LOGO! – Modbus/TCP Communication using the Example of SENTRON PAC

LOGO! 8; S7-1200; S7-1500; SENTRON 7KM PAC3200

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Table of Contents

1 Introduction and Task Description

This application example offers a completely configured connection for LOGO! 8 ("LOGO!" for short) for communication with a Modbus/TCP-compatible device.

In this application example, a SENTRON 7KM PAC3200 is used.

WARNING

This example demonstrates the functional implementation with LOGO!.

Possible requirements regarding functional safety (e.g. EMERGENCY stop) are not part of this example.

The user is responsible for compliance with the relevant guidelines!

The integrated functions of LOGO! offer many additional possibilities to solve applications in various areas quickly and easily.

With LOGO!, prefabricated function blocks support project creation, e.g. weekly time switch, pulse generator, astro timer, seasonal time switch, stopwatch and simple logic gates.

The LOGO! text display (TDE) and the integrated web server of LOGO! offer additional options for operation and monitoring using function keys and message texts.

Advantages of LOGO! versus a conventional electrical installation

Using LOGO! offers you the following advantages:

- Extendibility of the software program to include further tasks.
  In addition to the basic task description, additional independent subtasks can be configured depending on the application. For this purpose, LOGO! can be expanded with a wide variety of expansion modules.
- Straightforward, star-shaped arrangement of the wiring of the components.
- Use of simple switches (circuit breakers) or pushbuttons.
- Fewer components are required compared to a conventional solution.
- Communication options via Modbus/TCP, S7 connection, and KNX.

Target group

This application example is intended for specialists in electrical installations or automation.

Task description

This article focuses on the display of Modbus/TCP communication with LOGO!.

At a power connection, the measured variables voltage, current, apparent power, active power, and network frequency can be measured.

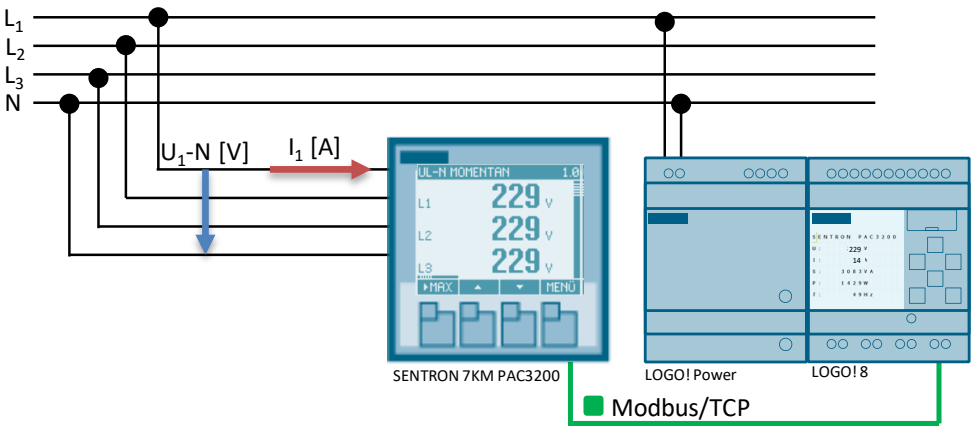
The measured variables should be transferred to the LOGO! base unit via the Modbus/TCP communication protocol, processed, and displayed, as shown in Figure 1-1.

A SENTRON 7KM PAC3200 power monitoring device is used for this purpose, or the "PAC3200", for short.

As a Modbus/TCP server, the PAC3200 makes the measured values available to the client, i.e. the LOGO! base unit.

To simplify matters, not all measured variables are measured from the power network shown [3P4W = 3 phases, 4 wires], i.e. a typical network with 3 phases (L1; L2; L3) and one neutral conductor (N), but only the variables between one phase (cable L1) and (N) one network [1P2W]. This information is important for commissioning the PAC3200 (Section 3.1).

Figure 1-1: Communication between the SENTRON 7KM PAC3200 and LOGO!



Notes

If you want to establish a connection via the internet, a secure VPN connection is possible.

