



User Manual

Version 1.3



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DOCUMENT HISTORY

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1.0	9/11/2021	2.0	-
1.1	26/03/2024	3.0.6	<u>Toolbox references</u> ; <u>asset tagging</u> ; screenshots of UI throughout; Titley Scientific contact details; <u>reset settings changes</u> ; <u>SD card capacity/availability</u> ; <u>temperature log files</u> ; <u>dashboard changes</u> ; <u>frequency response FAQ</u> ; <u>Toolbox firmware update</u> ; <u>flashing icon status table</u> ; <u>division ratio recommendation</u> ; <u>erase SD card</u> ; <u>additional metadata</u> ; <u>changes to file type/sample rate/microphone instructions</u> ; <u>GPS override</u> ; <u>additional schedule options</u> ; <u>schedule saved on-device</u> ; <u>SD card recommendations</u> .
1.2	13/05/2024	3.0.8	<u>Supported SD cards</u> ; <u>languages</u> ; <u>log start time</u>
1.3	21/10/2025	3.1	<u>Lithium battery recommendation</u> ; <u>Servicing recommendation</u> ; Chapter/section reordering throughout to match updated UI; <u>Sensor log frequency</u> ; <u>Sensor logging</u> ; Updated screenshots throughout; <u>Language options and instructions</u> ; <u>New FAQs</u> ; <u>Updated FAQs</u> ; <u>Schedule menu</u> ; <u>import/export schedules</u> ; <u>Updated setting terminology</u> ; <u>noise filter</u> ; <u>full screen sensitivity editor/VU meter</u> ; <u>VU meter ZC caveat</u> ; USB data cable requirements throughout; <u>microphone channel lock for ZC</u> ; <u>Change clock menu to device settings</u> ; <u>firmware update revision</u> ; <u>noise folder</u> ; sample rate options; <u>reset device settings</u> ; <u>LED behaviour during update</u> ; <u>updated data table</u> ; <u>time zone in log file</u> .

CONTENTS

GETTING STARTED	6
FEATURES OF THE CHORUS.....	6
GETTING TO KNOW THE CHORUS	6
MICROPHONES	9
POWER REQUIREMENTS	10
DATA STORAGE REQUIREMENTS	10
USB CONNECTION	11
USING THE CHORUS	12
STEP-BY-STEP GUIDE	12
TURNING THE RECORDER ON/OFF & SLEEP	14
UPDATING FIRMWARE	15
RECORDING MODES	17
Selecting a Recording Mode.....	18
SD CARD MENU	18
Erase SD Card	18
RECORDING SETTINGS	19
GENERAL RECORDING SETTINGS	19
Reset Settings	19
File Type	19
Sample Rate	20
Microphone	20
Maximum File Length	21
Filename Prefix	21
ACOUSTIC RECORDING SETTINGS.....	21
Gain	21
ULTRASONIC RECORDING SETTINGS	22
Activation Mode (Triggered or Constant Recording).....	22
Microphone Sensitivity (Triggered Activation Only)	22
Minimum Trigger Frequency (Triggered Activation Only)	23
Maximum Trigger Frequency (Triggered Activation Only).....	23
Minimum Event (Triggered Activation Only)	23
Minimum Recording Time (Triggered Activation Only)	23
10k High Pass Filter (Ultrasonic Recording Only)	24
Frequency Division Ratio (ZC File Type Only).....	24

Noise Filter (Triggered Activation Only).....	24
SCHEDULES	25
IMPORTING SCHEDULES	25
Import via SD Card	25
Import via USB cable	26
VIEWING SCHEDULES	26
EXPORTING SCHEDULES	27
Export onto SD Card	27
Load into Toolbox	27
GPS SETTINGS	28
TRANSECT MODE	28
REFRESH LOCATION.....	29
DEVICE SETTINGS	29
Reset Settings	29
CHANGE LANGUAGE	30
TIME ZONE.....	30
LOG START TIME	30
SENSOR LOGGING	30
SENSOR LOGGING FREQUENCY	31
WAV SAMPLE RATE PRECISION.....	31
DIGITAL ASSET TAG	31
RECORDER STATUS/INFO	31
TESTING YOUR CHORUS.....	32
FLASHING STATUS ICONS OR CHECK LED	33
PASSIVE DEPLOYMENT CONSIDERATIONS.....	35
WEATHERPROOFING.....	35
MOUNTING & PLACEMENT	36
EQUALISATION & CALIBRATION.....	37
COLLECTING YOUR RECORDER	38
DOWNLOADING DATA	38
HOW TO DOWNLOAD FROM AN SD CARD	38
FILE NAMES	39
DIAGNOSTIC LOG & SENSOR FILES	39

SOFTWARE	40
ANABAT INSIGHT	40
TOOLBOX within ANABAT INSIGHT	40
Using Toolbox	41
SCHEDULING IN TOOLBOX	42
METADATA	46
TROUBLESHOOTING & FAQs	47
How do I set up the detector for ultrasonic bat recording?	47
How do I set up the recorder for acoustic (audible sound) recording?	47
What is the difference between 'acoustic' and 'ultrasonic' recording?	48
The Chorus is recording huge quantities of ultrasonic files; how can I address this?	48
What is the sample rate, and what is the recommended value?	49
The Check LED on the front keeps flashing.	49
Can I record ultrasonic and acoustic at the same time?	49
What is the difference between monoaural, stereo, dual and simultaneous recordings?	49
What is the difference between constant activation recording and continuous recording mode?	50
There are a lot of echoes in the spectrogram.	51
What is the difference between full spectrum and zero crossing?	51
How far away can an animal be detected using the Chorus?	52
What does microphone frequency response mean?	53
Can I use the Chorus as an active recorder?	53
Can I power the recorder using solar panels or external battery?	53
The files recorded on my Chorus aren't being recognised/processed in a third party app?	53
FIRMWARE RELEASE NOTES	54
FURTHER INFORMATION	55

GETTING STARTED

FEATURES OF THE CHORUS

The Chorus is an easy-to-use, compact, lightweight and customizable recorder, designed for passive monitoring. Some of the key features of the Chorus include:

- Easy to use, weatherproof and robust.
- Includes one acoustic microphone.
- You can add additional microphones to record ultrasonic or stereo acoustic in one deployment.
- Microphones are user-replaceable.
- Records full-spectrum 16-bit WAV files or zero-crossing (ZC) files.
- Lasts for up to 50 nights (full spectrum ultrasonic) or 350 hours (acoustic) on 4 AA batteries*.
- Built-in GPS.
- Stand-alone recorder, no phone apps required for setup.
- Built-in temperature sensor.
- Automatic schedules for easy deployment, or create your own custom schedule.
- Transect mode available.
- Analyse recordings with our free software: Anabat Insight.
- Headphone output to check microphone performance.

*Ultrasonic battery life estimations based on 10% bat activity at 25°C and 10 hour nights recording at 320ksps using 4 alkaline AA batteries. Acoustic battery life estimations based on continuous mono recording at 32ksps using 4 alkaline AA batteries.

GETTING TO KNOW THE CHORUS

The outside of your Chorus case has a lockable latch, multiple mounting points (including a tripod mount), two microphone sockets, a check LED and lanyard with a magnet. Inside the Chorus case is the control panel, battery compartment, SD slot, headphone jack and basic instructions on use.

External Features



Internal Features



Dashboard



The main screen is called the Dashboard. This is where you can see information such as the status of your Chorus, the date and time, temperature, general recording settings and amount of data recorded to the [Recording folder](#) on the SD card.

The four large icons in the middle of the dashboard represent the main aspects of your recorder: the SD Card Menu, GPS Settings, Recording/Schedule Settings, and Device Settings.

You can use the left and right arrow buttons on the front of the Chorus to select one of the icons, then press **OK** button to enter the menu.

In addition, these icons will flash when there is an issue requiring attention. For example, if you don't have an SD card inserted then the SD card icon will flash. Similarly, if you have the wrong types of microphones connected for your sample rate, the microphone icon will flash.

When an icon is flashing, you can see more information about the issues in the status area at the bottom of the dashboard. All issues requiring your attention will be shown there. In the example screenshot below, you can see the "Check mics" warning.



Along the top of the dashboard you'll find the date, time and temperature, as well as indicators for low battery and headphones (if plugged in).

On the left and right sides of the dashboard are VU (Volume Unit) meters that will appear when microphones are connected to the left (A) and right (B) channels respectively. These bars will move up and down in response to the loudness of sounds, so you can see your microphones working. The symbol at the top of the VU meter will indicate what type of microphone is fitted – ultrasonic 📡 or acoustic 🎵. You can also view a full screen Microphone Sensitivity Editor with active VU meter and dBFS readout (for ultrasonic triggered recording) in the [microphone sensitivity](#) settings.

In the bottom left/right corners you'll see little icons referring to the soft keys (buttons below the screen). These change to indicate what pressing the soft keys will do in different menus. On the dashboard menu the left  will eject the SD card (making it safe to remove from the recorder) and the right button  will show the device information screen.

MICROPHONES

The Chorus comes supplied with one acoustic microphone. You have the choice of adding another of our low-profile, user-replaceable acoustic or ultrasonic microphones. Our flexible-gooseneck microphone extender accessory can be used with the ultrasonic microphone to more optimally position the microphone away from surfaces that may produce echoes or interference in the recordings. The Chorus has two channels, so you can customise your microphone setup to record in mono acoustic, mono ultrasonic, dual acoustic and ultrasonic (not simultaneously), or stereo acoustic.

Omnidirectional Acoustic Microphone Specifications

- Includes a replaceable water-resistant windsock.
- Built-in low noise preamplifier.
- High performance weather resistant electret microphone capsule with excellent sensitivity and low noise floor (-24dB sensitivity with 80dB signal-to-noise ratio).
- Frequency response of 20Hz – 20kHz.

Omnidirectional Ultrasonic Microphone Specifications

- Weather resistant (capsule protected by waterproof membrane). Please refer to [Weatherproofing](#) for considerations on using this microphone in rain.
- Low noise floor.
- Built-in low noise preamplifier.
- Improved frequency response when compared to previous generation electret-based ultrasonic microphones.
- Useable frequency response of 10kHz to 140kHz (response rolls-off beyond this point, [see here for more information on frequency response](#)).

POWER REQUIREMENTS

The Chorus is powered by 4 AA batteries. The Low Power Symbol  will appear at the top of the dashboard when the battery voltage is low. The recorder switches itself off when battery voltage becomes too low. If the battery symbol is  or the status message reads Batteries Low you should change the batteries immediately. All AA batteries must be removed from the battery holder immediately after use otherwise the batteries will slowly discharge and may leak, damaging the recorder and voiding warranty.

AA batteries can be alkaline, NiMh rechargeable, or lithium (1.5V). Carbon-zinc batteries are not recommended. Make sure all batteries are fresh and of the same type. Mixing old & new batteries or different types of batteries can cause erratic recorder behaviour and also cause batteries to leak. Battery life will depend on the condition and type of batteries being used, as well as ambient temperature, length of your recording session and amount of bat activity & ambient noise (if using triggered ultrasonic recording). Four high-quality alkaline AA batteries last up to 350 hours of acoustic recording, or up to 50 nights of triggered ultrasonic recording (based on 10% bat activity at 25°C and 10 hour nights). However, in practise recording conditions can vary, so be conservative when using battery life estimates to avoid the loss of sampling time should the batteries run out before you expect. Please refer to the [Weatherproofing](#) section for more details about how temperature can affect battery life.

