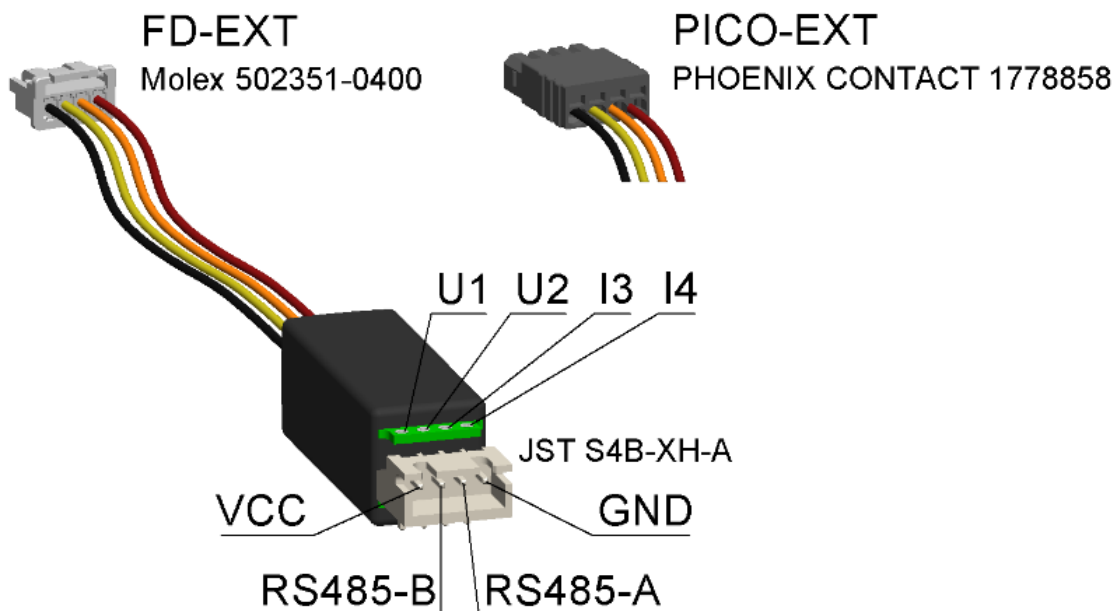


PICO-EXT / FD-EXT

Modbus-AnalogOut-Modules for PICO / FD-OEM

DATA SHEET



PICO-EXT / FD-EXT

Modbus-AnalogOut-Modules for PICO / FD-OEM

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1 OVERVIEW

The modules **PICO-EXT** and **FD-EXT** are extension modules for optical sensor OEM modules from PyroScience. The **PICO-EXT** is intended for the **PICO** family (PICO-O2, PICO-PH, PICO-T). The **FD-EXT** is used in combination with the **FD-OEM** family (FD-OEM-O2, FD-OEM-PH). Please refer to the separately available information and data sheets of these OEM modules for more information. The two versions **PICO-EXT** and **FD-EXT** possess the identical hardware and firmware, except for the different connectors aimed for the respective OEM family.

The modules **PICO-EXT** or **FD-EXT** can only be operated, if a **PICO** or a **FD-OEM** module is connected to them. If this is not the case, the **PICO-EXT** or **FD-EXT** will not start up and no Modbus communication is possible!

The modules **PICO-EXT** and **FD-EXT** provide 4 analog outputs and a Modbus interface. Each module has two digital interfaces, a RS485 interface and a UART interface. The UART interface is connected to a OEM module from the **PICO** or **FD-OEM** family. The RS485 interface can be connected to a Modbus bus. The 4 analog outputs consist of 2 current outputs and 2 voltage outputs, which can be used even if the module is not operated via the Modbus interface.