However, the VPN connection is not part of this application example, and the reader is referred to the relevant technical literature or information available online.

If the number of SENTRON 7KM PAC3200 devices needs to be expanded, additional Ethernet ports must be provided, e.g. via a switch.

2 Components Used

The application example uses the components listed in Table 2-1.

Table 2-1: Hardware and software components for the application example

Component	Quantity	Part number	Notes
LOGO!Soft Comfort V8.2 DVD	1	6ED1058-0BA08-0YA1	For upgrade to V8.2, see manual \3\
LOGO! POWER 24 V / 1.3 A	1(1)	6EP3331-6SB00-0AY0	-
LOGO! 12/24 RCE	1	6ED1052-1MD08-0BA0	4 relay outputs
LOGO! TDE	1(2)	6ED1055-4MH08-0BA0	Optional components
SENTRON 7KM PAC3200	1(3)	7KM2112-0BA00-3AA0	See manual \5\ Multi-range power supply unit with screw-type terminals Firmware version min. V2.4.2

(1) The SITOP 24V is an example of a power supply suitable for general industrial use.

(2) LOGO! TDE is an optional component, see Section 2.1.

(3) Alternative part numbers for SENTRON 7KM PAC3200

7KM2112-0BA00-2AA0 – Multi-range power supply unit with ring-terminal connections

7KM2111-1BA00-3AA0 – Low voltage power supply unit with screw-type terminals

Notes

If you want to use the application example with a LOGO! 230RCE (for 230 V), you will find additional information under \3\ or under the entry "TDE Central Control for General Consumers":

- https://support.industry.siemens.com/cs/ww/en/view/109755864

The application example consists of this manual and a LOGO! V8.2 switching program created with LOGO!Soft Comfort ("LSC", for short).

Table 2-2: Connectors for our application example

Component	File name	Notes
Documentation	109779762 _LOGO!_ModbusTCP_DOC_en.pdf	-
LOGO! switching program and S7 project	109779762 _LOGO!_ModbusTCP_CODE.zip	Requirements: LOGO!Soft Comfort V8.2

2.1 Hardware – LOGO!

In addition to the manuals, below you will find basic information on commissioning the LOGO! hardware used here.

Figure 2-1 shows the hardware setup with LOGO!. The assignments of the digital input and output signals for LOGO! can be found in Table 2-3.

Figure 2-1: Hardware setup for the application example (TDE optional)

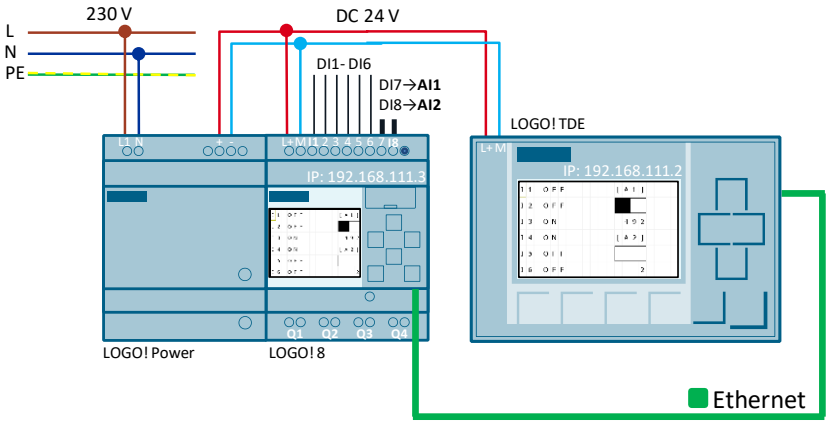


Table 2-3: Input and output signals in LOGO!

IOs	Description
Input [DI1]	Digital button (N/O contact for testing the warning light and warning message in the LOGO! display)
Output [Q1]	Digital output [1] (warning light)

Notes

For further information on mounting and wiring, please refer to the manual (\3\), Section: (LOGO! mounting and wiring).

Follow the connection instructions in the product information supplied with your device.