DATA STORAGE REQUIREMENTS

The recorder can use SDHC and SDXC memory cards. Titley Scientific highly recommends Sandisk® Extreme and Sandisk® Ultra SD cards, these cards have been tested with the Chorus and are recommended due to their reliable performance and low power consumption. Using other brands and models may result in reduced battery life or recorder malfunction and are not recommended. Titley Scientific does not support the use of microSD cards in adaptors, using these may result in data loss/malfunctions. Memory cards can be purchased from Titley Scientific, or most electronics/office stores.

The amount of storage required for a given deployment time depends on the file type used, sample rate, and the amount of ultrasonic sound activity if using triggered activation. All values in the table below are approximate per hour of recorded sound. SD card formatting options and trigger settings may change these estimates. You can estimate the amount of

data to be collected in a survey using the Battery/Data Estimator in [Toolbox within Anabat Insight](#).

Sampling Rate	Mono (p/hr)	Stereo (p/hr)
Full Spectrum 500Ksps	3.4GB	-
Full Spectrum 384Ksps	2.6GB	-
Full Spectrum 320Ksps	2.2GB	-
Full Spectrum 192Ksps	1.3GB	-
Zero Crossing	0.02GB	-
Acoustic 96Ksps	660MB	1.3GB
Acoustic 48Ksps	330MB	660MB
Acoustic 44.1Ksps	303MB	606MB
Acoustic 32Ksps	220MB	440MB
Acoustic 24Ksps	165MB	330MB
Acoustic 22.05Ksps	152MB	303MB

A note on triggered ultrasonic recording

During a typical night of triggered ultrasonic full spectrum recording 1 - 3GB of files per night are recorded. However, if there is a high level of bat activity, wind, or rain the recorder could easily record several gigabytes of files in a single night. Keep this in mind when choosing SD card capacity, or if using the [Noise Filter](#).

USB CONNECTION

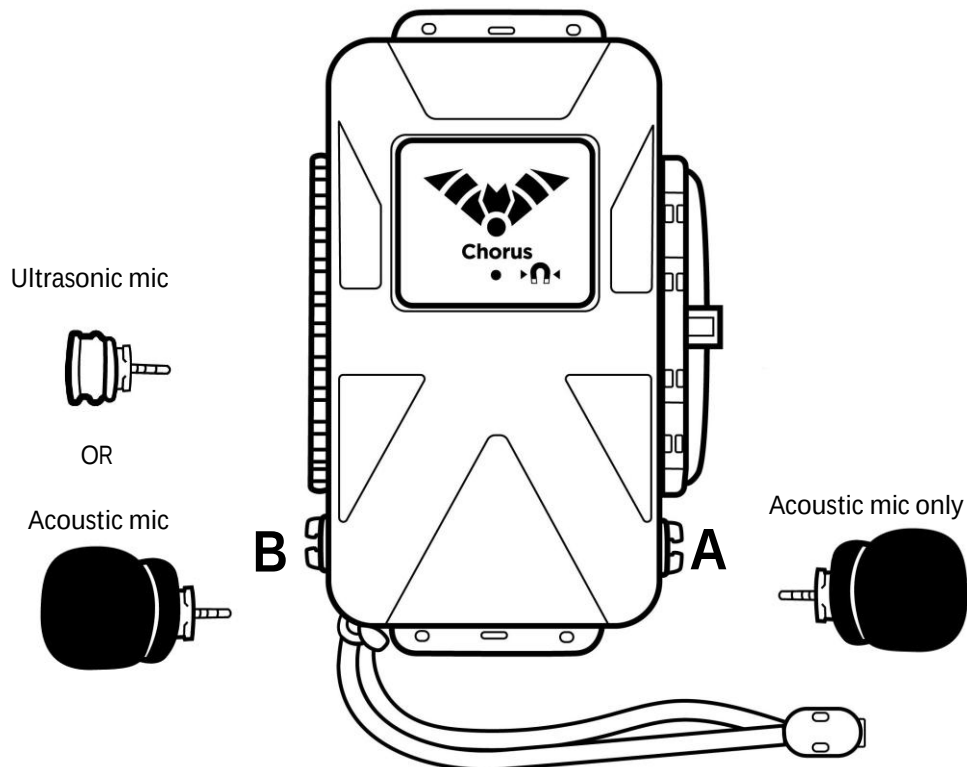
The Chorus can be used with a micro-USB cable (not supplied) for connection to your computer. Ensure you are using a good quality USB cable with a data line (usually thicker than power-only cables). You can use this cable to upgrade the firmware using Anabat Insight (see [Using Toolbox](#)). Firmware updates can also be performed using the SD card. See [Update Firmware](#) for more information. Note that the USB connection cannot be used to download recordings from the Chorus.

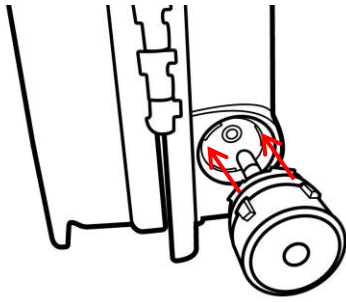
USING THE CHORUS

The Chorus is designed for fast and easy deployment. Before you start recording you must first set your current time zone (see [Time zone](#)). The clock will be automatically set when the GPS obtains a signal. We also highly recommend you check for firmware updates (see [Update Firmware](#)).

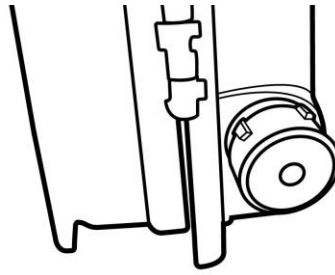
STEP-BY-STEP GUIDE

1. Connect your chosen microphone/s to the appropriate side (see below): acoustic can be on side A (latch) or B (hinge); ultrasonic on side B (hinge) only, refer to the image below. Carefully insert the microphone jack into the microphone socket (with locking tabs in correct alignment) until it clicks into place. Rotate the microphone clockwise an eighth of a turn to lock the microphone in place and make a good seal (see over page for diagram). Do not over-tighten the connector, this will cause damage to the microphone and recorder. It will only rotate 1/8th of a turn before hitting the end-stop. Ensure the dust cap is properly fitted to any unused socket to prevent water ingress. Failing to properly install the microphone or dust cap will void warranty.

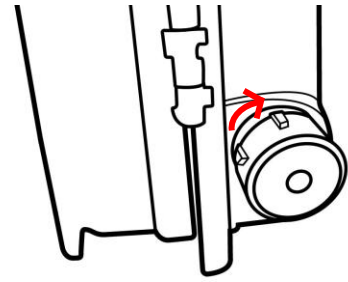




Align jack and locking tabs



Insert microphone until 'click'



Turn 1/8th turn to stop

2. Insert an SD card with sufficient memory for your recording period and fresh batteries. Ensure the SD card is unlocked and correctly orientated as per the diagram on the control panel when inserting. Refer to the [Data Storage Requirements](#) and [Power Requirements](#) above for more information on what SD card and batteries to use.
3. Turn the recorder on by pressing the **OK** button. Check that the clock is correct. If it is not, you may need to adjust the [time zone](#) and/or wait for a GPS fix to re-set the clock.
4. Choose your recording mode with the Mode button. Refer to [Recording Modes](#) for more information on how each of these modes work.
5. Select your microphone settings, choosing the appropriate [file type](#), [sample rate](#) and [trigger settings](#) for your application. Check your microphones are responding by clicking your fingers in front of the microphone/s: [the VU Meter](#) on the side of the screen (matching the microphone) will move to confirm that an audio signal is detected.

Please Note: When using [Schedule Mode](#), the microphone settings are defined when the schedule is created using your computer. In this case you are not able to adjust the microphone settings on the Chorus itself.

6. Wait for the GPS receiver to obtain a location. This normally only takes a couple of minutes but can take longer if there are trees or dense clouds obstructing the signal. Once a GPS fix is obtained, the GPS icon on the screen will stop flashing. The GPS fix will automatically set the clock, record the GPS location and determine the sunset/sunrise times.
7. If an issue requires your attention, the corresponding status icon will be flashing, as well as the Check LED on the outside of the unit. Check the Dashboard status messages for more information regarding the issue (see [Flashing Status Icons](#)).

8. Deploy your recorder. Once the Check LED has stopped flashing, you can lock the lid closed and place the recorder in its final deployment location and secure. Please refer to Passive Deployment Considerations for more information on choosing a site and weatherproofing requirements. You can use the magnet to check the recorder is functional after final deployment (see Testing Your Chorus).

Do not deploy the Chorus if the check led is flashing, recording may not occur.

9. Retrieve your recorder. After the deployment is complete, observe the following precautions when retrieving the recorder:
- If it is wet, dry the unit off before opening it to avoid water entering the unit.
 - Before removing the SD card, ensure the unit is fully powered down or press the on-screen eject button first to avoid data loss or corruption.
 - Remove the batteries before storing the unit. Batteries left in the recorder will leak and damage the unit, voiding warranty.
 - For more information, refer to Collecting Your Recorder.

TURNING THE RECORDER ON/OFF & SLEEP

Turn the recorder on by pressing the **OK** button.

To turn the recorder off, press and hold the **OK** button for 2 seconds, this will open the Off/Sleep menu, then press the **OK** button again. The recorder will shut down and no recording will occur. It is now safe to remove the batteries and SD card.

To send the recorder to sleep, press and hold the **OK** button for 2 seconds, this will open the Off/Sleep menu, then use the right arrow to select Sleep mode **Z^z**, and press the **OK** button again. In sleep mode the screen will be off, but the device will still record. To turn the screen back on, briefly press the **OK** button again. The Chorus will also automatically enter sleep mode to save power if there has been no user interaction for one minute.



Power off



Sleep

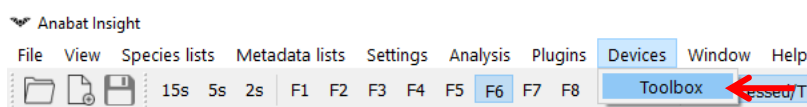
UPDATING FIRMWARE

It is important to keep the firmware on your Chorus up to date to ensure trouble-free operation. The Chorus firmware can be updated through Toolbox using an SD card, or via USB cable to your PC. Ensure you are using a USB cable with a data line (usually thicker than power-only cables). It is highly recommended that you subscribe to receive email alerts of new Chorus firmware updates using this website:

<https://titley.m-pages.com/5KR30x/chorus-firmware-updates-subscription-form>.

To update firmware:

1. Download Anabat Insight from [Titley Scientific](#) (free download).
2. Open Anabat Insight, under the Devices menu, select Toolbox.

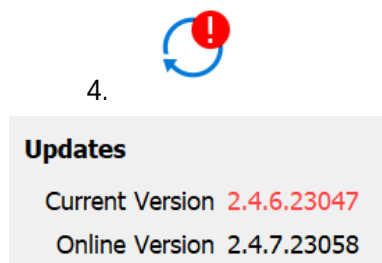


3. Under Selected Recorder, choose Chorus.
4. Click on the Updates tab  on the left of Toolbox.
5. You can update via USB cable or SD card (see instructions below).

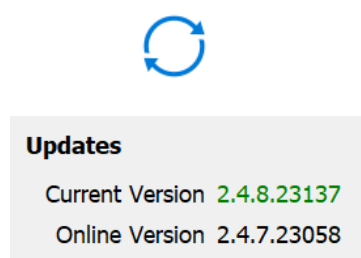
You can update via USB cable or SD card (see instructions below).

To update via USB cable:

1. Connect the Chorus to the computer via a good quality microUSB cable (ensure the cable has a data line – these cables are usually thicker than power-only cables).
2. Turn on by pressing the **OK** button.
3. Toolbox will state the current firmware version and the most recent online version. If the firmware needs to be updated an exclamation point will appear on the update tab (see below) and your current version will be displayed in red.



