SIMATIC S7-1500 Block for Connecting Modbus TCP Devices to Energy Suite V15

STEP 7 Professional V15, Energy Suite V15, SENTRON PAC Measuring Devices, Modbus TCP

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1 Overview

1.1 Introduction

SIMATIC Energy Suite provides the option to read energy data relevant to accounting, such as power and voltage values. However, the program blocks for advanced energy data added by TIA Portal V14 can only be generated using devices that are supported by the Energy Support Library (EnSL).

The block library described in this application example contains a block that allows you to integrate Modbus TCP devices into Energy Suite that are not supported by default by the EnSL.

A preconfigured data block allows you to integrate SENTRON 7KM measuring devices into your energy data program without additional configuration overhead.

Figure 1-1

1.2 Validity

NOTE Install the latest firmware on your Modbus TCP device.
Modbus RTU devices are not supported by this block.

This block library has been tested for the following products:

Software
- TIA Portal ab V15
- Energy Suite ab V15

Hardware
- SIMATIC S7-1500, from firmware version V2.5
- SENTRON PAC 5200
- SENTRON PAC 4200
- SENTRON PAC 3200
1.3 Mode of operation

The "Modbus_TCP_energyAdv" block reads the energy data of a Modbus TCP device (e.g., SENTRON PAC 3200) via the Modbus interface.

With Modbus-TCP devices, the measured data is written into data registers. The block accesses this data register and stores the energy data into the Energy-Suite data structure.

As the register map of the measured values is different for each measuring instrument type, you have to set a fixed register mapping of the measured values for each type. This register map allows the block to read the energy data via the Modbus TCP interface.

The energy data of the Modbus TCP device is then stored in the Energy Suite data structure to make it available in Energy Suite.

The "Modbus_TCP_energyAdv" block is written in SCL.

1.4 Content of the library

The library consists of the FB "Modbus_TCP_energyAdv" as well as the corresponding data types and the preconfigured data blocks. The blocks "LModbusTCP_InputStructures_*" contain the register map for the SENTRON PAC devices.

Figure 1-2
1.5 Components of the application example

This application example consists of the following components:

Table 1-1

<table>
<thead>
<tr>
<th>Component</th>
<th>File name</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentation</td>
<td>109749074_ModbusTCP_energyAdv_DOC_en.pdf</td>
<td>This document</td>
</tr>
<tr>
<td>Library</td>
<td>109749074_LModbusTCP_energyAdv_V2.zip</td>
<td>For integration into your project</td>
</tr>
</tbody>
</table>

1.6 Components used

This application example was created with the following hardware and software components:

Table 1-2

<table>
<thead>
<tr>
<th>Component</th>
<th>No.</th>
<th>Article no.</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP 7 Professional V15 (TIA Portal)</td>
<td>1</td>
<td>6AV2103-0AA05-0AA7</td>
<td>-</td>
</tr>
<tr>
<td>Energy Suite V15</td>
<td>1</td>
<td>6AV2108-0AA05-0AA5</td>
<td>-</td>
</tr>
<tr>
<td>SIMATIC S7 CPU 1513-1 PN</td>
<td>1</td>
<td>6ES7513-1AL01-0AB0</td>
<td>SIMATIC S7-1500 from Firmware version 2.5</td>
</tr>
<tr>
<td>SENTRON PAC 3200</td>
<td>1</td>
<td>7KM2111-1BA00-3AA0</td>
<td>You can also use different Modbus TCP devices.</td>
</tr>
<tr>
<td>Energy Suite Support Library</td>
<td>1</td>
<td>-</td>
<td>Download at Entry-ID: 109741558</td>
</tr>
</tbody>
</table>
2 Engineering

2.1 Interface description

The following sections explain the Modbus_TCP_energyAdv function block that performs the functionality described in this document.

