

TBR 800

User manual



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Introduction

About the TBR 800

The TBR 800 is a robust, low-power, standalone digital acoustic receiver with multifrequency capabilities. It employs state-of-the-art digital signal processing technology to operate in the 63-77 kHz frequency range. Maximizing data reception involves monitoring and adapting to background noise levels. The received data, logged temperature data, noise conditions, inclination, power consumption, and battery voltage are stored in the internal memory.

It offers adaptability and versatility for various application needs as a modular product that can be upgraded to a TBR 800 Release. When paired with the DeckBox field kit, the TBR 800 can transmit and provide status updates, including battery voltage and power consumption information upon request.

TBR 800 is a digital receiver, meaning all noise signals are picked up and analysed, but only those that match the established signal protocols are registered as detections. Because of this feature, our digital receivers have the possibility of utilizing several frequencies at once (multifrequency).



Figure 1: TBR 800 receiver

TBR 800 applications

Some examples include:

Fish behaviour and ecology: Acoustic telemetry can help researchers collect data from tagged fish's movement patterns, behaviour, and interactions.

Migration patterns: Acoustic telemetry play a crucial role in studying the intricate migration patterns, seasonal movements, and species' behaviour across diverse environments.

Estuarine and river systems: Using acoustic telemetry helps study estuarine and riverine systems, particularly for examining migration barriers, ensuring habitat connectivity, and tracking anadromous species (fish that migrate from the sea to rivers to spawn).

Fine-scale positioning: Allows researchers to track species movement precisely and in more detail for valuable insight into the behaviour and habitat use.

Conservation and restoration: By assessing the movement and behaviour of endangered species and the influence conservation measures pose, acoustic telemetry can be a valuable tool to map the situation and inform decision-makers.



Coral reef research: Researchers can gain insight into coral reef species by employing acoustic telemetry infrastructures and studying their behaviour, interactions, habitat connectivity, and preferences in a detailed and less intrusive manner.

Hydroelectric and water management: Acoustic telemetry can help assess animals' passage, behaviour, and responses to environmental changes caused by hydropower buildout and water management.

Invasive species management: Acoustic telemetry can track and investigate the introduction and spread of invasive species and facilitate high-risk areas via monitoring.

Aquaculture and fisheries management: Acoustic telemetry can be used in aquaculture practices to monitor behaviour and welfare, optimize feeding strategies, assess fish health, and improve overall management. In fisheries management, stocks can be examined by investigating movement, stock abundance, and the effectiveness of fisheries management strategies.

Oceanic structure monitoring: Acoustic telemetry can provide structural monitoring to analyse underwater conditions, study marine environments, and understand the dynamic changes within the aquatic realm.

Marine mammal studies: By tracking aquatic mammals such as otters, whales, and dolphins, researchers can investigate behaviour, migration, interactions, responses to environmental pressures, and more.

Product Specifications

Key information

Dimensions and depth	
Length	245 mm
Diameter	80 mm
Weight in air w/o battery	1100 g
Weight in air with battery	1300 g
Weight in water w/o battery	100 g
Weight in water with battery	300 g
Maximum depth	750 m



Battery	
Battery life	~ 24 months
Battery types	SL-2790 / TL-5937
<i>Multifrequency feature battery life:</i>	
2 frequencies	~ 21 months
3 frequencies	~ 18 months

Communication	
Air	Bluetooth communication
Water	Two-way acoustic communication with the Live transceiver that comes with the DeckBox field kit.

Data	
Data transfer method	Wireless Bluetooth
Data storage capability	3 million detections
Data handling software	ComPort - Free to download

Frequencies	
Available frequencies	63-77 kHz
Multi-frequency	3 frequencies simultaneously

On-board sensors	
Inclination	Degrees (°)
Water temperature	Temperature (°C)
Background noise	Signal-to-noise ratio (SNR)
Battery voltage	Volt (V)
TBR average current consumption	Milliampere (mA)

Other	
Multi-coloured LED interface	Green, yellow + red and blue
Free, upgradable receiver firmware	Yes
Open Protocol compatibility	Yes
<i>Advanced digital signal processing for reliable detection</i>	
Collision Suppression system	



Sensor log

Every 10 minutes, TBR 800 will save a sensor log that includes:

- Noise data
- Temperature
- Tilt of TBR 800
- Power consumption
- Voltage value (+ motor voltage value for TBR 800 Release)
- TBR 800 serial number
- Frequency
- Timestamp

Digital Signal Processing

The TBR 800 is a digital receiver, meaning that everything the receiver hears, the sounds in the water, are picked up and analysed digitally. The receiver's onboard computer constantly calculates the frequencies of the detected sound, the phase, and the intensity. How it is sampled and calculated can be changed through firmware and is not dependent on hardware tuning. This makes the digital receivers very flexible and allows for more precise and sensitive detection than what is possible through analogue signal processing.

The digital signal processing includes features such as:

Multifrequency - where our receivers can run detection on several frequencies at once.

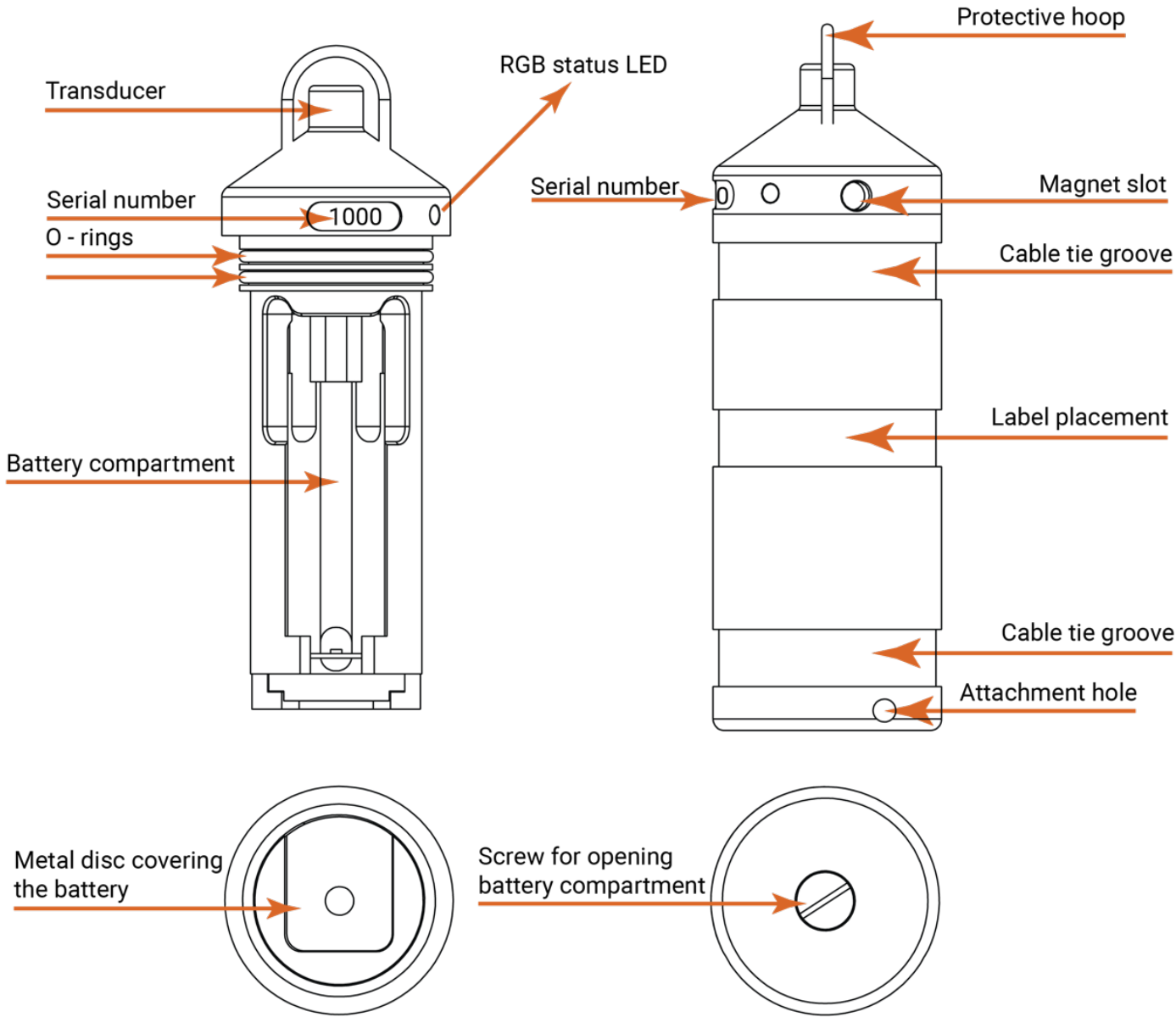
Signal collision reduction - Multichannel reception ensures that weak signals do not interfere with stronger signals, significantly reducing signal collisions, often seen with similar technologies. The TBR 800 logs the signal intensity of every detection, which provides information on signal detection conditions and the approximate range/distance.

Mitigate background noise - The digital receivers from Thelma Biotel are based on digital technology, which includes tools to filter out and mitigate background noise, assuring researchers can study all kinds of areas of interest, whether you find your species in noisy river systems or lively coral reefs. With dynamic adjustments of the signal threshold levels, the TBR 800 increases performance in challenging conditions where high noise levels are present, such as ambient and biological noise.

SNR/Signal-to-noise ratio - The digital signal processing offers excellent sensitivity and, thus, an extensive detection range for tags. Digital signal processing also allows the receiver to analyse the received signal strength; this is stored as SNR with every signal detection in the memory. The SNR, the signal strength, is reduced with increasing distance and increased background noise. That's why it is such a powerful tool in range testing and general analysis of your final data.



TBR 800 parts



Product safety



IMPORTANT, PLEASE READ BEFORE USING TBR 800:

Our users' safety and the equipment's proper operation are important to us at Thelma Biotel. This user manual section describes essential safety information and guidelines to ensure a safe and reliable experience when handling our equipment.

By following these recommendations, you will increase the user's safety and improve the performance and durability of your TBR 800 receivers. Whether you are experienced or new in the acoustic telemetry field, following these safety instructions will allow you to operate our equipment more safely and confidently.

Battery Safety

Information collected from: [Tadiran Batteries, Lithium Battery Information Sheet](#) [1]

The Lithium Thionyl chloride batteries used to power the TBR 800 contain chemicals that, if not handled correctly, could represent a health hazard.

Thelma Biotel uses Lithium Thionyl chloride batteries of the type SL-2790 / TL-5937 (these are the same batteries with names for different markets - Worldwide / America). The battery must always be handled carefully to avoid mechanical, electrical, or thermal damage. The battery must never be subject to short circuit, recharging, puncture, incineration, crush, immersion in water, force discharge, or be exposed to temperatures beyond the temperature range of the battery cell (–55 °C ... +85 °C).

More information about the battery safety can be found in the accompanying battery manufacturer manuals “[Lithium Battery Information Sheet](#)” [1] and “[Technical Brochure LTC-Batteries](#)” [2].

Receiver battery damage

If your receiver displays any signs of internal or external damage, the battery could be compromised, and the unit should be treated cautiously. Proper protective equipment must be used when investigating the unit to avoid inhalation of gases or contact with a chemical spill.



Signs of receiver damage

- The LED light lens has popped out of its port (internal pressure relieved)
- Any signs of water inside of the receiver
 - Additional weight over normal receiver weight
 - Water sloshing inside the receiver
- Premature non-responsive receiver. No LED indicator light long before the estimated battery lifetime is up.
- Visible physical damage, cracks, or leaks

Possible pressure inside of the TBR 800 receiver

A damaged receiver can possibly contain pressure when brought to the surface. The LED light lens is a pressure relief port and will pop out long before the internal pressure reaches dangerous levels. A missing LED port is a sure sign of a damaged battery, and careful handling must be followed to avoid exposure to battery acid. Minor pressure could also be released as the receiver is opened, and care should be taken to avoid possible spray or fumes exiting the casing when opening.

Possible internal water damage in the TBR 800 receiver

A water leak in the receiver can result in internal pressure and corrosion damage to the battery. A receiver with internal water damage needs to be handled according to safety procedures due to the pressure, and potential hazardous gases and liquids within resulting from the battery.



