

Breathpal Sensor manual

Version July 2026
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Global description

This manual refers to the Breathpal RIP sensor version 4.1 and 5.0.

The features of Breathpal are:

- Easy attachment and operation by use of RIP strap poppers and instant working
- Small and light to allow invisible wearing: 6,2 x 2,9 x 1,0 cm, 18 grams
- 18 hour battery life and raw data storage. Recharging and logging data retrieval over USB
- Accurate 2 channel RIP measurement: resolution up to 0.02% intersection surface change
- Low temperature drift and mutual influencing of both RIP bands
- Movement and orientation sensor: 3-D 12 bits accelerometer +/- 2G
- Temperature sensor: 1 °C resolution
- Tactile feedback with integrated vibration motor
- Sample speed up to 10 samples per second, Real Time Data stamps included.
- Green status LED
- Easy firmware upgrade

This document describes

1. Operation:

- How to use the sensor,
- how to attach and detach to a person
- Battery maintenance

2. Communication:

- connect the sensor and/or dongle to a PC

3. Status Led indication

4. Data Logging functionality

5. Data formats

6. Breath application

7. Suggestions are welcome



1. Operation

The full sensor contains following parts:

- 1 Breathpal main cabinet, for abdominal sensor strap, referred to as Breathpal + RIP strap
- 1 smaller device for secondary thorax sensor + RIP strap (optional)
- 1 USB to USBC (version 5.0) or USB to micro-USB (version 4.1) cable 2 meters

Breathpal can be operated in two ways:

- A. Battery operation with logging of data. Data can be retrieved from the device storage by using the Breath Windows application.
- B. USB connected to a Windows computer. The Windows Breath application can be used to view and store data, or the data can be processed by reading from a virtual COM port.

Attaching the sensor to a person

1. If battery operation is desired, be sure that the sensor battery is sufficiently charged. See "Battery maintenance".
2. If direct communication over USB is desired, first connect Breathpal to the computer using the USB cable.
 *Notice that before connecting the Breathpal to a computer using the USB cable, always one of the abdominal strap ends must first be detached. If still attached, the computer will not recognise the USB device.*
3. Place the Breathpal abdominal sensor on the front side the body on navel height, using a RIP strap around the body to keep it in place. Take care that round connector opening points upward, and the USB connector opening downward.
Notice that the sensor only will work when both ends of the abdominal strap are connected to Breathpal.

When the torax sensor is also used:

4. Place the thorax sensor on the front side the body on chest height, using a RIP strap around the body to keep it in place. Take care that the black cable points downward.
5. Connect the black cable of the secondary RIP sensor to the round connector of Breathpal. Push well to get good connection.

It is preferred, to wear the belts and sensors over a thin tight fit T-shirt or underwear.



A strap should need stretching of 5 to 35 cm. when connecting to the sensor. If the strap is too long or too short, a different length must be ordered. Do not fold the strap to shorten it, this will largely influence the measurements.

Detaching:

Above steps in opposite order.

Notice that during storage the abdominal strap must be detached, to stop the logging of data and the draining of the battery.



>>WARNING<< The Sensor is not tested for medical use. Attaching it to the body and connecting it to a mains powered computer introduces a certain risk of electrical shocks to the body.
Doing so is on the responsibility of the user that decides to attach it to its own body, after being informed on this risk and after waiving the responsibility of the developer or owner.

