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Insect Surveillance Technology

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USER MANUAL

TreeVibes: Detection of wood-boring insects inside wood

Title: Instructions for Use of the Device

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This document was produced by INSECTRONICS research and development group.

The document is intended to provide non-binding guidance to users, and has been subject to consultation throughout its development.

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1.0 Introduction

The purpose of this document is to present the operating procedures of the device and to communicate information on safety, use and performance. The intended use of the device is the long term systematic monitoring of trees and wooden structures against borers. A piezoelectric probe with an uncoated waveguide is inserted in the tree trunk to detect and record locomotion or feeding sounds of borers. The user can either use the supplied headphones and listen to the vibrations *in-situ* (i.e. to operate it manually) or install the device on the tree trunk and use the function that records and wirelessly transmits on a scheduled basis short recordings of the internal vibrations of a tree to the INSECTRONICS server. In the latter mode of operation, the device is sleeping and wakes up, takes a recording and sleeps again. At some point it wakes up transmits the recordings to the server and goes back to sleep. The parameters of the recording and reporting sessions are handled by the INSECTRONICS server, which also holds the transmitted recordings. The access and use of our server is free for our clients. The user can listen to the recording remotely and process it automatically to infer the infestation state of the tree with wood-boring insects that feed or move inside the tree. It has been extensively in field trials of the pests *Xylotrechus chinensis* and *Rhynchophorus ferrugineus*. The same approach can be applied to different trees and borers around the world by adjusting the length of the waveguide to the targeted trunk e.g., the mountain bark beetle, various longhorn beetles, *Rhynchophorus palmarum* and the *Anoplophora chinensis*.

This document **supersedes** any previous versions. The instructions manual is written in terms readily understood by the intended user and, where appropriate, supplemented with drawings and diagrams. Some pictures may include separate information for the professional user and the layperson. Comments or questions should be directed to INSECTRONICS whose contact details may be found on the INSECTRONICS's web page¹.

2.0 Assembling Instructions

When you open the packaging cardboard, you will find the following parts inside. There may be small differences in the power supply unit provided or the colour of the cables/unit.

1. USB Power cable (maybe different). You can use a USB Universal Mobile/Tablet charger
2. SD card (embedded)
3. Antenna
4. Waveguides (2 pieces, 6mm x 16cm, 6mm x 30.5 cm. You need to open a hole with the d6.5mm drill bit and then insert them)
5. Drill bits (2 pieces, d6mm x 24cm, and d2mm x 8.5cm)
6. Waveguide adapter (2 pieces for fastening the d2mm and d6mm drill bit to the recorder)
7. Recorder
8. Headset

Assemble the device according to the following picture (see Fig. 1). Note that the drill bits have different connectors and, therefore, it is not possible to mix them up with one another. The SD card comes embedded and fastened to the device. In any mode of operation, one needs to wait for approximately 6 seconds after switching on before the device becomes operational.

¹ <http://www.insectronics.net>



Figure 1. (Left) The main black box (10.8cm X 6.8cm X 6.8cm) contains the electronics and the SD card. A communication antenna, a waveguide and an adapter can be seen. The device has an embedded solar panel connected to its battery. (Right) The assembled device.

3.0 Applications

Here are some possible applications of the device:

1. Detection of wood-boring insects in forests, urban trees and trees of special/historic interest
2. Inspection of wooden pallets for transportation of goods
3. Detection of illegal chopping of trees or unauthorized removal of logs
4. Inspection of quarantine trees transported for plantation in harbors
5. Insertion of probe to the ground to detect larvae feeding on the root system of plants
6. Smart home monitoring of wooden houses and structures for termites
7. Detection of stored product pests in silos

4.0 Waveguides and drill bits

The waveguide is a solid, stainless steel bar, but large nails, bolts and drill bits can serve the same function, that is to act as a sound coupler between the wood and the piezoelectric crystal (see Table 1). A picture of the waveguides offered along with the purchased device is shown in Fig. 2. The adapter provided can be adjusted to other drill bits the user chooses as well. The drill bit itself can be used as a waveguide for a quicker installation but for optimal performance one should first drill a hole in the tree trunk using a drill bit and then fasten the associated waveguide. The small drill bits are used for wooden columns, decks, porch tongues, ceilings, furniture.

The sampling rate of the device is 8kHz in any mode of its operation. According to the Nyquist criterion, the spectral range of the recordings are half of the sampling rate. This is more than enough to identify the sound of wood-boring insects, which is of low pass nature.

