



Ranger

User Manual

Version 1.2



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DOCUMENT HISTORY

Manual Version	Release Date	Firmware Version	Major Additions and Changes
1.0	05/03/2024	3.0.4	-
1.1	10/05/2024	3.0.8	<u>Metadata addition</u> ; <u>Low battery terminology</u> ; screenshots updated throughout; <u>SD card recommendations</u> ; <u>language options</u> ; <u>log start time</u> .
1.2	21/10/2025	3.1.0	<u>Lithium battery recommendations</u> ; <u>update language instructions</u> ; <u>sensor logging</u> ; <u>schedule settings menu</u> ; <u>error in Minimum Recording Time corrected</u> ; <u>schedule settings update</u> ; <u>noise filter</u> ; <u>servicing recommendation</u> ; <u>VU meter</u> ; <u>USB data cable requirements throughout</u> ; <u>correct directional microphone frequency response</u> ; <u>noise folder</u> ; <u>update system information</u> ; <u>firmware update revision</u> ; <u>reset all profiles</u> ; <u>new FAQ acoustic vs ultrasonic</u> ; <u>updated screenshots throughout</u> ; <u>sample rate options</u> ; <u>microphone channel lock for ZC</u> ; <u>new FAQ third party app issues</u> ; <u>LED behaviour during update</u> ; <u>new FAQ large data volume</u> ; <u>New FAQ constant vs continuous</u> ; <u>New FAQ sample rates</u> ; <u>Time zone in log file</u> .

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GETTING STARTED

FEATURES OF THE RANGER

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

- Record acoustic (stereo or mono) and ultrasonic simultaneously.
- Easy to use stand-alone recorder, no phone required for setup.
- Automatic schedules for easy deployment, or create your own custom schedule using the colour touchscreen or using Toolbox in Insight .
- Weatherproof, robust, camouflaged, tripod mountable housing.
- Records full-spectrum 16-bit WAV files or zero-crossing (ZC) files.
- You can choose from our range of microphones to suit your needs, all of which are weatherproof and user-replaceable.
- Power with 4 or 8 AA batteries, or external power and solar panel options.
- Lasts for 100 nights (full spectrum ultrasonic) or 700 hours recording time (acoustic) on 8 AA batteries*.
- Built-in GPS with transect mode available.
- Built-in temperature sensor.
- Headphone output to check microphone function and listen to bats in frequency division audio.
- Analyse recordings with free Insight software.

*Ultrasonic battery life estimations based on 10% bat activity at 25°C and 10 hour nights recording at 320ksps using 8 alkaline AA batteries. Acoustic battery life estimations based on continuous mono recording at 32ksps using 8 alkaline AA batteries.

GETTING TO KNOW THE RANGER

The outside of your Ranger case has a lockable latch, multiple mounting points (including a tripod mount), 1 front-mount microphone socket, 2 side-mount microphone sockets, an external power socket, a check LED and lanyard with a magnet. Inside the Ranger case is the control panel, 2 battery compartments, 2 SD card slots, headphone jack and basic instructions on use.

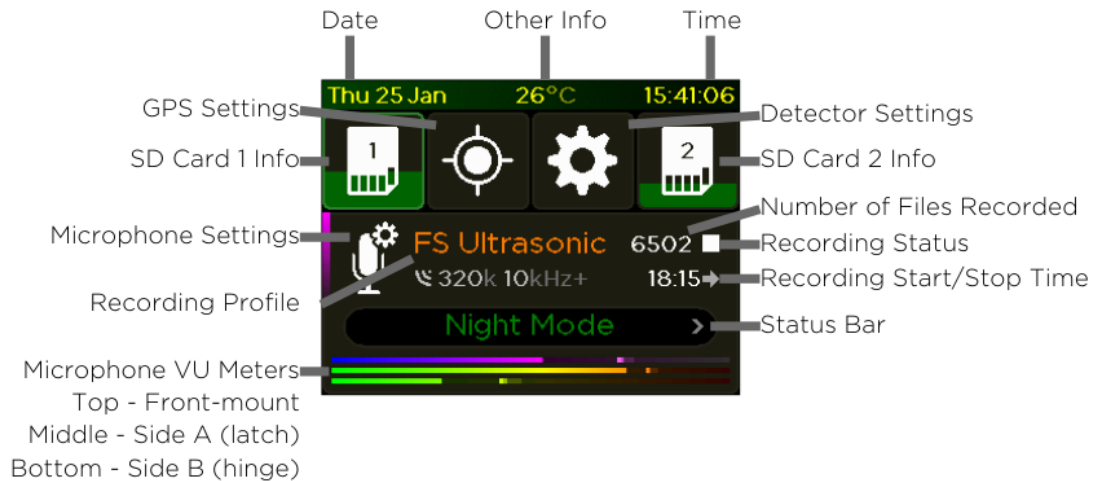
External Features



Internal Features



Dashboard



The main screen is called the **Dashboard**. This is where you can see information such as the status of your Ranger, the date and time, recording mode, SD card free space, and microphone signal. Note that the Ranger uses a type of touch screen known as “resistive touch”, which operates by detecting physical pressure on the screen surface rather than electrical conductivity. This has the benefit of working even if gloves are worn by the operator, but it does behave differently when compared to capacitive touchscreens found on most smartphones and tablets. To use the touchscreen effectively, apply gentle but firm “tap” with your fingernail, a stylus, or any non-sharp object such as a pen cap. Light touches or gestures will not register. Avoid using sharp or abrasive objects that could damage the surface, and ensure the screen remains clean and free of debris.

For more information on understanding the dashboard, see [Using the Dashboard](#).

MICROPHONES

The Ranger is compatible with a variety of microphones. The Ranger has three channels, so you can customise your microphone setup to record in mono or stereo acoustic, mono ultrasonic, or simultaneous acoustic and ultrasonic.

Side-Mount Acoustic Omnidirectional Microphone



- Low-profile.
- 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.

Front-Mount Ultrasonic Omnidirectional Microphone



- Weather resistant (capsule protected by waterproof membrane).
- 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.

Front-Mount Ultrasonic Directional Microphone



- Weather resistant (capsule protected by waterproof membrane).
- 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 250kHz.

Front-Mount Acoustic Omnidirectional Microphone



- Weather resistant (capsule protected by waterproof membrane).
- Low noise floor.
- Built-in low noise preamplifier.
- Improved frequency response when compared to previous generation electret-based ultrasonic microphones.
- Useable frequency response of 100Hz – 20 kHz.

Please note: For all microphones, please refer to **Weatherproofing** for considerations for use in the rain and wind.

POWER REQUIREMENTS

The Ranger can be powered by 4 or 8 AA batteries, or external power (with or without solar panels). The **Low Power Symbol**  will flash 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 flashing  or the status message reads **Batteries Low** you should change the batteries immediately. If both battery holders are being used, the set of batteries running low (main or lid) will be indicated by the flashing  on either side of a line.

Main batteries (left side) flashing - are low

Wed 17 Jan  10:18:44

Both battery sides flashing – both are running low

Wed 17 Jan   10:18:39

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 the warranty. Also note that when using external power, AA batteries should not be installed in the Ranger.

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 brand and type. Mixing old & new batteries or different types of batteries can cause erratic recorder behaviour and may 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). Eight high-quality alkaline AA batteries will last up to 700 hours of acoustic recording, or up to 100 nights of triggered ultrasonic recording, based on 10% bat activity at 25°C and 10 hour nights recording at 320ksps (ultrasonic) or continuous mono recording at 32ksps (acoustic). You can estimate your battery life using **Toolbox in Anabat Insight**.

