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# Raspberry Pi driver for the REX Control System (the RPiDrv module)

## User guide

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# Chapter 1

## The RPiDrv driver and the REX Control System

### 1.1 Introduction

This manual describes the **RPiDrv** driver for working with GPIO pins of the Raspberry Pi<sup>1</sup> minicomputer [1] within the **REX Control System**. Both input and output modes are supported. The driver also supports the PiFace Digital 1/2 [2] expansion board. The driver was developed by the **REX Controls** company.

### 1.2 System requirements

The **RPiDrv** driver can be used on all Raspberry Pi models which does have a network adapter (LAN / WAN).

In order to use the driver, the host computer (development) and the target computer (runtime) must have the following software installed:

#### Host computer

Operating system	one of the following: Windows Vista/7/8/10
REX Control System	version for Windows operating system

#### Target device

REX Control System	version for Raspberry Pi with the Raspbian distribution of GNU/Linux
IO driver	version for Raspberry Pi

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<sup>1</sup>Raspberry Pi is a registered trademark of the Raspberry Pi Foundation.

### 1.3 Installation of the driver on the host computer

The RPiDrv driver is included in the installation package of the Development tools of the REX Control System. It is necessary to select the corresponding package in the installer. The REX Control System typically installs to the

C:\Program Files (x86)\REX Controls\REX <version> folder.

The following files are copied to the installation folder:

Bin\RPiDrv\_H.dll – Configuration part of the RPiDrv driver.

Doc\PDF\ENGLISH\RPiDrv\_ENG.pdf – This user manual.

### 1.4 Installation of the driver on the target device (Raspberry Pi)

If there is no RexCore runtime module installed on your Pi, install it first using the Getting started guide of the REX Control System [3]. The installation includes all necessary drivers including RPiDrv.

If you want to install RPiDrv separately, it can be done from the command line of Raspberry Pi using the command

```
sudo apt-get install rex-rpidrv
```

## Chapter 2

# Including the driver in the project

The driver is included in the project as soon as the driver is added to the project main file and the inputs and outputs are connected in the control algorithms.

### 2.1 Adding the RPiDrv driver

The project main file with the **RPiDrv** driver included is shown in Figure 2.1. There are 2 blocks which must be added to the project to include the driver. First the **MODULE** block is attached to the **Modules** output of the **EXEC** function block. It must be renamed to **RPiDrv**.

The other block of type **IODRV** is connected to the **Drivers** output of the main **EXEC** block. The name of this block (**RPI**, see Fig. 2.1), is the prefix of all input and output signals provided by this driver. It is recommended to name the **IODRV** block according to the used platform:

- **RPI** – Raspberry Pi GPIO, PiFace Digital expansion board
- **UNP** – UniPi expansion board
- **PIO** – Intellisys PIO platform

The most important parameters of **IODRV** block are:

**module** – name of the module linked to the driver, in this case **RPiDrv** – the name is CASE SENSITIVE!

**classname** – class of the driver – the name is CASE SENSITIVE!

- **RPiDrv** – Raspberry Pi GPIO, PiFace Digital expansion board
- **UnpDrv** – UniPi expansion board
- **PioDrv** – Intellisys PIO platform