Figure 2-1

![Diagram of Modbus_TCP_energyAdv function block]

Table 2-1: Parameters of Modbus_TCP_energyAdv

<table>
<thead>
<tr>
<th>Name</th>
<th>P type</th>
<th>Data type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>REQ</td>
<td>IN</td>
<td>Bool</td>
<td>Request input: 0 = block inactive; 1 = block active</td>
</tr>
<tr>
<td>COM_INT</td>
<td>IN</td>
<td>&quot;typeMBTCP_energyAdv_ComInt&quot;</td>
<td>UDT that contains the data for the communication interface</td>
</tr>
<tr>
<td>DEVICE_TYPE</td>
<td>IN</td>
<td>&quot;typeMBTCP_EnergyAdv_DeviceType&quot;</td>
<td>UDT that contains the register addresses of the measuring device</td>
</tr>
<tr>
<td>DEVICE_ADRES S</td>
<td>IN</td>
<td>&quot;typeMBTCP_EnergyAdv_DeviceAdress&quot;</td>
<td>UDT that contains the connection data of the measuring device</td>
</tr>
<tr>
<td>DONE</td>
<td>OUT</td>
<td>Bool</td>
<td>This bit is set to 1 when a data record has been successfully read</td>
</tr>
<tr>
<td>BUSY</td>
<td>OUT</td>
<td>Bool</td>
<td>0: No request being processed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1: Request being processed</td>
</tr>
<tr>
<td>ERROR</td>
<td>OUT</td>
<td>Bool</td>
<td>0: No error</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1: Error occurred</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The STATUS parameter indicates the error cause</td>
</tr>
<tr>
<td>STATUS</td>
<td>OUT</td>
<td>DWord</td>
<td>Detailed status information of the statement. For details, see Chapter 2.3</td>
</tr>
<tr>
<td>advData</td>
<td>OUT</td>
<td>&quot;EnS_typeEnergyAdv&quot;</td>
<td>Data structure of the Energy Suite's advanced energy data</td>
</tr>
</tbody>
</table>
The structure of the "Modbus_TCP_energyAdv" function block follows the TIA Portal standard. The REQ input indicates whether the block's functionality is enabled or disabled.

**Description of the data types**

**typeMBTCP_energyAdv_ComInt**
The "ComInt" data type contains the data for the communication interface. The following table lists all variables included in this data type.

<table>
<thead>
<tr>
<th>Name</th>
<th>Data type</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware_ID</td>
<td>HW_IO</td>
<td>Hardware identifier of the local interface (PLC)</td>
</tr>
<tr>
<td>Local_Port</td>
<td>UInt</td>
<td>Port number of the local connection parameter</td>
</tr>
</tbody>
</table>

**typeMBTCP_energyAdv_DeviceAdress**
The "DeviceAdress" data type contains information about the connection settings for Modbus TCP communication. The following table lists all variables included in this data type.

<table>
<thead>
<tr>
<th>Name</th>
<th>Data type</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP_Adress</td>
<td>IP_V4</td>
<td>IP address of the measuring device</td>
</tr>
<tr>
<td>Port</td>
<td>UInt</td>
<td>TCP port number of the measuring device</td>
</tr>
<tr>
<td>Unit_ID</td>
<td>Byte</td>
<td>Modbus slave address. Note: Use only when the Modbus device is a gateway to an RTU measuring device.</td>
</tr>
<tr>
<td>Connection_ID</td>
<td>CONN_OUC</td>
<td>Unique connection number</td>
</tr>
</tbody>
</table>

**typeMBTCP_energyAdv_DeviceType**
The "DeviceType" data type contains the information for the measuring device's register map. It consists of an array of another UDT ("typeMBTCP_EnergyAdv_DeviceType_Value"), where each array element contains the configuration data for one measured value.

The following table lists all parameters included in the "DeviceType_Value" data type.

