

- Unified hardware, HMI, networking and development software
  – eliminating barriers of interoperability between common automation devices

Common “Core Intelligence” for integrated automation in the Compact Controller class
SIMATIC S7-1200: Three Areas of Innovation

2. Hardware

- Integrated Ethernet, Analog I/O, Motion Control I/O, with Scalable Expansion
  – eliminating the need for additional hardware; reducing space and cost

Compatible interfaces for Easy Integration, Startup and Reduced Cost
SIMATIC S7-1200: Three Areas of Innovation

3. One Software – One User Program: Controller, HMI, and Networking

Central Navigation Portal

I/O Config
Logic
HMI Config

Motion
Networking
PID Tuning

Step 7 Basic: An Integrated Automation development software for the Compact Controller class
Symbolic programming
Recipes
DB Online Handling
Calculate Box
TIA Portal – intuitive
TIA Portal – efficient
TIA Portal – proven

Modular, Powerful, Easy to use.
The Software…
SIMATIC STEP 7 Basic –

The integrated Engineering System
for Controller, HMI, Networking, and Drives

- One integrated engineering system – STEP 7 Basic including WinCC Basic for SIMATIC S7-1200 and HMI Basic Panels
- Task oriented, intelligent, intuitive editors
- Common engineering framework for hardware and network configuration, programming, diagnostics and much more

Customer Benefits:
- Intuitive: Easy to learn – Easy to use
- Efficient: One Development Software – One User Program; for Logic, HMI, Networking, Drives
- Sustainable: Software architecture forms a stable base for future innovations
Engineering software Innovations for the SIMATIC S7-1200…

- **Auto-detection and upload concept** –
  Extremely fast hardware configurations in design phase, and all documentation is stored in the CPU (symbols, comments, descriptions), much easier and quicker maintenance.

- **No separate stand alone software utilities** –
  And maintain separate configurations) for PID Loop Tuning, Motion Control using PLC Open instructions. It’s all built-in the engineering software and included with the user program.
Efficient Engineering

- Symbolic programming & indirect addressing in LAD/FBD
- Optimized LAD/FBD/SCL-Compiler for higher performance
- Calculate-Box in LAD/FBD for complex algorithms
- No limit by the size of module of 64 kByte – FBs/FCs with maximum 512 kByte, DBs with maximum 16 MByte
- Recipes can be stored directly in the CPU internal memory or external memory
- DB Online Handling simple data block changes are possible while online with a running controller
Innovative behavior of downloads

- Consistent download – all blocks affected by the changes will be downloaded to Controller
- DB actual values exist after downloading changes of comments, start values, tag names
- Freely selectable tags of the DB-values, that are saved in retentive memory

Plug & Play

- Quick and errorless detection of hardware via upload
- During project upload of hardware and software, symbolic addresses and comments will also be loaded
- Hardware detection & upload in RUN possible

Efficient commissioning and service by innovative upload-/download behavior
Compatibility

- Uniform conformity between controller families creates investment protection; so programming environment is the same for all controllers, and this helps you to facilitate full project modularity.

- Code modularity which allows the reuse of existing automation components like an SCL program. You can use the same code whether it’s for the S7-1200 or the larger S7-1500

- Tag database modularity maintains data integrity because you can create a tag database once, and simply reuse it for new projects as many times as you would like.
STEP 7 Basic Supports Beginners and Professionals

STEP 7 Basic provides two optimized views:

1. **Portal View**
   - All the tasks of an automation project are clearly organized.

The beginner gets started easily!

2. **Project View**
   - The complete project is hierarchically organized.
   - Quick, intuitive access to all editors, parameters and data.