Update required



Recorder is up to date

4. To update your recorder to the latest firmware, click Apply to Recorder. Update progress is shown with a progress bar in Toolbox, and by Recording Mode LEDs on the recorder flashing sequentially. When all the LEDs are illuminated the update is complete and the Chorus will restart. The update should take around a minute to complete, once complete a message will appear in Toolbox stating “**Firmware update complete**”. If the LEDs flash in a cycling/chasing pattern for more than a few moments, there has been an issue with the update – contact your local distributor for assistance.
5. When the update is finished, unplug the USB cable.

To update via SD card:

1. Insert a blank SD card into the computer. You can use the same SD card to update multiple Chorus recorders.
2. Click Apply to SD to save the most recent firmware to the SD card. Once completed, it will state ‘Update copied’. Do not change the file name on the SD card.
3. Safely eject the SD card from the computer.
4. Insert the SD card and fresh batteries into your Chorus then turn it on. After a few moments a message will appear: Update available. Select ✓ (left soft key) to start the update. Do not remove the batteries or power off the recorder while the update is being installed. If the update message does not appear then the update file wasn’t copied onto the card correctly or the firmware is already up to date.
5. Update progress is shown by Recording Mode LEDs flashing sequentially, when all the LEDs are illuminated the update is complete and the unit will restart. The update may take several minutes. If the LEDs flash in a cycling/chasing pattern for more than a few moments, there has been an issue with the update – try updating via USB cable method above.
6. You can now delete the update.adx file from the SD card or use the card again to update other recorders.

Please note: The Chorus will not update firmware if a low battery warning is displayed.



RECORDING MODES

The recording modes configure the time window that the recorder is “active”. You can choose between 5 different recording modes, outlined below. The LEDs on the inside of the case will indicate which mode is selected, if no LEDs are lit, the recorder is in Inactive Mode and will not record. Inactive mode is useful while configuring your recorder to avoid creating unwanted recordings.

Most modes require a GPS fix on the deployment day, as the recorder automatically calculates the sunset and sunrise times based on the current longitude and latitude.

If the recorder is left on, it will continue to record in the selected mode until the batteries run out or the SD card becomes full. Note that just because the recorder is active, does not necessarily mean that it will be recording; this will depend on how the Activation mode has been configured in the profile settings (refer to triggered or constant activation mode for further explanation).

Continuous Recording Mode

The continuous recording mode will be always active, regardless of the time of day, starting as soon as this mode is selected. No GPS fix is required for this mode, but the Chorus will still attempt a fix to geotag recordings and ensure the clock is accurate.

Night Recording Mode

The night mode is designed for efficient bat survey deployment but may also be suitable for other nocturnal animals. This recording mode will turn the recorder on 30 minutes before sunset and off 30 minutes after sunrise. Night-only mode requires a GPS fix.

Dusk & Dawn Recording Mode

The dusk & dawn mode is designed for peak bird recording times and may be useful for other crepuscular animals. This recording mode will turn the recorder on 90 minutes before sunset and off 90 minutes after sunset, and on again 90 minutes before sunrise and off 90 minutes after sunrise. Dusk & Dawn mode requires a GPS fix.

Day Recording Mode

The day mode is designed for efficient daytime deployment, suitable for diurnal animals such as birds. This recording mode will turn the recorder on 90 minutes before sunrise and off 90 minutes after sunset. Day mode requires a GPS fix.

Schedule Recording Mode

The schedule recording mode allows you to use a custom recording schedule created with the Toolbox in Anabat Insight then imported to your recorder (see SCHEDULES). You can

create schedules based on sunset/sunrise times or on absolute times. You can create multiple tasks to activate different microphones and sample rates at different times. The schedule is imported onto the recorder from the SD card, or via USB cable, and then saved in the internal memory. Schedule mode requires a GPS fix if your schedule is based around sunset and sunrise times. If you select Schedule Recording Mode, the Recording Settings icon on the Dashboard will switch to the Schedule Menu icon.

Please note: You cannot alter your recording settings on the Chorus if you are using Schedule Recording Mode, these need to be changed in the [Schedule tasks in Toolbox](#).

Selecting a Recording Mode

To select the recording mode, press the Mode button to cycle through the modes until the desired mode LED is lit.

A note on the GPS functionality

The recorder will automatically attempt to acquire a GPS fix daily. If a satellite fix cannot be found, the recorder will refer to the last GPS fix made. In this case, the recorder will state 'Fix received ... ago' in the [GPS Settings](#). If you are moving your recorder to a new location, make sure you turn the recorder off and on again at the new location to ensure a correct GPS fix, or enter the [GPS Settings](#) screen to turn the GPS back on.

SD CARD MENU

To check the SD card status or erase the card, use the left/right arrows to navigate to the SD Card Menu  (see below) and press the OK button, use the up/down arrows to navigate the SD Card Menu.



The SD Card Menu will display the card capacity, available space and file system.

Erase SD Card

You can erase your SD card on the recorder, which will also format the SD card with the best configuration for the currently configured recording settings. To do this go to the SD Card Menu, scroll down to 'Erase...' press the OK button to select and it will prompt a warning 'This will erase all data. Are you sure?' to proceed click ✓ (left soft key).

RECORDING SETTINGS

To access the Recording Settings menu, use the left/right arrows to select the microphone symbol  on the dashboard (see over), then press the **OK** button to select. Move to different settings by pressing the up/down arrow keys. To return to the dashboard, press the right soft key  to accept the settings listed.



Please note: If you are in Schedule Recording Mode, you can view the recording settings within the schedule tasks in the Schedule Menu. You cannot alter your recording settings on the Chorus if you are using Schedule Recording Mode, these need to be changed in the Schedule tasks in Toolbox.

GENERAL RECORDING SETTINGS

Reset Settings

You can always reset microphone settings to factory defaults, to do this, use the left/right arrows to navigate to the Recording Settings menu, then press the **OK** button to select. Press the down arrow to navigate to the bottom of the settings menu: **Reset...** Once selected press left soft key  to reset all settings in this particular menu to the factory defaults.

Please note: This will only reset the microphone settings, not general recorder settings such as time zone. To do this, reset the Device Settings.

File Type

You can choose between WAV (full spectrum) or ZC (zero crossing) file types. To change the file type, ensure File Type is selected in the Recording Settings menu, then use the left/right arrow buttons to toggle between types.

Notes on file type

- For ultrasonic recording, you can choose to record using either a full spectrum sample rate (WAV files) or zero crossing sampling (ZC files). ZC requires very little memory compared to WAV, however WAV files contain more acoustic information. A WAV file can be converted to or viewed in ZC after recording (however the reverse is not possible). For more information on the difference between WAV and

ZC files, refer to [What is the difference between full spectrum and zero crossing?](#) in the FAQs.

- Acoustic recording is always in WAV format.
- While recording, the selected file type/sample rate will be indicated by an icon above the corresponding microphone VU meter on the dashboard:  (ultrasonic WAV),  (acoustic WAV), and/or **Zc** (ultrasonic ZC).

Sample Rate

The sample rate will only be available to set in [WAV file types](#). To change the sample rate, ensure Sample Rate is selected in the Recording Settings menu, then use the left/right arrow buttons to change the sample rate.

The recommended sample rate will depend on the type of recordings you would like to make, and which microphone you are using. You can choose between acoustic  sample rates of 96, 48, 44.1, 32, 24, or 22.05ksp/s, and ultrasonic full spectrum  sample rates of 500, 384, 320, or 192ksp/s.

Please note: The Chorus comes with an acoustic microphone, however, to record ultrasonically, you will need to purchase the [Omnidirectional Ultrasonic Microphone](#).

Different recording settings will be available depending on whether you select an ultrasonic or acoustic sample rate.

Notes on sample rate

- The chosen sample rate should be at least double the highest frequency sound of interest (see [FAQs](#) for more information). Note that higher sample rates require more storage space on the SD card, refer to [Power and Data Storage](#).
- While recording, the selected [file type](#)/sample rate will be indicated by an icon above the corresponding microphone VU meter on the dashboard:  (ultrasonic WAV),  (acoustic WAV), and/or **Zc** (ultrasonic ZC).

Microphone

The microphone selection will only be available to change in [acoustic sample rates](#). Ultrasonic sample rates will use the microphone in channel B. If you select [ZC file type](#), the microphone will be locked to channel B.

Acoustic sample rates let you choose between:

- Monaural recording, using the acoustic microphone connected to side A;

- Monaural recording, using the acoustic microphone connected to side B;
- Stereo recording, using acoustic microphones connected on both sides.

To change the microphone channel, ensure Microphones is selected in the Recording Settings menu, then use the left/right arrow buttons to choose the channel/s.

Maximum File Length

The maximum file length represents the maximum length of a file and can be up to 1 hour. When a recording is triggered, the recorder will record files up to the specified length in time before starting a new file. Typically, a file length of 10 seconds is used for ultrasonic recording and 1 hour is used for acoustic recording.

Filename Prefix

You can choose a file prefix to be added to all files recorded or have no file prefix. To change the filename prefix, ensure Filename Prefix is selected in the Recording Settings menu, then use the left/right arrow buttons to toggle between the following options over the page:

- None – No prefix will be added.
- Type – The recording type associated with your chosen file type and sample rate will be added ("US" – Ultrasonic full spectrum, "AS" – Acoustic full spectrum, and "ZC" – Ultrasonic zero crossing).
- Serial number – The Chorus serial number will be used.
- Nickname – The nickname assigned in the Asset ID will be used.
- Asset ID – The Asset ID number will be used.

ACOUSTIC RECORDING SETTINGS

Gain

Gain changes the amplitude of the recorded microphone signal. You can adjust the gain of each of the two acoustic microphones independently, in increments of 3dB up to +15dB. Use the up/down arrow buttons to select Gain for each microphone channel and then use the left/ right arrow buttons to choose the gain that you want; a higher dB represents an increased amplitude.

A higher gain setting will pick up more sounds, but the recording will become distorted when there are loud noises. Typically, 12dB is the recommended setting.

Handy tip: When using two acoustic microphones, you can set one channel to a low gain and the other to a high gain to record both loud and quiet sounds with good quality. Otherwise, for normal stereo recording, make sure the gain settings for side A and B are equal.

ULTRASONIC RECORDING SETTINGS

Activation Mode (Triggered or Constant Recording)

This setting lets you choose how the Chorus behaves when it is “active” e.g. in Day mode, your Chorus is “active” during the daylight hours. Whether or not it is actually recording sound during the “active” period depends on the Activation setting. You can choose from either Constant, or Trigger. If you choose Constant, your Chorus is always recording whenever it is active. If you choose Trigger, then your Chorus is waiting for certain sounds before it will record to the card (see Trigger Settings listed below: sensitivity, minimum & maximum frequency etc.). Trigger is only available for ultrasonic recordings (ZC, or full spectrum WAV). Acoustic recordings are always Constant. For more information, [see the FAQs](#).

The triggered activation mode will record all sound for a set amount of time (usually a few seconds) every time it is triggered when active (based on recording mode selected: Night, Dusk & Dawn, Day, Continuous, or Schedule). The trigger is dependent on the trigger settings, such as [Sensitivity](#) and [Minimum Frequency](#) amongst others. Triggered activation mode is most often used for ultrasonic bat recording.

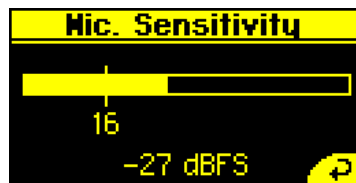
The constant activation mode will record all sound constantly (without triggers) in whichever recording mode is selected (Night, Dusk & Dawn, Day, Continuous, or Schedule). Constant activation mode is most often used in acoustic recording and soundscapes. If using this mode at ultrasonic sample rates, you require a large SD card with fast writing speed, minimum of Class 4.