LOGO! TDE

The external text display LOGO! TDE for LOGO! provides you with an inexpensive and central user interface for your applications.

You can adjust parameters and use the LOGO! TDE for troubleshooting.

The configuration of LOGO! TDE and the internal LOGO! display is done using the same function block.

The use of the TDE allows the display of all messages via the integrated web server and thus also the control of applications via a smartphone.

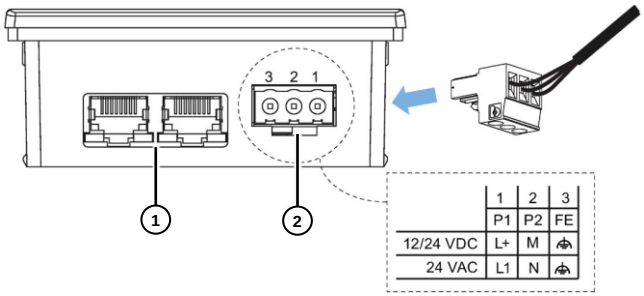
Connecting LOGO! TDE

The LOGO! TDE must be operated with a voltage of 12V DC or 24V AC/V DC and is installed separately. Siemens recommends protecting the LOGO! TDE by means of an 0.5 A fuse at the power supply.

The voltage connection is not polar. If you connect a DC power supply to the LOGO! TDE, you can connect the positive supply line or the negative supply line according to Figure 2-2 (2) either to pin 1 or to pin 2. Pin 3 must be connected to the ground.

Communication to LOGO! takes place via the Ethernet interface (1).

Figure 2-2: Connection of LOGO! TDE



Notes

The connection settings between LOGO! and LOGO! TDE can be found in the manual (\3\), Section: (LOGO! TDE settings menu).

You can find information on the LOGO! web server settings here:

- Activating the web server
- Operating the virtual base module on the web server

2.2 Hardware – SENTRON 7KM PAC3200

Figure 2-3 shows the external communication partner of LOGO! for Modbus/TCP communication in this application example:

- SENTRON 7KM PAC3200 power monitoring device.

For more detailed information, please refer to the manual [\5\], from which the most important features are summarized below.

Figure 2-3: SENTRON 7KM PAC3200 hardware overview

Properties – SENTRON 7KM PAC3200

The power monitoring device is used to display all relevant network parameters in low-voltage power distribution. It is capable of one-, two- or three-phase measurement and is used in two-, three-, or four-wire networks:

- Because of the wide measured voltage range, the PAC3200 used here with a multi-range power supply unit can be directly connected in any low-voltage network up to a nominal network voltage of 690 V.
  For the device version with an extra-low voltage power supply unit, direct connection to networks up to 500 V is possible.
  Higher voltages can be measured via voltage converters.
- Both x/1 A and x/5 A current transformers can be used for current measurement.

The integrated Ethernet interface or an optional interface module is used for communication.

- **This application uses the integrated interface for Modbus/TCP!**

The PAC3200 has a number of other useful functions:

- Monitoring, diagnostics, and service functions.
- A dual-rate active and reactive energy meter, a universal meter.
- Operating hours counter (runtime monitoring of connected consumers).
- Multifunctional digital input and digital output.
- User navigation is via the four function keys, with password protection available for access authorization.
- An adjustable backlight.