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 Ranger

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 over the page 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

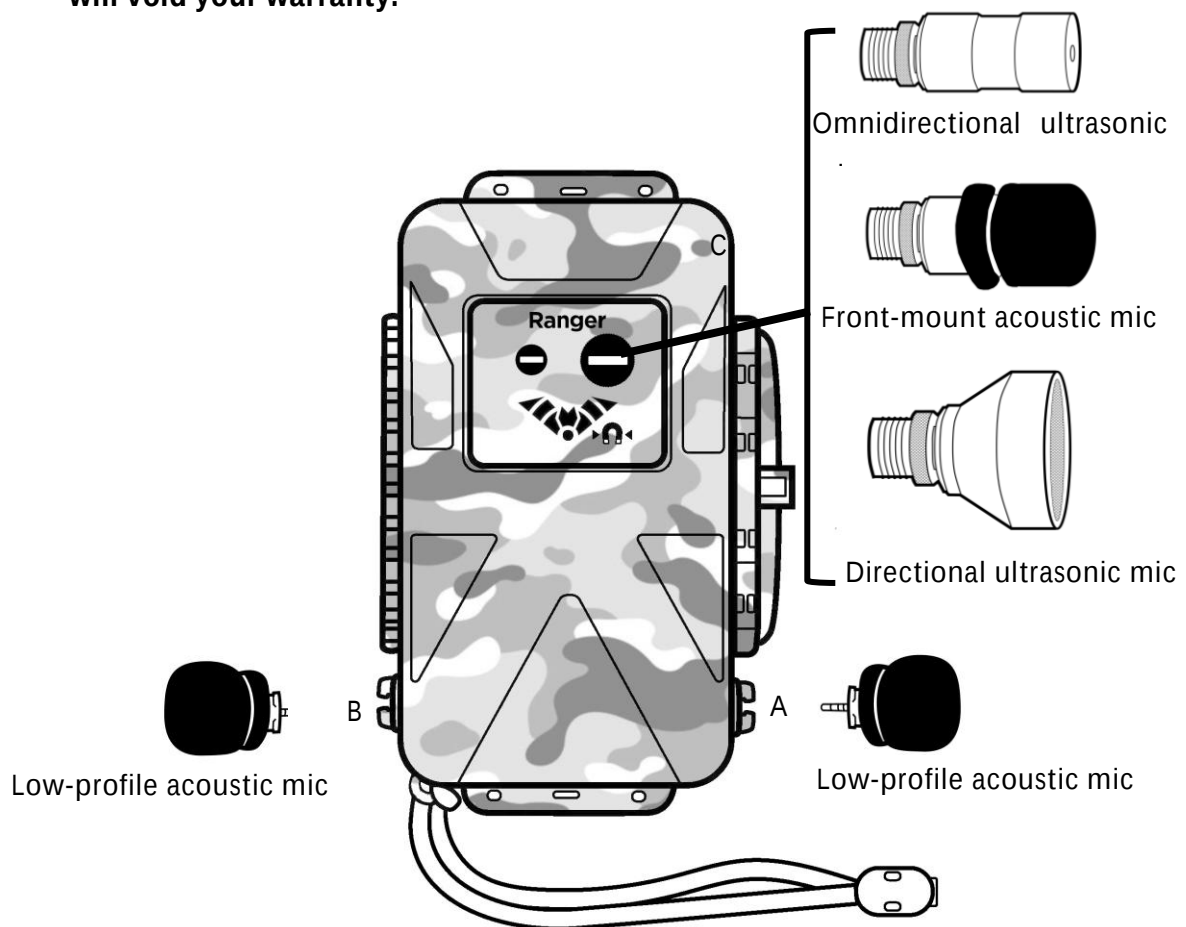
The Ranger uses a micro-USB cable (not supplied) for connection to your computer. Ensure you are using a good quality USB cable with a data line (usually thicker than power-only cables). You can use this cable to upgrade the firmware, adjust settings, create schedules and utilise other features in Anabat Insight (see **Using Toolbox in Anabat Insight**). 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 Ranger.

USING THE RANGER

The Ranger 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

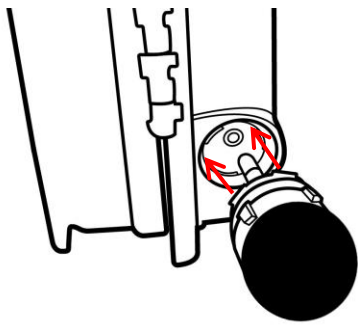
1. Connect your chosen microphone/s to the appropriate sockets, refer to the images below. **Ensure the supplied dust caps are properly fitted to any unused socket to prevent water ingress. Failing to properly install the microphone or dust cap will void your warranty.**



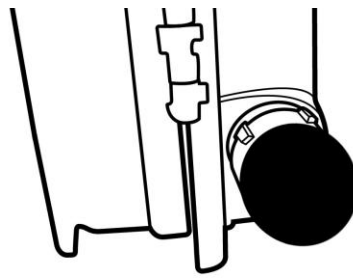
Channel A/B instructions:

Remove the dust cap covering the mic socket by turning it 1/8 of a turn, then pull the cap out of the socket and store it safely. 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**

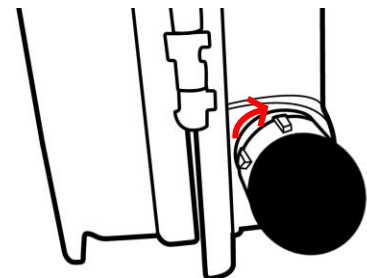
damage to the microphone and recorder. It will only rotate 1/8th of a turn before hitting the end-stop.



Align jack and locking tabs



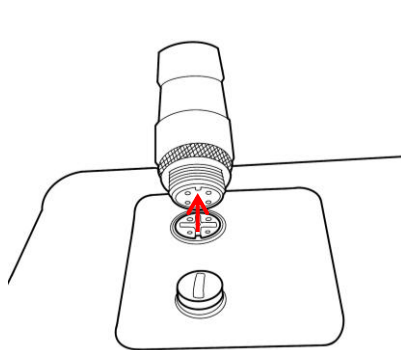
Insert microphone until 'click'



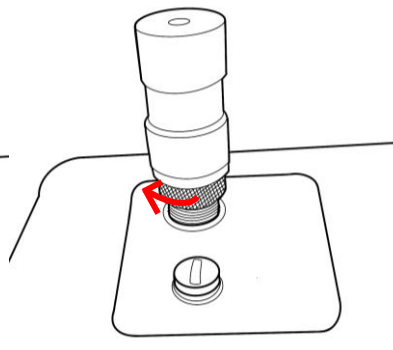
Turn 1/8th turn to end stop

Front-Mount Channel C instructions:

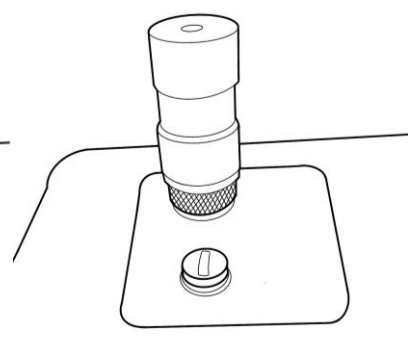
To connect a front-mount microphone, first remove the dust cap by unscrewing it anticlockwise and store it safely. Gently insert the microphone into the microphone socket, taking note of the notch to ensure correct alignment. Rotate the knurled ring clockwise to tighten the connection finger tight. **Do not turn the body of the front-mount microphone or over-tighten the locking ring.**



Line up notch, push to connect



Gently tighten the knurled ring



Stop once the connection is finger tight

2. Insert either 4 or 8 fresh batteries. Refer to **Power Requirements** above for more information on what batteries to use.
3. Insert an SD card with sufficient memory for your recording period. Ensure the SD card is unlocked and correctly orientated as per the diagram beneath the SD card slot when inserting. Refer to the **Data Storage Requirements** above for more information on what size SD card to use.
4. **Turn the recorder on** by pressing the  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.

