



# CHORUS

User Manual

Version 1.0



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## DOCUMENT HISTORY

Manual Version	Release Date	Firmware Version	Major Additions and Changes
1.0	9/11/2021	2.0	-

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## 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
- Lasts for up to 40 nights (full spectrum ultrasonic) or 300 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

### 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.

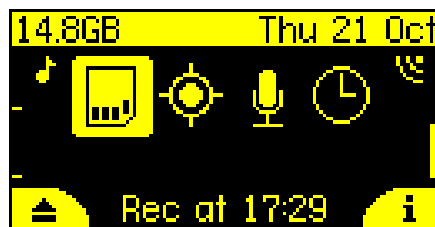
# EXTERNAL FEATURES



## 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, SD card free space, and microphone information.

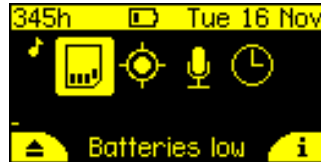
The four large icons in the middle of the dashboard represent the main aspects of your detector: the SD card, GPS, microphone(s), and the clock.

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 see more information and settings.



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, 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 "Batteries low" written below.



Along the top of the dashboard you'll find information about the current SD card (if you have one inserted), indicators for low battery and headphones (if plugged in), and the current date, time, and temperature.

On the left and right sides of the dashboard are VU (Volume Unit) meters that will appear when microphones are connected to the left and right 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 🎵.

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 device) 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. Both microphone types can be used with our flexible-gooseneck microphone extender accessory. 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 wind sock
- 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)

### A note on frequency response

All microphones exhibit a 'frequency response', which means they have differing sensitivities at different frequencies. A microphone may be sensitive at 40kHz, then somewhat less sensitive at 60kHz, then be very sensitive again around 80kHz. Microphone sensitivity doesn't "end" at a certain frequency, but instead tends to taper or 'roll-off' after 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).

## 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). Make sure all batteries are fresh and of the same type. Mixing old & new batteries or different types of batteries can cause erratic detector 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 300 hours of acoustic recording, or up to 40 nights of triggered ultrasonic recording (based on 10% bat activity at 25°C and 10 hour nights). However, in practice 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 amount of storage required for a given deployment time depends on the file type used, sample rate, and the amount of ultrasonic sound activity. All values in the table below are approximate per hour of recorded sound. SD card formatting options and trigger settings may change these estimates.

Sampling Rate	Mono (p/hr)	Stereo (p/hr)
Full Spectrum 500Ksps	3.4GB	-
Full Spectrum 320Ksps	2.2GB	-
Full Spectrum 192K	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 22.05Ksps	152MB	303MB

Please note: In all modes except Schedule mode, when there is an SD card present, the Chorus will periodically display the remaining recording time for your SD card in the top-left of the display, based on the currently chosen sample rate.

