

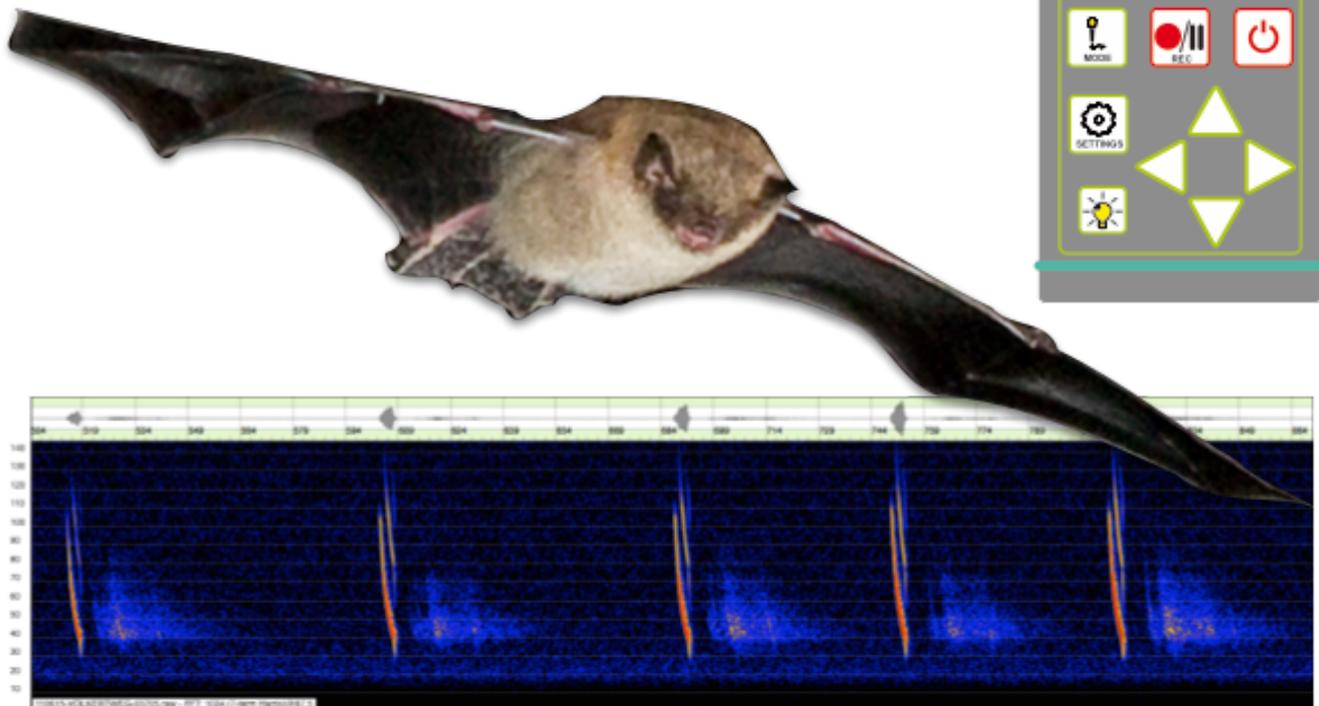
# **batcorder 3.1**

for batcorder 3.0 / 3.1

## **Manual**

Version 3.12 / en

Mar 2022



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## Instruction manual

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## Instructions for use and safety

These operating instructions belong to the *batcorder* product. It contains important information on commissioning and handling. Read these instructions carefully and observe the following safety and warning notices, especially if you pass this product on to third parties. Keep the operating instructions for future reference!

**These instructions describe the *batcorder 3.1* with the firmware version SW 3.23, with older devices of the type *batcorder 3.0* or older software versions, there may be slight deviations in operation. In addition, some functions may be missing in older firmware versions.**

## Symbols

The following symbols are used in these operating instructions. They are intended to make the user aware of important information.



### Caution!

Particular attention must be paid to sections marked with this symbol. Disregard can endanger people and material.



### Important NOTE!

This symbol marks advices concerning correct usage of the instrument. Neglecting these notes may lead to partial or total malfunction of the *batcorder* device.

## Waste disposal:

### *European Union:*

According to the European WEEE Directive 2002/96/EC on Waste of Electronic and Electrical Equipment we take our devices back for recycling or proper disposal. Please send them to us. Do not dispose devices at public or community supplied disposal systems!

### *Other countries:*

To reduce the environmental impact we take our devices back for recycling or proper disposal. We encourage you to send us back defective units or parts.

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## Safety precautions

We are not legally liable for injury to persons or damages to property caused by improper use or by ignoring the safety instructions. For such occasions the warranty expires.

## General instructions

- Do not operate the batcorder while driving a vehicle!
- Make sure that the device and its accessories are securely fastened, as people or the device can be damaged if they fall down.
- Do not leave the device unattended around children, as they can easily injure themselves from the microphone extender!
- Do not leave the device unattended around pets.
- The device is not designed for use with mains sockets.  
Do not apply external tension!
- If the batcorder is damaged or does not start, please contact our support via email: [info@ecoobs.de](mailto:info@ecoobs.de) or 0911 3768053. Please do not try to repair the damage yourself or by unauthorized persons.
- Avoid excessive mechanic strain on the batcorder, especially on the plugs if cables are tightened to the case. Strong vibrations, shaking or dropping may damage the device.
- Only use accessories supplied or authorized by ecoObs GmbH to avoid damages to the device.

## Battery pack

- The batteries are to be exchanged by qualified personnel only. Please contact us, if batteries have to be exchanged.

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## Application notes

- If the batcorder shows visible damage or any other problem, please contact our support immediately (see end of the manual). Never try to repair damage yourself or by unauthorized persons. Do not continue to use damaged or defective devices or accessories.
- Try to avoid electromagnetic fields when using the batcorder! Although the batcorder's electromagnetic compatibility is standard practice (EMC-safe), microphones are sensitive to such fields. These can interfere with the audio signal.
- **The microphone is sensitive to mechanical strain.** Avoid impacts on the microphone tip and lateral mechanical strain on the microphone extender. Never put stickers on the microphone extender!
- Dust or sticky substances can clog the microphone grid. Don't expose the batcorder to such conditions.
- The aluminum case is sealed up and the cordura bag keeps the batcorder dry. But the microphone has to be exposed to be sensitive to incoming sound waves. The fine mesh of the microphone grid is a comparatively good protection against raindrops. Nevertheless long lasting exposure to high humidity can lead to corrosion, thus to loss of sensitivity. Hence, avoid long-term outdoor exposure.
- Never change the SD card in recording mode. This can lead to a complete loss of data.
- Always lock the power plug carefully using the screw nut provided. Twisting the plug can break the plug. Do not use any tools for locking or opening (pliers, etc.).
- Avoid strong, short-term temperature fluctuations, direct sunlight and temperatures above 40 ° C or below 0 ° C.

If you have further questions, please contact our support team:

info@ecoobs.de or +49 911 3768053

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## Introduction

You have purchased the batcorder, a state-of-the-art bio-acoustical measurement device. It enables you to systematically record bat echolocation calls in natural habitats. The batcorder makes scientific research or ecological consulting studies much easier. To gain optimal results, we recommend to use our custom developed software packages bcAdmin4 (recording database), bcAnalyze3 (manual sound analysis) and batIdent (developed to identify European bat species). Information on the programs bcAdmin4, bcAnalyze3 and batIdent can be found on our homepage

<http://www.ecoobs.de> or <http://www.ecoobs.com>

### What is the batcorder

The batcorder was developed to automatically register bat activity (objective triggering and calibrated sensitivity). Hence, it is the choice solution for systematically recording bat activity in short or long-term monitoring studies. It has an intelligent and proven algorithm, triggering sound recordings when receiving bat calls. This way, only bat call sequences are recorded while other sound and ultrasound sources (like bushcrickets) are mostly ignored. Digital sound files are written in high quality (500 kHz, 16 bit) on an exchangeable SDHC card.

The batcorder is not a conventional bat detector. That means it does not transfer ultrasound to regular sound frequencies in the human hearing range. Thus, speaker or headphone jack are missing. Bats can not be heard directly in the field, but must be analyzed using signal analyzing tools.

An interference suppression for operation in wind turbines has been added for call recognition (from hardware revision H302, only batcorder 3.1).

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## Optional accessories

There exist a variety of optional accessories to use the batcorder in special ways. For usage in wind turbine nacelles a special **windturbine extension** is available. This allows the batcorder to be operated in a wind turbine nacelle and to be supplied with power via the system's landline network. In addition to a daily status SMS and a microphone test, the extension has further adjustments for operation in the nacelle.

We offer the **box extension** for autonomous long term monitoring (e.g. over crowns, on tree trunks, hunting pulpits or on wind measurement masts). This can optionally be equipped with a solar panel.

Since spring 2021, the heart of both extensions has been **Extension 4.0**, which now supports the 4G network (LTE).