5. Choose your recording mode with the **Mode button**. Refer to **Recording Modes** for more information on how each of these modes work.
6. Select your **Recording Profile**, choosing from the preset profiles or add your own custom profile with appropriate **file type**, **sample rate** and **trigger settings** for your application.
7. Check your microphone/s are responding by clicking (acoustic) or rubbing (ultrasonic) your fingers in front of the microphone/s: **the VU Meter** on the bottom 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 by the individual tasks that form the schedule. This allows you to use different microphones at different times.

Wait for the GPS receiver to obtain a location fix. 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.

8. 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 Bar** for more information regarding the issue (see **Flashing Status Icons**).
9. **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 Ranger**).

Do not deploy the Ranger if the Check LED is flashing, recording may not occur.

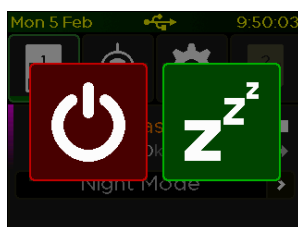
10. Retrieve your recorder. After the deployment is complete, observe the following precautions when retrieving the recorder:
 - If it is wet, dry the unit off before opening it to avoid water entering the unit.
 - Before removing the SD card, ensure the unit is turned off or **safely eject** the card 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  button.

To turn the recorder off, press and hold the  button for 2 seconds, this will open the **Off/Sleep menu**, press the  icon on the screen 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  button for 2 seconds, this will open the **Off/Sleep menu**, then press **Sleep mode**  icon on the screen. In sleep mode the screen will be off, but the recorder will still record. To turn the screen back on, briefly press the  button again. The Ranger will also automatically enter sleep mode to save power if there has been no user interaction for one minute.



Off

Sleep

USING THE DASHBOARD

You can familiarise yourself with the [dashboard here](#).

Thu 25 Jan 26°C 15:41:06

At the top of the Dashboard is the **Title Bar** displaying the date (left), time (right), and other information (centre) which by default will display the temperature, however it will also display the battery status, external power status, or USB connection when relevant. The background colour of this bar will be green when the unit is ready to record and there are no errors, and red if there is something that could prevent successful recording.



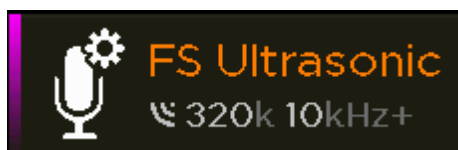
The **SD Card** buttons indicate the amount of used space with a colour fill. If the colour is green, you still have more than 50% free space, orange indicates 50 – 90% of your card is used, and red indicates you have less than 10% remaining. If there is no SD card inserted, the icon will be greyed out and flashing to indicate an issue. If you press on an SD Card button, you will enter the **SD Card Menu**.



The **GPS** button will flash if the last GPS fix is more than 24hrs old and a fix is required for the recording mode. It will also change to a **Transect icon**  if in **Transect Mode**. If pressed it will take you to the **GPS Information** screen.



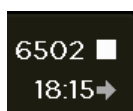
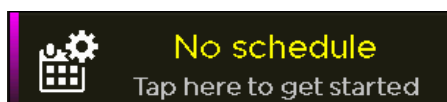
The **Device Settings** button will flash if the time zone is not set or is location-based guess that needs checking. When pressed it will take you to the **Device Settings Menu**.



The **Recording Profile** will display relevant summary information about the recording profile currently active. For example, for triggered recording, it will show

the sample rate and trigger frequency range. The **Microphone Settings**  icon will flash if there is an issue with your microphone/recording settings. Pressing anywhere on the microphone settings icon or recording profile will take you to the **Recording Profile Menu**.

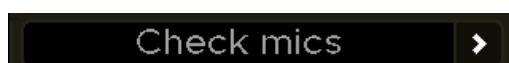
Please note: If the **Recording Mode** selected is **Schedule**, then the **Schedule Settings** will be displayed (see below).

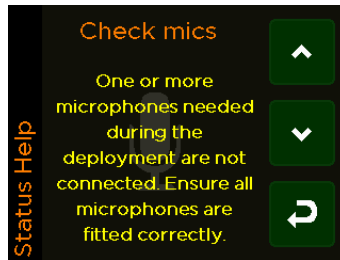


To the right of the **Recording Profile**, some summary information about your recording session is displayed. On the furthest right, either a   or  will be displayed indicating if active recording is taking place. The number of files recorded in the deployment (eg. since the recorder was turned on) to the **Recording folder** will be displayed to the left of this. If you are not currently recording, the recording start time will be displayed below this, if you are recording then the stop time will be shown.

The **Status Bar** near the bottom of the dashboard will display the recording mode (eg. Night Mode).

Please note: The **SD card**, **GPS Information**, **Device Settings**, **Microphone Settings** or **Schedule Settings** 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 icons will flash. When an icon is flashing, you can see more information about the issues in the **Status Bar**. All issues requiring your attention will be shown there, in the case of multiple issues, it will scroll between messages. In the example screenshot below, you can see "*Check mics*" written below. To find out more information about the issues and how to resolve them, tap on the status bar to enter the **Status Help**, where you can scroll through the current error messages and resolutions.





On the bottom of the dashboard are VU (Volume Unit) meters that will appear when microphones are connected. These bars will move right and left in response to the loudness of sounds, so you can see your microphones working. The bars correspond to the Front-mount microphone (top), Side A latch microphone (middle), and Side B hinge microphone (bottom) channels.

Dashboard Shortcuts

There are a number of shortcuts available on the dashboard to allow you to complete common tasks quickly.

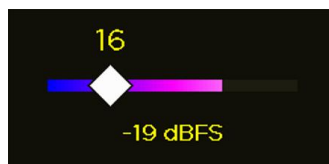
Pop-Up Sensitivity Editor

When an ultrasonic microphone using triggered recording is configured, a pop-up microphone sensitivity editor can be accessed by tapping on the VU meter at the bottom of the Dashboard. Drag or tap to move the sensitivity slider as required. Tap anywhere on the screen outside the pop-up to close it. This will change the sensitivity setting saved in the currently selected profile. Refer to the section on **Sensitivity** for more information about adjusting this level.

Dashboard VU Meter



Pop-Up Sensitivity Editor



Quick Eject SD Card

Double tap on the left or right SD card to eject the corresponding card.

Power/battery status screen

Tap in the centre of the Dashboard **Title Bar** to jump straight to the battery and external power voltage readouts.

Change current profile

Press and drag left or right on the **Recording Profile** to switch between profiles.

Please note: This only works when not actively recording.

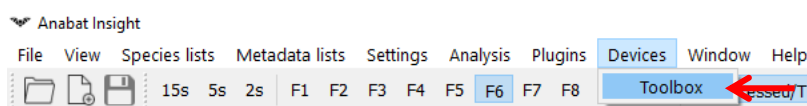
UPDATING FIRMWARE

It is important to keep the firmware on your Ranger up to date to ensure trouble-free operation. The Ranger firmware can be updated through **Toolbox** using an SD card, or via USB cable to your PC. It is highly recommended that you subscribe to receive email alerts of new Ranger firmware updates using this website:

<https://titley.m-pages.com/Ot7VRx/ranger-firmware-updates-subscription-form>

To update firmware:

1. Download and install **Anabat Insight** from **Titley Scientific** (free download). Or if you already have Anabat Insight installed, ensure you are running the most up-to-date version. If an update is required it will be indicated by a green bar near the top of the program window.
2. Open Anabat Insight, under the **Devices** menu, select **Toolbox**.