### 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.

## USB CONNECTION

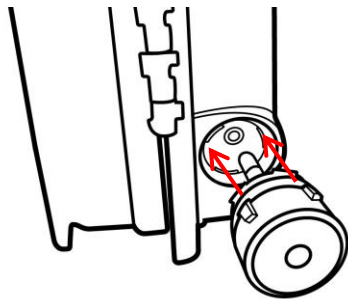
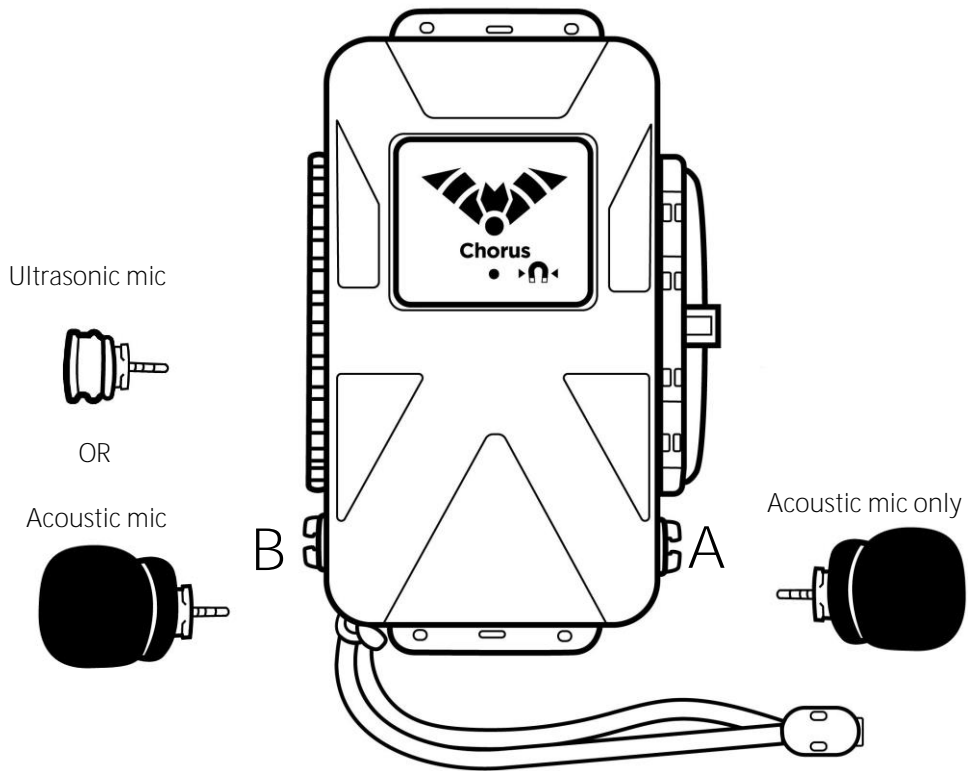
The Chorus can be used with a micro-USB cable (not supplied) for connection to your computer. You can use this cable to upgrade the firmware using Anabat Insight (see [Software](#)). Firmware updates can also be performed using the SD card. See [Update Firmware](#) for more information. Note that the USB connection cannot be used to download recordings from the Chorus.

## USING THE CHORUS

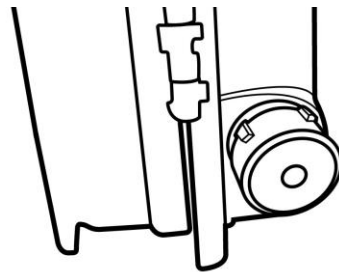
The Chorus is designed for fast and easy deployment. Before you start recording you must first set your current time zone (see [Time zone](#)). The clock will be automatically set when the GPS obtains a signal. We also highly recommend you check for firmware updates (see [UPDATE FIRMWARE](#)).

## STEP-BY-STEP GUIDE

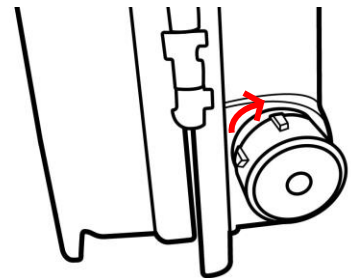
1. Connect your chosen microphone/s to the appropriate side (see below): acoustic can be on side A (latch) or B (hinge); ultrasonic on side B (hinge) only, refer to the image below. Carefully insert the microphone jack into the microphone socket (with locking tabs in correct alignment) until it clicks 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 1/8<sup>th</sup> 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 size 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 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 there is no need 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.

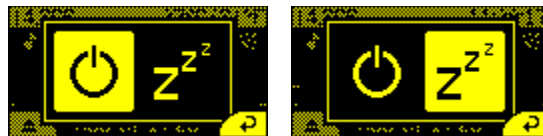
- Remove the batteries before storing the unit. Batteries left in the recorder will leak and damage the unit, voiding warranty.
- For more information, refer to [Collecting Your Recorder](#).

## 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 continue to hold the **OK** button to shut the recorder down. 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<sup>Z</sup>**, 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 the Chorus up to date to ensure trouble-free operation. The Chorus firmware is updated by using an SD card with the update copied onto it. It is highly recommended that you subscribe to receive email alerts of new Chorus firmware updates using this website: <http://eepurl.com/czjGxD>.

To update firmware:

1. Download the update file from this link <https://bit.ly/3DFejkY> and copy it to the root directly on an SD card. Make sure the file is named chorus.adx. You can use the same SD card to update multiple Chorus recorders.



