

Operating manual for the mp-Multiboard



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General Description

The mp-Multiboard is an evaluation board that allows to control up to four mp6 micropumps simultaneously with various waveforms, frequencies ranging from 8 Hz up to 800 Hz and amplitudes from 0 Vpp to 250 Vpp.

The mp-Multiboard has a pump driver and an Arduino compatible microcontroller onboard. Both can be fully configured by the user to fit the required application demands. The pump driver outputs are wired to four Molex flex cable connectors so that Bartels Mikrotechnik micropumps (mp6) can be directly attached. The pump driver is connected to the microcontroller through the I²C bus. Additionally there are multiple auxiliary connectors on board for future use to connect a flowsensor, pressure sensor and active valves. Some of the microcontroller I/O pins are externally connectable through a pin header for use in custom user projects. A micro-USB connector on the microcontroller can be used to supply power, upload software and for serial communication. An external power

Declaration of conformity.

Bartels Mikrotechnik GmbH declares that the products are compliant to the RoHS directive 2011/65/EU. The controller comply with the requirements of EMV 2014/30/EU and CE markings have been affixed to the devices. Additionally, the controllers are also compliant to the EU Low Voltage Directive 2014/35/EU.

Description of functions.

The micropumps have been developed for the transport of gases or liquids. The controllers have been developed for operating the micropumps. Bartels Mikrotechnik can assume no liability for damages resulting from the pump media. This applies especially for hazardous fluids.

The pumps must be operated with Bartels Mikrotechnik electronics. Bartels Mikrotechnik GmbH cannot guarantee the proper work of the units with customer specific electronics. If other controllers than the ones from Bartels Mikrotechnik are used, Bartels Mikrotechnik disclaims any warranty.

Moreover, please note that components of the controller and pump are operating with high-voltage. Therefore, persons wearing pacemakers are recommended to avoid the operating system.

Bartels Mikrotechnik assumes no liability for abnormal handling, improper or negligent use of the micropump and the controller that is not conform to the specified purpose of the system. This applies especially for micropump controllers, components and systems of other manufacturers, which have not been certified by Bartels Mikrotechnik.

We guarantee that the micropumps comply with the actual state of scientific and technical knowledge and due to this, the operational risks are limited to a minimum.

Do not open the housing of the micropump and the controllers. In those cases, Bartels Mikrotechnik cannot issue a guaranty anymore. Please keep this manual safe and give a copy to all users.

Proper use

Intended purpose.

The mp-Multiboard in combination with the mp-Highdriver4¹ is designed as a next step from the mp6-QuadEVA board to control up to four micropumps for gas pumping, i.e. four pieces of mp6-gas micropumps. Nevertheless, it is



also possible to pump liquids, with all our mp6 micropumps; though the higher frequencies will not result in a performance boost.

If liquids should be pumped, please regard the following:

The micropump is intended for pumping liquids or gases with varying flow rates controlled by the electronics. The mp-Highdriver4 is intended as a pump driver for the mp6.

Any other use of the micropump or controller unit is deemed improper.

Do not make any modifications or extensions to the pump or controller without the prior written consent of the manufacturer. Such modifications may impair the safety of the unit and are prohibited! Bartels Mikrotechnik GmbH rejects any responsibility for damage to the unit caused by unauthorized modifications to the pump and risk and liability are automatically transferred to the operator.

Other drivers which can be used with the mp-Multiboard are the mp-Lowdriver and the mp-Highdriver which are both for the use of one single mp6 micropump. For more detailed description of the single drivers please check it in the relevant manuals.

¹ mp-Highdriver4 was formerly known as mp6-QuadOEM

Misuse.

The use of liquids, which may alone or in combination create explosive or otherwise health-endangering conditions (including vapors) is not permitted.

Staff selection and qualification.

All work in connection with the installation, assembly, commissioning/decommissioning, disassembly, operation, servicing, cleaning and repairing of the pump and the controller must be carried out by qualified, suitably trained and instructed personnel. Work on electrical components and assemblies must be carried out by personnel with the necessary qualifications and skills.

Safety Notice.

The mp Highdriver4 generates voltages of up to 250 Vpp. All parts of the controller can carry voltages in this range. Therefore, the board should only be used by qualified personnel. Although the output power of the module is very low, proper insulation according to the application conditions needs to be considered by the customer. This especially applies to the bottom side of the PCB. Contact with water or other liquids needs to be prevented. The pump must not be unplugged while the board is active.

