Bamboo Control Software
Version: 1.0.9 Beta Test
Date: 03.11.2020

USER MANUAL

We thank you for using the Bamboo Control Software together with the Music of the Plants Bamboo device! In this document you will find an overview about the functions of the software and how it can be used.

Note: This is a Beta Test version software for research purpose. At the moment it is developed for PC only. *Any feedback from your side is useful for improving the development of this software and for increasing the knowledge* about the Plant World.

Note 2: **The software is working only with devices with Serial Number 2019…, 2020…and 2021…** . it is not guaranteed working with Serial Number 2018…

THE CONCEPT

Bamboo is measuring the resistance of the plant between 2 electrodes. One electrode is placed in the ground near the roots and one electrode clips onto the leaf.

According to electrotechnical rules Resistance is proportional to Voltage, so in the chart you can find the **measuring of both R-plant and DeltaV-plant**.

The measured electrical parameters

Note that the measured value **R-plant is a combination of 3 measures**:

1. the intrinsic resistance of the plant
2. the resistance of the contact between the leaf and metallic clip.
3. background noise

1. **the intrinsic resistance of the plant**

The only value we need for our research is the intrinsic resistance. That is the physical characteristic we use to understand the behavior of the plant. The plant can change its resistance according to physiological aspects and as response of the ambient stimulation. We believe that the plant can "consciously" modify its intrinsic resistance in order to communicate with us.

According to the Music of the Plants algorithm, changing of the resistance of the leaf means a different note.

The concept is quite similar to the human skin. Many instruments, like for example the *lie detector*, are working on the same principle. Anyhow we, human beings, are not able to change "consciously" the physical inner behavior of our skin.

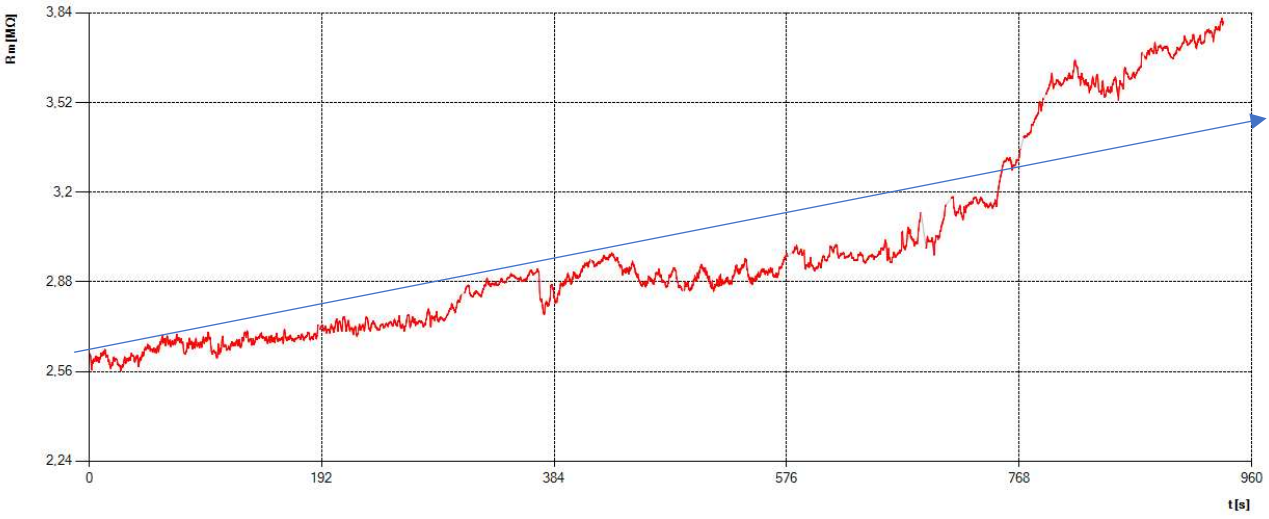
2. **the resistance of the contact between the leaf and the metallic clip**

The interface between the surface of the leaf and the metallic sensor is affected by dust, dirt, pores, hard veins of the leaf, etc. Our aim is to minimize this improper factor.

To do that, as written in our manual, we indicate to **moisten the leaf before clipping to increase the electrical conductivity**. ~~During~~ With time the added water ~~is getting~~ becomes dry affecting the measuring of the resistance.