2. 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. The Recording Mode LEDs will cycle to indicate the update is occurring and the Chorus will restart upon completion. If this message does not appear, the firmware is already up to date or the file wasn't copied to the card correctly.
3. You can now delete the chorus.adx file from the SD card or use the card again to update several Chorus recorders.

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



## RECORDING MODES

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.

### Night-Only Recording Mode

The night-only 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-Only Recording Mode

The day-only 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-only mode requires a GPS fix.

### Continuous Recording Mode

The continuous recording mode will record continuously (either triggered or constant activation mode depending on your settings), 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 ensuring the clock is accurate.

### Schedule Recording Mode

The schedule recording mode allows you to use a custom recording schedule created with the Scheduler Tool in Anabat Insight (see CREATING 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 saved on the SD Card, so keep this in mind when swapping out the SD card. Schedule mode requires a GPS fix if your schedule is based around sunset and sunrise times.


### Selecting a Recording Mode

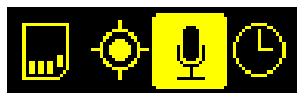
To select the recording mode, press the Mode button to cycle through the modes until the desired mode LED is lit.

### 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.

## RECORDING SETTINGS

To access the Recording Settings menu, use the left/right arrows to select the microphone symbol  on the dashboard (see below), 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.



### SAMPLE RATE & FILE TYPE (ACOUSTIC OR ULTRASONIC RECORDING)



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 or 22.05ksp/s, and ultrasonic full spectrum  sample rates of 500, 320 or 192ksp/s. Ultrasonic zero crossing sampling **Zc** is also available.

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

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

#### Notes on sample rate and file type

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

## SELECT THE MICROPHONE

The options available for the microphone change depending on the Sample Rate selected.

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.

Ultrasonic sample rates only permit monaural recording from the ultrasonic microphone connected to side B.

## 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 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, 3dB 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, make sure the gain settings for side A and B are equal.

### Maximum File Time

The maximum file time 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.

## 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.

The triggered activation mode will record all sound for a set amount of time (usually seconds to minutes) every time it is triggered when active (based on recording mode selected: Night Only, Dusk & Dawn, Day Only, 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 Only, Dusk & Dawn, Day Only, 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.

### Sensitivity

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 select Sensitivity and then use the left/right arrow buttons to choose the sensitivity that you want. Default is 16, and is suitable for most purposes.

### Minimum Frequency

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. Freq., then use the left/right arrow buttons to change the frequency. The default value is 10 kHz.

### Maximum Frequency

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. 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

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

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. Event, then use the left/right arrow buttons to change the time. The default minimum recording time is 2s.

### Maximum File Time

The maximum file time 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.

### 10k High Pass Filter


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 X (Off).

### 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 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 4 is generally only suitable for recording low frequency calls. A division ratio of 16 will save SD card space at the expense of recording resolution.


## GPS SETTINGS

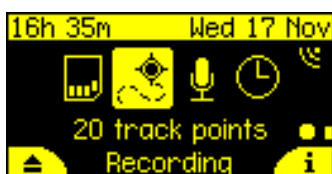
The Chorus attempts a GPS fix once the recorder is turned on, and whenever it is in the GPS Settings menu. If left on/sleeping, it will attempt a GPS fix every 24 hours. When the recorder is attempting a fix, it will try for up to 10 minutes. If it is unable to acquire a GPS fix, it will use the last 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.

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



## 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 X (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 and the number of points saved into the track file will be indicated.



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.



## CHECK LOCATION

To check the GPS information for your location, use the left/right arrows to navigate to the GPS Settings and press the **OK** button. The following information will be displayed (use the up/down arrows to navigate the menu):

- GPS location;
- Altitude;
- When the last GPS fix was received;
- The number of satellites currently in use (typically more satellites indicates a more accurate fix);
- HDOP (horizontal dilution of precision). The lower the number the more accurate the position. Numbers less than one typically indicate good accuracy;
- Whether the fix is 2D (inaccurate) or 3D (more accurate);
- Whether the GPS is currently on (GPS will automatically turn on when in the GPS settings menu).

