OVI-BOVI COW HEAT DETECTION SYSTEM

USER GUIDE
This Guide is written to help users and technicians understand, install and use Ovi-bovi Heat Detection System. While every effort was made to keep information in this Guide accurate and reliable, we reserve the right to change specifications of the product described in this Guide without notice at any time, to the benefit of the user.

Rev. 16 March 2017

Ovi-bovi system conforms to the requirements of Eurasian Customs Union technical regulations 020/2011 on electromagnetic compatibility of equipment, declaration № BY/112 11.01. TP020 003 20945, valid till 02-03-2022.

CAUTION

Ovi-bovi tags contain electronic parts and are powered by 3.6V Li-SOCl₂ non-user-serviceable batteries. Please contact your local authorities for details of where and how to dispose of used tags for environmentally safe recycling.
Contents

1. Ovi-bovi cow heat detection system at a glance ............................................................... 4
2. Technical specifications ....................................................................................................... 5
3. Setting-up the system ......................................................................................................... 7
   3.1. Receiver node assembly .............................................................................................. 7
   3.2. Software initialization ................................................................................................. 8
   3.3. Antenna mounting and tags attachment ...................................................................... 8
   3.4. Linking tags to cows .................................................................................................. 9
4. Using the system ................................................................................................................ 11
   4.1. SMS alerts ............................................................................................................... 11
   4.2. Activity plots ............................................................................................................. 12
   4.3. Replacing the tags .................................................................................................... 14
5. Troubleshooting ................................................................................................................ 15
6. Warranty ............................................................................................................................. 15
1. Ovi-bovi cow heat detection system at a glance

From economic perspective, **cow oestrus detection** is a major challenge in modern dairy farming worldwide, with average farm size growing and thus visual heat detection being less and less reliable. Methods to detect cow’s oestrus as suggested by research community vary in a wide range, between measuring progesterone concentration in milk (which provides golden standard in oestrus detection but is prohibitively expensive) to spectral analysis of cow’s mooing (which is more extravagant than efficient).

Ovi-bovi heat detection system (HDS) is used for timely and accurate detection of oestrus in dairy cows with individual wearable **activity tags**. Ovi-bovi tags fit standard 4 cm wide collars, with no need to worry about any specific tag position or orientation. Expected operation life of each Ovi-bovi tag is 10 years. A tag can be swapped from a cow to another cow anytime, with the new cow’s ID associated with the tag’s ID in the database.

![Image](image.png)

**Figure 1.** Attaching Ovi-bovi tag to a collar is no pain.

Ovi-bovi tag’s operation is enabled by **continuous monitoring of animal’s activity** with three-axis MEMS-based accelerometer. Soldered to the printed circuit board of the tag, accelerometer measures cow’s physical activity as a fraction of Earth’s gravity constant $g = 9.81 \text{ m/sec}^2$ within the $-2g$ to $2g$ range. Upon basic processing, cow activity data is transmitted by the tag wirelessly to Ovi-bovi receiver every 5 minutes.

When in heat, a cow shows **specific activity pattern** which allows to determine oestrus event automatically, by statistical analysis of accelerometer readings $a_x$, $a_y$, and $a_z$ according to the pre-defined algorithm. Once the heat is detected by the software, the farm staff gets SMS with optimal insemination time for the given cow. Activity data for each cow with the 5-minute resolution is stored on the server and can be accessed and visualized by the user anytime.
## 2. Technical specifications

Ovi-bovi HDS is manufactured according to the registered specification BY 191640612.001-2016 and includes the following units:

- individual collar-worn wireless activity tags for the cows;
- Ovi-bovi receiver;
- outdoor 433 MHz antenna (either 70 cm or 195 cm long);
- coaxial N-SMA cable to connect antenna to the receiver;
- twisted-pair Ethernet cable (cat5+) to connect Ovi-bovi receiver to the router;
- passive power-over-Ethernet (PoE) injector;
- 220V AC/12V DC 1.5A power adapter;
- dedicated Ovi-bovi software.