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

To update via USB cable:

1. Connect the Ranger 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  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.



Updates

Current Version **2.4.6.23047**

Online Version 2.4.7.23058

Update required



Updates

Current Version **2.4.8.23137**

Online Version 2.4.7.23058

Detector 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 Ranger 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 Ranger 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 Ranger then turn it on. After a few moments a message will appear: **There is new firmware available. Update to version X.X.X?** Select **Yes** 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 Ranger 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 file from the SD card or use the card again to update other recorders.

Please note: The Ranger 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 **Recording Mode 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 depends 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 Ranger 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 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. You can create a schedule on the recorder or with the **Toolbox in Anabat Insight** (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 microphone settings. Schedule mode requires a GPS fix if your schedule is based around sunset and sunrise times. If you select Schedule Recording Mode, the **Recording Profile** on the **Dashboard** will switch to the **Schedule Settings**.

Selecting a Recording Mode

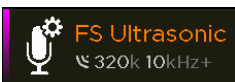
To select the recording mode, press the **Mode button** to cycle through the modes until the desired mode LED is lit.

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 acquired. 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 Information** screen to refresh the GPS fix.

RECORDING PROFILE / SETTINGS

To access the **Recording Profile / Settings** Menu, press anywhere on the Microphone

Settings or Recording Profile  on the dashboard.

Please note: If you are in Schedule Recording Mode, the recording profile/settings are saved as part of the schedule tasks. You can store up to 12 profiles and 12 schedule tasks, with a combined maximum of 16 profiles or tasks.

Recording Profile Menu



To exit the recording profile menu, press the  button on the right.

PRESET RECORDING PROFILES

There are 4 preset recording profiles you can choose from, these are designed to cover the 4 most common uses for the Ranger. To select a recording profile, tap the profile you want, then press ✓ **Use**. Profiles can be added, edited or deleted as required. The default profiles and their function are listed below:

- **Acoustic** – This will record in mono acoustic from Channel A.
 - File Type – WAV
 - Microphone Channel – A (latch-side)
 - Sample Rate – 44.1ksps
 - Gain – 12dB
 - Max File Length – 1hr
 - File Prefix – “Type”
- **FS Ultrasonic** – This is full spectrum ultrasonic recording.
 - File Type – WAV
 - Microphone Channel – C (front-mount)
 - Sample Rate – 320ksps
 - Activation - Triggered
 - Microphone Sensitivity - 16
 - Minimum Trigger Frequency – 10kHz
 - Maximum Trigger Frequency – 250kHz
 - Minimum Event Time – 2ms
 - Minimum Record Time – 2 seconds
 - HP Filter – On
 - Noise Filter - Keep
 - Maximum File Length – 10 seconds
 - File Prefix – “Type”
- **Simultaneous** – This will record full spectrum ultrasonic (from the front-mounted microphone) and mono acoustic (from Channel A) simultaneously.
 - File Type – WAV
 - Microphone Channel – A (acoustic) & C (ultrasonic)
 - Sample Rate – 384ksps (ultrasonic) & 48ksps (acoustic)
 - All other settings match both the FS Ultrasonic and Acoustic profiles above
- **ZC Ultrasonic** – This will record ultrasonic range in zero crossing mode.
 - File Type – Zero Crossing
 - Frequency Division Ratio - 8

File Prefix – “Type”

All other settings match the FS Ultrasonic profile above.

If you would like to reset a profile back to default values, tap the profile name, then select **Edit**, press the  refresh icon, then select **Yes**, and choose the profile you wish to reset to.

If you would like to reset all profiles back default values, tap the  menu icon, then select **Reset**, a warning will pop up stating ‘**This will remove your custom profiles, leaving only the factory defaults. Are you sure?**’, then select **Yes**.

CUSTOM RECORDING PROFILES

You can choose to edit the pre-existing profiles, add new profiles, as well as import or export profiles from an SD card.

To edit a pre-existing profile, tap the profile name, then select **Edit**. Use the   arrows on the right to move through the settings. On the setting you wish to edit, tap the   arrows to scroll through the options. Press the  button on the right to save your changes.

To add a new profile, press the  menu icon in the top right, then select **+ Add...** Choose the closest default template to your preferred profile settings. This will open a “New” profile, you can then edit the settings as you would a pre-existing profile. You can give the profile a new name, enter text by tapping using your fingernail, to reveal more letters/numbers/symbols either swipe right/left on the keyboard, or tap the green   buttons. To erase a letter tap the **x** icon in the top right, once the profile name is complete, tap the  icon in the top left.

To export profiles to the SD card, insert an SD card, press the  menu icon in the top right, then select **Export**. All profiles will be saved to the SD card into a file named “profiles.json” so you can import them onto other units.

To import profiles from an SD card, insert the SD card with the profile, press the  menu icon in the top right, then select **Import**. Imported profiles are added to the current profile list. Existing profiles with the same name as imported profiles will be overwritten by the profile from the SD card.

SETTINGS

Within a profile, there are several settings you can modify. To change these settings **edit a pre-existing profile**.

Profile Name

Tap the **Name** to change to new word/s. Enter text by tapping using your fingernail, to reveal more letters/numbers/ symbols either swipe right/left on the keyboard or tap the green ◀ ▶ buttons. To erase a letter, tap the **x** icon in the top right, once the profile name is complete, tap the ✓ icon in the top left.

Profile Colour

Each profile is assigned a colour, tap **Colour** to change. Select the colour by tapping anywhere on the colour map. Once complete, press the ↻ button on the right to save your changes.

File Type

You can choose between **WAV** (.wav) or **ZC** (.zc), toggle between using the ◀ ▶ arrows on either side of the file type.

For acoustic recording, or ultrasonic full spectrum recording, choose WAV. For ultrasonic zero crossing recording choose ZC. **See here to learn about the difference between full spectrum and zero crossing.**

Frequency Division Ratio (ZC 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 ◀ ▶ arrows on either side of **FD Ratio**. Typically, a division ratio of 4 is appropriate for most situations. A division ratio of 16 will save SD card space at the expense of recording resolution.

Microphone/Channel

To toggle between different microphone/channel options, use the ◀ ▶ arrows on either side of **Microphones**. The side channels (A and B) are acoustic only (can only use acoustic sample rates). The front-mount channel (C) is ultrasonic and acoustic compatible,

depending on the microphone attached. Combinations are available to provide mono (mic A, B, or C), stereo acoustic (AB), or simultaneous recording (AC, CB, ABC). If you select ZC file type, the microphone will be locked to channel C.

Sample Rate (WAV only)

Please note: Sample rate is only able to be changed/selected for WAV file types and is limited by the microphone/channel chosen.

To toggle between different sample rates, use the ◀ ▶ arrows on either side of **Sample Rate**. You can choose between acoustic sample rates of 96, 48, 44.1, 32, 24 or 22.05ksps, and ultrasonic full spectrum sample rates of 500, 384, 320 or 192ksps.

Notes on sample rate

- The chosen sample rate should be at least double the highest frequency sound of interest (see FAQ for more information). Note that higher sample rates require more storage space on the SD card, refer to Power and Data Storage.
- For simultaneous recording of ultrasonic and acoustic, the sample rates are locked at 384ksps (ultrasonic) and either 48ksps or 24ksps (acoustic).