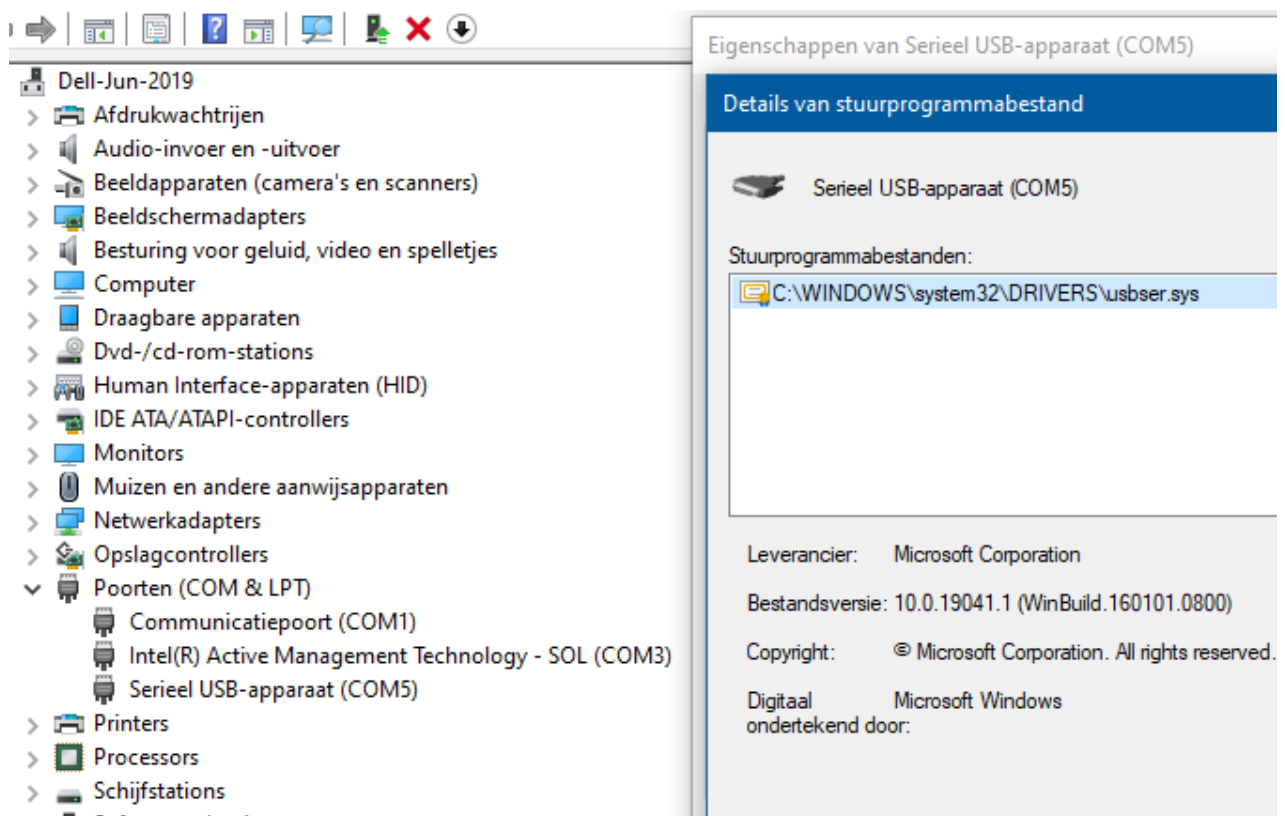
Battery maintenance

In case the battery status is unsure, attach the Breathpal to a PC or a USB phone charger using the USB cable, without the RIP straps connected. Do not attach the sensor to a person. Wait until the green light on Breathpal stops blinking and stays permanently on.

2. Communication

The Windows program Breath application can be used to make some settings to the sensor and retrieve stored measurement data, or real time display and export of the sensor data when the sensor is connected by USB cable or via the BLE dongle. See 5. Breath Application for a user guide for the Breath application).

When the Breathpal abdominal sensor or the dongle is connected to a Windows computer, a virtual COM port is created:



Besides using the Breath application, other applications can be used to communicate to this serial port. If necessary, use 8 data bits, 1 start bit, 1 stop bit, no parity, 9600 Bd, no handshake settings for the communication.

3. Status LED information

The green status LED visible on the front side of Breathpal has following indications:

When **connected** by USB cable to charger or computer:

- Stable ON: no communication, battery full, charging completed
- Flashing: communication with PC or charging

When **not connected** to charger or computer:

- Off: Abdominal strap not connected (Breathpal not operating) or battery completely drained
- Flashing every 3 seconds: data logging active

4. Data Logging functionality

Breathpal stores RIP data, accelerometer data, chip temperature and Time/Date labels in its non-volatile Flash memory. Memory size is 16 Mbyte, where approx. 15 bytes are used for every measurement. Currently, 2.5, 5 or 10 measurements per second can be taken, the frequency can be set from within the Breath program. At 5 measurements per second, capacity is about 60 hours of logging.

Measurement and data logging starts as soon as both ends of the Breathpal (abdominal) strap are connected (assumed that the battery is charged). Logging stops when the strap is disconnected. Logging is also done when Breathpal is communicating over the USB to the Breath application.

The stored measurements can be retrieved and written to file by use of the Breath program (see chapter 6). The memory can also be erased, which is wise to do before each session.

5. Data formats

Import data using Breath application

The program Breath can save sensor data to file. The format is Comma Separated Values (CSV). The parameters in each line are:

R1, R2, X, Y, Z, Timestamp, Sample number, Temperature, Event list

And typical lines look like this

```
6114,8358,-2,-86,1036,18/03/2021 09:18:41,152,22,/L12303/POWERUP_USB/2.5HZ/POWERUP_USB/2.5HZ
6114,8358,0,-93,1033,,153,22,
6114,8358,-1,-87,1042,,154,22,
6114,8358,-2,-91,1024,,155,22,
6114,8358,-1,-87,1036,,156,22,
```

The data can be imported into i.e. Excel for further analysis.