**Table 2-4: Parameters of an "advData[0]" array element**

<table>
<thead>
<tr>
<th>Name</th>
<th>Data type</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>Int</td>
<td>3 (unchanged)</td>
</tr>
<tr>
<td>Name</td>
<td>String</td>
<td>'voltage3N' (unchanged)</td>
</tr>
<tr>
<td>Type</td>
<td>String</td>
<td>'DInt', 'Real' or 'LReal'</td>
</tr>
<tr>
<td>Adress</td>
<td>DInt</td>
<td>22</td>
</tr>
</tbody>
</table>
2.2 Integration into the user project

Requirement

Before you start with the instruction, check the following:

- Communication via Modbus-TCP is activated on the measuring device.
- Modbus-TCP device and controller are in the same network.

**NOTE**

If you want to integrate other Modbus TCP devices into Energy Suite that are not part of the SENTRON PAC family, then create a data block with the Modbus register map of the device. Chapter 2.4 describes how to do this.

The following instructions describe how to integrate a SENTRON PAC 3200 into your Energy Suite program. Other devices can be connected in the same way, only the Modbus register mapping of the measured values differs depending on the device type.

Instructions

1. Open your TIA Portal project.

2. Unzip the "109749074_LModbusTCP_energyAdv_V2.zip" file and open the library in TIA Portal.

   **Figure 2-2 Open library view**

3. Drag the "Modbus_TCP_energyAdv" function block to your PLC program. You will find the function block in "Types" of the supplied library.

4. Open the library's "Master copies" and drag the "LModbusTCP_InputStructures_PAC_22_32_32T_42" data block to your PLC program.

   This data block contains the register map and is pre-configured for the following devices:
   - SENTRON PAC2200, PAC3200 (T) and PAC4200

   **You need this data block once per device.**
Note
For the SENTRON PAC 5100 and 5200 devices, use the "DeviceType_PAC_51_52" master copy. For other Modbus TCP devices, manually customize the register map. Chapter 2.4 shows you how to create a custom register map.

5. Compile the user program.
6. Open the "LModbusTCP_InputStructures_PAC_22_32_32T_42" data block in your project.

Figure 2-3

7. Open the structures "MB_Adv_ComInt" and "MB_Adv_DeviceAdress".
8. Configure the data block at the marked positions.

Figure 2-4 Configuring the data block

1. Enter the hardware ID of your controller.

Figure 2-5 Hardware identifier
2 Engineering

1. In the "ADDR[]" array, enter the IP address of your Modbus TCP device. Enter the IP address byte by byte in the individual array elements.

2. In "Connection_ID", specify a unique connection number. If you call the block multiple times, make sure to choose different numbers.

9. Call the "Modbus_TCP_energyAdv" function block in your plc program.
10. Assign a name to the instance DB, for example "EnO_DEV1_PAC3200_Adv".
11. Interconnect the block with the variables of the data block you have previously created.

Figure 2-6 Inputs of the block

Figure 2-7 Calling and interconnecting the Modbus block

Note

For each Modbus TCP device you want to integrate, you must call the block once. To do this, repeat steps 4 through 11.

If you make changes to the configuration data blocks, make sure to download the user program in its entirety.

12. Download the user program into your controller.
Creating an energy object

1. Open the energy object table and create a new energy object “EnO_Dev1_PAC3200” in the controller.
2. In “Energy data source”, specify the data block of the called function block. Select the advData subfolder and the “totalActPower” tag for a power value or “totalActEnergy” for an energy value.

Figure 2-8 Energy data source for the energy object

Figure 2-9 Create new energy object

3. Select the appropriate energy data type and an archiving period.

Figure 2-10 Energy objects
4. Generate the energy data program with the advanced energy data.

5. **Figure 2-11 Generating energy data**

![Image of generating energy data]

6. Download the user program to your controller.

**NOTE**
You need a valid license for the Energy Suite. Select the license depending on the energy objects used and activate the license as a runtime license in the properties of the controller.

**Result**
You can now access the energy data of the Modbus TCP device via the Energy Suite. The handling of energy data is unified.