1.1 Principle of Modbus Operation

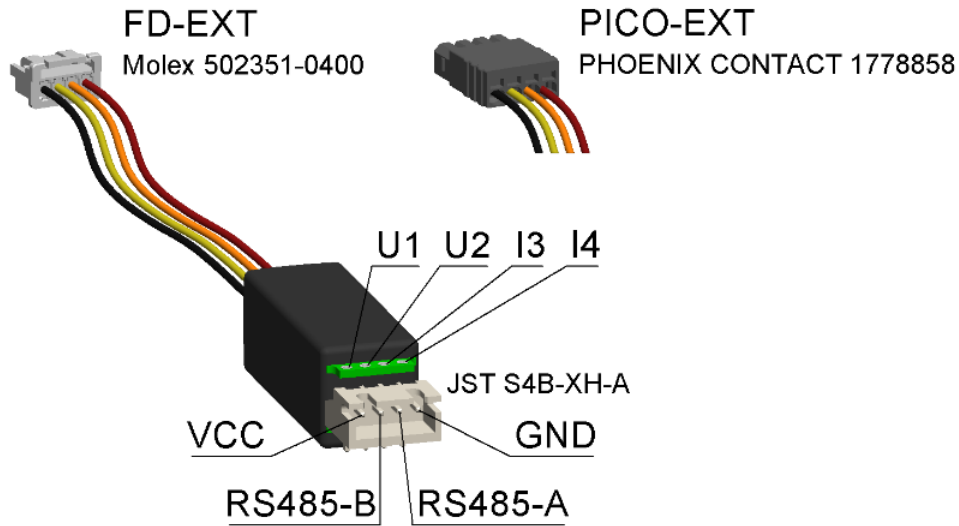
Several features of the modules **PICO-EXT** and **FD-EXT** (e.g. slave address, sample interval, analog output features) can be configured via the Modbus interface. The actual configuration (i.e. the content of the Modbus registers) is NOT saved within the module, but it is saved within the flash memory of the attached OEM module (**PICO** or **FD-OEM**). After a power cycle, the **PICO-EXT** and **FD-EXT** automatically read out the last configuration from the connected OEM module and loads them into the respective Modbus registers. Refer to chapter 3 for more details.

1.2 Stand-alone Operation with Analog Outputs

The modules can be operated in a stand-alone mode, where the module automatically triggers periodic measurements and outputs the results at the analog outputs. This stand-alone mode can be configured via the Modbus interface. However, PyroScience offers software tools for configuring such a stand-alone mode without any knowledge about Modbus. Please refer to chapter Fehler! Verweisquelle konnte nicht gefunden werden. for further details.

2 INTERFACES

The following figure provides an overview on the interfaces:



Always connect first the UART interface to the OEM module (**PICO** or **FD-OEM**), before applying power supply via the RS485 interface.

2.1 RS485 Interface

The RS485 interface (receptacle: S4B-XH-A from JST) provides the connection to the Modbus bus. It is based on the standard half-duplex configuration using two wires for the communication. The pin configuration is:

	Symbol	Description	Range	Comment
1	VCC	Supply Voltage	10 - 15 VDC (typ. 12V) *	typ. 30 mA current + currents used by analog outputs
2	RS485-B	Transceiver B	0 - 3.3V	5V tolerant
3	RS485-A	Transceiver A	0 - 3.3V	5V tolerant
4	GND	Ground		

*The minimum supply voltage of 10V is required to assure the full output range of the current outputs. If only the voltage outputs are used, then the supply voltage can be as low as 6V. If none of the analog outputs is used, then the supply voltage can be as low as 5V.

The RS485 configuration is: **19200 Baud, 8 data bits, 1 stop bit, even parity.**

2.2 Analog Outputs

The Module offers 4 solder points for 2 voltage outputs and 2 current outputs. The Ground pin (GND) of the RS485 interface serves as the ground for the voltage outputs, and as the current sink for the current outputs.

Pin	Parameter	Scaling	Output Range	Resolution
U1	any result register of the attached OEM module	configurable	0 - 5 V	14 bit
U2	any result register of the attached OEM module	configurable	0 - 5 V	14 bit
I3	any result register of the attached OEM module	configurable	4 - 20 mA	14 bit
I4	any result register of the attached OEM module	configurable	4 - 20 mA	14 bit

2.3 UART Interface

The UART interface (**FD-EXT**: 502351-0400 from Molex, **PICO-EXT**: 1778858 from Phoenix Contact) provides the connection to the OEM module. All communication via this UART interface is handled automatically, so no configuration is required.

Pin	Symbol	Description	Range
1	U _{supply}	Supply Voltage	3.3 VDC
2	TX	UART Transmit	0 - 3.3V
3	RX	UART Receive	0 - 3.3V
4	GND	Ground	

UART configuration: 19200 Baud, 8 data bits, 1 stop bit, no parity.

3 MODBUS IMPLEMENTATION

The RS485 interface of the module can be connected to a standard Modbus bus. Up to 247 devices can be connected to a single bus consisting of the 4 wires required by the RS485 interface (2.1). The Modbus protocol is a popular industrial communication protocol reckoned by its simplicity and robustness. Modbus libraries are available for virtually any programming language. Numerous data logging systems support the Modbus protocol.