## OTHER SETTINGS

### FILENAME PREFIX

You are able to choose between using the recorder serial number or the recording type as a filename prefix, or have no prefix. The recording type refers to whether the files are ultrasonic ("us") or acoustic ("ac") and is dependent on your sample rate. You can choose the prefix in the Recording Settings menu or in the SD Card menu. To change the prefix, use the up/down arrow buttons to select File Prefix, then use the left/right arrow buttons to choose between Serial #, "ac" or "us", or None.

### CLOCK & SCHEDULE

To check or change the time zone setting on your detector, use the left/right arrows to navigate to the Clock Settings ⌚ (see below) and press the OK button, use the up/down arrows to navigate the Clock Settings menu.



#### Time Zone

Your time zone relative to Greenwich Mean Time (GMT) will be shown. Use the left/right arrows to change the time zone in 15 minute increments. Remember to account for any daylight savings time that may be in effect.

#### Time Format

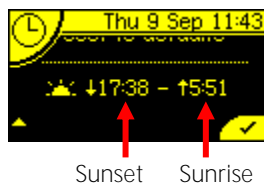
You can choose between 24 hour (e.g. 16:00) and 12 hour (e.g. 4:00pm) time formats. Use the left/right arrows to change the time format.

#### Schedule

This will indicate if a valid schedule is available on the SD card and give a summary of each of the recording tasks.

## Check Sunset/Sunrise Times

Use the down arrows to scroll below Reset to Defaults, the sunset and sunrise times will be displayed for your location (see below).

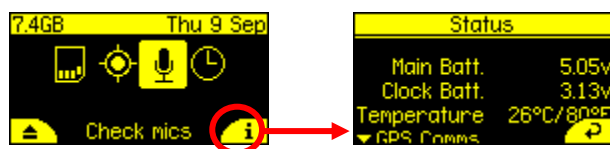


## RESET SETTINGS

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

## 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](http://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.
3. 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 brief flash indicates unit is working. To check the ultrasonic microphone, hold the magnet on the symbol and rub fingers near the microphone. The LED flickering faintly confirms that an ultrasonic audio signal are being detected.

## 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 detector 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

This represents an issue with your memory card. Check the following:

- Insert SD Card: You are yet to insert an SD card. Insert a fresh SD card into the slot.
- Checking Card: The SD card is being read, wait a moment.
- Low Storage: There is less than 10% of the SD card memory space left.
- Card Full: The SD card memory is full, eject the SD card and replace it.
- Card Locked: The SD card is locked, remove the card and unlock the write protection switch lock before reinserting.
- Bad SD Card: If the card is corrupt, or cannot be read. Either replace the card, or attempt to reformat the card.
- Remove SD Card: Will be displayed after you've pressed the eject button, this message will disappear once you have removed the SD card.
- Cannot Eject Now: The card cannot be ejected, wait a moment and try again.

### GPS

This indicates an issue with the GPS.

- No recent GPS fix: Your chosen recording mode requires a GPS fix, but you do not have a recent fix (must be less than 24 hours ago). Resolve by placing the detector in an area with clear sky views, with the case closed and the Chorus logo facing skywards then enter the [GPS Settings](#) menu to reactivate the GPS. It may take several minutes to secure a fix. If the Chorus cannot secure a new fix, it will revert to the last known location.

## Microphone

This indicates an issue with your microphone/s.

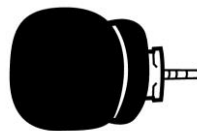
- Check Mics: There is no microphone attached for the recording type selected. Resolve by connecting either an acoustic or ultrasonic microphone, or change the Recording Settings to match the microphone attached.

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 and microphone are correct.



Ultrasonic mic



Acoustic mic

## Clock

- Time Zone Not Set: Time zone is unknown, enter the time zone.
- Check Time Zone: The time zone has been set via GPS, check the time zone to ensure it is correct.
- No Schedule: You have selected scheduled recording mode, but there is no schedule on the SD card. Resolve by saving a schedule to the SD card and inserting this card into the recorder.

## Other

- Batteries Low: The batteries are below 4.5V, replace the batteries before starting recording.
- Clock Battery Low: The CR2032 Coin Cell battery has dropped below 2.6V, replace the clock battery. Leave AA batteries installed while changing the clock battery to avoid loss of your settings.