The features of standard-type Ovi-bovi HDS are:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tag weight and size, max</td>
<td>100 g, 106 mm × 60 mm × 22 mm</td>
</tr>
<tr>
<td>Tag battery</td>
<td>2×AA Li-SOCl₂ 3.6V</td>
</tr>
<tr>
<td>Tag battery life</td>
<td>10 years</td>
</tr>
<tr>
<td>Ingress protection rating</td>
<td>IP67 (withstands up to 1 m water submersion)</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>−20°C to +85°C</td>
</tr>
<tr>
<td>Radio frequency band</td>
<td>433.05–434.79 MHz licence-free</td>
</tr>
<tr>
<td>Peak power emitted by the tag</td>
<td>10 mW</td>
</tr>
<tr>
<td>Free-space signal range</td>
<td>1000 m</td>
</tr>
<tr>
<td>Number of tags supported</td>
<td>1000</td>
</tr>
<tr>
<td>System calibration time</td>
<td>1 day</td>
</tr>
</tbody>
</table>

Each Ovi-bovi tag transmits data to the receiver every 5 minutes on a 24-hour basis in the license-free 433.05–434.79 MHz frequency band. Peak emission from the tag is under 10 mW (10 dBm) and the duty cycle is well below 0.1%, complying to the requirements of the European Electromagnetic Compatibility Directive 2014/30/EU and the Radio Equipment Directive 2014/53/EU, as detailed in ETSI EN 300 220-2. Ovi-bovi receiver does not emit any electromagnetic radiation.

The batteries in the tags have safe internal design including a very limited (<1g per cell) amount of lithium and the position of lithium against the inner wall of the cell case, so there is no danger of accident and explosion under short-circuit currents and thermal runaway conditions.

We supply 433 MHz antenna, coaxial and Ethernet cables, PoE injector and power adapter (all pictured in Figure 2) as produced by third-party companies. These items are available on the market and can be purchased by Ovi-bovi HDS user independently, provided the necessary technical specifications are met. To ensure smooth functioning, however, we recommend to use the units supplied by us, tested extensively before delivery.

A local area network with DHCP is required for Ovi-bovi HDS operation, and the network router (the one present on the farm) and the PoE injector (supplied by us) must be turned on constantly. The system can tolerate power outages for up to 1 hour due to redundancy induced deliberately into the tags’ messages, but longer outages will lead to data loss and hence to inaccurate cow heat detection. We therefore recommend to power the system via uninterruptible power source.

All the data received is stored by receiver and kept independently of power status; the receiver has capacity to keep the data for at least 10 years for each cow. We recommend to allow us to back-up your data automatically on our server, at no cost for you, but this is up to you to decide.
Figure 2. Receiver node includes Ovi-bovi receiver; 433 MHz antenna (70-cm-long version shown); coaxial N-SMA cable; twisted-pair Ethernet cable; AC/DC adapter; passive PoE injector.
Having internet connection at the farm is not an absolute must for running stand-alone Ovi-bovi system, but it is needed for SMS alerting (SMS notifications are dispatched via 3rd-party web service), for regular automatic backups of your data by us (if you allow this option), for automatic synchronization of system clock, and for getting unabridged support from us remotely at any moment. Any plain internet connection (e.g. with WiFi router) would suffice.

3. Setting-up the system

Please follow these steps to set-up stand-alone Ovi-bovi system with embedded server.

3.1. Receiver node assembly

1. Connect Ovi-bovi receiver to antenna with coaxial N-SMA cable. Do not mount antenna at this stage. If your antenna is A7-433, remove the screw on the side and pull off the N-type antenna connector for your convenience. Do not pull it too far though:

![Connecting coaxial cable to A7-433 antenna.](image)

*Figure 3. Connecting coaxial cable to A7-433 antenna.*
2. Connect Ovi-bovi receiver to your router with twisted-pair Ethernet cable and PoE injector at the end of the router.
3. Connect AC/DC adapter to the PoE injector, and plug it into the 220V outlet (UPS recommended).