Due to this phenomenon you will see the **curve of the R-plant increasing the value**.

In the picture below you can see the tendency to increase the total resistance due to the decreasing of conductance of the contact between the leaf and the clip.



3. **background noise**

This phenomenon **is well known by the academic world**. Many scientific articles are studying about this issue as it is affecting the measurements of the experiments.

In acoustic, background noise or ambient noise is any sound other than the sound being monitored (primary sound). Background noise is a **form of noise pollution or interference**.

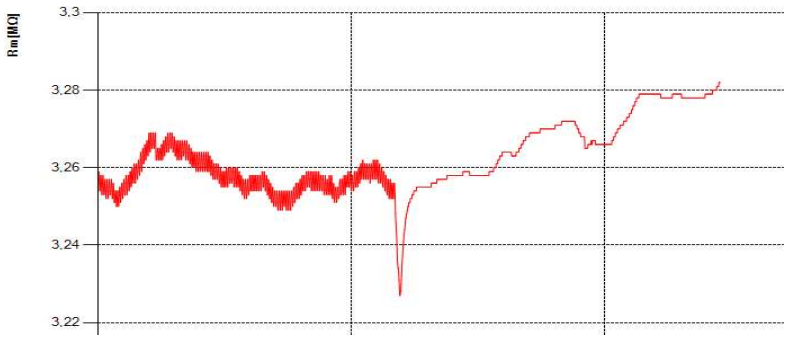
Background noises include environmental noises such as water waves, traffic noise, alarms, extraneous speech, bioacoustics noise from animals, and **electrical noise from devices such as refrigerators, air conditioning, power supplies, and motors**.

It is something hard to control in living ambient out of a laboratory and sophisticated sensors are needed to be applied to plants.

Our metallic sensor clips are necessarily affected by background noise but we have seen that it is not so heavily influencing the purpose of our level of research.

Anyhow, in our Bamboo device, **we have introduced the function of NOISE FILTER that is cutting the waives at 1 Hz**. That can be activated only with Bamboo Control Software.

See the difference when the filter is OFF (left side) and when the filter is ON (right side).



Sensibility

The parameter of sensibility controls the "gain", that means the amplification of the plant's signal.

By default the sensibility is automatic that means the device is selecting the value to give you the best output signal to produce a sound.

If the plant signal is low the device Increase the sensibility. If the plant signal is good the device minimizes the sensibility.

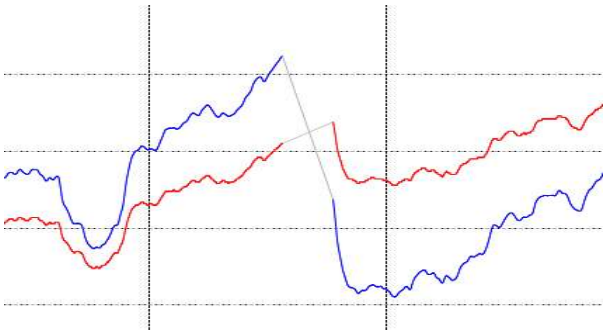
For research purpose, to have a more consistent response from plant, **we suggest to fix manually the sensibility**. In this case, if the plant changes the magnitude of the signal, we have a more clear and understandable correspondence.

You can find that in many cases there is no audible difference among various sensibility values. That means the plant's signal is powerful enough to be well perceived by the device.

Interruptions

During normal playing of the Bamboo you have noticed that sometime**s** the message *"await signal"* appears. It means that **the plant has varied its electrical signal out of the set range** and the device has to find a new working point.

In the graph you will see a *grey line*. That is NOT a measure but a graphical concept to connect simply 2 points.



Recording

- recordings are divided into 30 minutes segments each one in different files.
- name of the file includes date and hour/minute/second of stop recording
- you can add a comment during or after the recording. That is useful to remind you if some event happened to the plant or its environment during activities.

CONNECT THE BAMBOO

The program provides the following functions listed in a menu bar at the top:

- Connect and Disconnect the Device
- Make Updates to the Bamboo-Firmware
- Control settings of the device
- Control all the sound settings of the device
- Transfer the information on the SD-Card to the PC
- Direct live recordings via USB
- Show the recorded information
- Help, Version

At the bottom of the main window a line has been placed for all status information.