## 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 device 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.

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 1.5V lithium batteries 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 rain water runs off the microphone/s and doesn't settle on the element/s. Also make sure that the magnetic lanyard or the device 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 device can be padlocked closed. A lockable metal security box is also available for purchase from Titley Scientific.




## EQUALIZATION & CALIBRATION

In some situations where multiple recorders are deployed, it may be a requirement to ensure all the recorders being used 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 due to differences in age, wear and so on. Recorders can be equalized using a 'Chirper' which emits an ultrasonic signal at a constant frequency and amplitude.

Acoustic microphones can be tested using a standard sound level meter calibrator that outputs a 1kHz tone at 94dB.

## 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  button to bring up the Sleep/Off menu, continue holding the button until the unit shuts down or release then then press the  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:
  - Acoustic: This folder contains the acoustic sound recordings.
  - Ultrasonic: This folder contains the ultrasound recordings.
  - Log: This folder contains the log files for the deployment. This should be kept in case and future troubleshooting is required.
  - GPS: This folder contains the transect GPX files.

### FILE NAMES

Log 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 of these file types can be opened/viewed directly in [Anabat Insight](#). Zero Crossings files can also be opened with AnalookW. 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 15<sup>th</sup> March 2021 at 7:42:07pm.

## DIAGNOSTIC LOG FILES

The diagnostic log files contain information about the recording sessions on the SD card. Information such as temperature, battery voltage, GPS locations, settings and user interactions can be extracted from this file. The log file can be opened as a text file or in a spreadsheet application such as Microsoft Excel.

## SOFTWARE

The Chorus comes with a free version of Anabat Insight, available for download from [www.titley-scientific.com](http://www.titley-scientific.com)

Anabat Insight has the following features:

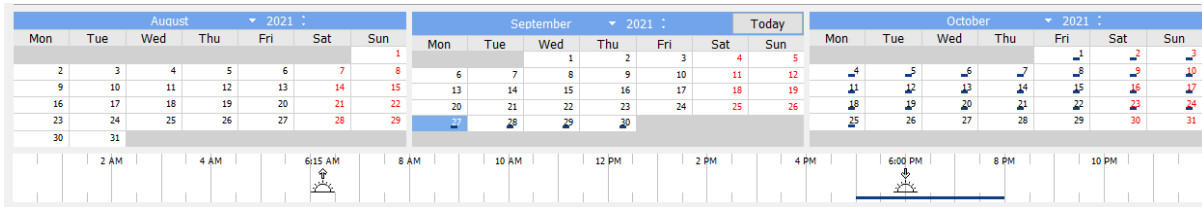
- View your files in full spectrum & zero crossing
- Use filters and scans to optimize your bat call analysis
- Display metrics for passes and individual bat pulses
- View & customize metadata
- Generate reports to present your analysis results
- Use built-in mapping to view your tracks & waypoints
- 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.

## CREATING SCHEDULES

In Anabat Insight, you can create a custom schedule for your Chorus as follows:

1. Open Anabat Insight. Go to Devices > Chorus Scheduler Tool. This will bring up the Schedule Manager.
2. Click the + button to create a new schedule task, give it a name and choose a task colour. To help pre-fill some recording settings, the type of recording is surmised from the task name. For example, if the name contains the word "bats" or "ultrasonic" then default ultrasonic microphone settings will be pre-filled. If the name contains "acoustic", or "birds" then acoustic microphone settings will be pre-filled.

3. This task will be shown in the schedule manager, and you can edit the task on the right. The calendar and daily schedule will display what tasks are running and when (see below). The sunset and sunrise times displayed below the calendar are based on your computer location if you are connected to the internet.



4. You can choose the following:
  - a. Date Range: By default, it will start on today's date and end 6 months in the future. Click on the Start and/or End date dropdown arrows to choose custom dates.
  - b. Days to Record: By default, it will record every day, to change this, click on the days of the week you do not wish to record on (the colour will disappear from that day).
  - c. Times: You can choose the when to Start and End the recording. If you want to have multiple periods per day, these should be created as separate tasks. You can choose when to start/end relative to sunset, sunrise, an absolute time, as well as end relative to start time (e.g. end 3 hours after start time).
  - d. Duty Cycle: If you wish recording to start and stop for fixed periods within your schedule (e.g. record 5 mins on, then 5 mins off). By default a schedule will be Always Recording. To enable a duty cycle, check Cycle on/off, then choose the amount of time on and off.
5. Check the task schedule by clicking on specific days on the calendar – coloured lines (corresponding with your task colours) will show when the recorder will be on.