	Length (cm)	Diameter (mm)	Usage
1	30.5	6	Large trees (e.g. palms, pines), roots of trees
2	16	6	Medium to small trees, roots of plants
3	24	6	Medium to small trees, roots of plants
4	8.4	2	Wooden structures, decks, ceilings, wooden pallets

Table 1. Dimensions of provided waveguides

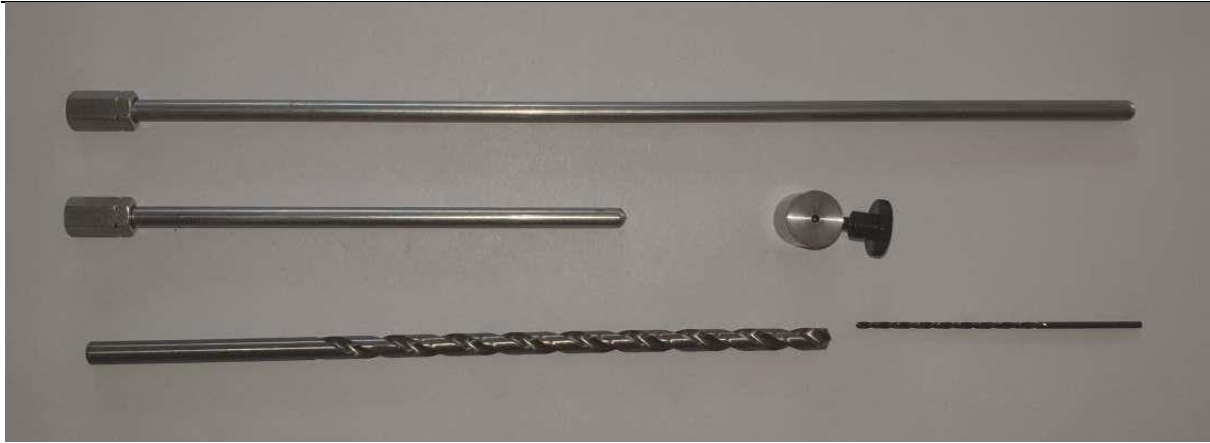


Figure 2. These are the waveguides that can be inserted in the tree trunks or wooden surfaces. The drill-bit can serve as a waveguide when fastened to the adapter (included).

5.0 Remote vs Manual Operation

A close-up of the cables' connectivity and switches can be seen in Fig. 3. The side lid is gradually removed when unfastening the large screw. Here we explain the connectivity of the cables from left to right. The first cable connects to the charger. While charging a red LED is on. Once the device is fully charged, the LED switches off. The second item is a three-positional switch. In the central position of the switch, the device is off. In the right position of the switch (R), the device outputs continuously to the earphones and does not store, neither transmits the recording. A green light is on during operating in the Right position. We include an earphone pair but any earphone/headphone is suitable. In the left position (L), it follows the recording schedule and writes to the SD card. The audio recording will be compressed and uploaded to the server. The circular socket is where the earphones must be plugged in.



Figure 3. The back of the device. Connectivity from left to right: The charger connects to the first input from the left (Charge). The second is a three-positional switch (Left-Middle-Right). The circular socket is where the earphones are plugged-in (E). The first slot on the right is the SD slot. The supplied SD card must be always fastened before powering-on.

The device contains batteries that must be charged before outdoors use. For indoor use, we suggest the mains supply in collaboration with our USB cable. For outdoor operation, the device has a solar panel on its back (see Fig. 4). The amount of power that can provide depends on the weather conditions and the shadow the tree provides but for many recording scenarios (see Section 9) is sufficient to function indefinitely.

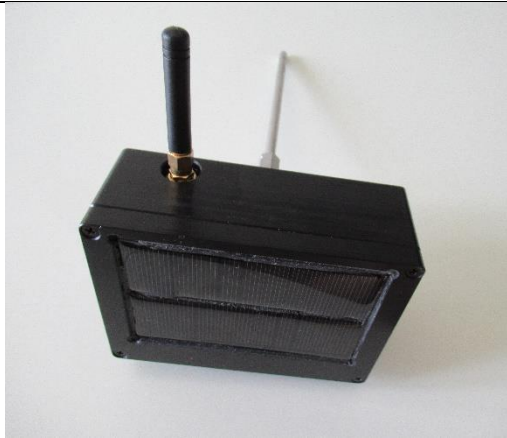


Figure 4. For outdoor operation, the device has a solar panel on its back. Do not cover the solar panel. The device is waterproof against rain. The antenna must always be pointing towards the sky when transmitting.