 **DANGER**

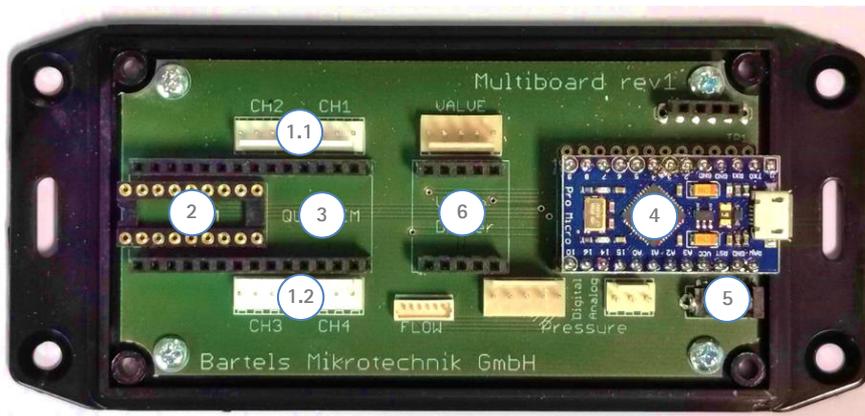
THE DEVICE CAN CARRY HIGH VOLTAGE!
BE CAREFUL, WHILE CONNECTING AND HANDLING THE BOARD!



Overview

The mp-Multiboard is available in different combinations and has the following standard components included:

- mp-Multiboard board
- micropump mp6
- Micro-USB cable
- selective: pump driver mp-Lowdriver, mp-Highdriver, mp-Highdriver4



The figure above shows the following components:

- | | | |
|--|----------------------------|------------------------------------|
| 1.1 & 1.2 Pump cable harness connector | 3. mp-Highdriver4 socket | 5. Power supply terminal connector |
| 2. mp-Lowdriver / Highdriver socket | 4. Arduino microcontroller | 6. Socket for valve driver |



Setup instructions

Make sure pump driver, pump cable harness and pumps are plugged in correctly; install the Arduino Pro Micro USB driver; connect the Multiboard via USB cable to the computer; start the Multiboard App

Do not disconnect pumps or driver while Multiboard is powered (via USB or otherwise)!

Electrical Characteristics

The Multiboard is powered via USB connection of the microcontroller. It does comply with the USB standard and does not require more than 500mA to operate under normal conditions. If in any case more current is needed on the board, an external power supply can be connected to the power supply connector labeled "POWER".

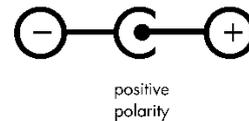


Figure 1: Connector Polarity

The power supply connector is directly wired to the RAW and GND pins of the microcontroller and tied to its onboard voltage regulator. Recommended input voltage for this connector is 7,5-12V. The mate plug should have an outer diameter of 3,5 mm and an inner diameter to be able to accept the 1 mm pin. See Figure 1 for connector polarity. A suited power supply is available in our store.

For all other characteristics of the microcontroller or the pump driver please refer to the corresponding manual or datasheet.

Information about the pump drivers and the mp6 micropumps is available on our download-page:

<https://www.bartels-mikrotechnik.de/downloads/>



Pump drivers

The Multiboard is compatible to our mp-Lowdriver, mp-Highdriver and mp-Highdriver4. Depending on the driver attached to the Multiboard, capabilities and ranges of amplitude and frequency can change. Please refer to the according manual for details. When attaching the pump driver make sure to follow the correct orientation as shown in the pictures below (notice the white dot always pointing outwards).



Use caution when removing the pump driver from the board in order to not bend the pins of the chip. IC pliers are recommended to be used for extraction.



Valve driver

The socket labeled "Valve driver" accepts our current dual valve driver that is able to drive two Takasago valves. The valves are current driven and the driver takes care of generating and supplying a constant current on two separate outputs on demand. The two outputs are digitally controlled via the Multiboard.