To change the activation mode, use the up/down arrow buttons to select Activation, then use the left/right arrow buttons to choose between Trigger or Constant.

Microphone Sensitivity (Triggered Activation Only)

This lets you control how loud the sound must be to trigger a recording. To trigger on quieter noises, increase the sensitivity setting (higher numbers are more sensitive). To trigger only on louder noises, reduce the sensitivity. The ambient noise level when deploying may be different to when your Chorus will be recording, and this should be kept

in mind when setting the sensitivity. Use the up/down arrow buttons to navigate to Mic. Sensitivity, pressing the left/right arrows will change the sensitivity. You can also press the **OK** button to bring up a full screen Microphone Sensitivity Editor, you can then use the left/ right arrow buttons to choose the sensitivity that you want relative to ambient noise on the VU meter. Default is 16 and is suitable for most purposes. The screen also includes a dBFS measurement of the incoming signal amplitude, refer to the section on [calibration/equalisation](#) for more information on how this can be used.



Minimum Trigger Frequency (Triggered Activation Only)

This is the minimum frequency that will trigger a recording. Any sound below this will not trigger a recording but may be recorded after a trigger occurs. A recommended minimum frequency is the lowest echolocation frequency you expect to record. To change this, use the up/down arrow buttons to select the Min. Trigger Freq., then use the left/right arrow buttons to change the frequency. The default value is 10 kHz.

Maximum Trigger Frequency (Triggered Activation Only)

This is the maximum frequency that will trigger a recording. Any sound above this will not trigger a recording but may be recorded after a trigger occurs. A recommended maximum frequency is the highest echolocation frequency you expect to record. To change this, use the up/down arrow buttons to select the Max. Trigger Freq., then use the left/right arrow buttons to change the frequency. The default value is 250 kHz. It is generally not necessary to adjust this setting unless you would like to exclude triggering on higher frequencies.

Minimum Event (Triggered Activation Only)

This is the minimum duration sound that will trigger a recording. You can set this to the minimum duration sound (e.g. bat pulse) to be recorded. To change this, use the up/down arrow buttons to select the Min. Event, then use the left/right arrow buttons to change the time. The default minimum event time is 2ms and is suitable for most situations.

Minimum Recording Time (Triggered Activation Only)

This is the minimum amount of time recording will continue after a trigger event. Set this to be longer than the shortest time between target sounds (e.g. bat pulses) you want to record. This will prevent an animal call (e.g. bat pass) being broken up into multiple files. If a file reaches the maximum length specified in the [Maximum File Time](#) it will be ended, and a

new file started. To change this, use the up/down arrow buttons to select the Min. Record Time, then use the left/right arrow buttons to change the time. The default minimum recording time is 2s.

10k High Pass Filter (Ultrasonic Recording Only)

This filter is a high pass filter that attenuates signals below 10 kHz. In typical bat recording situations, enabling this filter will reduce the number of noise files recorded and extend battery life. It is recommended to have the filter On unless intending to record sounds under 10KHz. To change this, use the up/down arrow buttons to select the 10k HP Filter, then use the left/right arrow buttons to choose between On and Off.

Frequency Division Ratio (ZC File Type Only)

The division ratio affects the amount of data which is saved in Zero Crossing recordings, the lower the division ratio, the greater the number of data points in the resulting sonogram. To change this, use the up/down arrow buttons to select the Freq. Div. Ratio, then use the left/right arrow buttons to change the ratio. Typically, a division ratio of 8 is appropriate for most situations. A division ratio of 16 will save SD card space at the expense of recording resolution.

Noise Filter (Triggered Activation Only))

There is an on-recorder noise filter available for ultrasonic triggered recording which determines the difference between structured and unstructured sounds. When enabled, it will direct recordings that contain structured sounds (i.e. bat calls) into the Recordings folder, and recordings without discernible structure will be directed to a Noise folder. The file count displayed on the Dashboard will only include files in the Recording folder. The algorithm produces results similar to the 'All Bats' filter in Anabat Insight; results will not match exactly.

Please note: No filtering option is ever perfect, there will always be cases where bat calls may be assigned as 'Noise' and noise will be deemed 'bat calls'. For this reason, we strongly recommend you test the function of the noise filter at the deployment site first to ensure it is separating bats from noise adequately in your target environment.

You can elect to Keep or Overwrite the noise files. If Keep is selected the Noise folder will be retained. When Overwrite is selected, if the SD card memory space falls below 5%, all the files in the noise folder will be deleted. This process will be repeated until there is 'bat call' recordings filling 95% of the card, after which point any file deemed to be noise will be automatically deleted. If you have two memory cards in use, it will follow this process for the

first card, and then the second card (ie. it will not wait until 5% remains on both cards before deleting the noise files).

To toggle between noise filter options, use the ◀ ▶ arrows on either side of Noise Filter.

Please note: As the Overwrite option may result in data loss (if memory space drops below 5%) we do not recommend you select it unless you anticipate a noisy environment (e.g. lots of rain, insects, wind etc.) and/or your storage space is limited; and you have tested the efficacy in your target environment or site. We do not recommend the use of Overwrite for zero crossing recordings as most memory cards should be sufficient for this recording format.

SCHEDULES

The Schedule Menu will replace the Recording Settings menu when you have selected Schedule Recording Mode. You must first create a schedule with Toolbox in Anabat Insight and import this onto your recorder. There are options to view schedules which have already been imported, Import Schedules from SD card, and Export Schedules to an SD card.

IMPORTING SCHEDULES

Once you have created a schedule, you can import it onto the recorder via SD card or USB.

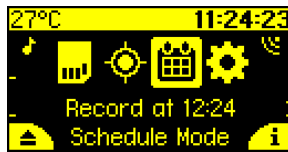
Import via SD Card

Once you have exported your schedule/s onto the SD card in Anabat Insight you can import them into the Chorus internal memory.

Please note: Any new schedules created will only be supported by recorders running firmware 3.1 or newer. Ensure your recorder is running the latest firmware before importing the schedule.

1. Insert the SD card with the schedule.json saved on it.
2. Turn the recorder on using the **OK** button, then select schedule recording mode using the Mode button. The microphone icon will change to the schedule menu icon as shown over page. You will automatically be prompted 'Would you like to

import the schedule from the card?'. Press the left soft key ✓ to import. This will overwrite the current schedule saved on the Chorus.



3. If you are not prompted, select the Schedule Menu using the left and right arrow keys and press OK.
4. Press the left soft key to open the ≡ menu.
5. Use the up/down arrow buttons to select [↩ Import, then press the OK button. It will state 'Successfully imported X tasks.', press the right soft key ↩ to return to the Schedule Menu.

You can use the SD card to update multiple recorders. You can then delete the schedule file from the SD card using the Erase function on your Chorus, or on your computer.

Import via USB cable

You can also apply a schedule directly to your recorder via USB cable in Toolbox in Anabat Insight.

1. Create the schedule in Toolbox.
2. Connect your Chorus to your computer via USB cable. Ensure you are using a USB cable with a data line (usually thicker than power-only cables).
3. Click the Apply button beneath the Scheduler task window. A pop-up window will state 'Schedule successfully applied to device', then click OK.

VIEWING SCHEDULES

To view the schedule(s) saved on your Chorus:

1. Use the left/right arrow buttons to select the Schedule Menu on the dashboard and press OK.
2. Your schedule tasks will be listed in order of priority. To view a task, use the up/down arrows to navigate to it, then press the OK button.

3. It will display the schedule name date range, days of week, hours recording, the sample rate and the microphone channel side. Pressing the up/down arrows in this view will change between schedule tasks if there are more than one.
4. Press the right soft key  to return to the dashboard.

Please note: You cannot alter your schedule task settings on the Chorus.

EXPORTING SCHEDULES

If you have a schedule already saved on your Chorus recorder, you can export it to an SD card to apply it to other recorders or load it into Toolbox in Anabat Insight to edit it.

Export onto SD Card

To export a schedule onto the SD card:

1. Turn the recorder on using the  button, then select schedule recording mode using the Mode button. The microphone icon will change to the schedule menu icon.
2. Select the Schedule icon on the dashboard using the left and right arrow keys and press .
3. Press the left soft key to open the  menu.
4. Use the up/down arrow buttons to select  Export, then press the  button. It will state 'Schedule successfully exported.', press the right soft key  to return to the Schedule Menu.

Load into Toolbox

You can also load a schedule directly into Toolbox in Anabat Insight via USB cable.

Please note: When you load the schedule into Toolbox, it will overwrite any schedules currently displayed in the scheduler window. Ensure you have saved any schedules you wish to retain before loading from your recorder.

1. Connect your Chorus to your computer via USB cable. Ensure you are using a USB cable with a data line (usually thicker than power-only cables).
2. Open Toolbox in Anabat Insight and click on the Schedule tab.

3. Click the Load button beneath the Scheduler task window. The schedule tasks from your Chorus will be displayed and available to edit or export to SD card or other Chorus recorders.

GPS SETTINGS

The Chorus attempts a GPS fix once the recorder is turned on, and whenever it is in the GPS Settings menu. If left on/sleeping, it will attempt a GPS fix every 24 hours. When the recorder is attempting a fix, it will try for up to 10 minutes. If it is unable to acquire a GPS fix, it will use the last known location. If it has never had a GPS fix (e.g. brand new recorder or clock battery just been replaced) and it is unable to get a fix, it will assume that 7am and 7pm are sunrise and sunset respectively.

Please note: You can set a GPS location override for instances where your recorder will not be able to get a fix (eg. cave, culvert, dense forest), for more information, see [Schedules](#).

To access the GPS Settings menu, use the left/right arrows to select the GPS icon  on the dashboard (see below), then press the **OK** button to select.



The following information will be displayed (use the up/down arrows to navigate the menu):

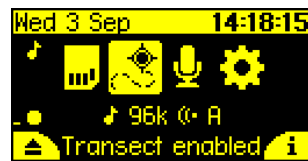
- GPS location;
- When the last GPS fix was received;
- Sunrise and sunset times;
- [Transect Mode](#);
- [Refresh Location](#).

To exit the GPS Settings menu, use the right soft key  to return to the dashboard.

TRANSECT MODE

Transect mode will use the built-in GPS to save your track as a GPX file by logging GPS points once per second. To turn on transect mode, use the up/down arrow buttons to select

Transect Mode, then use the left/right arrow buttons to choose between On and Off. Note that using transect mode will approximately halve the battery life. While in transect mode, the GPS icon on the dashboard will change as shown below.



Please note: Transect mode is automatically disabled when the Chorus is turned off & on again to prevent accidental battery drain. If you intend to undertake a transect, please ensure to enable transect mode each time you turn on the Chorus.

REFRESH LOCATION

To refresh the GPS location, use the up/down arrow buttons to select Refresh Location. A warning message will appear 'Forget current location and find a new one?', use the left soft key to select ✓.

DEVICE SETTINGS

To enter the Device Settings menu, use the left and right ◀ ▶ arrow keys to select the settings icon and press OK.



Then press the down or up arrow to navigate to the desired setting. To exit the Device Settings menu, use the right soft key ↶ to return to the dashboard.

Reset Settings

You can always reset device settings to factory defaults, to do this, use the left/right arrows to navigate to the Device Settings menu, then press the OK button to select. Press the down arrow to navigate to the bottom of the settings menu: **Reset...** Once selected press left soft key ✓ to reset all settings in this particular menu to the factory defaults.

Please note: This will only reset the device settings, such as time zone and sensor logging, not microphone settings such as sensitivity. To do this, [reset the Recording Settings](#).

CHANGE LANGUAGE

You can choose between a number of languages displayed on the Chorus. Currently we support English, Deutsch, Español, Français, and Polski more may become available.