3 Commissioning

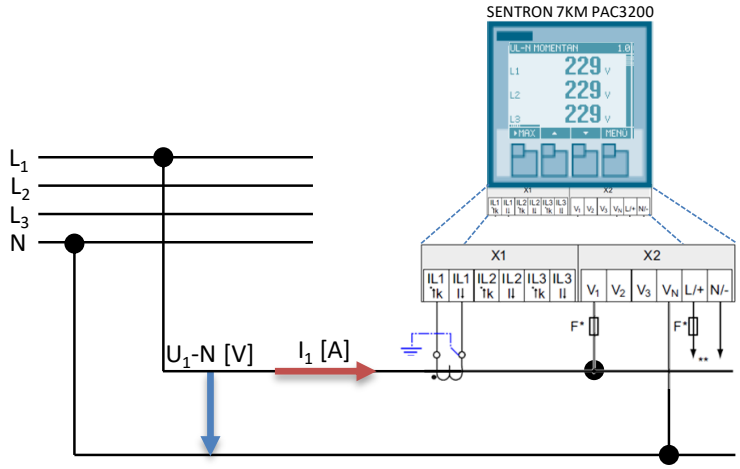
3.1 Commissioning – SENTRON 7KM PAC3200

The connection example used here for the PAC3200 is shown below. However, specific reference is made to the device manual \5\!

WARNING	**Incorrect connection can lead to malfunctions and failure of the device!** **Ensure that electrical equipment is never connected while under electrical voltage.** Before commissioning the SENTRON PAC3200, ensure that all connections have been made properly!

As per the task description, the measured variables for an L1 phase are measured against the neutral conductor N from a [3P4W] connection or the selected measured variables from a [1P2W] connection. Figure 3-1 shows the PAC3200 [1P2W] connection type with its terminal designations.
Here, an internal current transformer is used to measure current I_1 at terminal X1 and voltage U_1-N at terminal X2.

Figure 3-1: Connection type 1P2W on the SENTRON 7KM PAC3200



A supply voltage is required to operate the device. The type and size options for the supply voltage can be found in the technical data or on the identification plate and are described in the device manual \5\.

The following operating parameters must be specified in the device settings. Again, this information is found in the device manual.

- Connection type with voltage and current input
- Communication (Modbus/TCP)
- Language and password protection (optional)

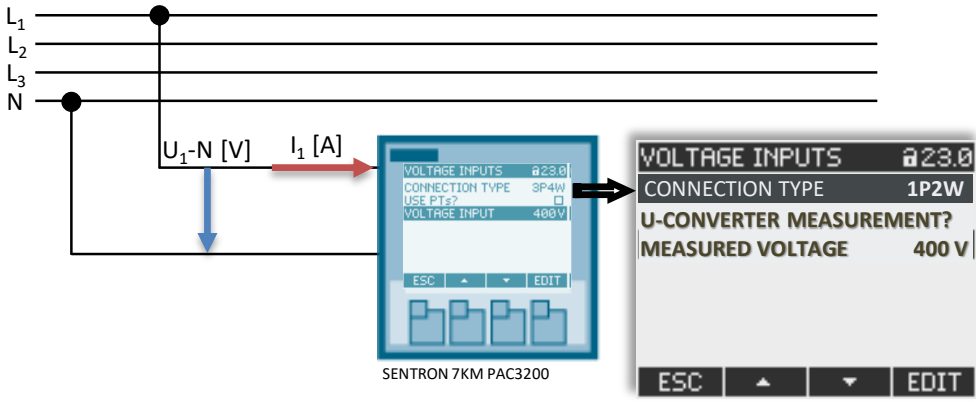
For this application example, additional device settings were configured to obtain measured values quickly and easily and to send the data via Modbus/TCP. You can change the device settings to suit your task description, but always observe all precautionary measures given in the manual and data sheets for the SENTRON 7KM PAC3200.

Setting basic parameters for the application example – Voltage input

Specify the implemented connection type to the device. Enter the short name of the connection type [1P2W] in the device settings.

1. Open the "MAIN MENU" via <F4>.
2. Go to the "SETTINGS" menu item via <F2> or <F3>.
3. Go to the "BASIC PARAMETERS" menu item.
4. Open the "VOLTAGE INPUTS" entry.
5. Select the connection type [1PW2], in accordance with Figure 3-2.