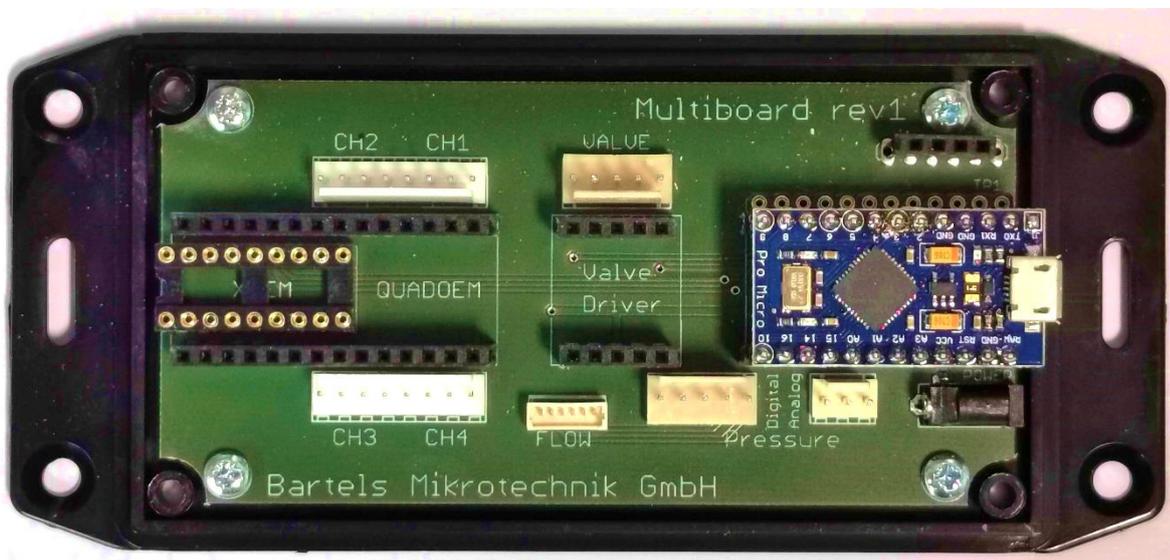
Attention: Since the valve driver needs a minimum of 4.5V to operate correctly, an external power supply needs to be attached to the Multiboard. The 5V rail of the Multiboard supplied by the USB is not reliable enough, to guarantee operation. See chapter Electrical Characteristics for more details.



Sensors

Since App version 1.5 (and Firmware 20210428) the Multiboard supports readout of digital flow and pressure sensors. The liquid flow-sensors of type SLF3S-0600F and SLD3S-1300F from the manufacturer Sensirion can be attached to the connector labeled "Flow" via a straight 6-pin ribbon cable. Both sensors can be bought from our store with the ribbon cable included. For measuring pressure, we have implemented the readout for Honeywell ABP-series 15PSI digital pressure sensor. This one is sold on our store with a cable and 5-pin connector already attached, fitting the pinheader labeled "Pressure digital".

Auxiliary connectors



The Multiboard has multiple auxiliary connectors available. Some of these are not in use at the moment and will be documented in this manual once fully implemented. Nevertheless, here is a list of the connectors and their (future) use:

CH2 / CH1, CH3 / CH4	Two 8-pin connectors for pump cable harness. Each cable harness has two FFC connectors on the other end to connect to the micropump flex cable
Valve	5-pin connector for two active valves
TP1	12-pin header for custom purposes
Flow	6-pin connector for an I ² C flow-sensor
Pressure digital	5-pin connector for an I ² C pressure-sensor
Pressure analog	3-pin connector for an analog pressure-sensor
Power	Barrel power supply connector



USB-driver

The most current USB-driver is commonly installed with the Arduino IDE. If you don't want to install the whole IDE and just need the driver, you can download the IDE including the driver as ZIP archive from the Arduino download site (<https://www.arduino.cc/en/software>) and install just the USB driver.

A driver-package is also included in the Multiboard App download.

Multiboard App

The Multiboard App is a Software tool that enables you to control various features of the Multiboard remotely via USB. It interfaces with the Arduino via the USB-Serial interface and calls the protocol commands of the Firmware. A description of the protocol and list of commands will be available in the future, allowing to use the Multiboard using other software like LabVIEW, Matlab and python.