To change the language, use the down arrow button to scroll down to Language, then use the left/right arrows to toggle between the languages. Press the right soft key ✓ to enable the language selection, you will also need to restart the recorder by pressing the ✓ (left soft key) to finish changing the language.

TIME ZONE

Your time zone relative to Greenwich Mean Time (GMT) will be shown. Use the left/right arrows to change to the desired time zone. Press the right soft key ✓ to activate the selected time zone. Remember to account for any daylight savings time that may be in effect.

LOG START TIME

By default, log files will start at midnight, you can choose to change this to midday by pressing the right soft key **i** on the dashboard. Use the down arrow button to scroll down to Log start time, then use the left/right arrows to toggle between midnight 00:00 or midday 12:00. Press the right soft key ✓ to enable your selection.

SENSOR LOGGING

Logging of sensor data (temperature, battery voltage) can occur whilst the recorder is active or all the time. This data is saved to the sensor log file. Use the ◀ ▶ arrows on either side of the Sensor Logging to toggle between While Active and Always. Note that when set to Always the power consumption will be increased, resulting in slightly reduced battery life.

SENSOR LOGGING FREQUENCY

The sensor log frequency sets how often the Chorus checks and logs the sensor data. Use the ◀ ▶ arrows on either side of the Sensor Log Freq. to toggle between 10, 15, 20, 30, and 60 minutes.

WAV SAMPLE RATE PRECISION

This setting determines how the sample rate is specified in the metadata of WAV files. Choose 'Standard' for better compatibility with third-party analysis software, or 'Precise' for more accurate metrics in Insight. Use the ◀ ▶ arrows on either side of the WAV Sample Rate to toggle between Standard and Precise.

Standard will set the sample rate reported in the WAV file to the identical number chosen in the sample rate settings. Precise will report the exact sample rate used by the hardware in the WAV file for maximum analytical accuracy (e.g. 44.101ksps instead of 44.1ksps), but some third-party applications may not support these WAV files correctly. Standard is the default and is recommended for most applications.

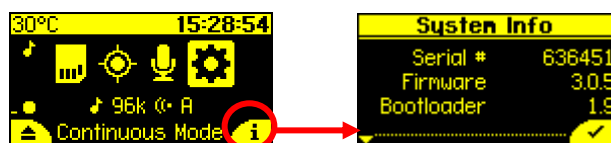
DIGITAL ASSET TAG

You can add a digital asset tag to your recorder which will save asset information in the metadata of all files recorded. This can include company name, device nickname, company contact, company address and asset ID. If you would like to add an asset tag, this can be done using [Toolbox](#) with your recorder connected via USB.

Please note: The device nickname is limited to 10 characters.

RECORDER STATUS/INFO

To see the recorder status and other information, press the right soft key **i** on the dashboard.



This will display:

- Recorder serial number
- Firmware version
- Bootloader version
- Main battery (AA) voltage, around 6V indicates fresh batteries
- Clock battery voltage, this should be around 3V
- Current temperature (°C/°F)
- About (QR code to www.titley-scientific.com)
- Regulatory information
- Diagnostic information (for factory use)

TESTING YOUR CHORUS

There are a number of ways to test the recorder:

1. To test the microphone/s before deployment, open the case, wake the recorder and rub/click your fingers in front of the microphone; the VU Meter (on the side of the screen relative to the microphone) will move up/down to confirm that an audio signal is being detected. The symbol at the top of the VU meter will indicate what type of microphone is fitted: ultrasonic 🦇 or acoustic 🎵.



2. To listen to the microphone signal, open the case and plug in your headphones. Wake the recorder by pressing the power button. To check an ultrasonic microphone, rub your fingers in front of the microphone, you should be able to hear the ultrasonic audio signal in frequency division in both ears. When checking acoustic microphone/s you will hear an audio reproduction in the left and/or right ears (either mono or stereo depending on the number of acoustic microphones). The amplitude of the acoustic audio will depend on the gain chosen in the microphone settings.

- To test the operation of the recorder while the case is closed, after deployment, place the magnet (at end of lanyard) on the magnet symbol  on front of the case; a continuous lid LED light indicates unit is working.

We also recommend you have any microphones serviced by your Titley Scientific distributor once yearly to ensure they are operating as expected.

FLASHING STATUS ICONS OR CHECK LED

If one or more status icons on the dashboard, or the Check LED (on the front), are flashing, this means that there is an issue with the recorder affecting deployment. The issue will be displayed as a status message at the bottom of the dashboard. If there are multiple issues, it will scroll through each message in the status message.

SD Card 	
Insert SD Card	There are no useable SD cards available to store recordings. Insert a blank, correctly formatted SD card before deployment.
Checking Card	The SD card is being read, wait a moment.
Storage Low	There is less than 50% of the SD card memory space left.
Card Full	SD card memory is full, eject the SD card and replace it.
Card Locked	The SD card is locked and cannot be written to, remove the card and unlock the write protection switch lock.
Bad SD Card	An SD card is unreadable. Either replace the card, or attempt to reformat the card.
Slow Card	An SD card is formatted with a slow file system or very small cluster size. Format the card before deployment.
GPS 	
No GPS fix	Your chosen recording mode requires a GPS fix but one has not yet been obtained. For optimum GPS reception, place the recorder in an area with clear sky views, with the case closed and the Chorus logo facing skywards. Enter the GPS Information screen to reactivate the GPS and monitor progress. It may take several minutes to acquire a fix.
Stale GPS fix	The last GPS fix was more than 24 hours ago. A new fix will be attempted. If the Chorus cannot secure a new fix, it will revert to the last known location .
Lost GPS fix	The recorder is in transect mode and the GPS fix has been lost.
Transect Enabled	Transect mode is currently in operation and using the GPS.
Clock not set	The system clock is not set. Get a new GPS fix in clear view of the sky to set the time.

Microphone 	
Check Mics	One or more microphones needed during the deployment are not connected. Resolve by connecting either <u>an acoustic or ultrasonic microphone (as needed)</u> , or change the <u>Recording Settings</u> to match the microphone attached.
Settings 	
Time Zone Not Set	Time zone is unknown; the time will not be correct until the offset from GMT (your time zone) is set. <u>Enter the time zone</u> .
Check Time Zone	The current time zone is a guess based on GPS location. Please <u>check that it is correct</u> .
Other	
Inactive Mode	Chorus is in Inactive Mode, no recording will occur. Choose a <u>Recording Mode</u> before deployment.
No Schedule	You have selected scheduled recording mode, but there is no schedule to follow. Resolve by <u>creating a schedule</u> or <u>change recording modes</u> before deployment
Expired Schedule	Schedule mode is selected but all the programmed tasks have finished and there are no future tasks. Update or replace the schedule accordingly.
No work to do	There are no schedule tasks, or you are in Inactive mode. <u>Change recording modes</u> or <u>create a schedule</u> before deployment.
Batteries Low	The main batteries are low, replace the batteries before starting recording.
Clock Battery Low	The CR2032 Coin Cell battery is missing or low, replace the clock battery. Leave AA batteries installed while replacing the battery to avoid losing settings.

Points to note when connecting the microphone or troubleshooting a “Check Microphone” error message:

- If you plan to record stereo acoustic files, ensure you have two acoustic microphones connected.
- Ensure the microphones are connected on the correct side(s). Acoustic microphones can be connected to either side, whereas the ultrasonic microphone must be connected to side B.
- Ensure you have the ultrasonic microphone connected when using ultrasonic recording (don’t accidentally leave an acoustic microphone connected on side B, or vice-versa).
- Your recording settings must match your installed microphone configuration. Make sure your chosen sample rate, file type and microphone channel are correct.



Ultrasonic mic



Acoustic mic

PASSIVE DEPLOYMENT CONSIDERATIONS

WEATHERPROOFING

The Chorus is designed as a weatherproof recorder, which means the recorder can be left in the field during rain, sunshine and snow without any additional weatherproofing. However, if the recorder is left in the rain, please consider the following advice:

1. The recorder is only weatherproof when the case is closed; do not open the case in the rain. Be careful not to get dirt or other contamination in the rubber seal around case, as this can allow the ingress of water into the recorder.
2. Mount the recorder so the microphone/s are pointing horizontally to prevent water droplets hitting the microphone element. Such water droplets generate large amounts of noise and can block ultrasound signals from reaching the microphone until they dry out. This needs to be considered when you are analysing your data. Sensitivity can be reduced by inclement weather. Do not let heavy rain land directly onto the face of the ultrasonic microphone. The impact force of the raindrops can permanently damage the sensitive element, reducing its sensitivity.
3. If recording is required during rain the microphone should be mounted in such a way so that water cannot land on the microphone element.
4. Dry off the case and microphone before opening the recorder or removing the microphones. This prevents moisture from entering the recorder.
5. The recorder should not be partially or fully submerged in water.
6. Desiccant sachets can be added inside the case to prevent condensation; these will need to be periodically replaced or dried in an oven.

Windy, dry conditions can result in electrostatic build-up which may damage the microphone. The movement of wind over an un-grounded object can build-up an electrical charge. Ultimately, the charge will discharge along a metal conductor, such as the metal in the microphone cable. This will result in a spark which could damage the microphone or recorder. Also be aware that mounting your microphone or recorder on a tall mast may attract lightning.

To minimise the chance of electrostatic damage,

1. Isolate the recorder from ground, i.e. operate it from internal batteries or make sure the external power supply doesn't have a path to ground.
2. In dry conditions avoid mounting microphones on tall non-conductive masts (inc. fibreglass and nylon), wood or metal masts are preferable.

3. Ground the microphone, either by making sure it is clamped to a properly grounded metal surface directly (metal to metal contact), or by attaching an earth wire to the body of the microphone (e.g. with a hose clamp) and then connect that wire to a grounded surface (e.g. metal mast or ground stake).

Mounting the recorder and microphone this way will give electricity from static build-up or lightning an alternative path to ground.

The recorder operates in a wide range of temperatures; however, the batteries you use will have temperature limits; these should be considered. Most Alkaline and Lithium batteries are recommended for use between -18°C to 55°C; and -20°C to 60°C respectively. Please note that in cold temperatures battery capacity (and therefore recorder run time) will be reduced. The capacity of alkaline batteries is significantly reduced in cold conditions and in these circumstances, it is recommended to use FR6 1.5V Lithium non-rechargeable LiFeS₂ batteries (eg. Energizer™ Ultimate Lithium) instead. Also be aware that if your recorder is left in direct sunlight, especially inside a vehicle, the temperature inside the case may be much higher than ambient temperature and can potentially damage batteries, causing them to leak.

MOUNTING & PLACEMENT

The placement of any recorder can have a significant effect on the results of a survey. It is important to consider the location and height of the recorder. The best signals will be obtained when the microphone is in the open away from other objects and pointing in the direction of the animal emitting vocalisations.

For bat surveys, recorders are typically placed in or beside a 'flyway', a corridor where bats will fly through or beside vegetation. You can place your recorder anywhere bats will fly, depending on your survey goals or target species. Avoid placing the recorder inside dense vegetation where bats cannot fly. Avoid having vegetation or other objects between the recorder and the bat's expected flight path, or close beside the recorder, as echoes will also be recorded. Also consider insect noise when choosing a location, insects close to the recorder can generate a lot of unwanted noise files.

We recommend that the Chorus is mounted vertically (refer to the section on weatherproofing) so that any rainwater runs off the microphone/s and doesn't settle on the element/s. Also make sure that the magnetic lanyard or the recorder itself is not being blown around in the wind as this may create unwanted noise on your recordings. It is also

important to avoid surface noise, such as vegetation brushing against the recorder case or microphone.