The values of R1 and R2 are the measured values of the abdominal and thorax RIP measurement. A value of 0 indicates that a belt is not connected. The values are related with the surface enclosed by the belt: A higher value corresponds to a higher surface. Read values are approximately in the range 5000 to 15000.

X, Y and Z are the readings of the three accelerometer axes, in the range -2048 to 2047, corresponding with acceleration from -2G to 2G.

A Timestamp is added every 10 seconds, in the above shown format 20/11/2019 13:11:40.

Temperature is in degrees Celsius. The resolution is one degree Celsius. Accuracy is not verified yet.

Event list is a text string with information on status and events, i.e. sample frequency and powerup moments (each separated by '/'). Exact meaning is not important for the scope of this user manual.

Import data directly from serial port

When Breathpal is connected to a computer and the Breath application is not active, the measurement data is sent to the serial port in a ASCII format. The format is as shown below. Each line contains the decimal value of Abdominal sensor, Thorax sensor, Accelerometer X, Y and Z, each value separated by a comma.

```
9563,44156,125,-66,-1016
9563,44156,129,-72,-1025
9564,44156,132,-69,-1018
9564,44156,131,-65,-1016
9564,44156,127,-65,-1019
9563,44156,128,-62,-1002
9566,44156,128,-64,-1016
9566,44156,121,-64,-1014
```

6. Breath Application (version 4)

The Windows application Breath.exe features:

- Retrieval of stored logging data from the sensor, and clearing of the sensor storage.
- Live display of measurements
- Changing of settings of the sensor

An installer for the application can be downloaded from the Breathpal website, page Resources.

Launch Breath application and connect to Breathpal

After launching Breath, choose the COM port to connect to the dongle or sensor. Notice that when connecting to Breathpal by USB, the following sequence is needed:

- a. Disconnect Abdominal strap
- b. Connect Breathpal to a PC using USB cable
- c. Start Breath application
- d. Select COM port
- e. Connect abdominal strap to Breathpal sensor

Some activity messages will be shown on the report area at the left side of the window.

Retrieval of stored logging data from the sensor

The length in bytes of the stored data is shown (895041 bytes in above example).

Press "History to file" to retrieve this data. You are prompted for a .csv file to write to.

After retrieving you are prompted to erase the storage in the sensor (Yes/No). You can erase any other moment by pressing "Erase memory". If not erased, new information will be appended to the existing storage information. (retrieval is not possible when connected wireless)