Beginners and professionals can implement an automation task quickly and efficiently.
Uniform Look & Feel for all editors and desktop with efficient system of views for

- Quick, direct access to:
  - All editors
  - All parameters
  - All variables
- Optimum flexibility
- Easily adapted to:
  - The task
  - Work preferences

Highly efficient engineering due to optimized handling of the software
Intelligent Drag & Drop Between Editors for PLCs, HMI and Drives

Functionality

- Assignment of hardware to symbols by means of Drag & Drop
- Automatic connection of tags between the PLC (from devices view, from tag table, from user program, etc.) and the HMI screen by means of Drag & Drop

Customers can focus on their application instead of the automation system intricacies
Single controller
Modular Board Concept
Removable Connectors
16 Bit Analog Inputs
Integrated HSC's & PTO's/PWM's
Line Driver I/O

Design and Handling
Performance
Technology Integrated
Integrated system diagnosis
Security Integrated
Engineering with TIA Portal
SIMATIC New Controller Generation
SIMATIC S7-1200: Easy PLC selection thanks to an optimized Portfolio

Switch-module
Power-module
Communication-modules
CPUs
Signal-modules
Technology-modules
Signal-boards

CSM
PM
13x CM / CP
CPU 1211C-1PN
CPU 1212C-1PN
CPU 1214C-1PN
CPU 1215C-2PN
CPU 1217C-2PN
22x I/Q
2xTM
11x SB
1x CB
1x BB
The Controller Hardware…
SIMATIC S7-1200 –

The SIMATIC S7-1200

- Space-saving modular controller for small systems requiring simple or advanced functionality for logic, HMI and networking
- Integrated Ethernet interface for programming, HMI connectivity and CPU-to-CPU communication
- Powerful built-in technology functions for high-speed counting, Analog-In, closed-loop PID control, basic motion control, and more

Customer Benefits:

- Advanced Engineering – Logic Control, HMI, Networking in One Software
- Simple networking between engineering, HMI panels and controllers
- Efficient solutions for technological tasks
Scalable and Flexible Design!

For designing and or expanding a controller system to exactly fit the individual machine requirements

- Scalable CPU Offering
- Signal Modules and Signal Boards for digital and analog I/O connection
- Communication Modules for Point-to-Point communication
- Future system expansion is quick and easy

High flexibility and scalability to fit each application
Removable Connectors –

- For the entire product range including the small CPU’s & even the Analog inputs and Analog outputs; which makes CPU & Signal module replacement fast and simple!

16 Bit Analog Inputs –

- Full resolution 16 Bit Analog input modules, RTD input modules & TC input modules

Integrated Digital I/O, Analog I/O and Motion Control I/O –

- This eliminates the need for additional hardware; reducing space and cost.
Modular Board Concept –

- Signal Boards add additional I/O’s without increasing the CPU’s footprint; so when you need just one RTD input, no problem!
- Battery Board is designed for long-term backup of the Real-time clock which gives an approximate 1 year run time.

Integrated High Speed Counters & Pulse Train Outputs/Pulse Wide Modulation Outputs –

- Up to 6 HSC’s possible & up to 4 PTO’s/PWM’s possible
- 4 PTO’s/PWM’s can be upgraded to to 200 kHz with optional signal board (*CPU1217 up to 4x 1MHz differential IO for stepper control…)

Additional I/O’s without increasing the CPU’s footprint saves time and costs
### CPU Features

