

# Open source Raspberry Pi with CANopen

*Revolution Pi involves the idea of providing an inexpensive industrially viable version of the Raspberry Pi under "Open Source" conditions and making a "community based project".*

Industry 4.0 and Internet of things (IoT) are changing the requirements for the control level dramatically. Firstly, the need for decentralized controllers (and communication in general) will increase considerably, and secondly, completely different applications will also be integrated gradually in higher-level networks.

Building technology, event technology, house technology, IoT requirements, private control tasks, surveillance technology, process automation, and of course automation technology as well, are moving closer together. Decentralized solutions are gaining in importance and thus the accompanying requirements for inexpensive, scalable, and industrially viable small control systems. Furthermore, there is a great need for connecting these small control systems to a CANopen network, for example. Even the desire for "Open Source" solutions is becoming greater and cloud solutions will already soon be the standard in the industry. But how could such a solution look like?

## Revolution Pi

Revolution Pi is an open, modular and inexpensive industrial PC based on the established Raspberry Pi while meeting the EN61131-2 standard. It is supplemented by digital and analog I/O modules as well as by appropriate Ethernet and fieldbus gateways such as CANopen. The hardware and software is "Open Source" and all circuit diagrams and source codes are open to everyone.

It's a small computer based on the Raspberry Pi Compute Module that has USB, Ethernet, and HDMI connections. Robust 24-V industrial hardware is integrated into its DIN rail housing. As a result, this hardware meets all requirements for a fully-fledged, industrially viable small control system.

The Revpi Core is an open platform, on which everything from the operating system to applications can be installed, which also runs on a Raspberry Pi. A specially modified Raspbian version with a real time patch and appropriate drivers for the expansion modules is available as an operating system. On this basis, the Soft PLC from logi.cals and Axel, Teamviewer, and Scada software Procon-Web-IoT can be used, for example. This means that the Revpi Core is a complete and operational PLC.

Through the modular design of the family, for example, CANopen can connect the Revpi Core to digital and analog input and output modules as well as certified gateways to all important fieldbuses.



*Figure 1: Due to the gateway expansion module for CANopen, The Revpi Core 3 can be integrated into a CANopen network (Photo: Kunbus)*

All cyclically exchanged process data stem from a central process image in the Revpi Core or are stored there. The central process image is a memory area, in which the process data are saved at predetermined addresses. Developers can write in the process image or read it from there by simply invoking the operating system. Connected gateways such as CANopen also exchange their data with the central process image of the Revpi Core.

The "Open Source" concept also allows users to use own software and program under Linux with Python. All drivers and operating software used as well as all process data can be accessed for this purpose. Developers can write their own application programs with Python, C+, or other programming languages and the well-known tools for Raspberry Pi and thereby use Linux functions to access the process image.

The I/O expansion modules come in four versions, which all have the same 28-pin I/O connector at the front:

- ◆ The standard version Revpi DIO has 14 digital inputs and 14 digital outputs
- ◆ The special version Revpi DI has 16 digital inputs and no outputs
- ◆ The special version Revpi DO has 16 digital outputs and no inputs
- ◆ Revpi AIO is the analog variant with four analog inputs, two analog outputs, and two RTD channels

In all four variants, the inputs and outputs are galvanically isolated from the logic component. All four versions are protected against disturbances, polarity reversal or surges according to EN61131-2 and can be operated (like the base module ) between -40 °C and +50°C ambient temperature and up to 80 % relative humidity. The power ▶

supply unit works with 10,2 V to 28,8 V input voltage and only requires a maximum of 50 mA.

The previous task of the modular gateways was to connect industrial networks to different network protocols (e.g. a CANopen network to a Profinet network). The approach of accommodating the individual protocols in separate DIN rail modules ensures high flexibility because all available protocol modules are mutually compatible. One benefit of the modular design is the cost factor, among other things, during changes of the technical conditions in the field. Whereas normal gateways, for example, must be replaced entirely when a network is changed, with our system only the module of the network concerned is replaced. To do this, the CANopen gateway (slave) is simply inserted into a DIN rail next to the Revpi Core and connected by means of a jumper. The gateway is enclosed in a plastic casing measuring 22,5 mm x 101,4 mm x 115 mm (W/H/D). The module is supplied with an operating voltage of 24 V, whereby the power consumption is less than 3 W. The network is connected with a connector type D-SUB 9M. The max. bit rate is up to 1 Mbit/s and up to 512 bytes of I/O data can be exchanged with the Revolution Pi. The data are stored in the process image of the Revpi Core and are available to other applications. The complete system has the protection class IP20. The CANopen expansion module has been tested and certified at CAN in Automation.

Revolution Pi firstly involves the idea of providing an inexpensive industrially viable version of the Raspberry Pi under "Open Source" conditions and making a

"community based project". Secondly, the Revolution Pi should advance the 4<sup>th</sup> industrial revolution. Thus, the Revolution Pi consists of many things. It is:

- ◆ A Raspberry Pi
- ◆ An industrial PC (IPC)
- ◆ A PLC
- ◆ An IoT gateway
- ◆ A web server
- ◆ A software platform
- ◆ A small control unit for an HMI
- ◆ A cloud solution

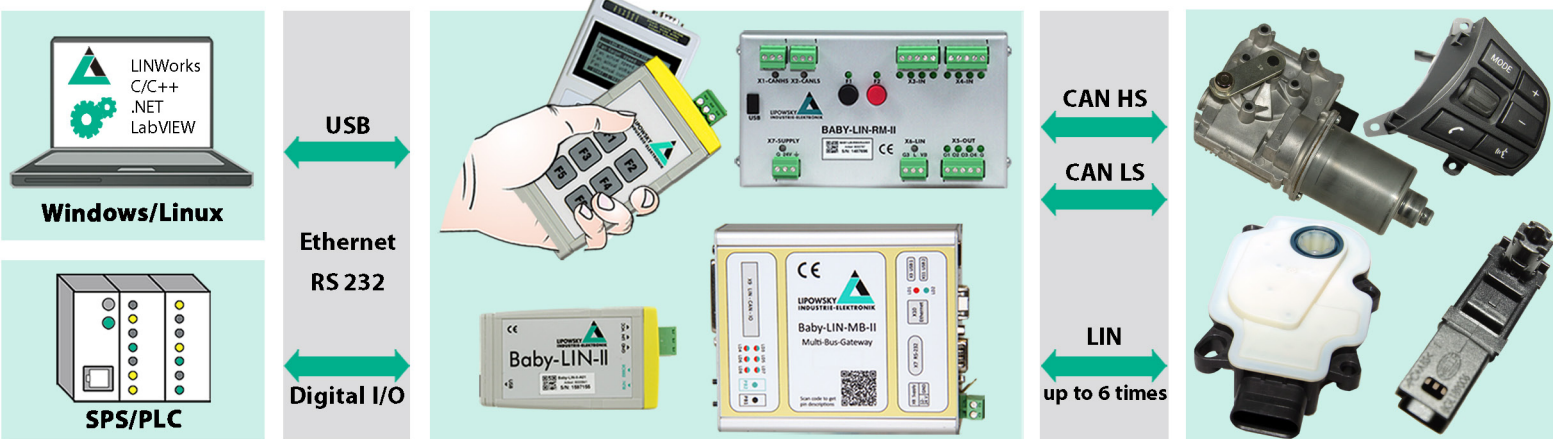
And all that together with a certified CANopen connection. ◀



Author

Andreas Müller  
Kunbus  
[a.mueller@kunbus.de](mailto:a.mueller@kunbus.de)  
[www.kunbus.de](http://www.kunbus.de)

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