

Exercise 7

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Introduction

In this exercise you will learn about simple visualization possibilities inside TwinCAT PLC.

Exercises

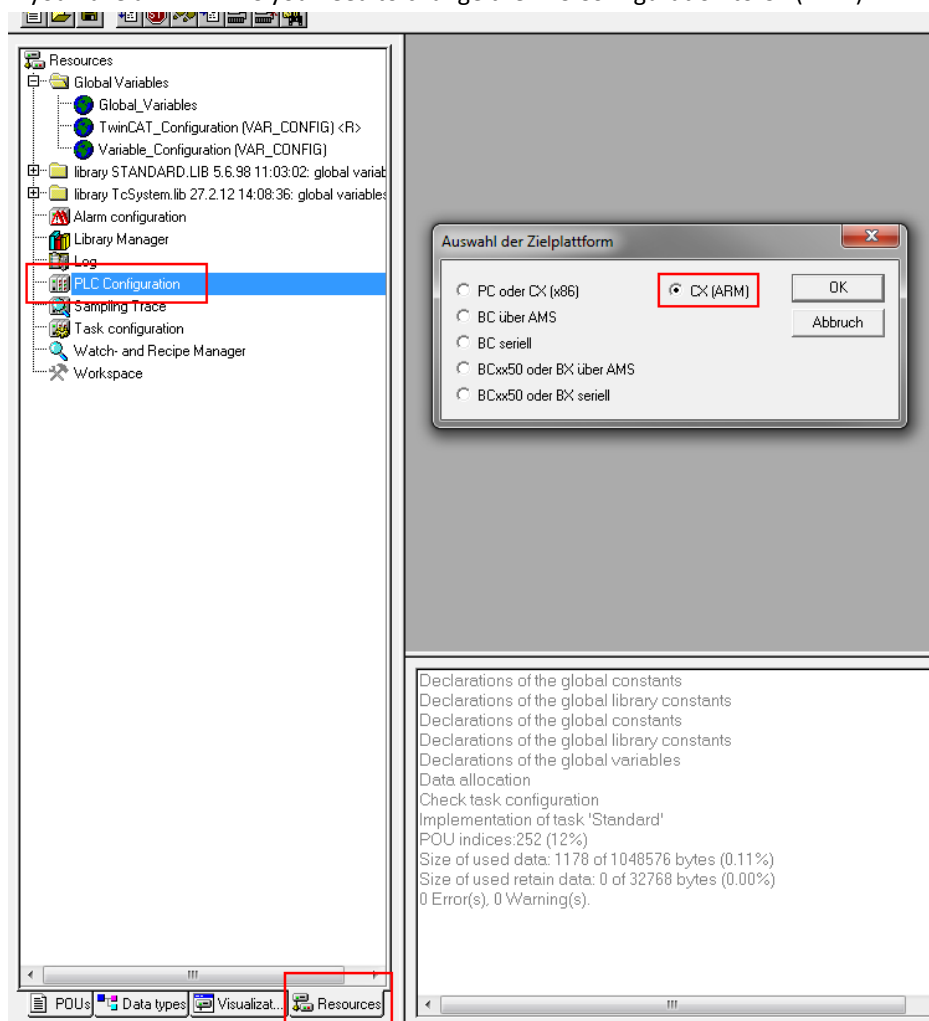
1. Connect PC and PLC

To establish a connection between your PC and the PLC work through the following topics of the "TwinCAT Guide":