After executing the app, the following screen opens up:

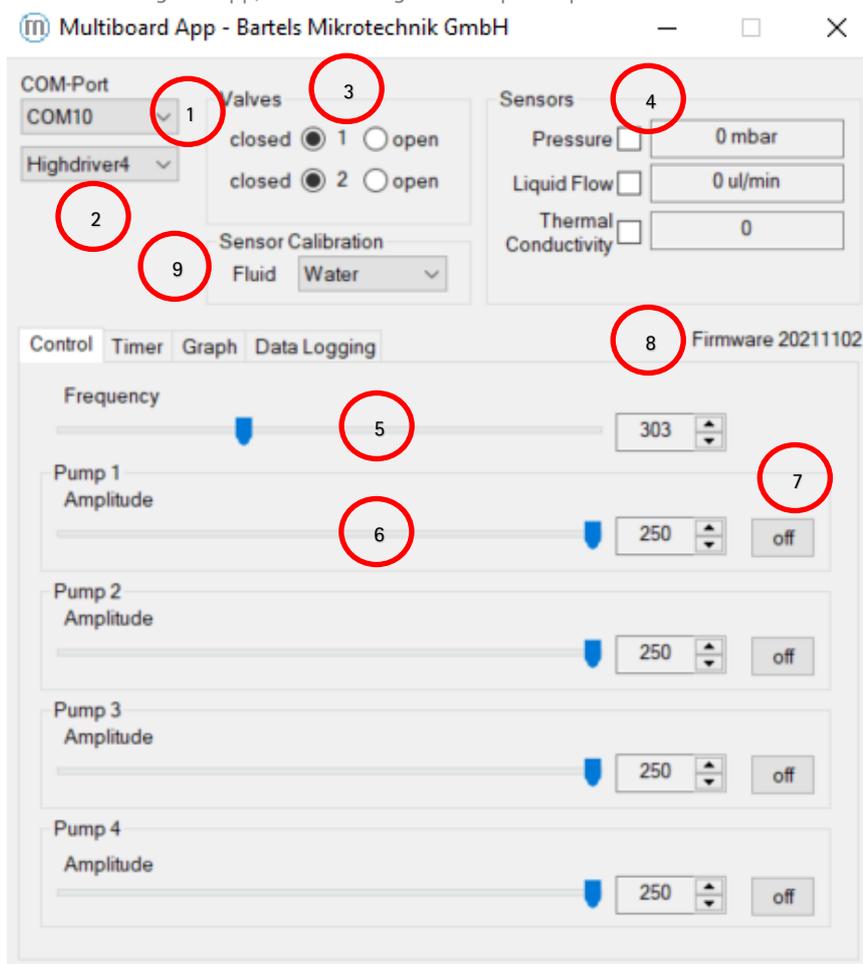


Figure 2 Multiboard App Gui

Select the COM-Port of your Multiboard in the list-box (1), followed by the pump driver currently inserted on the Multiboard in the list-box below (2).



Now you are able to adjust each pump's amplitude separately (6), switch every pump on and off (7) and change the frequency for all pumps globally (5).

The radio-buttons in the Valves-group (3) can be used to open and close active valves connected to the Multiboard, when a valve driver is plugged onto the Multiboard.

The checkboxes in the Sensors-group (4) can be used to enable & disable sensor readout when sensors are plugged into the Multiboard.

The Label (8) shows the current Firmware version on the Multiboard. Always check if newer Software is available on our Website to get the latest features of the Multiboard unlocked. The App and Firmware should be both up to date to make sure, there are no compatibility issues.

The liquid flow sensor comes with two different calibrations, one for water, the other for Isopropanol. You can select it. (9)

By selecting the Timer-tab you switch over to the Timer-mode user interface, showing settings to setup a timed on/off cycle of each pump:

