First Project

User guide

REX Controls s.r.o.

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Contents

Chapter 1

Introduction

The process of creating a control algorithm will be demonstrated on a very simple example with four Boolean variables representing manual switches. In In the follow-up manual [1], two of them will be replaced by physical inputs of the platform. A software timer will be used for measuring the time when the variables are true (i.e. the switches are in the `on` position). A Boolean signal will indicate that the interval of predefined length has elapsed.

Chapter 2

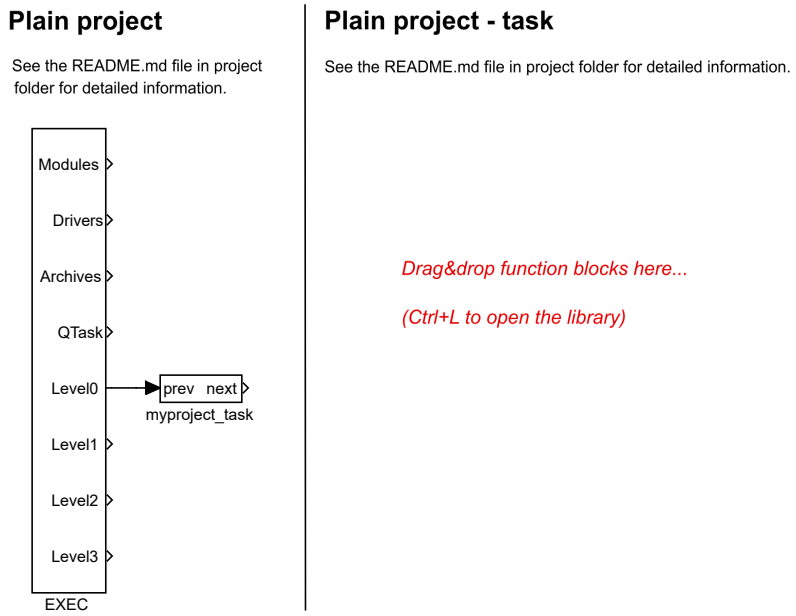
Creating a new project

The project configuration is created using the REXYGEN Studio program. Each project consists of at least two `.mdl` files. The first file is the main file of the project, which is used for configuration of tasks, drivers, priorities and timing. The other file(s) contain the individual control algorithms (tasks).

First, we will create the example 0101-01 from the example library from scratch[1]. Standard approach:

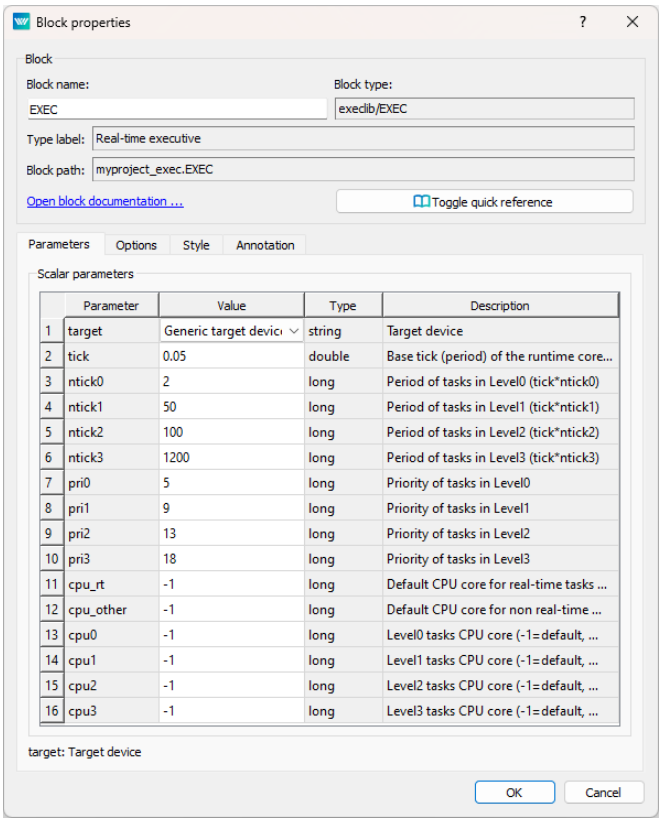
1. Run the REXYGEN Studio program. Start with a plain project and select a folder to save the project files in (e.g. `D:\GettingStarted`).
2. The folder will contain two important files:
   - `myproject_exec.mdl`
   - `myproject_task.mdl`
3. The `myproject_exec.mdl` is the project main file. It contains one `EXEC` block from the `EXEC` library. The other block is the `TASK` block from the same library and it is renamed to `myproject_task` to reference the second file of the project (`myproject_task.mdl`), which will contain the algorithm (the so-called task).