**cfgname** – name of the driver configuration file, but this driver does not use any

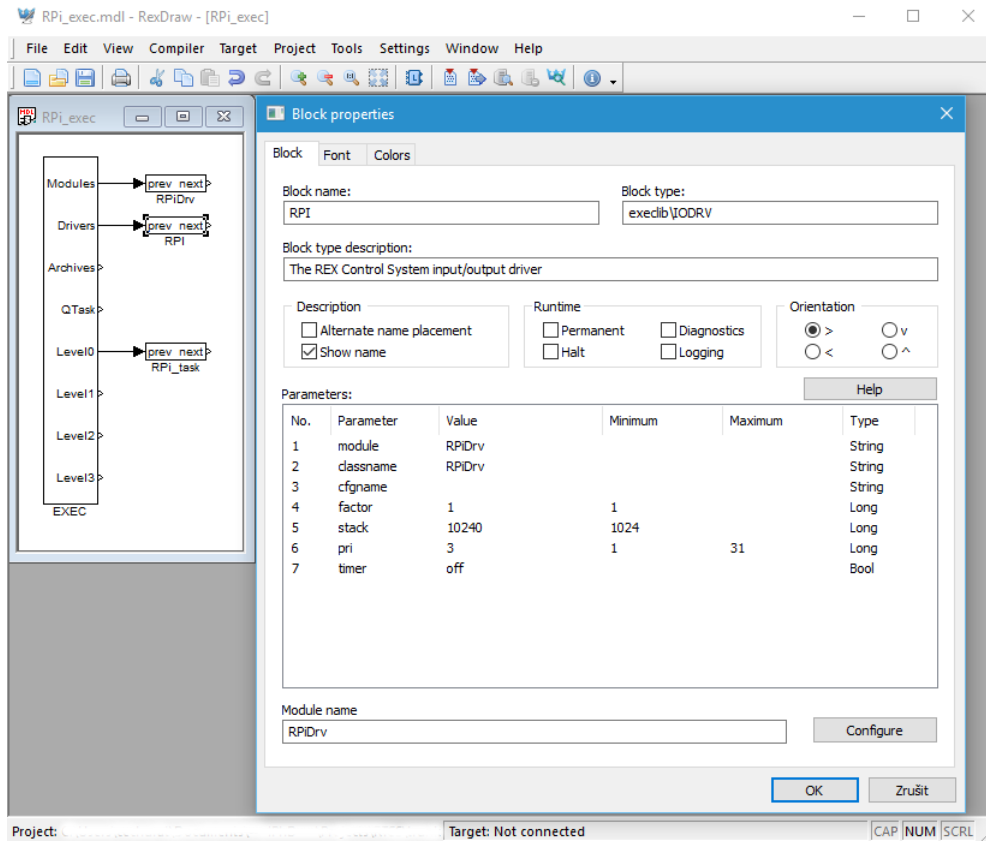


Figure 2.1: An example of project main file with the `RPiDrv` driver included

**factor** – multiple of the EXEC block’s tick parameter defining the driver’s task execution period

The above mentioned parameters of the `IODRV` function block are configured in RexDraw program. The configuration dialog is shown also in Fig. 2.1.

## 2.2 Connecting the inputs and outputs in the control algorithm

The inputs and outputs of the driver must be interconnected with the individual tasks (.mdl files). The individual tasks (QTASK or TASK blocks) are connected to the QTask, Level0, ..., Level13 outputs of the main EXEC block.

### 2.2.1 GPIO pins of the Raspberry Pi

Necessary IODRV block configuration for Raspberry Pi GPIO:

- Block name – RPI
- module – RPiDrv
- classname – RPiDrv

The inputs and outputs of the RPiDrv driver can be accessed as shown in Fig. 2.2.