How to handle a damaged TBR 800 Receiver

We recommend following these steps when handling a potentially damaged TBR 800 Receiver:

1. **Use protective gear** such as gloves, protective glasses, and respiratory protection, and work in a well-ventilated location.
2. **Always follow proper safety procedures** implemented in the area you are working in (Check country, state, and county rules where you are using your equipment).
3. If you suspect that the receiver is damaged and you are unsure what to do, **do not hesitate to contact the Thelma Biotel team: service@thelmabiotel.com**
4. If the receiver is potentially compromised and not handled immediately, remember always to keep the unit **stored in a safe location** in case of a breach. **Do not point the top part of the receiver** towards anyone else or yourself.

If you suspect a leak in the receiver, the best way to handle it is by wrapping it in a thick towel or similar fabric to catch any spray, liquid, gas, or pressurized parts. Contained in the towel you can use a flathead screwdriver to unscrew and open the receiver carefully. Opening a damaged receiver must be done either outside or in a well-ventilated area with protective gear, as stated above.

NOTE: if you don't feel comfortable with the procedure or have further questions, do not hesitate to [contact us](#) before opening the unit yourself.



Installation and setup

Open and install the battery



1. Open the housing using the supplied tool (or a coin, flathead screwdriver, etc.) and turn counterclockwise to expose the battery compartment.



2. Pull the battery compartment and receiver top to separate from the casing.



3. Insert the battery with the negative terminal towards the spring. Ensure that the battery spring is compressed correctly while sliding the battery in and clicking it into place.



4. The LED indicator will flash yellow during start-up. These flashes show the boot sequence and self-checks. When complete, the LED indicator flashes a 3x3 green light, and the receiver starts listening for acoustic signals.



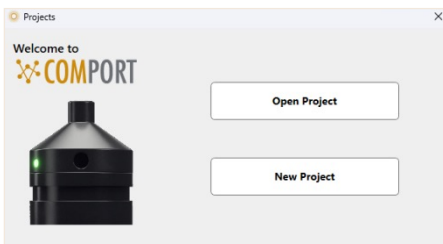
5. Put two humidity-absorbent bags in the opening over the battery. Check the colour of the pellets for quality. Blue colour pellets are ready to deploy, white/translucent needs to be dried or replaced.



6. Check O-rings for deformation and cracks. An initial sealing force is needed, and the O-rings must be round and pliable. When the cross section starts to become square and the rubber gets hard, they must be replaced. Only use light lubrication with silicon or O-ring grease for ease of installation. Sealing surfaces must be free of any dirt or fibres, scoring or scratches.



7. Insert the battery compartment into the casing and turn the screw on the bottom of the receiver casing clockwise until the gap by the main O-rings is completely closed. Do not tighten with force. Tightening the screw down hard will not make it seal better, only make it harder to open.



8. Connect to ComPort software to complete configuration and check clock synchronization.



IMPORTANT BEFORE DEPLOYMENT:

Ensure the LED indicator is flashing **green heart-beat signals**.

Rub the transducer tip and confirm that the TBR responds (observe the LED flashes green).



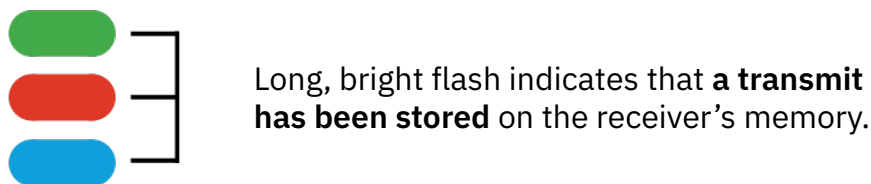
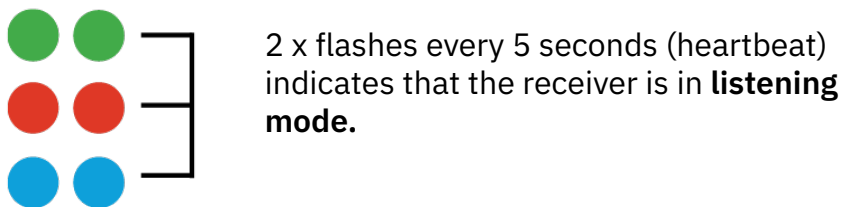
LED indicator status codes

The following section explains the meaning of the different colour codes and sequences of the LED indicator on the TBR 800. The LED indicator is located next to the serial number; **See section - TBR 800 parts.**

Colour codes:

- Green = Status OK
- Red = Clock not set or memory full
- Blue = Bluetooth is activated
- Yellow = Startup/ Bootup /Loading

Listening mode sequences:



Magnet controls

The following section explains how to use the different magnet controls to turn on Bluetooth, put the TBR 800 to sleep and wake the TBR 800 back up again.

Turn on Bluetooth:

1. Hold a magnet to the magnet slot à LED indicator will flash fast
2. Wait until the LED indicator flashes blue, and then **REMOVE THE MAGNET**
3. The Bluetooth times out after three minutes if no action is taken



Put TBR 800 to sleep:

1. Hold a magnet to the magnet slot
2. When the LED indicator starts flashing, **REMOVE THE MAGNET**
3. The TBR 800 will flash 10 times slowly
4. When the lights stop flashing, and lights up continuously, place the magnet back to the magnet slot
5. The TBR 800 will then flash 3 x 2 times to signal “good-night, good-night, good-night”

Wake TBR 800 from sleep

1. Hold a magnet to the magnet slot
2. The TBR 800 will flash 3 x 3 times to signal “good-mor-ning, good-mor-ning, good-mor-ning”

Start new project

When starting a new project, there are a few procedures, tips, and tricks to keep in mind to keep the workflow as seamless as possible

1. **Always create a “project folder” in a shared location** with a distinguishable and recognisable name for all members involved in the project. This helps to keep all the data in the project together in one folder, prevents new data from being downloaded into the wrong project, and ensures better traceability.
2. **ALWAYS check, and correct, the clock on the computer** that is used to download data before starting to download
3. **If several computers are used** to download data from receivers into the same project, the same shared “project folder” can be used, and the datasets can be merged, and duplicates can be removed later
4. If some **field computers are not using Wi-Fi**, data can be transferred via USB or Bluetooth after downloading the data. **Make sure the clock on the computer is correct** before downloading, as computer clocks tends to drift quite a bit.
5. **If several people are working on the same project simultaneously** on separate computers, e.g. downloading data from receivers, we recommend downloading the data on separate project files and merge these later to avoid conflict and mistakes on the same project file.

To set up a new project file for a new study in ComPort, simply:

1. Open ComPort
2. Choose “New Project” in the pop up window
3. Save the new project with a recognisable project name
4. Activate Bluetooth on TBR 800 and connect to ComPort to transfer data

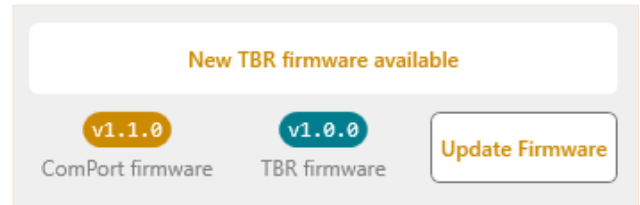


Configure TBR 800 with ComPort

Firmware

It is important to check that you have the newest firmware on your receivers before going through with configuration.

If you have an old firmware on your receiver, the **Update Firmware button will be highlighted when opening the configuration window**, allowing you to update your firmware. Simply click the “Update Firmware” button as shown to the right and follow the steps.

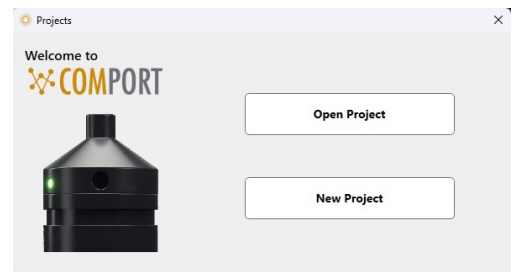


If you are using a custom firmware, refer to “Custom cases” under the section “Other”.

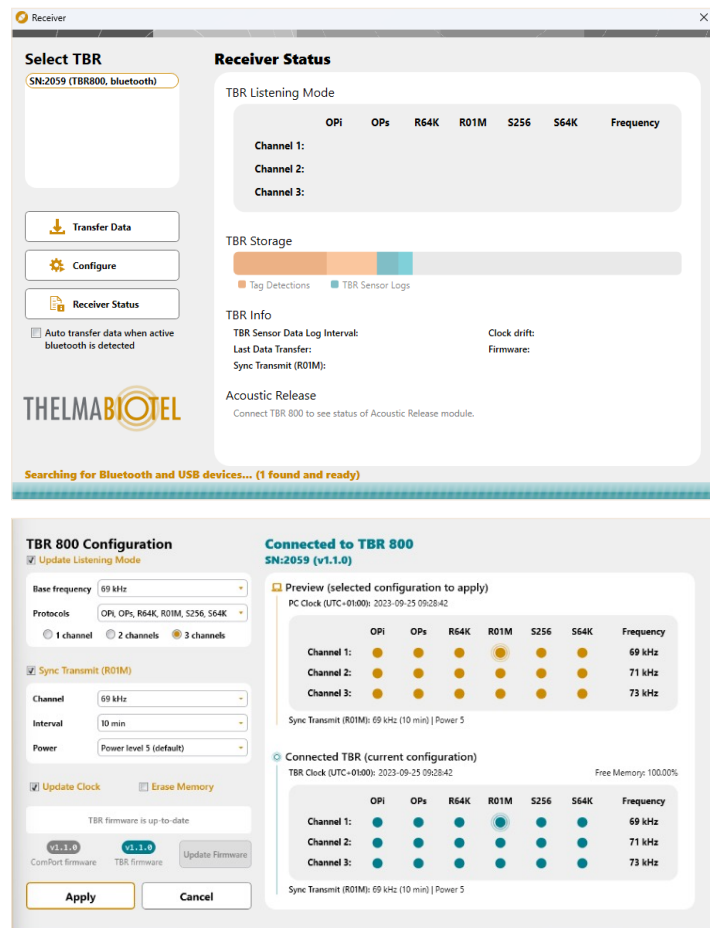
Open and start configuration

Before deploying the TBR 800, they need to be configured. Configuration is easily done by connecting the receiver to ComPort using Bluetooth. The following guide will show you how. You can also find the [configuration manual](#), from downloads on our website.

1. Open ComPort on your computer then create a new project or open an existing one (as pictured).
2. The receiver window will appear when clicking “New Project” or by clicking Connect TBR in the top left corner of the main window when opening an existing project.
3. Before connecting the receiver to your computer, make sure Bluetooth on your computer is activated. To switch the receiver into Bluetooth-mode, place a magnet next to the magnet slot. Hold it there until the LED-light starts flashing blue. **REMOVE MAGNET AFTER, OR BLUETHOOTH WILL TIME OUT.**



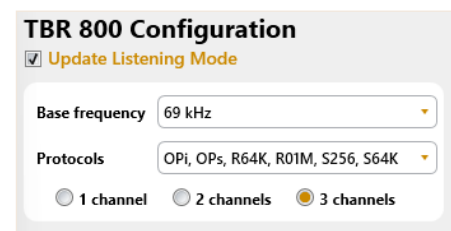
4. When the receiver is discovered, it will appear in the Select TBR box in the top left corner of the receiver window.
5. To start configuring the receiver, press Configure to the left in the receiver window, and a new window will appear.
6. The configuration window is separated into three sections: **Configuration, Preview, and Connected TBR**, as seen to the right:



Listening modes

To enable changes to the frequency and protocols that the receiver listens to tick the Update **Listening Mode** box under Configuration on the left-hand side.

- **Listening mode** is the combination of protocols and frequencies the receiver is decoding signals on.
- Once the box is highlighted, you can change the listening modes of the connected receiver





Frequency and multifrequency

1. First, **select the base frequency**. This is the frequency the receiver will be listening at. Make sure it is set to the same frequency as the transmitters you will use for the project.

When using **multifrequency and listening to two or three channels**, the **base frequency decides which frequencies the receiver is set to**.

NOTE: The battery life is slightly reduced when using multifrequency: Listening to 2 channels = 12.5% reduction, and listening to 3 channels = 25% reduction.