[1] All examples that are part of the REXYGEN Studio installation are marked with their unique code. The most up-to-date examples are available with the latest installation of the development tools or at https://www.rexygen.com/example-projects/



4. The task is connected to the `Level0` output of the `EXEC` block and therefore its timing is defined by `tick` and `ntick0` parameters of the `EXEC` block.

5. The `EXEC` block (and any other block) can be configured by double-clicking on it. A block parameters and properties dialog appears. The parameters of all blocks of the REXYGEN system are described in the Help (press the F1 key) and in the Block reference manual [2].

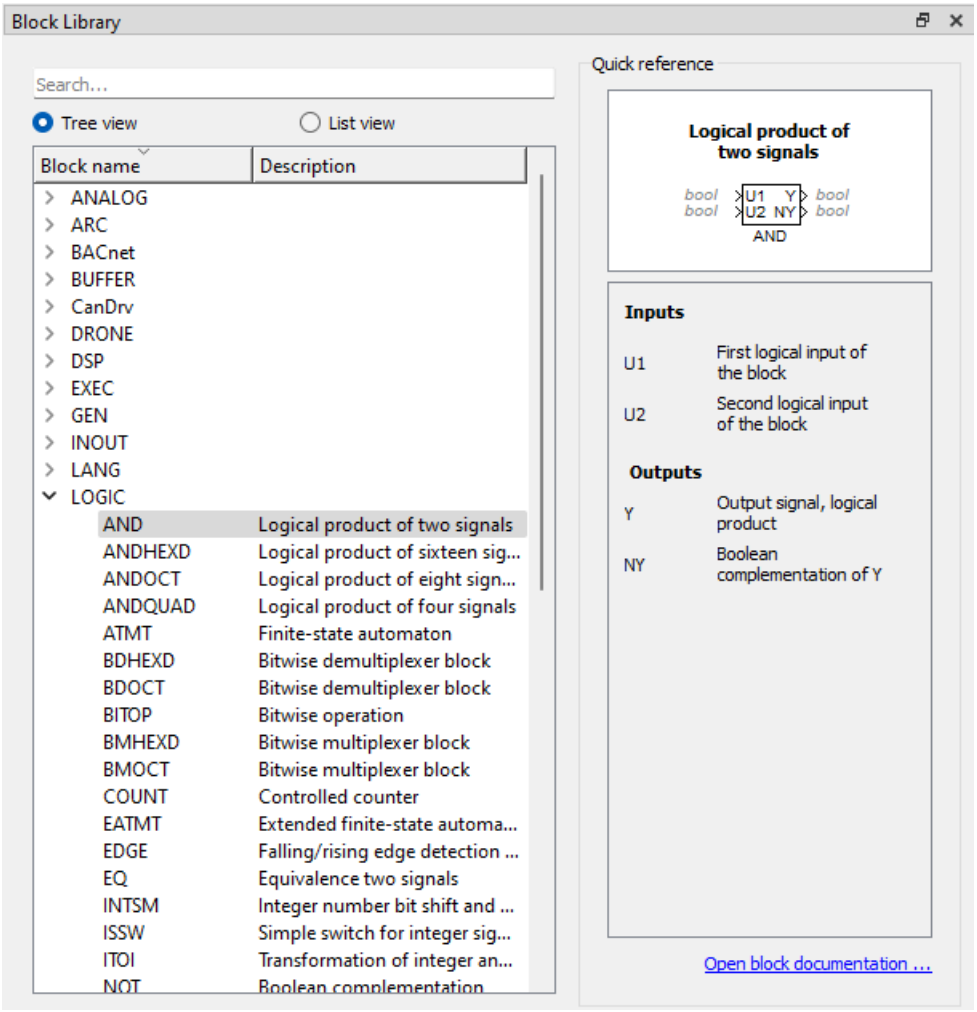


6. Note that `tick=0.05` and `ntick0=2`, therefore the task will run each 100 milliseconds ($0.05 \cdot 2 = 0.1s$). There is no need to change any parameter at the moment. Close the dialog.

7. You can delete all the descriptive texts in project files. These have no effect on the functionality and can be considered programmer's comments.

8. Open the `Block Library` - Choose *Window->Block Library* from the menu or use the *Ctrl+L* shortcut. The library will appear in the right part of the studio, if it wasn't there already.

9. By default, the library is in *Tree view* mode where the blocks are organized in sublibraries. Their location is always denoted as `sublibrary/block`, e.g. `LOGIC/AND` for the logical `AND` block in the `LOGIC` sublibrary. Inside a sublibrary, the blocks are ordered in alphabetical order.