Figure 3-2: "Voltage inputs" device settings



Setting basic parameters for the application example – Current input

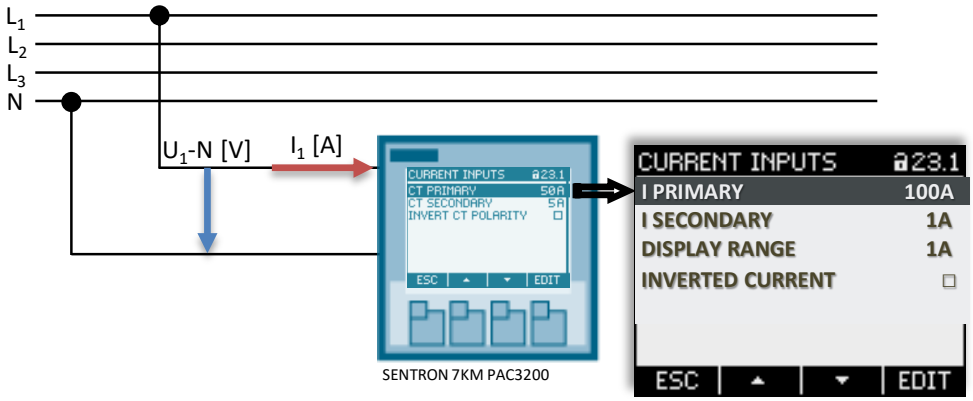
For the simulation of larger currents and outputs, the division ratio of the current transformer can be parameterized.

Enter 100A as the primary current and 1A as the secondary current.

If you connect a laptop as a consumer, for example, a current of 140 mA is measured on a 230 V network. The division ratio 100:1 thereby indicates a current of 14 A. (The active power is obtained using P = U*I*cosφ)

1. Open the "MAIN MENU" via <F4>.
2. Go to the "SETTINGS" menu item via <F2> or <F3>.
3. Go to the "BASIC PARAMETERS" menu item.
4. Open the "CURRENT INPUT" entry.
5. For the parameters, enter the values from Figure 3-3.

Figure 3-3: "Current input" device settings

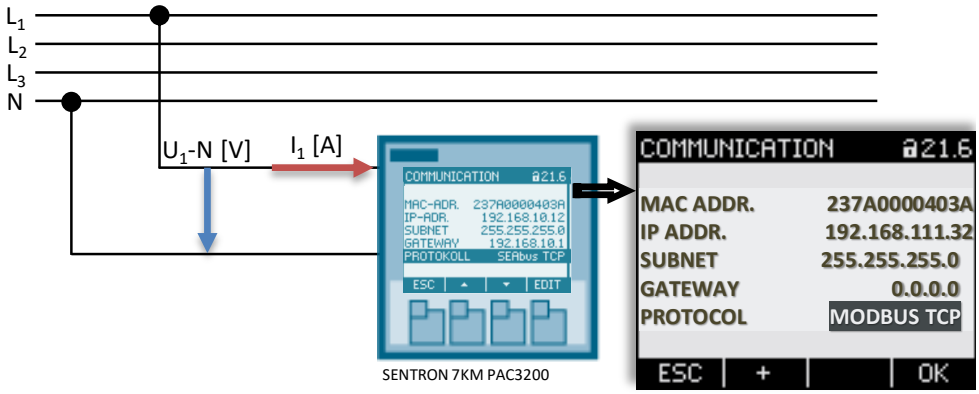


Setting the communication type to Modbus/TCP

During the initial commissioning of the PAC3200, the SEAbus/TCP communication protocol is set by default. Change the setting as explained below and set the IP address and subnet mask.

1. Open the "MAIN MENU" via <F4>.
2. Go to the "SETTINGS" menu item via <F2> or <F3>.
3. Go to the "COMMUNICATION" menu item.
4. Change the IP address and the subnet mask.
5. Go to the "PROTOCOLL" menu item.
6. Change the transmission protocol to Modbus/TCP, see Figure 3-4.

Figure 3-4: "Modbus/TCP" communication protocol



3.2 Commissioning the Application Example

1. Unzip the supplied .zip file with the LOGO! switching program.
2. Configure and connect the hardware setup in accordance with the specifications of the application example and the respective manuals.
3. Start LOGO!Soft Comfort V8.2.
4. Open the supplied LOGO! example program *.lsc.
5. Transfer the program to the LOGO! Hardware.
6. Use the information in this documentation to review the communication functions.

