

BAR-LT

Bioacoustic Audio Recorder - Long Term

User Guide

Version 1.2



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2 FEATURES

- Small and light.
- Easy to use interface with large graphical display.
- Ultra-low noise recordings.
- Built in GPS for location, transects and time synchronisation.
- Record up to 2TB of data on 4 SD memory cards.
- Optional FLAC lossless compression (store around 40% more recordings!).
- Sunrise and sunset based scheduled recordings.
- Microphone serial number tracking.
- Microphone detection line so you know the microphone is properly connected.
- Supports multiple sample rates: 8kHz, 16kHz, 22.05kHz, 32.0kHz, 44.1kHz, 48kHz, 96kHz (with corresponding anti-aliasing filters at their Nyquist frequencies).
- Adjustable gain from 10 to 60dB in 1dB increments.
- Standard microphone includes a 20dB class A pre-amp and output driver to drive long cables.
- View and edit the schedule in the field on the recorder itself or via Scheduler software on your PC.
- Detailed diagnostic log files.
- Camouflaged, robust, waterproof, lockable enclosure made from a durable UV resistant plastic.

3 A MESSAGE FROM FRONTIER LABS

Thank you for using our Bioacoustic Audio Recorder – Long Term (BAR-LT).

We designed the BAR-LT with the goal of creating the best possible bioacoustic recorder for scientific field research. To that end we created a recorder that is simple to use and easy to deploy with best in class sound quality so you can hear quiet and distant calls, and we made it strong and reliable with the smallest size and weight possible so it's easier to carry in a backpack. We included features like GPS location and time-synchronisation to save you manual work in record keeping and we designed smart microphones with the lowest noise, a built in pre-amp and cable driver that tells the BAR when they're connected and what type of mic it is. And we designed it to use high-density rechargeable lithium batteries instead of bulky and wasteful Alkalines that just end up in landfill.

We designed the BAR to make your field work easier and more reliable. We hope you enjoy using it and if you have any feedback or ideas for improvements, we would love to hear from you.



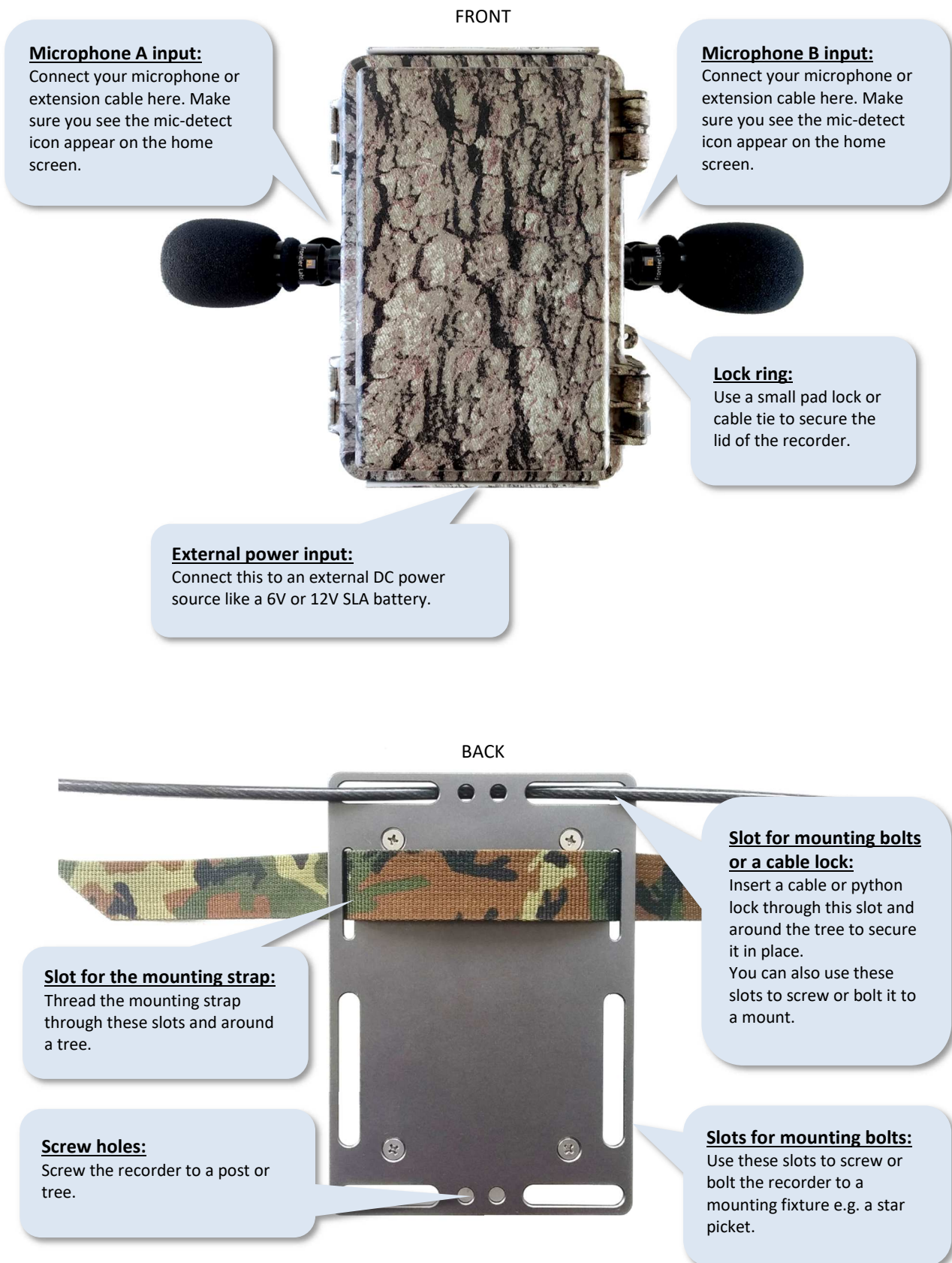
Michael Maggs



Mark Calder

4 OVERVIEW

4.1 GETTING TO KNOW YOUR RECORDER (OUTSIDE)



4.2 GETTING TO KNOW YOUR RECORDER (INSIDE)

Power button:

Press this to turn the recorder ON or OFF. Powering off the recorder stops all future recordings until it is powered on again.

Light sensor:

This is used to detect if the lid is open or closed. If you use the recorder in a very dark environment, it might think the lid is closed and turn off the screen.

SD Card slots:

Insert up to 4 SD cards to store recordings. To eject the cards, push them down and they will spring back out. Do not eject cards while the BAR is on.