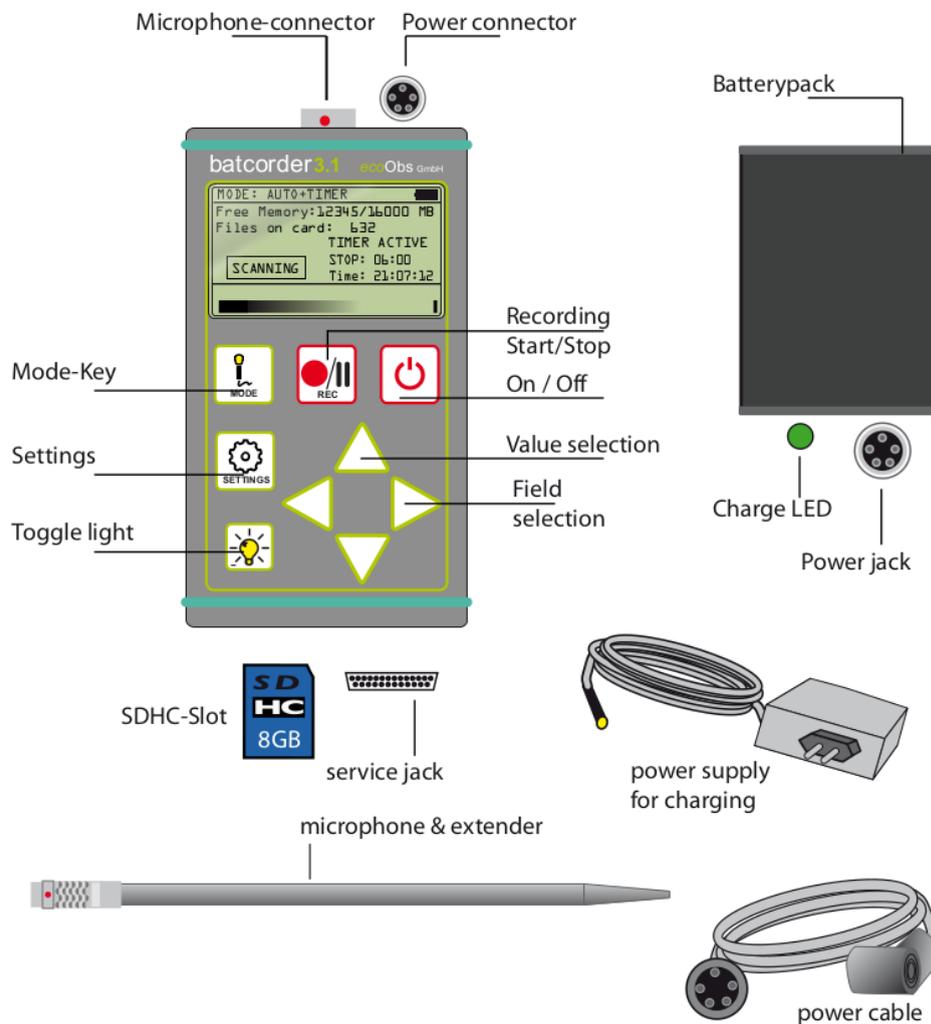
For more information on the two extensions, see

<https://ecoobs.com/products/hardware/extensions/wind-turbine-extension/> and <https://ecoobs.com/products/hardware/extensions/box-extension/>



Extensions that were bought before the release of the batcorder 3.1 are compatible. If necessary, the firmware of the control module must be updated.

## Overview



### Included in standard delivery

- (a) *batcorder* + *Cordura*® bag
- (b) NiMH battery pack incl. charging electronics (6V / 2.4 Ah)
- (c) Power supply for the battery charger (110-240 V)
- (d) cables to connect *batcorder* and battery pack (5 pins, powercable)
- (e) microphone extender + microphone
- (f) cables for charging, connecting the power supply with the battery pack, (not shown)
- (g) Manual (not shown)
- (h) hard-case for secure transport (not shown)

## Microphone

The microphone has a significantly improved connector compared to the previous model, which means that microphones can no longer be exchanged between batcorder 2.0 and 3.x.

The microphone is attached to the tip of a 16 cm aluminum pole. This extender accounts for good recording quality from all sides (omnidirectional). Its connector fits to the middle jack (five pins) on the batcorder front plane. It locks itself when plugged-in and can be untucked by pulling the plug. Plug and connector feature a red dot, these have to be aligned, then the connector can be plugged in correctly. Even though pole and connector are rather robust, shearing forces should be avoided. Please note also the paragraphs on calibration at the end of the manual.

### Microphone capsule

The surface of the microphone capsule must not be damaged or pasted! The capsule is sensitive to mechanical loads and must not be touched directly during transport and installation! The microphone membrane of the capsule is protected from raindrops by a fine microphone grille. However, prolonged exposure to moisture inevitably leads to corrosion processes and thus to an increasing loss of sensitivity. This process is part of normal wear and tear, as well as the fact that dust or sticky substances (dirt, dust, pollen, etc.) can increasingly clog the microphone grille. In order to guarantee the simultaneous use and the comparability of the recordings, we urgently recommend that the microphone be checked regularly by ecoObs GmbH at least once a year. The stick microphone is tested and, if the sensitivity of the microphone capsule changes, it is either recalibrated or replaced.



Please note the information on calibration in the chapter Microphone calibration from page 42.



Important for a new installation or a microphone change: The correction factor of the microphone used (MCF) must be re-entered into the batcorder once. (See chapter Settings starting on page 15)

### Temperature sensor

The temperature sensor logs the outside temperature on the microphone. The reproducibility of the measured value is  $<0.5$  ° C. The deviation from the actual temperature is approx.  $\pm 2$  ° C.

The measured temperature is recorded in the log file every 15 minutes.

### Power supply

Next to the microphone jack there is a five pole jack. Use this for for connecting the battery pack. It allows a runtime of up to 200 hours of scanning and recording with the standard battery pack.



The jack should be secured with the knurled-nut to avoid a slack joint. Take care to not twist the cable when attaching the pack and do only use the knurled-nut for tightening the cables. Please mind the right orientation of tongue and groove of the connectors. The tongue has to point to the microphone (batcorder) respectively to the LED (battery pack).



The batcorder is built to run with a voltage of 6V to 16V. You may need a special cable to connect other batteries than the standard battery pack. Please note, that other voltages or mixing up the polarity may damage the batcorder if no precautions are taken.

### Battery pack

The battery housing contains charging electronics for charging the battery (NiMH type). A suitable power supply unit and a special connection cable for charging are included. The light-emitting diode flashes to indicate the rapid charging process. After approx. 4 hours or after the battery has been fully charged, the charging electronics switch to a lower charging current. This is indicated by the LED lighting up continuously. The battery will then continue to be charged gently. Fully charged batteries are supplied with a trickle charge. If the charger is then plugged in again briefly, the rapid charging current starts again until the battery is either fully charged or the 4 hours have passed.



Batteries should always be charged in well-ventilated rooms.



If the batteries were deeply discharged, it is advisable to repeat the charging process. To do this, interrupt the connection from the charger to the battery pack shortly after the first charging process has been completed. A new charging cycle is started if the batteries have not yet reached full capacity.



The battery cells in the battery pack are permanently installed and can only be changed by the manufacturer of the batcorder, ecoObs GmbH. Never change the battery yourself!



*Batcorder 3.1 cannot be used with old battery packs.*

You can differentiate between battery packs based on the LED colors (red = old, green = new). The batcorder 3.1 battery packs can be operated on old batcorders, but the charge status indicator shows the wrong value with the new type of batteries!

### **Internal battery**

In addition to the external battery pack, the batcorder 3.x has an internal battery that allows operation for two to four nights. This is useful e.g. for transects. The internal battery is charged by connecting the power supply unit with the charging cable directly to the batcorder. After approx. Two hours, the charge is 95%, after which a switch is made to a lower charging current. The battery is then fully charged after another two hours. If the batcorder is started during the charging process, the charging status is displayed. You should repeat this charging process regularly (at least every few weeks), this is the only way to fully charge the internal battery.

## SD-Karte

The slot to insert the SDHC card is located at the bottom end of the casing (opposite to the microphone/power connector) of the batcorder. It is secured by a lid. Open the lid to access the slot. Press slightly on the back lid of the batcorder top while simultaneously lifting and flapping back the lid (see drawing). The lid features seal up of the SDHC slot. Thus, correct closing is important.



With some practice the lid can easily be opened. Always remember that you don't have to use force, otherwise you may damage the batcorder.

The SDHC card has to be pushed slowly into the central slot of the batcorder 's backplane until it snaps in. The contacts of the SDHC card have to point downward and to the batcorder (see drawing). For removal the card has to be pushed gently inside the batcorder and will be thrown out (push-in-push-out). The batcorder supports SDHC cards of up to 32 GB and SDXC of up to 128 GB.