3.1 Modbus RTU

An essential element of the Modbus protocol are slave addresses and registers. Every Modbus device possesses a configurable slave address (range 1-247) and a certain set of registers, which contain e.g. integer numbers. There exist read-write registers (e.g. temperature offset) and read-only registers (e.g. the result of a temperature measurement). The Modbus RTU protocol provides commands, allowing a “master device” (e.g. a PC) to read or write specific registers from a device with a specific slave address.

The **FD-EXT** and **PICO-EXT** modules comply with the “BASIC Implementation Class” of Modbus using the RTU mode. Details can be found in the official documentation “Modbus over serial line specification and implementation guide” provided by the **Modbus - Organization, Inc.** Please refer to the homepage: <https://www.modbus.org/>. Here you can get all information e.g. how to read and write Modbus registers.

3.2 PyroScience Unified Protocol

All optical meters from PyroScience with firmware generation 4 (i.e. firmware version \geq 4.0, introduced in 2020) comply to the so called PyroScience Unified Protocol (PSUP). This has the advantage for developers that custom software written for operating e.g. a laboratory device FireSting-PRO can be almost unchanged transferred to an OEM device like the PICO-O2 or FD-OEM-O2.

The **FD-EXT** and **PICO-EXT** modules act now as a translator between the PyroScience protocol and the Modbus protocol. All further details, especially the Modbus register map, can be found in the reference manual “PyroScience Unified Protocol” available for download on the PyroScience website here:

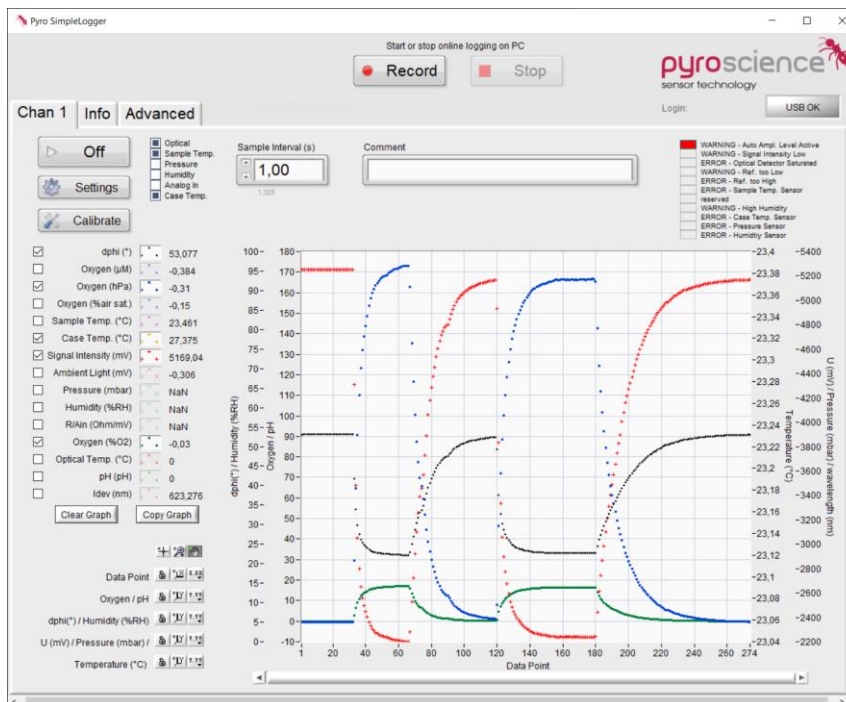
<https://www.pyroscience.com/en/downloads/oem-devices>

4 EVALUATION SOFTWARE

PyroScience offers the USB adapter cable EXT-USB for evaluation purposes, which allows to operate the PICO-EXT or FD-EXT modules with the free software package Pyro DeveloperTool. It offers simple settings and calibration procedures, as well as basic logging features. Furthermore, it allows to configure the broadcast mode and the analog outputs (“stand-alone mode”). This way, the modules can be configured and operated without any usage of the Modbus interface.

Using the software Pyro DeveloperTool always requires 3 items from PyroScience:

1. An OEM module (e.g. PICO-O2 or FD-OEM-PH)
2. A Modbus-AnalogOut-Module (e.g. PICO-EXT or FD-EXT)
3. The USB adapter cable EXT-USB



4.1 Installation

System requirements: PC with Windows 7/8/10 and min. 1000 MB free disk space.