Keypad buttons:

Use these buttons to navigate the menus. Press the circular ENTER button to access the Main Menu or select/accept the current menu item. Use the UP/DOWN buttons to scroll through menu items or increment / decrement a selected item.

Battery slots:

Insert up to six 18650 Lithium-Ion rechargeable batteries. The more batteries you use the longer it will record for.

Desiccant bucket:

Insert the silica gel desiccant bucket here every time you deploy. The colour changes from orange to dark green when it is wet and needs to be replaced.

Battery level:

Shows the battery level (% full). Will adjust to show the correct level if powered from an external 6V or 12V battery.

GPS status:

Shows number of visible satellites. Flashes when getting a GPS fix. Shows a tick when completed.

Microphone detected:

Shows if a microphone is detected or not. The channel A/B is displayed next to the icon.

Recording information:

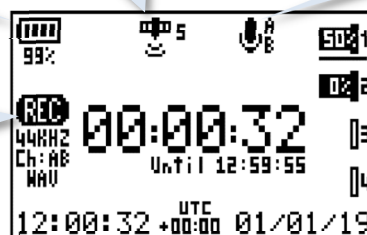
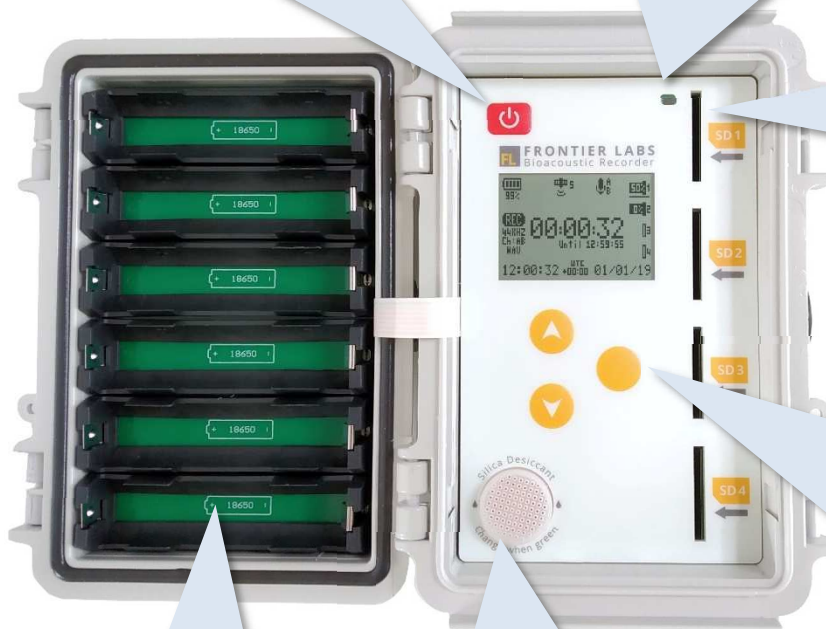
Shows sample rate, channels, and file format. Large digits show the duration of the current recording and the time it will end.

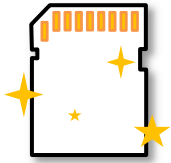
Inserted SD cards (1 to 4):

Shows % used space. Underline shows active card.

Current time and date:

In HH:MM:SS [UTC timezone] DD/MM/YY format. Flashes when updating from the GPS.



Before you deploy:

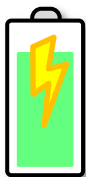
Format your SD cards before every deployment. (Do not just delete the files.) Formatting your cards keeps them running at their maximum speed by cleaning out the filesystem. We recommend using exFAT for cards 32GB and above. You can format your cards using a PC or directly on the BAR-LT.

We recommend using San Disk ultra, class 10 or higher. We have found them to have the best power consumption and reliability in the field.



Check your recording schedule on the BAR-LT or using the Scheduler program on your PC. (See 6.0 Recording Schedule.)

- By default, the BAR-LT comes pre-programmed with a schedule that records continuously all day every day, broken into 1-hour blocks.
- If your schedule contains sunrise or sunset based recordings, it is good practice to set the location in the Scheduler program to roughly where the recorder will be deployed. This provides a backup location value inside the schedule file that the recorder can use to calculate sun-based times if it is unable to get a GPS position fix in the field.
- To load a schedule onto the recorder, save the schedule file as ***schedule.flc*** on your SD card then insert it into the recorder. If you are running firmware v3.30 or later then it will automatically detect the new schedule file and ask if you would like to copy it across. Otherwise press the **ENTER** button to bring up the main menu then navigate to **Utilities → Transfer Schedule → Copy from SD card**.

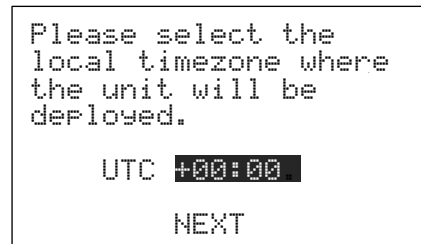
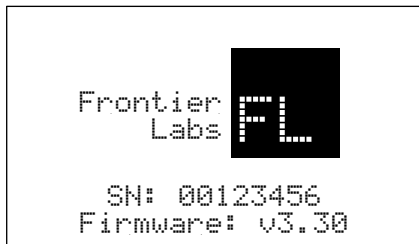


Charge your batteries. Unfortunately, due to transport regulations we are not allowed to ship your batteries fully charged. Please make sure you charge your batteries before each use. Our chargers take up to 6 batteries each and take about 5 hours to charge from empty.

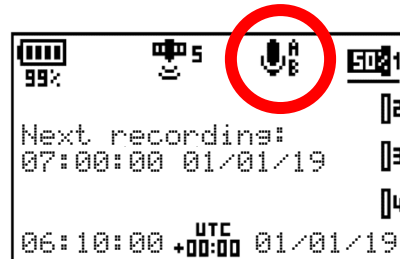
Now is a good time to check everything is working as expected before heading out into the field. Run through the operating procedure listed below and check the time of the next scheduled recording is correct. You can then turn it off until you are ready to deploy it.

Operating procedure:

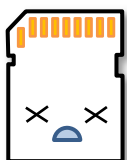
1. Insert the SD cards into the SD card slots of the BAR-LT.
2. Insert up to 6 batteries in the battery holders.
3. Turn the recorder on with the Power button.
 - As the recorder turns on, it shows the serial number and firmware version on the screen.
 - If the unit has been without a battery for a while, the Setup Wizard will appear and ask you to enter the time zone where the recorder is being deployed (note daylight savings is not taken into account).