Please note: If you select Always Recording for the Duty Cycle, this means the detector will either be 'listening' ready to record when triggered for the period specified, or constantly recording for the period specified depending on which Activation is chosen in the task settings.

6. Each recording task has its own microphone settings under Task Settings. This allows you to use different recording settings and microphones at different times of the day.
  - a. Choose the microphone from the dropdown menu – this will dictate what settings need to be set for the task. Choose between Acoustic Mono A, Acoustic Mono B, Acoustic Stereo (requires a second acoustic microphone), Ultrasonic Full Spectrum (requires an ultrasonic microphone), or Ultrasonic Zero Crossing (requires an ultrasonic microphone).

Please note: Once you have created your schedule, ensure you have connected the appropriate microphone/s to the correct sides of the Chorus.

- b. Choose the settings appropriate to your microphone and survey goals.

### Task Settings

Sample Rate – The sample rate the recorder will use for this task

Gain A – Set the gain for the acoustic microphone on Side A

Gain B – Set the gain for the acoustic microphone on Side B

Activation – Choose between Constant or Triggered (ultrasonic recording only)

Additional ultrasonic recording settings:

Freq. Div. – Frequency division ratio (ZC file recording only)

Min. Freq. – Minimum frequency of the trigger

Max. Freq. – Maximum frequency of the trigger

Min. Event Time – Minimum event time for the trigger

Min Rec. Time – Minimum recording time post-trigger

Max. File Time – Maximum file time

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

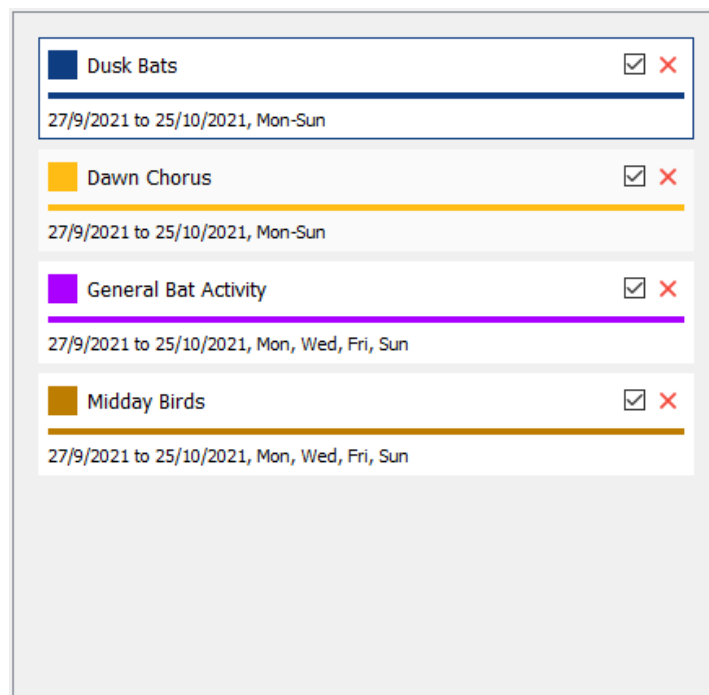
Optional metadata fields:

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)

Please note: Not all Task settings listed above will be available, it will depend on your Microphone and Activation. For more information on each setting, click the setting name.

7. Ensure all schedule tasks you would like enabled are checked in the Schedule Manager (see below).



8. Once you have finished creating your schedule task, you can either add another task (repeat steps 2 – 5), or you can save the schedule.
9. To save the schedule, click the Save button, choose your save location (either on your computer or on the SD card you wish to use in the recorder), then press Save.

Please note: Your schedule file must be saved as "schedule.csv" on the SD card in order to be recognized by the Chorus as a schedule.

10. You can copy this schedule onto multiple SD cards to use on a set of Chorus'.

Example schedules are shown on the following pages.