<table>
<thead>
<tr>
<th></th>
<th>CPU 1211C</th>
<th>CPU 1212C</th>
<th>CPU 1214C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 CPUs</td>
<td>DC/DC/DC, AC/DC/RLY, DC/DC/RLY</td>
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<td>DC/DC/DC, AC/DC/RLY, DC/DC/RLY</td>
</tr>
<tr>
<td>Work Memory, Integrated</td>
<td>30 KB</td>
<td>50 KB</td>
<td>75 KB</td>
</tr>
<tr>
<td>Load Memory, Integrated</td>
<td>1 MB</td>
<td>1 MB</td>
<td>4 MB</td>
</tr>
<tr>
<td>Retentive Memory, Integrated</td>
<td>10 KB</td>
<td>10 KB</td>
<td>10 KB</td>
</tr>
<tr>
<td>Memory Cartridge</td>
<td>SIMATIC Memory Card (optional)</td>
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</tr>
<tr>
<td>Integrated Digital I/O</td>
<td>6 Inputs / 4 Outputs</td>
<td>8 Inputs / 6 Outputs</td>
<td>14 Inputs / 10 Outputs</td>
</tr>
<tr>
<td>Integrated Analog I/O</td>
<td>2 Inputs, 0 -10VDC, 10 bit resolution</td>
<td>2 Inputs, 0 -10VDC, 10 bit resolution</td>
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</tr>
<tr>
<td>Process Image Size</td>
<td>1024 Bytes for Inputs / 1024 Bytes for Outputs</td>
<td>1024 Bytes for Inputs / 1024 Bytes for Outputs</td>
<td>1024 Bytes for Inputs / 1024 Bytes for Outputs</td>
</tr>
<tr>
<td>Signal Board Expansion</td>
<td>1 max.</td>
<td>2 max.</td>
<td>8 max.</td>
</tr>
<tr>
<td>Signal Module Expansion</td>
<td>none</td>
<td>2 max.</td>
<td>8 max.</td>
</tr>
<tr>
<td>Max. Local I/O – Digital</td>
<td>14</td>
<td>82</td>
<td>284</td>
</tr>
<tr>
<td>Max. Local I/O – Analog</td>
<td>3</td>
<td>19</td>
<td>67</td>
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## SIMATIC S7-1200 CPUs
### CPU1211C – CPU1214C (2 of 2)

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</tr>
<tr>
<td>Pulse Outputs</td>
<td></td>
<td>Up to 4 total 4 @ 100kHz max (DC Outs)</td>
<td></td>
</tr>
<tr>
<td>Line Driver Inputs/Outputs</td>
<td></td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Pulse Catch Inputs</td>
<td>6</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Time Delay / Cyclic Interrupts</td>
<td></td>
<td>4 total with 1 ms resolution</td>
<td></td>
</tr>
<tr>
<td>Edge Interrupts</td>
<td>1) 6 rising &amp; 6 falling</td>
<td>1) 8 rising &amp; 8 falling</td>
<td>1) 12 rising &amp; 12 falling</td>
</tr>
<tr>
<td>Real Time Clock / Retention Time</td>
<td></td>
<td>20 days typ. / 12 days min. at 40°C</td>
<td>Maintenance free Super Capacitor</td>
</tr>
</tbody>
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1) 4 additional using digital signal board
## SIMATIC S7-1200 CPUs
### CPU1215C – CPU1217C (1 of 2)

### CPU Features

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<td>4 MB</td>
<td>4 MB</td>
</tr>
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<td>Up to 6 total 4 @ 1MHz max</td>
</tr>
<tr>
<td>Pulse Outputs</td>
<td>Up to 4 total 4 @ 100 kHz max (DC Outs)</td>
<td>Up to 4 total 4 x PTO / PWM, @ 1 MHz max (DC Outs)</td>
</tr>
<tr>
<td>Line Driver Inputs/Outputs</td>
<td>N/A</td>
<td>2) 4 x 1.5V differential inputs</td>
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<tr>
<td></td>
<td>Maintenance free Super Capacitor</td>
<td>2) 1.5 differential signals allow connection to up to 4x stepper motors simultaneously @ 1MHz. The CPU1217 is the only S7-1200 CPU that has this built in feature</td>
</tr>
</tbody>
</table>
New S7-1217C FW V4.0 dedicated Motion CPU …

CPU 1217C DC/DC/DC (only this version!)
- 2 PN Port
- 85 ns Bit performance
- 125kB
- 14DI / 10DO / 2AI / 2 AO – Maximum 10 x DI 24VDC / 6 x DO 24VDC

PTO / PWM; High Speed Counters; Line Driver I/O
- 6 HSC – 4 @ 1 MHz Maximum
- 4 PTO / PWM – 4 @ 1 MHz Maximum
- 4 Line Driver Inputs – 1.5V Differential signal
- 4 Line Driver Outputs – 1.5V Differential signal

Higher accuracy with Differential I/O

* Additional usage of Signal Boards still possible
Expandability

- Communication Modules to the left
- Expansion Modules to the right
Comprehensive networking for SIMATIC S7-1200

- **Profinet Master** – Distributed Profinet architectures are possible for I/O, HMI, Drives & other Profinet field devices. NO communication module is required!