- If the receiver listens to **2 channels**, it will choose the frequencies **+2 kHz above the base frequency**; in this case, it would be 69 and 71 kHz.
- If the receiver listens at **3 channels**, it will choose the frequencies **+2 kHz and +4 kHz above the base frequency**; in this case, it would be 69, 71, and 73 kHz.
- If any frequencies other than base frequency +2 and +4 kHz will be used, it will be handled as custom. Contact Thelma Biotel if this applies to your project.

TBR 800 Configuration

☒ Update Listening Mode

Base frequency: 69 kHz

Protocols: 63 kHz, 64 kHz, 65 kHz, 66 kHz, 67 kHz, 68 kHz, 69 kHz, 70 kHz, 71 kHz, 72 kHz, 73 kHz, 74 kHz, 75 kHz, 76 kHz, 77 kHz

☒ Sync Transmitter

Channel: 69 kHz

Interval: 70 kHz

Power: 71 kHz

☒ Update Clock

Base frequency: 69 kHz

Protocols: OPI, OPs, R64K, R01M, S256, S64K

☐ 1 channel ☐ 2 channels ☒ 3 channels

Protocols

2. The next step is to **set the protocol** that the TBR will transmit. This **must be the same** as the transmitters you want to listen to. The 'OPI, OPs, R64K, R01M, S256, S64K' option will cover most users.

TBR 800 Configuration

☒ Update Listening Mode

Base frequency: 69 kHz

Protocols: OPI, OPs, R64K, R01M, S256, S64K

☐ 1 channel ☐ 2 channels ☒ 3 channels

☒ Sync Transmitter

Channel: S64K

Interval: HS256

Power: DS256

OPI, OPs

OPI, OPs, R64K, R01M, S256, S64K



TBR 800 built-in sync transmit (R01M)

The main use of the sync transmit is to synchronise the receiver clocks for PinPoint positioning. The sync transmitter used to be an own transmitter used in addition to the receivers for time synchronisation, but Thelma Biotel have integrated the technology into the TBR 800 receiver. There are many benefits of this, including getting the sync transmit at the exact location of the TBR 800 for more precise readings and synchronisation.

Sync Transmit (R01M)

Channel: 69 kHz

Interval: 10 min

Power: Power level 5 (default)

The sync transmit can be turned on and off by ticking and un-ticking the box next to “Sync Transmit (R01M),” as shown in the figure to the right.

Recommended settings and practices

Protocol for the sync transmit – R01M:

TBR 800 will always send on the R01M protocol due to its greater number of free IDs, robustness, and lower chance of false detections.

We recommend keeping the sync transmit on in most cases:

In many cases, the sync transmitter can serve as an extra layer of protection, such as discovering drifting in the receiver’s location or as a backup to other sync transmit receivers if something unforeseen happens.

What frequency channel should you use?

- If you expect **many transmitters at once in the grid** or have a tight grid of receivers, we recommend having the sync transmit on a separate frequency channel from the transmitters to avoid collisions. This means more battery usage for the receiver, but it is well worth it if there is a potential for high rates of collisions.
- If few transmitters are **expected in the grid simultaneously, or you have a wide grid of receivers**, using the same frequency is recommended to save battery on the receiver.



Sync transmits at 10-minute intervals for main sync receivers in the grid:

- **NEVER use a sync transmit with a higher frequency than every 10 minutes** (e.g., 1 minute, 5 minutes, or 8 minutes). Sending sync transmits too frequently could potentially make the signals hard to distinguish.
- The main sync transmit receivers in the grid are those that synchronize the clocks most frequently. These should be set to a 10-minute sync transmit interval.
- To avoid collisions of the sync transmits between each other and with transmitters, the sync transmitters will randomly send within a +/- 30-second window of the transmit interval.

Sync transmits at 60-minute interval for all other receivers in the grid:

- We recommend having the other receivers in the grid on a 60-minute sync transmit interval to serve as extra protection if one of the main sync transit receivers fails to send a signal.

In most cases, we recommend using power level 5 for the sync transmits:

- In most cases, the power level of the sync can be set to 5 (Default)
- In cases where it is desirable to limit the range, for example, in areas with a high number of signals and large chances for collisions, the power level can potentially be adjusted down.



Sync transmits for PinPoint analysis

Redundancy of sync transmits is key to getting precise positioning estimation in PinPoint analysis. All clocks naturally exhibit some drift, and because each receiver has its own quartz crystal-based independent clock with millisecond resolution, these clocks can vary slightly.

- Clock drift may amount to approximately 250 milliseconds per day, depending on temperature variations.
- To synchronize the clocks within the grid, the TBR 800 comes with a built-in synchronization transmitter.
- When the same signal is detected by several receivers, the measured arrival time can be compared to expected values based on known distances and the estimated speed of sound.
- This synchronization method allows all receivers within the detection range of one sync transmitter to be precisely synchronized.
- A common clock reference is utilized across the synchronization transmitters, with one receiver serving as the master clock (see Figure 2 below).

PinPoint does not require exact clock time, but it relies on accurate timing between the receivers in the grid. Meaning that it is more important that the TBR clocks match rather than having the exact correct time.

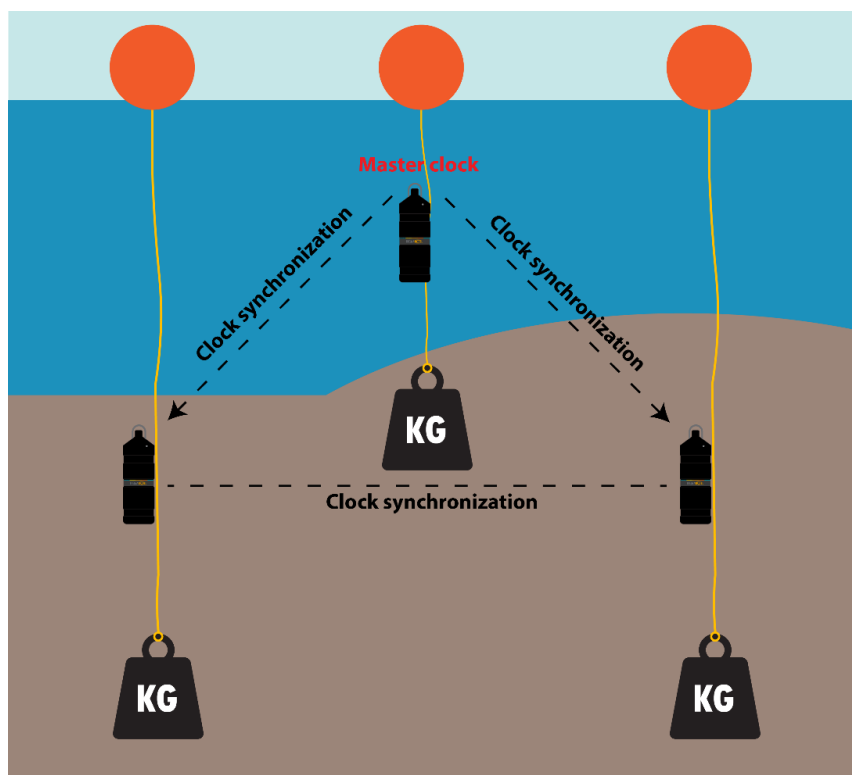


Figure 2: Visualisation of clock synchronisation between three receivers, with one receiver serving as the “master clock”



General tips and tricks for using the sync transmit with PinPoint

- Always have a sync transmit on all receivers
- Have receivers in range of other receivers with a sync transmit on
- Avoid any form of blockage of the range of sight between receivers – this will wrongly calculate the distancing
- Do not use a sync transmit interval more frequently than 10 minutes
- If the battery allows it, always put the sync transmit on its own frequency channel

Clock settings and dealing with clock drift

All clocks drift over time, and so does the internal clock of the TBR receivers. To maximize the value of your timestamped telemetry data, you need to know about clock settings and make a few informed choices on how to deal with clock drift. Different setups might demand different approaches on how to deal with clock settings. An important key to achieving accuracy is to ensure that you always start off correctly by syncing your computer clock to internet or GPS time before doing receiver operations.

Access the 'Date and Time settings' menu on your computer and select 'Sync Now' before initializing the receivers and setting the TBR clock.

A few basic specifications of the TBR 800 and clocks in general:

The TBR 800 uses a high precision clock circuit. The manufacturer specifies a maximum drift of 6.5 seconds per month. However, clock accuracy may be affected by aging over time, and a conservative approach when deciding on a time synchronization strategy is recommended.

- TBR 800 has a small backup battery to keep track of time when the main battery is depleted or not connected. It keeps the clock running when replacing batteries.
- The backup battery powers the clock circuit in the TBR 800 for about a month when fully charged. Charging of the clock's backup battery happens automatically when the receiver is in active listening mode.

If the backup battery is depleted, the internal clock will reset to its default value of 1 January 2000. The TBR 800 will indicate this state by emitting red heartbeat signals.

- The clock in a computer or tablet doesn't have the same extreme requirements as in the TBR 800. They will drift several times more than the TBR 800 clock.
- A computer uses internet time servers and internet time correction to keep their clocks accurate and synchronized. When the computer is connected to internet, it will correct the clock at regular intervals (e.g. weekly, daily). These intervals, however, might allow significant drift for our application. You should actively sync the computer clock with internet before setting the TBR clock.



GPS is an alternative source of accurate time:

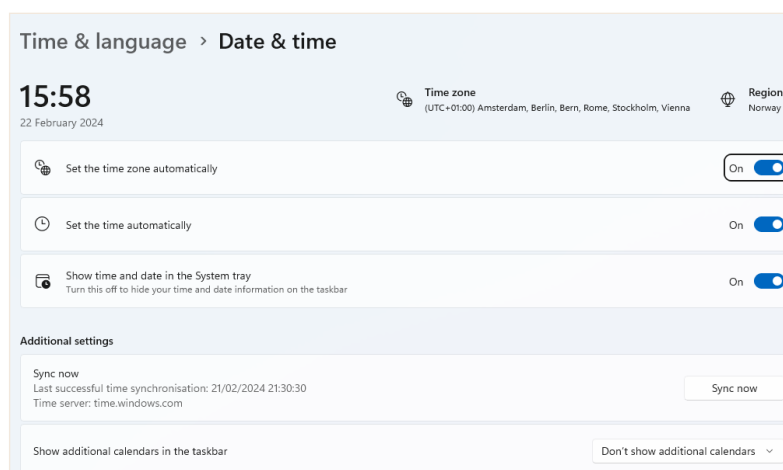
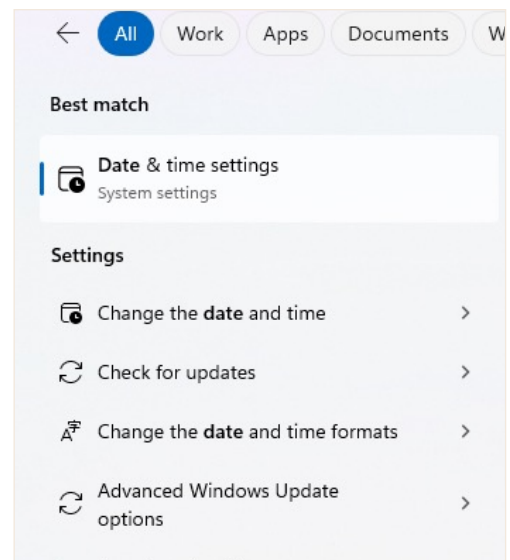
There are USB GPS receivers and computer programs which corrects the computer clock to the GPS time automatically. This can be very valuable if your computer can't be connected to internet. The event log feature in ComPort documents the observed time difference between the computer clock and the TBR 800 clock. Every time a TBR is disconnected from ComPort, the time difference is stored in the event log. The log also shows when the TBR clock is corrected. See more about the event log feature in the “Log function” section under “Thelma Biotel softwares”.

Ensure accurate computer time

Access the ‘**Date and Time settings**’ menu on your computer and select ‘**Sync Now**’ before initializing the receivers and setting the TBR clock.

Start writing “**date**” in the Windows search bar, and you will be guided to the correct settings section.

If you don't have access to a time server, the progress will just keep spinning. If you are unable to synchronize, check your internet connection. Without internet you need a GPS unit to synchronize your computer to global time.





ComPort clock handling

How you deal with clock drift depends on the nature of your project. A project investigating a species' migration pattern through a fjord or a larger river system does not require the clock to be correct to the second. However, a more accurate time synchronization is vital if you run a project documenting an individual's response to a sudden, specific event. Depending on your case, you must decide how to handle clock drift.