3.2. Software initialization

4. Scan your local network (you may use free network scanner like Fing for iOs or Android, www.fing.io) and map out the IP address of the Ovi-bovi receiver.
5. Open a web browser on your tablet, laptop or PC, and navigate to the receiver’s network address, like http://192.168.100.6/. Ovi-bovi app will be launched.
6. Go to Settings & Info → Diagnostics; you will see Received signal strength indication (RSSI) for all the tags arriving and populating the graph, in 5-minute intervals for each tag.

![Figure 4](image.png)

Figure 4. “Settings & Info” → “Diagnostics” tab showing RSSI for two tags.

3.3. Antenna mounting and tags attachment

7. Once the signals from the tags appear in the app, carry the tags to where your cows spend most of their time, and place antenna at its planned location.

Placing antenna correctly is critical for good wireless connectivity. It should not be shadowed by the walls of a nearby building, placed in close proximity to power lines or to metal constructions. If your cows are pastured in the fields, antenna elevation should be enough to cover all the areas.

The receiver should be placed as close to antenna as possible, preferably within 1 meter (by default we provide 1-meter-long coaxial cable to connect antenna and the receiver – this is because the damping of the signal with the length in the cable should be minimized by all means).

8. If signals continue to arrive and their RSSI is not too low (i.e., not below 75), you may mount the antenna and put the tags on cows.
3.4. Linking tags to cows

9. Open **Herd Management** tab in the app and make sure it is populated with your cows:

![Herd Management tab](image)

**Figure 5.** “Herd management” tab with four cows already registered.

When you order the system, you are asked to share -basic inventory data about your cows with us, so that we can fill this table with that data (cows’ IDs, dates of birth etc.) for you in advance. We do not require but recommend you to do so to speed up setting up the system at your farm.

![Cow identification](image)

**Figure 6.** This cow is identified with two types if ID’s: 5-digit ear tag (#94253) and 3-digit collar tag (not seen in this photo). For each cow you can specify up to 3 ID types in the Ovi-bovi app.
At any moment you can add new cows you plan to monitor – just click **Add** and fill in the fields:

![Add cow screen](image1)

**Figure 7.** “Add cow” screen.

10. For now, **Ovi-bovi tag ID** fields are empty. When attaching a tag to the cow, fill in that cow’s **Ovi-bovi tag ID** field:

![Edit cow screen](image2)

**Figure 8.** “Edit cow” lets you can correct and expand the data.
Once the tags are put on cows and are registered in the app, the data from the tags start accumulating immediately. However, before we can fully trust the alerts and advices from the newly mounted activity tags, another major though invisible step follows — their automatic calibration. This is “individualization”: each cow has its own behavioural pattern and each farm is specific, so for better “understanding” of an animal by a tag we have to wait a few days after mounting the tags to let them collect and process data to find the “characteristic averages”.

After these few days or at least one day of calibration, the system is fully functional. One final step is to check whether your e-mail address (used for sending you automatic notifications and system reports) and phone number (used for automatic SMS alerts) in the system are correct:

![Figure 9. “Settings & Info” → “Settings” tab.](image)

In this same tab, you can also choose identifiers for up to three types of cows’ IDs. We have “Collar tag ID”, “Ear tag ID” and “Cow name” by default, but if your inventory system is different, just type in the appropriate names. You can change the names as many times as you need. If you use less than three IDs for your cows, it is not a problem either – leave the unused fields blank.

4. Using the system

4.1. SMS alerts

Normally the system needs no attention from the user other than checking emails or SMS alerts sent automatically when a heat for some cow is registered.

To automatically detect cow oestrus after its onset with due reliability, up to 8 hours may be needed; it means that when the alert is sent, the cow is already in heat for about 6-8 hours. At the same time, it is known that it may take as little as 8 to 16 hours from the onset of cow oestrus to the moment of her insemination to achieve best conception results. That’s why we recommend to **inseminate a cow within 8 hours following the receipt of heat alert**.
However, before deciding to inseminate a cow it is recommended to view her activity graphs in order to see the patterns, and look for the previous cycle.