Since firmware version SW307, the batcorder has created its own folder for each start in auto / timer mode and saves the recordings there. This removes the limit of a maximum of 65,000 recordings on an SD card.



Please note that the batcorder can only be operated with SDHC / SDXC cards. The cards do not require a special speed class. Do not use an SD card adapter.

The batcorder will ask you to rewrite the FAT table whenever you insert a new or computer manipulated (formatted or otherwise changed directory structure) SDHC card. Accept that step with „Continue“, but be advised that all existing files will be erased when continuing! This step is necessary to lay out the FAT table and sector size such that the batcorder can use it with optimal speed.

If necessary, the card must be formatted with the computer beforehand. If the batcorder rejects the card with the message "No valid file system", please reformat the card on your computer with exFAT or NTFS. After every change that your computer makes to the SD card, the batcorder has to reformat the card.

If you want to erase data from the card, the batcorder offers an Erase function. This function is accessed via the settings page SDHC-CARD+CLOCK. To erase the card press the keys REC +  $\Delta$  After confirming the erase action all data is removed without recovery.



In order to avoid that a computer writes to the SD card without authorization and the batcorder then wants to format the card, we strongly recommend using the write protection of the SD card. The batcorder itself ignores this so that it can be recorded without any problem.

### Service jack:



A service jack is located next to the SDHC slot. We use it for applying software updates or doing internal tests. Connecting non-compatible devices can damage or destroy the batcorder.

### Display illumination

The display illumination has an extremely low power consumption and therefore isn't affecting the runtime of the battery pack much. It is no problem to use the illumination in Manual- or Auto-Mode (e.g. at transects) permanently. Display brightness can be varied when in Settings-Mode by pressing the light button and using the up/down ( $\Delta$ ,  $\nabla$ ) arrow keys for adjusting the illumination.

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## Setting up the batcorder

For setting up the batcorder you need additional accessory not packed with the standard delivery: SDHC/SDXC card.

### Preparing the power supply

The batcorder includes a sealed up battery pack (rechargeable, 6V / 2.4 Ah, NiMH). This pack includes internal charging electronics. It has to be recharged within the aluminum casing. It can not be exchanged by yourself. Before first use we recommend a full charge cycle.

### Assembling the batcorder

1. Insert SDHC card
2. Connect the battery pack (angular connector at the batcorder, straight at the battery pack)
3. Connect the microphone (don't forget to remove the protector for recording)

### Switching the batcorder on

Press the On/Off button for approximately 3 seconds to start the batcorder. The batcorder will search for attached equipment (approx. 7 seconds). The settings screen is displayed after this step.



You can start the batcorder without a SDHC card to check settings.  
The recording modes require an inserted SDHC card.

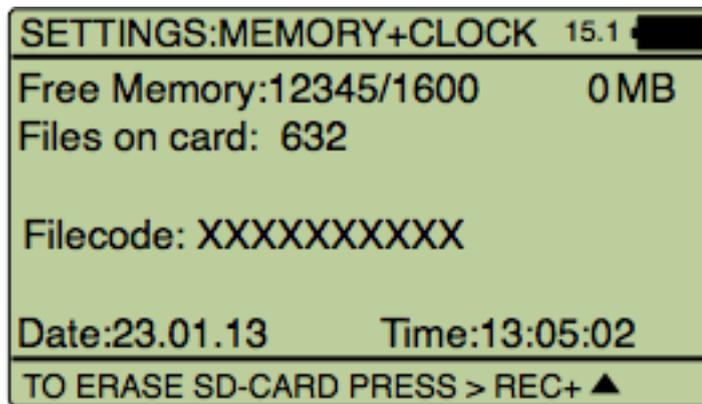
## Settings

On the setting pages you can navigate between fields using the left/right arrow keys (◀, ▶). The up/down arrow keys (▲, ▼) change the selected value. After starting the batcorder, the SETTINGS: MEMORY + CLOCK display appears first.

### SETTINGS: MEMORY+CLOCK

At this screen you can change the following settings:

- 1) Erase SDHC card
- 2) Filecode (part of the filename)
- 3) Date and Time
- 4) Set the MCF



- 1) Using the **Erase** function you can format a SDHC card. Press REC + ▲ key. to start the process. After a confirmation screen, all files get erased from the card.
- 2) The **Filecode** consists of ten alphanumeric characters (including underscore) and is used as identification of a recording.
- 3) **Date and Time** should be set as accurately as possible, since they are used to mark recordings and to control automatic activation. The batcorder does not automatically recognize the change in summer / winter time, so this must be adjusted manually if required. For daily practice, however, it is recommended to leave the batcorder permanently in a “time zone” and to switch from summer to winter time later in bcAdmin4. In addition, any environmental data (temperature, wind, etc.) are often also consistently available in a “time zone”. This makes it easier to correlate the recordings with the environmental data. In

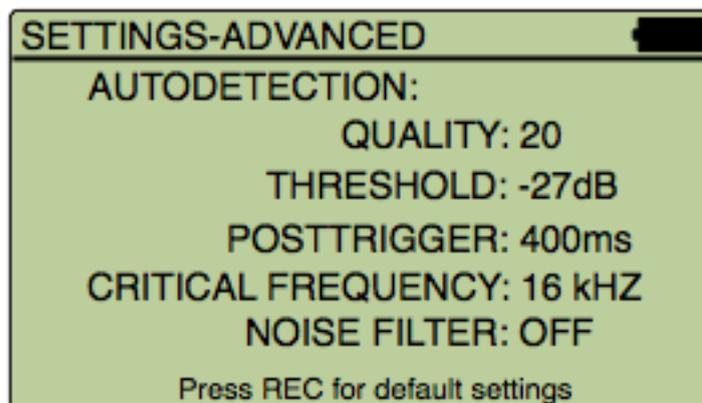
addition, it should be noted that the time change takes place in the middle of the night and therefore a correction in bcAdmin4 is necessary later, even if the change is made manually on the batcorder.

- 4) Pressing the **REC** button together with the **▷** button takes you to the menu for setting the microphone correction factor (MCF). The batcorder calibration value does not have to be re-entered. You can find the MCF on the sticker on the microphone.

Next to the **battery symbol**, the current measured temperature is also displayed in degrees Celsius (only if a microphone is connected).

## SETTINGS-ADVANCED

The advanced setting screen contains parameters of the signal recognition algorithm (Quality, Threshold, Critical Frequency) as well as the post-trigger time in milliseconds. Press the **Set** key in the MEMORY + CLOCK display to open the SETTINGS-ADVANCED display.



Changes to these values influence call detection. Wrong values may lead to improper or incomplete call recognition. These settings should not be changed within one sample period. Otherwise comparisons between different locations or nights are not possible anymore.

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### Quality

The quality value is used to distinguish a bat call from an "interfering signal". The quality value is set to 20 by default, because this value is usually optimal. An increase leads to the reception of signals that no longer meet the strict criteria of a bat call. A lowering can lead to the fact that some calls or types do not generate any recording (positive triggering). This means that with the value 0 the call identification is so strict that even many bat calls can be dropped out. With a value of 40, almost all supra-threshold sounds are recorded. As a rule, you should leave this value at 20. At locations with a lot of potential interfering recordings, a reduction to values from 16 to 18 can provide a slightly better result.

### Threshold

The Threshold influences the recording range of the batcorder. The device is set to a fixed sensitivity. This is chosen by means of a 40 kHz signal at full gain if played with 96 dB SPL at the microphone. The threshold value is dependent on this calibration. The standard value of -27 dB is approximate to an amplitude of 4.75% of the maximal amplitude. If you want to increase the recording range, or pick up species calling very quietly in special situations, Threshold has to be lowered to a value of -30 dB or -36 dB. A change of the threshold value does not change the batcorders gain! Only signals with amplitudes above the threshold will be analyzed. Possible values are -18, -24, -27, -30 and -36 dB (experimental -42 dB). If you use a value different from -27 dB you have to adjust the appropriate setting in bcAdmin. When importing from the SD card using the log file, bcAdmin4 automatically reads in the set value for each session and automatically adjusts the analysis accordingly, depending on the selected presetting.

A difference of  $\pm 6$  dB implies halving/doubling in sensitivity. Due to atmospheric attenuation this can not be transferred to recording distance directly, but it gives a good approximation. Für eine vereinfachte Betrachtung kann auch hier von Verdoppelung / Halbierung ausgegangen werden.

