

OVI-BOVI COW ACTIVITY MONITORING AND HEAT DETECTION SYSTEM USER GUIDE



This Guide is written to help users understand, install and use Ovi-bovi cow activity monitoring & oestrus detection system. While every effort was made to keep information in this Guide accurate and reliable, we may change specifications of the product described in this Guide without notice at any time, to the benefit of the user.

Rev. 01 January 2020



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 $3.6V \text{ Li-SOCl}_2 \text{ non-user-serviceable batteries}$. Please contact your local authorities for details of where and how to dispose of used tags for environmentally safe recycling

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1. Ovi-bovi system at a glance

Ovi-bovi system is used for timely and accurate **detection of oestrus** in cows or heifers and for **measuring chewing time**, all by means of individual wearable activity tags. Ovi-bovi tags fit standard 4 cm wide neck collars, with no need to worry about any specific tag position or orientation. Operation life of each Ovi-bovi tag's battery is well above **10 years**. A tag can be **swapped** from a cow to another cow anytime, provided new cow's ID being linked the tag's ID in the database.



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

Each Ovi-bovi tag transmits data to receiver **every 20 minutes** on a 24-hour basis in the licensefree 433.05–434.79 MHz frequency band. Transmission range is normally **up to 5 km** (depends on terrain and on antenna elevation) while peak emission from the tag is **under 10 mW** (10 dBm) and duty cycle is << 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.

Internet connection is required for Ovi-bovi system 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 data received is stored in the **cloud-based database** independently of current power status of the receiver though, and can be accessed from any device via web browser. Ovi-bovi 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 laptop is also perfectly ok – no matter Windows, Linux or whatever OS you have.

When in heat, a cow shows specific activity pattern which allows to determine oestrus automatically, by internal analysis of accelerometer readings a_x , a_y and a_z according to the predefined algorithm. Once heat is detected by the software, **SMS or Telegram alert is sent**; we recommend you check and, if needed, breed the cow **within 8 to 12 hours** from getting the alert. In addition to heat, health conditions of four kinds are tracked:

- low activity
- low chewing
- anestrus (defined as more than 45 days with no heat detected)
- too frequent heats (defined as heats reoccurring in less than 15 days)

Another type of alerts are lost tag alerts – when a tag is inactive for over 5 hours, it may be lost or taken away from the animal by farm staff; so an alert goes and suggests to check.

2. Technical specifications

Ovi-bovi system is manufactured according to the registered specification BY 191640612.001-2016. Its default features are:

Tag weight and size, max	80 g, 106 mm × 60 mm × 22 mm
Ingress protection rating	IP67 (withstands up to 1 m water submersion)
Operating temperature	–20°C to +85°C
Radio frequency band	433.05–434.79 MHz licence-free
Peak power emitted by the tag	10 mW
Free-space signal range	10 km
Number of tags supported	1000 (more by request)
System calibration time	1 day
Tag battery life	10 years



Figure 2. Receiver node includes Ovi-bovi receiver, coaxial N-SMA cable, twisted-pair outdoor Ethernet cable, 220V AC/24V DC PoE adapter, and standard patch cord to your router.

3. Setting-up the system

Please follow these steps to assemble and launch Ovi-bovi system:

- Connect Ovi-bovi receiver with your router through PoE adapter: twisted-pair Ethernet cable goes from receiver to the POE port of adapter, and another, standard Ethernet patch cord goes from LAN port of the adapter to available LAN port of your router. Plug the adaptor into 220 V outlet (UPS recommended). Look at the little button on receiver's front panel: within half a minute it should start shining green.
- Open web browser on your tablet, laptop or PC, and navigate to your app's Diagnostics page, <u>https://my.ovi-bovi.com/#/system</u> (login and password should be obtained before). There you will see received signal strength indication (RSSI) graph that should start being populated, in approximately 20-minute intervals for each tag.
- 3. Take A7-433 antenna, remove the screw on the side and pull off the N-type antenna connector for your convenience (do not pull it too far though); connect coaxial N-SMA cable to it and fix it back with the side screw. Connect free (SMA) end of N-SMA cable to Ovibovi receiver. Now newly received RSSI in the plot should rise 20 to 40 dBm higher.



Figure 3. Connecting coaxial cable to A7-433 antenna.

4. Carry the tags to where your cows spend most of their time, and preliminarily place antenna at its planned location. If signals continue to arrive and their RSSI is not too low (not lower than -100 dBm), you may firmly mount antenna and put tags on cows.



Figure 4. Good practice is to mount antenna on a pole standing a bit above the roof or the wall. No wall or metal construction should block the plastic (long) part of antenna.