5.1 The communication modem

The device bears a 4G-communication modem and uses an EMNIFY SIM-card to offer global coverage (see <https://www.emnify.com/>). The product comes with 1 GB free data pack but the user is responsible to renew the data bundle in the same way as ones mobile phone (renewal comes by contacting INSECTRONICS). The user can see the progressive consumption of his/her own device MBs through the INSECTRONICS server.

6.0 The Use of the SD Card

The simpler and preferred way to access the recordings is through the INSECTRONICS server from where they can be downloaded by the user. This is a powerful feature of this device as it allows retrieving data from remote trees the moment they are created. If there is no access because of bad mobile connection the recordings will be uploaded once the connection has been restored. The access to the INSECTRONICS server comes with a password that is delivered with the device.

The service of the INSECTRONICS is free but the user must download the data before they exceed 1 GB. This storage limit corresponds to thousands of recordings. Once the limit is exceeded, the older recordings are permanently deleted so that the limit is reached again. This means that the user should consider the upload service as a temporary service. However, in any case THERE IS NO LOSS of data because everything is stored in the SD card of the device. Note that the storage capacity of the card is 32 GB. In the unlikely situation a user has stored so many files they must retrieve this data OTHERWISE THEY WILL BE PERMANENTLY DELETED. Note however that this storage amount is huge for the application of tree monitoring.

IMPORTANT: The SD card must be inserted in the device BEFORE powered on as seen in the picture below. When you insert the SD you will hear a click that tells you it is fastened OK. The SD card will contain the time-stamped recording in compressed format.

7.0 Deployment on trees

Quick start of using the device on trees. See examples of its use in Figs. 5a, 5b and Fig. 6.

1. Make a hole in the tree trunk using the d6.5mm drill (provided). The waveguide will not fasten correctly into a hole made with a drill of a different diameter.

2. Insert the FULL LENGTH of the steel waveguide in the hole (see Fig. 5b-right, Fig. 6). Alternatively, use the provided adapter to match the d6mm drill bit as a waveguide.
3. Fasten the device on the waveguide. NEVER hit the device or the waveguide with a hammer to fasten it.
4. The antenna must be facing UP towards the sky (not down).
5. Switch the 3-positional switch to the left and see the blue LED blinking.
6. Close the slit leading to the switches/SD with the plastic cover. The switches and sockets must not be visible. Fasten the plastic screw by hand.



Figure 5a. A *X. chinensis* positive case in a mulberry trunk. (left) The sensor mounted horizontally in a suspicious trunk in the laboratory (left). Two alive larvae have been found after cutting the suspicious trunk in slices (middle and right). The larvae tunnels can be seen in the picture on the right.