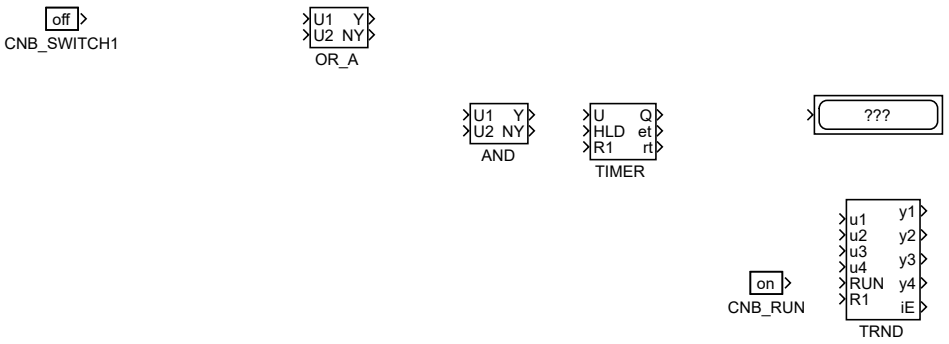
10. You can also switch the library to *List view* mode, where all the blocks are sorted alphabetically, regardless of the sublibrary they belong to.

11. Locate the following function blocks in the `Block Library` and drag them to the task file:

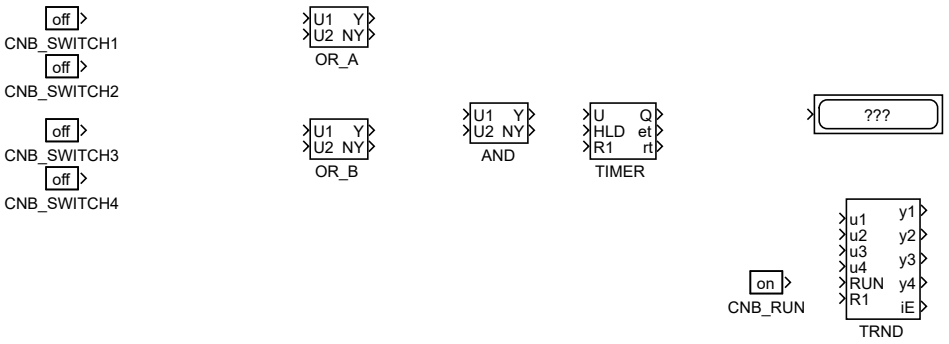
    - `MATH/CNB` – constant of type `Boolean`. Once dropped, double-click to display the parameters dialog and change the name to `CNB_SWITCH1`. Also set the parameter `YCN` = `off`.
    - `LOGIC/OR` – logical OR. Rename it to `OR_A`.
    - `LOGIC/AND` – logical AND.
    - `LOGIC/TIMER` – a timer block. Set parameter `mode` = `2: Delayed ON`, `pt` = 5.0.
    - `INOUT/Display` – a display to show values in real-time.

- `ARC/TRND` – real-time recording. Set parameters `l` = 2000, `Title` = `My timer`, leave the default values otherwise.
- `MATH/CNB` – constant of type `Boolean`, change name to `CNB_RUN`, set parameter `YCN` = `on`.

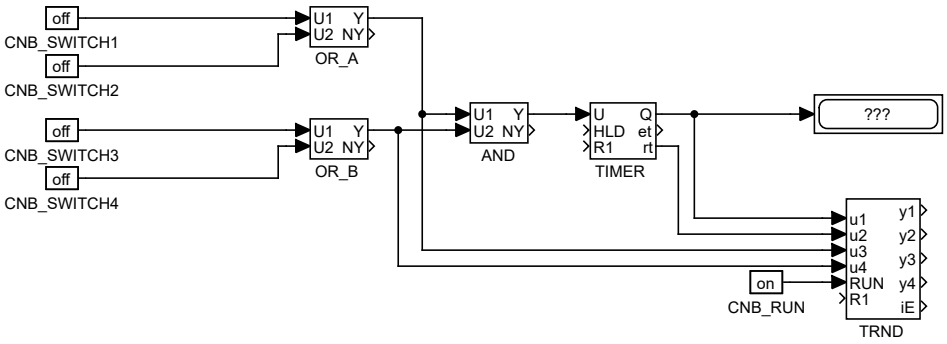
Tip: You can also insert blocks by starting to write their name and selecting the desired block from the whisperer.



12. Duplicate the `CNB_SWITCH1` block with right mouse button dragging. Or simply Copy&Paste the block.
13. Duplicate the block 2 more times.
14. Duplicate also the `OR_A` block. Rename the duplicate to `OR_B`.