The screenshot displays the Chorus software's schedule configuration interface. At the top left, a window titled "Dusk Bats" shows the date range "8/10/2021 to 22/10/2021, Mon-Sun". The main configuration area includes:

- Date Range:** Start date: 08-Oct-21, End date: 22-Oct-21
- Days to Record:** All days (Mon-Sun) are selected with blue bars.
- Times:** Start recording at 1h Before sunset, End recording at 2h After sunset.
- Duty Cycle:**  Always recording,  Cycle on/off
- Task Settings:**
  - Microphone: Ultrasonic Full Spectrum
  - Sample Rate: 500K
  - Activation:  Trigger
  - Sensitivity: 16
  - Min. Freq: 10kHz
  - Max. Freq: 250kHz
  - Min. Event Time: 2ms
  - Min. Rec. Time: 2s
  - Max. File Time: 10s
  - 10kHz HP Filter:  Enabled
  - Metadata Key: Bat Survey
  - Metadata Value: Dusk

At the bottom, there are three calendar views for September, October, and November 2021. The October calendar shows recording days from Oct 8 to Oct 22. A time axis at the bottom indicates recording times from 2 AM to 10 PM, with a sunset icon at 5:20 AM and a sunrise icon at 5:51 PM.

Example 1: The above schedule will record daily from 8 – 22 October, from 1hr before sunset to 2hrs after sunset, in ultrasonic full spectrum, default settings. Every file recorded will include the metadata Bat Survey: Dusk.



Dawn Chorus
✕

8/10/2021 to 22/10/2021, Mon-Sun

Load
Save
+

**Date Range**

Start date: 08-Oct-21 | End date: 22-Oct-21

**Days to Record**

Mon Tue Wed Thu Fri Sat Sun

[Orange bars under Mon-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**

Microphone: Acoustic Stereo

Sample Rate: 48K

Gain A: +0dB

Gain B: +0dB

Max. File Time: 1h

Metadata Key: Bird Survey

Metadata Value: Dawn

September 2021							October 2021							November 2021						
Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			

2 AM 4 AM 6 AM 8 AM 10 AM 12 PM 2 PM 4 PM 5:51 PM 8 PM 10 PM

Example 2: The above schedule will record daily from 8 – 22 October, from 90mins before sunrise to 90mins after sunrise, in acoustic stereo, default settings. Every file recorded will include the metadata Bird Survey: Dawn.

General Bat Activity
✕

8/10/2021 to 5/11/2021, Mon, Wed, Fri, Sun

Load
Save
+

**Date Range**

Start date: 08-Oct-21 | End date: 05-Nov-21

**Days to Record**

Mon Tue Wed Thu Fri Sat Sun

[Black bars under Mon, Wed, Fri, Sun]

**Times**

Start recording at: 2h | After sunset

End recording at: 1h 30m | Before sunrise

**Duty Cycle**

Always recording |  Cycle on/off

**Task Settings**

Microphone: Ultrasonic Zero-Crossing

Freq. Div: 8

Activation:  Constant |  Trigger

Sensitivity: 17

Min. Freq: 12kHz

Max. Freq: 250kHz

Min. Event Time: 2ms

Min. Rec. Time: 2s

Max. File Time: 10s

10kHz HP Filter:  Enabled |  Disabled

Metadata Key: Bat Survey

Metadata Value: Night Activity

September 2021							October 2021							November 2021						
Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			

2 AM 4 AM 6 AM 8 AM 10 AM 12 PM 2 PM 4 PM 5:51 PM 8 PM 10 PM

Example 3: The above schedule will record Monday, Wednesday, Friday and Sunday nights from 8 October for 1 month, from 2hrs after sunset to 90 mins before sunrise, in ultrasonic zero crossing (sensitivity 17; minimum frequency 17). Every file recorded will include the metadata Bat Survey: Night Activity.

