



See Page 1 for
Quick Start Checklist

Song Meter SM4

BIOACOUSTICS RECORDER

User Guide

Last updated on August 1, 2019.

CONTENTS

1	Quick Start Checklist	1
2	Overview	2
2.1	Introduction	2
2.2	Visual Tour	3
2.3	The Main Menu	4
3	Setup and Installation	5
3.1	Opening the Recorder	5
3.2	Turning Power On and Off	6
3.3	Installing Internal Batteries	7
3.4	Connecting External Power	7
3.5	Inserting SD Memory Cards	8
3.6	Connecting and Mounting External Microphones	9
3.7	Replacing a Built-in Microphone	11
3.8	Connecting the GPS Accessory	12
3.9	Securing the Recorder	13
3.10	Locking the Keypad	14
3.11	Mounting the Recorder	15
3.12	Replacing the Clock Battery	16
3.13	Reading the Recorder Temperature	16
4	Settings	17
4.1	Navigating the Menus	17
4.2	Setting the Date and Time	17
4.3	Setting the Prefix for Recorded Files	18
4.4	Setting the Location and Time Zone	18
4.5	Setting the Solar Calculation Method	19
4.6	Audio Settings	20
4.7	Setting a Delayed Start	22
4.8	Setting the LED Indicator Mode	23
4.9	Advanced Settings	23
5	Making Scheduled Recordings	25
5.1	Recording Operation Overview	25
5.2	Using a Quick Start Schedule	25
5.3	The Recording Screens	27
5.4	Checking the Status of the Recorder	28
5.5	Monitoring Live Audio with Headphones	28
5.6	Stopping a Recording Schedule	29
5.7	Making an Instant Recording	29

5.8	Retrieving and Viewing Recordings.....	30
5.9	Kaleidoscope Software.....	30
5.10	Analyzing Recordings with Kaleidoscope Pro's Cluster Analysis	31
5.11	Recording Files	31
5.12	Recording Metadata.....	31
5.13	Recording Summary Text File	32
6	Creating Custom Simple Schedules	34
6.1	Schedule Blocks.....	34
6.2	Editing a Schedule	35
6.3	Adding or Deleting Schedule Blocks.....	36
6.4	Schedule Block Examples.....	37
7	Creating Custom Advanced Schedules	40
7.1	Creating and Editing an Advanced Schedule	40
7.2	Using Loops.....	41
7.3	Advanced Schedule Commands.....	41
7.4	How to Work with the Schedule Checker.....	43
7.5	How to Resolve Schedule Checker Errors.....	44
8	Importing and Exporting Schedules	45
8.1	SM4 Configurator Software	45
8.2	Importing a Schedule	45
8.3	Exporting a Schedule	46
9	Utilities	47
9.1	Exporting Diagnostics	47
9.2	Resetting to Factory Default Settings.....	47
9.3	Testing Microphones' Sensitivity with the Calibrate Utility.....	47
9.4	Formatting SD Memory Cards.....	48
9.5	Updating the Firmware	49
10	Specifications	50
10.1	Physical	50
10.2	Power	51
10.3	SD Memory Cards.....	51
10.4	Audio	51
10.5	Microphones	52
11	Warranty and Disclosures	54

Revised and Translated User Guides

This guide is regularly updated and improved. New versions can be downloaded from <http://www.wildlifeacoustics.com/support/documentation>. It is also available from the same webpage in Spanish, French, German, Chinese and Japanese translations.

Tutorial Videos

Visit <http://www.wildlifeacoustics.com/support/tutorial-videos> to view tutorial videos for the SM4.

Contacting Support

For issues or questions not addressed in this guide, contact the Wildlife Acoustics Support Team:

- Email: support2019@wildlifeacoustics.com
- North America (toll-free): 1-888-733-0200
- Outside North America: US+1 978-369-5225 (Toll charges may apply.)

1 Quick Start Checklist

- ❑ Release the side latch, open the security cover, and then open the middle section to access the battery bay. Check that the gasket is undamaged and free of debris that will interfere with the seal.
- ❑ Install four (4) new alkaline or NiMH D batteries. Close the middle section. To use external batteries, see *Connecting External Power in Chapter 3*.
- ❑ Insert one SD memory card in slot A and an optional second card in slot B.
- ❑ Reformat card(s) using the built in format utility (see *Formatting SD Memory Cards* in the Utilities Chapter).
- ❑ Slide the power switch down to **INT** for internal battery power. The recorder powers on and the main menu appears on the display. (If using an external power source, slide the switch up to **EXT**.)
- ❑ Press **CHECK STATUS** to verify the time, microphone, SD memory cards, battery voltage, temperature, and firmware version.
- ❑ Check Wildlife Acoustics' website for new firmware and update if necessary (see section 9.5).
- ❑ Use the keypad to select **Quick Start** and choose a recording schedule.
- ❑ Navigate to **Main Menu > Settings** to set the time and date. For schedules that start or end at times relative to sunrise or sunset (for example, *Record Sunrise → Set*), you must also set the latitude and longitude and time zone. Alternatively, temporarily attach the available GPS accessory to auto-set, the location, date, and; however, you must manually set the time zone. It is not set by the GPS and must be set prior to plugging in the GPS for the recorder to correctly calculate local time from GPS time.
- ❑ Press the **SCHEDULE START** button. The schedule begins:
 - The SM4 *sleeps* (display goes blank) to conserve battery power if a recording is not scheduled in the next 45 seconds.
 - The SM4 *wakes* (display illuminates) at the next scheduled recording start time and saves recordings to the SD memory card(s).
- ❑ Close the security cover and latch. To secure the recorder, attach an optional lock. Mount the recorder in a suitable location and leave.
- ❑ When the deployment ends, press and hold **SCHEDULE STOP** to finish recording. Eject the SD memory card(s) and review the recordings.

2 Overview

2.1 Introduction

The latest generation in the Song Meter series, the SM4 is a weatherproof, programmable audio recorder designed for the periodic, seasonal, and long-term monitoring of wildlife bioacoustics in almost any environmental condition.

You can schedule daily recordings to meet a variety of needs including times that are relative to sunrise and sunset, specific duty cycles with on/off recording patterns, and continuous monitoring all day and all night. The SM4 optimizes battery life and memory capacity to record for extended periods of time. Using both memory slots and new alkaline batteries, a typical deployment can record for up to 400 hours spanning several months.

Features

- Lightweight, portable, and completely weatherproof
- Two (2) built-in low noise microphones for two-channel stereo sound (built-in microphones can also easily be replaced, if necessary)
- Supports one or two standard SDHC or SDXC memory cards
- Weatherproof keypad and backlit display for easy entry and status
- LED indicator provides recording and sleep mode feedback
- Integrated top and bottom mounting flanges are designed to work with cable locks, screws, radiator clamps, bungee cords, and other fasteners
- Easy to set up and use with convenient Quick Start daily recording schedules and one-touch start
- Advanced Schedule mode allows creation of more advanced schedules
- Customize schedules and estimate impacts on SD memory cards and battery life with the free SM4 Configurator software
- One-touch status check shows memory card utilization, battery voltage, and other recorder health information without interrupting recordings
- External power option using an SM3/SM4 power cable (sold separately)
- Self-generated diagnostics assist in basic troubleshooting
- Internal temperature and battery voltage logging
- Headphone port for real-time monitoring and system verification
- Optional GPS accessory automatically sets the date, time, latitude, and longitude and logs recording coordinates

2.2 Visual Tour



ITEM:	DESCRIPTION:
Display	Backlit screen displays all main menu items, settings, values, message prompts, and status information.
Security Cover	Protects the recorder. The cover swings open/closed and can be secured with a standard lock (sold separately).
Latch	Grip and pull to open the security cover. To close, push the security cover down until the latch clicks.
LED Status Indicator	Flashes green once a second when recording.
Keypad	Press the keypad buttons to navigate the menus and options on the display. Buttons include ▲Up or ▼Down, ◀Left or ▶Right, ENTER, SCHEDULE START, SCHEDULE STOP, and CHECK STATUS.
Mounting Flanges	Rugged and ready for almost any environment. Use the top and bottom cutouts to mount the recorder.
Power Switch	Slide down to turn power on using internal battery (INT). Slide up to use optional external power (EXT) or to turn off (if no external power).
Built-in Microphone	On left and right, integrated replaceable low-noise stereo microphones.
Memory Slots A and B	Insert removable SD memory cards to store recordings.
Lock Ring	Insert the shackle of an optional key or combination lock to secure your recorder.
GPS Connection	Use the available GPS option to automatically set the date, time, and location settings.
Pressure Vent	Temperature, UV, and water-resistant vent and a self-regenerating desiccant packet control humidity and prevent condensation.
Headphone Jack	Connect headphones and press ENTER to listen to real-time audio as it is recorded.

2.3 The Main Menu

Refer to the following table when navigating the main menu on the display.

Menu Item	Description
Quick Start	
Record Always	Records continuously 24 hours a day.
Record 30on & 30off	Repeats an hourly duty cycle made up of 30 minutes of recording followed by 30 minutes of sleep.
Record 5on & 55off	Repeats an hourly duty cycle made up of 5 minutes of recording followed by 55 minutes of sleep.
Record Sunrise→Set	Based on your location, date, and sunrise/sunset settings, records continuously from sunrise until sunset.
Record Dawn & Dusk	Based on your location, date, and sunrise/sunset settings, records 2 hours centered at sunrise and 2 hours centered at sunset.
Settings	
Audio	Configure audio settings for recordings.
Date and Time	Set the local date and time for your recorder.
Location	Set the recorder prefix ID and the latitude, longitude, and time zone for your location.
Sunrise/Sunset Type	Set the method used to calculate the sunrise and sunset times. Choices include astronomical, civil, or nautical twilights or the actual sunrise/set times.
Delay Start	Delays the start of your daily schedule until 00:00 on a specified date.
LED Indicator	Choose to display LED indicators always or only for the first several minutes after you start the schedule.
Advanced	Settings for advanced users.
Schedule	
Edit Schedule	Add, modify, or delete schedule blocks.
Import Sched+Setts	Import a schedule and settings from an SD card.
Export Sched+Setts	Export the current schedule and settings to an SD card.
Utilities	
Export Diagnostics	Save status and troubleshooting information to an SD card to send to the Wildlife Acoustics Support Team.
Set factory default	Restore the original recorder settings to their factory-fresh values and revert to a like-new state. CAUTION: Any custom schedules or settings are replaced.
Calibrate Mic	Test the sensitivity levels of built-in or connected microphones with a third-party external calibrator and enter the sensitivity so that it is stored in the recording's meta-data.
Format all cards	Erase and reformat the SD memory cards. CAUTION: All data on the cards is permanently lost.
Firmware Update	Update the recorder with a new firmware file that you download to an SD memory card.

3 Setup and Installation

3.1 Opening the Recorder

When instructed by the procedures in this guide to open the recorder, follow the steps below.



1. Locate the handle for the security cover on the front right side of the recorder as shown.
2. Grip the handle and lightly pull it to release the latch. The cover flips open and rotates along its hinged spine like a book, exposing the display and keypad in the middle section. At this point, you can insert memory cards, adjust the power switch, and connect an optional GPS or headphones. Continue with the next step only when you are installing batteries, or replacing a built-in microphone.
3. Press the small circular indentation between SD memory card slots A and B with your thumb to release the middle section. If it is difficult to release the section, press down closer to the gasket seam. This section swings open exposing the battery bay.

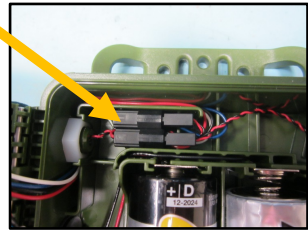
To close the cover, reverse the steps:

NOTE: Before deployment, examine the black rubber gaskets around the edge of the front and back of the control panel. The gasket should be free of debris and tears. Note that exposure to unusually high levels of UV exposure can soften or degrade the rubber. Consider covering the SM4's gasket with some opaque tape or cloth to extend life. DEET, a common ingredient in insect repellent, is known to degrade the plastic used in the SM4's enclosure. Replacement gaskets are easy to install and can be ordered by contacting our sales team.