View and change settings

See and set user information

See and synchronise Real Time Clock info of the device

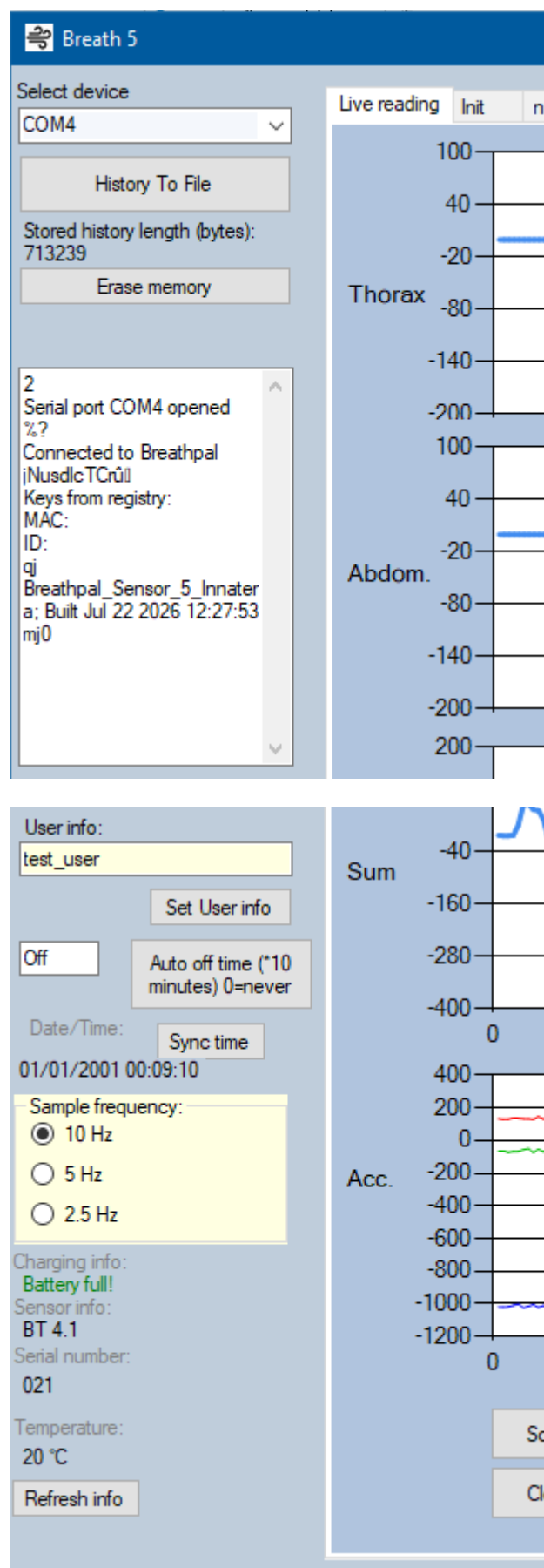
Select sample frequency

See battery charging or battery full state

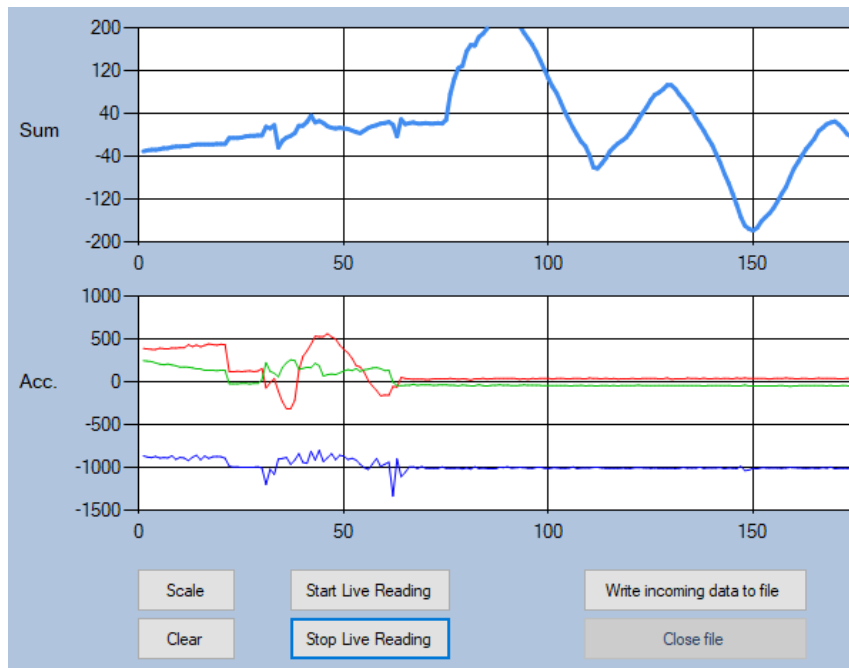
Device information and Serial number

Temperature

The User info can be edited and written to the dongle by pressing "Set".



Live display of measurements

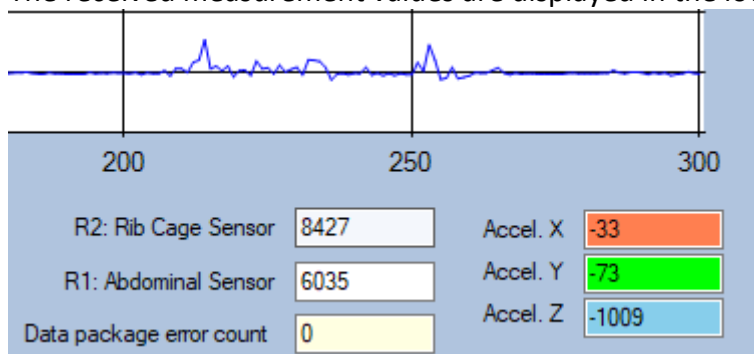


Press “Start Live Reading” and “Stop Live Reading” buttons for starting and interrupting of live display of the measurements.

The buttons “Scale” and “Clear” serve to manually change the display of the breathing graphs. “Clear” sets the three graphs to value zero, and from then on the (inverted) offset of incoming values is displayed. “Scale” scales the graphs to show all values. Experiment with this yourself.

The incoming live measurements can be logged to file in .csv format, by pressing “Write incoming data to file”. You will be prompted to select a file. End the file logging by pressing “close file”.

The received measurement values are displayed in the lower right area:



Notice the “Data Packages error count” field. This lists the amount of packages that come in and where the package numbers are not sequential, mostly caused by a packet loss in the BLE connection. Increasing numbers indicate a weak wireless connection, try to lower the distance between sensor and dongle or to avoid objects or bodies between sensor and dongle.

In the .csv file output, single or up to 3 missing samples are replaced by empty values with the EVENT_LIST showing /MISSING or /PACKETGAP. Such .csv lines will look like:

```
/////////MISSING  
/////////PACKETGAP
```

7. Suggestions are welcome

Breathpal is still in development. Any suggestions on communication format, behaviour, construction or documentation are welcome, and may yet be easy to implement.