Midday Birds ✕

8/10/2021 to 5/11/2021, Tue, Thu, Sat

**Date Range**

Start date:  End date:

**Days to Record**

Mon
  Tue
  Wed
  Thu
  Fri
  Sat
  Sun

**Times**

Start recording at:  Time

End recording at:  Time

**Duty Cycle**

Always recording
  Cycle on/off

On time:

Off time:

**Task Settings**

Microphone:

Sample Rate:

Gain A:

Max. File Time:

Metadata Key:

Metadata Value:

Load
Save
+

September 2021							October 2021							November 2021						
Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		1	2	3	4	5	4	5	6	7	8	9	10	1	2	3	4	5	6	7
6	7	8	9	10	11	12	11	12	13	14	15	16	17	8	9	10	11	12	13	14
13	14	15	16	17	18	19	18	19	20	21	22	23	24	15	16	17	18	19	20	21
20	21	22	23	24	25	26	25	26	27	28	29	30	31	22	23	24	25	26	27	28
27	28	29	30											29	30					

2 AM	4 AM	6 AM	8 AM	10 AM	12 PM	2 PM	4 PM	6 PM	8 PM	10 PM
		🕒			---			🕒		

Example 4: The above schedule will record Tuesdays, Thursdays and Saturdays from 8 October for 1 month, from 11am – 1pm, with a 10min on/off duty cycle, in mono acoustic (gain +6dB). Every file recorded will include the metadata Bird Survey: Midday Calls.

## CHECKING SCHEDULES

Once you have schedules saved to the SD card, you can check them on the Chorus. To check the schedule:

1. Insert the SD card with the schedule.csv saved on it.
2. Turn the detector on using the **⏻** button, then use the arrows to select the Clock Settings **🕒**, and press the **⏻** button again.
3. Use the down arrow to select Schedule then press the **⏻** button.
4. Your schedule tasks will be listed by name, to view a task, use the up/down arrows to navigate to it, then press the **⏻** button.
5. It will display the 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.

## 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)
- 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)

## 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, Schedule).
3. Choose your preferred File Type: Full Spectrum (.wav) or Zero Crossing (.zc).
4. Change the Sample Rate to an ultrasonic 🦇 frequency (500, 320 or 192ksp/s).
5. Ensure the recorder is in Triggered Activation Mode and check the trigger settings are appropriate.

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 wind socks 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 (Continuous, Day Only, Night Only, Dusk & Dawn or Schedule).
3. Change the Sample Rate to an acoustic 🎵 frequency (96, 48, 44.1, 32 or 22.05ksps)

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. When deploying the recorder, insert the SD card with the schedule saved on it, then 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.

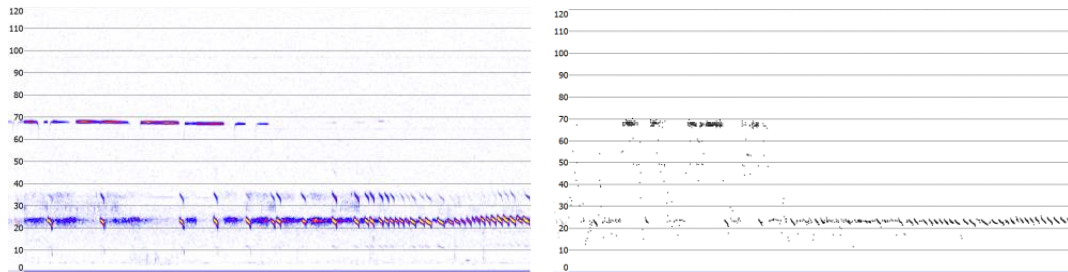
There are a lot of echoes in the spectrogram.

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 detector/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.



Full Spectrum

Zero Crossing

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 a bat be detected using the Chorus?

Detection distances will vary with frequency and loudness (amplitude) of the bat calls, atmospheric attenuation, and the directional characteristics and sensitivity of the bat 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 bat 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 bat calls are more difficult to detect than loud (high amplitude) or low frequency calls. Call amplitude can vary within an individual, as many 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 ('whispering bats') will be more difficult to detect from a distance than other species. In addition, bat 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 bat calls over greater distances.

The sensitivity 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 setting.

Given all the above, it is obvious that detection distances will vary enormously. Many bats 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](http://www.titley-scientific.com)).

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 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.

## FURTHER INFORMATION

For further information please visit the Titley Scientific website: [www.titley-scientific.com](http://www.titley-scientific.com)