- Placing antenna correctly is critical for good wireless connectivity. If your cows are pastured in the fields, antenna elevation should be high enough to cover all areas. Use https://link.ubnt.com/ or other resources for prior inspection and planning. Also avoid sharp bending of coaxial (short) cable. In theory, coaxial cable is lossless when straight, but bending leads to losses even with ideal core dielectrics. The tighter we bend the cable the more losses we have.
- For better accuracy of rumination sensing and for cows comfort we advise that Ovi-bovi tags hang loosely. Please check that the collars are not too tight and that the tags tend to hang freely on collars, mostly in the bottom position under cows' neck. If a tag is on the side, far from its lowest position, it means the collar is probably too tight. (Yes this is opposite to e.g. SCR Dairy requirement for tight collars and precise positioning of their tag on cow's neck.)



Figure 5. Loose hanging of Ovi tags is absolutely ok.

4. Linking tags to cows

Activity data from tags physically put on cows start accumulating in the app only after tags are linked to cows in the app. This can be done in one of two ways, whichever is easier for you:

NFC-assisted way. You can link tags to cows with a smartphone (with NFC enabled) while tagging the animals in the barn or at milking parlour by means of the following procedure: one takes a tag, scans it with a smartphone and, when asked by the app to provide cow's ID, types in the ID of a particular cow standing before him. Then the scanned tag should be placed on that cow.

Manual way. On your PC or laptop, open *Cows* tab in the app and click *plus* button to add cow:

Cc	ows										•	
							Current	Archive	Q S	earch for		
	-	ID 🔺	Group	Tag ID	Age	Inseminated		Notes				
											+	
	_								_			_

For each cow, fill in her ID, her group and her tag's ID. Other fields may be filled in now or later:

Add cow			 Image: Image: Image:
ID *		Tag ID	
Date of birth		Group	
			*
Inseminations	Bull	Notes	
	+		
Pregnancy check			
		T	
			Save

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 one (just one!) day after mounting the tag to let it collect and process data to find characteristic individual averages. This calibration is fully automatic; just wait for a day, for each tag, before you can fully trust it.

5. Using the system

5.1. Activity and rumination plots and thresholds

Each cow's activity and rumination data are shown in a plot like this:



The terms used are:

Rumination (the grey "skyline" in the plot) is sensed by continuously comparing the amplitudes of frequency spectrum components at characteristic rumination frequency around 1 Hz and at a marginal reference frequency, with threshold tunable via NFC if needed. Its raw output is in seconds per 10-minute interval, averaged on server over 3 to 5 last hours for better perception, shown in minutes per hour in the plot.

Individual activity (blue line in the plot) indicates, in relative units, at each moment, how much a cow was moving during 10 hours preceding that moment in relation to her average activity in a few days preceding the same moment. Use individual activity for heat detection for isolated cows only; close to or larger than 1.0 **threshold** is recommended.

Any type of running-time data aggregation and smoothing (in particular, calculating the "moving means" for individual activity) induces phase shift in the smoothened data. With 10-hours averaging implied by default in Ovi-bovi algorithm, the curves lag behind actual activity pattern by roughly 5 hours.

Group activity (grey oscillating stripe of varying width in the plot) is average activity of the group of cows by the given moment. This measure, calculated internally on the server, is very important for tracking any abrupt activity ups or downs of the whole group of cows related e.g. to sudden weather changes, and also for filtering out natural circadian rhythms for better detection of heat in individual cows.

Appropriate cow grouping in the app is critical to achieve perfect heat detection accuracy. False heat alerts and/or missed heats may occur if groups are too small (under 15 animals) or too heterogeneous (made up of cows of different breeds, ages and/or stages of their reproductive cycle). Avoid small or heterogeneous groups.

Adjusted activity (orange line in activity plot) is the most relevant metrics for heat detection. It is based on individual activity of a given cow adjusted for the difference between that individual activity and the average activity of her group (i.e., group activity) at each time point. For the cattle in free-stall barns or greasing freely, adjusted activity **threshold** is usually around 1.0. For tied animals, a somewhat lower threshold is usually recommended.

Heat is orange-highlighted span of time when cow's adjusted activity exceeds threshold level. If default (1.0) threshold for adjusted activity leads to false heat alerts, it can be chosen a bit higher; if any true heats are missed, on the contrary, it should be set to a bit lower value, like 0.95 here:



5.2. The alerts

You can get alerts over Telegram messenger or by SMS. To get SMS alerts, you need to fill in your phone number (or several numbers, comma separated) on the Settings page of Ovi-bovi app. To get alerts via Telegram, you have to subscribe to our Telegram bot. Telegram is preferred for foreign countries where SMS messaging via local GSM operators can be problematic.

Ovi-bovi sends its users Telegram or SMS alerts of three types:

- 1. Cow heat alerts
- 2. Cow health alerts
- 3. Lost tag and electricity blackout alerts

Heat alert is sent within a few minutes after activity of a cow rises above threshold. We recommend to **inspect & inseminate a cow within 8 to 12 hours following heat alert**.