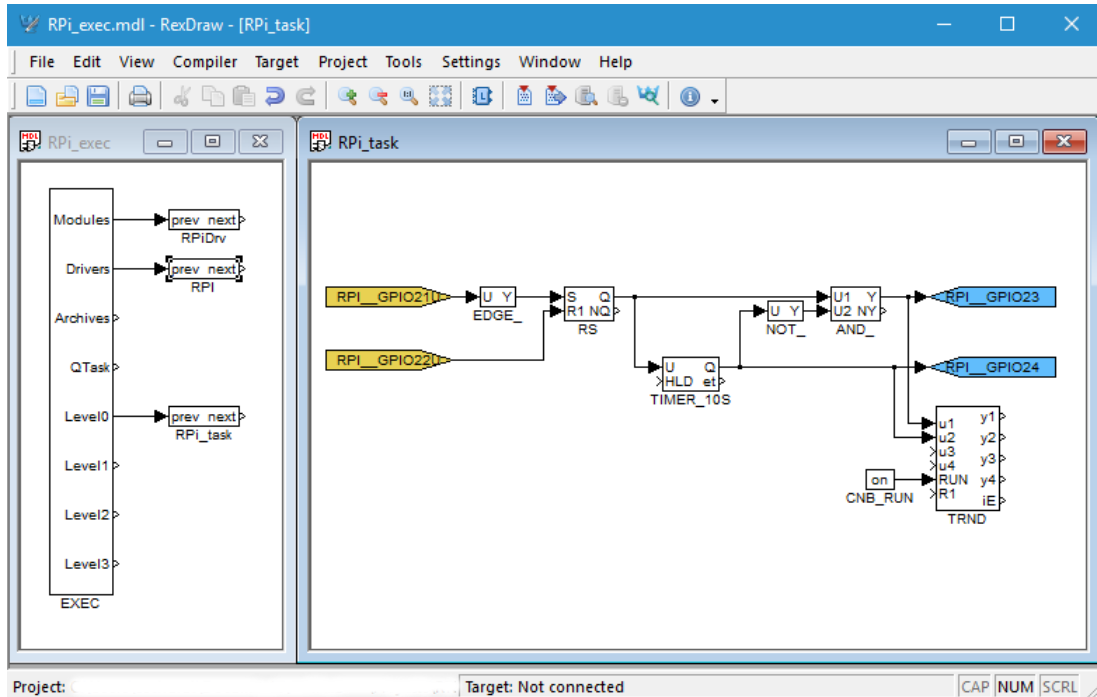


Figure 2.2: Example of input and output flags of the RPiDrv driver

One block of the **From** type allowing the user to read one input has the **Goto** tag set to **RPI\_\_GPIO21U**, while the other has this tag set to **RPI\_\_GPIO22U**. The number in the flag corresponds with the GPIO pin number and the **U** letter activates the pull-up resistor. The block of **Goto** type allowing the user to set (write) one output has the **Goto** tag set to **RPI\_\_GPIO23**, the other output is accessed via the **RPI\_\_GPIO24** flag. The blocks always have the **RPI** prefix right at the beginning of the tag followed by two **\_** characters (underscore).

Similarly for other pins we can use e.g. the flags:

- **Goto**, **RPI\_\_GPIO22** – digital output 22
- **Goto**, **RPI\_\_GPIO23H** – digital output 23, which is set to logical 1 (HIGH, ON) immediately upon initialization
- **Goto**, **RPI\_\_PWM18** – PWM output on pin 18

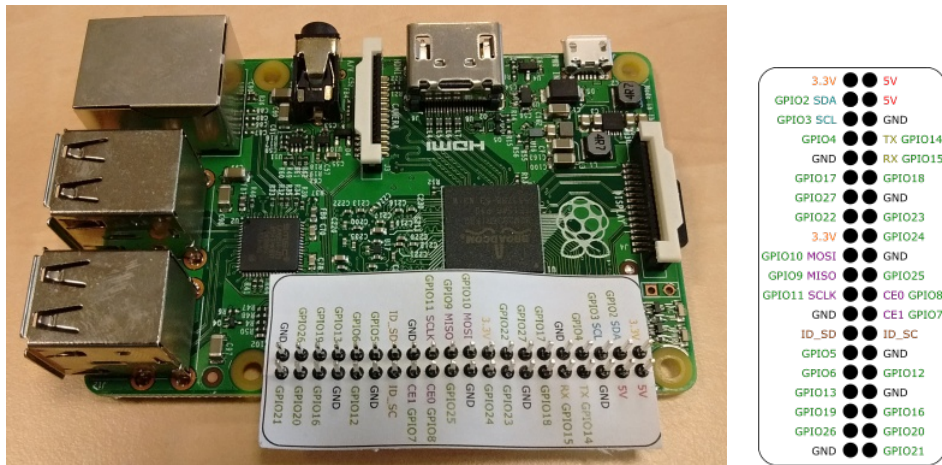


Figure 2.3: GPIO pins numbering for Raspberry Pi.

- From, `RPI__GPIO7U` – digital input 7 with internal pull-up resistor
- From, `RPI__GPIO8D` – digital input 8 with internal pull-down resistor
- From, `RPI__GPIO21` – digital input 21 without any internal pull-up/down resistor

In general, the link to a particular GPIO pin consist of the driver name `RPI`, two underscores `__`, pin mode (`GPIO` or `PWM`), pin number and an optional symbol `U` for internal pull-up or `D` for internal pull-down in inputs and `H` or `L` for initial state in outputs. The pin numbering on Raspberry Pi is shown in Fig. 2.3.