Either way; it is important that you make sure to synchronize the clock of the computer you are using for ComPort. Make a habit of running an internet or GPS time sync before you connect to the TBR.

The following section describes the two ways of managing TBR receiver time-settings in ComPort

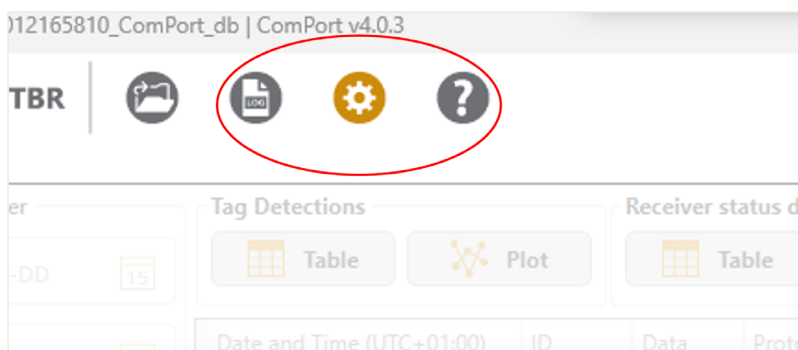
1. When starting a study

- You need to make sure the configuration meets your study requirements and that you set the TBR clocks every time you start a study session.
- Make sure you start the procedure by updating the computer clock (See above section "Ensure accurate computer time")
- The TBR clocks are set through the receiver configuration feature in ComPort. In the Configuration window, make sure you have checked the "Update Clock" selection box before applying your settings.



2. When running data transfers in an ongoing study

- Make sure you update the computer clock before accessing the TBR receiver. This is always a proper safety measure (See above section "Ensure accurate computer time").
- When connecting to a receiver (during data transfer etc.), ComPort has three choices of how to handle clock synchronization. You will find these in the ComPort options menu.





The different choices are as follows:

Synchronize receiver time on connect:

- a) **if clock not set (default)**
- b) **always**
- c) **never**

a) Sync. time on connect: “if clock not set (default)”

This setting will automatically synchronize the receiver clock with the PC clock on connect if the receiver clock has been cleared.

This choice is beneficial when doing fine-scale positioning where precise clock synchronization is needed. When not adjusted during the deployment phase, the clock drift will become a smooth curve without sudden jumps in time. This makes it easier to do curve fitting and to create a mathematical model that can be used to correct the time during post-processing.

b) Sync. time on connect: “Always”

This setting will automatically synchronize the receiver clock with the PC clock on every connection.

When selecting this option, it is very important to remember to keep the PC clock up-to-date before connecting to a receiver. One advantage of this option is that the receiver clocks can regularly synchronize to a common reference. This will limit how far the clocks may drift.

c) Sync. time on connect: “Never”

The clocks will never synchronize automatically on a connection, and this is generally not recommended. The setting is for those who want to stay in complete control of all time adjustments during the study. Nothing will happen with the clock unless you actively push a time synch through the configuration procedure.



Clock setting recommendations

The synchronization of TBR clocks doesn't have to be extremely accurate for the typical large-scale migration study, the presence/non-presence studies.

- Ensure you initiate and access your receivers on a computer with a recent time sync.
- For the clock settings in ComPort, you can choose to have ComPort automatically adjust time whenever you connect to a receiver (clock setting b).

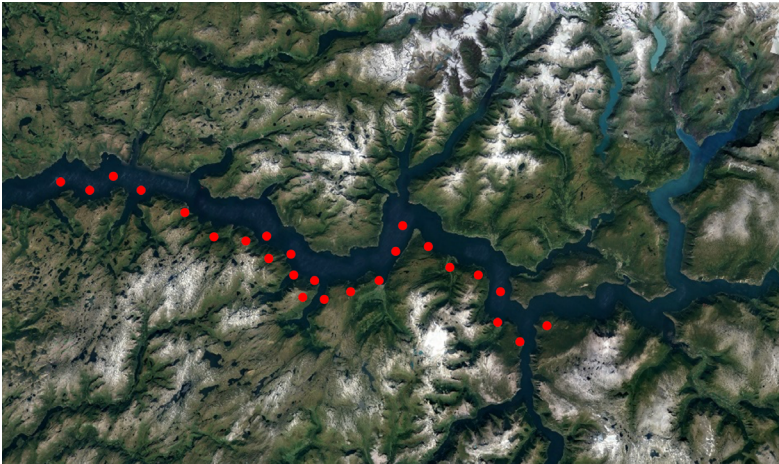


Figure 3: Fjord and river system with red dots representing placed TBR 800 receivers. Map by Google earth.

For a setup with overlapping receivers in a grid, where you need to filter your data to remove duplicate detections (same transmit detected on several receivers).

Here, you need to put more effort into ensuring the receiver clocks are synchronized. You also need to keep a relatively accurate time sync internally within your grid of receivers.

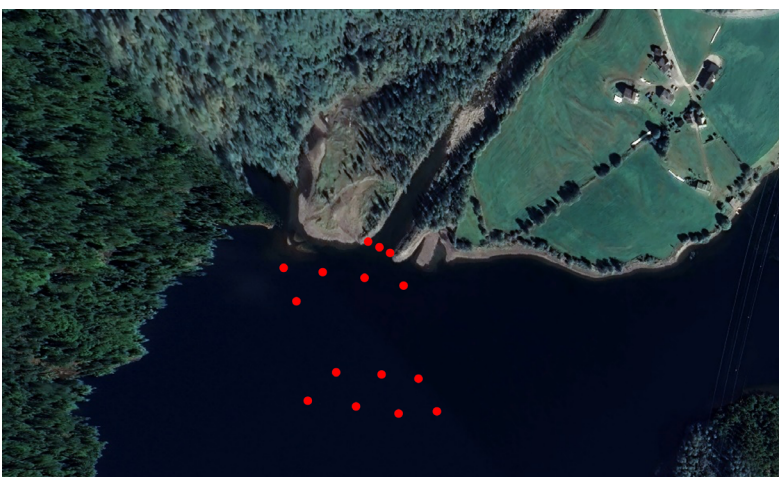


Figure 4: River runoff into a lake with TBR 800 receivers represented as red dots placed close together. Map by Google earth.



- Make sure you initiate and access your receivers on a computer with a recent time sync.
- In these cases, you must maintain the total drift of your TBR clocks to a level less than the minimum transmit interval of your tags. Then, you can run a filter where all detections of the same ID within that time are treated as one detection. For the 60-120sec tags, that would be ± 30 seconds.
- We suggest you enable the TBR 800 sync transmit feature as a backup. This allows you to perform both rough and fine-scale alignment of timestamping in post-processing of your data. The simplest solution will be to run a default sync transmit interval of 10 minutes at power level 5. Use a separate frequency channel for the sync transmit, apart from the frequency you use for the other transmitters. Make sure you enable listening at both frequencies for all the receivers. You find more information about the TBR 800 built-in sync transmit feature under “TBR 800 built-in sync transmit (R01M)” in the section “installation and setup”.
- For the clock sync. settings in ComPort, you can either choose to run choice a) if clock not set. This is recommended if you intend to use the sync. transmits to align the time in post processing. Or you can choose to have ComPort automatically adjust the time on every connect; choice b) then you must visit the receivers often enough to keep time drift within the limit decided by your transmit intervals. See above and contact support at mail@thelmabiotel.com for further advice. TBR 700 has a less accurate clock and must be treated differently.

Another time-keeping strategy is needed in a project where you investigate a response to an abrupt change or stressor (like a light turning on/off, explosions, or similar).

Here, you must put more effort into ensuring the receiver clocks are synchronized with external, global time.

- Make sure you initiate and access your receivers on a computer with a recent time sync.
- With the computer properly time synced, you should use the “always” choice b) sync. on connect setting.
- Using the built-in sync transmit of TBR 800 might not be feasible, as receivers can be too far apart to hear each other.
- Make sure you access and correct the receivers’ clocks at regular intervals. Contact support at mail@thelmabiotel.com to discuss the appropriate interval for adjusting the clocks in our specific project.

For a PinPoint, YAPS, or any other 3D tracking study, you need to track time with an accuracy of milliseconds or better. Two different approaches, GPS and sync transmit, can achieve this kind of accuracy. For guidance, contact support at mail@thelmabiotel.com.

- Make sure you initiate and access your receivers on a computer with a recent time sync.
- Both the time-sync and position calculations rely on the documented positions for the receivers. Make sure you record it as accurately as possible. For optimal accuracy, you



- should use a corrected GPS, like the ones used for surveying construction sites.
- For positioning studies, you must always enable the TBR 800 sync transmit feature. This allows you to align timestamping in post-processing of your data (PinPoint, YAPS, etc.). We recommend using a 10-minute interval for the sync transmits.
 - For the clock settings in ComPort, you should choose to have ComPort automatically adjust time only if it is not set (choice a). You don't want to allow the TBR time to be set during deployment. Setting the time during deployment will cause a shift in timestamping. PinPoint requires some time to regain control over time synchronization, and you will lose positioning data during that period.

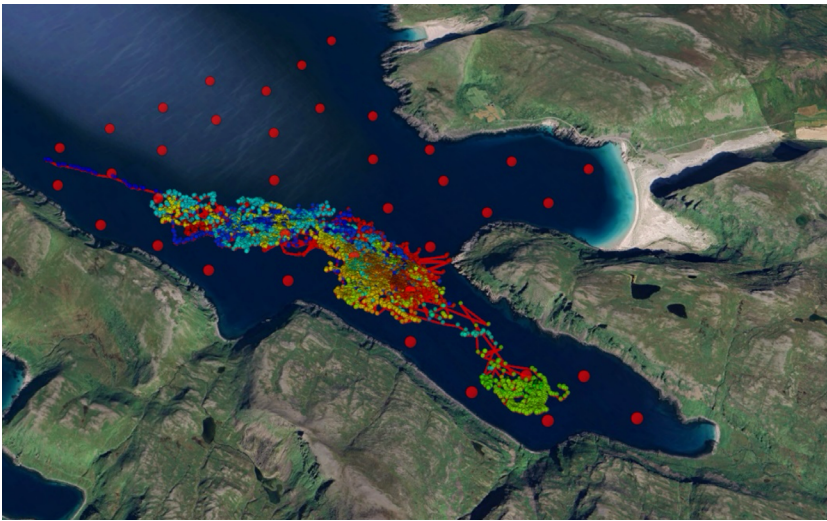


Figure 5: Tracking King Crab with PinPoint. The red dots are TBR receivers.

Alternative strategy/product:

Live transceiver with Link LoRa

This product provides you with an online website to access and view your data as they are detected. Very relevant to clocks and time-settings, the Link LoRa nodes also have a GPS receiver. The GPS clock is extremely accurate and a source of correct global clock timing.

Using a couple of Link LoRa nodes as the main time reference in your grid of receivers lets you have global correct timing for your PinPoint or otherwise time synchronized data.



Calculations, drift compensation

As described above, post-processing for clock sync is important in PinPoint and YAPS. It is necessary to have sync transmit data to perform this. Other efforts to adjust timestamping in post-processing are generally not recommended. We strongly suggest you investigate the different strategies for keeping track of the time and choose the appropriate actions before the fieldwork begins. Adjusting the timestamping/clock in post-processing might seem like a good idea. However, there are some issues that reduce the value of a linear time correction to be applied in post-processing:

- The logged time drift is the difference between the computer and the TBR clock. We know the TBR clock has limited time drift, but the computer clock is inaccurate if it is not recently aligned with an internet time server or GPS. This data point should not be trusted to “correct” your data.
- The ComPort log only records the actions and events within that actual project file. If someone has used another ComPort file to access and adjust the TBR clocks, the events will be logged in different files.
- The time drift of any clock circuit is temperature-driven and individual to each clock. Temperature changes lead to changes in time drift. The temperature during a deployment is rarely fixed and then a linear approach to time correction will have limited value.
- Time drift can be both positive and negative and is often designed to swing around the clock’s design temperature. Temperature changes can then lead to the clock speeding up or slowing down. This is also an argument for why a linear approach to time correction should be avoided, especially if correcting for long time periods where temperature has changed a lot.