15. Connect the blocks as shown below. To connect the blocks, drag the output arrow of one block to the input arrow of the other block using the left mouse button. The connection will be established when the line goes bold and green. After releasing the mouse button you can recognize a successfully connected line by its style. A full line terminated by a full arrow at the input of the connected block indicates a valid connection. A dashed red line ending with a thin arrow indicates an unconnected line. New branch of an existing line can be created by dragging an existing line with the right mouse button.

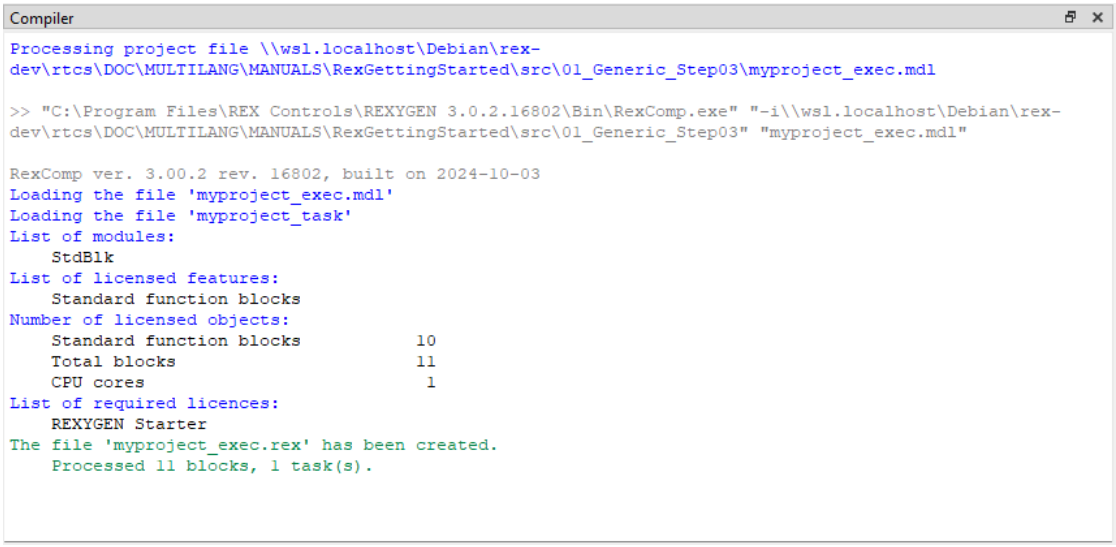


At this moment the executive configuration `myproject_exec.mdl` and the corresponding `myproject_task.mdl` file with the algorithm are ready. The algorithm will be evaluated in the direction of the arrows, starting from the source `CNB` blocks, passing through the `OR`, `AND` and `TIMER` blocks and finishing at the `Display` and `TRND` blocks. **Congratulations**, your first project is ready for compilation!

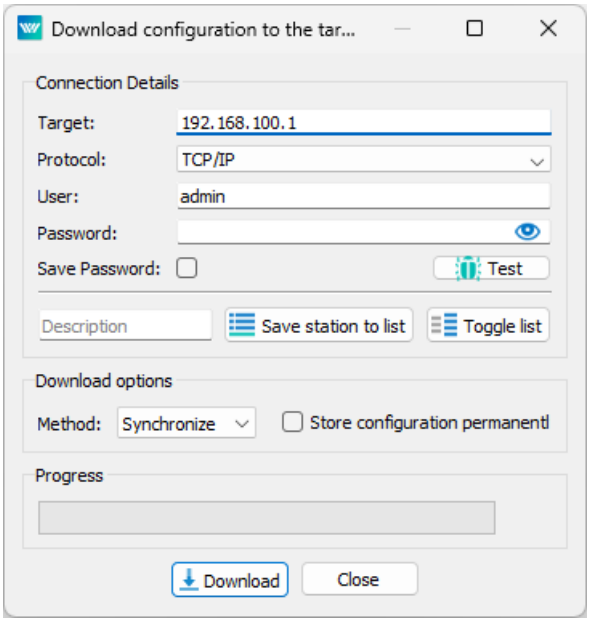
Chapter 3

Compiling and running a project

The developed algorithm must be compiled to binary form prior to deploying. Pick *Project/Compile* from the menu or use the icon from the toolbar. The compiler output is displayed in the `Compiler window`. If no error is found, the `myproject_exec.rex` file is created.



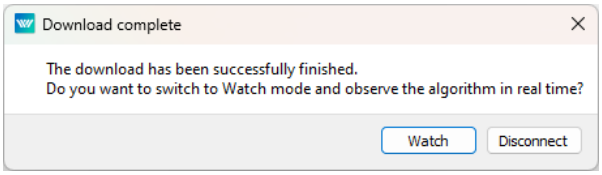
At this moment it is possible to deploy the control algorithm to the target platform. Use *Project/Compile and Download* in the menu or click the icon for this purpose. A dialog for defining the target device appears upon successful compilation.