1. Gently and firmly push the middle section (display and keypad) down until it snaps into place.

NOTE: Be sure the large black inline connectors above the D batteries are well seated in the channel or the can get lodged between the battery case and the middle section and prevent proper closing.

2. Gently and firmly push the security cover down until it snaps into place.
3. Align the security cover latch with the locking ring and snap into place.



3.2 Turning Power On and Off

Follow these steps to switch recorder power on and off based on your choice of internal or external power source. Only one power source (internal or external) can be active at a time.

1. Open the cover to access the power switch on the side of the middle section above memory slot A.
2. Slide the switch down to **INT** to turn power on when using internal batteries; slide the switch up to **EXT** to turn power on when connected to an external battery. Only one power source is used at a time. Whichever position does not have a battery installed is functionally *off*.
3. When you want to turn the recorder off to conserve battery power, slide the switch to the opposite position (**EXT** when using internal batteries and **INT** when using an external battery).

NOTE: Do not turn the power off when a recording is in progress. To safely exit from recording, press **SCHEDULE STOP**, allow the recorder to return to the **Main Menu**, and then switch the power off. Avoid quickly switching power off and on again (avoid quick switches between **INT** and **EXT**). The recorder can interpret this sudden loss and restoration of power as an error and may start creating diagnostics.

3.3 Installing Internal Batteries

The recorder uses four size D alkaline or NiMH batteries.

NOTE: We prefer Energizer brand of alkaline batteries for their superior performance.

The SM4 enters a very low-power sleep state between scheduled recordings to conserve energy and maximize efficiency for long deployments. Prior to installation, we recommend that you test all batteries with a high-quality pulse load battery tester such as the ZTS MINI-MBT.

1. Open the recorder.
2. Insert batteries with their polarity (+/-) orientation as shown on the battery bay markings.

NOTE: Do not mix batteries of different types, and do not mix old and new batteries. Remove batteries before storing the recorder for an extended time.

3. Close the middle section and gently press down until it snaps into place.
4. To turn on power, slide the power switch to **INT**.
5. When not in use, set the power switch to **EXT** to conserve internal battery power. Without an external battery source, consider the **EXT** position to be *off*. Only one power source (internal or external) can be active at a time.

TIP: Use the Song Meter SM4 Configurator software to estimate the recording requirements for your schedules including battery life and memory storage.


3.4 Connecting External Power

With the optional external power cable, the power connector can accept voltages from 5-17 volts DC. It is intended for 6 or 12-volt external batteries.

CAUTION: If you are unfamiliar with configuring external battery power systems, consult a local installer for assistance.

1. Each power cable is shipped with a snap-on ferrite to meet standards limiting electromagnetic emissions and protecting against electrostatic discharge. Install the ferrite near the end of the cable as close to the recorder as possible.
2. Loop the cable through and snap the ferrite shut. A zip tie is included for further securing the ferrite. The image shows the ferrite as shipped (right) and as installed (left).



- Align and seat the cable into the **EXT POWER** port on the side of the recorder. Turn the grey locking ring (black on older SM3 cables) clockwise  firmly until it stops and locks into place.



- The external power cable includes F2-size spade connectors and ring terminals. Connect the cable to a 6 or 12-volt battery using one of the connectors provided. The SM4 provides protection against accidental reverse polarity connections.
- Open the security cover and slide the power switch up to **EXT**.
- (Optional) Set a minimum voltage to prevent damage to lead-acid batteries that are not designed for deep discharge.
- When not in use, set the power switch down to **INT** to conserve external battery power. With no internal batteries installed, consider the **INT** position to be *off*. Only one power source can be active at a time.

3.5 Inserting SD Memory Cards

The SM4 saves recordings to one or two SD memory cards installed in the memory card slots.

NOTE: We prefer the SanDisk brand of memory cards for their superior performance.

The following table shows the stereo recording capacity in hours for each card size by sampling rate to help you choose the right memory card size:

SD Card (GB)	8,000	12,000	16,000	22,050	24,000	32,000	44,100	48,000	96,000
16	139	93	69	50	46	35	25	23	12
32	278	185	139	101	93	69	50	46	23
64	556	370	278	202	185	139	101	93	46
128	1,111	741	556	403	370	278	202	185	93
256	2,222	1,481	1,111	806	741	556	403	370	185
512	4,444	2,963	2,222	1,612	1,481	1,111	806	741	370

NOTE: The above table shows recording capacity for uncompressed WAV recordings. Three levels of compression can be set in the Audio Settings menus that will significantly increase these times. More information can be found in the Audio Settings section 4.6 of this guide.

1. Open the security cover and locate memory slots A and B on the side below the power switch.
2. Insert one required SD memory card slot A or B. Push the card straight in until it clicks into place. Make sure the small read/write switch on the card is to allow write access.
3. (Optional) To extend deployments, or have a redundant card in case there is an issue with the first, insert a second SD memory card in the remaining slot.



in
until
set
to

NOTE: You can use slot A, slot B, or both for recording; however, when importing and exporting schedules or updating the firmware you must use slot A.

4. Reformat card(s) using the built-in format utility (see *Formatting SD Memory Cards* in the Utilities Chapter).
5. Press **Check Status** and verify that the card is shown with an appropriate capacity.
6. To remove a card when recording is completed, push it in and release it. The spring-loaded slot ejects your card so you can pull it away.

NOTE: Do not remove SD memory cards while the SM4 is recording. This could corrupt the card.

3.6 Connecting and Mounting External Microphones

Instead of using the built-in microphones, you can connect one or two external SMM-A2 microphones (sold separately). When one or more external microphones are connected, they automatically disconnect the internal microphone for that channel (s). The two microphone connectors for channels 0 and 1 mate with our weatherproof acoustic microphones or an extension cable.

The cabled SMM-A2 acoustic microphone is completely weatherproof when installed correctly. It features a hydrophobic membrane transparent to acoustic signals to prevent unpressurized water from entering the microphone and a windscreen to which provides a critical second layer of protection to absorb the impact of wind-blown rain so that only unpressurized water reaches the membrane. We also recommend positioning

the microphone so that it is aimed slightly downward or lower to further minimize water entry.

The SMM-A2 can be deployed up to 100m away from the recorder. Cables are available in 3, 10, and 50-meter lengths and can be interconnected to form other lengths.

1. Each extension cable is shipped with a snap-on ferrite required to meet legal requirements for limiting electromagnetic emissions and for immunity from electrostatic discharge. Install the ferrite near the end of the cable as close to the recorder as possible. Loop the cable through and snap the ferrite shut. A zip tie is included for further securing the ferrite. The image below shows the ferrite as shipped (right) and as installed (left).



2. Align and seat the cable(s) into the keyed connector ports.
3. Turn the grey locking ring (black on older SM3 cables) on the microphone or cable clockwise \cup firmly until it stops and locks into place.
4. Replace the windscreen when the foam begins to break down and flake. With normal outdoor use over time, the foam windscreen fades to brown; however, color degradation does not indicate a loss of integrity.

Avoid Microphone Damage from Electrical Discharge

Mounting microphones high off the ground, especially in dry or windy conditions, could result in microphone damage from electro-static build-up. We recommend checking with a professional licensed electrician or installer with experience in outdoor antennas or weather instruments for advice suitable to your situation. Here are some tips to avoid damage:

- Avoid mounting microphones on tall plastic masts including those made of fiberglass or nylon for deployments in dry conditions. A breeze flowing over the plastic mast can build up a sizeable electrical charge much like rubbing a balloon. Eventually, the electric charge will be strong enough to discharge with an attraction to the mass of metal in the cable resulting in a spark that could damage the microphone. Wood or metal masts will mitigate this problem.

- If the best path to ground is through the microphone and/or SM4BAT then the microphone and/or the recorder could be severely damaged. To protect against this, you need to create a better and safer alternate path to ground, much the way a lightning rod on a house functions. One way to do this is to use a pipe clamp to clamp a heavy gauge (12 AWG) wire from the microphone to ground by securing the other end of the wire to the metal frame of a grounded tower structure, or securing the wire to a metal pipe planted 2 meters into the earth. The connections must be electrically strong with low resistance.
- See section below on how to protect the recorder using the available Song Meter Surge Suppressor.

Avoid Recorder Damage from Electrical Discharge

The Song Meter Surge Suppressor protects the recorder from power surges from electrostatic discharge or electrical storm activity that could come down the microphone cable and damage the recorder. This accessory should be used wherever microphones are mounted at elevation. The Surge Suppressor is installed between a microphone cable and the recorder and includes a grounding attachment which is connected to a good earth ground.

This ensures that an electric surge travelling down the microphone cable is shunted to ground before damaging the recorder.



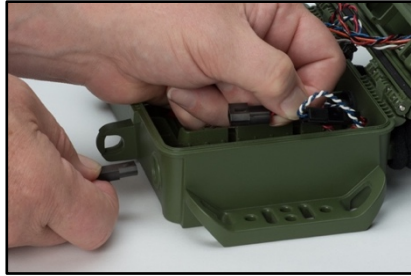
3.7 Replacing a Built-in Microphone

The built-in microphones are easily replaceable should they become damaged. Replacement microphones are sold with a new windscreen and O-ring seal.

1. Open the recorder.
2. Firmly grasp both sides of the inline connector located above the battery bay and pull the connector from the socket. Do not pull on the wires, only the connector.
3. Remove the windscreen from the damaged microphone.



- Loosen the microphone from the outside, turning it ⤴ counter-clockwise. If the microphone is too tight to loosen by hand, use a 5/8-inch wrench. Remove the microphone (left).



- Push the connector for the new microphone through the hole (right).
- Carefully engage the threads on the new microphone and hand tighten ⤴ clockwise a few rotations.
- Use a 5/8-inch wrench to finish tightening until snug. The flat of the microphone should touch the housing. Do not over-tighten.
- Plug the inline connector into the socket.
- Install the windscreen.
- Test the new microphone to ensure it is working correctly.

3.8 Connecting the GPS Accessory

The optional GPS accessory automatically sets the date, time, latitude, and longitude of the recorder. If you have several SM4 recorders to deploy in the field, you can use a single GPS accessory to set them up.

- Navigate to **Main Menu > Settings > Location > Timezone** and set the time zone. The GPS does not set the time zone.

NOTE: The time zone must be set prior to using the available GPS accessory to automatically set the correct time. The SM4 adjusts the time from the GPS based on the time zone setting and sets the recorder's clock after this calculation. If you change the time zone after the clock has been set, this automatic adjustment does not take place and the clock will not be set correctly.

2. Open the security cover and plug the GPS cable into the GPS port on the side of the recorder.
3. The recorder automatically detects the presence of the GPS. When the recorder wakes up, the GPS is powered up.
4. Wait for the GPS to communicate with the satellites.



- a. A few seconds after connecting the GPS Accessory, the GPS status is shown on the top right of all menu screens. When the GPS has successfully communicated with the satellites, the status changes from asterisks to FIX.
 - b. Or, on the CHECK STATUS screen, a question mark (?) appears between the date and time to indicate that the GPS accessory is attempting to acquire satellite data.
5. When the GPS has successfully acquired satellite data, the question mark (?) changes to a number sign (#) and the location, date, and time are automatically set. Coordinates are given in decimal degrees and use the WGS-84 coordinate system.