Do not connect the USB adapter cable to your PC before the software has been installed! The software will automatically install the appropriate USB-drivers.

Installation steps:

- Download the Pyro DeveloperTool from <https://www.pyroscience.com/en/downloads/oem-devices>

- Unzip and start the installer and follow the instructions.
- Connect the modules (e.g. PICO-O2 + PICO-EXT + EXT-USB) to a USB 2.0 port of your windows PC.
- Start the Pyro DeveloperTool software.

4.2 Configuring Stand-alone Operation

For general information on adjusting settings and on performing proper sensor calibrations, please refer to the **Pyro DeveloperTool manual** available on <https://www.pyroscience.com/en/downloads/oem-devices>.

If the Pyro DeveloperTool detects a PICO-EXT or FD-EXT module, there will be a special behavior when the user closes the software. A configuration Window will appear, allowing to adjust the analog outputs and the broadcast mode. For example, you can configure the voltage output U1 for 0-100 %O₂, and the voltage output U2 for the temperature 0-50°C. Then you enable the broadcast mode (the push button turns green) and enter e.g. a broadcast interval of 2000 ms. Now you close the window.

Now remove the USB adapter cable EXT-USB from the PICO-EXT or FD-EXT, as it does not provide enough voltage in order to realize the full output range of the analog outputs. As soon as 12V DC are applied to the power supply pins of the PICO-EXT or FD-EXT, the modules will automatically start periodic measurements (e.g. with 2000 ms interval) and the voltage outputs will output the measurement results.

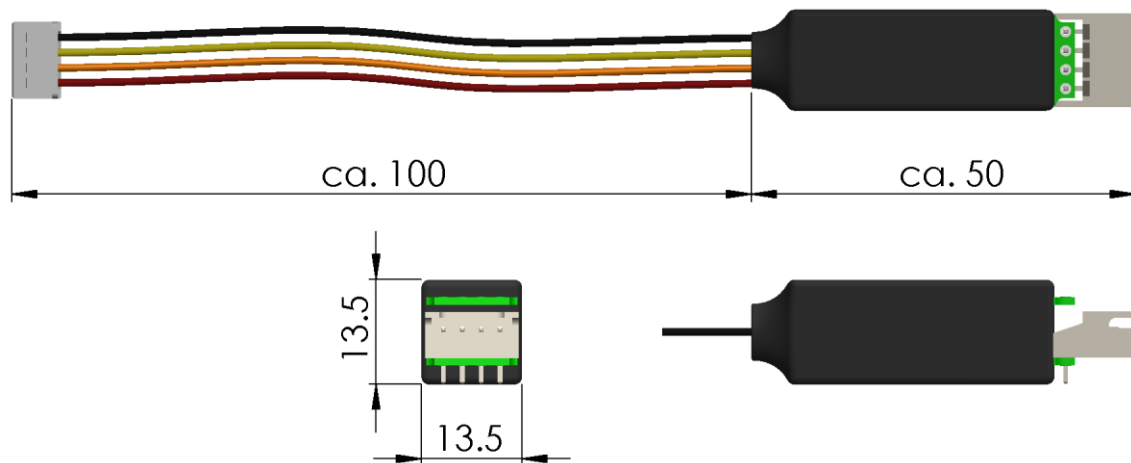
Note: While the Pyro DeveloperTool is operating the module, the analog outputs are inactive!

Explanation for advanced user: The Pyro DeveloperTool activates a so called transparent mode within the PICO-EXT or FD-EXT. This mode allows to communicate directly with the microcontroller of the connected OEM module (e.g. PICO-O2 or FD-OEM-PH), while the “Modbus microcontroller” on the PICO-EXT or FD-EXT is inactive. As the Modbus microcontroller operates also the analog outputs, the latter are also inactive during the transparent mode. For more in-depth information refer to the reference manual “PyroScience Unified Protocol” available for download on the PyroScience website here:

<https://www.pyroscience.com/en/downloads/oem-devices>

5 APPENDIX

5.1 Dimensions



5.2 Warnings

Do not use these products in safety critical devices or in any other application where failure of the product could result in loss of life, personal injury, or damaged property.

This device and the sensors are not intended for aerospace, medical, breath control, diving, military or other safety-relevant applications.

Avoid all sources of ignition especially if the sensors are used in pure oxygen or oxygen enriched atmospheres.

The information and specifications in this document are subject to change without prior notice.

The data contained in this document is for guidance only. Customers should test under their own conditions, to ensure that the sensors are suitable for their own requirements.

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