- **Profibus Master & Slave** – Distributed Profibus architectures are possible for I/O, Drives & other Profibus devices, and integration into existing plant networks is easy.

- **AS-i Master** – The new AS-i Master is configured completely in the TIA Portal, and creating a new AS-i network is so simple it only takes a few clicks. AS-i networks do not require any separate software!

- **CANopen Master** * – Enables you to connect to CANopen devices, as well as you to connect to devices running Transparent CAN 2.0A

* Please contact HMS for more information on this device.
Comprehensive networking for SIMATIC S7-1200

- Modbus TCP – Enables you to communicate as a Modbus master or slave with devices, and only a TCP Function Block is required!

- IO-Link Master – Fast and easy integration IO link devices such as; SIRIUS Starter products and RFID readers.

- TCP/IP – Using the open communication instructions you can communicate with other CPUs, with other PCs and with devices using standard TCP/IP communication protocols. NO communication module required!
Comprehensive networking for SIMATIC S7-1200

- RS-485, RS-422 & RS-232 – The S7-1200 CPU supports Point-to-Point communication (PtP) for character-based serial protocols, and this gives maximum freedom and flexibility for using the PtP communication instructions in the user program.

- Modbus RTU – With the Modbus instructions you can communicate as a Modbus master or slave with devices which support the Modbus RTU protocol.

- USS – With simple USS instructions you can control the operation of drives which support the universal serial interface (USS) protocol.
Motion Control

PID Control

Trace

Integrated system diagnosis

Design and Handling

Performance

Technology Integrated

Integrated system diagnosis

Security Integrated

Engineering with TIA Portal
SIMATIC S7-1200 FW V4 engineered with TIA Portal
Highlight – Technology Integrated

Motion control functions

- Flexible connection of drives by PROFINET, PROFIBUS or analog interfaces
- The new S7-1217C has 1.5V Differential Outputs for open-loop speed and position control
- Easy programming of the movements with PLCopen motion blocks
- Unified configuration / parameterization for controller / HMI / drives
- Intuitive diagnostic and commissioning tools (Control Panel, Trace)
- Easy fault detection by automatic alarm signals to the engineering system
- PTO/PWM for open-loop speed and position control of stepper motors and servo drives

Easy scalability by integrating the same motion control functions in all controllers

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Trace

- Recording of up to **16 different tags** in separate CPU memory area (outside of work, load or retentive memory)
- Support of **2 independent traces** at the same time
- Cyclic acquisition (real-time), not to lose any values
- Multiplex trigger conditions to filter for desired events
- The recording occurs independently of Engineering System on the CPU, to simplify the search of sporadic problems
- Exportable measurements for documentation and further processing of data by user (csv and ttrec file)

Program- and application diagnostics at real-time for recognizing even sporadic problems
Integrated PID control

- For a wide range of closed loop control applications
- Used as a controller with continuous or discrete output or as a step controller for valves
- Easy commissioning by means of automatic parameterization
- Integrated protection of human and machine

PID Compact / PID 3-Step

- Continuous PID controller with analog or discrete (PWM) output special designed for step by step control of valves
- Auto-Tuning
- PID controllers are the same for both S7-1200 and S7-1500

Cost savings through integrated PID control with high quality auto-tuning
Manipulation