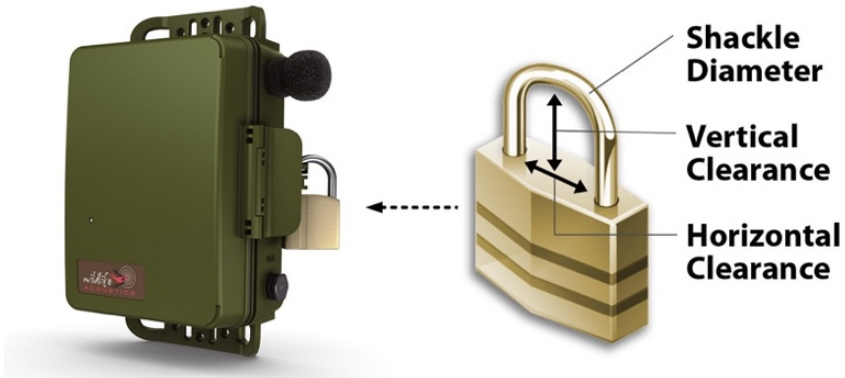
NOTE: The **Location Settings** coordinates as seen on the display in the main menu are read-only when the GPS is attached. You cannot change them.

6. Disconnect the GPS. The available GPS accessory consumes about 90 mA of additional current—more than four times the current of the recorder itself. For passive recording, we recommend that you use the GPS to automatically set the clock and location at the beginning of the deployment but do not keep it attached for the duration of the deployment.

NOTE: If you are still prompted for latitude and longitude when starting a schedule, it most likely means the GPS accessory does not yet have a fix. Be aware that it can be difficult to acquire a GPS signal in thick vegetation. Also note that the GPS cannot be used for precision time synchronization on the SM4 as it can on the SM3.

3.9 Securing the Recorder

Close the cover to protect the recorder from environmental conditions. To secure the recorder with a standard key or combination lock, press the latch down and insert the lock shackle through the lock ring.



The following requirements apply to the size of the lock and assure that the security door cannot be opened or cracked:

	Minimum:	Maximum:
Shackle Diameter	1/8 inch (3 mm)	3/8 inch (9 mm)
Vertical Clearance	5/8 inch (16 mm)	1.0 inch (25 mm)
Horizontal Clearance	1/2 inch (13 mm)	1.0 inch (25 mm)

NOTE: The lock should be rated for outdoor use.

3.10 Locking the Keypad

For large scale projects, it is occasionally desirable to lock down the SM4 such that only authorized personnel are able to modify the configuration. This can prevent modifications by someone who may inadvertently put deployments at risk by making changes without understanding their consequences.

The SM4 Configurator software can be used to export an .SM4S configuration file that will require a user-selectable 4-digit code to change any settings on the recorder. The user can still navigate through all the menus and screens. However, any attempt to change configuration settings or the clock will fail with an error. The time and GPS coordinates may still be set/updated by plugging in the GPS accessory.

NOTE: This is not a cryptographic solution but the level of security is sufficient to prevent the casual user from changing configuration settings that could impact the success of a deployment.

A locked recorder will show [LOCKED] in the lower right corner of the Main Menu.

Use the steps below in the SM4 Configuration Utility to lock or unlock a recorder.

1. Configure your schedule and settings as normal in the SM4 Configuration program.
2. Save the *.SM4S* configuration file using the menu selection "*File->Save with lock/unlock code...*". The user is prompted to enter a 4-digit code and indicate if the configuration is to be locked or unlocked.
3. When the *.SM4S* configuration file is imported into the SM4 from the "*Schedule->Import Sched+Setts*" menu, the recorder will be in one of the following states depending on whether the recorder was locked or unlocked and if the *.SM4S* is locked with a code or not:
 - a. If the SM4 was unlocked and the *.SM4S* file is locked with a code, the SM4 configuration will be updated and locked with the code. The user will first be prompted to make sure they understand that the configuration will be locked.
 - b. If the SM4 was locked, and the *.SM4S* file is unlocked with a matching code, the SM4 configuration will be updated and unlocked. This is how an SM4 can be returned to an unlocked state.
 - c. If the SM4 was locked, and the *.SM4S* file is locked with a matching code, the SM4 configuration will be updated and the SM4 remains locked with the code. This is how a locked configuration can be updated with a new locked configuration.
 - d. If the SM4 was locked, and the *.SM4S* does not contain a matching code, then the import will fail with an appropriate error.

WARNING: Once the recorder has been locked, it cannot be unlocked without the proper code except by contacting Wildlife Acoustics Support.

3.11 Mounting the Recorder

Use the holes in the top and bottom mounting bracket for mounting the recorder with cable locks, screws, radiator clamps, bungee cords, or other fasteners. The enclosure is fully weatherproof and does not require additional protection.

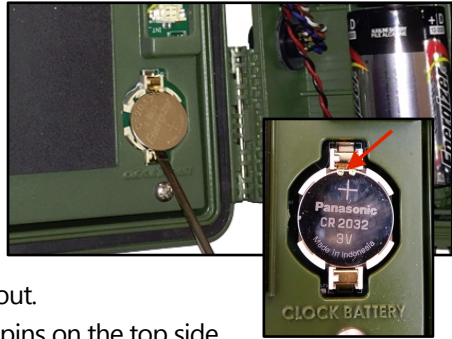


NOTE: Do not mount the recorder using a cable lock or other nonflexible cord to a growing tree. Circumferential growth could cause the cable to warp or break the recorder's mounting bracket. The tree won't like it either.

3.12 Replacing the Clock Battery

A separate button cell CR2032 lithium battery maintains real-time clock settings when the four main D batteries are being exchanged or are no longer operational. The included battery should last up to 3 years. Use the steps below to replace the internal clock battery.

1. Open the security cover and the middle section to access the battery bay.
2. Locate the circular **CLOCK BATTERY** bay behind the display and keypad opposite the main battery bay.
3. Gently insert a flathead screwdriver to pry the old battery out.
4. Slide a new battery under the two pins on the top side with the CR2032 lettering facing you.
5. Push down on the lower side until you feel the battery seat.



3.13 Reading the Recorder Temperature

The recorder includes an integrated temperature sensor to log temperatures inside the enclosure. This is intended for diagnostics only. Heat from the electronics and/or sunlight on the enclosure can significantly increase the temperature reading above ambient air conditions.

Press the **CHECK STATUS** button to view the current temperature reading.

4 Settings

4.1 Navigating the Menus

To navigate the main menu, select items, and configure the values for various settings, use the following basic steps. All procedures in this guide assume you are familiar with these steps.

1. Press **▲ Up** or **▼ Down** and **ENTER** to navigate any menu.
For example, navigate to **Main Menu > Settings > LED Indicator**.
2. Press **ENTER** or **▶ Right** to select menu items and continue to the next editable item. **ENTER** and **▶ Right** are interchangeable in the menus with the exception of the line where schedule blocks are added and deleted.
3. Press **▲ Up** or **▼ Down** to select values.

Tip: To accelerate the pace when selecting higher or lower values, press and continue to hold down the **▲ Up** or **▼ Down** arrow buttons.

4. Press **ENTER** or **▶ Right** to save your edits.
5. Repeat these steps as required. The exact buttons you press may vary by setting and parameter.
6. Press **◀ Left** to exit a line without saving and return to the previous menu.

TIP: For improved visibility in low-light environments, press any button on the keypad to illuminate the display. The backlight remains lit while you continue operating the recorder and turns itself off after 30 seconds of inactivity.

4.2 Setting the Date and Time

Follow these steps to set the date and time manually unless you are using the available GPS accessory to automatically set the current date and time.

1. Navigate to **Main Menu > Settings > Date and Time**.
The date and time appear on one line in the following format:

YYYY-MMM-DD HH:MM:SS

2017-Oct-22 20:17:45

2. Press **▶ Right** to set the date (year, month, and calendar day). As you adjust the month and day, the corresponding sunrise and sunset times appear (according to the Sunrise/Sunset Type setting) for that date.
3. Press **▶ Right** to set the time (hours, minutes, and seconds).
4. To adjust any value, press **▲ Up** or **▼ Down**.
5. Press **ENTER** when finished.

NOTE: The recorder does not automatically adjust for Daylight Saving Time.

4.3 Setting the Prefix for Recorded Files

You can specify a custom filename prefix of up to 12 characters to identify each recorder. The default prefix combines the model number with the serial number.

The prefix appears in every recording file name and easily identifies recordings made on a specific recorder or from a common shared schedule. Follow these steps to change the recorder prefix:

1. Navigate to **Main Menu > Settings > Location > Prefix.**
2. Specify a 1 to 12-character prefix from left to right:
 - a. At the first position, press ▲ Up to cycle through the alphabetic characters A to Z. Press ▼ Down to cycle through the numbers 9 to 0. You can also select a hyphen (it is above the digit 9).
 - b. Press ► Right to advance to the next position in the prefix and repeat the previous step.
3. To erase characters, select the blank character. It is higher than the hyphen and lower than the letter A. All of the characters to the right of the blank character are erased.
4. When finished, press ► **Right** to advance to the last position and then press **ENTER.**

NOTE: The prefix can only contain capital letters, numbers, and hyphens. When you change the default prefix, the serial number of the recorder no longer appears in the recording file names; however, it does still appear in the metadata inside the file.

4.4 Setting the Location and Time Zone

You must manually set these parameters if you are not using the available GPS accessory to automatically set the latitude and longitude. The time zone cannot be set automatically by the GPS and must be set manually.

NOTE: The time zone must be set prior to using the available GPS accessory to automatically set the correct time. The SM4 adjusts the time from the GPS based on the time zone setting and sets the recorder's clock after this calculation. If you change the time zone after the clock has been set, this automatic adjustment does not take place and the clock will not be set correctly.

The selections you make for latitude, longitude, and time zone enable the recorder to determine the specific sunrise and sunset times for each day.

Specify the local time zone (as used to set the clock) in hours relative to UTC (Universal Time Coordinated). Exact hour, half, and quarter time zones (:00 :15 :30 :45) are supported.

NOTE: Schedules and settings exported from one recorder and imported on a second recorder do not overwrite the **Prefix, Latitude and Longitude, Time Zone, or Battery Cutoff** settings on the second recorder. Schedules created or edited by the Song Meter SM4 Configurator software can selectively overwrite any setting upon import.

1. Navigate to **Main Menu > Settings > Location > Latitude.**
 - a. To enter degrees of latitude north of the equator, press ▲ Up.
 - b. To enter degrees of latitude south of the equator, press ▼ Down.
2. Navigate to **Main Menu > Settings > Location > Longitude.**
 - a. To enter degrees of longitude west of the prime meridian, press ▲ Up.
 - b. To enter degrees of longitude east of the prime meridian, press ▼ Down.
3. Navigate to **Main Menu > Settings > Location > Timezone.**
Enter the time zone relative to UTC.

NOTE: The recorder does not automatically adjust for Daylight Saving Time.

4.5 Setting the Solar Calculation Method

The SM4 can schedule recordings relative to sunrise and sunset times, and adjusts these times as they change during the year. You can choose from four different methods of calculating the sunrise and sunset.

1. Navigate to **Main Menu > Settings > Sunrise/Sunset Type.**
2. Select one of the following solar calculation types:
 - **sunrise/set:** When the sun is just below the horizon.
 - **civil:** When the sun is 6 degrees below the horizon.
 - **nautical:** When the sun is 12 degrees below the horizon.
 - **astronomical:** When the sun is 18 degrees below the horizon.
3. The calculated sunrise and sunset times for the method that you select appear for at the bottom of the screen.
4. Press **ENTER** to save your changes.

NOTE: Sunrise and sunset calculations also require other settings including the date and time, latitude, longitude, and time zone.

4.6 Audio Settings

When your schedule starts, it applies your current audio settings. When you import or export a schedule, the settings are included.

1. Navigate to **Main Menu > Settings > Audio**.
2. Select an audio setting to adjust its value using the **▲ Up** or **▼ Down** buttons.
3. Press **ENTER** to save your changes.

The following sections describe each audio setting.

Channel

Select the audio channel or channels. The left microphone is on channel 0 and the right microphone is on channel 1.

Values: stereo, left, or right

Default: stereo

Left and Right Gain

You can adjust the left or right channel audio gain setting to boost the input level of the audio signal from the corresponding microphone. The default 16 dB gain is generally a good compromise between having fidelity of weaker signals while maximizing dynamic range to handle louder signals. A lower gain setting might be necessary in loud environments to avoid clipping. A higher gain setting might be necessary if you are trying to analyze very weak signals.