**Note**
For information about using SIMATIC Energy Suite, refer to the following application example or the Energy Suite manual.

Application example: "SIMATIC Energy Suite – Getting Started"

Manual: "SIMATIC Energy Suite V14 SP1"
2.2.1 Checking the online values

Now you can check whether you have successfully integrated the measuring device:

1. In TIA Portal, open the data block you specified when calling the Modbus block; in this application example: "EnO_Dev1_PAC3200_Adv".

2. Connect online to the controller.

3. Monitor the "EnO_Dev1_PAC3200_Adv" block.

4. "Output > advData" displays the energy data of the measuring device (2).

**NOTE**
If no data is displayed, check that the measuring device is switched on and connected to the controller. The "STATUS" output value helps to diagnose the error.

Also check the firmware version of the devices.
2.3 Error handling

The block provides error and status information via the "STATUS" output parameter.

The "STATUS" output parameter is written as a double word: 16#7000 xxxx.

The first word of the "Status" parameter describes the error of the "Modbus_TCP_energyAdv" block. The second word (marked with "xxxx" above) represents the status of the MB_CLIENT instance.

The following error codes are programmed for the block:

<table>
<thead>
<tr>
<th>Error code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>16#7000 xxxx</td>
<td>No job active</td>
</tr>
<tr>
<td>16#7001 xxxx</td>
<td>Job active</td>
</tr>
<tr>
<td>16#8000 xxxx</td>
<td>Error in the lower-level MB_CLIENT instance</td>
</tr>
<tr>
<td>16#8401 xxxx</td>
<td>Invalid HW ID (range of values: 0 to 65535)</td>
</tr>
<tr>
<td>16#8402 xxxx</td>
<td>Invalid local port (port numbers: 1 to 49151)</td>
</tr>
<tr>
<td>16#8403 xxxx</td>
<td>Illegal IP (range of values: 0 to 255)</td>
</tr>
<tr>
<td>16#8404 xxxx</td>
<td>Illegal port (range of values: 1 to 49151)</td>
</tr>
<tr>
<td>16#8405 xxxx</td>
<td>Illegal unit ID (range of values: 1 to 49151)</td>
</tr>
<tr>
<td>16#8406 xxxx</td>
<td>Illegal connection ID (range of values: 1 to 49151)</td>
</tr>
<tr>
<td>16#8410 xxxx</td>
<td>Illegal index variable in DEVICE_TYPE (do not change default assignment)</td>
</tr>
<tr>
<td>16#8411 xxxx</td>
<td>Illegal name variable in DEVICE_TYPE (do not change default assignment)</td>
</tr>
<tr>
<td>16#8412 xxxx</td>
<td>Illegal type variable in DEVICE_TYPE (allowed: 'DINT', 'REAL', 'LREAL')</td>
</tr>
</tbody>
</table>

Note

For the error codes of the MB_CLIENT instance, refer to the "WinCC Advanced V14 SP1" manual or the TIA Portal Online Help.

The following link takes you directly to the right place in the manual:

MB_CLIENT STATUS Parameter Description
2.4 Custom register map

If you want to integrate other Modbus TCP devices into Energy Suite that are not part of the SENTRON PAC family, proceed as follows:

Preparations

In the device manufacturer's manual, look for the Modbus register map for the energy data.

Customizing the addresses

1. Drag the "DeviceType_Modbus_general" data block to your PLC program. Expand the "*_DeviceType" data structure.
   Each of the 29 arrays represents one measured value (e.g., voltage1N).

2. For the total of 29 measured values, change the register address of the measured value "Adress" and the data type "Type".
   For the register map of your Modbus TCP device, refer to the device manual.

To integrate the Modbus TCP device into the Energy Suite program, continue with Step 5 in Chapter 2.2.
2.5 Visualizing the energy data

The "EnS Visu V14 SP1" TIA Portal library from Online Support allows you to easily visualize the energy data of the Modbus TCP device on your operator panel.