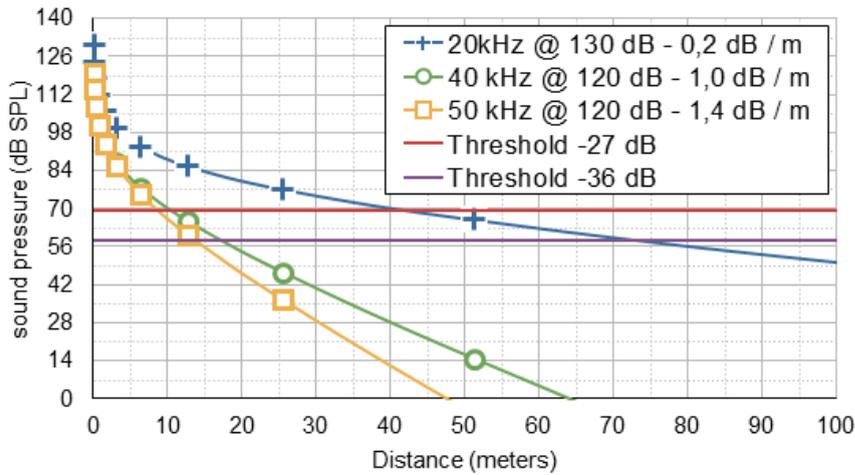


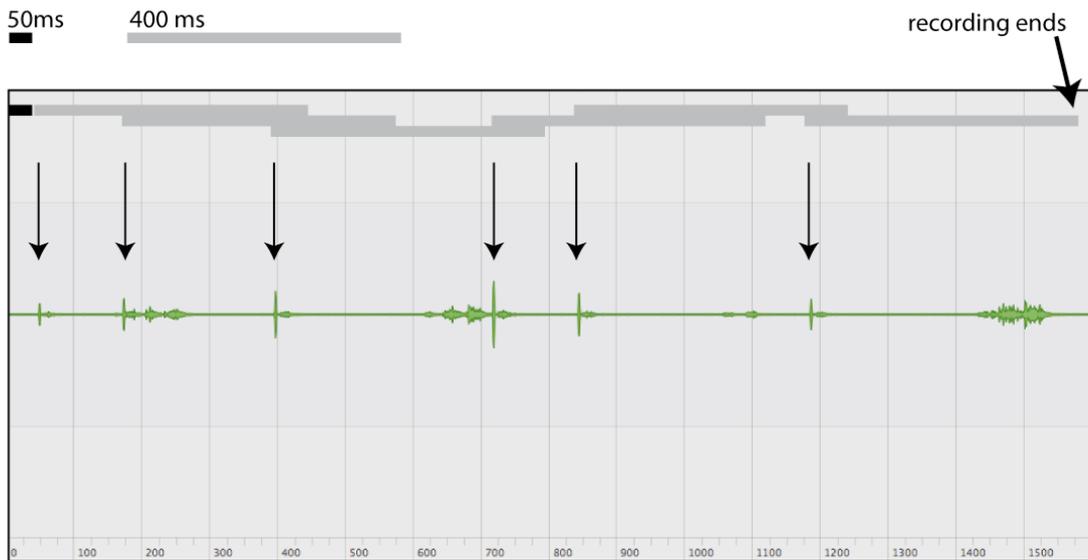
Figure: Approximation of recording distance for two different threshold settings based on typical bat calls. Note the explanations in the next paragraph.

The figure above shows recording distances for three different frequencies based on assumptions of call intensity and attenuation. These should be seen as an indication. The real recording distance varies widely - mainly due to factors like temperature, wind, call direction and most important call intensity of the bat. The later can be adjusted by factor 10 by the calling individual. Only guideline values and ranges can be given. Another approach is grossly negligent and highly error-prone

**Posttrigger**

The post trigger is defined by the interval between two successive detected calls that are still written into the same sound file. After this interval, a new recording is started if a call is recognized. We recommend a value of 400 ms or 600 ms. Possible values are 0 ms, 200 ms, 400 ms, 600 ms and 800 ms.

Pretrigger/Posttrigger



The graph explains pre- and posttrigger times of the batcorder. Arrows indicate positive trigger events (= bat calls). The pretrigger of 50 ms is not adjustable.

**Critical Frequency**

The third setting, is important for bat call recognition. Calls below this frequency are ignored in the analysis, thus, the signal is neither filtered analogously nor digitally. Possible are all values from 14 to 110 kHz in steps of 2 kHz.

**Noise Filter**

From hardware version H302 (only batcorder 3.1), the noise filter can be used to filter some interfering signals that are falsely triggered in advance. For this purpose, numerous interfering recordings were evaluated and the call recognition was adapted so that short events that can be safely separated from bat calls are recognized and do not trigger a recording. Especially when using the batcorder 3.1 on some types of wind turbines, the noise filter ensures significantly less background noise recordings. Bat calls are not filtered out, so you get valid data. The filter can be activated (ON) and deactivated (OFF).



The filter is very conservative and does not filter bat sounds. Nevertheless, when using the batcorder on nacelle it should only be activated when faults occur in order to otherwise work absolutely in

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accordance with the specifications of RENEBAT / ProBat.

### **Default Settings**

Reset the batcorder to default settings with Quality = 20, Threshold = -27 dB, Posttrigger = 400ms and Critical Frequency = 16 by pressing the REC key.

These values are optimal for the analysis with bcAdmin and bcDiscriminator.

### **Specific Settings**

If accessories, e.g. the WTE extension, are connected to the batcorder, there may be other menu displays to choose from (see the respective operating instructions for the WTE extension, the BOX extension and the extension 4.0).

If the batcorder is used for nacelle monitoring following the german research project guidelines the following settings should be chosen:

- Threshold -36 dB
- Posttrigger 200ms
- Quality 20
- CeriticalFrequency 16 kHz

## Recording

The batcorder has three different recording modes:

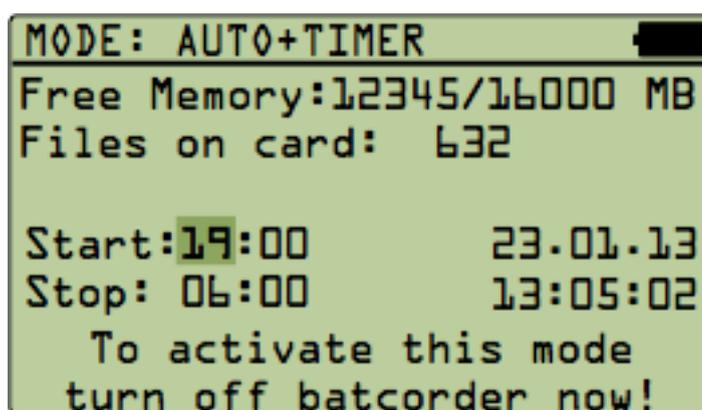
- automatic, timer started recording: Auto+Timer Mode
- automatic, manual started recording: Auto-Mode
- manual recording: Manual-Mode

The three modes can be selected one after the other using the **MODE button**. First the **MODE: AUTO + TIMER** appears, then the **MODE: AUTO** and then the **MODE: MANUAL** display.

### Auto+Timer-Modus

Usually the batcorder is set up in the field and should start sampling bats at a fixed time (sunset) and end automatically at the end of the night. The **Auto + Timer mode** is designed for this automatic use.

When reaching the start time, the batcorder starts automatically and begins the SCANNING mode (caller identification active). When reaching the chosen stop time, it stops the bat detection again powers off. The timer remains active, so the batcorder restarts automatically the next time the start time is reached.



```
MODE: AUTO+TIMER
Free Memory:12345/16000 MB
Files on card: 632

Start:19:00      23.01.13
Stop: 06:00     13:05:02

To activate this mode
turn off batcorder now!
```

**Start/Stop** controls the automatic start and stop time of the batcorder. Adjust these entries as you like. **Now turn off the batcorder, without switching to another screen** and the Auto+Timer mode is activated.

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A successful activation is additionally displayed by a message. You have to confirm this and the activation is signaled by a short message.



Avoid changing the SDHC card after you have activated the Auto+Timer mode. If the newly inserted card is not properly formatted, the batcorder will stop on the SDHC format step after powering itself up. It will not start sampling activity.



If the batcorder was not properly connected to the power supply or the internal battery is empty at start time it will power up. If connected afterwards it won't start as well.



If you manually interrupt the scanning process in Auto+Timer mode by pressing the REC key, this will end this mode and the batcorder stops without activating the timer.

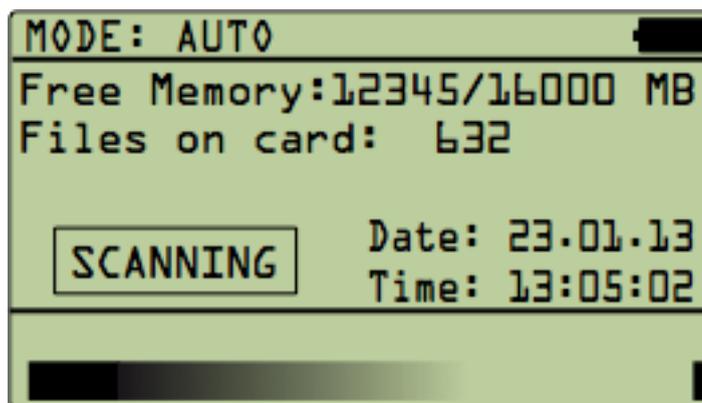
The timer can be set for run times of up to 23:59 hours. It will automatically start again 24 hours after the first auto start. The auto start cycle continues as long as the batcorder was not powered up manually or runs out of power. If the battery power is low while active and scanning, the batcorder stops the scanning process and terminates sampling before powering off. This is documented in the log file with a power low message.