- The home screen will then say “Waiting for GPS synchronisation” until the clock is automatically updated by the GPS or manually set by the user.
 - Once the clock has been updated it will display the time of the next scheduled recording or start recording if it is in the middle of a recording period.
3. Connect the microphone(s) and check the **microphone detect** status icon appears.



4. It's a good idea to wait until the GPS has acquired a fix before leaving the site in case you need to move to a clearing to get a better signal. It only records a GPS fix once after it has been switched on, then disables the GPS to conserve power. If you turn the unit on more than 1 day before the first recording is scheduled it will automatically try to get a new fix when it starts up for that first recording. This lets you setup everything in the office, lock the lid and have untrained volunteers deploy the recorders without having to do anything.



WARNING: Never eject SD cards while the unit is switched on as this can result in loss of data and corruption of the file system. Always switch the BAR off before swapping SD cards.

4.4 MENUS

Press the **ENTER** button from the home screen to access the **Main Menu** and use the **UP/DOWN** buttons to select different menu items.

```

- MENU -
Recording Schedule >
Manual Recording  >
Settings          >
Utilities         >
< Back

```

Menu Item	Description
Recording Schedule >	
Transfer Schedule >	Copy the schedule file from the SD card onto the recorder. You can also save the stored schedule back on the SD card so you can transfer it to other units.
+ New entry	Add a new recording to the schedule.
[recording name]	View, edit or remove an existing scheduled recording.
Manual Recording >	
[Start]	Starts a manual recording and ignores the scheduled recordings. This can be useful if you want to make a short annotation when you are deploying your recorder.
Settings >	
Gain ChA:	Set the gain of the recordings on channel A from 10dB to 60dB.
Gain ChB:	Set the gain of the recordings on channel B from 10dB to 60dB.
Name:	The name you give to the recorder. This will appear in the filename and meta-data of your recordings and in the logfile (if enabled in the Filename settings menu).
Solar powered: YES/NO	This setting is used to protect external batteries from being over discharged. (See 8.8 Configuring for Solar Power)
Clock settings >	Set the local time, date and time zone of where the unit is being deployed and disable/enable the GPS time sync feature.
Filename settings >	Configure the file name layout including name, serial number, and GPS stamp.
Utilities >	
Battery Status >	View the voltage of the internal or external batteries.
GPS Status >	View the signal strength of the available satellites.
GPS Transect >	This starts a GPS transect where the position is recorded every second to a .gpx file and recordings are saved as waypoints.
SD Card Info >	View the status of the SD memory cards and format the SD memory cards. WARNING: Formatting the cards will permanently erase any recordings on them.
Mic Calibration >	This shows the sensitivity of the microphone elements allowing you to track the health of the microphones. (See 5.2 Microphone Calibration)
Device info >	View the serial number and current firmware version. You can also update the firmware of the recorder from the SD memory card.

5 MICROPHONES

All our microphones have a built-in class A pre-amp with a fixed gain and an output driver so the signal does not attenuate over the cable.

They also include an onboard memory chip containing a serial number and date of manufacture. This information is saved in the diagnostic log file as well as embedded in each recorded file as metadata, allowing you to better track your data and microphone age. Microphone extension cables are available so you can place the second microphone in a different place away from the first one.



The recorder can detect which type of Frontier Labs microphone is attached and adjust its internal gain so that the total system gain stays the same even when you change to a microphone with a different pre-amp.

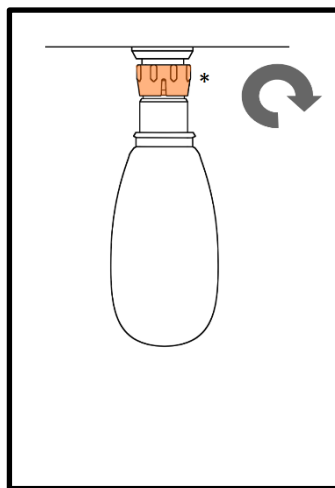
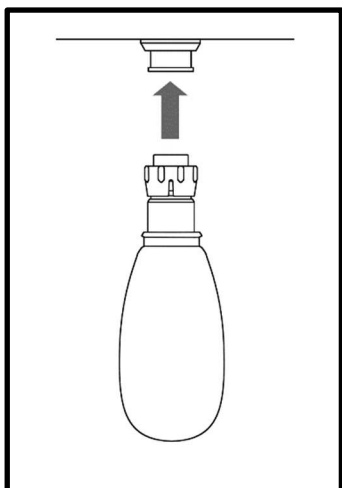
There are currently 3 types of microphones you can connect to your BAR-LT recorder:

Microphone	Pre-amp Gain	Frequency response	Description
Standard (black)	20dB	80Hz – 20kHz	The standard black bodied microphone is ideal for most applications. It uses a highly sensitive, ultra-low noise, omnidirectional sensor element with an 80dB S/N ratio and 14dBA self-noise.
Low frequency (green)	20dB	20Hz – 20kHz	The low-frequency green bodied microphone is exactly the same as the standard microphone but uses a 20Hz high pass filter to allow more low-frequency sounds through. This can be useful for studying creatures that produce low frequency sounds, like Elephants or Koalas.
Hydrophone	0dB	20Hz – 4kHz	High-quality omnidirectional hydrophone designed by Aquarian Audio Products designed for depths <80m.

5.1 ATTACHING A MICROPHONE

Plug the microphone into the connector. Push the locking ring in and turn it clockwise until it locks the microphone into place. ***Do not try to twist the entire microphone.***

Make sure you see the **microphone detect icon**  appear on the **home screen**.



5.2 MICROPHONE CALIBRATION

Over time, the sensitivity of your microphones will decrease as the materials age and are exposed to the elements. Calibrating your microphones allows you to measure and track their sensitivity over time.

It should be noted that most sound level calibrators only output 1 frequency (1kHz) and there is anecdotal evidence that higher frequencies are affected more as microphones age, so while this is not a complete test it does give a useful indication of overall microphone health.

To calibrate your microphone, you will need:



Any standard IEC942 Class 1 sound level calibrator with a 94dB output at 1kHz.

A 1" microphone adapter. Please contact sales@frontierlabs.com.au to order one of these.