In addition to this programmable gain setting, the built-in microphones have a low-noise 26 dB preamplifier gain stage that is discussed in the next section.

The default setting of 16 dB, when used with built-in microphones and with the **Preamplifier Gain** set to **26 dB**, is equivalent to 48 dB gain on a Song Meter SM2 and 24 dB gain on an SM3. In addition, the SMM-A1 microphone is, on average, 2 dB less sensitive than the built-in microphones or the SMM-A2, so an additional 2 dB of gain is necessary for equivalence.

Values: 0 to 59.5 dB in 0.5-dB increments

Default: 16 dB

Left and Right Preamplifier Gain

You can set 26 dB of preamplifier gain for the internal microphones. This gain does not apply to external microphones; the setting will have no effect. The external microphones have preamplifier gain built in. Preamplifier gain should generally be on for recording from internal microphones as it is lower

noise than the regular gain. Set to **off** for use with very loud signals that might otherwise clip, for example calibrating microphones or recording very loud noises.

Values: off, 26 dB

Default: 26 dB

Left and Right Filter

You can set a left or right channel high-pass filter, which only allows signals higher than the specified frequency to be recorded. For recording very low frequency sounds such as elephants, set this to **off**. Otherwise it is useful for reducing wind and anthropogenic noise and should be set to at least 220 Hz. The high-pass filter is a two-pole filter, which attenuates sounds at 12 dB per octave. For example, if the filter was set to **1 kHz**, a 500 Hz sound would be attenuated by 12 dB as it is one octave lower than the filter's 1 kHz frequency. Every 6 dB represents a halving of sound level, so the 500 Hz sound would appear in the recording at one-fourth of its original amplitude.

Values: off, 220, or 1000 Hz

Default: off

Sample Rate

Your choice of rate determines the number of samples per second used to make a recording during a recording period. Higher sample rates provide the ability to record higher frequencies. Choose a sample rate that is at least double the highest frequency to be recorded.

Values (Hz): 8000, 12000, 16000, 22050, 24000, 32000, 44100, 48000, or 96000

Default: 24000 Hz

Max Length

You can specify the maximum length (time duration) of recordings. The recorder also enforces its own 2.0 GB maximum recording file size. When a recording reaches either maximum, it ends and a new recording file starts.

NOTE: Back-to-back recordings and recordings that are split when maximum length is reached may start a few seconds late to allow time for file operations on the SD memory card. This may result in smaller files than the **Max Length** setting. For example, a recording might show a duration of 14:57 even though you set **Max Length** to 15:00.

Values: 1 minute up to 24 hours in 1-minute increments

Default: 01h: 00m

NOTE: If the SM4 is set to record continuously with no duty cycle and Max Length is not divisible into 24 hours, then the last recording of each 24-hour recording period will truncate. The 24-hour period begins and ends at the time the **SCHEDULE START** button was pressed to start the schedule.

Compression

SM4 WAV file compression can be selected to record in a proprietary compressed W4V format. The W4V format is a WAV file compression developed specifically for minimizing loss of useful information in bioacoustics audio recordings while maximizing compression to save on valuable card space. W4V records the same rich meta-data as when recording to WAV. There are three compression levels which result in the following compression:

- W4V-8: 50% (allows recording twice as long on a given card as compared to uncompressed WAV)
- W4V-6: 62.5% (allows recording almost three times as long on a given card as compared to uncompressed WAV)
- W4V-4: 75% (allows recording four times as long on a given card as compared to uncompressed WAV)

The compression algorithm does increase the noise floor of the recording but for most bioacoustics uses, the difference between an uncompressed WAV and W4V-8 and W4V-6 will be undetectable since the noise floor in the recorded environment will be higher than the increased recording noise floor. W4V-4 will likely cause a slight increase in broadband noise in the background of the recording. It is best to experiment with your particular environment to make sure the increased noise is either undetectable or tolerable.

Wildlife Acoustics' Kaleidoscope Viewer and Pro software can natively open the compression formats. The free Kaleidoscope Converter can be used to convert the files to standard WAV format for use in other software packages. Additionally, the W4V algorithms are open-source under GPLv3 license. Please contact us if you are interested in a commercial license.

Values (Hz): none, W4V-8, W4V-6, or W4V-4

Default: none

4.7 Setting a Delayed Start

The Delay Start setting waits until a future date to start your schedule. The recorder delays the start of the schedule until 00:00 of the specified day.

1. Navigate to **Main Menu > Settings > Delay Start**.

2. Set a future start date and set **Enable** to **yes**.

When you start the schedule, a warning reminds you of the delayed start. If the date is in the past, no warning appears and the schedule starts without delay.

4.8 Setting the LED Indicator Mode

The LED indicator blinks green once per second when recording. This light is visible on the front of the recorder even when the security cover is closed.

1. Navigate to **Main Menu > Settings > LED Indicator**.

2. Choose **always** or **5 minutes only**.

When you choose **5 minutes only**, the LED only appears for approximately the first five (5) minutes of recording after you press **SCHEDULE START** or **CHECK STATUS** or until the first time the unit sleeps. This setting minimizes drawing attention to the recorder and allows you to maintain some level of camouflage when recorder security or visibility is a concern.

4.9 Advanced Settings

The following describes each advanced setting.

Setting a Minimum External Battery Voltage

You can set a minimum voltage cutoff to help prevent damage to external lead acid batteries from over-discharge. If the external battery voltage falls below this cutoff, the schedule is suspended. The SM4 then wakes every 24 hours to check the voltage and resumes the schedule if the voltage is restored.

1. Navigate to **Main Menu > Settings > Advanced > Battery Cutoff**.
2. Press **▲ Up** or **▼ Down** to adjust the power cutoff in volts from 0.0 to 12.0 in 0.1-volt increments.
3. Press **ENTER** to save your changes.

NOTE: Leave the cutoff value at 0.0 if you are using internal batteries. Any non-zero setting decreases internal battery life as the recorder prematurely suspends operation. Also use a setting of 0.0 for external batteries that are designed for deep discharge.

Enter the Microphone Sensitivity

This setting does not affect the recordings and can be ignored if your analysis does not require knowing exact recording amplitudes.

This setting allows known microphone sensitivities to be entered, which will be saved in the recordings' meta-data for use in noise analysis or for

traceability. Use the value determined during the calibration procedure as described in the Utilities chapter in this guide. If the possible error is tolerable, the nominal sensitivity of the microphone from the Specification chapter of this guide could also be used

1. Main Menu > Settings > Advanced

2. For both L (Left) and R (Right) microphone sensitivity settings, select the desired value by using the **▲ Up** or **▼ Down** buttons.
3. Press **ENTER** to save your changes.

Values: +10.0 to -200.0 dB in 0.1 dB increments

Default: 0.0 dB

The sensitivity value entered above, the gain setting, the preamplifier setting and the full-scale reference of the analog to digital converter are all used to calculate a correction factor that is stored in the recording's meta-data. This correction factor can later be used to calculate sound pressure levels or other noise calculations from the recordings. In Wildlife Acoustics' Kaleidoscope Pro software, this correction factor is automatically used in the Noise Analysis Module to adjust the reported calculations.

Selecting Schedule Mode

The SM4 can operate in Simple Schedule or Advanced Schedule Modes.

1. Main Menu > Settings > Advanced > Schedule Mode

2. Use the **▲ Up** or **▼ Down** buttons to toggle between the two modes.

The Simple Schedule Mode is easier to configure but has the limitation of only being able to perform the same schedule every day. The Advanced Schedule Mode can be programmed to run different recording schedules on different days.

5 Making Scheduled Recordings

5.1 Recording Operation Overview

The recording schedule determines when each day the SM4 records and when it sleeps while waiting for a recording period. While recording, the recorder samples audio signals at a specified sample rate and saves WAV files to SD memory cards.

This chapter guides you in using the Quick Start schedules, and the next two chapters describe creating your own Simple or Advanced schedule, as well as importing and exporting schedules.

5.2 Using a Quick Start Schedule

The Quick Start menu includes pre-configured Simple Mode schedules that satisfy most scheduling requirements. They also serve as excellent starting points for editing your own schedule if you need something a little different. Creating custom schedules is described in the next chapter but the remainder of this chapter should be read first to understand how to run any schedule.

NOTE: It is advised to use the SM4 Configurator software whenever possible to double-check that the chosen schedule will behave as desired. These same quick start schedules are available in the Configurator to allow you to easily enter your location and double-check your schedule on the graphical calendar.

1. Navigate to **Main Menu > Quick Start**
2. Choose one of the following Quick Start schedules and press **ENTER**.

Name	Definition of schedule
Record Always	Records continuously 24 hours a day.
Record 30on & 30off	Repeats an hourly duty cycle made up of 30 minutes of recording followed by 30 minutes of sleep.
Record 5on & 55off	Repeats an hourly duty cycle made up of 5 minutes of recording followed by 55 minutes of sleep.
Record Sunrise→Set	Based on your location, date, and sunrise/sunset settings, records continuously from sunrise until sunset.
Record Dawn & Dusk	Based on your location, date, and sunrise/sunset settings, records 2 hours centered at sunrise and 2 hours centered at sunset.

NOTE: The Record Always quick start schedule will start at the time the **SCHEDULE START** button is pressed to begin the schedule. If you prefer to have recordings start on the hour, you must set a duty cycle, for example 59 minutes of recording and a 1 minute pause. Duty cycled recordings will start on the hour. Or use the Delay Start setting to set a future start date to force the SM4 to start recording at midnight.

3. When you change schedules, the following confirmation message appears:

```

Overwrite Schedule?
-No
-Yes

```

- Select **Yes** to continue loading the selected recording schedule. This overwrites any and all blocks of the existing schedule in the unit with the built in schedule selected. All other settings are unchanged.
- Select **No** to retain the current schedule.

Tip: If you want to save any custom edits or blocks you already made to a schedule, select **No** here to go back and export that schedule to a memory card, and then you can choose a new schedule and select **Yes** here with confidence knowing your previous schedule was backed up.

4. Press **SCHEDULE START** to start the schedule or **◀ Left** to return to the Quick Start menu. The new Quick Start schedule is loaded even if you return to the menu. See the next chapter for details on running and stopping the schedule.

Tip: The recorder automatically attempts to start the current schedule after three (3) minutes of inactivity.

5. When you press **SCHEDULE START**, warning messages may alert you about needed settings, missing SD memory cards, or incompatible or missing microphones.
6. Each warning is displayed for several seconds. You can proceed immediately to the next warning by pressing **▼ Down**. After the last warning, the recorder will attempt to run the schedule.
7. While any warning is being displayed, you can press **SCHEDULE STOP** or **◀ Left** to avoid running the schedule and return immediately to the main menu. Adjust any settings or hardware configurations to resolve the warnings. Press **SCHEDULE START** again when you are ready.
8. One of the following screens appear:

If your schedule records always:

```

2017-Dec-0510:58:37
Preparing to record
A CONTINUOUS #00001

```

If your schedule calls for specific start and end times that define a contiguous recording period, recording within the next 45 seconds, then the first recording period start and end times are shown:

```
2017-Dec-05 10:58:37
Preparing to record
A 11:00-17:00 #00002
```

If you defined a duty cycle that calls for an even smaller segment of recording time, that time range appears:

```
2017-Dec-05 10:58:37
Preparing to record
A 11:00-11:30 #00003
```

If the first recording period start time is more than 45 seconds into the future, then the recorder goes to sleep to conserve power:

```
2017-Feb-10 11:05:00
Going to sleep until
2017-Feb-10 19:15:00
```

The recorder wakes up 30 seconds before the next scheduled recording period so that it is ready to record on time.

5.3 The Recording Screens

While it is recording, the SM4 shows a screen like one of the following:

```
2017-Apr-25 23:50:48
Currently recording:
A CONTINUOUS #00088
STEREO @SR=48000
```

```
2017-Apr-26 09:02:48
Currently recording:
B 09:00-09:30 #00089
STEREO @SR=24000
```

Both examples show the following details on four (4) lines:

- Line 1: The current date and time.
- Line 2: The **Currently recording:** status message.
- Line 3: The current card slot that the recorder is writing to (**A** or **B**) followed by the beginning and ending times of the current recording period or **CONTINUOUS** if the schedule is set to record all the time (the Quick Start **Record Always** schedule for example). On the right side of the same line is the running count of recording files saved since the recorder was last powered on.
- Line 4: The current recording channel and sample rate.