If it is past the set start time, you still can switch on the Auto +Timer mode instantly with a shortcut. Press the REC and the POWER key at the same time and hold down the REC key until the TIMER screen appears.

## Auto-Mode

Switching to the Auto mode, the device initially is in pause mode until the scanning process for call detection is started with the REC key. It can be switched to the pause state again by pressing the REC key a second time. This mode proves useful if you walk transects and you want to automatically record bat calls with the same detection algorithm the autonomous batcorder mode uses.



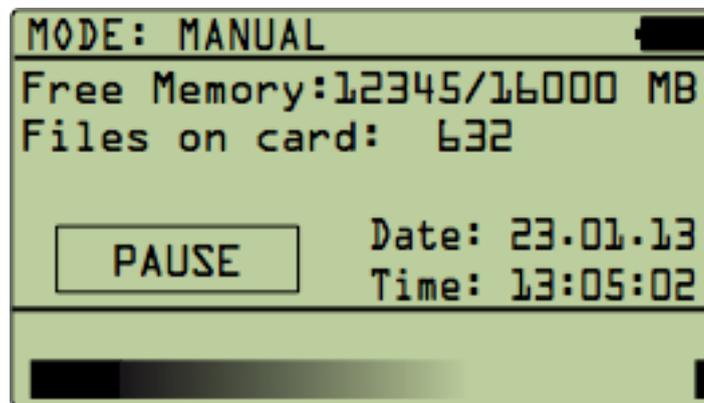
As long as the scanning is in progress, the batcorder can not be turned off or switched to a different screen. Only after deactivation of the scanning progress by pressing the REC key, the other keys are unlocked.



**24h continuous recording:** We recommend to not use AUTOMode, but set a timer to for example 12:10 start and 12:00 end. This will make data import to bcAdmin much easier.

## Manual-Mode

Using the manual mode, recordings are started or stopped only by pressing the **REC** key. This mode is useful if signals have to be recorded that are not triggered by the automatic modes or if the recording time has to be controlled manually.

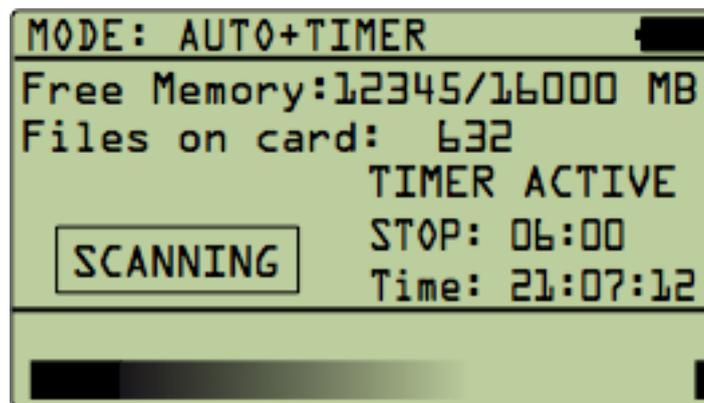


## Display elements in the recording modes

In recording mode the batcorder displays different status information. In the upper right corner a battery indicator shows an approximated battery status. By a **Li** the batcorder indicates that it is running on its internal battery. This display is a rough guide, the actual battery run time depends heavily on temperature and the age of the battery pack. In addition, the current temperature measured at the microphone plug is displayed in degrees Celsius.

First and second line show the used memory versus total memory of the SDHC card, as well as the number of recordings stored on the card. Below, a rectangular info field indicates **NOT ACTIVE**, **PAUSE**, **WAIT**, **SCANNING** and **RECORDING** operations of the selected mode. At the lower screen edge, a bar shows the sound input level. A small open rectangle on the right side of the bar indicates overdrive of the input signal.

If the batcorder was activated by the timer, the display is showing this accordingly. **AUTO-TIMER** mode can be stopped by pressing **REC**. If an extension with GSM module is connected, it will also send a SMS.



## Instructions for use

Detecting bat calls reliably and in a quantitative manner poses high demands on setup and actual recording location. Automatic triggering, recording and computerized analyzing on species level highly depends on the proper detector setup. We therefore recommend to follow the pieces of advice. The user guidelines were compiled particularly regarding influences on the triggering mechanism, automated call analysis (with bcAdmin) and automated discrimination (batIdent).

## Acoustic and electromagnetic influences

Noise in the audio signal can be induced by either acoustic or electromagnetic interferences. Such signals can influence bat call analysis dramatically. Even though the batcorder possesses a robust triggering-algorithm in most environmental setups, known sources of disturbance should be avoided. While the batcorder will cope with these situations, nevertheless it may record more parasite recordings or miss some bats. Also, the automated analysis of calls may suffer. The following list gives sources of perturbation, based on our knowledge:

- 
- Strong electromagnetic fields (for example power lines, big coils, power switchboards, wind turbines, ...) may lead to additional recordings of noise and noise in recordings.
  - AC sources (for example neon lamps, energy saving lamps, ...) may produce narrow bandwidth ultrasonic noise.
  - Strong wind streaming alongside irregular shaped bodies (for example trains, cars, ...) create low frequency noise as well as broadband noise and can mask bat calls.
  - Reflections from nearby objects can interfere with bat calls, since calls as well as echoes of the calls arrive with very small time differences at the microphone. This leads to interferences and thus to a decline of the trigger algorithms performance. Thus, the microphone should be placed at least at 2m distance (height & range) to any objects. Recording close to vegetation, walls, underneath bridges, underpasses as well as above sealed roads or water bodies is not recommended. Often the box extension will improve recordings at such locations, since it shields for example echoes from behind the microphone.
  - Many bushcrickets have calls in the ultrasonic spectrum. At a distance of 2 meters or more to vegetation, the signal strength of these calls is reduced, hence, generates only few to none trigger events.

### **Site selection and recording modalities**

Not all locations are equally suitable for using a bat detector. Even if the above-mentioned sources of interference are excluded, there are locations that prove to be unfavorable due to various properties. The most important are:

- 
- **Hibernaculum or swarming site:** A bat detector set up inside or in front of a hibernaculum will lead to a huge number of recordings in autumn and spring. This makes data analysis more difficult. Social calls as well as unspecific echolocation calls near structures may lead to uninterpretable recordings. The more species and individuals are recorded at the same time, the less predictions can be made on bat density or quantification of activity. We recommend avoiding such sites, if studying general bat activity. Place the batcorder at distances of at least 50 to 100 meters of such sites to gain a more useful measure of activity.
  - **Bodies of standing water:** many bat species are hunting at lakes and other water bodies. Thus, such sites lead to good results for accessing the overall species diversity of an area. But comparison of bat activity to recordings from other sites is difficult for similar reasons as mentioned before (swarming sites). In addition reflexions from the the water surface will degrade the quality of the recordings. We recommend to place the batcorder in a distance of at least 5 to 10 meters to the waterside.
  - **Wind turbines:** Often bat detectors are installed on top of wind turbines (inside the hull or outside). Recording at such sites has to be planned very carefully. Depending on the turbine type and the actual setup, acoustic and electromagnetic disturbances, mechanic strain, acoustic shadowing, reflections as well as extreme climate conditions (wind, rain, ...) may lead to severe problems. For this location we have developed the wind turbine extension, which helps to improve the recording setup.
  - **Car transects:** A method sometimes chosen for monitoring purposes are car transects. That means, bat activity is measured along a driven distance. We advise against using this method, since danger of acci-dents rises, and recording while driving goes along with a lot of noise. In addition the mechanical strain on the device, echos from the car surface and the potential displacement of sensitive species have to be taken into account.

We are not liable for damage or failure caused by improper installation or use.

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## Miscellaneous

### Sound format

Recordings with the batcorder are written as raw audio files without header information. The data is organized as PCM values with an amplitude resolution of 16 bit, LittleEndian byte order (Intel) and a sample rate of 500 kHz. The files can be read with any sound software that is capable of opening raw audio files with the necessary sampling parameters. This should work in SASLab Pro (Avisoft; user defined import format), Pettersson Batsound (chose .dat file, samplerate of 50 kHz!), Audacity (use 50 kHz samplerate!) and Amadeus Pro (Hairer; import raw audio file).

### Filenames

Each recording gets a unique filename using a fixed scheme. The names are chosen to support easy archiving and quick recognition of recordings. The filename begins with the date: DDMMYY (for example 100707 for July, 10th 2007). This is followed by the ten characters long filecode (see Settings SDHC-CARD+CLOCK) and a consecutively numbered count. A valid filename, is for example

100707-LOCATIONAX-00095.RAW

By choosing descriptive file codes and including the date, filenames are easily recognizable. Thus, recordings can easily be assigned to an event.