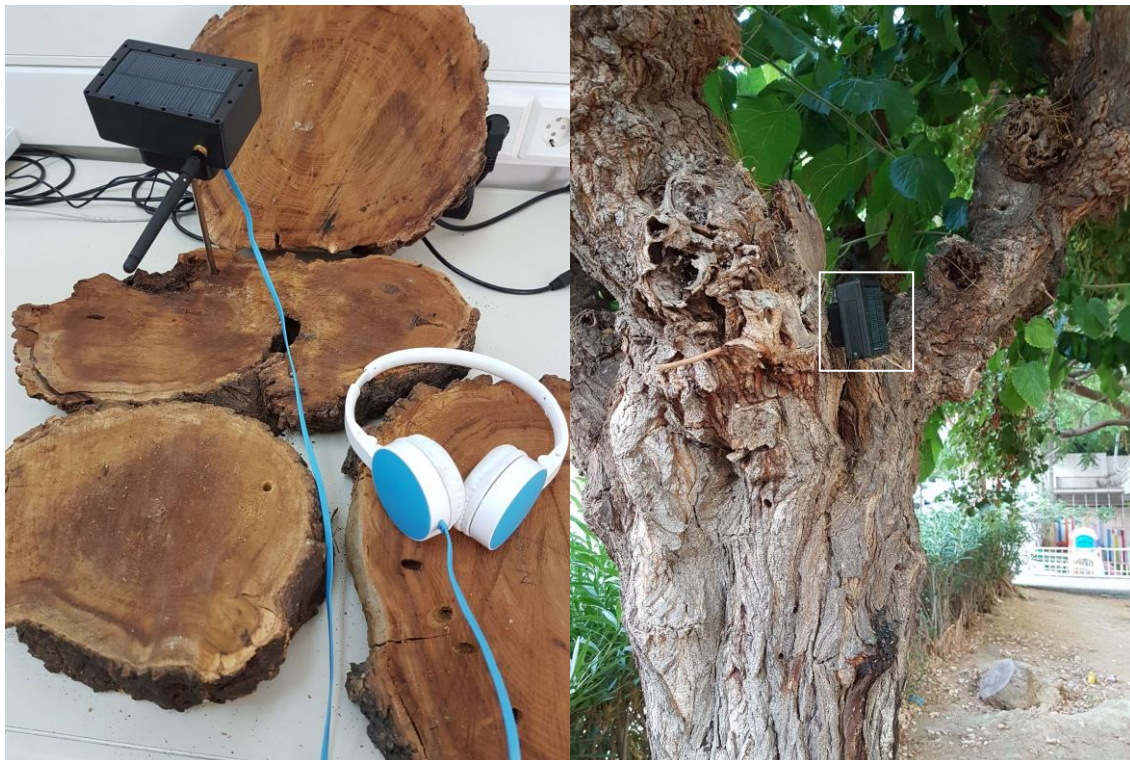


Figure 5b. Operating in continuous output mode. The user examines the internal activity in the trunk through the headphones, (**Left**) Manual inspection of slices of a trunk. (**Right**) Remote examination of tree in the field.



Figure 6. Operating in transmission mode. The device attached to a palm tree listening for *R. ferrugineus*. The white rectangle is located around the device. The recordings bearing a time-stamp are uploaded to INSECTRONICS server where the user can examine them and download them.

8.0 Time-Scheduling of the device's operation

The device is pre-configured to record at any time of the day. However, the user may want to record e.g. every hour except at nights or to shut down the device for a week. In such a case, use your password to access your device through the INSECTRONICS portal (<https://www.insectronics.net/login>). Once you enter the portal, click on the icon of your device and you will see a pop-up window like in Fig. 7a-7b. You need to schedule your device by clicking on the tab 'schedule' of the corresponding device. Define the time span within which you want the device to operate (see Fig. 8). The time-scheduler is preconfigured to operate at a 24/7 basis. You can click on the blocks to exclude hours/days that you want them to be excluded.

The device will function within the time span the user selects. The device will be updated on the user's preferences the next time it is connected to the server to upload recordings (i.e. the effect of changing these settings is not immediately valid). The exact time of the next update can be seen on the screen (see in Figure 7 Next-update column below Time zone).

CAUTION: *If you do not have a specific reason to change the scheduler, consider leaving it in the pre-configured mode.* If you exclude certain days and hours by mistake and then you forget that you have done so, you will not be receiving the recordings you expect. If that happens, see again the Time-Scheduling and correct the timetable according to your needs.

8.1 Explaining the INSECTRONICS Server

After changing the location of the device, in case you do not see the correct GPS coordinates on the map you need to logout and then login again so that it is updated. Make sure that the antenna is facing towards the sky.

Next Update: The time new data and possibly setting will be uploaded to the server.

Battery Life: Power sufficiency (%)

Signal Level: Quality of wireless communication

Data consumption: The MB you have used so far. You have available 1GB. When you consume this amount, the device will stop reporting to the server and will resume after the communication fee is paid. However, the line-out operation through the earphones is not affected.

Action: Center map/Notes/Schedule/Edit. *Center Map* centers the map on the device, *Notes* allows you to keep some notes in case you are in the field inspecting a tree. You can write down in the text box and/or upload a picture of the tree surroundings. *Schedule* allows you to set the recorder to follow a timetable in case e.g. you want to shut down the recording sessions for a week because of bad weather, or record only at daylight or only at nights etc. *Edit* allows you to set the duration and frequency of the recordings. It also allows you to set the frequency with which you want these data to be delivered to the server through which they will be available to the observer.