You can also purchase a gooseneck microphone extender, which we recommend for mounting the ultrasonic microphone, so it can be directed away from flat reflective surfaces.

The Chorus case is designed so that the recorder can be padlocked closed. A lockable metal security box is also available for purchase from Titley Scientific.

EQUALISATION & CALIBRATION

In some situations where multiple recorders are deployed, it may be a requirement to ensure all the recorders are equalized to the same trigger sensitivity. This is important whenever quantitative comparisons of acoustic activity will be made. Levels of sensitivity will vary among recorders and microphones due to differences in age, wear and so on.

Ultrasonic

For ultrasonic recording, calibration can be performed using a reference signal generator, commonly referred to as a chirper, which emits a stable ultrasonic tone at a known frequency and amplitude. When the Chorus is set to ultrasonic recording with triggered activation, the Microphone Sensitivity Editor screen displays a dBFS (decibels relative to full scale) measurement from microphone channel B. A value of 0 dBFS represents the maximum recordable signal level; all other signals will register as negative values.

To test a microphone effectively:

- Position the chirper at a fixed, repeatable distance and angle from the microphone.
- Observe the dBFS reading once it stabilises you can compare it to a known reference value (e.g. a brand new microphone) operating within acceptable limits.
- Ensure environmental conditions (e.g. temperature, humidity) and setup geometry are consistent across devices and tests to minimize variability.
- If required, adjust the trigger sensitivity to account for any slight variations in microphone performance between devices.

Even small changes in chirper placement or orientation can significantly affect the measured signal, so precise control of the test setup is critical.

Acoustic

For acoustic microphones (channels A and B), calibration is typically performed using a sound level calibrator that emits a 1kHz tone at a standardized sound pressure level - usually

94 dB SPL. Whilst the Chorus does not provide a dBFS readout for acoustic channels, you can:

- Observe the VU meter response on the dashboard to verify signal detection and amplitude;
- Record a .wav file and analyse its amplitude using audio software to assess consistency across devices.

Please note that the coupling of the acoustic calibrator to the microphone is critical and the windsock should be removed for this testing.

COLLECTING YOUR RECORDER

Best practice is to take the recorder to a clean, dry place out of the weather. Then dry it off as best as possible if it is wet. If the unit is taken inside, there could be a large temperature difference, let it equilibrate to room temperature before opening the case. A cold recorder opened in a warmer place will often result in a film of water condensing over the electronics. Make sure the inside of the case is completely dry before closing the lid.

To turn the recorder off, open the case, press the **OK** button to bring up the Sleep/Off menu, continue holding the button until the unit shuts down or release then then press the **OK** button again to shut down immediately. If the recorder does not respond to the power button the batteries may have gone flat. Remove the SD card to download the data to your computer. Remove AA batteries for long storage periods. Do not remove the SD card without first turning off the recorder or pressing the on screen eject **▲** button otherwise the SD card data could be corrupted or lost.

DOWNLOADING DATA

HOW TO DOWNLOAD FROM AN SD CARD

Once you have recorded the files onto the SD card, you can simply transfer the files from the SD card onto your computer or an external memory source. These files can be opened with Anabat Insight or other sound analysis software packages.

1. To begin, remove the SD card from the recorder after shutting it down or pressing the on screen eject button. Failure to follow this procedure could result in data loss or corruption.

2. Insert the SD card into your computer (if it has a SD card slot) or into an external SD card reader (available from Titley Scientific).
3. Open the SD card folder in Windows Explorer.
4. Copy/cut the files from the SD card folder into the desired folder/storage device. Make sure to include the log file with the recording files. Files will be arranged on the card in folders as follows:
 - Recordings: This folder contains recordings grouped into subfolders based on the recording settings or schedule.
 - Noise: This folder will only be created if the Noise Filter is turned on. It will contain files deemed to be 'noise'.
 - Log: This folder contains the log and sensor files for the deployment. This should be kept in case future troubleshooting is required.
 - GPS: This folder contains the transect GPX files (if created).

FILE NAMES

Log and sensor files are stored as CSV files, with extension of .csv. Files are recorded as either full spectrum, with the extension of .wav, or zero crossing, with extension of .zc. Both file types can be opened/viewed directly in the free version of Anabat Insight. The full spectrum files can be opened in any software that accepts .wav files.

File names include the date and time of the recording beginning: YEAR-MM-DD_HH-MM-SS.filetype for example 2021-03-15_19-42-07.wav was a full spectrum file recorded on 15th March 2021 at 7:42:07pm. You can also elect to add a file prefix to your file names.

DIAGNOSTIC LOG & SENSOR FILES

The diagnostic log files contain all the information about the recording sessions on the SD card. Information such as recorder settings, time zone, GPS locations, files recorded, and user interactions can be viewed in these files. Each log file is a .csv which can be opened in Excel.

The recorder will also create sensor files that contain the temperature and battery voltage. Each sensor file is a .csv which can be opened in Excel. For more information see Sensor Logging.

SOFTWARE

ANABAT INSIGHT

Anabat Insight is the free software you can use to view and analyse zero crossing and full spectrum recordings from your Titley Scientific recorders. You can open/view .zc and .wav files in Anabat Insight. The program offers the following features:

- View your files in full spectrum & zero crossing
- Use filters and scans to optimize your bat call analysis
- Display metrics for passes and individual bat pulses
- View & customize metadata
- Generate reports to present your analysis results
- Use built-in mapping to view your tracks & waypoints
- Export mapping data to GIS programs
- Listen to and view spectrograms of stereo and mono acoustic recordings.
- Create custom recording schedules to be used on the Chorus

Anabat Insight is available to download for free at the Titley Scientific website (www.titley-scientific.com). We are regularly updating Anabat Insight software to improve its functionality and capabilities, so please ensure that you are using the latest version.

TOOLBOX within ANABAT INSIGHT

Toolbox is available within Anabat Insight and can be used for the following:

- Update the firmware
- Check the serial number and firmware version of your Chorus
- Set the clock/time zone
- Create an asset ID tag
- Change the recording settings
- Choose your recording mode
- Set a schedule
- Estimate the battery life
- View the data and log files on the SD Card
- View the GPS locations on Google maps

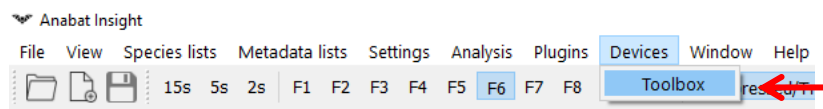
For instructions on how to use Toolbox with your recorder, see the [Anabat Insight User Manual on our website](#).

Using Toolbox

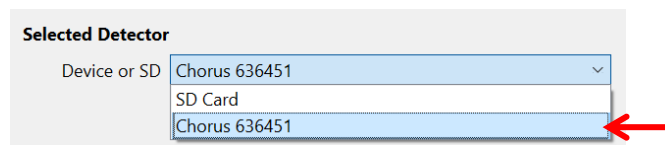
To use Toolbox with your Chorus, you will either need an SD card, or to connect the recorder via USB to your computer. Ensure you are using a USB cable with a data line (usually thicker than power-only cables). For certain functions (eg. setting the clock or checking the firmware version), you need to connect to the PC.

To connect the Chorus to a PC:

1. Download and install Anabat Insight from <https://www.titley-scientific.com/anabat-insight.html>
2. Turn on your recorder and connect the USB cable from the recorder to the PC. Ensure you are using a USB cable with a data line (usually thicker than power-only cables).
3. Open Anabat Insight, under the Devices menu, select Toolbox.

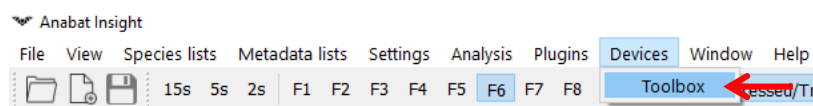


4. Your Chorus should automatically be detected; it may take several moments to load when you first connect your Chorus while the drivers are setup.

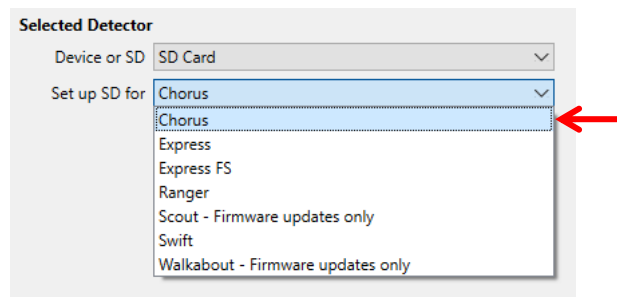


To set up an SD card for Chorus:

1. Download and install Anabat Insight from www.titley-scientific.com
2. Insert a blank SD card into your computer.
3. Open Anabat Insight, under the Devices menu, select Toolbox.



4. Under Device or SD, select SD card from the dropdown menu.
5. Under Setup SD for, select Chorus from the dropdown menu (see over).



SCHEDULING IN TOOLBOX

To create a schedule, you will need to use Toolbox. For instructions on how to do this, see the [Anabat Insight User Manual on our website](#). You can create schedules with multiple tasks, each with their own unique settings from the options below:

Task Name – Choose the name for the scheduled task.
Task Colour – Choose the colour for the scheduled task (only displayed in Anabat Insight).
Deployment Location – Set your deployment location to set sunrise/sunset times.
GPS Override – Will set the GPS location (inc. sunrise/sunset times on the recorder, regardless of GPS fix recorder receives. Ideal for caves or dense forest with unreliable GPS fixes.
Date Range – The start and end date for recording.
Days to Record – Which days of the week to record.
Times – What times of day to record (set times or relative to sunset or sunrise).
Duty Cycle – Turn on/off duty cycling (record on for set period then off for set period).
Microphones – Choose the microphone channel.
Sample Rate – The sample rate the recorder will use for this task.
Gain A – Set the gain for the acoustic microphone on <u>Side A</u> .
Gain B – Set the gain for the acoustic microphone on <u>Side B</u> .
Max. File Duration – Maximum file time.
File Name Prefix – Set the prefix assigned to all files recorded in this scheduled task. Choose between none, serial number, recording type, device nickname or asset ID.
Transect Mode – Use transect mode.
Metadata Key – You can add a custom metadata key to be added to every file recorded in this schedule task (e.g. Survey Type).
Metadata Value – You can add a custom metadata value to be added under the Metadata Key (specified above) to every file recorded in this schedule task (e.g. Dusk Emergence).
Min. Temperature – Set the minimum temperature required for recording to occur.
Additional ultrasonic recording settings:
File Type – Choose between .wav (full spectrum) and .zc (zero crossing).

Ultrasonic Activation – Choose between Constant or Triggered.

Microphone Sensitivity – Set the sensitivity of the ultrasonic microphone.

FD Ratio – Frequency division ratio (ZC file recording only).

Min. Trigger Frequency – Minimum frequency of the trigger.

Max. Trigger Frequency – Maximum frequency of the trigger.

Min. Event – Minimum event time for the trigger.

Min. Recording Duration – Minimum recording time post-trigger.

10kHz High Pass Filter – Enable or disable the 10kHz High Pass Filter.

Noise Filter – Choose between Off, Keep or Overwrite.