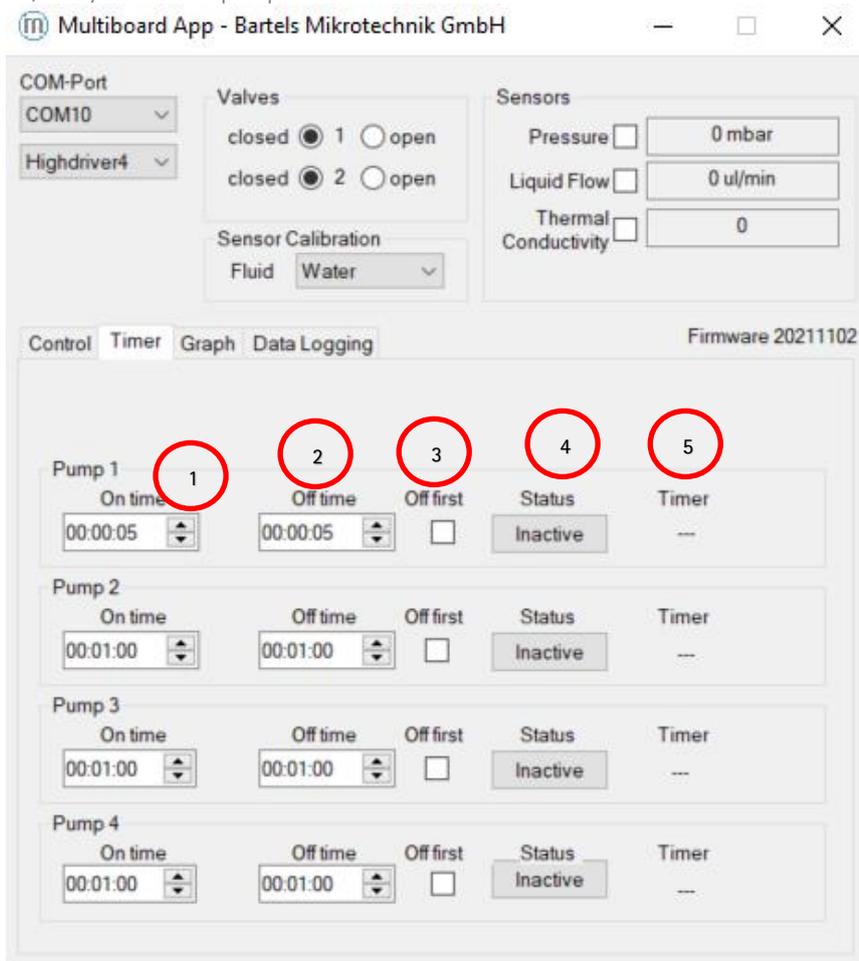


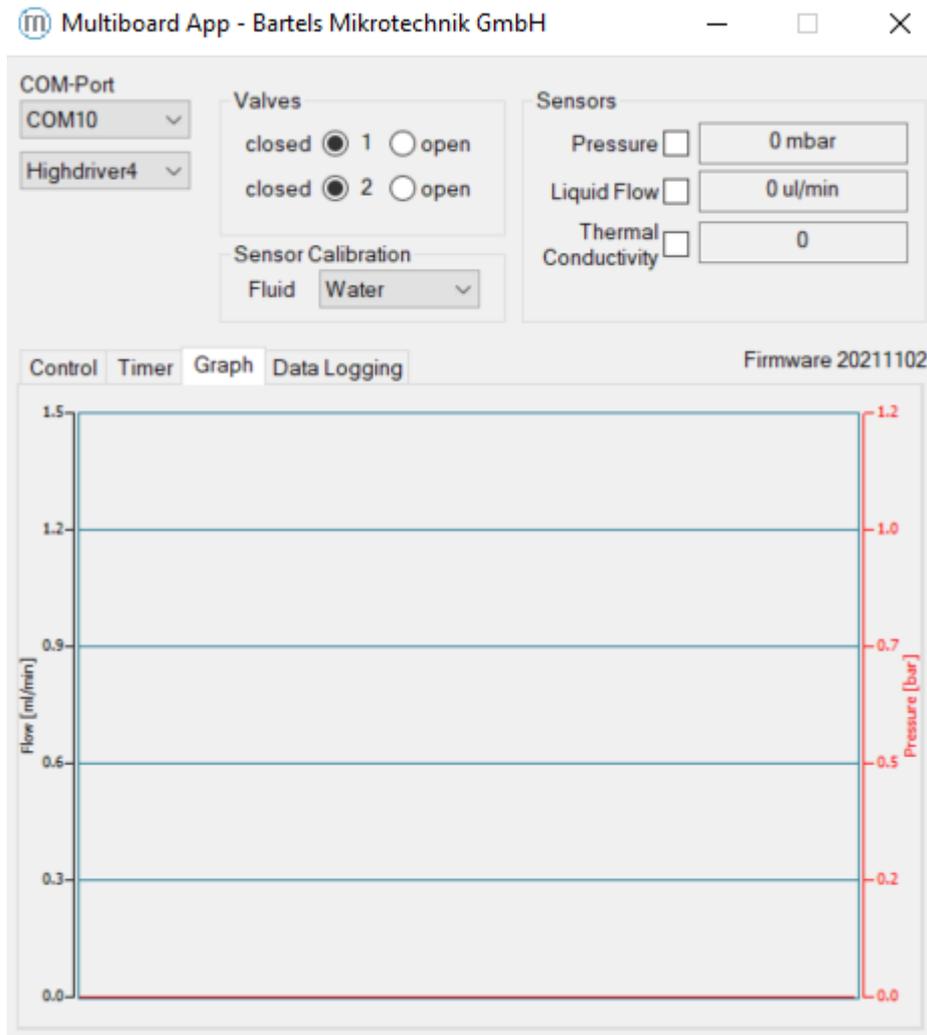
Figure 3: Multiboard App GUI in "Timer mode"