Activation (Triggered or Constant Recording)

This setting lets you choose how the Ranger behaves when it is “active”, e.g. in **Day mode** your Ranger is “active” during the daylight hours. Whether or not it is actually recording sound during the “active” period depends on the **Activation** setting. For more information see FAQs. You can choose from either **Constant** or **Triggered**. To toggle between activation options, use the ◀ ▶ arrows on either side of **Activation**.

Please note: Triggered is only available for ultrasonic recordings. If you wish to use the noise filter, you must choose triggered recording. Acoustic recordings are always Constant.

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.

Gain (Channel A & B only)

Gain changes the amplitude of the microphone signal for acoustic recording. You can adjust the gain of each of the two side channels (A and B) independently, in increments of 3dB up to +15dB. use the ◀ ▶ arrows on either side of the applicable **Gain**.

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, make sure the gain settings for side A and B are equal for normal stereo recording.

Please note: You cannot change the gain of ultrasonic recording, or on Channel C (front-mount), even if an acoustic microphone is attached.

Sensitivity (Triggered Activation Only)

This lets you control how loud the sound must be to trigger an ultrasonic 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 Ranger will be recording, and this should be kept in mind when setting the sensitivity. You may wish to re-consider the deployment location of the Ranger if the ambient noise is too high, rather than reducing the sensitivity level and recording fewer bat passes.

To change the sensitivity, press the ▶ arrow on the right of **Mic. Sensitivity**, this will display a slider and VU meter with incoming microphone signal. Use your fingernail to drag the slider or tap on a specific position to choose the desired sensitivity, then tap the ↻ button on the right to save your changes. 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 Frequency (Triggered Activation Only)

This is the minimum frequency (kHz) 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, press the ➤ arrow on the right of **Min. Trigger Freq.** and then use the ▲ ▼ arrows above each digit to choose the value, then tap the ↻ button on the right to save your changes. The default value is 10 kHz. Setting this higher can reduce the number of noise recordings but be careful not to exclude any bats that may be of interest.

Maximum Frequency (Triggered Activation Only)

This is the maximum frequency (kHz) that will trigger a recording. Any sound above this will not trigger a recording but may be recorded after a trigger occurs. To change, press the ➤ arrow on the right of **Max. Trigger Freq.** and then use the ▲ ▼ arrows above each digit to choose the value, then tap the ↻ button on the right to save your changes. 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 (milliseconds) that will trigger a recording. You can set this to the minimum duration sound (e.g. bat pulse) to be recorded. To change, press the ➤ arrow on the right of **Min. Event** and then use the ▲ ▼ arrows above each digit to choose the value, then tap the ↻ button on the right to save your changes. 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 (seconds) 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 Length** it will be ended and a new file started immediately. To change, press the ➤ arrow on the right of **Min. Record Time** and then use the ▲ ▼ arrows above each digit to choose the value, then tap the ↻ button on the right to save your changes. The default minimum recording time is 2s.

10k High Pass Filter (Ultrasonic Only)

This filter is a high pass filter that attenuates signals below 10 kHz. In typical ultrasonic 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, tap **HP Filter** to toggle between  (On) and  (Off). This setting only applies to sample rates of 192ksps or higher. For sample rates lower than this the filter is automatically disabled.

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 (eg. 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.

Maximum File Length

The maximum file time represents the maximum length of a file and can be up to 1 hour. 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 between several prefixes which will be added to the start of all recordings including:

- Recorder serial number
- Device nickname
- Device Asset ID
- Type. This refers to whether the files are ultrasonic full spectrum ("us"), acoustic ("ac"), or zero crossing ("zc") and is dependent on your file type and sample rate.
- Or no prefix.

To toggle between prefix options, use the ◀ ▶ arrows on either side of **File Prefix**.

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 tap **Transect** to toggle between  (On) and  (Off). Note that using transect mode will more than halve the battery life.

While in transect mode, the GPS icon on the dashboard will change to . For more information on using transect mode, [see here](#).

Metadata Key

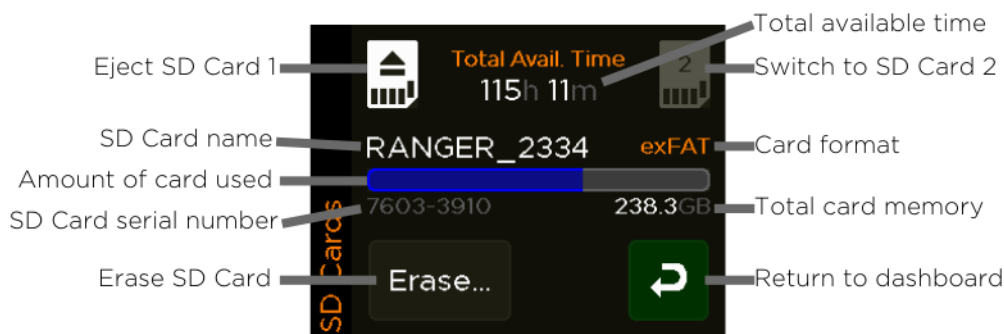
You can add a custom metadata key to be added to every file recorded with this profile (e.g. Site). To do this tap **Metadata Key**. Enter text by tapping using your fingernail, to reveal more letters/numbers/ symbols either swipe right/left on the keyboard or tap the green   buttons. To erase a letter, tap the **x** icon in the top right, once the profile name is complete, tap the  icon in the top left.

Metadata Value

You can add a custom metadata value to be added under the **Metadata Key** (specified above) to every file recorded with this profile (e.g. Cat Tien National Park). To do this tap **Metadata Value**. Enter text by tapping using your fingernail, to reveal more letters/ numbers/symbols either swipe right/left on the keyboard or tap the green   buttons. To erase a letter, tap the **x** icon in the top right, once the profile name is complete, tap the  icon in the top left.

SD CARD MENU

Access the **SD Card Menu** by tapping on either of the **SD Card** buttons. Depending on which SD Card button you selected, it will show you the information for the card in SD card slot 1 or 2. This includes the **Total Available Time** (based off the recording mode and profile/schedule currently selected), the SD card name (if it has one), the card format, the card serial number, the space used and the total memory space on the card. You can also **eject the card**, or **erase/format the card** from this menu. You can switch between card slot 1 and 2 by pressing on the opposing card icon at the top of the menu. To exit the SD Card Menu and return to the dashboard tap .



EJECT SD CARD

You should only remove an SD card if the recorder is off, or the card has been safely ejected, otherwise you risk corrupting the card and any files recorded. To eject the SD card, select the appropriate card slot, then tap the . If this  is shown, it means the card can be safely removed. You can also double-tap on the corresponding card icon from the dashboard to eject it.

ERASE / FORMAT SD CARD

You can erase your SD cards on the recorder, which will also format the SD card with the best configuration for the currently chosen recording settings. To do this go to the **SD Card Menu**, select the appropriate card slot, then tap the **Erase...** button, it will prompt a warning '**All information on the card in slot X will be lost. Erase card now?** To proceed tap **Yes**.