5.4 Checking the Status of the Recorder

We recommend that you perform this procedure to check the status of the recorder and SD memory cards before every deployment.

1. Press the **CHECK STATUS** button.

NOTE: When the recorder is sleeping, you must press and hold the button to see status. First you will see a boot screen and then the “Going to sleep until” screen appears. Another press of the Check Status button is required to view the Check Status screen shown below.

2. The Check Status screen appears. For example:

```
2017-Oct-23  9:14:48
R:1.0.0 Mic0:IN 1:A2
SD A: 7/64 B: EMPTY
Bat: 5.2V Temp:17.00
```

The following status information appears:

- **Line 1:** The current date and time.
- **Line 2:** The installed firmware version and the currently connected microphones on channels 0 and 1:
IN: a built-in microphone
A1/A2: an external acoustic microphone
- **Line 3:** The consumed memory as a fraction of the total capacity in GB for the SD memory cards in slots A and B. In this example, 7 GB have already been used on a 64 GB card in slot A and there is no card in slot B.

NOTE: *WP* will appear in place of the consumed memory for any card with a write-protection switch ON.

- **Line 4:** The internal battery or external power supply voltage, and the internal temperature in degrees Celsius.

NOTE: The internal temperature of the recorder is intended for diagnostics and not as an accurate measurement of outside air temperature.

3. (Optional) You can press the **CHECK STATUS** button again to return to the previous screen. The status screen automatically stops appearing after ten (10) seconds.

5.5 Monitoring Live Audio with Headphones

You can connect headphones to the headphone jack to listen to real-time audio as it is recorded. Headphone audio can be heard only during a live recording.

1. Open the security cover and insert the headphone cable into the headphone jack on the side below the GPS port.
2. You can start a schedule, start instant recording mode (Refer to section 5.7 below), or allow a currently running schedule to continue.
3. Press **ENTER** during a recording to enable monitoring on headphones.



CAUTION: Initial headphone volume may be loud.

4. Press **▲ Up** or **▼ Down** to adjust the volume.
5. Press **ENTER** again to toggle the headphone output on and off. Headphone sound automatically resets to off when the current recording period ends.

5.6 Stopping a Recording Schedule

When a schedule is running, or scheduled to run, you have the option to stop it.

1. Press and hold the **SCHEDULE STOP** button for several seconds.
2. When you stop a running schedule, the current recording is saved to the SD memory card before it ends.
3. The recorder automatically attempts to resume the current recording schedule after three (3) minutes of inactivity. When not recording for an extended period of time, power the recorder *off*.

5.7 Making an Instant Recording

In addition to running a schedule, you can start an instant recording anytime. Starting an instant recording is like forcing a record *always* schedule for 24 hours.

1. Verify the recorder is turned on and displaying the main menu. If the recorder is sleeping, press and hold **SCHEDULE STOP** to wake it.
2. Press and hold both the **▲ Up** and **▼ Down** keys at the same time.
3. After a brief **Preparing to record** screen, the recorder immediately starts continuous instant recording.

```

2017-Oct-14 14:50:48
Currently recording:
A CONTINUOUS
STEREO @SR24000

```

4. Press **SCHEDULE STOP** to stop instant recording. After 24 hours, instant recording will automatically stop and the current schedule will begin.

NOTE: The length of recordings made during instant recording is dictated by the **Max Length** setting in **Audio Settings**.

5.8 Retrieving and Viewing Recordings

Transfer recordings to your computer by removing the SD memory card (s) from the recorder and copying the files to your computer using a built-in or USB memory card reader.

NOTE: If the recorder is left to run until the batteries are mostly depleted, it is possible that you will find the SD memory card(s) in a DIRTY state. The recordings are fine and can still be transferred to your computer. Once you have transferred all recordings, clear the DIRTY state using the built-in formatting utility. see *Formatting SD Memory Cards* in the Utilities Chapter for more information. In addition, there will likely be multiple .sm4dump files on the card as the recorder assumes there is an issue when the power is intermittent. These can be ignored. It is also possible to get a **fatal clock error** if the batteries were fully depleted, this will not persist once batteries are replaced.

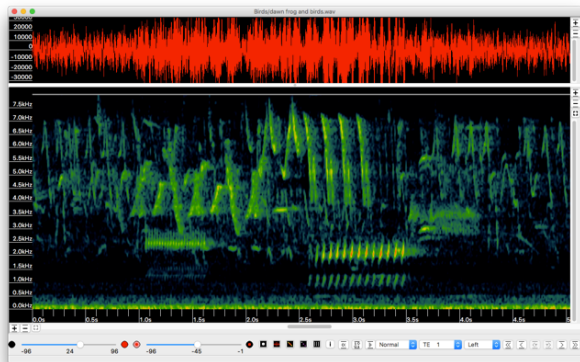
The WAV recordings are compatible with all popular audio analysis and viewing programs as well as Wildlife Acoustics Kaleidoscope software.

5.9 Kaleidoscope Software

Wildlife Acoustics recommends and supports our Kaleidoscope software, which allows you to easily view, search and classify your recordings.

Kaleidoscope Viewer is a free download and

Kaleidoscope Pro with Cluster Analysis software is available for purchase at www.wildlifeacoustics.com.

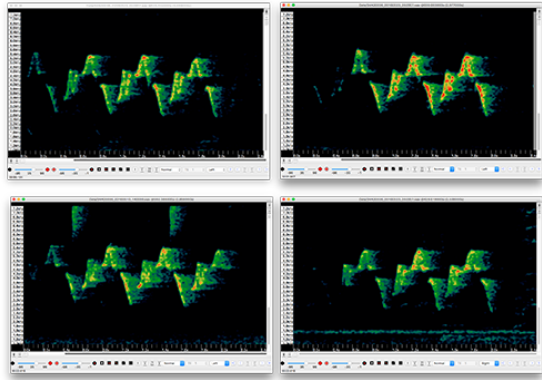


5.10 Analyzing Recordings with Kaleidoscope Pro's Cluster Analysis

Kaleidoscope Pro's acoustic Cluster Analysis detects similar vocalizations in one or many recordings, and quickly sorts them into Clusters. The resulting Clusters can be quickly reviewed and labeled to identify the species present in the recordings.

Weeks of recordings can be clustered and reviewed in minutes allowing analysis of enormous recording collections, which would otherwise be extremely time intensive or impossible to analyze.

Use the labeled Clusters to create classifiers that can automatically recognize species of interest in other recordings. These classifiers can be applied in batch mode to any number of recordings and the classifications easily reviewed.



5.11 Recording Files

Audio recording files are saved in the **Data** folder on each SD memory card and use the following naming convention:

PREFIX_YYYYMMDD_HHMMSS.wav

PREFIX: The current prefix as set in the location settings.

YYYYMMDD_HHMMSS: The date-time stamp including the year, month, day, hour, minute, and second when the recording started.

.wav or W4V: The audio file name extension for Waveform Audio File Format (WAVE) or Wildlife Acoustics' proprietary compression format.

5.12 Recording Metadata

Values for the attributes listed below are stored as metadata in your recordings. The Wildlife Acoustics Support Team can use metadata to troubleshoot issues.

NOTE: You can open a recording in the SM4 Configurator computer software to view the schedule and settings used to make the recording.

Device Model: The device model name. For example, *SM4*.

Device Serial Number: The unique serial number of your recorder.

Firmware Version: The firmware version installed on the recorder.

Prefix: The prefix assigned to the recorder in the location settings.

Timestamp: The date and time when the recording started.

Temperature: The internal temperature of the recorder when the recording started.

GPS Coordinates: The location of the SM4 when the recording first started. The file metadata stores the location coordinates that you manually entered on the recorder as well as the coordinates from the GPS accessory if attached. Coordinates from the GPS will have the text string WGS84.

Schedule and Settings: The schedule and all settings in use when the recording was made.

5.13 Recording Summary Text File

Approximately once per minute during a recording, the SM4 appends a line to the summary text (.txt) file. This file is in comma-separated values (.csv) format. You can open it in Microsoft Excel, in database software, or in a text editor. The file begins with a header line which identifies the fields that appear in each line of summary data:

```
DATE, TIME, LAT, , LON, , POWER(V), TEMP(C), #FILES, MIC0 TYPE, MIC1 TYPE
```

Three (3) lines from a sample summary file appear below:

```
2017-Jan-22, 17:15:24, 42.00000, N, 71.00000, W, 5.9, 12.00, 0, A1
```

```
2017-Jan-22, 17:16:38, 42.20000, N, 71.10000, W, 5.9, 11.75, 0, IN
```

```
2017-Jan-22, 17:17:47, 42.35000, N, 71.18200, W, 5.9, 11.75, 1, IN
```

DATE & TIME: The date and time for each entry. This is the time taking into account the time zone set in the location settings.

LAT & LON: Latitude and longitude coordinates in decimal degrees with identifiers for north (N), south (S), east (E), and west (W). If the GPS accessory is installed at the time the log entry is written, the identifiers are capitalized indicating that the latitude and longitude was written from the GPS using the WGS-84 coordinate system. If no GPS is attached, the identifiers are lower case indicating that the coordinates were previously written by GPS or entered by the user.

POWER(V): The internal battery or external power supply voltage. In the example, the voltage is 5.9 volts.

TEMP(C): The temperature in degrees Celsius inside the recorder. In the example, the internal temperature has fallen from 12.00 to 11.75 degrees.

#FILES: The number of recording files written since the previous summary file line. Since a new summary line is written one per minute, if your recording is longer than 1 minute a zero appears on all lines until the recording is concluded.

MIC0TYPE & MIC1TYPE: The microphone types currently attached to channels 0 and 1. When an internal mic is used, **IN** appears. External mic values include **A1** or **A2**. The underwater variant displays **H1** indicating an attached hydrophone.

6 Creating Custom Simple Schedules

In addition to using one of the Quick Start schedules, you can create your own schedule using the built-in editor, or import a schedule from an SD memory card made on another recorder or the Song Meter SM4 Configurator software on your computer. You can also export the current schedule to an SD memory card.

NOTE: It is advised to use the SM4 Configurator Software whenever possible to double-check that the programmed schedule will behave as desired. Schedules created on the SM4 can also be double-checked by importing them into the Configurator and viewing on the graphical calendar.

SM4 schedules are flexible and portable. Schedules exported from recorders or created by the Song Meter SM4 Configurator software include all configurable settings. The appropriate settings are applied when a schedule is imported. This coupling of schedules with their settings enables you to share entire configurations from one recorder to another.

6.1 Schedule Blocks

Schedule blocks are the core components that define a daily recording schedule. Every schedule has at least one block. A block has the following three lines:

```

START:  time hh:mm or
        rise +/-hh:mm or
        set  +/-hh:mm

DUTY:   always or
        ON hh:mm OFF hh:mm

END:    time hh:mm or
        rise +/-hh:mm or
        set  +/-hh:mm

```

Each block defines a single continuous recording period between its **START** and **END** times (if **DUTY** is **always**), or a series of smaller non-continuous duty cycles (if **DUTY** is **ON** and **OFF**) that repeat between the **START** and **END** times. The combination of all the duty cycles and recording periods generated by all the blocks makes up the daily recording schedule. The **START** and **END** times for the block can be a fixed time or relative to sunset or sunrise. Times are specified using a 24-hour clock (HH:MM). When

relative to sunset or sunrise, a positive (+) or negative (-) offset can be specified.

The **DUTY** cycle determines how often recording occurs between the start and end times. When set to **always**, recording is continuous between the start and end times. When set to **ON** and **OFF**, recording occurs for the specified number of hours and minutes (**ON**) followed by a period of inactivity (**OFF**). The duty cycle repeats as many times as possible before the **END** time is reached.