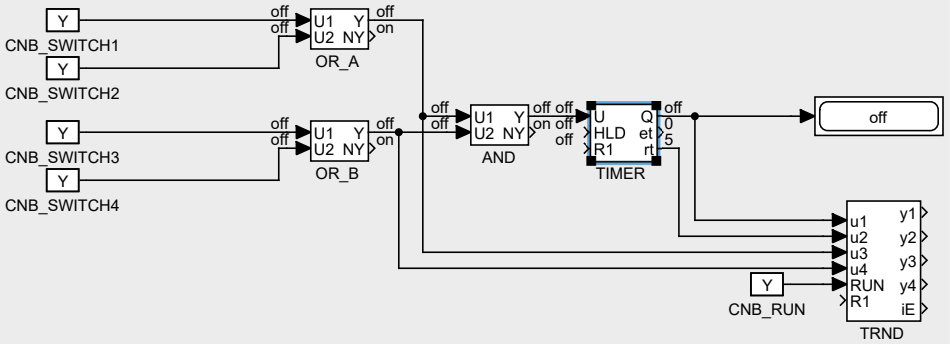
Enter your platform's IP address in the `Target` field and login information. The default user is **admin** and the default password is **blank**. Leave the other elements unchanged and click `Download`.

If there is no licence on your platform, you need to get one first. You can get a DEMO licence for free. See [3] for details and come back afterwards.

As soon as the download is complete it is possible to switch the REXYGEN Studio to the so-called *Watch mode* and watch the control algorithm in real-time – click `Watch`.

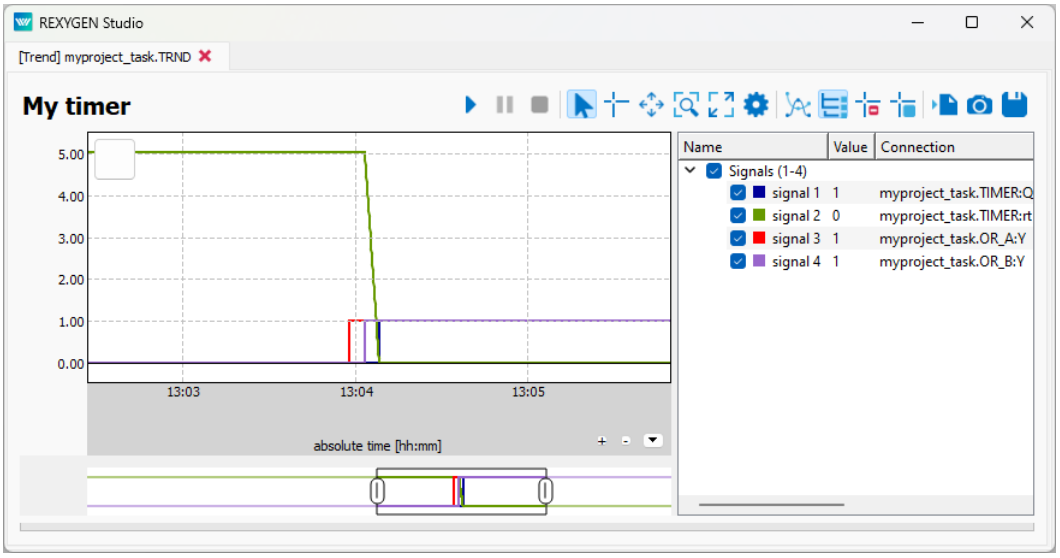


In the *Watch mode*, the background of all files goes gray and you cannot move or delete any blocks or connections. Right-click the `TIMER` block and select *Watch selection* in the menu to watch the inputs and outputs of the timer. You can do the same with the `OR` and `AND` blocks (or any other selection).



Now it is possible to double-click the `CNB_SWITCH1` block and change the Boolean variable to `YCN` = `on` (tick the checkbox and click OK). Once you do the same with the `CNB_SWITCH3` block, the outputs of both `OR` blocks are `on` and the `Y` output of the `AND` block goes `on` and the `TIMER` starts to count down. Observe the `rt` output.[1] Once the timer reaches zero, its output `Q` is set to `on` and it remains `on` as long as the `U` input is `on`.