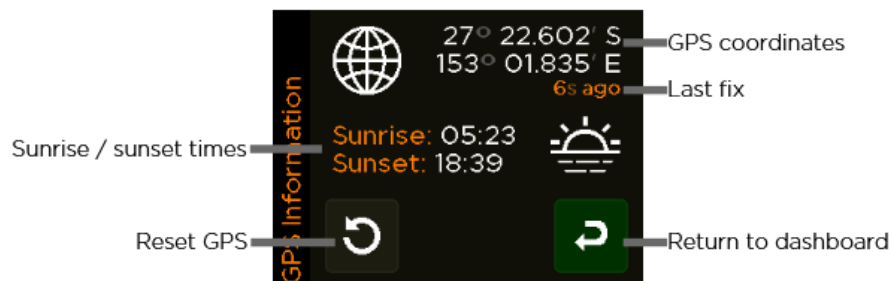
Please note: Erasing / formatting the card will erase all data on the card, so ensure you have downloaded your data beforehand.

GPS

The Ranger attempts a GPS fix once the recorder is turned on, when recording begins, and whenever it is in the **GPS Information** screen. If left on/sleeping, it will attempt a GPS fix every 24 hours. If the Ranger fails to get a GPS fix three times in a row during a deployment, the GPS will not try again for the duration of the deployment (to save power). 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.

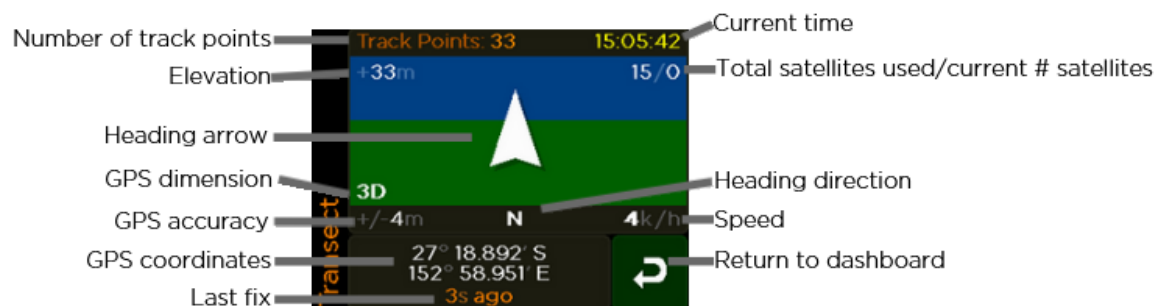
To access the **GPS Information** screen, tap the GPS icon  on the dashboard. The location coordinates will be displayed in the top right; the sunrise and sunset times will also be displayed. To exit GPS Information and return to the dashboard tap .



Please note: You can set a GPS location override for instances where your recorder will never be able to get a fix (e.g. cave, culvert, dense forest). To do this, create a schedule using Anabat Insight. Alternatively, get a GPS fix prior to entering the area with no GPS signal and the Ranger will continue to use this location for the rest of the deployment.

TRANSECT MODE

If you currently have **Transect Mode** turned on in your Recording Profile and the recorder is currently active, the GPS information screen will display the following:



On this screen you can determine:

- Number of track points.
- Elevation.
- Heading (requires movement at minimum of 4km/hr).
- GPS dimension: whether the fix is 2D (inaccurate) or 3D (more accurate).
- GPS accuracy.
- GPS coordinates.
- When the last GPS fix was last received.

- Speed.
- Number of satellites from the last position update / current number of satellites.
- Overspeed warning: when the speed is above the set GPS Warning Speed, the display will change from green to red to indicate the desired maximum transect speed has been exceeded. Refer to **GPS Warn Speed** in the Display Settings.

To exit the GPS information screen and return to the dashboard tap ↶.

DEVICE SETTINGS

You can access the **Device Settings** menu by tapping on the  icon on the Dashboard. The Device Settings menu allows you to edit the regional and display settings, create/edit a digital asset tag, view system and regulatory information, change the sensor log frequency and external power cutoff. To exit Device Settings and return to the dashboard tap ↶.

REGIONAL SETTINGS

To view/edit the **Regional Settings**, tap **Region** in the **Device Settings** menu. From here, you can view/edit the following:

- **Language** – choose between multiple language options, see below for more information.
- **Date Format** - choose between Day-Month-Year or Month-Day-Year.
- **Time Zone** – increase the hours + or – relative to GMT to suit your time zone. Remember to account for any daylight savings time that may be in effect.
- **Temperature Scale** – choose between Celsius and Fahrenheit.
- **Distance Units** – choose between Metres, Feet and Yards.

Toggle between the Regional Settings options using the ◀ ▶ arrows on either side of the relevant setting. To exit Regional Settings and return to Device Settings tap ↶.

Installing alternate languages

Languages available for installation include English, English (US), Español, Français, Polski and Deutsch. Only two languages can be installed on the recorder at a time, English plus an alternate language. You can use [Toolbox within Anabat Insight](#) to choose your preferred languages.

To install alternate languages firstly open Toolbox within Anabat Insight and either connect your recorder **via USB** or **set up an SD card** for your Ranger.

If connected with the USB, navigate to the  **Device Settings tab** of **Toolbox**. Under **Language** choose your preferred **English** and **Second Language** from the dropdown menus, then click **Apply**.

If using an SD card to install alternate languages, navigate to the  **Update tab** of **Toolbox**. Click **Apply to SD**, then safely eject the SD card from your computer. Insert the SD card into your Ranger, if you are prompted to update the firmware, follow the prompts. Then navigate to the **Device Settings** menu, and tap on **Region**, under **Language** use the ◀ ▶ arrows on either side to change to your preferred language. Tap the ↻ button, it will warn you **'This language will be installed. Continue?** Tap **OK** to install or **Undo** to return to the previous language selection. The recorder will restart.

At any point you can switch between English and your alternate installed language on your Ranger without using USB or SD card.

DISPLAY SETTINGS

To view/edit the **Display Settings**, tap **Display** in the **Device Settings** menu. From here, you can view/edit the following:

- **Display Timeout** - choose if the screen goes to sleep automatically after 1 minute, or Never. Note that if the screen is always on this will rapidly drain the batteries.
- **Navigation Buttons** – choose between the left or right side of the screen for the navigation buttons. You must return to the dashboard to activate this change.
- **Red Screen** – Red screen can be used to reduce the impact of the screen on your night vision. Choose if the red screen is off, always on, or on after dark (based on sunset/sunrise times).
- **GPS Warn Speed** – gives a visual warning when this speed is exceeded. The warning will only appear in the **GPS information screen** when **Transect Mode** is active. This is useful to avoid overspeed when performing driving transects.
- **Recalibrate Touchscreen** – To access this option, tap ♥ in the Display Settings menu. Confirm if you wish to recalibrate the touchscreen. When recalibrating,

ensure you tap the circle precisely using a stylus or fingernail. You can attempt to recalibrate the screen if the touches appear inaccurate or erratic.

Toggle between the Display Settings options using the ◀ ▶ arrows on either side of the relevant setting. To exit Display Settings and return to Device settings tap ↶.

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 a device nickname, company name, asset ID, contact name and contact address/email. The device nickname will also be displayed on the start screen. To view/add/change your asset tag, tap on **Asset Tag** in the **Device Settings** menu. Tap on the feature you would like to add/edit (e.g. Nickname). Enter text by tapping using your fingernail, to reveal more letters/numbers/ symbols either swipe right/left on the keyboard or tap the green ◀ ▶ buttons. To erase a letter, tap the ✕ icon in the top right, once the text is complete, tap the ✓ icon in the top left.

You can also add an asset tag using **Toolbox** with your recorder connected via USB.

To view the Asset Tag for the recorder, tap on 👁 icon in the top right corner.



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

SYSTEM INFORMATION

To view the **System Information**, tap **System Info** in the **Device Settings** menu. From here, you can view the following:

- Recorder Serial Number
- Firmware Version Number
- Bootloader Version Number
- Battery / External Power Voltage
- Diagnostics – This is for factory use; you may be instructed to use this by technical support. To exit the diagnostics screen, press the ⏻ button.