Taking temperature changes into account could help, but it requires you to perform a temperature characterization of the time drift in each TBR clock. Choosing an appropriate time sync strategy before the study is started will always yield better results.

Please contact support at mail to mail@thelmabiotel.com when you have further questions about clock drift and what strategy to use in your setup. We can also help you with data analysis/calculation services like PinPoint positioning analysis.

Erase memory

When starting a new project, it is a good practice to erase the memory on the receiver. However, make sure that the old data is backed up on your computer. To erase the receiver memory, simply tick the “Erase Memory” box in the configuration window.





Check settings and apply

Once you have decided which settings to apply, you can **verify them in the Preview box** at the bottom right of the page.

- Click the Apply button, and the settings in Preview will be transferred to the Connected TBR (current configuration box).
- When you apply the settings (or cancel), the receiver will automatically disconnect, and you are ready to set up the next receiver.

The selected settings will be stored on your computer.

- When **configuring multiple receivers**, you can **effectively configure them by opening the configuration window and pressing ENTER or the Apply button**.
 - You do not have to re-enter the configuration settings for the remaining receivers, given that they are the same.
 - To quickly cancel, press ESC on your keyboard.

Preview (selected configuration to apply)
PC Clock (UTC+01:00): 2023-09-25 10:03:29 Memory will be erased

	OPI	OPs	R64K	R01M	S256	S64K	Frequency
Channel 1:	●	●	●	●	●	●	69 kHz
Channel 2:	●	●	●	●	●	●	71 kHz
Channel 3:	●	●	●	●	●	●	73 kHz

Sync Transmit (R01M): 69 kHz (10 min) | Power 5

Connected TBR (current configuration)
TBR Clock (UTC+01:00): 2023-09-25 10:06:44 Free Memory: 100.00%

	OPI	OPs	R64K	R01M	S256	S64K	Frequency
Channel 1:	●	●	●	●	●	●	69 kHz
Channel 2:	●	●	●	●	●	●	71 kHz
Channel 3:	●	●	●	●	●	●	73 kHz

Sync Transmit (R01M): 69 kHz (10 min) | Power 5

Apply

Cancel

Testing

The TBR 800 should always be tested before deployment as a precautionary practice, and to investigate the range availability under different conditions. The signal range is significantly reduced during testing above water, and the TBR 800 transducer and transmitter need to stay close.

Testing above water:

Remember that the range is largely reduced above water, and the transmitter should be close to the receiver transducer for testing but never less than 10 cm between

Testing with TBR receiver and transmitter:

1. Connect the receiver to LiveView via Bluetooth
2. Activate a transmitter using the steps described in the Transmitter – Start and stop guide
3. Place the transmitter close to the top part of the receiver transducer with at least

10 cm distancing between.

WARNING – Be careful to secure the TBR so it does not roll off a table, as this can cause shock damage

4. The receiver transducer and transmitter should ideally point radially toward each other and stay still without any touching
5. Watch in LiveView as the detections from the transmitter are registered
6. Check the transducer tip for sensitivity in LiveView by tapping/rubbing
7. A spike of over level 60 should appear in LiveView following



Figure 6 : Transmitter to the left, and TBR 800 receiver to the right.

Testing communication with Live transceiver:

1. Connect the Live transceiver to LiveView via Bluetooth
2. Place the Live transducer close to the TBR 800 transducer with at least 10 cm distancing between

WARNING – Be careful to secure the TBR so it does not roll off a table, as this can cause shock damage

3. Click on “Acoustic messaging” in the left-hand menu in LiveView, type in the serial number of the receiver into the “Remote TBR Selection,” and choose one of the frequencies the receiver is listening to in the drop-down menu
4. Try sending a query by choosing, for example, “TBR configuration” and then “Base frequency channel, listening mode” and “send single device info query”
5. Make sure the TBR 800 and the Live transceiver communicate by viewing the “Receiver TBR info,” where the base frequency and protocols should appear
6. You can also send a query about “Data statistics” and “Number of detections (sent in 2 parts)” to check the number of detections of the receiver
7. Next, you can open ComPort, connect to the TBR, and download the test data to ensure that the test detections have been received.



Figure 7 : Live transceiver to the left, and TBR 800 receiver to the right.

Testing in water:

Testing in water can often be referred to as range testing to check the available range of the TBR receiver in the field under the current conditions. Testing can be done similarly to the procedure mentioned above but with larger distances between the TBR receiver and transmitter or Live transceiver.



Range testing

Depending on the study site, there are several ways to perform a range test. The best solution is to deploy a grid of receivers and transmitters in relevant locations for a few weeks to gather relevant site-specific variation data. It is also useful to deploy reference transmitters as the study is running to investigate the acoustic conditions during the study period.

Below, we have described an example of how a range test could be conducted in an area of open waters. Depending on the conditions, this must be adjusted to your study site. It is important to note that when selecting transmitters for range testing, you should use the transmitter with the shortest-range specifications to accurately determine the shortest possible range in the grid at current conditions. Range transmitters will send frequently and have a counting function that makes it easy to detect a lost transmit.

Example of how to conduct a range test in open waters:

1. Start two transmitters by following the [“Start & Stop guide”](#) found under downloads on our website
2. Roll the transmitters tightly into a piece of duct tape with the serial number tag facing outwards and visible
3. Pinch the tape around the transmitters to make sure it is tight and secured
4. Attach this to a rope and make sure it is secured properly
5. Let the GPS warm up and acquire the maximum number of satellites to get maximum location accuracy before storing the waypoint.
6. Configure one receiver and place it in an easily retrievable location. Mark the receiver’s GPS coordinates.
7. Move a chosen distance away from the receiver location
8. Lower the rope with the connected transmitters well under the water surface
9. Wait until the transmitters have transmitted at least five times
10. Repeat this step at chosen distances away from the receiver. An example of different distances could be 50 meters, 100 meters, 200 meters, 500 meters, etc.
11. Retrieve the receiver and download the test data
12. Open the data in ComPort to view graphs and get an overview of the current range in the area

Remember: If you have a large grid, it is important to test several areas of the grid to get a correct picture of the range conditions.



Deployment

The distribution of your array is crucial to getting the most use out of your TBR 800 receivers. In this section, we will highlight how to place them successfully.

Remember to test your receivers before deployment to ensure the setup is correct.

Pre-deployment planning

It is vital to undergo pre-deployment planning for a successful deployment. In this process, you can define the study's objectives and research questions and align them with the deployment strategy plan for the receivers.

NOTE: Remember to investigate if there are any permits or permissions that are needed for deploying equipment in the area

Receiver distribution /array design

The effective detection range of the receivers varies widely on several factors, such as transmitter power, sound attenuation, frequency, background noise, and thermal/salt layers. When deciding on the array design, the first step is to determine the number and positions of receivers you are deploying within the study area. It is important to consider:

- Range
- Water depth
- Currents
- Noise conditions
- Obstructions
- Salt layers
- Temperature layers
- Expected movement of the species in question

Optimize the receiver layout to maximize coverage and data collection by considering the following array design tips:

1. Attempt to deploy receivers in a way that maximizes the clear space of the signal path to and from the receivers
2. Try to the best of your ability to place the receivers in the same water layer as you believe the transmitters will spend most of their time
3. Avoid having receivers and transmitters on opposite sides of haloclines
4. Try to deploy the receivers away from noise sources, the water surface, and locations with high levels of current turbulence
5. Do not deploy receivers on structures with high levels of vibrations that can transfer noise from machines, etc
6. Use plastic strips rather than hose clamps for deployment to avoid clamping ovally, risking leakage
7. Control the data after a period to check for noise conditions and move if there are high levels of noise recorded



Receiver mooring

Depending on where you are deploying your receiver, it is important to choose mooring that can withstand the environmental conditions in the area. Follow manufacturer guidelines for mooring equipment, and always check the receivers before deploying them to locate any potential visual damage. The receiver should stay as fixed in one spot as possible to retrieve the best possible data for your study. This is especially important if post-processing includes a [PinPoint analysis](#).

When choosing the mooring for your receivers, it is vital to consider the bathymetry and environmental conditions of the study site; here is an example of one of the more common mooring solutions:

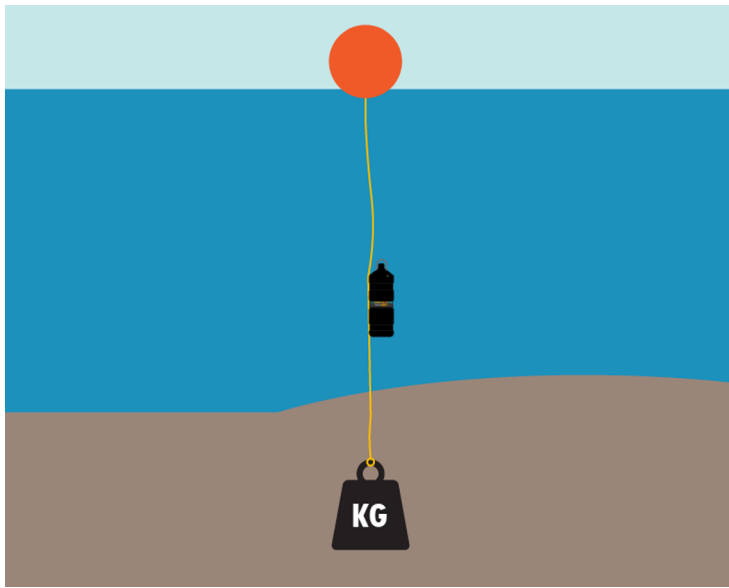


Figure 8: Example mooring setup for TBR 800 receiver

The mooring solution pictured to the left can be adapted to site-specific conditions with solutions such as:

- Steel-reinforced moorings
- Selecting specific shapes or thicknesses of ropes and buoys to reduce drift
- Utilizing a second underwater buoy for stability
- Employing upstream anchors
- Adding a secondary weight with a creep line to facilitate a backup-recovery plan in case of lost buoyancy

Other examples of mooring solutions include:

- Without buoy – pipe cast into a concrete slab
- Pipe enclosed into the substrate (for soft substrates) with the receiver attached to the pipe and a buoy connected to the top via rope

Remember to select the appropriate mooring equipment for the study site in question. It is important to consider factors such as:

- Currents
- Substrate stability
- Human interference
- Salinity and temperature

Most of the time, the above factors can be mitigated by using more weight, denser materials, or adding an underwater buoyancy device for stability.

NOTE: NEVER use the receiver protective hoop as an attachment point for rope or any such deployment mooring



Biofouling mitigation

If biofouling significantly overgrows the transducer, it has the potential to influence the system's performance. Techniques such as anti-fouling paint or manual wash/scrub can be helpful, but more scientific backing in the area is required to guarantee the efficacy of such preventative measures.

Receiver deployment strategy

The deployment strategy of the receiver array can vary depending on factors such as detection range, research question, researchers' advice, and so forth. We recommend investigating the different strategies and finding one or a combination that best suits your study. There are a few more widely used strategies to mention:

- The receivers can be positioned in a **standardized grid pattern** for general movement tracking
- The receivers can be placed in a **gate formation** (single or double gates) to investigate the movements across – this can be very useful in investigating migrants
- The receivers can be placed in a **strategic grid**, where a specific location of interest is being investigated, and thus the receivers are placed deliberately close to or in that location

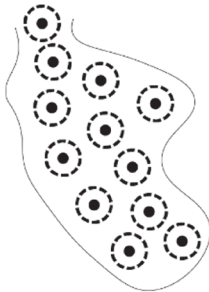


Figure 9: Standardized grid pattern example



Figure 10: Gate formation example

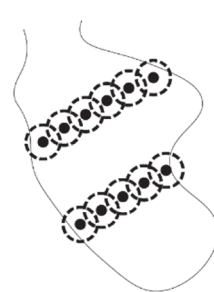


Figure 11: Double gate formation example

When it comes to the detection area of the TBR 800, it is, for all practical purposes, omnidirectional. The transducer operates well in the radial and axial directions, but the casing induces a shadow with its composition of engineering plastics, air-filled cavities, etc. To keep it simple, we suggest positioning the receivers where they keep a free line of sight from the receiver tip to the volume where you would like to observe the transmitters. What is hidden behind the “cone” of the receiver casing top is hidden from the receiver and transmitters, thus less likely to be detected (See Figure 12 below).