4.2. Activity plots

In the app, **Herd Overview** tab shows activity thumbnails for all monitored cows:

![Figure 10. Heat alert message on a phone.](image1)

![Figure 11. “Cows’ activity” screen.](image2)
Click on a thumbnail of a cow you choose. You will see detailed information for that cow:

![Image](image1.png)

**Figure 12.** “Cow details” screen.

Scroll down to see cow activity charts. Heat, when detected, is shown with semi-transparent fill. The data can be zoomed-in using the sliders below the chart:

![Image](image2.png)

**Figure 13.** Cow activity plot with heat event shown.
The onset of heat is determined reliably when activity level reaches one standard deviation from its basic level; passing through the half-threshold of 0.5 std deviation can then be interpreted as the moment the heat actually started. It should be noted however that any type of running-time data aggregation and smoothing (and in particular, calculating the “moving means” needed to determine heats as spikes over the normal activity level) induces phase shift in the smoothed data. With 10-hours averaging implied by default in the Ovi-bovi algorithm, the curves lag behind actual activity pattern by roughly 5 hours.

4.3. Replacing the tags

If necessary, a tag can be swapped from a cow to another cow anytime, with the new cow ID associated with the tag’s ID in the database. First go to Herd Management where all your registered cows are listed, some with Ovi-bovi tag IDs associated, and some probably without:

![Herd Management Screen](image)

**Figure 14.** “Herd management” screen.

Click **Edit** against the cow you are going to put the tag off, and delete the **Ovi-bovi tag ID** field. Save the changes and return to the **Herd management** tab. Then click **Edit** against the cow you are going to put the tag on, and fill in the **Ovi-bovi tag ID** field with the tag’s number. Done!

Ovi-bovi system front-end is a web-based application, hence it is platform-independent. The best experience would be using an iPad or Android tablet, due to its mobility, but a standalone PC or a laptop is also perfectly ok – no matter Windows, Linux or whatever OS you have.
5. Troubleshooting

Although each tag and every component of Ovi-bovi HDS are tested before shipment, accidental problems and malfunctions may occur during operation. The following table will assist you in resolving these problems:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ovi-bovi receiver not seen by the app</strong></td>
<td>Check that the Ethernet cable is plugged into the receiver; that the PoE injector is connected to the Ethernet cable, the router, and the AC/DC adapter; and that both router and adapter are powered on. If all seems ok, unscrew the four bolts, remove the cover of the receiver, take a photo of its guts and send the photo to us by email. We will try to identify what’s wrong, and we will send you the replacement if needed.</td>
</tr>
<tr>
<td><strong>Zero cow activity level shown by one of the tags</strong></td>
<td>If the tag attached to a cow reports zero activity for more than one hour, you’ll be warned automatically. Most probably the tag was lost; find it and put it back. Less probably, the tag’s circuitry was damaged and sends zeros erroneously; then (a) break tag’s casing with any tool, (b) take off the circuit board and cut the batteries off, (c) send the board to us. Once the board arrives, we will send you the replacement tag.</td>
</tr>
<tr>
<td><strong>No signals from one or some of the tags</strong></td>
<td>If signals disappear for a limited period of time, it means that the cows are probably out of wireless coverage zone during that time. Consider finding a better place for receiver antenna; contact us for advice. If signals from a tag disappear for one day or longer, that could be due to the frequency drift of the tag’s quartz crystal. Send us the silent tag and we will send you the replacement immediately. If signals from many or all of the tags stop arriving at once, that could be due to the frequency drift of receiver’s quartz crystal. Contact us and let us reconfigure the receiver remotely.</td>
</tr>
</tbody>
</table>

6. Warranty

The warranty for Ovi-bovi HDS is five years from the day of delivery. We replace any tags or receiver for free in case of their electronics malfunction. Contact us with any questions, complaints or reclamations via e-mail at info@ovi-bovi.com, or by mail at:

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Ovi-bovi cow heat detection system

Type: __________  S/N: __________

Registered specification: BY 191640612.001-2016

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