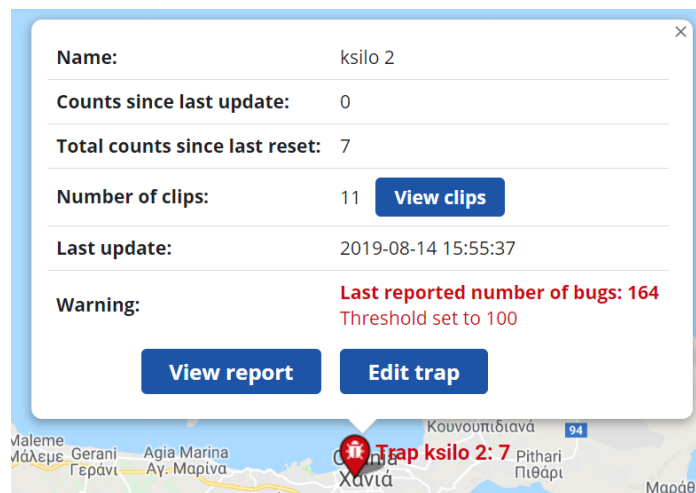


Figure 7a. Pop-up window when someone clicks on device's icon on the map in Insectronic's server. *View clips*, leads to a window where one can listen and manipulate recordings (e.g. download them), *View report*, leads to a window where temperature and number of clips per day are plotted, *Edit trap*, leads to settings configuration (e.g. repetition, duration and uploading frequency).

Yellow
Running out of battery

Red
Insect count out of bounds

Traps: Timezone: Europe/Athens

Name	Number	Next update	Counts	Battery level	Signal level	Data consumption	Reset	Enabled	Actions
flyMagnet	5	2018-07-22 10:44:58	0	91% (V)		N/A	0	1	Center map Notes Schedule Edit
Ksilofagos	3	2019-06-19 13:58:13	0	56% (V)		N/A	0	1	Center map Notes Schedule Edit
ksilo 2	42	2019-08-14 15:55:37	7	100% (V)		N/A	0	1	Center map Notes Schedule Edit

0 traps selected:

Reset
Delete

Add new trap

Figure 7b. IINSECTRONIC's server: *Schedule*, leads to Figure 8 time-scheduler. Recordings will be made within the time span of the scheduler.

Duration and frequency of recordings have an effect on the power consumption only. The frequency of data transmission affects the amount of data you have prepaid as well as power consumption.

After one clicks the *Schedule* tab of the corresponding device, a clickable timetable appears as in Fig. 8.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
00:00							
01:00							
02:00							
03:00							
04:00							
05:00							
06:00							
07:00							
08:00							
09:00							
10:00							
11:00							
12:00							
13:00							
14:00							
15:00							
16:00							
17:00							
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							

Unselect All

Update trap schedule Cancel

Figure 8. Insectronic's server time-table of a specific device. The user may select the hours and days of device's functioning. The device is pre-set to a 24/7 basis recording schedule.

8.2 How to set the recording and reporting update

Look at Fig. 7a the 'Edit trap' tab. Click on the 'Edit trap' tab. You will see a picture like in Fig. 9. You need to specify General Parameters in `recTime=5_repeatPeriod=60_Reg2=5678` and click on 'Update trap' in the same figure.

The repeatPeriod is in MINUTES

The recTime in SECONDS

`recTime=5_repeatPeriod=60` means every 1 hour the device will record vibration activity for 5 secs and will store the recording to the SD card.

In the following picture, on the left column one can see the 'Trap updates' in minutes. This is how often one needs to upload the recordings to the server. Though the device records every 1 hour the user may want to examine the recordings collectively once every half-day. If so, the 'Trap update' needs to be set to $60 \times 12 = 720$

8.3 Where are my uploaded recordings?

- Click on the corresponding balloon of the device you want on the map.
- Click 'View clips'
- Click inside the 'Date from' and 'Date to' tabs to select the days you want from the pop-up calendar
- Click 'Refresh'

- e) Select the recordings you want by either clicking few in the tic-box of each recording or 'Select All'.
- f) Click on 'Download'
- g) You need to wait a little depending on the number of the recordings selected. On the down-left corner, you will see zip file downloading in your computer. Inside the zip are the requested files.

IMPORTANT NOTICE

To avoid users the settings are constrained in between reasonable limits. If the user by mistake violates the range of a parameter e.g. set 0 as duration of recordings, the device ignores the settings of frequency of recordings, duration and reporting and defaults to the values `recTime=10_repeatPeriod=60_Reg2=5678` and trap update 720. Of course, the user can change any parameter as long as it is correct. These are the hard limits applied by the manufacturer to ensure reasonable functioning.

recTime: minimum 1 sec, maximum 20 minutes

repeatPeriod: minimum every 5 minutes, maximum every 1 week

Device update: minimum every 5 minutes, maximum every 2 weeks

In the unlikely case that the user needs to override these limits please contact INSECTRONICS to remove these settings.