All the input and output flags for the Raspberry Pi GPIO pins are prepared by default in the folder

`C:\Program Files (x86)\REX Controls\REX <version>\Examples\RaspberryPi_examples\00_IO_Flags`.

Visit the [http://elinux.org/RPi\\_Low-level\\_peripherals](http://elinux.org/RPi_Low-level_peripherals) webpage for detailed information about individual GPIO pins.

### 2.2.2 The PiFace Digital expansion board

Necessary `IODRV` block configuration for PiFace Digital:

- Block name – `RPI`
- module – `RPiDrv`
- classname – `RPiDrv`

Because the inputs and outputs of the board are strictly separated, the input flags contain `PFI` string and the output ones contain `PFO` string as shown in Fig. 2.5. Similarly to the GPIO pins, the pull-up resistors in inputs can be activated by the optional



character U in the signal name. There are no pull-down resistors available on the PiFace Digital.

All the input and output flags for the PiFace Digital expansion board are prepared by default in the folder

C:\Program Files (x86)\REX Controls\REX <version>\Examples\PiFaceDigital\_examples\00\_IO\_Flags.

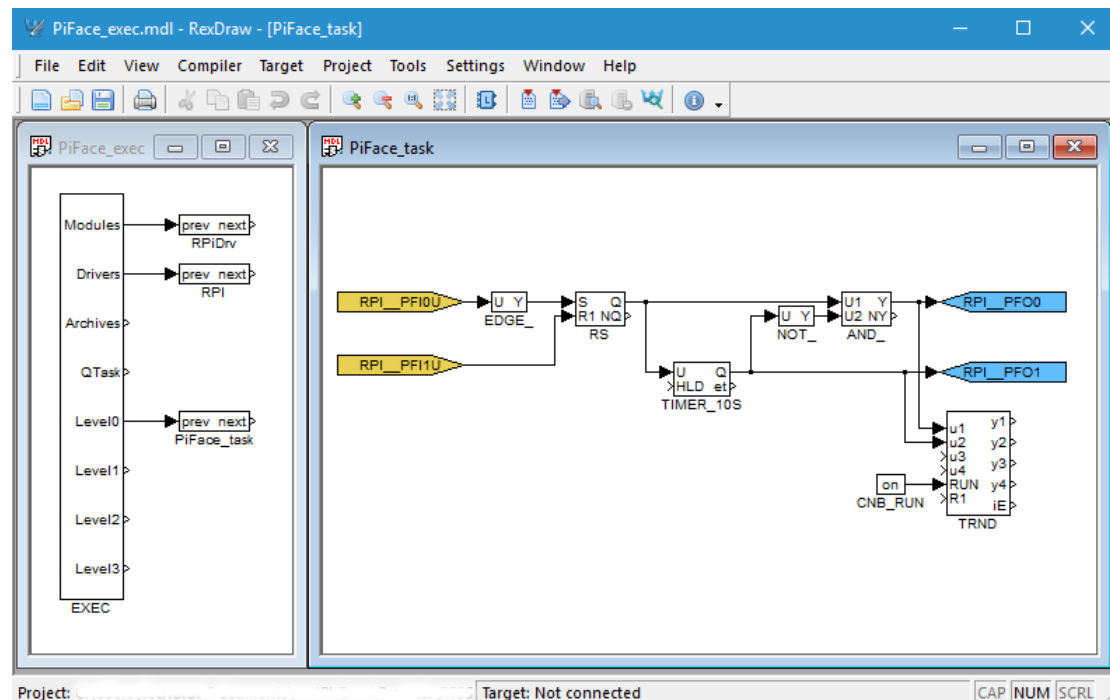


Figure 2.4: Input and output flags when using PiFace Digital

The numbering of the screw terminals of the PiFace Digital is depicted in Fig. 2.5.

It is also possible to read/write all eight inputs/outputs of PiFace Digital at once. This is faster than working with the individual signals. In that case the user must use the INOCT and OUTOCT blocks named RPI\_\_PFI and RPI\_\_PFO respectively.

### Multiple PiFace Digital boards

It is assumed by default, that the PiFace Digital board is configured to have the address 0. If it is not the case, the address must be included in the input/output flag. E.g. RPI\_\_PFO3C2 refers to the 4th output of the PiFace Digital card with address 2.