To measure the sensitivity of your microphone:

1. Insert the 1" microphone adapter into the calibrator.
2. Remove the foam windshield from the microphone by cutting the zip tie around the base.
3. Plug your microphone into the BAR-LT and insert the end into the microphone adapter.
4. Turn the BAR-LT on and navigate to **Menu → Utilities → Mic Calibration**.
5. The Mic Calibration screen shows the sensitivity of the microphone, the serial number, microphone type and date of manufacture of microphones connected to channel A and B.
6. Turn the calibrator on and set it to 94dB output. The sensitivity of the microphone should be around $-28\text{dB} \pm 2\text{dB}$ when a 1kHz source is used.



6 RECORDING SCHEDULE

6.1 OVERVIEW

Recording times and settings are controlled by the recording schedule which is stored in memory on the BAR-LT. The schedule allows you to program recordings to start at a particular time and date with repeating periods throughout the day and over multiple days. In this way you can maximise your deployment time by only recording the times you are interested in or sub-sampling throughout the day and/or alternating days.

The schedule can contain multiple schedule entries which can be individually programmed to have different start and end times, repeating periods and different recording settings like sample rate, compression and the channel it records from.

Each schedule entry has the following fields that determine when the recordings will take place:

Field	Description
Start time	This the time that the first recording of the day will start. This can be an absolute time, e.g. 06:00 or sun based e.g. sunrise - 01h30m
Start date	This is the date that the first recording will take place. If this is set in the future, then recorder will sleep until this date is reached.
Recording duration	This is the length of time each recording will run for.
Repeat throughout the day? (YES/NO)	This option allows the recording to be repeated every repeat period until repeat stop time is reached. This allows you to easily sub-sample across a day. E.g. start at sunrise and record for 10 minutes every hour until sunset.
- Repeat period	The period of time between the start of a recording and start of its next repeated recording. If repeat period is equal to recording duration , then it will perform back-to-back recordings with a 5 second gap it uses to prepare each new recording.
- Repeat stop time	This is the time that the last recording of the day will start. This can be absolute time, e.g. 20:00 or sun based e.g. sunset + 01h30m
Repeat over multiple days? (YES/NO)	This option allows the recordings to repeat over days and then stop at a particular date.
- Daily repeat period	This is the length (in days) of the repeating cycle. If this is set to 1 it will record every day until the stop date is reached. If it's set to 2, it will record every second day. If it's set to 3 it will record for one day every third day, etc.
- Stop date	This is the last day on which recordings will occur.

Some examples of the types of recordings you can schedule are shown below:

Entry name	Description
Dawn	Start at Sunrise -1hr and record for 2hrs every day @ 44.1kHz with FLAC compression from mic channel A.
Dawn to Dusk	Start at Sunrise +1hr and record for 5mins every hour until Sunset - 1hr every day @ 22kHz with no compression (WAV) from mic channel B.
All day	Start at 01/May/2019 at 00:00 and record for 5mins every hour until 23:00 every 2 nd day until 31/July/2019 @ 22kHz with no compression (WAV) from both mic channels A&B.

Schedules can be created and edited on a computer or on the recorder itself.

6.1.1 SAMPLE RATES

Recordings can be sampled at 8kHz, 16kHz, 22.05kHz, 32.0kHz, 44.1kHz, 48kHz or 96kHz. Choosing the sample rate is a trade-off between file size and the maximum frequency that can be recorded. This maximum frequency is called the Nyquist frequency and is **half** of the sample rate. As a reference, CD quality audio is sampled at 44.1kHz.

Below is a table of common samples rates that are typically used for a given target species. This table should be considered as a guide only.

Common sample rate (kHz)	Target species
500	Bats
250	
96	
48	Birds
44.1	
32	
22.05	Frogs
16	
8	



In order to accurately record a sound, we must sample it at **at least** double the frequency of the sound.

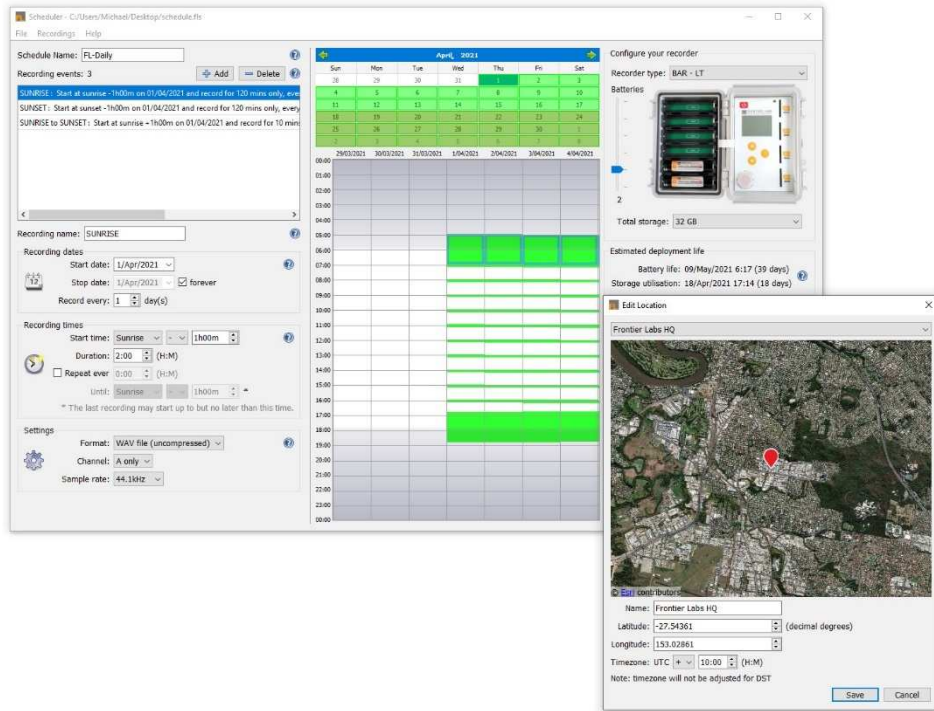
6.1.2 COMPRESSION OPTIONS / FILE FORMATS

Recordings can be saved in either WAV (uncompressed) or FLAC (compressed) file formats. FLAC is a lossless compression format and files are about 40% smaller than uncompressed WAV files for typical nature recordings. However, compression results will vary depending on the density and complexity of the sounds being recorded.

6.2 PROGRAMMING THE SCHEDULE ON A COMPUTER

To create a schedule on your computer you must first install the Scheduler GUI program which can be downloaded from the Frontier Labs website: <https://frontierlabs.com.au/software>

The Scheduler GUI program allows you to create and edit recording schedules and view the estimated battery life and time when the SD-card will be full.



For more information on creating schedules please see the Scheduler User Manual which is included with the Scheduler software.