The duty cycle begins at the **START** time, not when you begin running the schedule. For example, if you begin the following schedule by pressing **SCHEDULE START** at 10:50, the recorder sleeps until the next 15-minute **ON** duty cycle occurs at 11:00.

```
START: time      07:00
DUTY: ON00:15OFF00:45
END:   time      19:00
01/01  [ADD]
```

A typical schedule might only need one block; however, you can combine up to ten (10) blocks in a single schedule and can even overlap them. The SM4 scans all blocks and combines all their recording periods.

For example, you can create a schedule to record continuously from sunset to sunrise in one block and to record 5 minutes on the hour throughout the whole day (24 hours) in another block. The recorder combines these, resulting in 5-minute recordings during the days and continuous recordings during the nights.

In another example, if one block generates a recording period from 08:00 to 10:00, and a second block generates a recording period from 09:00 to 11:00, the resulting schedule yields a single recording period from 08:00 to 11:00.

6.2 Editing a Schedule

Use this procedure to edit a schedule directly on the recorder using the Display and buttons. We recommend that you edit schedules using the Song Meter SM4 Configurator software whenever possible; however, if you are in the field and need to edit a schedule, this method is convenient.

The recorder comes from the factory with the *Record Always* Quick Start schedule pre-loaded. You can select or import another schedule if that provides a better starting point for your custom schedule.

1. Navigate to **Main Menu > Schedule > Edit Schedule**.
2. Edit any of the three lines of a schedule block:

- a. **START:** Press ▲ Up or ▼ Down to select rise, set, or a specific time. Press ▲ Up or ▼ Down to adjust the + plus or – minus sign for times that are relative to sunrise or sunset. For example, enter rise -01:15 to start recording one hour and fifteen minutes before the calculated sunrise time.
 - b. **DUTY:** Schedules can record continuously between the START and END times (always) or for a specific repeating duty cycle within those times (ON & OFF). To learn more, see the schedule examples in this chapter.
 - c. **END:** Press ▲ Up or ▼ Down to select rise, set, or a specific time. Press ▲ Up or ▼ Down to adjust the + plus or – minus sign for times that are relative to sunrise or sunset. For example, enter rise -01:15 to start recording one hour and fifteen minutes before the calculated sunrise time.
3. Press **ENTER** to save your changes.

TIP: To undo your changes in any line, you can press ◀ **Left** to return to the start of the line and revert to its original value.

6.3 Adding or Deleting Schedule Blocks

When you edit a schedule, you can add or delete schedule blocks.

To add a new block:

1. Press ▼ **Down** repeatedly to navigate to the bottom line of the last block in the schedule.
2. Press ► **Right** to advance to **[ADD]** and press **ENTER**. The bottom line below the block shows the number of the block you are viewing and the total number of blocks.

```
START: time    00:00
DUTY:  always
END:   time    00:00
02/02  [ADD]   [DEL]
```

TIP: To move to the previous schedule block, press ▲ **Up** when on the **START** line. To move to the next schedule block, press ▼ **Down** when on the bottom line.

To delete a block:

1. Press ▲ **Up** or ▼ **Down** to navigate to the bottom line of the block.
2. Press ► **Right** to advance to **[DEL]** and press **ENTER**.

The following example stretches the display to demonstrate the concept of adding multiple code blocks in a schedule:


```
START: set      -00:05
DUTY:  always
END:   rise     +00:00
01/03      [DEL]
```

```
START: time     09:15
DUTY:  always
END:   time     11:15
02/03      [DEL]
```

```
START: set      +02:15
DUTY:  always
END:   rise     +01:30
03/03 [ADD] [DEL]
```

6.4 Schedule Block Examples

This section provides recording schedule examples that demonstrate how schedule blocks work. A schedule specifies when the SM4 records but does not necessarily result in a single file for the entire period. The number of recordings for a given schedule will be dictated by the **Max Length** setting.

Record Continuously All Hours of Every Day

The following schedule records continuously all day and night, 24 hours per day.

```
START: time     00:00
DUTY:  always
END:   time     00:00
01/01      [ADD]
```

NOTE: This schedule appears under the **Quick Start** menu as **Record Always**. It runs continuously until you press **SCHEDULE STOP** or it runs out of power or memory space.

Whenever the start and end times are identical and **DUTY** is set to **always**, your schedule is essentially the same as the **Record Always** schedule.

Record Continuously for a Portion of Each Day

The following schedule records continuously for the same six (6) hours daily:

```
START: time     04:00
DUTY:  always
END:   time     10:00
01/01      [ADD]
```

The **Max Length** audio setting determines the maximum recording file duration in hours and minutes. For example, to capture output from this

schedule in hourly segments (6 recordings per day), set the **Max Length** setting to 01h:00m.

Record in 15-Minute Segments

The following schedule starts at six o'clock in the evening and records for the first 15 minutes of every hour until six o'clock in the morning.

```
START: time    18:00
DUTY: ON00:15OFF00:45
END:   time    06:00
01/01  [ADD]
```

Record in 5-Minute Segments Every Hour

The following schedule records for 5 minutes at the beginning of each hour all day and continues indefinitely.

```
START: time    00:00
DUTY: ON00:05OFF00:55
END:   time    00:00
01/01  [ADD]
```

NOTE: The **ON** and **OFF** periods need not add up to an hour, but if they do not add up to a factor of 24 hours, the duty cycle truncates and restarts at the start time. For example, a duty cycle with **ON** 00:04 and **OFF** 00:03 divides 24 hours into 205 7-minute cycles plus one 5-minute partial cycle. In the 206th cycle, the schedule records for 4 minutes and then pauses for only 1 minute (instead of 3). This pattern repeats daily.

This schedule appears in the **Quick Start** menu as **Record 5on & 55off**.

Record Continuously Before Sunset until Sunrise

The following schedule starts every day 30 minutes before sunset and records continuously until sunrise on the following day.

```
START: set      -00:30
DUTY:  always
END:   rise     +00:00
01/01  [ADD]
```

Record in Multiple Blocks Relative to Sunset and Sunrise

The following schedule uses two blocks. The first block defines a period relative to sunrise and the second block defines a period relative to sunset. The combined result records for two hours centered at sunrise and two hours centered at sunset.

This schedule appears in the **Quick Start** menu as **Record Dawn & Dusk**.

```
START: rise    -01:00
DUTY:  always
END:   rise    +01:00
01/02          [DEL]
```

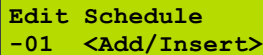
```
START: set     -01:00
DUTY:  always
END:   set     +01:00
02/02  [ADD]   [DEL]
```

7 Creating Custom Advanced Schedules

7.1 Creating and Editing an Advanced Schedule

Use this procedure to edit the currently active schedule directly on the recorder using the LCD screen and buttons. To learn more about each command and available settings, see 7.3 Advanced Schedule Commands. You can create a new schedule from scratch at line 1 using the recorder.

1. At the **Song Meter Main Menu**, select **Schedule**, and press **ENTER/MENU**.
2. Press **▼ Down**, select **Edit Schedule**, and then press **ENTER/MENU**.
3. The following screen appears:



```

Edit Schedule
-01 <Add/Insert>
  
```

4. Press **► Right** and then press **▲ Up** or **▼ Down** to cycle through the available schedule commands.
5. Select a command and press **► Right**. Press **▲ Up** or **▼ Down** to adjust the associated parameters for the command.
6. Press **► Right** to complete line 01 and repeat these steps for line 02 and each subsequent line.
7. When finished, press **◀ Left** to check the schedule. Any schedule errors appear. Press **▼ Down** to cycle through multiple errors
8. Press **◀ Left** to exit.
9. Navigate to **Main Menu > Schedule > Edit Schedule**.
10. Press **▼ Down** to select a line in the schedule.
11. To edit the line, press **► Right** to advance to the command or value and then press **▲ Up** or **▼ Down** to make adjustments. When finished, press **◀ Left** or **ENTER/MENU**.
12. To add or insert a line:
 - a. Press **▲ Up** or **▼ Down** to select the **<Add/Insert>** entry on the last line of the schedule and press **ENTER/MENU**. A new line appears at the bottom of the schedule.
 - b. Press **◀ Left** and then press **▲ Up** or **▼ Down** to change the line number for the new line. Press **ENTER/MENU** to confirm the line number.
 - c. To edit the new line, press **► Right** to advance to the command or value and press **▲ Up** or **▼ Down** to make adjustments. When finished editing, press **► Right** or **ENTER/MENU**.
13. To delete a line:
 - a. Press **▲ Up** or **▼ Down** to select the line you want to delete.

- b. Press ► **Right** to advance to the command for that line.
 - c. Press ▲ **Up** or ▼ **Down** until the <Delete> command appears.
 - d. Press **ENTER/MENU**. The line is removed and all higher lines cascade down in sequence by one line.
14. When finished editing all lines, press ◀ **Left**.
 15. Any schedule errors appear. Repeat these steps to resolve the errors or press ◀ **Left** to ignore. Press ▼ **Down** to view the next problem. Press ▼ **Down** after the last problem to return to the **Schedule** menu. To return to the **Schedule** menu before reviewing all the problems, press ◀ **Left**.
 16. When no errors exist, the following message appears:

Schedule edit OK

7.2 Using Loops

An essential logical structure in any computer schedule, a *loop* repeats a task until a necessary event occurs. For example, you need a schedule that waits, and continues to wait until sunrise; and then you want it to record, and repeat that action, recording over and over until 15 minutes before sunset. Loops are programmed by using pairs of **REPEAT** and **UNT** (until) commands, nested to any depth. Loops have an explicit ending condition, such as a date for an **UNTD** command or a count for an **UNTCOUNT** command. In addition, loops have an implicit ending time, inherited from any enclosing loops. The implicit ending time is the earliest of all the enclosing loop ending times. In other words, the ending condition of a loop is either its own ending condition or the implicit ending time, whichever occurs first. **RECORD** and **PLAY** commands likewise inherit an implicit ending time from any enclosing loops, perhaps causing a **RECORD** command to finish earlier than indicated by its own duration parameter or causing a **PLAY** command to not play its file at all. **UNTCOUNT** loops do not have an ending time of their own, although they do pass along any implicit ending time that they inherit. If a schedule contains just one loop, a **REPEAT/UNTCOUNT** loop, with a **RECORD** command inside that loop, then the **RECORD** command will always run for its full duration, and the loop will end after the specified count of iterations.

7.3 Advanced Schedule Commands

Use the following commands to create schedules for your specific recording needs. An Advanced Schedule can contain up to 99 command lines.

NOTE: Some commands listed in this section refer to *sunrise* or *sunset* in a general sense and depend on them in schedule calculations. The recorder recognizes different methods for calculating precise sunrise and sunset times. To specify a method and view the next available sunrise and sunset times, select **Sunrise/Sunset Type** in the **Settings** menu.

AT DATE DDMMYY

Causes the schedule to wait until the specified date. YY are the last two digits of the year in the current century beginning with the year 2000.

NOTE: If you start the schedule after the specified **AT DATE**, the command is ignored and the schedule continues.

AT TIME hh:mm:ss

Causes the schedule to wait until the specified date time.

NOTE: If you use an AT TIME, AT SRIS or AT SSET command in a repeating schedule and start the schedule after the time indicated, the recorder will assume you wish to record starting at the previously occurring sunset, sunrise or time and begin recording immediately.

For example, if you have a schedule that starts with AT TIME 16:00:00 and you are in the field starting the schedule at 17:00:00, the recorder will not wait until 16:00:00 the next day, but instead will start recording immediately.

AT SRIS±hh:mm:ss

Causes the schedule to wait until sunrise, plus or minus the specified time.

AT SSET±hh:mm:ss

Causes the schedule to wait until sunset, plus or minus the specified time.

REPEAT

Indicates the beginning of a loop. Must be ended by an **UNT** command.

UNTDATA DDMMYY

Ends a loop when the specified termination date is reached. Any **RECORD** commands in progress in this loop are forced to stop recording.