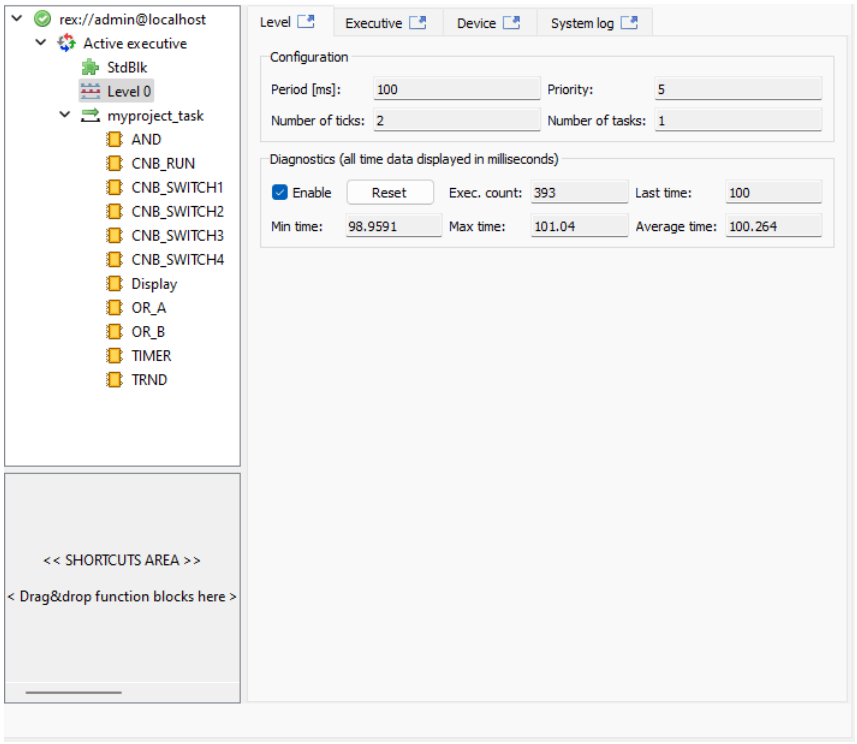
You can double-click the `TRND` block to see the signals in a real-time graph. The red line is the output of the `OR_A` block, the magenta line is the output of the `OR_B` block, the green line is the remaining time of the timer and the blue line is the Boolean output of the timer.



Try turning the `CNB` blocks `off` and change the `pt` parameter of the `TIMER` block. Afterwards turn the `CNB` blocks `on` again and observe the signals in the `TRND` block again. As you can see, you can modify any parameter in real-time, which allows you to fine tune your algorithm.

[1] Do not get confused by the default 1 second refresh rate of the *Watch mode*. The algorithm on the target device runs each 100 milliseconds as mentioned earlier.

It is also possible to open a `Diagnostics tab` of the algorithm. Pick *Target/Diagnostics* from the menu or click the icon and you will see the algorithm in a tree view which allows you to monitor the control algorithm in full detail. You can verify that the sampling rate of your algorithm is indeed 100 milliseconds. You can also adjust parameters of individual function blocks, which has the same effect as modifying them directly in the *Block properties* dialog.



Now you can switch REXYGEN Studio back to the *Development mode*. You can do so by deactivating the *Watch mode* (use the icon). You are offered synchronization of the changed parameters with the source files of the project, choose `No` at this moment.

All changes made while in the *Watch mode* are not permanently stored in the target device (unless you decide so, see [4]). Upon restarting the RexCore runtime module the algorithm will start with the parameters defined in the project source files, which were valid when compiling and downloading the algorithm to the target device. To apply the changes permanently, you have to transfer the changes to the source files and *Compile and Download* the project one more time which defines new startup values.

Chapter 4

Adding a user interface (HMI)

The next step in developing a control algorithm is its user interface, or HMI, **H**uman-**M**achine **I**nterface. It allows anyone (even those who are not familiar with the REXYGEN system) to interact with the algorithm. The HMI of the REXYGEN system relies on modern web-based technology and the HMI is therefore accessible via web browser on desktop PC, tablet or smartphone.

In this tutorial, a simple HMI will be created using the so-called *WebBuDi* technology. It provides very simple indicators and input elements to interact with the control algorithm via a web page (Web Buttons and Displays).

The steps to create the HMI are described below. This is how the HMI will look like in the end:

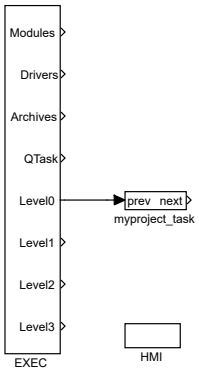
1. In the folder with the project files, create a `hmisrc` subfolder. Inside this folder,