6.2.1 COPYING A NEW RECORDING SCHEDULE ONTO THE RECORDER

To use a new schedule file created in the Scheduler software you must first copy it onto the internal memory of the recorder.

To copy a new schedule onto the recorder you must:

1. Save the schedule file as ***schedule.flx*** on your SD card then insert it into the recorder.
2. If you are running firmware v3.30 or later then it will automatically detect the new schedule file and ask if you would like to copy it across.
3. Otherwise, press the ENTER button to bring up the main menu and navigate to **Recording Schedule → Transfer Schedule → Copy from SD card**

6.2.2 SAVING A SCHEDULE BACK ONTO THE SD CARD

There are times when you may want to save the schedule that is currently stored in a recorder back onto an SD card e.g., to program into other units, for record keeping or to send to other colleagues.

To save the schedule that is running on a recorder:

1. Press the ENTER button to bring up the main menu.
2. Navigate to **Recording Schedule → Transfer Schedule → Save to SD card**.
3. The file will be saved as **schedule.flx** and will override any existing file that may be present on the card.

6.3 PROGRAMMING THE SCHEDULE ON THE RECORDER

6.3.1 MAKING A NEW SCHEDULED RECORDING

To create a new scheduled recording on the BAR-LT recorder:

1. Navigate to **Main Menu** → **Recording Schedule**.
2. Use the UP/DOWN buttons to select **+ New entry** then press ENTER.
3. Set the **Start Time/Date**, recording **Duration** and the recording settings such as sample rate and file/compression type (WAV or FLAC).
4. To repeat a recording during the day, select the **Repeat** option and press ENTER to toggle the status to **YES**. Then set the repeat period and the time you want the repeating to stop.
5. To repeat the recordings every day or every *n* days (skipping the days in between), select the **Repeat daily** option and press ENTER. Then set the repeat period in days and then the day you want the repeating to stop. Note this is the last day on which recordings will take place.
6. Set the sample rate for the recording. The options are: 8kHz, 16kHz, 22.05kHz, 32.0kHz, 44.1kHz, 48kHz, 96kHz.
7. Select **Save** and press ENTER.

```
- SCHEDULE -  
Transfer Schedule >  
+ New entry  
REC  
REC_SUNRISE  
REC_SUNSET  
< Back
```



```
- NEW ENTRY -  
Start 07:00  
Start 01/01/19  
Duration 01h00m  
Repeat: YES  
  every 01h00m  
  until 09:00  
Repeat daily: YES  
  every 01 days  
  until 01/06/19  
Rate 44.1kHz  
Channel A+B  
File WAV uncompressed  
[ Save ]  
[ Delete ]  
< Back
```

Note, when creating a new entry on the BAR the name will be automatically set to REC, REC_SUNRISE or REC_SUNSET depending on the type of entry being made.

6.3.2 VIEWING / EDITING A SCHEDULED RECORDING

To view or edit an existing scheduled recording:

1. Navigate to **Main Menu** → **Recording Schedule**.
2. Use the UP/DOWN buttons to select the schedule entry you wish to edit then press ENTER.
3. Edit the fields you want to change then select **Save** and press ENTER.

```
- SCHEDULE -  
Transfer Schedule >  
+ New entry  
REC  
REC_SUNRISE  
REC_SUNSET  
< Back
```

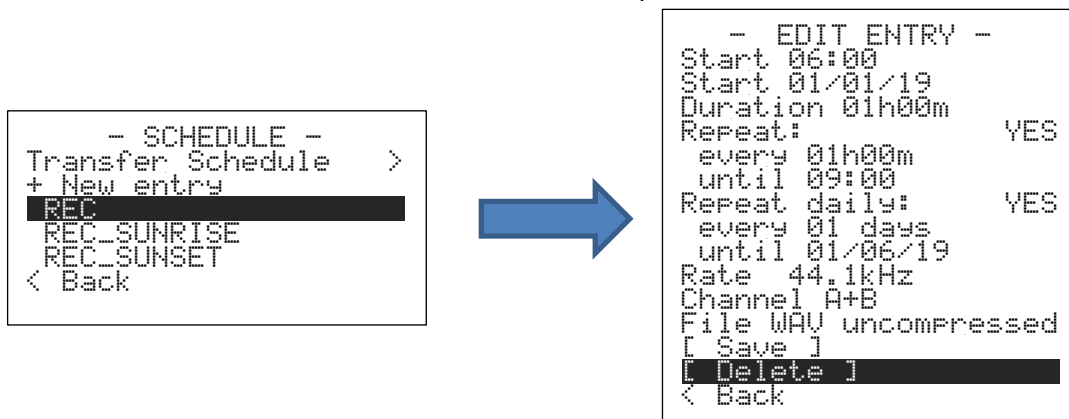


```
- EDIT ENTRY -  
Start 06:00  
Start 01/01/19  
Duration 01h00m  
Repeat: YES  
  every 01h00m  
  until 09:00  
Repeat daily: YES  
  every 01 days  
  until 01/06/19  
Rate 44.1kHz  
Channel A+B  
File WAV uncompressed  
[ Save ]  
[ Delete ]  
< Back
```

6.3.3 DELETING A SCHEDULED RECORDING

To delete a scheduled recording:

1. Navigate to **Main Menu** → **Recording Schedule**.
2. Use the UP/DOWN buttons to select the schedule entry you wish to delete then press ENTER.
3. Use the UP/DOWN buttons to select **Delete** then press ENTER.

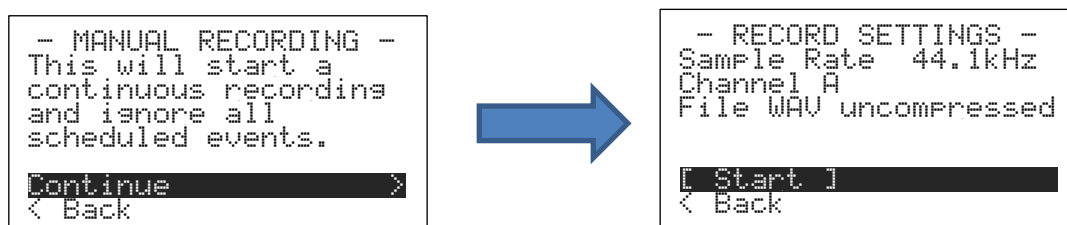


6.4 MANUAL RECORDING

A manual recording starts recording immediately and records until you press the ENTER button. Whilst in a manual recording, it ignores any scheduled recordings. This can be useful if you want to make a short annotation when you are deploying your recorder or just want to start recording without having to edit the schedule.