### Log file

The batcorder creates a log file on the SDHC card to control its proper function (LOGFILE.TXT). This file holds entries to all important events. Activation and deactivation of each mode are stored, as well as each recording. Furthermore, the **SETTINGS ADVANCED** are printed for each start event (**auto on**, **timer on**) as simple list of Quality, Threshold, Posttrigger and Critical Frequency and the status of the noise filter (01 for active / OFF for deactivated) in the form of a simple string: "20; 27; 400; 16; OFF".

A valid log entry for an event (not a recording) consists of five fields separated by tabulators: Mode (**A**uto on/off or **T**imer on/off), date (DD.MM.YY), time (HH:MM:SS), filecode and settings:

```
Auto on    30.03.08    19:00:44 FILECODE    SETTINGS
```

A **recording** entry consists of five elements. The kind of recording (**A** automatic, **T** timer, **M** manual), date, time, filename and recording duration (milliseconds):

```
M    30.03.08    19:08:30    300308-UNIXXXXXXXX-0003.raw    979ms
```

The temperature measurements are recorded as separate lines every 15 minutes from the start of the acquisition. A temperature reading is marked by ° C (Celsius) in the first column. In the same way as recording entries, the date and time follow. The last column is the temperature in degrees Celsius:

```
C    04.11.13    05:30:00    18.1 °C
```

A complete log file looks for example like:

```
Batcorder SW3.23 / logfile 3.1
created on 10.05.2021 21:22:16
```

```
Files total:000014
```

```
TIMER ENABLED 10.05.21    18:37:41    TIMER START: 21:22    TIMER STOP: 22:22
```

```
Timer on    10.05.21    21:22:32    XXXXXXXXXXXX    "20;27;400;16;OFF"    4.14V
C    10.05.21    21:22:32    17.1∞C
T    10.05.21    21:22:34    050408-XXXXXXXXXX-00001.raw    1112ms
T    10.05.21    21:22:36    050408-XXXXXXXXXX-00002.raw    935ms
T    10.05.21    21:35:37    050408-XXXXXXXXXX-00003.raw    871ms
C    10.05.21    21:37:32    16.8∞C
T    10.05.21    21:43:38    050408-XXXXXXXXXX-00004.raw    835ms
C    10.05.21    21:52:32    16.9∞C
T    10.05.21    21:52:39    050408-XXXXXXXXXX-00005.raw    710ms
T    10.05.21    21:58:40    050408-XXXXXXXXXX-00006.raw    606ms
C    10.05.21    22:07:32    16.5∞C
T    10.05.21    22:09:41    050408-XXXXXXXXXX-00007.raw    602ms
T    10.05.21    22:22:42    050408-XXXXXXXXXX-00008.raw    598ms
Timer off   10.05.21    22:22:45
M    10.05.21    21:22:50    050408-XXXXXXXXXX-00009.raw    1357ms
```

```

M 10.05.21 21:22:52 050408-XXXXXXXXXX-00010.raw 1148ms
M 10.05.21 21:22:53 050408-XXXXXXXXXX-00011.raw 975ms

Auto on 10.10.13 23:28:20 XXXXXXXXXXXX "20;27;400;16;01"
A 10.05.21 23:28:23 050408-XXXXXXXXXX-00012.raw 1032ms
A 10.05.21 23:28:24 050408-XXXXXXXXXX-00013.raw 831ms
A 10.05.21 23:28:25 050408-XXXXXXXXXX-00014.raw 1116ms
Auto off 10.05.21 23:28:26
    
```

In addition, various errors on the SD card and when sending SMS (only with extensions) are saved in the log. In addition, after the firmware updates have been carried out, a third line is written under the first two lines in the log file with the following information:

```
UPDATE 04.05.21 SW3.23/LGF3.2
```

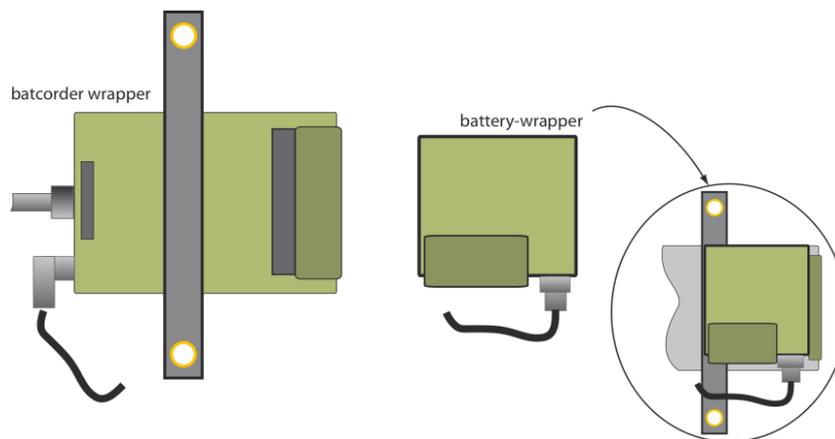
If the timer is deactivated manually during the recording time, the following message appears in the LOGFILE:

```
Timer manually turned off      10.05.21      22:11:07
```

## Field setup

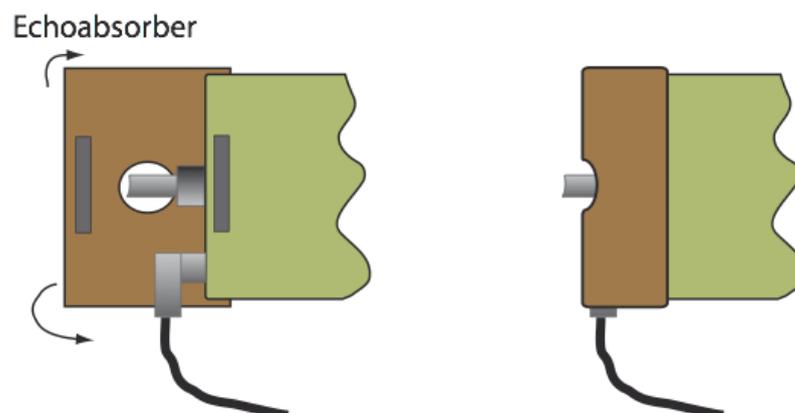
### Attaching the battery pack

The batcorder's cordura® bag is designed to easily attach the battery pack. Battery pack and batcorder cases have Velcro® fasteners for solid fixation (see drawing).



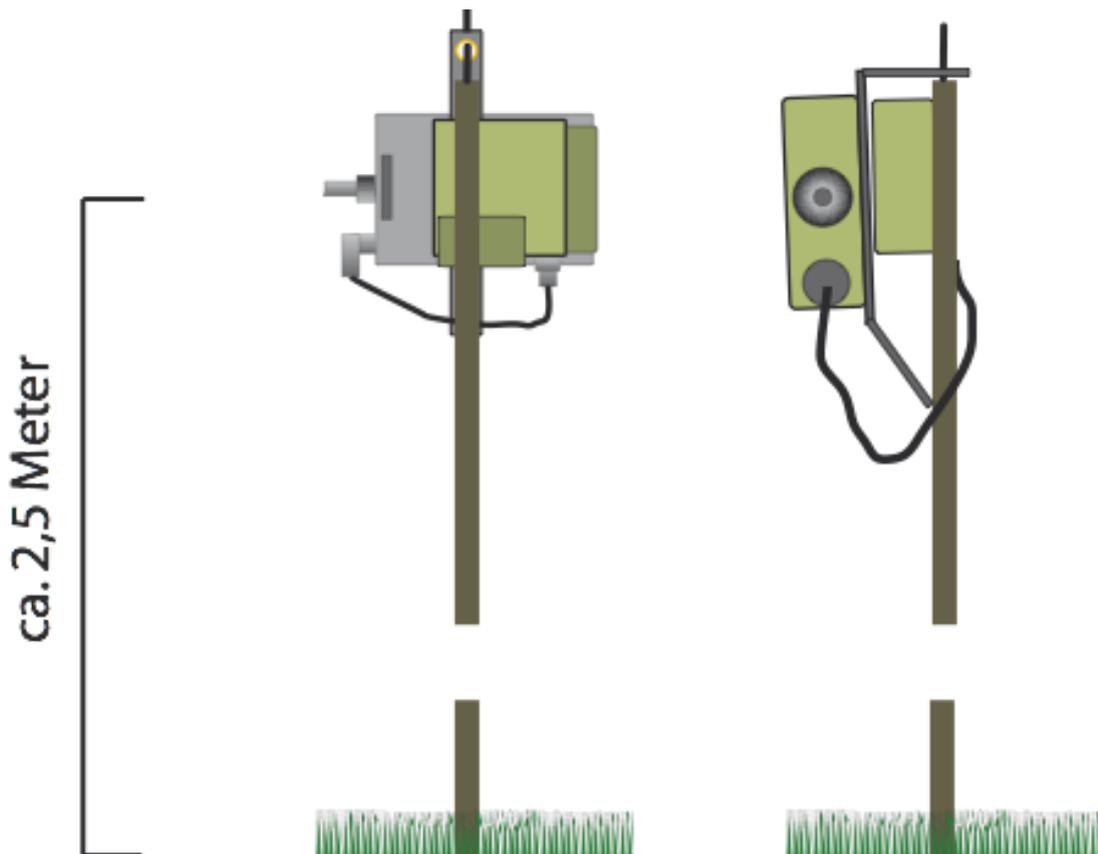
### Echoabsorber

The batcorder is delivered with a special echo absorbing velvet cloth. This minimizes echos reflected directly from the batcorder. We recommend installing it whenever you record bat calls. Otherwise, interferences will occur. These disturb call analysis.