The "On time" (1) defines how long the pump is to stay activated (pumping), while the "Off time" (2) defines how long the pump is to stay deactivated before starting a new cycle. When "Off first" (3) is ticked, the cycle starts with

the pump deactivated. By pressing the "Status" button (4) this periodic pumping can be activated/deactivated for each pump. The indicator "Timer" (5) shows the current state of the pump (on/off) and the time remaining for this part of the cycle.

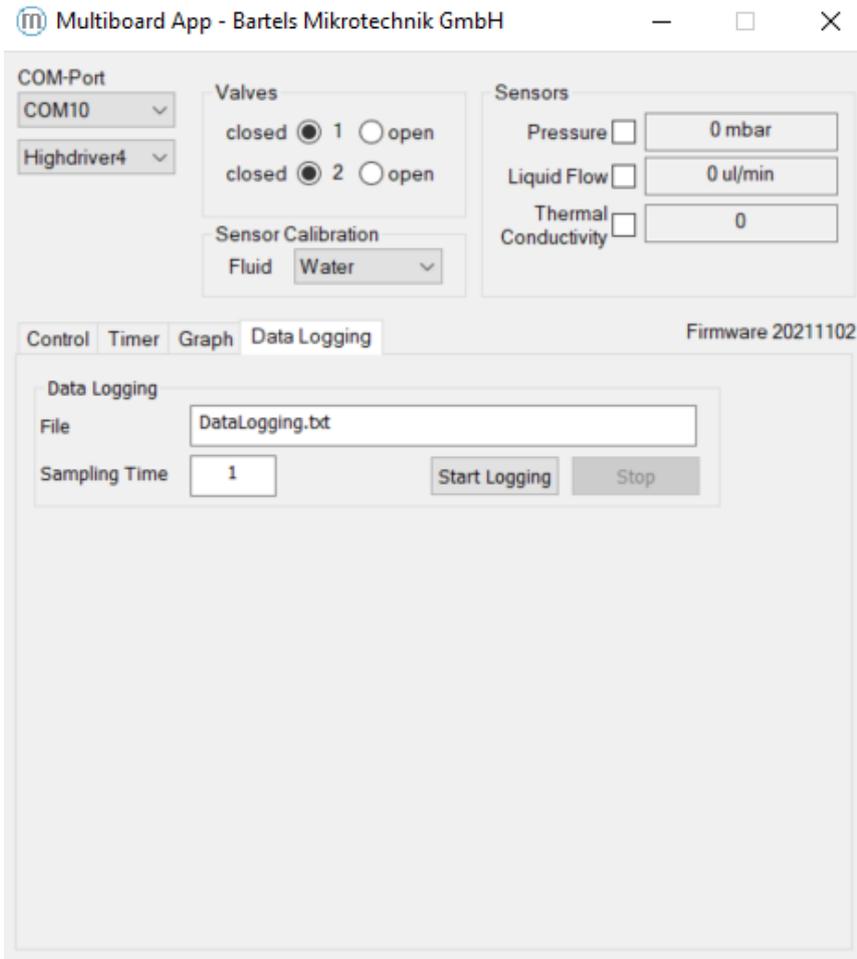
The on/off button on the Control-tab is disabled and greyed while timer mode is active. The frequency and amplitude controls are not disabled since they still take effect on the pumps in timer mode.