You can start a manual recording in 2 ways:

1. Navigate to **Main Menu** → **Manual Recording**.
2. Select the desired sample, recording channel and file format.
3. Select **[Start]** then press ENTER.



Or you can use a shortcut from the home screen:

1. Simply hold down the UP and DOWN buttons and it will start a manual recording using the recording settings you used last.

7 CONFIGURING THE RECORDER

7.1 SETTING THE DEVICE NAME

If set, the device name will appear in the filenames and meta-data of the recordings and in the logfile.

1. To set the name of the recorder, navigate to **Main Menu → Settings → Device Name**.
2. Press the UP/DOWN buttons to select the desired letter/digit then press the ENTER button to move to the next character. (Available characters are A-Z, a-z, 0-9)
3. To finish editing the name select the blank character and press the ENTER button.

7.2 SETTING THE TIME AND DATE

The time and date are automatically set from the GPS once it is turned on however you can manually set the time and date.

1. Navigate to **Main Menu → Settings → Clock Settings**.
2. Select the time and with the UP/DOWN buttons and press the ENTER button to move to the next digit.
3. Increase the value of each digit using the UP/DOWN buttons then press ENTER to continue.

7.3 SETTING THE TIMEZONE

Use the following steps to set the timezone of the recorder. (Note that daylight savings is not taken into account.)

1. Navigate to **Main Menu → Settings → Clock Settings → Timezone**.
2. Use the UP/DOWN buttons to increase/decrease the timezone value then press ENTER to save the selection.

7.4 SETTING THE GAIN

You can set the total signal gain of the recorder between 10 and 60dB. This figure takes into account the gain of the microphone. The BAR can detect what model of Frontier Labs microphone is attached and adjust its gain so that the total signal gain will stay the same even if you change to a microphone with a different pre-amp, see *5.0 Microphones*.

1. Navigate to **Main Menu → Settings → Gain ChA / Gain ChB**.
2. Use the UP/DOWN buttons to increase/decrease the gain value then press ENTER to save the setting.

8 UTILITIES

8.1 VIEWING THE STATUS OF THE SD MEMORY CARDS

To view the status of the SD memory cards including the amount of used and free space:

1. Navigate to **Main Menu → Utilities → SD Card**.
2. Use the UP/DOWN buttons to select a specific card (1-4) for more information.

8.2 FORMATTING SD MEMORY CARDS

We strongly recommend formatting your SD memory cards each time you deploy your recorder and not just delete the files off them. This allow your cards to keep running at their maximum speed by cleaning out the filesystem. We recommend you format your cards on your computer but can also do it on the recorder. When you format your card on the recorder it will automatically choose the best file system (FAT32 or exFAT) for the size of your card.



WARNING: Formatting the cards will permanently erase all the data on it.

To format your SD memory cards, follow these instructions:

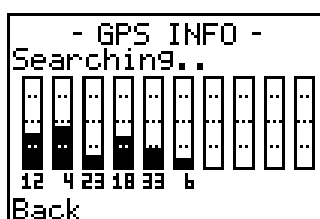
1. Navigate to **Main Menu → Utilities → SD Card**.
2. Use the UP/DOWN buttons to select the card (1-4) that you want to format then press ENTER.
3. Select the **Format Card** option and press ENTER.
4. A confirmation message will appear, select **YES** then press ENTER.
5. The SD memory card will be formatted (this may take some time) then you will be returned to the **SD Card** menu.

8.3 VIEWING THE GPS SATELLITES

To view the status of the GPS system and the available satellites:

1. Navigate to **Main Menu → Utilities → GPS Info**.

This screen shows the status of the GPS as well as the signal strength of up to 12 GPS satellites that are visible to the recorder. The number under each graph shows the satellite ID number and the height represents the signal strength of that satellite as a percentage out of 100%.



It is normal for the number of visible satellites to change over time but the more satellites and higher signal strength then the faster and more accurate the position fix will be. Generally, a signal strength above the first dotted line (25%) is good.

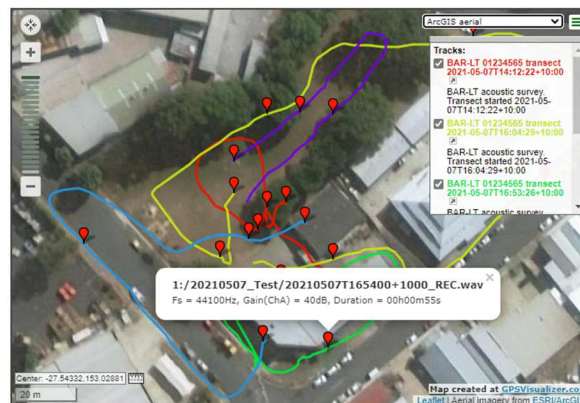


The GPS works best with a clear unobstructed view of a large area of the sky, if you are unable to get a fix and the number of visible satellites is low and/or the signal strength of each satellite is low then consider moving the recorder into a clearing until it gets a fix. This should only take a few minutes.

8.4 GPS TRANSECT MODE

GPS transect mode continuously logs the GPS position once per second to a file on the SD card called GPS_log.gpx. GPX files are a common file format compatible with most GIS and mapping software.

Each time GPS Transect mode is enabled it starts a new track, which saves a continuous path of GPS positions, until Transect mode is disabled. Each time a recording starts it saves a waypoint to the file which contains meta-data of the recording such as the sample rate, channel gain, duration, recorder serial number.



8.5 VIEWING THE FIRMWARE VERSION

To see what version of firmware your recorder is running, navigate to **Main Menu → Utilities → Device Info**.

8.6 UPGRADING THE FIRMWARE

As new features and bug-fixes are released, we encourage you to upgrade the firmware of the recorder to take advantage of these improvements.

If you are running firmware v3.30 or newer, then it automatically scans the SD card for new firmware when you turn the recorder on and asks if you would like to upgrade.
If you are running older firmware than v3.30, then follow the steps below.

1. Download the new firmware file and save it onto an SD memory card.
2. Insert the SD memory card into the recorder.
3. Navigate to **Main Menu → Utilities → Device Info**.
4. Select **Upgrade Firmware** then press ENTER.
5. A confirmation message will appear, select **YES** then press ENTER.
6. The firmware will be upgraded then you will be returned to the **Firmware** menu.

8.7 VIEWING THE BATTERY VOLTAGE

To view the voltage and percentage full of the internal or external batteries navigate to **Main Menu → Utilities → Battery Status**.