UNTTIME hh:mm:ss

Ends a loop when the specified termination time is reached. Any **RECORD** commands in progress in this loop are forced to stop recording.

NOTE: If **UNTIME** is set to the same time as **AT TIME**, the recorder will not repeat the loop indefinitely, it will interpret that you wish to start and then instantly stop the loop and will not make any recordings within that loop.

UNTSRIS±hh:mm:ss

Ends a loop at sunrise, plus or minus the specified time. Any **RECORD** commands in progress in this loop are forced to stop recording.

UNTSSET±hh:mm:ss

Ends a loop at sunset, plus or minus the specified time. Any **RECORD** commands in progress in this loop are forced to stop recording.

UNTCOUNT {<count>, INF}

Ends a loop after <count> iterations. **INF** specifies an infinite count.

RECORD hh:mm:ss

Starts a new recording of the specified duration. If the **RECORD** command is inside a repeat/until loop, the recording may end early to match the outer loop ending time.

Recording files larger than 2.0 GB are divided into smaller segments.

The recording period will be broken into the length as set in the **Max Length** setting of the **Audio Settings** menu.

PAUSE hh:mm:ss

Pauses the schedule for the specified amount of time. If you set the duration of the **PAUSE** command to greater than 1 minute (3 minutes if using the GPS option), the SM4 enters low-power sleep mode and wakes up at the next scheduled recording.

7.4 How to Work with the Schedule Checker

The Schedule Checker runs automatically to verify the configuration of the hardware and software, and to check your schedule for errors or warnings. If it detects contradictory commands, the Schedule Checker reports the latter of the two as the error source. Use the Schedule Checker output to correct your schedule, save it, and then attempt to import or run it again.

1. The Schedule Checker runs at all of the following times:
 - After you finish loading or importing a schedule.

- After you finish editing a schedule and press the main buttons on the device to exit the editor as viewed through the LCD screen.
 - Before you press the **SCHEDULE START** button to run a schedule or if the schedule starts automatically after 3 minutes of no activity.
2. The Schedule Checker performs several tests on the current schedule and shows *errors* (if any), followed by *warnings* (if any), and their matching line number in your schedule.
 3. To view the next error or warning, press the ▼ **Down** button.
 4. To exit the Schedule Checker, press the ◀ **Left** button. You can also exit by pressing ▼ **Down** after the last error or warning.
 5. If no buttons are pressed for 60 seconds while a problem is displayed, the Schedule Checker times out and exits.
 6. When the Schedule Checker exits:
 - If you were loading or editing a schedule, you return to the main menu.
 - If you were running a schedule and there are no errors (only warnings or no problems at all), your schedule starts.

7.5 How to Resolve Schedule Checker Errors

When a schedule contains *warnings*, you can address them or ignore them and continue, the schedule will run with *warnings*. However, when a schedule contains one or more *errors*, it will not run. To resolve an error, edit the schedule and adjust a parameter or add, move, or delete a command line. Refer to the following list of the most common possible schedule warnings and errors.

SM3 Schedule Errors and Warnings

Message	Explanation
Unmatched REPEAT:	a REPEAT command for which no corresponding subsequent UNT_X command can be found.
Unmatched UNTX:	an UNT_X command for which no corresponding preceding REPEAT command can be found.
Inf lp bfr REC:	the schedule has an infinite loop before reaching any RECORD command.
Unreachable command:	the schedule has commands following an infinite loop.
No RECORD:	the schedule contains neither a RECORD command.

8 Importing and Exporting Schedules

8.1 SM4 Configurator Software

In addition to configuring schedules and settings on the recorder, you can use the Song Meter SM4 Configurator software to confirm schedule behavior on a graphical calendar and to estimate power consumption and SD memory card usage for schedules that you plan to run.



We recommend using the software to configure the recorder's settings and schedule when possible as the additional visualization and information it provides allows you to be sure that your schedule and settings will perform as intended. The software is free and available for Mac, Windows, and Linux at www.wildlifeacoustics.com. You can also open a WAV file made with the SM4 in the configurator to see the schedule and setting used to make the file. That information is stored in the meta-data of the WAV so it is always available in the future.

8.2 Importing a Schedule

You can import a schedule file (for example, `mySchedule.SM4S`) from an SD memory card. The imported schedule includes the Simple Schedule as well as an Advanced Schedule, if one was created. It also includes settings.

NOTE: If both an Advanced Schedule and Simple Schedule are configured in the imported schedule, the selected schedule mode as set in Advanced Settings of the imported schedule will dictate which schedule is immediately loaded. To access the other schedule, simply change the schedule mode.

1. Save a custom schedule to the top-level directory (not in a folder) of an SD memory card from the Song Meter SM4 Configurator software, or export a schedule to an SD memory card from another recorder.

2. Insert the SD memory card in slot A of the recorder.
3. Navigate to **Main Menu > Schedule > Import Sched+Setts**.
4. At the **Select Schedule File** prompt, press **▲ Up** or **▼ Down** to select a schedule file on your SD memory card. Press **ENTER**.

NOTE: The file name must be 28 characters or less. The recorder does not recognize or display longer file names on the import screen.

5. If no warnings or errors are found, the following message appears and the imported schedule is now the current schedule:

Schedule imported

6. Press **◀ Left** to return to the **Schedule** menu. You can now edit or start the schedule.

NOTE: Schedules exported from a recorder and imported on another will not override the second recorder's **Prefix, Latitude, Longitude, Time zone, or Battery Cutoff** settings. Schedules created or edited by the Song Meter SM4 Configurator software have the option to override any of those settings.

8.3 Exporting a Schedule

You can export the schedule including its settings to an SD memory card. The Simple schedule is exported as well as the Advanced Schedule, if one was created. Which schedule will be loaded upon import to another recorder depends on the selected schedule mode as set in Advanced Settings on the recorder you are exporting from.

1. Insert an SD memory card in slot A.
2. Navigate to **Main Menu > Schedule > Export Sched+Setts**.

The following message appears:

Schedule exported

The exported file is named with the recorder prefix and the .SM4S extension. For example: SM400155.SM4S

The default prefix is the device model and serial number. You can specify a new prefix on the recorder in the settings.

CAUTION: If a file with that name already exists on the SD memory card, it is overwritten.

After exporting the schedule, you can share it with others, load it on another recorder, or edit it using the SM4 Configurator software.

9 Utilities

9.1 Exporting Diagnostics

This procedure exports a diagnostic file that can be used to assess the audio performance, settings, schedule, and status of the recorder. The Wildlife Acoustics Support Team can use this information to help diagnose problems. The recorder will also create a dump file temporary loss of power for over five seconds or if it senses other types of failures.

1. Insert an SD memory card into slot A.
2. Navigate to **Main Menu > Utilities > Export Diagnostics**.
3. The recorder performs internal diagnostic tests and then exports the test results, the current schedule, and the settings to a file. The file is named with the recorder prefix, the date and time, and the .sm4dump extension:
`PREFIX_YYYYMMDD_hhmmss.sm4dump`
4. Remove the SD memory card and insert it into a computer in order to send the file to Wildlife Acoustics.

9.2 Resetting to Factory Default Settings

This procedure restores all recorder settings to their original default values as they were configured when your recorder was first assembled and tested.

1. Navigate to **Main Menu > Utilities > Set factory default**.
2. Select **Yes** on the confirmation screen.

CAUTION: When you select **Yes** and reset defaults, your custom settings and any edited schedules are erased.

9.3 Testing Microphones' Sensitivity with the Calibrate Utility

The sensitivity of built-in or external acoustic microphones can be measured and the value entered so it will be stored in the recordings' meta-data for later use in noise analysis or for traceability. This calibration utility displays dBV at 1kHz. A standard microphone calibrator will produce a 94dB SPL (1 Pa) 1kHz tone at the microphone. The expected value for the built-in or external microphones is the sensitivity as shown in the Specifications chapter of this guide, within the shown tolerances.

NOTE: This procedure is only valid for third-party microphone calibrators that emit a calibrated 1.0 kHz signal.

1. Navigate to **Main Menu > Utilities > Calibrate Mics**

MICROPHONE CALIBRATE	
@1kHz :	
Ch 0 :	-4.8 dBV
Ch 1 :	-73.6 dBV

The SM4 automatically sets gain to 0 dB, preamplifier gain off and all high pass filters off to assure an accurate reading.

2. Test the microphone by generating a 1 kHz signal with a professional microphone calibrator and sliding it over the microphone.
3. Read the value on the screen and press any button to end the calibration.
4. The measured sensitivity can be entered into the recorder in the Advanced menu in the Settings menu. An entered value will be saved in the recordings' meta-data for use in noise analysis or for traceability.

9.4 Formatting SD Memory Cards

This procedure formats the inserted SD memory cards. Use this procedure prior to all deployments for optimal performance and to ensure that the cards are empty. The recorder will never overwrite existing data on a card. This procedure will also clear a card that has been declared DIRTY. A card is labeled DIRTY if a process was interrupted which could have resulted in card corruption, for example a card is pulled from the recorder while it is in the process of recording or the battery voltage goes too low while the recorder is recording. The latter is a likelihood if the recorder is left to record until the batteries die. This is fine, copy recordings to a computer and format the card using this process.

WARNING! This procedure erases all data on the SD memory card. Verify that you have saved any important schedules or recording files before running this utility.

1. Insert an SD memory card in slot A and an optional second card in slot B.
2. Navigate to **Main Menu > Utilities > Format All Cards.**
3. At the **Confirm: Format All?** prompt:
 - Select **No** to cancel this procedure. Any existing data files remain on the SD memory card(s).
 - Select **Yes** to format the SD memory cards in both slots.
4. If you select **Yes**, progress messages appear, and then the display returns to the **Utilities** menu.

9.5 Updating the Firmware

The SM4 is field-upgradeable. Firmware updates are periodically available with fixes or improvements.

1. Download new firmware from www.wildlifeacoustics.com. (While visiting our website, you can join our mailing list to receive important notices about your SM4 and related products.)
2. Save or copy the firmware file to the top-level directory (not in a folder) of an SD memory card and insert it into the recorder in slot A.
3. Navigate to **Main Menu > Utilities > Firmware Update**.
The recorder scans the SD memory card for .SM4 firmware files.
4. At the **Select upgrade file** prompt, select the firmware update file and press **ENTER**. The recorder applies the new firmware and restarts.

10 Specifications

10.1 Physical

Length: 8.6 inches (218 mm)

Width: 7.3 inches (186 mm)

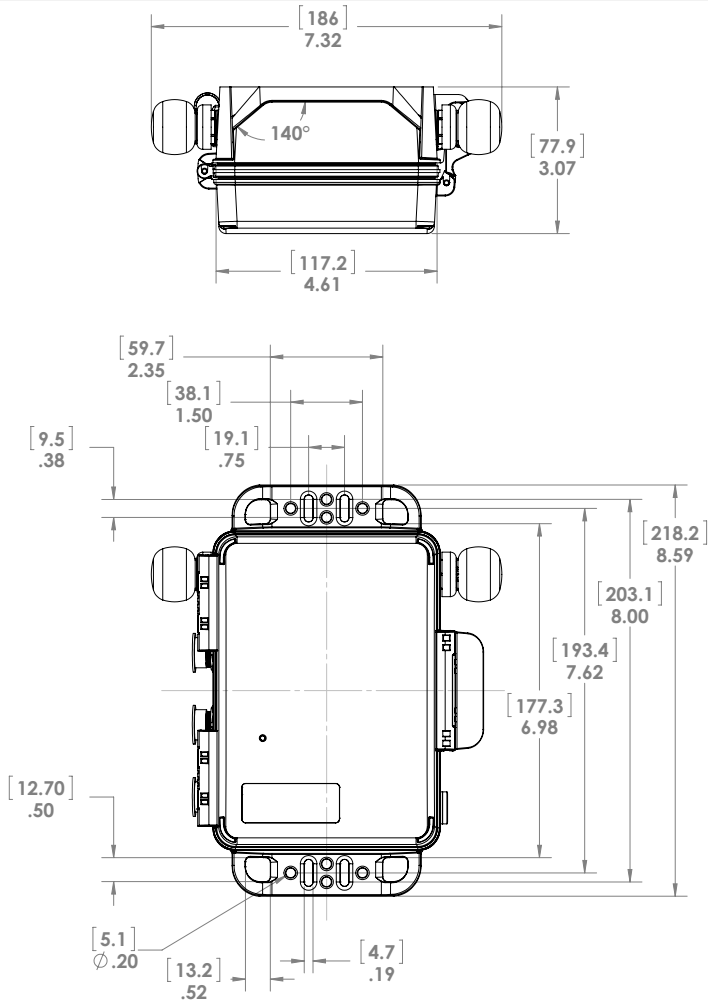
Depth: 3.1 inches (78 mm)

Weight: 1.6 pounds (0.73 kg)

Weight with 4 D Batteries: 2.9 pounds (1.3 kg)

Operating Temperature: -4°F to 185°F (-20°C to 85°C) (excluding batteries)

Enclosure: Weatherproof, polycarbonate housing.