Notes

In the application example, the IP address 192.168.111.3 has been preset for LOGO!. You will find a description of the general procedure for assigning the IP address of a LOGO! 8 in the manual (\3\), Section: (Configuring network settings).

The default IP address of the PAC3200 is: 192.168.111.32

LOGO!, the PAC3200, and your PC must be in the same subnet: 255.255.255.0

4 Communication Setup

4.1 Modbus/TCP

Basics

The Modbus TCP/IP protocol shown in Table 4-1 is used for the secure exchange of process data and is based on the client/server principle, which allows a large number of devices to be connected.

TCP/IP packets are used to transmit the process data.

The TCP port [502] is permanently reserved for Modbus/TCP.

Table 4-1: Modbus TCP/IP protocol structure

Transaction number	Protocol identifier	Remaining bytes	Address	Function	Data
2 bytes	2 bytes (always 0x0000)	2 bytes (n+2)	1 byte	1 byte	n bytes

LOGO!

LOGO! communication via Ethernet TCP/IP permits the use of different protocols.

The Modbus communication is available as of LOGO! device version LOGO! 8 FS:04. You can recognize this by the name |X|5|6| directly to the left of the OK button on the LOGO! base unit.

For LOGO!, the large variety of devices offers a wide range of possible applications, including in connection with water and wastewater, for energy consumption measurement and optimization, connection with heating, air conditioning and ventilation, as well as for buildings and industrial applications.

As a Modbus client, LOGO! provides a register area (buffer) in which the process data of the Modbus server is received from or sent to the server.

SENTRON 7KM PAC3200

The SENTRON PAC3200 devices, as servers, provide Modbus/TCP communication.

The measured variables are output as floating point values and are linked to Modbus function codes (0x03 and 0x04), which can be found in the manual \5\, as shown in Figure 4-1.

Because of this offset, the start address [Register 2] must be entered in LOGO! for the voltage value U_{L1}-N and [Register 14] for the current value through L1.

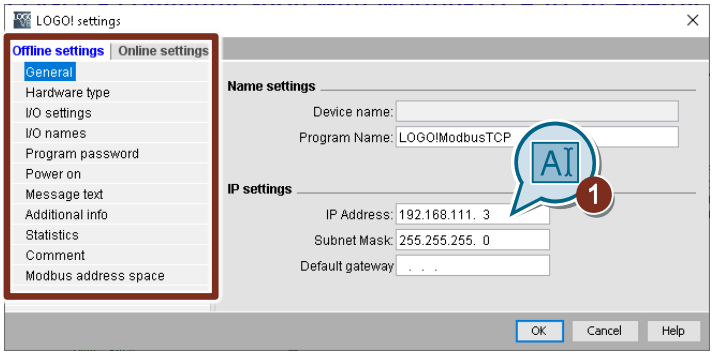
Figure 4-1: PAC3200 manual – Table (available measured variables)

Offset	Number of registers	Name	Format	Unit	Value range	Access
1	2	Voltage V_{a-n}	Float	V	-	R
3	2	Voltage V_{b-n}	Float	V	-	R
5	2	Voltage V_{c-n}	Float	V	-	R
7	2	Voltage V_{a-b}	Float	V	-	R
9	2	Voltage V_{b-c}	Float	V	-	R
11	2	Voltage V_{c-a}	Float	V	-	R
13	2	Current a	Float	A	-	R

4.2 Settings in LOGO!Soft Comfort (LSC)

1. In the LOGO!Soft Comfort V8.x menu, select "File" → "Settings". Click "General" and set the IP address and subnet mask for the LOGO! base unit, see Figure 4-2.