### 2.2.3 The UniPi expansion board

Necessary IODRV block configuration for UniPi expansion board:

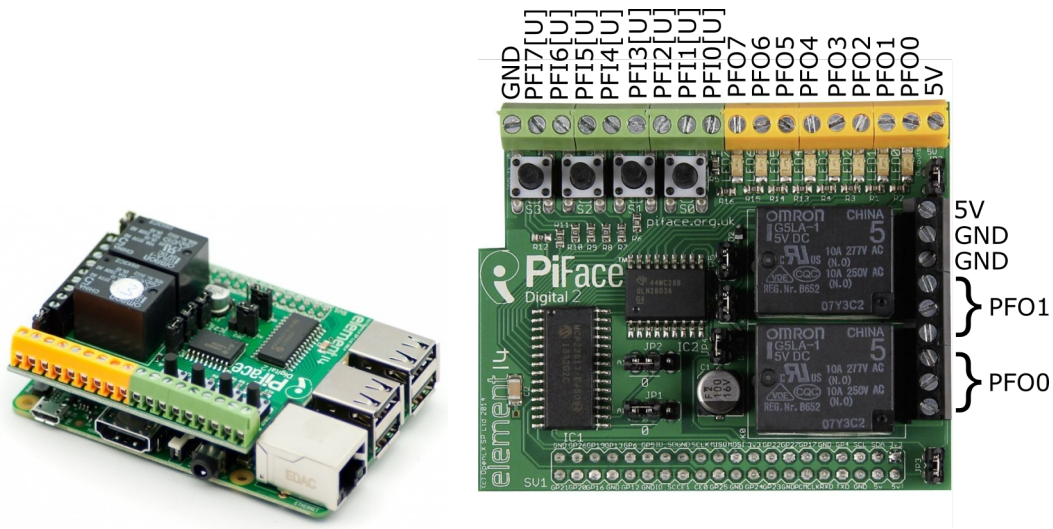


Figure 2.5: PiFace Digital 2 – numbering of the screw terminals

- Block name – UNP
- module – RPiDrv
- classname – UnpDrv

The inputs and outputs of the UniPi expansion board can be accessed as shown in Fig. 2.6. The link to a particular IO pin consist of driver name UNP, two underscores \_\_, pin number and an optional. The pin numbering of the UniPi expansion board is shown in Fig. 2.7. All the input and output flags for the UniPi expansion board are by default prepared in the folder

C:\Program Files (x86)\REX Controls\REX <version>\Examples\UniPi\_examples\00\_IO\_Flags.

#### 2.2.4 The Intellisys PIO expansion board

Necessary IODRV block configuration for Intellisys PIO expansion board:

- Block name – PIO
- module – RPiDrv
- classname – PioDrv

The inputs and outputs of the Intellisys PIO expansion board can be accessed as shown in Fig. 2.8. The link to a particular IO pin consist of driver name PIO, two underscores \_\_, pin number and an optional. The pin numbering of the Intellisys PIO expansion board is shown in Fig. 2.9. All the input and output flags for the Intellisys PIO expansion board are by default prepared in the folder