create a file named `index.hmi.js` and edit it with your favorite text editor. The content should be the following:

```
REX.HMI.init = function(){

//Indicators and virtual switches - group A
  var switchesA = {
    column: 1,
    title: 'Switches - group A',
    rows: [
      {type: 'DW', alias: 'switch1', desc: 'Switch 1', cstring: '
    myproject_task.CNB_SWITCH1:YCN'},
      {type: 'DW', alias: 'switch2', desc: 'Switch 2', cstring: '
    myproject_task.CNB_SWITCH2:YCN'},
      {type: 'DR', alias: 'S1orS2', desc: 'S1 OR S2', cstring: '
    myproject_task.OR_A:Y'},
    ]
  };
  REX.WebBuDi.addSection(switchesA);

//Indicators and virtual switches - group A
  var switchesB = {
    column: 1,
    title: 'Switches - group B',
    rows: [
      {type: 'DW', alias: 'switch3', desc: 'Switch 3', cstring: '
    myproject_task.CNB_SWITCH3:YCN'},
      {type: 'DW', alias: 'switch4', desc: 'Switch 4', cstring: '
    myproject_task.CNB_SWITCH4:YCN'},
      {type: 'DR', alias: 'S3orS4', desc: 'S3 OR S4', cstring: '
    myproject_task.OR_B:Y'},
    ]
  };
  REX.WebBuDi.addSection(switchesB);

//Timer input
  var timerInput = {
    column: 2,
    title: 'Timer input',
    rows: [
      {type: 'DR', alias: 'inputA', desc: 'Group A', cstring: '
    myproject_task.AND:U1'},
      {type: 'DR', alias: 'inputB', desc: 'Group B', cstring: '
    myproject_task.AND:U2'},
      {type: 'DR', alias: 'AandB', desc: 'A AND B', cstring: '
    myproject_task.AND_:Y'},
    ]
  };
  REX.WebBuDi.addSection(timerInput);
```

```
//Timer settings and status
  var timer = {
    column: 2,
    title: 'Timer',
    rows: [
      {type: 'AW', alias: 'interval', desc: 'Timer interval', cstring: '
    myproject_task.TIMER:pt'},
      {type: 'AR', alias: 'rt', desc: 'Remaining time', cstring: '
    myproject_task.TIMER:rt'},
      {type: 'DR', alias: 'timerQ', desc: 'Timer output', cstring: '
    myproject_task.TIMER:Q'},
    ]
  };
  REX.WebBuDi.addSection(timer);

  //Add real-time trend
  REX.HMI.Graph.addTrend({cstring: 'myproject_task.TRND'});
  REX.HMI.Graph.setMaxBufferSize(200);

  // Change title of the page
  REX.HMI.setTitle('My timer - HMI example');
}
```

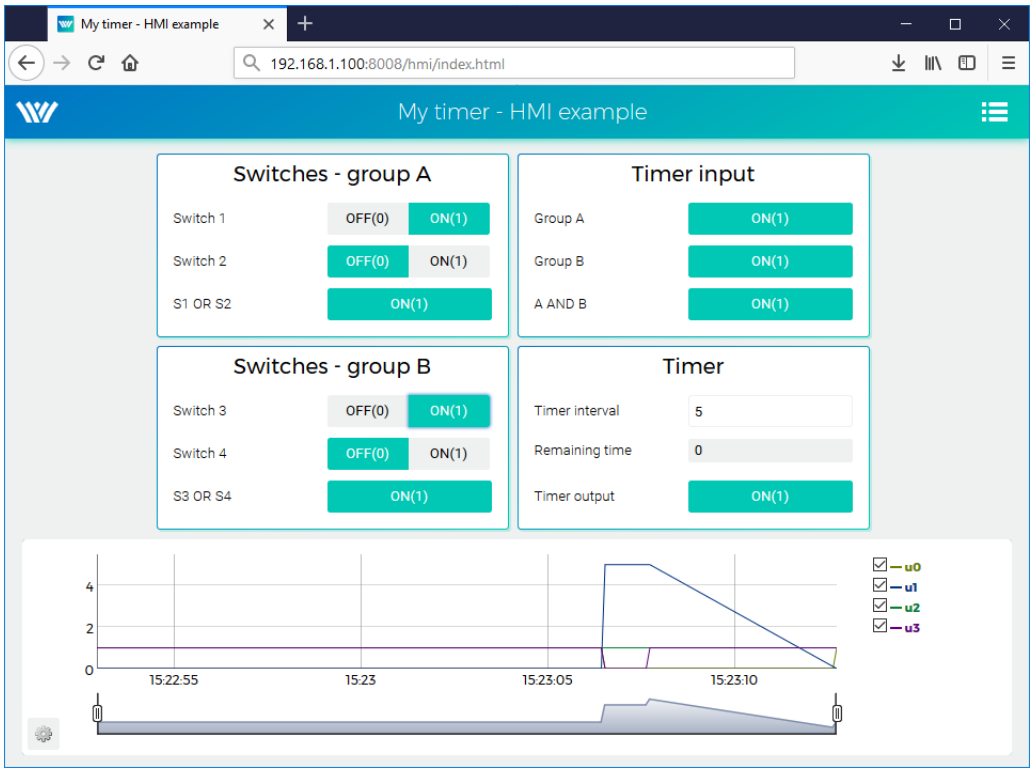
2. This file will be processed when compiling the project. However, it is necessary to add the `EXEC/HMI` block into the project main file first.