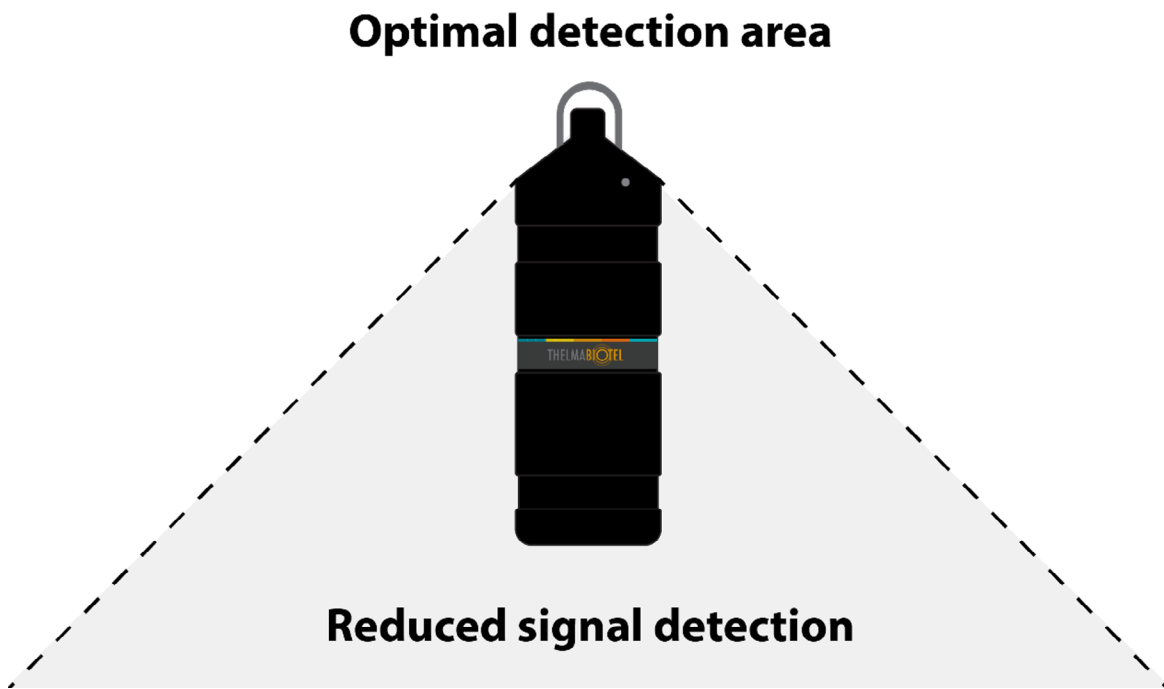


Figure 12 : Standard acoustic receiver detection area – rule of thumb

Due to this design, it can be a good idea to place the receiver upside down, higher up in the water column, if you are investigating a bottom-dwelling species, or the correct way, further down in the water column, if the species stays further up in the water column, as illustrated in figure 13.

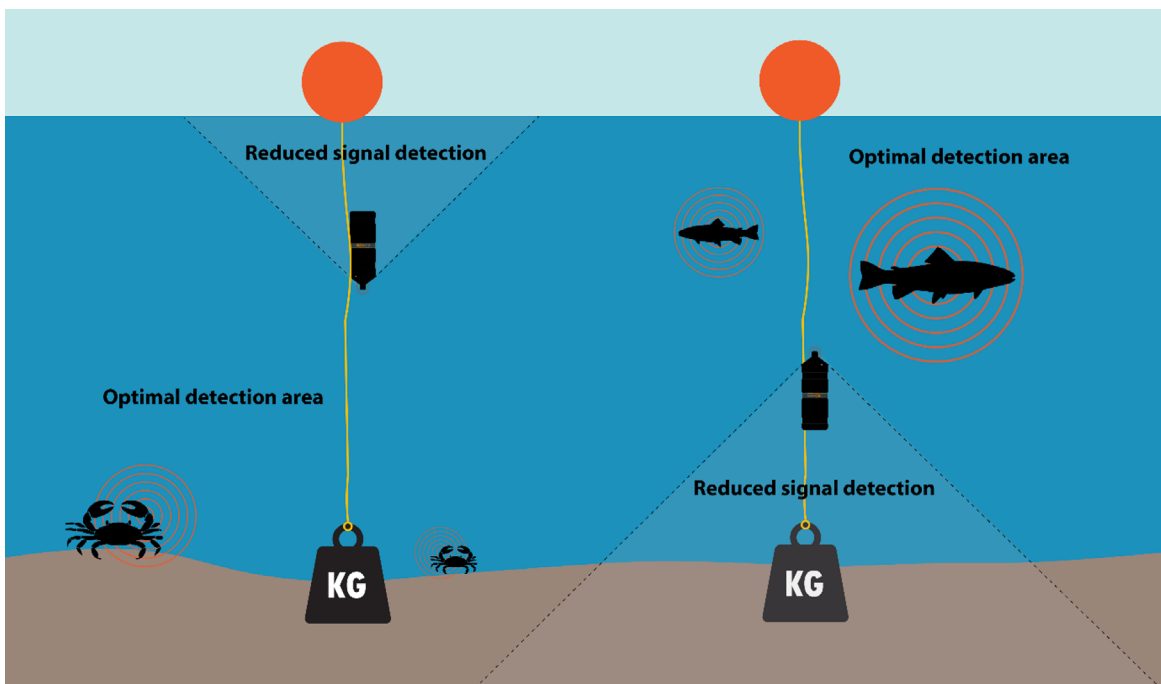


Figure 13: Recommended receiver placement and rotation regarding the study species expected location in the water column.



PinPoint – Array of receivers

If you plan to submit your data for a PinPoint analysis, it is crucial to deploy the receivers correctly and accurately, following the PinPoint procedures. The following section will highlight the method of deploying your receivers when the data is used in a PinPoint analysis. The PinPoint analysis will only be as accurate as the technology measuring the positioning of the grid of receivers. Due to this, it is vital to receive positioning data with as little error as possible.

If you plan to get PinPoint analysis of your data, Thelma Biotel should have sent out a form to fill out when the receivers are being deployed. If you have not received this form, please get in touch with us at mail@thelmabiotel.com

Receiver and sync. Transmitter positions:

1. Firstly, turning on the sync transmit for the TBR 800 is the most vital action
2. When deploying the receivers and the sync transmitters, it is vital to get the **GPS measurement and depth as accurately as possible**.
 - a. Different types of GPS can be significantly different in accuracy. For optimal precision, seek more information about your GPS in the accompanying manual.
 - b. The GPS often needs some time after being turned on to connect to all available satellites, so do not take the measurements directly after turning the unit on
 - c. If the GPS is mounted to a larger vessel, monitoring the antenna's location or GPS signal on the ship is essential.
 - d. The GPS position measurement should be as vertically aligned over the deployed TBR 800 as possible, held for at least several seconds.
 - e. Can be a good idea to note the error margin of the GPS as the coordinates are taken
 - f. Try to set up the mooring of the receivers to reduce the overall drift as much as possible.

We recommend using **equilateral triangles** for the receiver array geometry when setting up a grid to undergo PinPoint analysis (As shown in Figure 14):

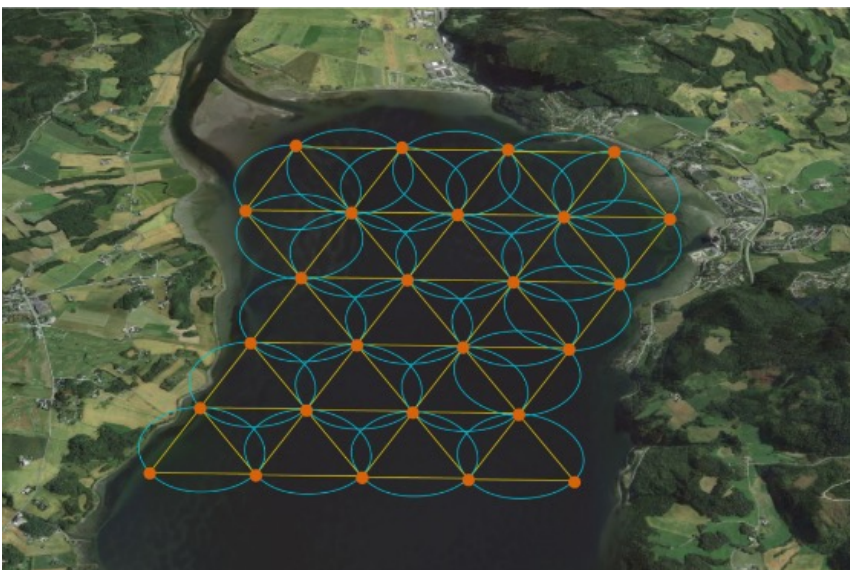


Figure 14: For PinPoint to work, the receivers need to be deployed so that the distance and angles between each receiver form equilateral triangles. The blue circles around the equilateral triangles show where the tagged animal needs to be to get the most accurate tracking results.



Note that the **error sensitivity is high directly behind the receivers**, as seen in Figure 10, as the small red dots.

The error sensitivity also increases with depth.

Be conservative with distancing the receivers from each other when considering the range.

Remember that the **range changes with the environmental noise conditions**, and it can thus be a good idea to be conservative with the distancing. We always recommend covering a smaller area or using a higher number of receivers rather than stretching the receivers' range to the maximum. The recommended approach is to initially collect data for a smaller area with conservative distancing, assess the SNR within the detections, and then consider increasing the distance after a testing period if available.

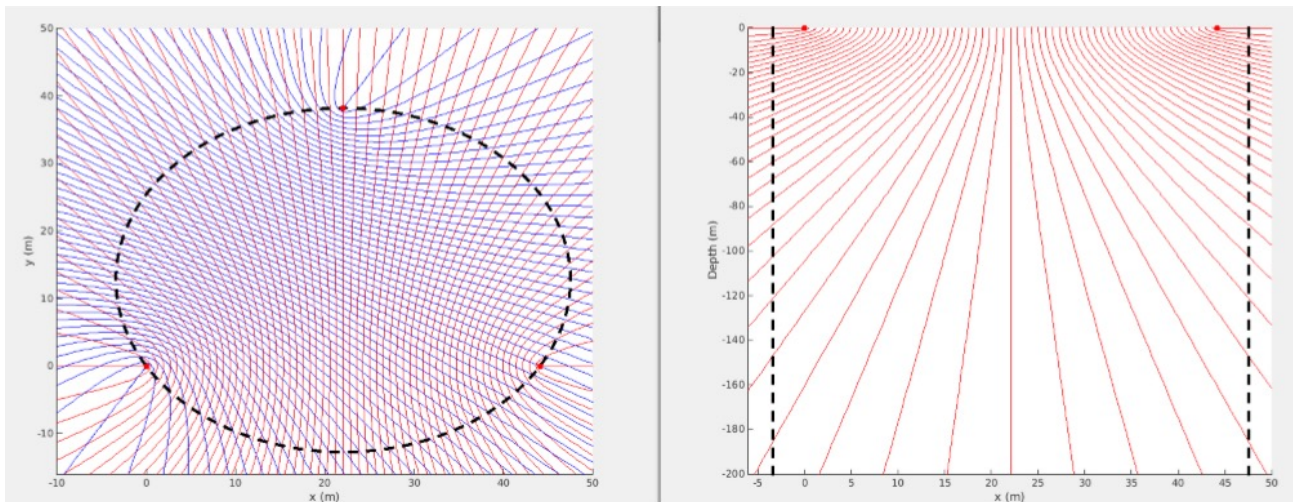


Figure 15: Smaller regions between the hyperboloids represent areas of less error sensitivity. The error sensitivity increases with depth.

Ensure the **receivers are deployed to allow unobstructed signal transmission** and prevent signal reflection:

- Signal reflection can be challenging to filter out in the post-data processing

Avoid deploying around sources of high acoustic noise, such as large currents or waterfalls:

- This can impact the listening ability of the receiver
- If a noisy area is important to investigate, we recommend examining the noise and range conditions with range tests before deployment

Investigate different temperature or salinity layers in the study area:

- The receiver signal range can differ between temperatures or different salt concentration layers



Thelma Biotel software

ComPort is our free software for managing telemetry data. ComPort allows you to upload, view, and analyse your tracking data quickly and easily. Uploading large amounts of data is handled efficiently using the receiver's built-in Bluetooth connection. ComPort can also be used to update the firmware of the TBR 800. **LiveView** is the Live tracking and data visualization software delivered by Thelma Biotel. It provides live streaming of acoustic data to your computer or with the Live and DeckBox field kit. LiveView is used as a visual reference when starting and stopping transmitters, for manual tracking, communicating with deployed TBR family receivers, and calling up acoustic releases.