Copy protection

Access protection

Know-How protection

Security Integrated
Higher Know-How Protection

- Password protection against unauthorized opening of the program blocks with STEP 7 and so protecting against unauthorized copying of e.g. developed algorithms
- Password protection against unauthorized evaluation of the program blocks with external programs
  - from the STEP 7 project
  - from the data of the memory card
  - from program libraries

Protection of intellectual property and effective investment
Higher Copy Protection

- Binding of blocks to the serial number of the memory card or serial number of the CPU
- Protection against unauthorized copying of program blocks with STEP 7
- Protection against unauthorized duplicating the project saved on the memory card

Protection against unauthorized reproduction of executable programs
Higher Access Protection (Authentication)

- New degree of Protection Level 4 for Controller, complete lockdown (also HMI connections need password) *
- Configurable levels of authorization (1-3 with own password)
- For accessing over Controller and Communication Module interfaces

Extensive protection against unauthorized project changes

* Only possible in connection with SIMATIC HMI Panels
Higher Protection of Manipulation

- Improved Protection against manipulated communication of controller access through digital checksums
- Protection against network attacks such as intrude of faked / recorded network communication (Replay attacks)
- Secure password transfer at authentication
- Detection of manipulated firmware updates through digital signatures
SIMATIC HMI Basic Panels 2nd Generation
The right product for simple applications

Basic Panels (2nd Generation)
The perfect panel for simple applications.

Comfort Panels
The perfect panel for advanced applications.

Mobile Panels
The perfect panel for "anywhere" applications.

Key Panels
The perfect panel alternative for hard-wired push button stations.
SIMATIC HMI Basic Panels 2nd Generation
Highlights

- High resolution wide-screen display with many more colors
- Fits same cutout as comparable size Comfort Panel
- Perfect for simple applications with SIMATIC S7-1200
- Innovative graphical user interface with modern object styles
- USB Interface for input devices, archiving and project transfer*

* Project transfer not available at initial release
HMI Integrated

STEP 7 Basic contains the powerful HMI software WinCC Basic for configuring the SIMATIC Basic Panels

- More templates
- For controller + HMI just one:
  - Save
  - Compile
  - Download
- Recipes
- Large graphics library
- Layer technology
- Extensive functions for alarms
- Properties in a flat hierarchy
- Intelligent functions

Integrated HMI, extremely easy to use, but also powerful and flexible
**Visualization Integration**

**Integration of HMI and PLC**

- Perfectly integrated, not just in the network view, but also in the exchange of tags and symbols.
- Tags can be imported from different editors (e.g. symbol tables, program block) into the HMI screen directly. If a connection has not yet been configured, it will be automatically created in the background.

High quality thanks to automatic consistency and easy configuring.
Wizard for new HMI projects

- The following settings are possible:
  - Associated PLCs
  - Basic screen layout, inclusion of a corporate logo
  - Alarms
  - Number and hierarchy of screens
  - The system screens that should be automatically generated
  - Arrangement of buttons

Each project can, of course, also be created manually, or assembled from components in the library.

With the support of the system, finish the project quickly and easily
Easy definition of the screen navigation

- Drag screens directly to a function key
- Drag screens directly to another screen (the button and action are created automatically)
One Programming Software – One User Program for Logic, HMI, Networking - Reduced engineering time/cost, easier to maintain, easier to reuse.

- Assignment of hardware to symbols by means of Drag & Drop
- Automatic connection of tags between the PLC (from devices view, from tag table, from user program, etc.) and the HMI screen by means of Drag & Drop
- Re-use of content which is only specified once (Libraries)
Project Wide Functionality

libraries

- Creating project components and re-using any components in a library
- Users can create elements such as blocks, tags, alarms, HMI screens, individual modules or complete stations in local or global libraries
- These elements can be re-used within the project as well as in other projects

- Re-use of content which is only specified once
- Easy exchange of data between separately developed project components via the global library
Automatic generation of the cross-reference list

- All the instances of use of a tag are displayed – regardless of whether they are in the PLC or HMI or both.
- A mouse-click on the use case opens the editor and the tag is marked automatically.