Example schedules created in Anabat Insight are shown on the following pages:

The screenshot displays the 'Scheduler' interface in Anabat Insight. On the left, a task named 'Dusk Bats' is selected, with a date range of '15/9/2025 to 15/3/2026, Mon-Sun'. The 'Deployment Location' section includes a 'Find' button and a checkbox for 'Use location for GPS Override'. The 'Date Range' is set from '15/09/2025' to '15/03/2026'. The 'Days to Record' section shows a calendar grid with days from Monday to Sunday. The 'Times' section specifies 'Start recording at 1h Before sunset' and 'End recording at 2h After sunset'. The 'Duty Cycle' is set to 'Always recording'. The 'Task Settings' section on the right includes fields for 'Name' (Dusk Bats), 'Color' (blue), 'File Type' (wav), 'Sample Rate' (320 kbps), 'Microphone' (B (Ultrasonic Microphone)), 'Ultrasonic Activation' (Trigger), 'Microphone Sensitivity' (16), 'Min Trigger Frequency' (10.0kHz), 'Max Trigger Frequency' (250.0kHz), 'Min Event' (2ms), 'Min Recording Duration' (2s), '10kHz High Pass Filter' (On), 'Noise Filter' (Off), 'Max File Duration' (10s), 'File Name Prefix' (None), 'Transect Mode' (checkbox), 'Metadata Key' (Bat Survey), 'Metadata Value' (Dusk), and 'Min Temperature' (checkbox). At the bottom, a calendar view for September 2025 is shown, with a timeline from 2 AM to 10 PM. The calendar highlights the dates from September 15 to 30, 2025, with a blue bar indicating the recording period.

Example 1: The above schedule will record daily from 15 – 30 September 2025, from 1hr before sunset to 2hrs after sunset, in ultrasonic full spectrum, default settings. Every file recorded will include the metadata Bat Survey: Dusk.

Scheduler

Dusk Bats

15/9/2025 to 30/9/2025, Mon-Sun

Dawn Chorus

15/9/2025 to 30/9/2025, Mon-Sun

Click to create a new task

Import

Export

Load

Apply

Deployment Location

Location

Find

✕

Use location for GPS Override

Date Range

Start date

15/09/2025

End date

30/09/2025

Days to Record

Mon

Tue

Wed

Thu

Fri

Sat

Sun

Times

Start recording at

1h 30m

Before sunrise

End recording at

1h 30m

After sunrise

Duty Cycle

Always recording

Cycle on/off

Task Settings

Name

Dawn Chorus

Color

File Type

wav

ZC

Sample Rate

44.1 kbps

Microphone

A + B (Stereo Acoustic)

Acoustic Gain A

+12dB

Acoustic Gain B

+12dB

Max File Duration

1h

File Name Prefix

None

Transect Mode

Metadata Key

Bird Survey

Metadata Value

Dawn

Min Temperature

August 2025

September 2025

Today

October 2025

Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
				1	2	3	1	2	3	4	5	6	7			1	2	3	4	5
4	5	6	7	8	9	10	8	9	10	11	12	13	14	6	7	8	9	10	11	12
11	12	13	14	15	16	17	15	16	17	18	19	20	21	13	14	15	16	17	18	19
18	19	20	21	22	23	24	22	23	24	25	26	27	28	20	21	22	23	24	25	26
25	26	27	28	29	30	31	29	30						27	28	29	30	31		

2 AM

4 AM

6:00 AM

8 AM

10 AM

12 PM

2 PM

4 PM

6:00 PM

8 PM

10 PM

Example 2: The schedule on the previous page will record daily from 15 – 30 September 2025, from 90mins before sunrise to 90mins after sunrise, in acoustic stereo, default settings. Every file recorded will include the metadata Bird Survey: Dawn.

Scheduler

Dusk Bats

15/9/2025 to 30/9/2025, Mon-Sun

Dawn Chorus

15/9/2025 to 30/9/2025, Mon-Sun

General Bats

15/9/2025 to 15/10/2025, Mon, Wed, Fri, Sun

Click to create a new task

Import

Export

Load

Apply

Deployment Location

Location

Find

X

Use location for GPS Override

Date Range

Start date

15/09/2025

End date

15/10/2025

Days to Record

Mon

Tue

Wed

Thu

Fri

Sat

Sun

Start recording at

2h

After sunset

End recording at

1h 30m

Before sunrise

Duty Cycle

Always recording

Cycle on/off

Task Settings

Name

General Bats

Color

File Type

wav

ZC

FD Ratio

8

Ultrasonic Activation

Constant

Trigger

Microphone Sensitivity

17

Min Trigger Frequency

12.0kHz

Max Trigger Frequency

250.0kHz

Min Event

2ms

Min Recording Duration

2s

10kHz High Pass Filter

On

Off

Noise Filter

Off

Max File Duration

10s

File Name Prefix

None

Transect Mode

Metadata Key

Bat Survey

Metadata Value

Night Activity

Min Temperature

Only Record Above

10°C

August

2025

September

2025

Today

October

2025

Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
				1	2	3	1	2	3	4	5	6	7							
4	5	6	7	8	9	10	8	9	10	11	12	13	14	6	7	8	9	10	11	12
11	12	13	14	15	16	17	15	16	17	18	19	20	21	13	14	15	16	17	18	19
18	19	20	21	22	23	24	22	23	24	25	26	27	28	20	21	22	23	24	25	26
25	26	27	28	29	30	31	29	30						27	28	29	30	31		

2 AM

4 AM

6:00 AM

8 AM

10 AM

12 PM

2 PM

4 PM

6:00 PM

8 PM

10 PM

Example 3: The above schedule will record Monday, Wednesday, Friday and Sunday nights from 15 September 2025 for 1 month, from 2hrs after sunset to 90 mins before sunrise, in ultrasonic zero crossing (sensitivity 17; minimum frequency 12), only when minimum temperature is above 10°C. Every file recorded will include the metadata Bat Survey: Night Activity.

The screenshot shows the Chorus Scheduler interface. On the left, a list of tasks includes 'Dusk Bats', 'Dawn Chorus', 'General Bats', and 'Midday Birds' (which is selected and highlighted with a red border). The 'Midday Birds' task is configured for the date range '15/9/2025 to 15/10/2025, Tue, Thu, Sat'. Below this list is a button that says 'Click to create a new task'. At the bottom left are buttons for 'Import', 'Export', 'Load', and 'Apply'.

The main configuration area is divided into three sections:

- Deployment Location:** Includes a 'Location' field with 'Find' and 'X' buttons, and a checkbox for 'Use location for GPS Override'.
- Date Range:** 'Start date' is '15/09/2025' and 'End date' is '15/10/2025'.
- Days to Record:** A calendar grid showing days of the week. Tuesday, Thursday, and Saturday are highlighted in orange.
- Times:** 'Start recording at' is '11:00 AM' and 'End recording at' is '1:00 PM', both with 'Time' dropdown menus.
- Duty Cycle:** Radio buttons for 'Always recording' and 'Cycle on/off' (which is selected). Below are 'On time' and 'Off time' fields, both set to '10m'.

The **Task Settings** section on the right includes:

- Name:** 'Midday Birds'
- Color:** A red square icon.
- File Type:** 'wav' (selected) and 'ZC'.
- Sample Rate:** '44.1 kbps'.
- Microphone:** 'A (Acoustic Microphone)'.
- Acoustic Gain A:** '+12dB'.
- Max File Duration:** '1h'.
- File Name Prefix:** 'None'.
- Transect Mode:** A checkbox.
- Metadata Key:** 'Bird Survey'.
- Metadata Value:** 'Midday Calls'.
- Min Temperature:** A checkbox.

At the bottom, there is a calendar view for August, September, and October 2025. The days of the week are listed as columns. The dates 15th through 31st are visible, with some dates having small orange squares indicating recording days. Below the calendar is a timeline from 2 AM to 10 PM with 10-minute intervals. A small icon of a bat is shown at 6:00 AM and 6:00 PM.

Example 4: The above schedule will record Tuesdays, Thursdays and Saturdays from 15 September 2025 for 1 month, from 11am – 1pm, with a 10min on/off duty cycle, in mono acoustic (gain +12dB). Every file recorded will include the metadata Bird Survey: Midday Calls.

For instructions on how to export or import schedules between Toolbox and your Chorus, [see here](#).

METADATA

All metadata recorded on the Chorus is saved to files in the GUANO (Grand Unified Acoustic Notation Ontology) format. This format is now the standard across bat acoustic fields. For recordings from a Chorus, it includes the following:

- Timestamp
- Recorder make and model
- Recorder ID (serial number)
- Asset tag
- GPS location

- Internal temperature at time of recording
- Recorder firmware version
- High pass filter status (On or Off if applicable)
- Trigger & microphone settings
- Battery voltage
- Custom metadata (if using a schedule)
- SD card serial number
- Moon age (number of days since last NEW moon)
- Travel speed (only if transect is enabled)

TROUBLESHOOTING & FAQs

How do I set up the detector for ultrasonic bat recording?

If you are using the Chorus with an ultrasonic microphone to record ultrasonic frequencies (e.g. bat echolocation), you will need to check the following settings:

1. Mount an ultrasonic microphone to the 'hinge' side (side B).
2. Place the recorder in your desired Recording Mode (e.g. Night Only, Continuous).
3. Choose your preferred File Type: WAV (Full Spectrum / .wav) or ZC (Zero Crossing / .zc).
4. If using WAV, change the Sample Rate to an ultrasonic 🦇 frequency (500, 384, 320, or 192kps).
5. Ensure the recorder is in Triggered Activation Mode and check the trigger settings are appropriate for your recording situation.

How do I set up the recorder for acoustic (audible sound) recording?

If you are using the Chorus with an acoustic microphone/s to record audible frequencies (e.g. birds, frogs, other vocalising wildlife), you will need to check the following settings:

1. Mount one or two acoustic microphone/s with windsocks on the recorder. If only using one acoustic microphone, it's recommended to mount it to the 'catch' side (side A).

2. Place the recorder in your desired Recording Mode (e.g. Continuous, Day Only).
3. Choose WAV (Full Spectrum / .wav) for the File Type.
4. Change the Sample Rate to your preferred an acoustic 🎵 frequency (96, 48, 44.1, 32, 24, or 22.05ksps).
5. Ensure the recording settings are appropriate for your situation.

What is the difference between 'acoustic' and 'ultrasonic' recording?

Acoustic recording refers to the recording of audible sounds, such as bird song, animal vocalisations and frog calls. Ultrasonic recording refers to the recording of high frequency sounds typically above the level of human hearing. Both the microphone and the sample rate determine if you are recording ultrasonic or acoustic. There are set microphones/channels for acoustic or ultrasonic recording. Sample rates of 96ksps and below are classed as 'acoustic' and rates of 192 and above are ultrasonic.

The Chorus is recording huge quantities of ultrasonic files; how can I address this?

It is always best to have a memory card that exceeds your expected capture requirements. If you think you'll capture 32GB we suggest at a minimum, use a 64GB card. You can use the data estimator tool in Toolbox within Anabat Insight to help guide this, ensure your activity level in Toolbox is set to High.

There are several options to reduce the number of files your record. Firstly, check your trigger settings to ensure they are optimized for your deployment, specifically ensure your minimum trigger frequency is set as high as possible without missing your lowest frequency bat, and your minimum event duration is not set too short. Secondly, lowering the sensitivity can help reduce number of files, however this will result in a trade-off in the ability to record quiet sounds. You can also turn on the noise filter to separate noise from bat calls, and choose the overwrite setting to delete noise files when memory storage runs low.

You can also reduce the size of the files recorded. Higher sample rates equate to larger files, so reduce your sample rate to the lowest possible setting without missing your highest frequency bat (see FAQ below for more information).

Finally, you can always apply noise filters to your data during your post-recording analysis in [Anabat Insight](#) (free to use). There is a built-in 'AllBats' filter, and you can utilise other filtering features (such as smoothness, synthetic filters and metric parameters) to help sort files into more useful batches and eliminate unwanted noise post deployment.

What is the sample rate, and what is the recommended value?