To connect Bamboo Control Software: Connect the Bamboo with the USB-cable to the PC and

switch on the device. If the device does not connect automatically use "Device/Connect" to connect the device with the software.

DEVICE

All functions that are directly related to the device are combined under the menu item "Device".

Connect

Click "Connect" on the menu to connect the device. The device must be on. In the status line at the bottom of the program window you can see the status.

If the program does not connect, connect the Bamboo again to the USB-cable and click again on the button "Connect".

Disconnect

Click "Disconnect" on the menu to disconnect the Bamboo. In the status line at the bottom of the program window you will see the information.

Settings

Here you can control all parameters that are directly connected to the device.

- change the background light of the device display
- change the contrast of the device display
- look for the battery status of the device
- set the hardware input filter of the device
- change the device language

Update Firmware

Click the "Update Firmware" to open the UPDATE window.

Follow the displayed instructions.

SOUND

Here you can control all the sound parameters of the device:

- change the volume of the device
- choose the Profile [P1-P12]

Additionally, for the Bamboo M version:

- change the instrument
- change the scale
- change the base frequency
- change mystery
- change the flow (notes per minute)
- change the chord
- change the event parameter reverb, chorus and spatial
- overwrite a predefined profile [P1-P12] with P0
- normal setting - go back to the predefined factory sound settings [P1-P12]

SD-CARD

Here you can transfer the saved records from the SD-card to the computer. They can be transferred individually or all together (select the files in the list using the PC keyboard “Shift Key” and the “Control Key”).

You can select the storage location on the PC.

The data is saved in simple text files with columns of numbers (separated with blank space). You can open it, watch it and also process it with other programs.

The saved parameters in the moment are:
t ; t[s] ; Rm[MΩ] ; ΔU[mV] ; note ; gain ; filter ; range ; played ; status

- **t** -- time base (60 is 1s)
- **t[s]** -- time in s
- **Rm[MΩ]** -- absolute resistance of the plant in MΩ
- **ΔV[mV]** -- Voltage change of the plant signal at the input amplifier in mV
- **note** -- calculated note [36-95]
- **gain** -- gain level [0-15]
- **filter** -- filter on/off [0-1]
- **range** -- range value [0-1]
- **played** -- if 0 one note is played
- **status** -- status level [0-3] 3= the Plant play music

It is also possible to format the SD-card. Attention: All data will be DELETED!

USB CONTROL

Here you can directly record and display (live) data from the Bamboo-Device. You can select the storage location on the PC and a recording duration. Values are 1min - 3min - 5min - 10min -15min or free. If a predetermined value has been selected, the recording stops automatically, otherwise you have to stop.

To visualize the entire recording, use the "Load graph" feature after you finish recording.

The data is saved in a simple text file with columns of numbers (separated with blank space). You can open it and also process it with other programs.

If you are in free mode, data is stored in packets of 30 minutes. For 30 minutes each, a separate file is created, but the measurement continues until you stop.

The saved parameters in the moment are:
t ; t[s] ; Rm[MΩ] ; ΔU[mV] ; note ; gain ; filter ; range ; played ; status

- **t** -- time base (60 is 1s)
- **t[s]** -- time in s
- **Rm[MΩ]** -- absolute resistance of the plant in MΩ
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Note	Octave										
	-1	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
C	0	12	24	36	48	**60**	72	84	96	108	120
C#	1	13	25	37	49	**61**	73	85	97	109	121
D	2	14	26	38	50	**62**	74	86	98	110	122
D#	3	15	27	39	51	**63**	75	87	99	111	123
E	4	16	28	40	52	**64**	76	88	100	112	124
F	5	17	29	41	53	**65**	77	89	101	113	125
F#	6	18	30	42	54	**66**	78	90	102	114	126
G	7	19	31	43	55	**67**	79	91	103	115	127
G#	8	20	32	44	56	**68**	80	92	104	116	
A	9	21	33	45	57	**69**	81	93	105	117	
A#	10	22	34	46	58	**70**	82	94	106	118	
B	11	23	35	47	59	**71**	83	95	107	119	

HELP

User manual, website link, version.

For direct help: Move the mouse over the element (Button, Slider, Box, ...) and wait a few seconds until the help is displayed in an overlapping window. When nothing comes up move a little bit the mouse and stay above the element.