To exit System Information and return to Device Settings tap ↶.

LOG START TIME

By default, the Ranger will start new log files at midday. Use the ◀ ▶ arrows on either side of the **Logs Start At** to toggle between **00:00** (midnight) and **12:00** (midday).

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 Ranger 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.

EXTERNAL POWER CUTOFF

If you are running the Ranger from an 12V external power supply, you can set the minimum voltage when the recorder will automatically turn off. Use the ◀ ▶ arrows on either side of

the **Ext. Pwr Cutoff** to adjust it between 8 - 11 volts in steps of 0.5. This can be used to protect an external battery for over-discharge. If you are using an external battery cutoff or solar regulator system, be sure to set this level lower than the one configured on your external regulator to ensure that the Ranger does not shut down earlier than expected.

REGULATORY INFORMATION

To view the **Regulatory Information** for your region, tap **Regulatory** in the **Device Settings** menu. To exit this screen, tap anywhere to return to **Device Settings**.

RESET SETTINGS

You can reset the **Device Settings** to factory defaults, to do this tap ▼ in the Device Settings to **Settings Reset...** It will ask '**Are you sure you want to reset settings to factory defaults?**'. Tap **Yes**, then **Okay**. To exit Device Settings and return to the **Dashboard** tap ↶.

Please note: This will not reset your profile, microphone or schedule settings. To reset your profile or microphone settings to factory default, [see here](#). The language will be reset to English but the secondary installed language will remain available.

SCHEDULES

To use the **Schedule Recording Mode**, you'll need to have a schedule set up. You can do this on the Ranger itself, or to visualise more complex multi-task scheduling, you can use [Toolbox in Anabat Insight](#). For instructions on how to create a schedule in Toolbox, please see the [Anabat Insight user manual](#).

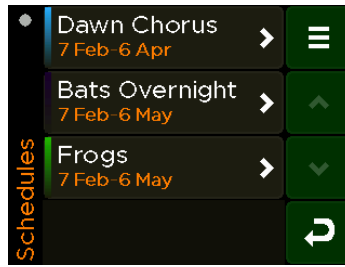
CREATE A NEW SCHEDULE

To get started creating a schedule, first choose **Schedule** for the **Recording Mode**. In the **Dashboard**, the status message will state '**No Schedule. Tap here to get started**', tap this message. Tap on the schedule screen to create a new schedule.

1. Choose a schedule name (eg. Dawn chorus). Tap on **Name**, then enter text by tapping using your fingernail, to reveal more letters/numbers/ symbols either swipe

right/left on the keyboard or tap the green ◀ ▶ buttons. To erase a letter, tap the ✕ icon in the top right, once the text is complete, tap the ✓ icon in the top left.

2. Allocate a **Task Priority**. If there are conflicting/overlapping tasks, then this will decide which task will take priority.
3. Choose a colour for the task. Tap **Colour**, then choose a colour on the colour map.
4. Choose the microphone settings. Tap **Mic Settings**, then start by choosing the closest **preset profile template** from **Acoustic**, **Full Spectrum Ultrasonic** or **Zero Crossing Ultrasonic**. You can still customise your settings after this step.
5. Customise any settings for the profile you selected. **See here for further details on this step.** Then tap ↻ to return to the schedule.
6. Scroll down using the ▼ to edit the next Schedule settings.
7. Choose your recording start and end dates. Tap **Dates**, use the ◀ ▶ arrows on either side of the day and month to choose the start date (top) and end date (bottom). The years covered by the recording period will be displayed at the bottom. Then tap ↻ to return to the schedule.
8. Choose the days of the week you would like to record. Use the ◀ ▶ on either side of **Days of the Week** to toggle between every day, weekdays, weekends, Mon/Wed/Fri or Tue/Thu/Sat. Then tap ↻ to return to the schedule.
9. Choose the start and end time for recording. Tap **Start**, choose the relative or absolute start time at the top of the screen. Then use the ▲ ▼ arrows above each digit to choose the Hour and Minute values. Then tap ↻ to return to the schedule. Repeat for **End**.
10. Scroll down using the ▼ to edit the final Schedule settings.
11. Choose if you would like the schedule on or off, by toggling between ☒ (Active) and ☐ (Inactive).
12. If you would like to employ advanced settings, such as Duty cycling (on/off periods throughout a recording window), or minimum temperature for recording. Tap **Advanced**. Use the ◀ ▶ on either side of **Duty Cycle (mins)** to toggle between Always, 1 on/1 off, 5 on/5 off, 10 on/10 off, 10 on/20 off, 10 on/50 off, 15 on/15 off or 60 on/60 off. Toggle **Minimum temperature** between ☒ (On) and ☐ (Off), when **On**, choose the minimum temperature that recording will start. Then tap ↻ to return to the schedule.
13. Tap ↻ to return to the **Schedules Overview**.



Schedule Overview

If you already have a schedule saved, you can create multiple schedule tasks that will record simultaneously (if not conflicting). To add another schedule task, tap on the existing schedule task next to **Schedule Settings**  on the dashboard. Tap the menu  in the top right, then tap **Add** to create another schedule task.

Please note: If you have multiple schedule tasks running simultaneously (e.g. an acoustic task and an ultrasonic task), it will prompt the following message: **As these schedules will run concurrently with *X Task*, specific sample rates have been selected.** Tap OK.

IMPORT A SCHEDULE FROM AN SD CARD

To import a schedule from an SD card, first ensure that the SD card has a schedule.json file saved on it that has been exported from a Ranger or created in using Insight, then insert the SD card and turn the recorder on.

1. Choose **Schedule** for the **Recording Mode**.
2. In the **Dashboard**, either tap the status message ('**No Schedule. Tap here to get started**') or the existing schedule task name next to **Schedule Settings** .
3. Tap the menu  in the top right, then tap **Import** and the schedule file from the SD card will be saved to the Ranger. This will overwrite the current schedule saved on the Ranger.

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.

EXPORT A SCHEDULE TO AN SD CARD

To export a schedule to an SD card, first create the schedule, then insert an SD card and turn the recorder on.

1. Choose **Schedule** for the **Recording Mode**.

2. In the **Dashboard**, tap the existing schedule task name next to next to **Schedule Settings** .
3. Tap the menu  in the top right, then tap **Export** and the schedule file from the Ranger will be saved to the SD card in a file called "schedule.json". This can be loaded onto other recorders or opened in Insight.
4. Remember to **safely eject the SD card** before removal.

EDIT/COPY/DELETE A SCHEDULE

To edit, copy or delete a schedule from the Ranger, choose **Schedule** for the **Recording Mode**. In the **Dashboard**, tap the existing schedule name next to next to **Schedule Settings** . In the **Schedules Overview**, tap the appropriate schedule, then select either **Edit**, **Copy** or **Delete**.

TESTING YOUR RANGER

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 (ultrasonic microphone) or click (acoustic microphone) your fingers in front of the microphones; the **VU Meter/s** (on the bottom of the dashboard) will move across to confirm that an audio signal is being detected.



The bars correspond to the Front-mount microphone (top), Side A latch microphone (middle), and Side B hinge microphone (bottom) channels.

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; the Check LED on the front should flash once to indicate the unit is operational. When the magnet is held on, if an ultrasonic microphone is attached, it will flicker with the ultrasonic signal being received.

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. Tapping on the status bar will give a listing of the errors with a more detailed explanation of the problem.