1. Power the PLC
2. Establish connection
3. Open System Manager
4. Select Target System

2. Download and build project

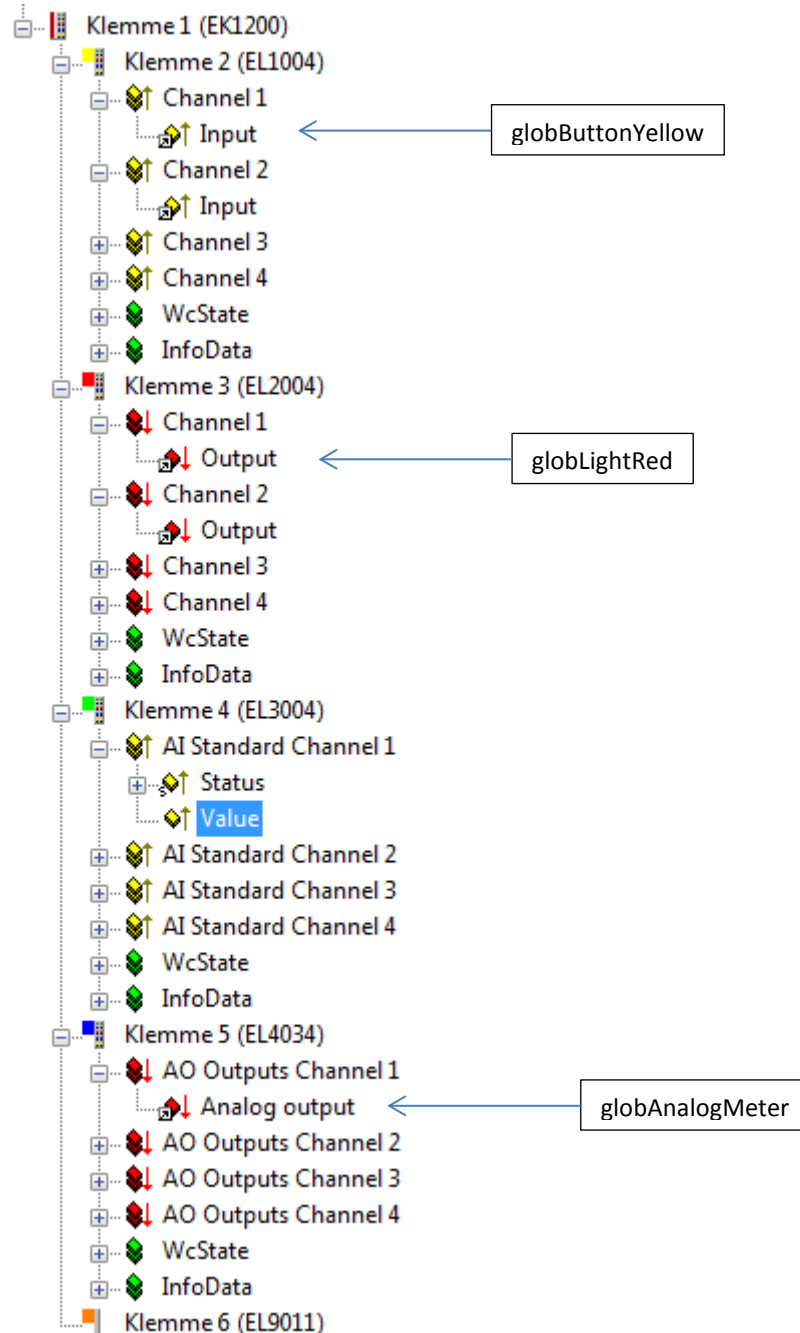
1. Download and save the exercise template project called Ex7_template.pro
2. Open the template project in "PLC Control".
3. Have a look at the global variables in the resources tab of the project. These variables will be connected to the hardware.
4. If you have an ARM PLC you need to change the PLC Configuration to CX (ARM)



5. Build the project.

3. Configure hardware

1. In "System Manager" change to "Config Mode"
2. Work through chapter "Automatic Terminal Configuration" in the "TwinCAT Guide".
3. Follow the instructions in the "TwinCAT Guide" to assign the variables to hardware:
 - a. Append a PLC Project
 - b. Link SW variables and terminal IOs according to the description below



- c. Activate configuration
4. In "PLC Control" run the project and with the global variables test if you can read the buttons, control the lights and the analog meter.