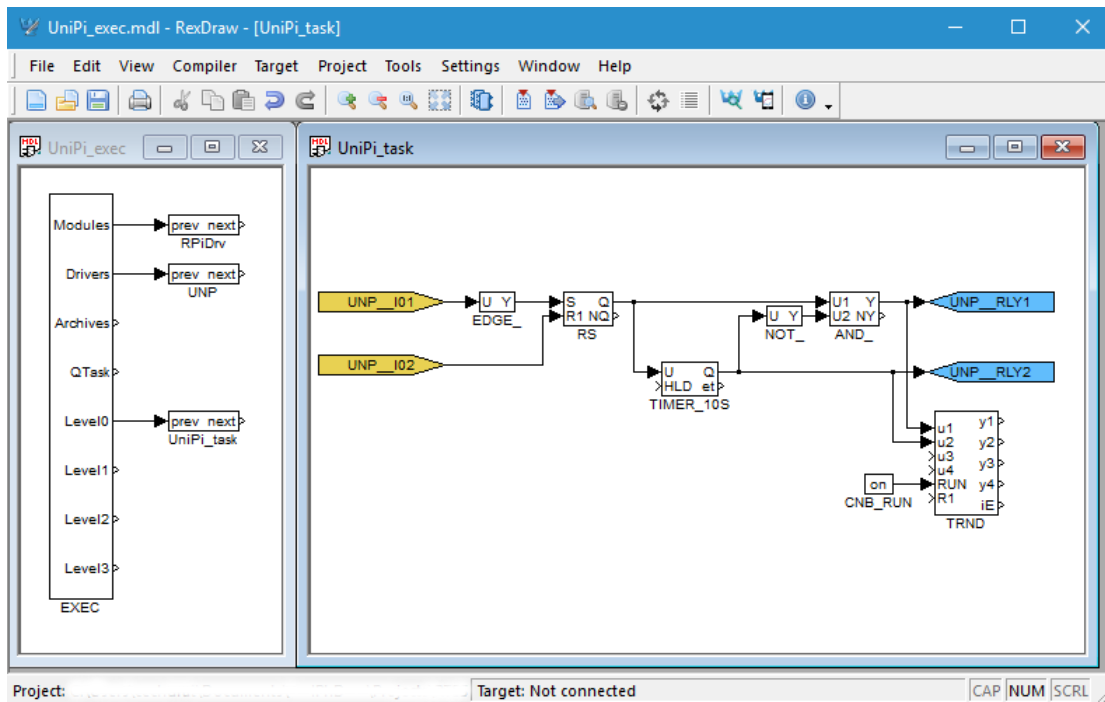


Figure 2.6: Input and output flags when using UniPi

C:\Program Files (x86)\REX Controls\REX <version>\Examples\PIO\_examples\00\_IO\_Flags.



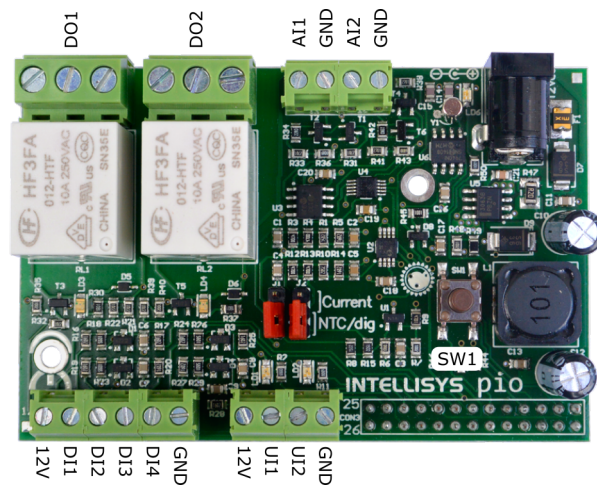


Figure 2.9: Intellisys PIO – numbering of terminals

## Chapter 3

# Troubleshooting

In the case that the diagnostic tools of the REX Control System (e.g. **RexView**) report unexpected or incorrect values of inputs or outputs, it is desirable to test the functionality outside the REX Control System (command line tools, simple Python script, etc.). Also double check the configuration – the most common problems include:

Hardware problem – incorrect wiring

GPIO pin access problem – the GPIO pin is used by other device (SPI bus, I2C bus, serial line) or program

In the case that the given input or output works with other software tools and does not work in the REX Control System, report the problem to us, please. E-mail is preferred, reach us at [support@rexcontrols.com](mailto:support@rexcontrols.com). Please include the following information in your description to help us process your request as soon as possible:

- Identification of the REX Control System you are using. Simply export it to a file using the **RexView** program (Target → Licensing... → Export).
- Short and accurate description of your problem.
- The configuration files of the REX Control System (.mdl files) reduced to the simplest case which still demonstrates the problematic behavior.

# Bibliography

- [1] The Raspberry Pi Foundation. Raspberry Pi. <http://www.raspberrypi.org>, 2013.
- [2] University of Manchester. PiFace Digital Interface. <http://www.piface.org.uk>, 2013.
- [3] REX Controls s.r.o.. *Getting started with REX on Raspberry Pi*, 2013.