Edit trap settings

IMEI: *
867584031542538

Serial number: *
446367

Name: *
ksilo 2

Trap updates every: (1 to 7200 minutes) *
180

Alarm email:
iraklis.rigakis@diodebell.com

Threshold for alarm email:
10000

Threshold (%) for low battery alarm:
10

Description:
testing

Number:
42

Latitude:
35.5094414
[Pick latitude from current centre of map](#)

Longitude:
24.0163651
[Pick longitude from current centre of map](#)

General Parameters:
recTime=10_repeatPeriod=120_Reg2=5678

Trap Parameters:
GPs=60_Test2=efghi_end__

☒ Trap enabled
☐ Check to reset count in next update

Update trap **Cancel**

Figure 9. Trap update controls how often one needs to see the recordings (e.g once per day). General Parameters control how often one needs recordings to be taken (e.g. 20 seconds recording's duration every 1 hour).

9.0 Frequently Asked Questions

1. *Where are my recordings? I do not see them in the 'View clips' tab*

ANSWER: Ensure you have fastened the antenna on the device. The antenna is mandatory when you transmit recordings and is not needed in a continuous manual mode (i.e. when you hear through headphones). Check that you have switched to the Left and not to the Right. Ensure the device is charged. Ensure that there is a mobile signal in the area. If there is no mobile signal, the recordings will be stored in the SD

card and will be uploaded once connection is re-established. Check if you have available data in your data bundle otherwise contact Insectronics to update your available data. Ensure that you have not accidentally unselected all days and all hours in the time-scheduler.

2. *My device is not in its correct location on the map. Why?*

ANSWER: Ensure you have fastened the antenna on the device and the antenna looks towards the sky. If you are inside a building, you cannot get the coordinates and what you see on the map are the coordinates of the previous connection. The location will be updated in the next transmission of recordings (see next update in the main menu). You can speed up this process by switching off the device and then on again while you are outside the building. Try logging out and the logging in again.

3. *It is raining. Should I leave it on the tree? Will it malfunction later on?*

ANSWER: Ensure you have fastened the side lid and the antenna is pointing towards the sky. The device has been design for outdoor operation so yes leave it. Do not submerge the device into water.

4. *The waveguide does not fit in the whole I have drilled. What can I do?*

ANSWER: You have two options: a) use the drill bit as a waveguide by fastening the adapter on the free side of the bit. Then fasten the device on the adapter or, b) reverse the rotation in your electric drill and move the drill bit during rotation inside out the hole many times so that you remove any debris. The waveguide will then fit in the drilled whole. Do not hit the waveguide with the device as you will harm the device.

5. *Are my recordings stored in the SD card permanently?*

ANSWER: It is pre-configured that the transmitted recordings are also kept in the SD card. You can alter this option in the setting menu. Once the SD card is full it will start erasing old files so you have better keep an eye on the process.

6. *Can I use the device in a location without mobile connection?*

ANSWER: Yes. If there is no connection the recordings will be stored in the SD card and will be uploaded once the connection is re-established. Moreover, they can always be retrieved manually from the SD card (the recordings bear a creation time-stamp on their filename. See also Section 11).

10.0 Power Sufficiency & Data consumption

When users install the device on a tree they want to know, how long it will operate without having to recharge it. The device has a solar panel in its back; therefore, there is trade-off between incoming energy and consumed energy to satisfy a recording/reporting schedule. The amount of harvested solar power depends on the illumination condition of the location and the season. We offer some approximate calculations in Table 2 based on the assumption that the user has fully charged the device before installing it.

Interval secs	between	Duration (seconds)	Reporting	Power Sufficiency	Data consumption
Every 1 hour		20	1 per day	Indefinitely	1.15 MB/day 34.56MB/month
Every 1 hour		20	2 per day	Indefinitely	1.15 MB/day 34.56MB/month
Every 1 hour		20	12 per day	Indefinitely	1.15 MB/day 34.56MB/month
Every 1 hour		60 (1 min)	4 per day	Probably Indef.	3.4 MB/day 102.24MB/month
Every 1 hour		600 (10 min)	4 per day	1-3 days	34.08 MB/day 1GB/month
Every 2 hours		10	1 per day	Indefinitely	288 KB/day 8.64MB/month
Every 3 hours		20	1 per day	Indefinitely	384 KB/day 11.52MB/month
Every 3 hours		60 (1 min)	1 per day	Probably Indef.	1.13 MB/day 34MB/month
Every 3 hours		600 (10 min)	1 per day	10 days-1 month	11.36 MB/day 341MB/month

Table 2. Time schedule and reporting to the server vs. Power sufficiency and data consumption. In bold, the suggested and pre-configured schedule. Proposed schedules in bold. The device comes with a 1GB data bundle.