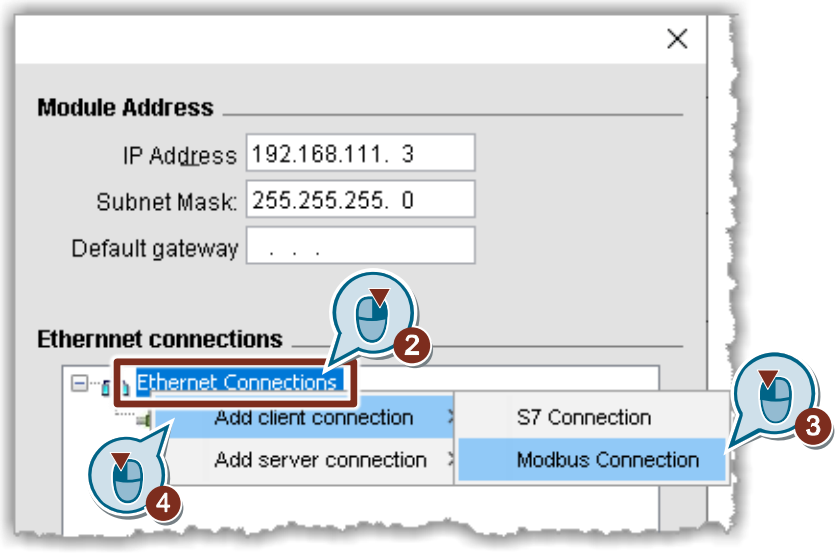
Figure 4-2: Offline settings – General



In the LSC menu, select "Tools" → "Ethernet connections" and create a new Modbus connection, with LOGO! acting as the client.

2. Right-click Ethernet connections, Figure 4-3…
3. …and select the client connection for LOGO!.
4. Select the Modbus connection protocol for the connection.

Figure 4-3: Selecting the Ethernet connection – (Modbus connection protocol)



Notes

At this point, you also have the option of setting up LOGO! as a server. This allows data to be retrieved from the PAC3200 (now a client) provided by LOGO!.

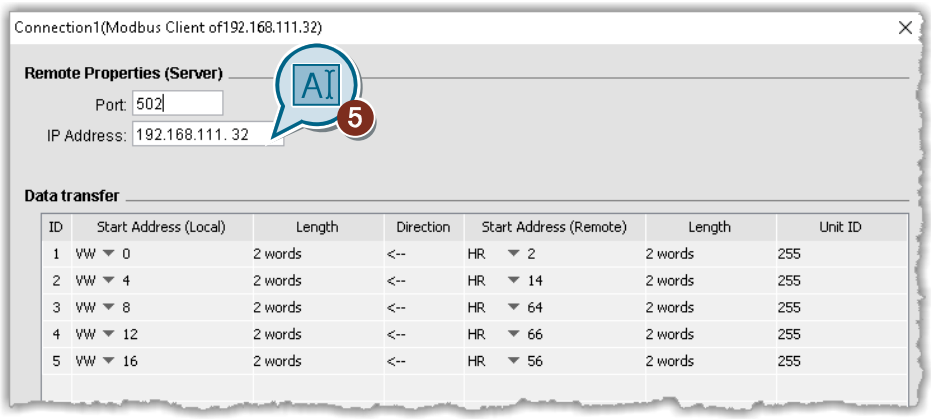
The TCP port and IP address of the server (PAC3200) are specified for LOGO! under "Decentralized properties (server)" in Figure 4-4.

5. Set the properties as follows.

In the data transfer table, you specify which data from the PAC3200 should be transferred to LOGO!. These are double Words, i.e. 4 bytes each, whose formats are transferred as floating point values. This is described below in Section 5.

If you want to read out other measured values from the PAC3200, please refer to the table of available measured variables in the device manual \5\.

Figure 4-4: Local connection properties



Notes

If you use a device from another manufacturer, you should find a similar table for the Modbus/TCP communication.

5 Example Program

As per the task description (Section 1), the PAC3200 supplies measured values via Modbus/TCP to the LOGO! base unit.

Figure 5-1 shows the LOGO! switching program for the application example.

At (Position 1), the measured values from the PAC3200 are read and processed.

The PAC3200 supplies double Words as floating point values, see Figure 4-1. The values to be processed are communicated to LOGO! under "Start address (dec.)" in Figure 4-4 and assigned to the start address (local) in the variable memory of LOGO!.