The internal and external battery voltage will be displayed as Volts and % full. For external batteries, the recorder detects if it's connected to a 6V or a 12V battery and adjusts its full/empty thresholds accordingly. This way it does not damage the battery by over-discharging it.

8.7.1 DEFINING A CUSTOM BATTERY

By default, the recorder is expecting that you connect a lead-acid battery as the external power source, as these are easy to get and relatively inexpensive. However, lead-acid batteries can be quite heavy whilst other battery types, such as Li-Ion or LiFePO4 are much lighter. But different battery chemistries have different full and empty Voltages, which the recorder needs to know so it can shut down when the battery is empty (and not over-discharge it).

To specify custom battery values, navigate to **Main Menu → Utilities → Battery Status → Custom Battery**.

Below is a table of recommended voltages you should use for each battery type. Note you will see that SLA and LiFePO4 have very similar empty Voltages so it is not necessary to specify a custom battery if you are using a LiFePO4 battery.

Battery Type	Full Voltage (V)	Empty Voltage (V)
SLA (default battery type)	12.75	11.5
LiFePO4 (4 series cells)	13.6	11.8
Li-Ion (3 series cells)	12.6	9.0

8.8 CONFIGURING FOR SOLAR POWER

Configuring the recorder for solar power prevents the external batteries from damage by being over-discharged but will also keep recording when they are charged up again. It works by detecting when the external batteries run flat, then it stops future recordings and goes to sleep for 24 hrs to allow the batteries to recharge. When it wakes up it checks the external battery voltage, if they have sufficient charge then it continues the recording schedule, if the batteries are still flat then it goes to sleep for another 24 hrs and repeats the process until the batteries are charged. If this field is set to false and then the recorder does not attempt to wake up again when it detects the batteries are flat.

To configure the recorder for solar power, follow the instructions below:

1. Navigate to **Main Menu → Settings → Solar Powered**.
2. Use the UP/DOWN buttons to select **YES** then press ENTER.

9 TIPS AND TROUBLESHOOTING

9.1 DIAGNOSTIC LOG FILES

The BAR generates a detailed diagnostic log file every time it is used. Each action that is performed is logged with a time and date stamp. Even if there is no SD memory card present the BAR will log a small amount to internal memory until an SD card is inserted and then dump the internal buffer to the log file. Log file is saved in the root folder of the SD card. The log files also contain information about each recording, such as the gain used, the time it started and ended, the battery charge remaining and how much SD card space is left.

If the BAR behaves unexpectedly or you miss a recording that you think should have occurred, check the log file to see why.

9.2 RECORDING TIME VS SAMPLE RATE

The table below shows the typical recording time vs the sampling rate of the recorder when powered from one to six 18650 batteries with a capacity of 3400mAh. Note that with a higher sampling rate the SD card is written to more often which causes the power consumption to increase.

Sample rate	Total mono recording time per battery (hrs)					
	1	2	3	4	5	6
16 kHz	165	330	495	660	825	990
22.05 kHz	155	310	465	620	775	930
32 kHz	150	300	450	600	750	900
44.1 kHz	140	280	420	560	700	840
48 kHz	125	250	375	500	625	750
96 kHz	120	240	360	480	600	720

* NB: These figures should be considered as indicative only as other factors such as SD card brand and ambient temperature can have a large impact on battery life.

9.3 SD CARD SIZE VS RECORDING DURATION

The PC Scheduler software (*See 6.2 Programming the schedule on a computer*) automatically calculates how much space the scheduled recordings will take up and how full the selected SD cards will be. Alternatively, the table below shows how many hours of recording will fit on each sized SD card for a given sample rate. Higher sample rates take up more space and therefore cannot record for as long on the same SD card. These figures are for a single channel (mono) recording in uncompressed WAV file format. If you are recording in stereo, simply half the number of hours you can record. If you are recording in lossless compressed FLAC file format, you typically save around 40% however the compression rate will vary with the complexity of the soundscape.

SD Card size	Total hours of recording that can fit on an SD CARD for each sample rate (mono recording). (hrs)					
	16 kHz	22.05 kHz	32 kHz	44.01 kHz	48 kHz	96 kHz
16 GB	138	100	69	50	46	23
32 GB	277	201	138	100	92	46
64 GB	555	403	227	201	185	92
128 GB	1111	806	555	403	370	185
256 GB	2222	1612	1111	806	740	370
512 GB	4444	3224	2222	1612	1481	740

The BAR-LT can hold up to 4 SD Cards for a total of 2TB of storage. When a card becomes full, or has an error, it automatically moves down to the next card and starts recording to it, until all the cards are full.

The total recording times will also be limited by the number of batteries / external power available to the recorder. The PC Scheduler software makes it easy to find the optimal combination of batteries and SD cards for given recording schedule.



We recommend using San Disk ultra, class 10 or higher. We have found them to have the best power consumption and reliability in the field.

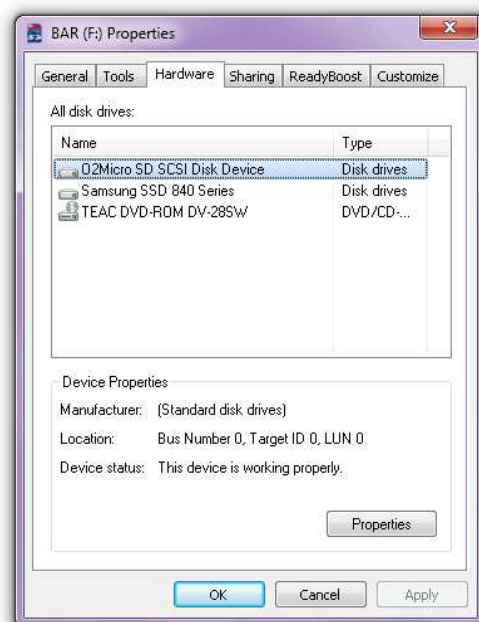
9.4 DISABLING WINDOWS CACHE SETTINGS

In Microsoft Windows, the default behaviour of removable drives (i.e. SD memory cards) is to have file caching enabled, which postpones writing data to the card until a later time in order to improve system performance. This means it is very easy to remove the disk and leave with either the old *schedule.flc* file still on the card or none at all if the card was empty to start with. Even when you re-load the file directly from the card to check it, there is no guarantee that the correct file has been copied onto the disk yet.