Recognize relationships and errors easily, also in large projects.
Introduction to the TIA Portal
S7-1200 and Basic Panels

Ken Sechnick
DF FA ES N
E-Mail: kenneth.sechnick@siemens.com
One engineering framework for all automation tasks
Including visualization, automation and drives

TIA Portal
Totally Integrated Automation –
Discover efficiencies with the TIA Portal

Totally Integrated Automation Portal

- STEP 7 V13
- Safety V13
- WinCC V13
- Startdrive V13

SIMATIC PC & PLC
Safety
SIMATIC HMI
SINAMICS

Single engineering framework for factory automation
TIA Portal editor layout

- **Project Tree – PLC project data**
- **Project Tree – HMI project data**
- **Task Cards – Screen objects and tools**
- **Editor view – Screen development editor**
Demo Equipment –
S7-1200 Hands-On Workshop
Module 1 – Intuitive Development
Lab Exercises
Module 1 – Intuitive Development

**Goal:**
Demonstrate the reduction in engineering time needed to configure an automation system with PLCs and HMIs.

Module 1 - main take away items:

- A clear understanding of how the TIA Portal can integrate PLC and HMI in ONE software environment

- Understand how the **Library feature** can help them **reuse program parts** that have already been developed

- Experience how a project with PLC and HMI can be configured and working in a short time
Configuring Hardware

Task 1: PLC Hardware Configuration

Overview
1. Create a new project and add an Unspecified CPU S7-1200
2. Auto-detect the S7-1200 in Demo kit
3. Configure CPU and write a simple latching circuit
Configuring and Testing a Program

**Task 2:** Use the Library to add preconfigured PLC tags and then add some test logic

**Overview:**
1. **Add preconfigured PLC tag and watch tables from the Library**
2. Use watch tables to monitor and modify I/O values on the demo unit
3. Add test logic for potentiometers on demo kits
2 kinds of libraries

1. Project library
   - Unique for each project
   - Attached to the project (opened, saved and closed with project)

2. Global library
   - Independent from projects
   - For cross-project use of objects
   - Can be saved on local PC or on a company server

Elements

- Master copies: work as a clipboard
- Type: instance principle
Elements that can be stored in a Library

- Program blocks
- Devices (PLC, HMI, etc.)
- Watch tables
- Data types
- Templates
- Variables
- HMI screens
- Scripts
- Alarms
- And others

Project library

Additional folders for organization

Global libraries

Elements in a library are divided in types & master copies

Parts of the selected element are shown
An existing object can be copied to a library simply by Drag & Drop.

The object can then be reused in other parts of the project or other projects.

Master copies can also be copied from one library to another.
Adding Preconfigured PLC tags from Global Library:

1. Open Global library by clicking on the Open global library button in the Global libraries area of the Libraries tab. Select the library “S7-1200 Intro” located in the Student folder on the Windows desktop.

2. Drag and drop the S7-1200 Demo IO Tag Table object from the Master copies folder of the library to the PLC tags folder of the project tree. A new tag table will be added.

Customer Benefit -> How can a Library object be reused?

Library objects that were previously saved to the Project library or Global library can be copied back into the existing project via drag and drop.

For this lab exercise, we will copy library objects that contain a PLC tag table and a PLC Watch table.
Task 3: Add HMI Panel

Overview:
1. Add a Basic Panel HMI to the project
2. Use the **HMI Device Wizard** to connect it to the S7-1200 PLC and PROFINET Network, and to create default screens and screen navigation
3. Complete the S7-1200 demo IO Test Screen
Add additional PLC and HMI objects

**Task 4: Visualize the Raw and Scaled Potentiometer values**

**Overview:**
1. Add tags and code to PLC to display Potentiometer values
2. Add HMI objects to display Potentiometer values
3. Test CPU and HMI changes
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