GENERAL

siemens s 7 1200 plc programming examples

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Introduction

Siemens' S7-1200 PLC family has become a staple in modern automation, thanks to its compact design, versatile I/O options, and the intuitive TIA Portal environment. Whether you're a seasoned automation engineer or a newcomer eager to dive into PLC programming, having a solid grasp of practical examples is essential. In this comprehensive guide, we'll walk through a variety of Siemens S7-1200 PLC programming examples—from simple LED toggles to complex PID control loops—while highlighting best practices, troubleshooting tips, and resources to accelerate your learning curve.

Understanding the Siemens S7-1200 PLC

Hardware Overview

The S7-1200 series is built around the **CPU 1214C** as a flagship model, offering up to 128 /kB of internal memory, 32 /kB of data memory, and a 32 bit CPU core. The modular architecture allows you to attach digital, analog, and communication modules—such as **CP 1211-1** for digital inputs or **CP 1212-3**for analog inputs—making it adaptable to a wide range of applications.

Software Stack: TIA Portal

All programming for the S7-1200 is performed within the **Totally Integrated Automation Portal (TIA Portal)**. This unified platform integrates project management, PLC programming, HMI design, and network configuration, reducing the need for multiple software packages. TIA Portal supports the IEC 61131 3 languages, ensuring that your code is portable and standards compliant.

Programming Languages Supported

Ladder Diagram (LD)

Ladder Diagram remains the most widely used language in PLC programming. Its graphical representation mirrors electrical schematics, making it intuitive for technicians and engineers alike.

Functional Block Diagram (FBD)

FBD provides a block based approach that excels in representing complex logic, especially when integrating mathematical functions and custom blocks.

Structured Text (ST)

Structured Text offers a high level, C like syntax that's ideal for algorithmic tasks, data manipulation, and advanced calculations.

Instruction List (IL) and Sequential Function Charts (SFC)

While IL has largely been deprecated, it remains available for legacy projects. SFC is useful for modeling sequential processes and state machines.

Getting Started with TIA Portal

Installation and Setup

1. Download the latest TIA Portal installer from Siemens' official website.
2. Run the installer and follow the wizard, selecting the "PLC" and "HMI" modules.
3. Activate the product using your Siemens ID.

Creating a New Project

1. Open TIA Portal and click New Project.
2. Name your project (e.g., MyS7-1200Examples) and choose a location.
3. Click Create to initialize the project workspace.

Configuring the PLC

Drag the **CPU 1214C**from the device catalog into the project tree. Double click to open the configuration window, where you can assign IP addresses, configure I/O modules, and set communication parameters.

Basic Programming Examples

LED Control with Ladder Diagram

This classic example demonstrates how to toggle an LED using a simple push button. The code uses a **rising edge detection block (R_TRIG)** to toggle the output state.

```
VAR
  Button : BOOL;   // Input from push  button
  LED    : BOOL;   // Output to LED
  Toggle : BOOL;   // Internal toggle
END_VAR

// R_TRIG block
IF R_TRIG(Button) THEN
  Toggle := NOT Toggle;
END_IF;

// LED assignment
LED := Toggle;
```

Motor Start/Stop with FBD

In this example, we create a motor control routine that includes a start button, a stop button, and a run indicator. The FBD uses **AND**, **OR**, and **NOT** blocks to manage the logic.

- StartBtn – Push button input
- StopBtn – Push button input
- MotorRunning – Output to motor drive
- RunIndicator – LED indicating motor status

The logic: *MotorRunning = (StartBtn AND NOT StopBtn) OR MotorRunning*. This ensures the motor stays on until the stop button is pressed.

Temperature Monitoring with Structured Text

Suppose you have an analog temperature sensor connected to **AIN1**. The following ST snippet reads the sensor, converts the raw value to Celsius, and triggers a heater if the temperature drops below 20 /°C.

```
VAR
  TempRaw   : INT;   // Raw ADC value
  TempC     : REAL;  // Temperature in Celsius
  HeaterOn  : BOOL;  // Heater control
END_VAR

TempRaw := AIN1;  // Read analog input
TempC   := (TempRaw * 0.48828125) - 50.0;  // Convert to Celsius

IF TempC
```

Advanced Programming Examples

PID Control Implementation

PID controllers are fundamental in process automation. Siemens provides a **PID**block that can be instantiated directly in TIA Portal. Below is a typical configuration:

- Setpoint – Desired temperature
- ProcessVar – Measured temperature
- Output – Heater duty cycle

In ST, you might call the PID block as follows:

```
PID1(
  Setpoint := Setpoint,
  ProcessVar := TempC,
  Output := HeaterDuty,
  Kp := 2.0,
  Ki := 0.5,
  Kd := 0.1,
  SampleTime := 1000  // in milliseconds
);
```

Remember to calibrate the PID parameters for your specific application.

Multi Phase Motor Control

Controlling a three phase motor often requires precise timing of the phase currents. The following example demonstrates how to generate a three phase sinusoidal waveform using **FBD** and **ST** together.

```
VAR
  PhaseAngle : REAL;  // Angle in degrees
  PhaseA, PhaseB, PhaseC : REAL; // Phase voltages
END_VAR

PhaseAngle := (Time * 360) / MotorSpeed;  // Time  based angle calculation
```

```
PhaseA := SIN(PhaseAngle * DEG_TO_RAD);
PhaseB := SIN((PhaseAngle + 120.0) * DEG_TO_RAD);
PhaseC := SIN((PhaseAngle + 240.0) * DEG_TO_RAD);
```

Data Logging and Historian Integration

For trend analysis, you can log data to a local **SQL Server** database or a Siemens **SIMATIC Historian**. The following ST snippet writes the temperature to a table called *TempLog* every 5 /seconds.

```
IF (Time MOD 5000) = 0 THEN
  SQLInsert("TempLog", "Timestamp, TempC", CONCAT(Time, ", ", TempC));
END_IF;
```

Safety Integrated Control (SPS)

When safety is paramount, you might integrate a **SPS (Safety PLC)** with the S7-1200. The SPS handles critical safety functions (e.g., emergency stop), while the S7-1200 manages non safety logic. The two systems communicate via **PROFIBUS DP** or **PROFINET** with safety specific tags.

Debugging and Simulation Techniques

Online Diagnostics

Use the **Online & Diagnostics** mode to monitor real time values, view variable states, and check tag communication. The **Watch Window** is invaluable for spotting unexpected values.

Simulation Tools in TIA Portal

Before deploying to hardware, simulate your logic using the built in **Simulation** feature. Create virtual input and output devices, run the program, and verify that the outputs match your expectations.

Using the PLC Debugger

The debugger allows you to step through the program cycle by cycle. Place **breakpoints** on critical lines, inspect variable values, and use the **Step Into** and **Step Over** functions to trace execution flow.

Best Practices for Siemens S7-1200 Programming

Modular Design

Encapsulate reusable logic into **function blocks (FBs)** or **program blocks (OBs)**. This reduces code duplication and simplifies

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