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	One or more SD cards 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 Ranger logo facing skywards. Enter the <u>GPS Information</u> 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 Ranger cannot secure a new fix, it will <u>revert to the last known location</u>
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.
Recorder 	
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	Ranger is in Inactive Mode, and 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 batteries in the lid/main compartment of Ranger are low. Please replace before deployment.
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.
Remove batteries	External power has been connected but internal AA batteries are still

	fitted. Remove the AA batteries from the recorder.
External Power Low	The external power is at the external power cut off voltage. Check the external power supply.

PASSIVE DEPLOYMENT CONSIDERATIONS

WEATHERPROOFING

The Ranger 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. For further instructions on this, **[see the guide on our website here](#)**.

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 (e.g. 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 Ranger 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 microphone extension cable, which we recommend for mounting the ultrasonic microphone, so it can be placed away from flat reflective surfaces.

The Ranger 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 Ranger is set to ultrasonic recording with triggered activation, the Sensitivity Editor screen displays a dBFS (decibels relative to full scale) measurement from microphone channel C. 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 Ranger 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 practise 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, press and hold the  button for 2 seconds, this will open the **Off/Sleep menu**, press the  icon on the screen 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. 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 before storing the recorder. **Do not remove the SD card without first turning off the recorder or ejecting the SD card** 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 **safely ejecting the card**. **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 using your file 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 profile 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 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 **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 & customise 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 Ranger.

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 Ranger

- **Change the language**
- 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

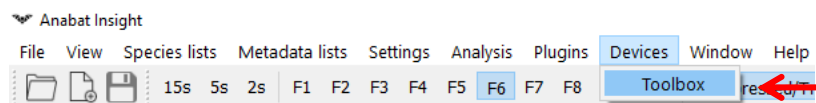
For further instructions on how to use Toolbox with your recorder, see the **Anabat Insight User Manual on our website.**

Using Toolbox

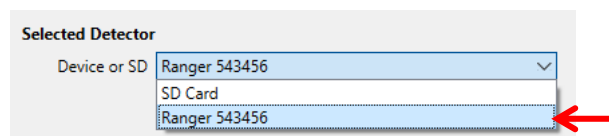
To use Toolbox with your Ranger, you will either need an **SD card**, or to **connect the recorder via USB** to your computer. For certain functions (eg. checking the recorder info or firmware version), you need to connect to the PC.

To connect the Ranger to a PC:

1. Download and install **Anabat Insight** from **<https://www.titley-scientific.com/product/anabat-insight/>**, or if you already have Anabat Insight installed, ensure you are running the most up-to-date version.
2. Turn on your recorder and **connect a USB cable** (with a data line) from the recorder to the PC.
3. Open Anabat Insight, under the **Devices menu**, select **Toolbox**.



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

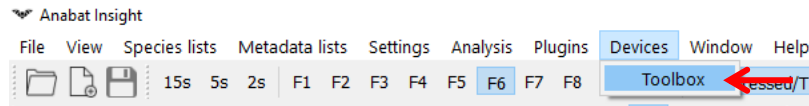


To set up an SD card for Ranger:

1. Download and install **Anabat Insight** from

<https://www.titley-scientific.com/product/anabat-insight/>, or if you already have Anabat Insight installed, ensure you are running the most up-to-date version.

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 **Ranger** from the dropdown menu.

METADATA

All metadata recorded on the Ranger 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 Ranger, 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)
- Recording Profile/Schedule Task name
- Colour Code (from profile/task settings)

TROUBLESHOOTING & FAQs

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.

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

If you are using the Ranger 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 front channel (channel C)**.
2. Place the recorder in your desired **Recording Mode** (e.g. Night Only, Continuous, Schedule).
3. **Choose your preferred profile**: Full spectrum ultrasonic (.wav) or Zero crossing ultrasonic (.zc).

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

If you are using the Ranger 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.
2. Place the recorder in your desired **Recording Mode** (Continuous, Day Only, Night Only, Dusk & Dawn or Schedule).
3. **Choose the acoustic recording profile**.

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.

Please note: If you are in **Transect mode**, the Check LED will flicker with the microphone signal (without the magnet attached), do not mistake this for a flashing Check LED.

The Ranger 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).

Can I record ultrasonic and acoustic at the same time?

You are able to record ultrasonic and acoustic simultaneously, using the **simultaneous profile** or **custom schedule**. For example, you can record acoustic for 24hr/day and

ultrasonic only through the night. To do this, you will need an acoustic microphone and ultrasonic microphone.

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

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

Monoaural – “Mono” recording is recording one file from one microphone. This is how Titley Scientific’s legacy Anabat range of bat detectors work. The Ranger can 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 Ranger 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 Ranger.

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 possible using a custom schedule or profile with the Ranger.

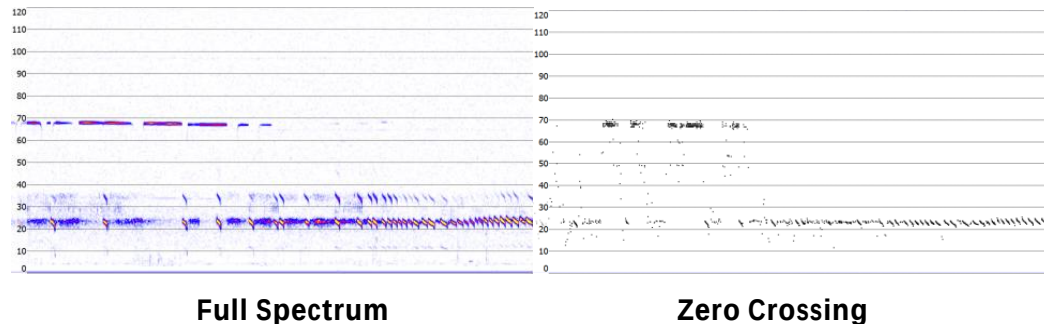
There are a lot of echoes in the spectrogram.

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 microphone away from any flat surfaces (such as boxes or walls). This will produce much clearer recordings.

You may also wish to purchase microphone extension cable accessory from Titley Scientific, which allows you to position the ultrasonic microphone 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.



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.

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

The recording mode, set by the Mode button on the recorder interface (e.g. 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.

How far away can a bat be detected using the Ranger?

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 <https://users.lmi.net/corben/Beta/>).

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 Ranger as an active recorder?

While the Ranger 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?

Yes, the Ranger can be powered externally. You can purchase a **fused power lead** and/or **solar panel accessories** from Titley Scientific.

The files recorded on my Ranger 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.
- Live dBFS displayed for ultrasonic microphone in microphone sensitivity editor to help you better check your microphone performance.
- 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.
- Mic ABC option added which allows Profiles to record simultaneous stereo acoustic and full spectrum ultrasonic, without the need for a multi-task schedule.

Changes:

- Added a new system global setting to control whether WAV files report the precise sample rate used by the hardware (e.g. 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.
- Additional status messages to better aid in diagnosing potential deployment concerns, and changed the conditions under which some existing messages will appear.
- Swapping between acoustic sample rates ($\leq 96\text{ksps}$) and ultrasonic sample rates ($>96\text{ksps}$) in the Profile editor when microphone C is selected will now display a message to change microphones to the correct type for the sample rate chosen.
- Changed the way shut down occurs when external power voltage drops below the cutoff, to more reliably wake up when power is restored.

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.
- Miscellaneous fixes for quality of life and stability.
- GPS coordinates now appear in log files.
- Mic C VU meter now responds appropriately when an acoustic microphone is attached to the front connector.
- Fixed some issues with the GPS Information screen not refreshing correctly.

FURTHER INFORMATION

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