3. Double-click the HMI block to edit its parameters. Set `GenerateWebWatch` = `off` and confirm. WebWatch is another type of HMI, which you do not need at the moment. See [5] for details, it is a very interesting tool for developers and technicians.

4. The HMI is now an integral part of your project. Compile the project again and you will see that the compile log contains more information. The `index.html` file is generated from the source `index.hmi.js` file. All the HMI files are generated into the `hmi` subfolder (HTML, JS and CSS files) and included in the resulting binary `myproject_exec.rex` file.

5. After you download the project to the target device, you can access the HMI via web browser. Go to menu *Target/Web Interface* which will open the webpage. Remember the default login credentials: admin with blank password.



6. You can toggle the switches and observe the results. The virtual switches are linked to the individual `CNB` function blocks therefore the effect is the same as toggling the values directly in REXYGEN Studio.

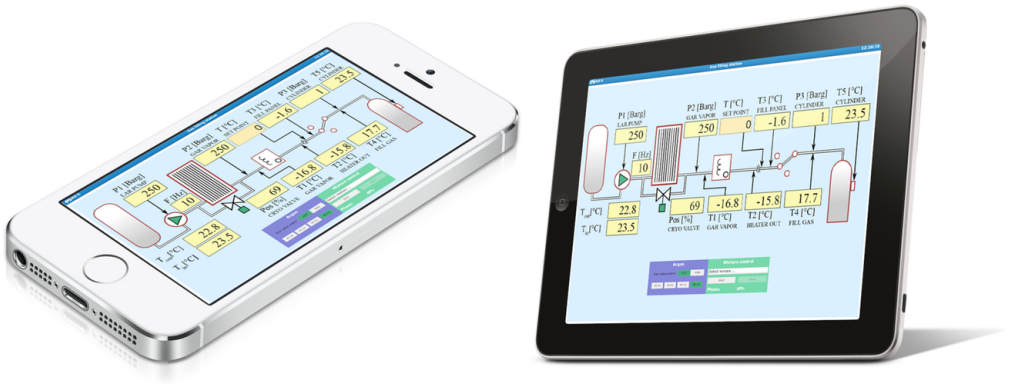
7. You can also change the timer setting and shorten or lengthen the interval.

8. See [5] for detailed information about WebBuDi elements and possible customization (colors, backgrounds etc.).

9. The default URL address is `http://192.168.1.100:8008/hmi/index.html` (replace 192.168.1.100 with the IP address of your platform).

10. The default port of the webserver (8008) can be changed in RexCore settings. See [6] for details.

Please note that there is also a program called REXYGEN HMI Designer, which allows you to create graphical user interfaces. The accompanying manual [7] shows the steps to create a basic graphical interface for the example created above. The more complex HMIs in the images below are shown for inspiration purposes only.



Chapter 5

Ready for interaction with the outer world

Well done! You have created the example 0101-01 from scratch[1]. You have learned the basic workflow for developing and running your algorithms using the REXYGEN system, which is the same for all platforms. Now, it's time to add the so-called *input-output drivers* so that the algorithm can interact with sensors, actuators, and external data. The configuration of inputs and outputs specific to target devices, based on the example project presented in this chapter, is discussed in the I/O Configuration of Target Platforms guide [8].

[1] All examples that are part of the REXYGEN Studio installation are marked with their unique code. The most up-to-date examples are available with the latest installation of the development tools or at https://www.rexygen.com/example-projects/

Bibliography

[1] REX Controls s.r.o.. *Konfigurace vstupů a výstupů na cílových platformách*, 2024. →.

[2] REX Controls s.r.o.. *Function blocks of REXYGEN – reference manual*, 2024. →.

[3] REX Controls s.r.o.. *REXYGEN Licensing – User guide*, 2024. →.

[4] REX Controls s.r.o.. *REXYGEN Studio – User manual*, 2024. →.

[5] REX Controls s.r.o.. *REXYGEN HMI – User manual*, 2024. →.

[6] REX Controls s.r.o.. *RexCore – User manual*, 2024. →.

[7] REX Controls s.r.o.. *Tvorba HMI v REXYGEN HMI Designer*, 2024. →.

[8] REX Controls s.r.o.. *I/O Configuration of Target Platforms*, 2024. →.

Documentation reference number: 17159