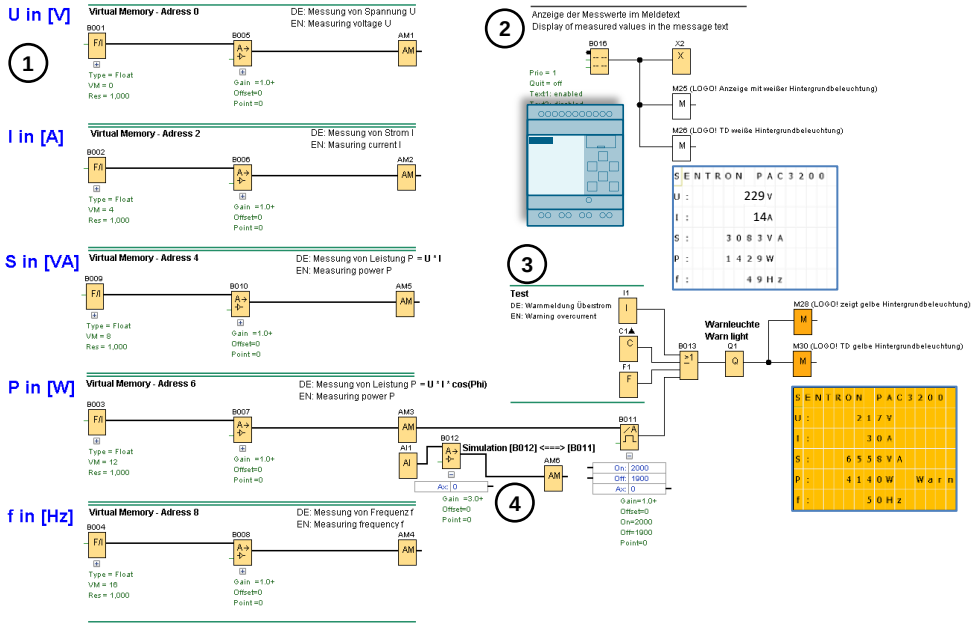
However, LOGO! only works with integers, and cannot process these floating point values directly. The LOGO! block [Floating point/integer converter = F/I converter] is used for further processing.

At (2), the texts for display on the LOGO! display are defined.

At (3), as an example, a warning message is defined for an excessive active power value. If the value set in the block [threshold switch] is exceeded, an alarm is triggered at the LOGO! output [Q1]. This would also allow you to switch off a consumer in a controlled manner, for example, to limit the power consumption of your application.

The alarm can be tested by pressing <F1> on the LOGO! TDE, the cursor key "ESC+▲" on the LOGO! base unit, or a key on the digital input [I1]. In the LSC simulation mode (4), you can connect the output from [B012] to [B011] and test various settings.

Figure 5-1: LOGO! switching program – Overview



Notes

The simulation function is available in LSC for illustrating the LOGO! switching program, allowing you to test individual adjustments directly. Follow the course of the red active switching signals in the LOGO! switching program.

The online test displays the program currently running on LOGO! with the respective switching states.

6 Appendix

6.1 Service and support

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6.2 Links and Literature

Table 6-1: Links and Literature

No.	Subject
\1\	Siemens Industry Online Support - https://support.industry.siemens.com
\2\	This entry - https://support.industry.siemens.com/cs/ww/en/view/109779762
\3\	LOGO! 8 user manual - https://support.industry.siemens.com/cs/ww/en/view/109741041
\4\	LOGO! logic module (Application examples, expansion modules) - http://www.siemens.com/logo
\5\	SENTRON PAC3200 Power Monitoring Device Manual - https://support.industry.siemens.com/cs/ww/en/view/26504150
\6\	Web Based Training (WBT) for Modbus and time synchronization with LOGO! 8 - https://wbt.siemens.com/sitrain/LOGO-MODBUS_EN/story_html5.html?lms=1

6.3 Change documentation

Table 6-2: Change documentation

Version	Date	Change
V1.0	07/2020	First version