## General echo avoidance

A carefully chosen set up is necessary to get well and echo-reduced recordings. Place the batcorder on top of a 2.5 meters high pole and place it in approximately 2 to 4 meters distance to vegetation structures or other sound reflecting surfaces (including stems of trees). This minimizes interferences of direct sound and echos at the microphone. Such interference can lead to the extinction of sound waves.



## Attachment at a tarp pole

The cordura® bag has a strip with a two metallic eyes that can be stripped over the bolt at the top of a tarp pole respectively attached to the tarp pole via a small strip (lower eye). Care should be taken to ensure that the stick microphone is aligned horizontally and that it points slightly upwards. On the one hand, this prevents water droplets from collecting on the microphone grille and, on the other hand, prevents rain or condensation from running off over the microphone tip along the microphone rod.

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## Further information for field setup

Many of the commonly used bat detectors are placed inside plastic boxes or other casings (safety against theft or rain) when used as simple automatic bat detection systems. Usually, these are either placed on the ground or attached to trees. Furthermore, a couple of solutions exist to place the microphone facing downwards onto a reflecting surface (indirect sound paths).



All these solutions are counterproductive to good recordings. Such setups lead to multiple paths sound waves, that can lead to interferences at the microphone. Additionally the microphone loses it's omni-directionality.

The box extension is a possible solution, as such an attachment is also possible with the batcorder. Visit our homepage for more information. If you need a special attachment or something similar for a special application, we recommend that you contact us. We will be happy to help you with the planning and give you tips for optimal installation.

Besides, we always recommend to consider the tips mentioned in this manual. These are based upon years of experience in making ultrasound recordings with and without automated recording systems and call analysis.

## Firmware update

The batcorder firmware is continuously developed and improved. Your batcorder's firmware (shown as SW at startup in the lower right of the screen) can easily be updated from a SDHC card to participate of these improvements.



Please make sure to use the correct firmware for your device!

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We highly recommend that you subscribe to our newsletter at [www.ecoobs.de](http://www.ecoobs.de) so that you will be informed immediately about updates.

You will see the current version of the firmware of your batcorder when you start the device as HXXX (hardware version) and SXXX (software version). Only a few steps are necessary to update the software version. **It is important to follow these steps exactly, as failure of the update process will make the batcorder inoperable and you have to send it to us for reprogramming.**

You need an SD card to carry out the update. This must be prepared according to the following steps. Please read these instructions carefully before you start the update!



Please also deactivate all kind of software that interacts with the SDHC card unasked (virus scanners, ...).



Note: The hardware version "Hxxx" cannot be updated via a firmware update. The batcorder must be sent to us for this purpose.

### 1. Format card with the batcorder

Insert the card into the batcorder and press (**REC + Δ Pfeil oben**) in the MEMORY+CLOCK Menü or by accepting **Continue** when starting the batcorder (only possible if the card has been changed in the computer).

### 2. Copying the update file

Insert the SDHC card into your computer's card reader. Copy the update file onto the card. Do not change anything else on the card, copy, move or delete no other files! Make sure that no other applications are accessing or changing the SDHC card! Eject the card after the copy process finished. The update files for the firmware are always named according to the same scheme; the firmware version SW 323 is named UPDAT323.BIN.

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### 3. Actual update process

Insert the card again into the batcorder. Then Turn on the batcorder and follow the on screen instructions. If the update was successful, the updated software number appears on the bottom right of the display when the batcorder is started (SW3XX).



The SDHC card can be used to update further batcorders without repeating the first two steps.

### Possible errors

Update imported, but the device can no longer be started or it behaves in an undefined manner: the update has failed (e.g. incorrect download, defective card, unnoticed access to the SD card while editing on the computer). As a rule, your batcorder can be revived, but only by ecoObs and not on site. Please contact the support.

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## Tips, Tricks & possible problems

### Formatting SDHC cards

The batcorder writes on SDHC cards in a PC/Mac compatible format (FAT32). If necessary, the batcorder will ask you to format the SDHC card. This happens, for example, after manipulating the card or its contents with the computer.



**Attention:** Even after formatting the card with the computer, the batcorder will rewrite the FAT table. Always manually format the card with the batcorder prior to its use in Auto + Timer mode. Otherwise the batcorder may not be able to start in Auto+Timer mode.

### Switching SDHC cards

Do not switch between SDHC cards while recording or the device may crash and lose all data.

### No remaining space on the SDHC card

If the card is full with recordings while sampling, the batcorder will shut down and add an entry to the log file.

### SD card defective

SD cards do not last indefinitely. The cards are subject to wear while writing or, for example, from electromagnetic radiation. Some cards fail the first time you use them. We recommend using each SD card only once, especially when using the batcorder continuously (in gondolas, etc.). This should then be archived in a safe place so that you always have a copy of the raw data. In general, we recommend always keeping sufficient replacement cards in stock and changing the SD cards after a field season.

Not all data is necessarily lost, sometimes the batcorder stops recording or small errors occur, e.g. in the log file. Depending on the error, data recovery companies can usually restore almost 100% of the cards. Depending on the card and the

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error, the costs for this range from € 200 to € 1000. The batcorder can recognize some defects and displays them with an error code when it starts. In this case, use a different SD card and the error should be resolved. If this is not the case, please contact us.

The possible error codes are:

**Code 1:** FAT\_Directory error.

The card contains deleted or invalid entries in the file table. Either the card encountered a write error or - more probable - was written to by another device.

**Code 2:** FAT\_TAB1\_ERROR. The file allocation table is defective. Reason probably a write error. Reformat card. If the error continues to appear replace the card.

**Code 3:** FAT\_TAB2\_ERROR. The FAT copy is defective. Very probably a writ error. Reformat card. If the error continues to appear replace the card.

**Code 4:** FAT\_CLUSTER\_ERROR. Error in the chaining of clusters. Reformat card. If the error continues to appear replace the card.

**Code 5:** SD.CARD ACCESS ERROR. The batcorder wasn't able to read the card. Card is in wrong format. If format is correct, the card is defective. Replace the card.

### **Low battery voltage / run time**

If the voltage of the external battery pack is too low for operation, the internal battery is used. If the internal battery is also discharged, the batcorder switches itself off and add an corresponding entry to the log file.

The batcorder runs less than two nights on a single battery charge. A couple of reasons can be responsible for this. Rechargeable batteries have only a limited lifetime, expressed in numbers of charging cycles. The older the batteries, the less capacity they can hold. If your batteries are old or have already been used a high number of charge cycles, they should be exchanged. Furthermore, batteries

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prefer temperatures above 10° C. If reduced run time occurs in cold nights, the low temperatures are probably the reason. The newer the battery, the better it copes with such situations. Please note that the batcorder is not built to be used at temperatures below 0°C. The number of recordings taken in a single night strongly influence battery consumption. When writing to SDHC card, the current drain nearly doubles in comparison to scanning operation. Thus, more recordings lead to higher battery consumption.

### ***batcorder* is not responding**

If, contrary to expectations, the batcorder does not react to keystrokes, i.e. if it has crashed, you can switch it off in a controlled manner by pressing the **power key** for at least 10 seconds. Disconnecting the external power supply is not sufficient in this case, as the internal battery then takes over the power supply.

### ***batcorder* does not start**

It is possible that only the internal battery is discharged. Connect the batcorder to the charger for at least 2 to 4 hours to charge the internal battery.

### **None or only few bat recordings**

If you achieve only a few recordings after one night of sampling at a location with high bat activity, this might be due to the following reasons:

- a) **Disadvantageous setup:** Setting up the microphone close to reflecting surfaces (vegetation, walls, water bodies, ground) leads to strong echoes and therefore interferences of echo and signal. This will affect the call detection of the batcorder. A different setup is highly recommended.
- b) **Changed settings (Settings Advanced):** If you have changed any of the advanced settings, you may have changed vital parameters for bat call detection. Please make sure that Quality is set to 20, Threshold to -27 dB and Critical Frequency to 16 kHz. Especially low values for quality (0 to **10** influence the triggering and bias it towards high quality calls.
- c) **Connectors not tightened:** Check if all connectors are not only connected but tightened via the screw-nut.