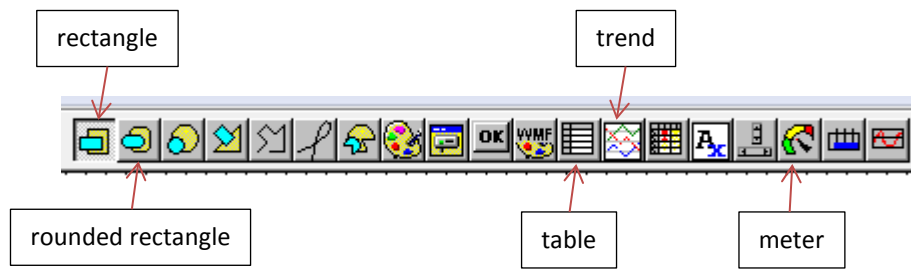
5. Advanced PV installation monitoring

In exercise 5 you indicated the power output etc. of solar panels on the analog meter. TwinCAT PLC offers an easy way to create a simple PC based user interface. We will use this to deliver a better monitoring of 3 solar panels.

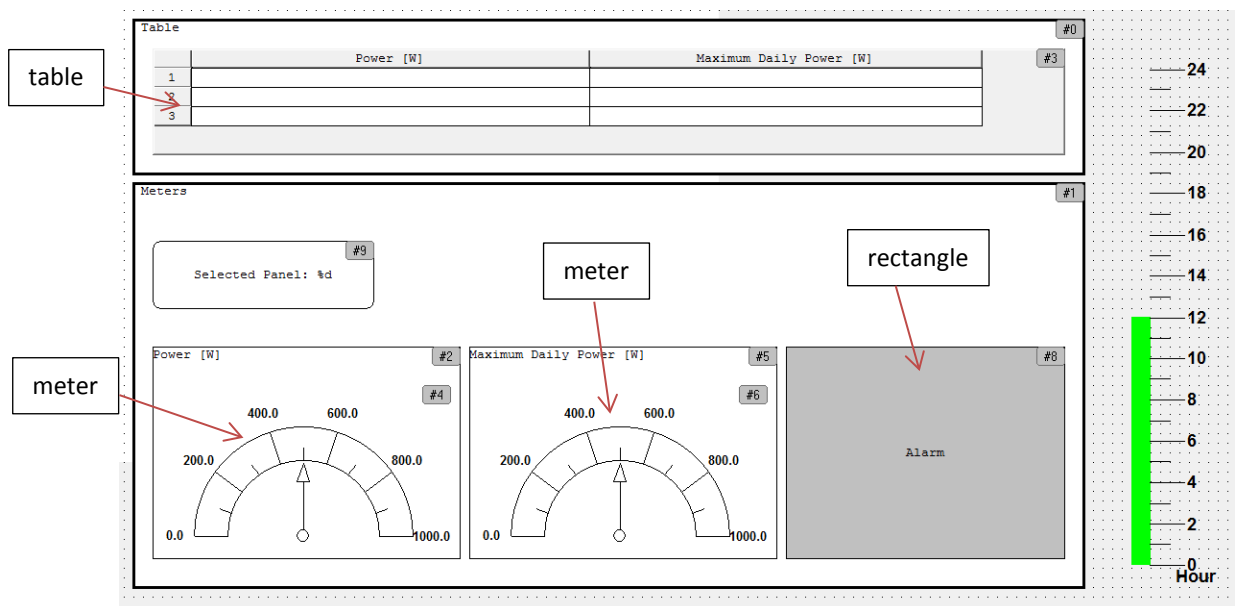
The places where you have to write some code are marked in the project template.

1. Open the exercise template project in "PLC Control".
2. In the the Data types tab complete the Measurement STRUCT. It will hold information about the current power output, the maximum power output of a day, the accumulated energy of a day and an alarm in case the power output is 0. In the STRUCT add the fields:
 - a. power of type REAL
 - b. maxPower of type REAL
 - c. energy of type REAL
 - d. alarm of type BOOL
3. A global ARRAY is needed to hold the measured solar panel values. In global variables add:
 - a. ARRAY globMeasurements of type Measurement with indices from 1 to MEASUREMENTS_COUNT_MAX.
4. In PROGRAM RecordMeasurement the globMeasurements ARRAY is filled with the current power output values.
 - a. In the IF statement the measurements are initialized. Use a FOR loop to set power and maxPower of each globMeasurements entry to 0.
 - b. After the IF statement set the power field (variable belonging to a STRUCT) of each entry in globMeasurements. You can get the current power output of the panels from globSolarPanelPower1, globSolarPanelPower2 and globSolarPanelPower3.
 - c. Afterwards create a FOR loop that analyzes the power field of each entry of globMeasurements and sets the remaining fields of the entry:
 - i. field maxPower should be the highest power output that occurred in a day
 - ii. field energy should be the accumulated energy of a day in kWh
 - iii. field alarm should be TRUE when the power output is 0
5. In PROGRAM DisplayMeasurements the acquired power measurements are used to control the analog meter and the red light.
 - a. In the IF statement (falling edge of yellow button) increment the global variable globSelectedPanel. Set it to 1 if it is larger than MEASUREMENTS_COUNT_MAX.
 - b. After the IF statement set globAnalogMeter to $power / 1000 * 32767$ of the currently selected entry (use globSelectedPanel as the index) in globMeasurements.
 - c. Afterwards set globLightRed to TRUE if the power of any entry in globMeasurements is 0. You can use the keyword OR to build your IF statement condition.