Sample rate refers to the number of 'samples per second' taken during recording, measured in kilo samples per second (ksps). The recommended sample rate (Nyquist frequency) should be at least double the highest frequency of interest. For example, if your highest frequency bat echolocates up to 150kHz, then your sample rate needs to be above 300ksps. You should note that the larger the sample rate, the larger the file size (by orders of magnitude).

The Check LED on the front keeps flashing.

If the Check LED is flashing without the magnet applied, it means there is an issue affecting deployment. Do not deploy until you resolve the issue. To check the issue/s, open the case and look at the status message/s on the dashboard. See [Flashing Status Icons](#) for more information on how to resolve these issues.

Can I record ultrasonic and acoustic at the same time?

You are unable to record ultrasonic and acoustic simultaneously, however you can create a schedule to record ultrasonic and acoustic during the same deployment. For example, you can record acoustic through the day and ultrasonic through the night. To do this, you will need an acoustic microphone (supplied) and ultrasonic microphone (optional extra). Use the [scheduler tool](#) to create a schedule with multiple periods for ultrasonic and acoustic, then save this schedule to the SD card you plan to use for deployment, or apply it directly to your Chorus via USB cable. When deploying the recorder select [Schedule Recording Mode](#).

What is the difference between monoaural, stereo, dual and simultaneous recordings?

When you have a multi-channel recorder (a recorder that can have multiple microphones, such as the Chorus), there is some terminology to understand:

Monoaural – “Mono” recording is recording one file from one microphone. This is how Titley Scientific’s Anabat range of bat detectors work. The Chorus can also record mono acoustic or ultrasonic.

Stereo – Stereo recording is recording one file from two microphones. The recording will have multiple ‘channels’, i.e. left & right. This gives the recordings a sense of a spatial soundscape when played back, or you can set different microphone gain for the left & right channels to capture both loud and soft sounds without distortion. The Chorus is capable of recording stereo acoustic files.

Dual – Dual recording is recording multiple files from two microphones on a schedule, but not simultaneously. For example, you can record ‘file X’ from the acoustic microphone at 2pm, then record ‘file Y’ from the ultrasonic microphone at 6pm. **This is possible using a custom schedule with the Chorus.**

Simultaneous – Simultaneous recording is the ability to record multiple files, from two (or more) microphones at the same time. For example, you can record ‘file X’ from the acoustic microphone AND ‘file Y’ from the ultrasonic microphone at exactly the same time. **This is not possible with the Chorus.**

What is the difference between constant activation recording and continuous recording mode?

The recording mode, set by the Mode button on the recorder interface (eg. Night or Continuous) refers to when the recorder is “active” or “listening”. In continuous recording mode, the recorder is “listening” all the time (24 hours a day). It won’t necessarily record files when it’s “listening”, that will depend on the activation. The activation refers to when files should actually be saved to memory. A constant activation mode means that files are constantly be recorded (without gaps) regardless of what sound, if any, is present. If it’s in triggered activation mode, it will only save files to memory if the sounds pass certain trigger settings.

To be clear here is a synopsis of what will be recorded:

Continuous + Constant: It will save all sounds, without gaps, 24 hours a day for as long as the battery or memory cards last.

Continuous + Trigger: It will save only files when a ‘triggering’ sound occurs, 24 hours a day.

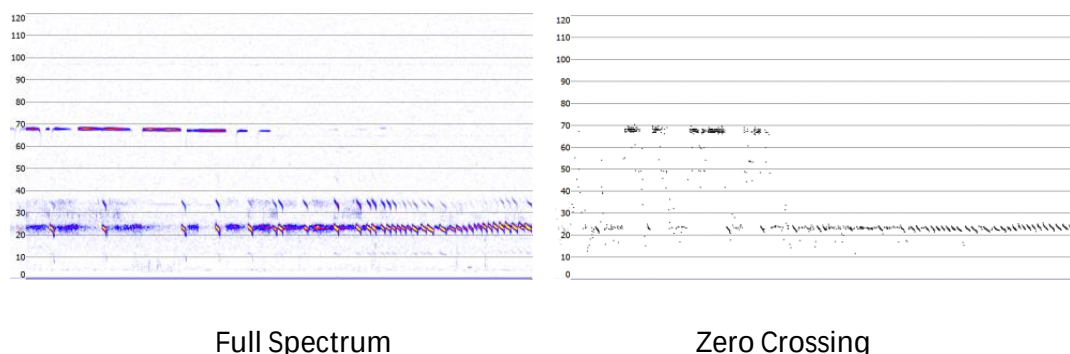
There are a lot of echoes in the spectrogram.

When recording in full spectrum, if you find that your spectrogram has excessive echoes (“messy”), it is likely due to echoes from where the microphone was mounted. We recommend that you mount the recorder away from any flat surfaces (such as boxes or walls). This will produce much clearer recordings.

You may also wish to purchase the flexible ‘gooseneck’ accessory from Titley Scientific, which allows you to position the ultrasonic microphone approximately 15cm away from the recorder/mounting surface.

What is the difference between full spectrum and zero crossing?

There are two main recording formats for ultrasonic files, zero crossing analysis (.zc) and full spectrum (.wav). Acoustic files are only available as full spectrum. Full spectrum records the full spectral information within a sound file, just like a music file. Whereas zero crossing analysis renders the spectral information down into a series of time vs. frequency dots. Examples are shown on the next page.



The advantages of full spectrum include the ability to see intensity, harmonics, multiple bats calling at the same time, and faint bat pulses during high ambient noise. The disadvantages of full spectrum are that they are much larger files (typically 6 times the size of a zero crossing file), they require more processing power to record and are slower to render on a computer for post-recording analysis. The advantage of zero crossing analysis is the small file size, so memory space is not an issue, and many published guides to bat calls are based on zero crossing analysis. The disadvantages of zero crossing are that spectral information is lost (which may be helpful to species identification), and that in cases of high frequency ambient noise (e.g. insects), bat calls may not be recorded fully.

It is important to note that full spectrum files can be converted to zero crossing post-recording, but zero crossing files cannot be converted to full spectrum. Deciding which recording format is best will depend on the aims of your survey and the recording environment.

How far away can an animal be detected using the Chorus?

Detection distances will vary with frequency and loudness (amplitude) of the animal calls, atmospheric attenuation, and the directional characteristics and sensitivity of the animal recorder. It will also be affected by the amount of structural clutter (obstacles such as vegetation) which can block the path of the signal.

The frequency and amplitude of the animal call have a major influence on how far away the call can be detected and makes some species easier to detect from afar than others. Quiet (low amplitude) and high frequency animal calls are more difficult to detect than loud (high amplitude) or low frequency calls. Call amplitude can vary within an individual, for example bats will reduce the amplitude of their calls as they approach prey or depending on the context in which they are flying. Call amplitude can also vary between species. Species which always produce low amplitude calls (eg. 'Whispering bats') will be more difficult to detect from a distance than other species. In addition, animal calls of higher frequencies cannot usually be detected from as far as those of lower frequencies, as higher frequencies suffer greater absorption by the atmosphere than lower frequencies.

Atmospheric absorption depends upon weather conditions such as temperature, humidity and air pressure. This relationship is complex, but in general, cool dry conditions will allow the detection of animal calls over greater distances.

The sensitivity (if using triggered ultrasonic recording) or gain (if doing acoustic recording) of the recorder also has a major influence on detection distance, and while there is always some variability in sensitivity among units, the biggest influence is the sensitivity or gain settings.

Given all the above, it is obvious that detection distances will vary enormously. Many animals are easily detected over 30m under typical conditions, while some species which call at low frequencies may be detectable from as far as 100m. However, some species will be hard to detect from even 1m away. This is why activity levels measured acoustically cannot easily be compared between different species. However, acoustic indices of activity are generally much less biased than indices based on capture data.

Further information on detection distances and the calculation of detection fields and distances can be obtained from the software AnaVolumes (you can download at www.titley-scientific.com).

What does microphone frequency response mean?

Microphones exhibit a 'frequency response', which basically means they have differing sensitivities at different frequencies. A microphone may be very sensitive at 40kHz, then lower sensitivity at 60kHz, then be very sensitive again around 80kHz. Microphone sensitivity doesn't just flat-line at a specific frequency but has a tendency to 'roll-off' around a certain frequency. When we refer to the 'maximum frequency', this is the point where the frequency response has begun to taper off. However, the microphone can still detect higher frequency sounds (they just need to be louder or closer to the microphone).

Can I use the Chorus as an active recorder?

While the Chorus is designed as a passive recorder, it can be used as an active recorder by connecting your headphones, you will hear a live frequency division output in the case of ultrasonic recording. You can also use the built-in GPS to log your track using the [Transect Mode](#) function.

Can I power the recorder using solar panels or external battery?

No, the Chorus cannot be powered externally.

The files recorded on my Chorus aren't being recognised/processed in a third party app?

In some cases (e.g. BTO Pipeline or Kaleidoscope) the sample rate prevents the file from being opened/processed. This is due to the precise sample rate being reported in the WAV file metadata. For pre-existing recordings with this issue you can use a third-party application such as Audacity to resample your existing data to the required sample rate. For future recordings, make sure the WAV sample rate setting is configured to Standard. Please refer to the section regarding the [WAV Sample Rate setting](#).

FIRMWARE RELEASE NOTES

Changes and improvements in firmware version 3.1.0:

New Features:

- Noise filter for triggered ultrasonic recording (both FS and ZC) to categorise files as either 'noise' or 'recording', with optional removal of 'noise' files when SD cards become greater than 95% full. For more information, see the updated user manual.
- Multilingual support - Available languages include English, Spanish, French, Polish, or German.
- Chorus now has an expanded microphone sensitivity editor superimposed on a VU meter, similar to Ranger, to aid in sensitivity modification (to access, press Power/OK when the Mic Sensitivity setting is selected in the Recording settings screen).
- dBFS displayed for ultrasonic microphone in microphone sensitivity editor.
- Time zone information in log files (always at the start of every log file, in the header next to the file date) and in recording metadata.
- Power and temperature logging now has a setting that allows logging even when recording isn't active.
- New "Expired Schedule" status message is shown when recorder is in Schedule mode and all tasks finish in the past.

Changes:

- Added a new system global setting to control whether WAV files report the precise sample rate used by the hardware (44.101ksps) or the standard sample rate as specified in the Profile (44.1ksps) to improve third party application compatibility. Defaults to "Standard".
- Recording settings interface changes to show the Microphone Channel setting when the ZC file type is selected. It is locked to the ultrasonic microphone in this case, but visible as a reminder to show which microphone must be connected.
- Additional logging to assist troubleshooting.
- Added protection against physical buttons being held down 'forever' (which previously would have prevented power saving modes from occurring).
- Removed support for importing schedule.csv files - all schedule import/export is now in JSON format.

- Small Dashboard user interface rearrangement to be more consistent with Ranger (Settings icon added, Clock icon removed, Microphone icon becomes Calendar icon when in Schedule mode).
- Changes to various user interface components to accommodate longer text when using non-English languages.
- Schedule import/export user interface changes.
- Additional status messages to better aid in diagnosing potential deployment concerns and changed the conditions under which some existing messages will appear.
- If the asset tag includes a nickname, the nickname will be displayed on the top right of the splash screen.

Fixes:

- Fixed an issue with schedule JSON files that sometimes resulted in incorrect recording start dates being used.
- Fixed an issue where a locked SD card would not show as locked on the Dashboard.
- Improved acoustic microphone detection to provide more accurate "mic detect" status messages.
- GPS coordinates now appear in log files.
- Mode button should now always cycle through recording modes regardless of which screen is displayed.
- Ultrasonic VU meter and record/pause icon on Dashboard now present when recording ZC files.
- Miscellaneous fixes for quality of life and stability.

FURTHER INFORMATION

For further information please visit the Titley Scientific website: www.titley-scientific.com