ComPort – Acoustic data management and receiver configuration

How to install ComPort

1. Send an email to comport@thelmabiotel.com and receive an automatic reply with the link to download the newest version of ComPort
2. Download the file “ComPortInstaller v-.-.zip” from the email received
3. Open the downloaded zip file and extract the contents
4. Run the “ComPortInstaller v-.-.exe” to install ComPort
5. Follow the installation instructions
6. You should now have the newest version of ComPort on your computer/tablet

ComPort projects

ComPort is managed by using projects, where each project is saved in its own .tbdb-file

- A tbdb file is a database file that saves data in tables and ensures the safety of data coming in and out
- tbdb files run their own version number, and thus, newer files cannot be opened in older versions of ComPort
- ComPort also supports. tbrarw files for import and export of data
 - tbrarw is a text file that saves the data in an encrypted raw format that ensures the integrity of the data
 - The encrypted data in tbrarw files can be uploaded to the [European Tracking Network](#) (ETN), for example.
 - tbrarw files are generated automatically when transferring data from the receiver to the computer.
 - Transferring data is the only way to generate tbrarw files to ensure the integrity of the data



Standard location for tbdb files are:

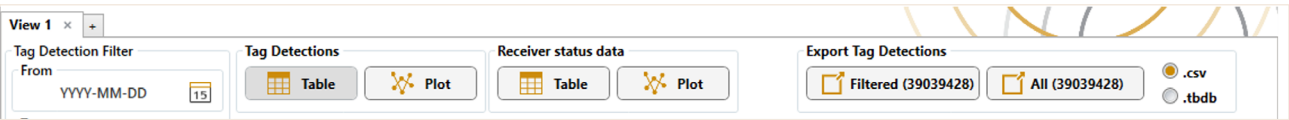
%UserProfile%\Documents\ThelmaBiotel\ComPort

Standard location for tbrarw files are:

%UserProfile%\Documents\Thelmabiotel\ComPort\ReceiverDataTransfers

Navigating ComPort

In the view header, you can select to view **Tag detections** or **Receiver status data**. Tag Detections show all the data received from the transmitters. Receiver status data shows temperature, tilt, frequency, current, and background noise, which are logged from the receivers’ sensors every 10 minutes.

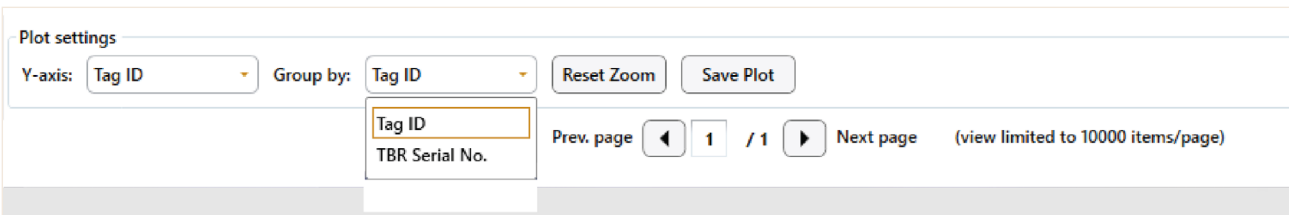


The **Export tag detections** selection is regulated by the type of data that is selected :

- The number in the parenthesis shows data points included
- By filtering the data, time and size can be saved with less amount of data where applicable
- Data can be exported to .cvs or .tbdb, where .tbdb creates a new project file

You can choose to view your data in a table or plot view for both tag detections and receiver status data.

- In **plot view**, choose between viewing different parameters on the Y-axis or group by in the bottom navigation bar:



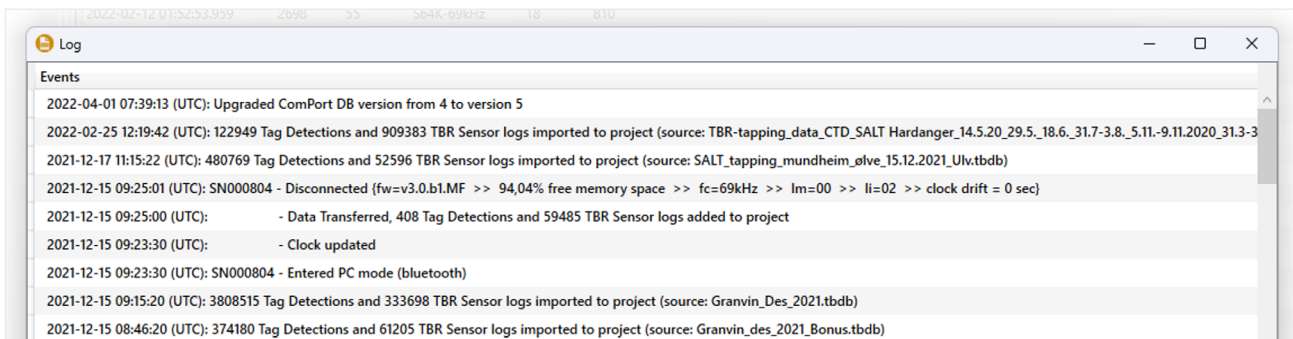


- In plot view, only the first 24 “Group by” unique values will receive a unique colour + symbol combination. The rest of the data points are collected into the grey x “other”
- If the data set exceeds 10,000 data points, it splits into pages to keep processing time reasonable
- Navigate by using arrows at the bottom of the page or type in page number you wish to view
- To zoom in or out of the plot, hold the cursor over the plot and scroll using your mouse or mouse pad
- Zoom in or out on a single axis by holding the cursor on the axis label and then scrolling normally
- Move around on the plot area by right-clicking and holding and dragging the plot or holding down Alt and dragging the mouse around the plot
- Use the reset zoom button to restore the original view
- Current view can be saved as an image or PDF file by clicking save plot.

Log function

The log function lists what has happened in the project file. Every time the TBR unit is disconnected, a line with the configuration and status is created. The log shows the updates that have been made to the unit.

The log function can be very useful for troubleshooting!



User Settings in ComPort

1. **Time zone:** Influence the time display in graph
2. **Synchronize receiver time on connect:** Update the clock on TBR 800 when connected to ComPort
3. **Warn me if available TBR memory is below:** Get a warning if the TBR 800 memory goes under a chosen threshold (60% is standard)
4. **Allow custom firmware:** This needs to be changed from “No” to “Yes” if you wish to install custom firmware.

NOTE: you will not get notifications about new available firmware when “yes” is chosen



Importing data into ComPort

You can import either .tbdb files or .tbrarw files into ComPort

.tbdb - you can import data from another ComPort project file into the opened project file

.tbrarw - you can import encrypted raw format files into the opened project file

Manage TBR 800 Data in ComPort

Handling large amounts of data can be difficult and ComPort includes several features to help with large datasets. To get a better overview, we encourage users to play around with filtering, views, and exports (creating subsets or CSV files).

Filtering

ComPort has an advanced filtering system that provides a dynamic image of the database. Creating subsets of the data can provide a more comprehensive view and allow for better post-processing.

The left sidebar contains a Tag detection filter, where you can filter the data using several groups and items of choice. The number of detections within each group is stated in parenthesis next to each item. Remember to press Apply to update the view.

- The number of detections chosen to filter out will determine the processing speed
- The same filter is implemented in the table and plot view
- Updates undo, redo, apply, and clear are at the bottom of the tag detection filter menu

Views

ComPort allows you to create separate views with different filters applied and switch between them.

- To create a new view, click the “+”-tab in the upper left corner
- Multiple views allow for switching between different filter settings, such as data or specific IDs
- Clearing the filter will return all project data

Export

When closing projects, the sub-views will disappear unless you have exported them.

- Export sub views to a new .tbdb-or .csv-file by checking off Filtered under Export Tag Detections



LiveView Communication

Bluetooth

Firstly, to communicate, it is necessary to investigate whether your computer, tablet and receivers are connected to Bluetooth.

- If your computer/tablet is not connected to Bluetooth, and you cannot connect, checking if the device has Bluetooth abilities can be necessary. If not, refer to the section “Start new project” describing transfer via USB.
- Make sure your TBR 800 receiver is connected to Bluetooth. Refer to the section “Magnet controls” on how to connect TBR 800 to Bluetooth.

LiveView installation

How to install LiveView:

1. Send an email to liveview@thelmabiotel.com and receive an automatic reply with the link to download the newest version of LiveView
2. Download the file “LiveViewInstaller v-.-.zip” from the email received
3. Open the downloaded zip file and extract the contents
4. Run the “LiveViewInstaller v-.-.exe” to install LiveView
5. Follow the installation instructions
6. You should now have the newest version of LiveView on your computer/tablet

LiveView and TBR 800

LiveView is primarily designed for communication with the Live transceiver, but it can be employed in various ways to streamline the entire acoustic telemetry process. Its main functions when used directly with the TBR 800 include initiating and stopping transmitters (See [Transmitter – Start & Stop guide](#)) or conducting tests, such as office-based testing before fieldwork (See Testing with TBR receiver and transmitter under installation and setup).



Communication with TBR 800 using Live and LiveView

Acoustic messaging with TBR 800

Calculation of distance to remote TBR 800

- Live measure the time from the sent signal to reception at TBR 800
- When the signal is received back from TBR 800, it is divided by 2 to get the time for one way
- The time is then multiplied by the speed of sound underwater to find the distance
- You can finetune the accuracy of the distance calculation by changing the temperature and salinity values in LiveView
- The pre-defined template of seawater and freshwater is 35 PPT salinity and 0 PPT salinity

Acoustic messaging types

- **Single** – send a single message to TBR 800 – repeat till you receive an answer or 3 failed attempts (can be changed in settings)
- **Broadcast** – send a message to all TBR 800 within range, and receive an answer within 5 minutes from the receivers that received the message
- **Looping** – continuous sending of queries with 3 different modes:
 - Same query to one TBR 800 unit until the user stops it (or if there is too many non-responsive queries)

Acoustic queries to choose from:

Categories:

- **Release related** – Only applies to TBR 800 Release
- **Operational data**
 - Main battery voltage, tilt angle
 - Main battery voltage, %free memory
 - Average TBR current, 3 hours data (100 μ A resolution)
 - TBR temperature
- **TBR configuration**
 - Base frequency channel, Listening mode
 - Sync transmit frequency, power, and interval
 - TBR 800 firmware
- **Data statistics**
 - Number of detections (sent in 2 parts)
 - Number of TBR sensor logs (sent in 2 parts)
- **Acoustic noise**
 - Average & peak noise, 10 min data [channel 1]
 - Average & peak noise, 10 min data [channel 2]
 - Average & peak noise, 10 min data [channel 3]



Receiver care

Proper maintenance is important to ensure reliable operation and data quality from your telemetry equipment. Maintenance can be performed on site or by sending the receivers to Thelma Biotel for service and performance checks. Periodic maintenance helps extend the receiver's operational life and ensures consistent performance.

The following steps describe the general maintenance procedure for all Thelma Biotel receivers.

General receiver maintenance

Follow these steps for regular receiver maintenance:

1. **Cleaning:** Remove biofouling using a soft brush or non-abrasive scrubber. Excessive fouling may interfere with the sealing surfaces when replacing batteries and increase the risk of leaks.
2. **Visual inspection:** Examine the receiver and its seals for damage, corrosion, and cracks.
3. **Battery replacement:** Replace batteries according to the battery manufacturer's recommendations. Dispose of used batteries in compliance with local regulations.
4. **Drying agent:** Replace the drying agent (silica gel packs) when replacing the battery.
5. **Firmware updates:** It is recommended to check for firmware updates before starting a new study. Updating during an ongoing deployment is usually not necessary unless there are critical fixes or important improvements relevant to your setup.
6. **Acoustic signal check:** You can test the basic functionality of the transducer by gently tapping the top of the receiver while monitoring the signal in the LiveView plot. A distinct signal response confirms that the transducer is functioning. Receivers can also be sent to Thelma Biotel for service and maintenance, where more thorough functionality tests are performed.