Figure 2-17 EnS_Visu: faceplate

Figure 2-18 EnS_Visu: advanced energy data

2.5.1 Preparations

Check the name of the instance DB of the Modbus block and the energy object. If you are using the "EnS Visu" library for visualization, change the names as follows:

Energy object: EnO_Name
Instance DB: EnO_Name + "_Adv"

In the application example:
Energy object: "EnO_Dev1_PAC3200"
Instance DB: "EnO_Dev1_PAC3200_Adv"

Figure 2-19 Name of energy object and instance DB

Note: Make sure that SIMATIC Energy Suite V14 SP1 Update 2 or higher is installed on your system.
2.5.2 Short instructions

Note
For detailed instructions for using the "EnS_Visu" library, refer to the following application example:
"SIMATIC Energy Suite – Visualization Examples"

1. Download the "EnS_Visu" library from the following entry page:

2. Open the master copies of the library.

3. Depending on the operator panel you are using, copy all objects from the "VisuComfort/RTAdvanced" or "VisuRuntimeProf" folder to your project.

WinCC Runtime Advanced/Comfort

4. Open "Properties > Interface" of the faceplate object and interconnect the faceplate with the following elements:
- energyAdv -> with "advData" of the instance DB of the Modbus block ("EnO_Dev1_PAC3200_Adv")
- energyBasic -> with "energyBasic" of the energy object
- energyMeta -> with "energyMeta" of the energy object

Figure 2-21 Interconnecting the faceplate
2 Engineering

5. Customize the object references of the two pop-up screens.
   - Use the <CTRL> + <A> key combination to select all objects of the "energyBasic_PopUp" pop-up screen.
   - Right-click an object and select "Change object references" from the context menu.
   - In the "Find in reference" field, enter "EnO_Name".
   - Replace all search results with the energy object name; e.g., in this example: "EnO_Dev1_PAC3200".
   - Click the "Replace All" button.
   Perform the same steps for the second pop-up screen.
6. Rebuild the operator panel ("rebuild all").
7. Load the operator panel/Runtime.

Note
If you want to visualize more than one energy object, you have to insert the faceplate and the pop-up screens multiple times. Before you insert the pop-up screens once again, change the names of the existing pop-up screens in the project.

The detailed procedure is described in the application example "SIMATIC Energy Suite - Visualization Examples" (https://support.industry.siemens.com/cs/ww/en/view/109739775).

WinCC Runtime Professional

4. Open "Properties > Interface" of the faceplate object and interconnect the faceplate with the following elements:
   - energyAdv -> with "advData" of the instance DB of the Modbus block ("EnO_Dev1_PAC3200_Adv")
   - energyBasic -> with "energyBasic" of the energy object
   - energyMeta -> with "energyMeta" of the energy object
   - EnO_name -> with the "name" tag from "energyMeta" of the energy object

5. Rebuild Runtime ("rebuild all").

Note
If you want to visualize more than one energy object, drag another faceplate to your screen and interconnect it. You do not need a second screen window and you do not have to drag any other screens to your project.
3 Appendix

3.1 Service and Support

Industry Online Support
Do you have any questions or need assistance?
Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.
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https://support.industry.siemens.com/cs/ww/en/sc/2067
3.2 Links and literature

Table 3-1

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
</tr>
</thead>
</table>
| \1\ | Siemens Industry Online Support  
https://support.industry.siemens.com |
| \2\ | Link to the entry page of the application example  
| \3\ | Application example: SIMATIC Energy Suite – Visualization Examples  
| \4\ | Application example: "SIMATIC Energy Suite – Getting Started"  

3.3 Change documentation

Table 3-2

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.0</td>
<td>09/2017</td>
<td>First version</td>
</tr>
<tr>
<td>V1.1</td>
<td>04/2018</td>
<td>Revision and update to V15</td>
</tr>
</tbody>
</table>