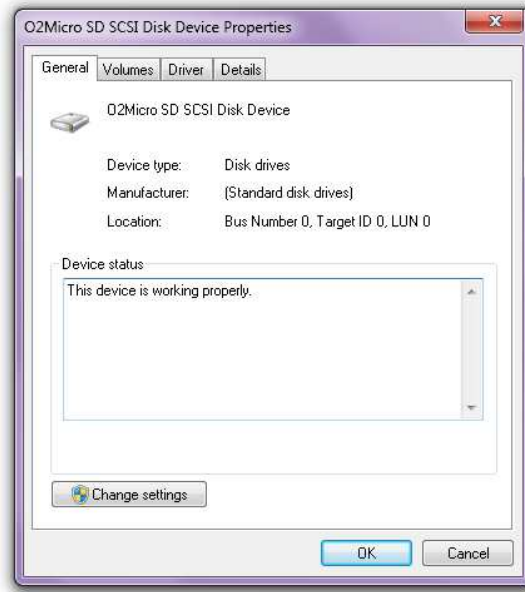
To prevent this, you must select **Safely Remove Hardware and Eject Media** from the right-hand side of the start bar, or disable the file caching settings for your SD card drive (*recommended*).

To disable file caching:

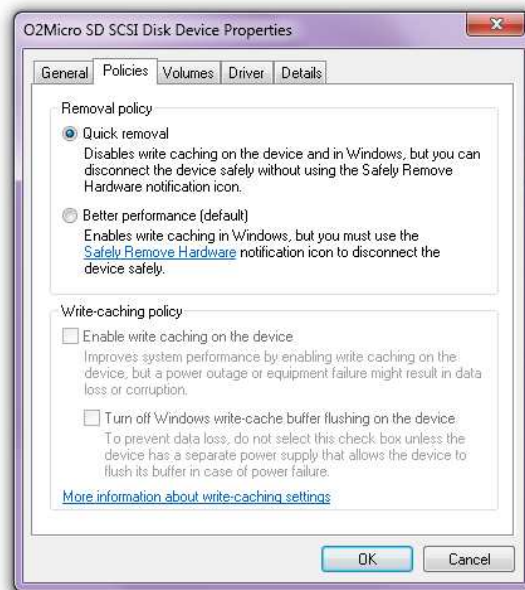
1. Right click on the SD card in **My Computer**, then click **Properties**.
2. Click on the **Hardware** tab at the top of the window
3. Select the drive of the SD card. (It may have a strange name, look for the letters "SD")
4. Double click on the drive in the list or click the **Properties** button



5. In the Device Properties window, click **Change Settings**



6. Click the **Policies** tab at the top of the window
7. Select the **Quick Removal** policy then click **OK**

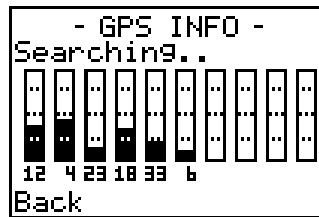


9.5 NO GPS LOCK

If you are unable to get a GPS lock, then consider moving the recorder into a clearing and turning it OFF and then ON to restart the searching process.

The GPS works best with a clear unobstructed view of a large area of the sky and it takes longer under cloudy skies. Deploying the recorder near the bottom of cliffs, in caves or under a dense canopy will likely result in the GPS taking longer to get a fix, or failing to get a fix.

If you are having trouble getting a fix, navigate to the **Main Menu → Utilities → GPS Info** to view the GPS status, the number of visible satellites and a graph of their signal strength as a percentage out of 100%.



A minimum of 3 GPS satellites are required to get a fix. The more satellites it can see and the higher the signal strength then the faster and more accurate the position fix will be.

If the number of visible satellites is low and/or the signal strength of the satellites is low then consider moving the recorder into a clearing away from walls and tall trees so you can see more of the sky and horizon. Once the recorder has a position fix you can move it back to where you want it deployed.

9.6 SHOWING THE INCORRECT TIME

This is most likely caused by an incorrect time zone setting.

By default, the recorder will automatically update its clock from the GPS satellites every time it is switched on (this may take a minute or two). If the clock is being updated to an incorrect time then navigate to **Main Menu → Settings → Time/Date Settings** and check the **Timezone** field. You must ensure this is set correctly to the location the unit is being deployed in.

*Note that daylight savings time is **not** taken into account.*

9.7 INCORRECT DAWN/DUSK TIMES

Dawn and dusk times are calculated on the recorder based on its GPS location when it was last turned ON.

If the recorder is unable to get a GPS position fix, then the position that you set in the Scheduler GUI program when the schedule was created will be used as a backup. If the position specified here is largely different from the real location of the BAR then there will be a discrepancy between the calculated and real dawn/dusk times. For example, 0.3 degrees of longitude away (or 30km E/W if you were at the equator) would result in about 1 minute of error.

9.8 "NO RECORDINGS SCHEDULED" WHEN THERE SHOULD BE

When you see the "No Recordings Scheduled" screen (shown below) this means there are no more scheduled recordings left to be done in the future and there is nothing left for the recorder to do.

This can occur for the following reasons:

- **Past the End Date:** Double check the start and end dates of the recordings are what you were expecting as well as the time and date on the home screen of the recorder as you may be past the end time and date of the last recording.
- **No GPS position for sun-based recordings:** Sun based recordings require location information to calculate the sun rise and set times. If no GPS position could be found and there was no backup location set in the schedule file then sun-based schedule entries are ignored. (Note this will not occur if you used the Scheduler GUI program on the PC. When you make a new schedule on the recorder directly, you can't set a backup location and you must get a GPS fix when you deploy it.)

9.9 SILENT RECORDINGS

The most likely cause of this is that the microphone was not properly connected.

Make sure that you see the **microphone detected** symbol on the top row of the **home screen** to know that the microphone is properly attached. Unplug the microphone then plug it back in again and check that the symbol appears.

Note that after the microphone is pushed on, the locking ring at the base of the connector needs to be turned to lock it into place, see *5.1 Attaching a microphone*.

9.10 CALCULATING GAIN

To convert a gain value given in dB into a multiplication factor of the original signal, you can use the following equation:

$$\text{multiplication factor} = 10^{(\text{Gain in dB})/20}$$

For example, 20dB gain is 10 to the power of (20 divided by 20) giving 10^1 which equals a multiplication factor of 10.

Below is a table of common gain values in dB and the corresponding value as a multiplication factor of the original signal.

Gain (dB)	Gain (multiplication factor)
10	3.16 (or $\sqrt{10}$)
20	10
30	31.6
40	100
50	316
60	1000



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