O-ring maintenance

1. **Inspection:** Regularly inspect O-rings for cracks, dirt, fibers, deformation or other signs of wear. To check for deformation, gently roll the O-ring between your fingers. If it feels square or has noticeable edges, it should be replaced.
2. **Lubrication:** Apply a compatible silicone or PTFE-based lubricant to the O-rings before sealing to prevent damage during assembly.
3. **Seal replacement:** Replace any O-ring showing damage or wear to prevent water leakage into the receiver.
4. **Regular replacement:** O-rings should be replaced regularly to maintain proper sealing and ensure the TBR receivers perform reliably over time. Contact Thelma Biotel for O-ring specifications or to order O-ring kits directly from us.



NOTE: Some O-rings are difficult to access and replace. Replacing these is part of the “Thelma Biotel Receiver Service and Performance Check”.



Thelma Biotel receiver service and performance check

The service includes complete O-ring replacement and seal inspection, drying agent replacement, firmware update and full performance testing. Contact us at service@thelmabiotel.com to schedule a service and performance check for your receivers.

Thelma Biotel receiver service kits

For more comprehensive maintenance, Thelma Biotel provides service kits containing O-rings and drying agent. These kits are intended for use during scheduled maintenance or when preparing receivers for redeployment.

Sleep mode

Sleep mode can be used to avoid unnecessary detections after configuration and before deployment. If used, it is essential to wake the receiver before deployment to ensure it is actively listening. Due to its extremely low power consumption, the TBR 800 can remain in sleep mode for extended periods with virtually no impact on battery life.

The procedure when using sleep mode is as follows:

At the configuration location/base

1. Insert the battery into the TBR 800
2. Check firmware version and listening mode against the transmitters used in the study
3. Activate sleep mode following the steps under “Magnet controls” in “Installation and setup”
4. Prepare all equipment for deployment

At the deployment location

1. Wake the TBR 800 from sleep mode using the steps under “Magnet controls” in “Installation and setup”
2. Tap on the transducer to confirm the receiver responds by blinking the LED light in green
3. Deploy the receiver



Troubleshooting

Common issues and solutions

The receiver is nonresponsive and will not power up

If the receiver is not powering up, there are several different solutions you can try to solve the issue.

1. Make sure that the TBR 800 is not in sleep mode.
Tap the top transducer or putting the magnet in the Bluetooth activation slot and seeing the LED flashing continuously, then flashing 10 times slowly before flashing constantly. Remember to keep the magnet away from the Bluetooth activation slot after the flashing begins, or you will put the TBR 800 to sleep mode if it was not previously.
2. Check the orientation of the battery in the unit.
Make sure that the battery is placed correctly, and if unsure how to place the battery, seek out directions under the section **“Open and install the battery”**
3. Check that the battery has voltage.
You can check the battery voltage using a multimeter if available. If not, you can try with another battery for comparison, and if the TBR 800 powers up, there might be a problem with the existing battery.

The receiver will not connect to Bluetooth

1. Make sure that you DO NOT leave the magnet in or near the Bluetooth activation slot
 - The magnet should only be in the magnet slot until the Bluetooth light (blue) starts flashing. If the magnet is kept in or near the slot, the Bluetooth will time out and disconnect shortly after.
2. Problems connecting to Bluetooth
 - Ensure that the device is not too far away from the computer
 - There might be an issue on the Bluetooth card if no other option will fix it. If so, [contact](#) Thelma Biotel customer support



Water leakage or suspected shock damage

Issues can arise from water entering the receiver following shock or a compromised receiver

- If handled correctly, the receiver should not experience leakage down to 750 meters of depth
- If there is any suspicion of a pressurized receiver, remember to handle it with extreme caution and wear all necessary protective equipment
- If any of the following signs are evident, please consider if the receiver has been compromised and could potentially be pressurized:
 - The LED light lens has popped out of its port (internal pressure relieved)
 - Any signs of water inside of the receiver
 - Additional weight over normal receiver weight
 - Water sloshing inside the receiver
 - Premature non-responsive receiver. No LED indicator light long before the estimated battery lifetime is up.
 - Visible physical damage, cracks, or leaks

How to handle a pressurized receiver

1. **Use protective gear** such as gloves, protective glasses, and respiratory protection, and work in a well-ventilated location.
2. **Always follow proper safety procedures** implemented in the area you are working in (Check country, state, and county rules where you are using your equipment).
3. If you suspect that the receiver is damaged and you are unsure what to do, **do not hesitate to contact the Thelma Biotel team:** [Contact us](#)
4. If the receiver is potentially compromised and not handled immediately, remember always to keep the unit stored in a safe location in case of a breach. Do not point the top part of the receiver towards anyone else or yourself.

If you suspect a leak in the receiver, the best way to handle it is by wrapping it in a thick towel or similar fabric to catch any spray, liquid, gas, or pressurized parts. Contained in the towel you can use a flathead screwdriver to unscrew and open the receiver carefully. Opening a damaged receiver must be done either outside or in a well-ventilated area with protective gear, as stated above.

NOTE: if you don't feel comfortable with the procedure or have further questions, do not hesitate to [contact us](#) before opening the unit yourself.



Comport and LiveView

Where can I get the ComPort and LiveView software?

Both ComPort and LiveView is free to download. Follow the steps under to download and install the software applications.

1. Send an email to comport@thelmabiotel.com / liveview@thelmabiotel.com
2. Installation instructions with a download link will be sent to you automatically

Download the installation file(s) and follow the instructions to install on your computer

The receiver is not obtaining any data

If your receiver is not obtaining any data, there might be a mismatch between its listening mode and the protocol and frequency the transmitters are sending on.

- Open ComPort on your computer or tablet and go to the receiver window (Connect TBR)
- Activate Bluetooth on the receiver by holding the magnet to the magnet slot until the blue flashing begins
- Select configure to open the configuration window and make changes to the listening mode
 - Selecting status will briefly connect the TBR and show the current listening mode and configuration without opening the configuration window
- Change and correct the listening mode if there is a mismatch between the transmitters and the current listening mode

Not being able to connect to ComPort:

If you are not able to connect your TBR 800 to ComPort, there could be a few reasons why.

- Make sure that you are not using Bluetooth on several other devices in close proximity. This could interrupt the signal between the receiver and ComPort



Data

I can see that the LED light on the receiver is blinking, but no data is being saved

If the transmitted data is not being saved but you can see that the TBR 800 is receiving signals, the protocol might be wrong. This means that the receiver can attain the signals but is not able to decode them as it is not speaking the same “language.”

- Configure the receiver and make sure the correct listening mode is set

Unknown IDs in the dataset

If you have unknown IDs in your dataset, this might be a result of false detections due to signal collisions or high noise conditions. Older protocols have a higher chance of getting false detections due to a weaker checksum. Some numbers have a higher chance of triggering false positives, such as numbers with many consecutive zeroes when translated into binary readings

Spillover between frequency channels/Same ID detected on several frequencies

If signals are very strong, they can spill over into several frequencies. For example, if the transmitter is very close to the receiver, the signal significantly exceeds in strength. Signals meant for 69 kHz might spill over into 67 kHz and 71 kHz if the transmitter is right next to the receiver.



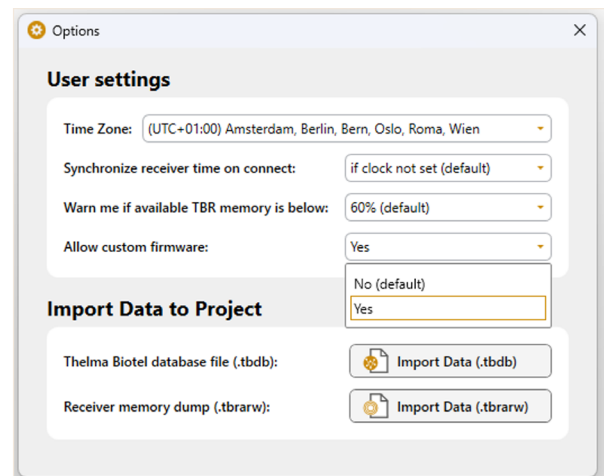
Other

Custom cases

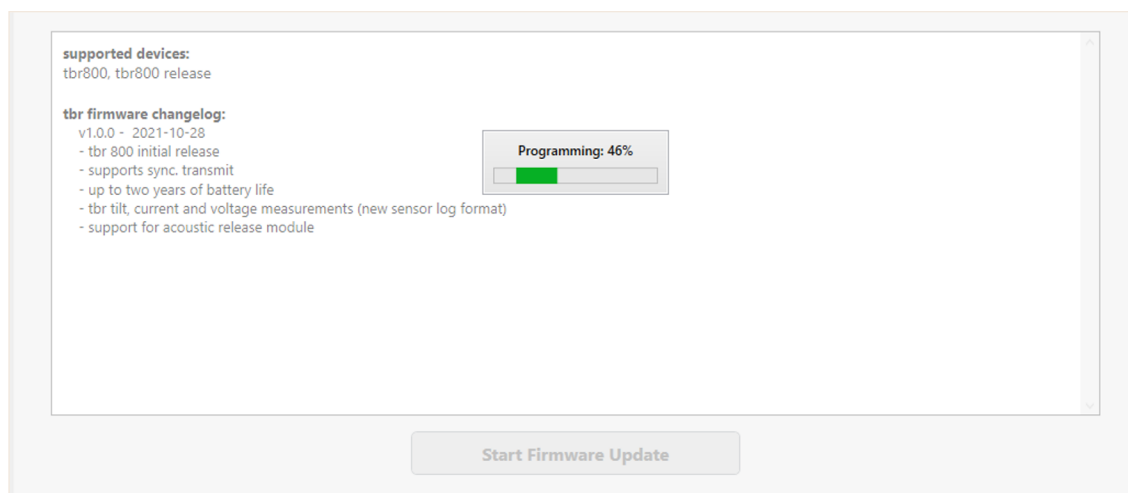
Update to a custom firmware

To install custom firmware on your receiver, you need to have the custom firmware Tbrfw file downloaded.

1. In the main ComPort window, click the settings icon in the top left corner for options
2. In the options window, click on the “Allow custom firmware” toggle bar and choose the option “Yes”
3. **NOTE:** You will no longer be notified about new standard firmware when custom firmware is activated. This is to avoid overwriting your custom firmware with standard firmware. A warning will be given if entering the configuration window with custom firmware on the receiver, but custom firmware handling closes the options window
4. Activate Bluetooth on receiver and computer
5. Choose the receiver and connect via configure
6. Click update firmware, and find the downloaded firmware you want to install from files



Click “Start Firmware Update”





Battery information

The battery used in the TBR 800 is a DD cell Lithium Thionyl Chloride battery of the type “SL 2790” (TL-5937 in Asia and America), belonging to the 3.6-volt system in the series SL700/2700 – iXtra for long-term high performance.

As described in the Tadiran [Batteries Technical Brochure LTC—Batteries](#), “It is a general feature of thionyl chloride batteries that voltage remains stable throughout their lives.” This means that the voltage will generally stay stable throughout deployment as long as it is used correctly.

Can I use two D–cell batteries instead of one DD-cell battery?

No!

Always use the specified DD-cell battery whenever possible. If, for some reason, this battery is not available, a dummy battery with one D–cell battery can be used with proper instructions. However, this will greatly reduce the receiver’s battery time.

Two D cell batteries should not be used. If this setup is used despite our recommendation, the batteries must be connected in parallel and never in series. For optimal battery stability, safety, and lifetime, Thelma Biotel always recommends using the specified DD cell battery in the TBR 800. From [Tadiran Batteries Technical Information](#):

“The battery should not be connected in series with an electrical power source that would increase the forward current through the battery.”

Shock sensitivity

The TBR 800 receivers equipped with the Tadiran lithium batteries can be sensitive to shock, especially when the shock is concentrated on the transceiver tip on the top. A shock to the receiver has the potential to damage the battery unit. If you believe that the receiver has experienced shock and is damaged, please refer to the “Product safety” section.



References

- [1] Tadiran Batteries, 'Lithium Battery Information Sheet' (February 2018). <https://www.swe.com/files/694/> accessed 1 February 2024
- [2] Tadiran Batteries, 'Technical Brochure LTC-Batteries'. <https://tadiranbatteries.de/wp-content/uploads/2024/01/technical-brochure-ltc-batteries.pdf> accessed 1 February 2024