By selecting the Graph-tab you switch over to a Graph showing the current sensor values of the attached (and enabled sensors):



By selecting the Data Logging-Tab is possible to write the data that are read out by the sensor. The Data Logging function stores a txt.-file in the folder from which the Multiboard app is executed. The sampling time can be changed in [s].





USB/Serial Communication Protocol

The Multiboard is connected to the computer via the USB connector of the Arduino pro micro. It acts as a USB-Serial interface so the Multiboard appears on the computer as a COM-Port inside the device manager. To communicate with the Multiboard any software capable of sending and receiving data to/from a serial port can be used. Programs like Hyperterminal and PuTTY can be used to send commands directly, while programs like LabVIEW, Matlab and Python can be used to write software that interacts with the user and the Multiboard allowing for more automation and ease of use.

A list of commands used to control the Multiboard can be found in the table below:

SELECTLOWDRIVER SELECTHIGHDRIVER SELECTQUADDRIVER SELECTNONE	Tells the Multiboard which driver is currently on the board and initializes the driver
PON	turns all pumps on
POFF	turns all pumps off
P<p>ON P1ON	Turns the selected pump <p> on Example: Turns pump #1 on
P<p>OFF P1OFF	Turns the selected pump <p> off Example: Turns pump #1 on
P<p>V<a> P1V250	Sets the amplitude for the selected pump <p> to the chosen value <a> Example: Pump #1 set to 250 Vpp
P<p>V? P1V?	Gets the amplitude for the selected pump <p> Example: Returns "250" meaning 250 Vpp for pump #1
F<f> F100	Sets the frequency (for all pumps) to the chosen value <f> Example: Sets the frequency to 100 Hz.
V1ON V2ON	Turns valve 1/2 on
V1OFF V2OFF	Turn valve 1/2 off
DPON DPOFF	Enables/disables pressure readout
DFON DFOFF	Enables/disables flow readout
MC	sets signal form modus SRS
V	Displays the current firmware version
(enter key)	displays current settings of the Multiboard



Package Dimensions

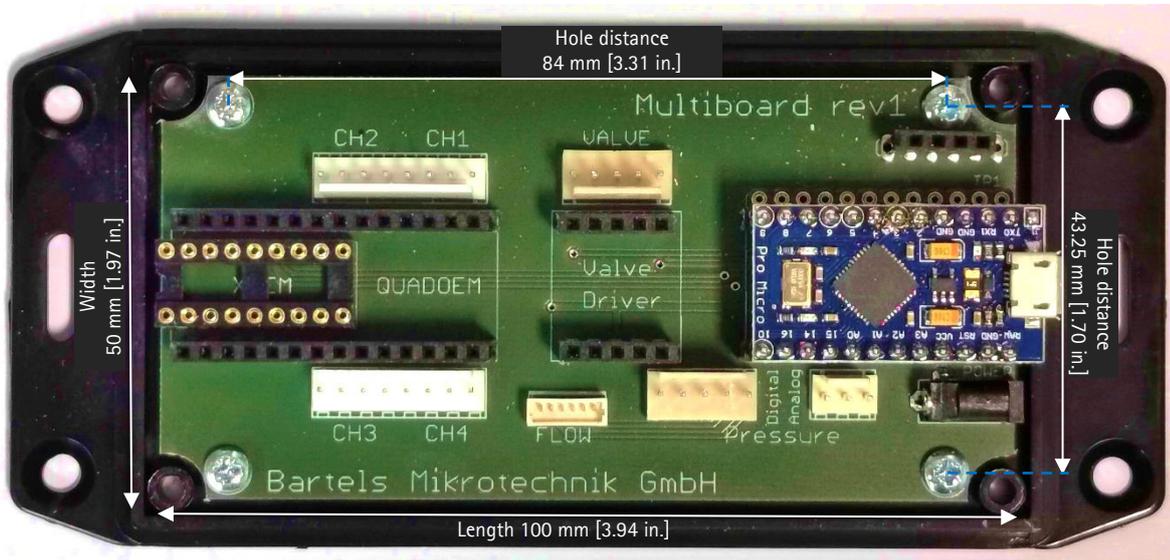


Figure 4: Package Dimensions



All values are approximate and no guarantee of specific technical properties.

Changes in the course of technical progress are possible without notice.

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