11.0 Format of the files

An example of the filename if the stored snippets is as follows:

F_20190812193118_1.wav

The file name “keeps” the time of an event and registers the environmental parameters if the temperature-humidity-illumination sensor is attached.

F stands for File

2019 stands for the year (e.g. 2019)

08 for the month (August)

12 for the day of the month

19 for the hour of the day

31 for the minute of the hour

18 for the second of the minute (therefore the time stamp is 30/04/2019 00:15:23)

_1 is a serial number of the recording that allows it to be better eye-tracked in the folder

Temperature is transmitted to the server but is mainly used for telemetry. It can be accessed by the ‘View report’ tab and looking at the temperature chart.

12.0 Setting the time correctly to different time-zones

A real-time clock is embedded in the device. The device will be delivered tuned to the local time of the client. However, the real-time clock can be altered to any local time as follows:

1. Insert the SD card of the device to a personal computer/laptop
2. Create a new file in the SD card with name time.txt (use a simple editor)
3. Write with a text editor (e.g. notepad) according to the following example:
29/04/19 23:38:51
4. Remove the SD card from the computer
5. With the recorder switched off, insert the SD card to the recorder
6. Turn ON the recorder. The data will be passed to the device and the time.txt will be deleted

13.0 Examples of Recordings

In Fig. 10 there some examples of the recordings that can be obtained. The recordings can be read and processed with typical languages as Python and Matlab as well as with commercial sound processing such as Adobe Audition. The Fig. 10 has been obtained via Matlab 2018b using the following commands:

```
[x,fs] = audioread([File.folder '\\' File.name]);  
x2=x(50*fs:50*fs+2*44100);  
subplot(2,1,1); t=0:1/fs:(length(x)-1)/fs;  
plot(t,x);grid on;axis('tight');xlabel('Time (s)');  
subplot(2,1,2); t2=50+0:1/fs:50+(length(x2)-1)/fs;  
plot(t2,x2);grid on;axis('tight');xlabel('Time (s)');
```

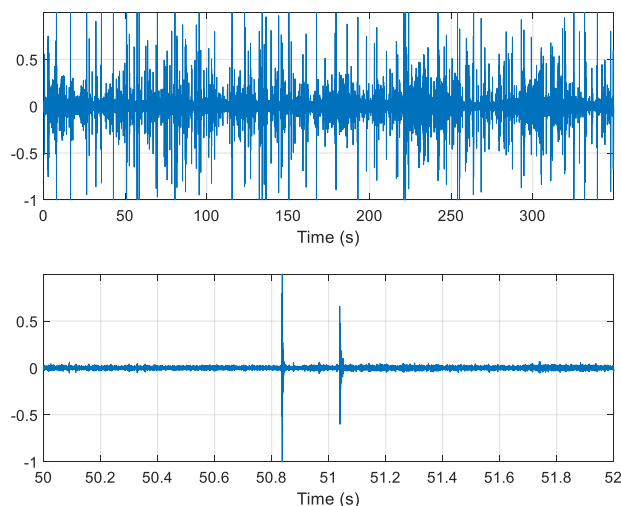


Figure 10. Mulberry examined in the field was found positive for *X. chinensis*. (top) time domain recording of the vibrations inside a tree trunk acquired using the device, (bottom) zoom-in detail of the same recording between the 50-52 sec. One can clearly see and hear the pulses standing out from the background noise.

14.0 Caution

Please read the following carefully to avoid problems with the use of the device.

1. If you want to experiment to be acquainted with the device, turn the 3-positional switch to the right. You will be able to record continuously and to listen through the headphones. This action does not involve the communication modem and does not consume your pre-bought communication time that comes along with the buying of this device.
2. Once you turn the 3-positional switch to the left, you decide to transmit data. This action costs as if you would use your mobile phone in a foreign country. Therefore, one needs to be careful not to consume the available prepaid GB data-pack that comes along with your order. The device is preconfigured to get 10 sec recordings every 1 hour and transmit them every 4 hours. Read carefully Section 9, Table 2.
3. If your available data are exhausted, then you need to contact INSECTRONICS to renew the communication data. In this case, the user will be charged only for the mobile communication services fee. Note that the action of renewing the data bundle will be sparse and anticipated **once per 2 years** if the user works within the limitation we suggest (every one hour 10-20 sec recordings).
4. Your device has been tested extensively prior to shipping in environments exceeding 35 °C and high humidity working on a 24/7 basis for at least 10 days without observing malfunctioning.
5. Avoid using it in environments with extreme intensity of electric light and electromagnetic radiation. Avoid holding an activated mobile phone/tablet near the device (<1m) while operating the insect recorder. It will not cause a permanent malfunction but may cause interference in some recordings.