Correct insemination timing can create a significant improvement in pregnancy rate on the farm. Optimal time from the onset of heat to insemination depends on many factors (breed and age of a cow, semen preparation etc.) and should preferably be calculated **based on statistical analysis of insemination success records for the given farm**. This can be done after several months of proper usage of Ovi-bovi system, with insemination data carefully filled in by the staff for each cow. However, default 8 to 12 hours rule is a good proxy.

However, some alerts may in fact be false alerts, and with some experience people can see it, for a given cow, by her present activity level and by her previous heats and history in general.

As mentioned in introductory section, Ovi-bovi system monitors health conditions of four kinds:

- low activity
- low chewing
- anestrus (defined as more than 45 days with no heat detected)
- too frequent heats (defined as heats reoccurring in less than 15 days)
- The tags measure general activity level and chewing time, so any abrupt change in those two parameters (general activity and chewing) can be used for illness detection. However, this is not a way to diagnose any particular illness such as mastitis, but only a suggestion to inspect a cow. Contrary to the statements in many advertising brochures from the sellers of activity monitoring tags as to the possibility to detect certain illnesses, such as mastitis, with those tags precisely, we are unaware of scientific evidence published in peer-review journals which would support such claims.

Finally, you may get **lost tag alerts** – when a tag is inactive for over 5 hours, it may be lost or taken away from the animal by farm staff; and **electricity blackout alerts** generated when Ovibovi receiver is powered off or gets no messages from tags for more than 1 hour.

5.3. The reports

Each month a report for your farm is generated by Ovi-bovi, sent as PDF file to your email address. An example can be downloaded here, <u>ovi-bovi.com/files/ovi-report-example-en.pdf</u>, for a typical farm with 350 tags.

The report contains data useful for farm owner or manager, such as: **daily number of tags linked to cows** (to see how many tags are actually in use); **number of heat alerts received** and **number of registered inseminations** (both following heat alerts and without heat alerts from the system); **times from heat alert to insemination**, for each breeding event and on average.

In the report, detailed analysis of heat detection performance is made, with all discrepancies between Ovi-bovi data and actual inseminations being highlighted. In general, discrepancies of two kinds are possible: cow **not** bred despite her **high** activity (i.e., heat detected by the system and heat alert received by the staff); cow **bred** despite her **low** activity (i.e., heat not detected by the system and heat alert not received by the staff).

Discrepancies of the first kind can occur when (1.1) **insemination is considered not feasible** because of young age or low weight, or endometritis, or other health issues; (1.2) **insemination is missed** by inseminator who e.g. failed to arrive in time; (1.3) **heat was considered false** in the course of cow inspection by inseminator or veterinarian, which may signify that activity threshold is too low so it should be increased in the app to get rid of false heat alerts.

Discrepancies of the second kind can occur because of either **inadequately high** threshold set in Ovi-bovi app (which should then be decreased by the user for better sensitivity), or app usage errors such as: tag number registered in the app **does not correspond** to the tag actually worn by that cow; cow is linked to the **wrong group** in the app by mistake; groups are **too small** (under 15 animals) or **too heterogeneous** (made up of cows of different breeds, ages and/or stages of their reproductive cycle).

We recommend to inspect each case and perform appropriate actions to improve farm's KPI and Ovi-bovi usage experience in the forthcoming months.

6. Swapping 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. This is a usual demand on farms where the number of tags is limited so that just $\frac{1}{3}$ or $\frac{1}{2}$ of the herd is equipped with the tags — those cows from calving until their new pregnancy is confirmed — so the farm staff regularly replace tags from cow to cow.

When you take off the collar with the tag and let it still for 5 hours, the system **automatically** deletes this tag from the cow it was linked to, and puts that cow into archive. On a big farm, when 50 or more cows may be checked for pregnancy on a single day, and their tags physically removed, this automatic archiving of cows is of great help to the farmer – he needs no manual labor to de-link tags from those cows.

However, you can **manually** delink the tag from a cow if you want it immediately. Click *Edit* cow's page, then delete *Tag ID* and save it:

ID *				Tag ID	
35252.6				13	
Date of birth				Group	
25.10.2018				А	
Inseminations		Bull		Notes	
11.12.2019 16:09	+	200789			
Pregnancy check					
			T		
					Save 🕤

Now this tag's ID is free and can be linked to any other cow.

7. Troubleshooting

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

Problem	Solution
No signals arrive from any of	Check that the Ethernet cable is plugged into the receiver; the
the tags	PoE adaptor is connected to the receiver and the router; and both router and adapter are powered on. If all seems ok, un- screw 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 replace- ment if needed.
No signals from one or some of the tags	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 or some other malfunction. Send us the silent tag(s) and we will send you the replacement.

6. Warranty

The warranty for Ovi-bovi system 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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