- 
- d) **Microphone protective cap:** The microphone is protected against mechanical damage by a short plastic tube during transport. Check if you removed this cap.
  - e) **MCF not entered or entered incorrectly**
  - f) **The microphone sensitivity is too low.** We recommend annual calibration of the microphones to compensate for a change in sensitivity or, if necessary, to replace the microphone capsule.
  - g) Use the log files to check if the batcorder terminated on account of low batteries or a full SDHC card.

### **Too many recordings, many bushcricket recordings**

- a) **Microphone too close to vegetation:** Placing the microphone close to vegetation may lead to a higher sound pressure level of bushcrickets, singing in the vegetation. This can lead to bushcricket calls triggering recording events. Move the microphone further away from vegetation.
- b) **Wrong advanced settings -> Quality:** Check if Quality is set to 20 in the advanced settings screen. Values above 20 lead to triggering by signals that are not similar to a bat call. The higher the selected value, the less selective the triggering algorithm is.

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## Support

### batcorder serial number

Each device has a unique serial number on a durable sticker located at the batcorders bottom side. This number allows to recognize each of your batcorders. Please send us this number with every bug or problem report.

### Software updates and versioning

The batcorder software is improved regularly. You can easily install the updates yourself in most cases. Update files (free of charge) are available on our homepage ( <http://www.ecoobs.com/cnt-bcupdate.html> ). Follow the instructions in the Firmware update chapter from p. 34.

### Error descriptions and contact

As any other device, the batcorder can encounter errors. These can often be fixed very easily, thus we recommend to contact us with a detailed error description prior to sending the batcorder. Please always include the batcorders serial number, as well as its hardware and software versions (Hxxx Sxxx) in your report. Furthermore, tell us how to reproduce the error. In most cases, many questions can be answered quickly and safely over the phone.

### Never send the device in unsolicited.

If you are asked to send it in, please use our return form on our homepage in the Downloads area. Please fill out the form completely.

### ecoObs GmbH can be reached at:

ecoObs GmbH  
Hermann-Kolb-Str. 35b  
90475 Nürnberg  
Germany  
Mail: [info@ecoobs.de](mailto:info@ecoobs.de)  
Telephone: 0049 (0) 911 - 376 80 53

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## Microphone calibration

Both batcorder and microphone are calibrated before delivery to ensure comparability of recorded data when used either simultaneously or sequentially [40 kHz @ 96 dB SPL equals full gain]. The calibrated sensitivity is only guaranteed for the microphone delivered with this batcorder unit. Please use only the supplied microphone and do not exchange microphones of different batcorders! If you have to switch between different microphones, you have to adapt the MCF of the microphone accordingly (see next page). The correct value can be found on the sticker on the microphone.

We recommend the annual calibration check by ecoObs GmbH. Please send the microphone to the address below, we will then check the correction factor and inform you of the necessary changes and the procedure for adapting the batcorder. Please refer to our online price list for the costs of the test.

**Please note that you mustn't stick stickers to the microphone pole or use thick touch-up pens for marking. We have to manually remove such labels before we can calibrate the microphone.**

### Send to:

ecoObs GmbH  
Hermann-Kolb-Str. 35b  
90475 Nürnberg  
Germany

## Adjustment of the Microphone Calibration Factor

If a batcorder 3.1 microphone is recalibrated, replaced or exchanged by a disc microphone, the microphone correction factor (MCF) needs to be adjusted for the batcorder.

### Method

1. Start the batcorder as usual.
2. If necessary, move the input cursor to the **first field of the file code** in the **SETTINGS: MEMORY + CLOCK** start menu.
3. Press **REC** together with the **RIGHT ARROW** button ▷.
4. The menu for adjusting the **Microphone Correction Factor (MCF)** opens.
5. The MCF value can now be changed in steps of 1 using the **UP / DOWN arrow** buttons △, ▽.
6. Press **REC** to save the new value and leave the menu or press **SET** to leave without saving.
7. Once the new MCF value has been saved, the batcorder is again ready for use with the new or serviced microphone.

## Technical Details

Product	<i>batcorder</i>
Description	Call triggered, automatic bat recorder

### File- / Sound Properties

Type-of-recording	real-time
Samplingrate	500 kHz
Amplitude-resolution	16 bit
Sensitivity	16 - 150 kHz (ca. 32 dB loss at 150 kHz)
Sound-samples	LittleEndian, PCM, w/o header
Memory-type	SDHC-card (FAT32), 4/8/16/32 GB capacity SDXC-Karte (FAT32), 64/128 GB

**Recording properties**

type of microphone	FG series, Electret, power-supply 1,3 V
signal-to-noise ratio (SNR)	ca. 80 dB
Directionality	0 to -9 dB loss at 0 - 180° incidence

**Analoge-circuitry**

Highpassfilter	16 kHz, Butterworth, 10th order
Lowpassfilter	150 kHz, Butterworth, 10th order
Overall-gain	calibrated: 40 kHz @ 96 dB SPL = full gain

**Power Supply and Usage**

Power supply	NiMH 6V 2400mA (14,4Wh) internal Lithium-Ionen 3,7V / 1,15 Ah (4,25 Wh)
Charger (AC/DC converter)	Input 100V- 240V 1A max, Output 12V 1A
Power consumption (Scanning)	ca. 68 mW (lights off, 8 GB Transcend-Karte)
Power consumption (Writing)	ca. 140 mW (lights off, 8GB Transcend-Karte)
Runtime with 100% battery charge and 10 hours of timer operation	ext+int. battery max 22 nights (220 hrs.) int. battery max 4 nights (40 hrs.)

Temperature range for operation	0°C - 40°C
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Technical details are subject to change.

## EC Declaration of Conformity



*in accordance with EMC regulation 2004/108/EG*

*in accordance with LVD 2006/95/EG*

### Responsible person for documents

*Claus Schuster*

*Hermann-Kolb.Str. 35b, 90475 Nürnberg*

### The manufacturer

**ecoObs GmbH**, *Hermann-Kolb.Str. 35b, 90475 Nürnberg, Germany*

**hereby declares for the product:**

Product description: batcorder 3.1 - digital bat call recorder

**complies with the relevant sections of the above referenced specifications - including any changes applicable at the time of the declaration.**

**Nürnberg, 01.02.2013**

A handwritten signature in black ink that reads "C. Schuster".

(Claus Schuster)  
Managing Director, Development

A handwritten signature in blue ink that reads "V. Runkel".

(Dr. Volker Runkel)  
Managing Director, Application



### Declaration of Conformity

For the following equipment :

Product Name: AC/DC Switching Adaptor

Model Designation: GSMwxy (w=18,25,36 ; x=B,E ; y=05,07,09,12,15,18,24,48)

is herewith confirmed to comply with the requirements set out in the Council Directive, the following standards were applied :

**RoHS Directive (2011/65/EU)**

**MDD Directive (93/42/EEC)**

EN60601-1:2006+A11+A1+A12; EN60601-1-11:2010 TUV certificate No : TA50266669

**EMI (Electro-Magnetic Interference)**

Conducted emission / Radiated emission

EN55011:2009+A1:2010 Class B

Harmonic current EN61000-3-2:2014

Voltage flicker EN61000-3-3:2013

**EMS (Electro-Magnetic Susceptibility)**

EN60601-1-2:2007

ESD air EN61000-4-2:2009 Level 4 15KV

ESD contact EN61000-4-2:2009 Level 4 8KV

RF field susceptibility EN61000-4-3:2006+A1:2008+A2:2010 Level 3 10V/m

EFT bursts EN61000-4-4:2012 Level 3 2KV/5KHZ

Surge susceptibility EN61000-4-5:2014 Level 3 1KV/Line-Line

Conducted susceptibility EN61000-4-6:2014 Level 3 10V

Magnetic field immunity EN61000-4-8:2010 Level 4 30A/m

Voltage dip, interruption EN61000-4-11:2004 >95% dip 0.5 periods 30% dip 25 periods >95% interruptions 250 periods

**Note:**

The power supply is considered as a component that will be operated in combination with final equipment. Since EMC performance will be affected by the complete system, the final equipment manufacturers must re-qualify EMC Directive on the complete system again.

For guidance on how to perform these EMC tests, please refer to TDF (Technical Documentation File).

This Declaration is effective from serial number EB6xxxxxx

Person responsible for marking this declaration :

MEAN WELL Enterprises Co., Ltd.

(Manufacturer Name)

No.28, Wuquan 3rd Rd., Wugu Dist., New Taipei City 248, Taiwan

(Manufacturer Address)

Johnny Huang/ Manager, Certification Center :

(Name / Position)

(Signature)

Ted Cheng/ Director, Sales Dept. :

(Name / Position)

(Signature)

Taiwan  
(Place)

Apr. 20th, 2016  
(Date)