15.0 WARRANTY

15.1 OTHER WARRANTY RIGHTS AND NATIONAL LAW

1. This warranty does not exclude or limit the buyer's statutory rights provided by national law, in particular, any such rights against the seller that arise from a legally effective purchase contract.

2. The warranty regulations mentioned herein are applicable unless they constitute an infringement of national warranty law.

15.2 ONLINE REGISTRATION

3. INSECTRONICS warrants the mechanical and electronic components of this product to be free of defects in material and workmanship for a period of two (2) years* from the original date of purchase, in accordance with the warranty regulations described below. If the product shows any defects within the specified warranty period that are not excluded from this warranty as described under
4. If the product shows any defects within the specified warranty period INSECTRONICS shall, at its discretion, either replace or repair the product using suitable new or reconditioned parts. In the case that other parts are used which constitute an improvement, INSECTRONICS may, at its discretion, charge the customer for the additional cost of these parts.
5. If the warranty claim proves to be justified, the product will be returned to the user freight prepaid.
6. Warranty claims other than those indicated above are expressly excluded.

15.3 RETURN AUTHORIZATION NUMBER

7. To obtain warranty service, the buyer (or their authorized dealer) must communicate with INSECTRONICS through e-mail BEFORE returning the product. All inquiries must be accompanied by a description of the problem. INSECTRONICS will then issue a return authorization number.
8. Subsequently, the product must be returned in its original shipping carton, together with the return authorization number to the address indicated by INSECTRONICS.
9. Shipments without freight prepaid will not be accepted.

15.4 WARRANTY REGULATIONS

10. Warranty services will be furnished only if the product is accompanied by a copy of the original retail dealer's invoice. Any product deemed eligible for repair or replacement under the terms of this warranty will be repaired or replaced.
11. If the product needs to be modified or adapted in order to comply with applicable technical or safety standards on a national or local level, in any country which is not the country for which the product was originally developed and manufactured, this modification/adaptation shall not be considered a defect in materials or workmanship. The warranty does not cover any such modification/adaptation, irrespective of whether it was carried out properly or not. Under the terms of this warranty, INSECTRONICS shall not be held responsible for any cost resulting from such a modification/adaptation.
12. Free inspections and maintenance/repair work are expressly excluded from this warranty, in particular, if caused by improper handling of the product by the user. This also applies to defects caused by normal wear and tear.
13. Damages/defects caused by the following conditions are not covered by this warranty:
 - a) Improper handling, neglect or failure to operate the unit in compliance with the instructions given in INSECTRONICS user or service manuals.
 - b) Connection or operation of the unit in any way that does not comply with the technical or safety regulations applicable in the country where the product is used.
 - c) Damages/defects caused by force majeure or any other condition that is beyond the control of INSECTRONICS.

- d) Any repair or opening of the unit carried out by unauthorized personnel (user included) will void the warranty.
- 14. If an inspection of the product by INSECTRONICS shows that the defect in question is not covered by the warranty, the inspection costs are payable by the customer.
- 15. Products which do not meet the terms of this warranty will be repaired exclusively at the buyer's expense. INSECTRONICS will inform the buyer of any such circumstance. If the buyer fails to submit a written repair order within 6 weeks after notification, INSECTRONICS will return the unit C.O.D. with a separate invoice for freight and packing. Such costs will also be invoiced separately when the buyer has sent in a written repair order.

15.5 WARRANTY TRANSFERABILITY

- 16. This warranty is extended exclusively to the original buyer (customer of retail dealer) and is not transferable to anyone who may subsequently purchase this product. No other person (retail dealer, etc.) shall be entitled to give any warranty promise on behalf of INSECTRONICS.

15.6 CLAIM FOR DAMAGES

- 17. Failure of INSECTRONICS to provide proper warranty service shall not entitle the buyer to claim (consequential) damages. In no event shall the liability of INSECTRONICS exceed the invoiced value of the product.

* Customers in the European Union please contact INSECTRONICS Support for further details.