6. Let's create the PC user interface now. Some interface elements you will use are:



a. In tab Visualization open the object "Latest". It will show the latest measured values. Add the missing interface elements so it will look like this:



b. Now the interface elements need to be configured properly. To do this right click an interface element and select "Configure":

i. The table configuration:

1. In tab "Table" set "Data array" to globMeasurements
2. In tab "Columns" select columns power and maxPower. Once selected double click on them and change their column header to "Power [W]" and "Maximum Daily Power [W]"

ii. The left meter configuration:

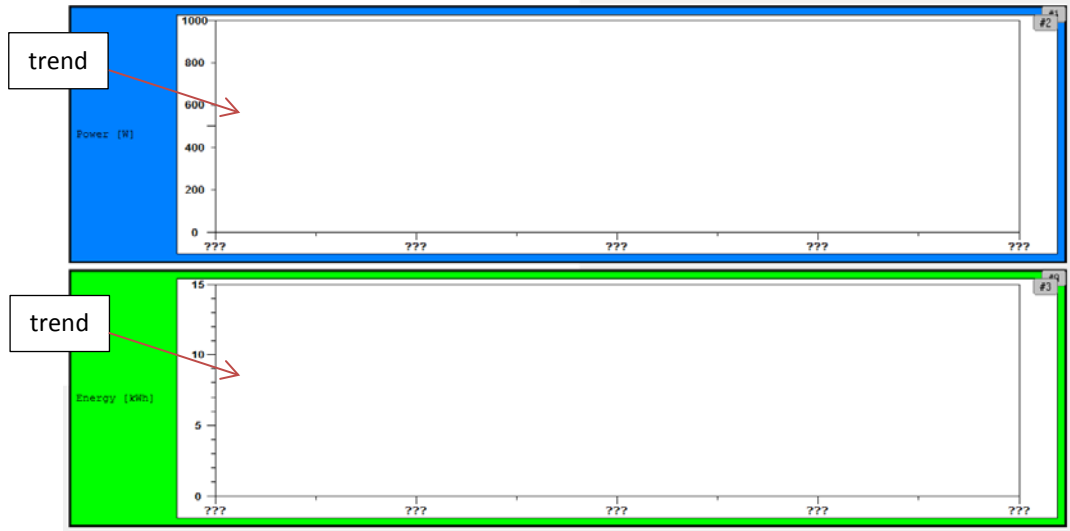
1. Click variable/scaling
2. Set scale start to 0
3. Set scale end to 1000
4. Set variable to globMeasurements[globSelectedPanel].power

iii. The right meter configuration needs to be the same as the left one but with the maxPower instead of the power field.

iv. The rectangle configuration:

1. In tab "Text" set "Content" to Alarm
2. In tab "Colors" click on "Color/Inside" and choose grey
3. In tab "Colors" click on "Alarm color/Inside" and choose red
4. In tab "Variables" set "Change color" to globMeasurements[globSelectedPanel].alarm

c. In tab Visualization open the object "Trends". It will show the measured values over time.



- i. The upper trend configuration:
 1. Click choose variable
 2. Add `.globMeasurements[1].power`, `.globMeasurements[2].power` and `.globMeasurements[3].power`
Set their colors and linetypes
- ii. The lower trend configuration needs to be the same as the upper one's but with the energy field instead of the power field.