10.2 Power

Battery Specifications: The recorder uses four (4) standard D size disposable alkaline batteries or rechargeable NiMH batteries.

Estimated Recording Time:

Alkaline batteries (14,000 milliamp-hours at 1.5V each): up to 400 hours

NiMH LSD batteries (9,500 milliamp-hours at 1.2V each): up to 250 hours

Power Consumption: Recording: 135 – 185 mW Sleeping: 1.8 mW

NOTE: SD memory cards consume more than half of all the power used by the recorder. The recording time and power consumption varies with different card types and manufacturers by as much as 50%. Based on their low power consumption in our tests, we recommend SanDisk SDHC/SDXC cards; however, third-party card performance cannot be guaranteed and other brands may also offer similar performance. Other factors, such as card capacity, battery type and quality (including rechargeable batteries), temperature, and sample rate also affect recording time.

External Power Voltage: 5 – 17 volts DC

Clock Backup Battery Type: 3.0-volt lithium CR2032 (approximate 3-year life)

Internal Clock Accuracy: 3.5ppm from -40°C to 0°C, 2.0ppm from 0°C to 40°C (Temperature-Compensated Crystal)

10.3 SD Memory Cards

Type: Supports class 4 or faster SDHC and SDXC (no reformat required)

Capacity: Supports up to 32 GB SDHC or up to 512 GB SDXC per slot.



10.4 Audio

Channels: 2

Recording Format: 16-bit PCM .wav

Analog to Digital Converter Full-scale: 0.707V rms (2v p-p)

Preamplifier Gain: 0 or 26 dB (only applies to built-in microphones)

Amplifier Gain: 0.0 – 59.5 dB in 0.5-dB steps

Noise Floor: -93 dBV, A-Weighted (@0 dB gain, HPF disabled)

High Pass Filter: Selectable 2-pole at 220 Hz or 1 kHz

Supported Sample Rates (Hz):

8000, 12000, 16000, 22050, 24000, 32000, 44100, 48000, and 96000

Anti-Alias Filter Performance:

Fraction of Sample Rate:	Anti-Alias Filter Gain (dB):
0 to 0.39	±0.1
0.4125	-0.25
0.45	-3.0
0.5	-17.5
0.55	-75.0

10.5 Microphones**Built-in microphones or SMM-A2 acoustic external microphone**

Enclosure: Weather resistant

Sensitivity built-in: -35 ± 4 dB (0 dB=1V/pa@1kHz)

Sensitivity SMM-A2: -9 ± 4 dB (0 dB=1V/pa@1kHz)

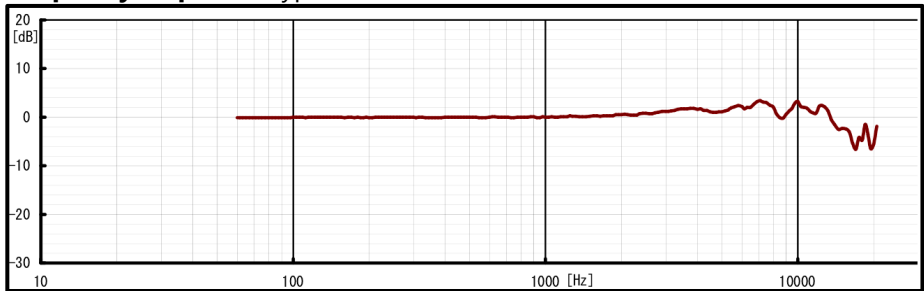
Signal-to-Noise Ratio: 80 dB typical at 1kHz (1 Pa, A weighted network)

Dynamic Range with Preamplifier ON: 14 - 100 dB SPL at 0 dB gain

Dynamic Range with Preamplifier OFF: 39 - 126 dB SPL at 0 dB gain

Directionality: Omnidirectional

Frequency response: Typical as shown in chart below.



SMM-A1 acoustic external microphone

Enclosure: Weather resistant

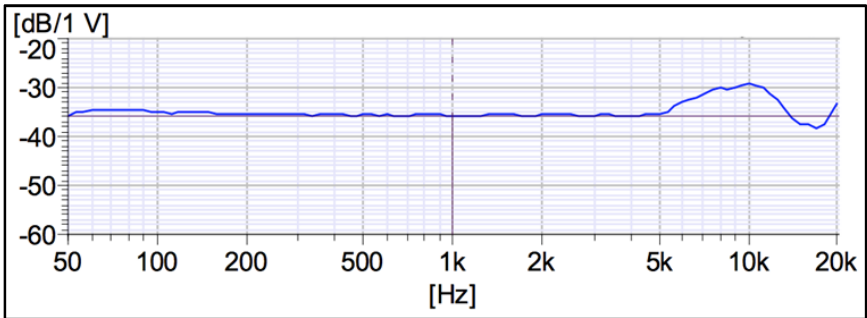
Sensitivity: -11 ± 4 dB (0 dB=1V/pa@1kHz)

Signal-to-Noise Ratio: > 68 dB

Dynamic Range: 26 dB – 102 dB SPL at 0 dB gain

Directionality: Omnidirectional

Frequency response: Typical as shown in chart below.



11 Warranty and Disclosures

Except as specifically provided herein, Wildlife Acoustics makes no warranty of any kind, express or implied, with respect to this product.

Hardware Limited Warranty

Product	Components	Warranty Period
Song Meter SM4	All components (excluding built-in and external microphones and accessories)	3 Years
	Built-in and external microphones (excluding windscreens)	18 Months
	Accessories	1 Year

Wildlife Acoustics, Inc. Limited Warranty

HARDWARE: Wildlife Acoustics, Inc. ("WAI") warrants to the original end user ("Customer") that new WAI branded products will be free from defects in workmanship and materials, under normal use. Refer to the Hardware Limited Warranty table at the top of this page for the applicable warranty period from the original date of purchase.

WAI warrants refurbished WAI products, marked and sold as such, for ninety (90) days from the original purchase date.

SOFTWARE: WAI warrants to Customer that any WAI branded software will perform in substantial conformance to their schedule specifications for a period of ninety (90) days from the date of original purchase. WAI warrants the media containing software against failure during the warranty period. WAI makes no warranty or representation that the operation of the software products will be uninterrupted or error free, or that all defects in the software products will be corrected.

EXCLUSIONS: This warranty excludes (1) physical damage to the surface of the product, including cracks or scratches on the outside casing; (2) damage caused by misuse, neglect, improper installation or testing, unauthorized attempts to open, repair, or modify the product, or any other cause beyond the range of the intended use; (3) damage caused by accident, fire, power changes, other hazards, or acts of God; or (4) use of the product with any non-WAI device or service if such device or service causes the problem.

Any third party products, including software, included with WAI products are not covered by this WAI warranty and WAI makes no representations or warranties on behalf of such third parties. Any warranty on such products is from the supplier or licensor of the product.

No warranty is provided by WAI unless the product was purchased from an authorized distributor or authorized reseller.

EXCLUSIVE REMEDIES: Should a covered defect occur during the warranty period and you notify WAI, your sole and exclusive remedy shall be, at WAI's sole option and expense, to repair or replace the product or software. If WAI cannot reasonably repair nor replace then WAI may, in its sole discretion, refund the purchase price paid for the product. Replacement products or parts may be new or reconditioned or comparable versions of the defective item. WAI warrants any replaced or repaired product, part, or software for a period of ninety (90) days from shipment, or through the end of the original warranty, whichever is longer.

OBTAINING WARRANTY SERVICE: Customer should refer to the WAI website at www.wildlifeacoustics.com/support/contact-support for information on obtaining warranty service authorization. Methods for obtaining warranty service may vary depending on whether purchases were made from an authorized provider of WAI products or from WAI directly. All requests for warranty service authorization must be made within the applicable warranty period. Dated proof of original purchase will be required. Products or parts shipped by Customer to WAI must be sent postage-paid and packaged appropriately for safe shipment. WAI is not responsible for Customer products received without a warranty service authorization and may be rejected. Repaired or replacement products will be shipped to Customer at WAI expense. All products or parts that are replaced become the property of WAI. WAI shall not be responsible for Customer software, firmware, information, or memory data contained in, stored on, or integrated with any products returned to WAI for repair, whether under warranty or not. The repair and replacement process for products or parts in locations outside of the United States will vary depending on Customer's location.

WARRANTIES EXCLUSIVE: THE FOREGOING WARRANTIES AND REMEDIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, TERMS OR CONDITIONS, EXPRESS, IMPLIED OR STATUTORY, INCLUDING WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY, CORRESPONDENCE WITH DESCRIPTION, SATISFACTORY QUALITY AND NON-INFRINGEMENT, ALL OF WHICH ARE EXPRESSLY DISCLAIMED BY WAI AND ITS SUPPLIERS.

LIMITATIONS OF LIABILITY: NEITHER WAI NOR ITS SUPPLIERS SHALL BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, INDIRECT, SPECIAL, OR PUNITIVE DAMAGES OF ANY KIND, LOSS OF INFORMATION OR DATA, LOSS OF REVENUE, LOSS OF BUSINESS OR OTHER FINANCIAL LOSS ARISING OUT OF OR IN CONNECTION WITH THE SALE OR USE OF THIS PRODUCT, WHETHER BASED IN CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT PRODUCT LIABILITY OR ANY OTHER THEORY, EVEN IF WAI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND EVEN IF ANY LIMITED REMEDY SPECIFIED IN THIS LICENSE AGREEMENT IS DEEMED TO HAVE FAILED OF ITS ESSENTIAL PURPOSE. WAI'S ENTIRE LIABILITY SHALL BE LIMITED TO REPLACEMENT, REPAIR, OR REFUND OF THE PURCHASE PRICE PAID, AT WAI'S OPTION. IN NO EVENT SHALL WAI'S LIABILITY FOR ALL DAMAGES RELATED TO THE PURCHASE OF PRODUCT EXCEED THE AMOUNT PAID FOR THE APPLICABLE PRODUCT. THE FOREGOING LIMITATIONS WILL APPLY EVEN IF THE ABOVE STATED REMEDY FAILS OF ITS ESSENTIAL PURPOSE.

DISCLAIMER: Some countries, states, or provinces do not allow the exclusion or limitation of implied warranties or the limitation of incidental or consequential damages so the above limitations and exclusions may be limited in their application to you. When implied warranties may not be excluded in their entirety, they will be limited to the duration of the applicable written warranty. This warranty gives you specific legal rights; you may have other rights that may vary depending on local law. Your statutory rights are not affected.

GOVERNING LAW: This Limited Warranty shall be governed by the laws of the Commonwealth of Massachusetts, and by the laws of the United States, excluding their conflicts of laws principles. The United Nations Convention on Contracts for the International Sale of Goods is hereby excluded in its entirety from application to this Limited Warranty.

DECLARATION OF CONFORMITY (EN 45014)

Manufacturer:

Wildlife Acoustics, Inc.
3 Mill and Main Place, Suite 210
Maynard, MA 01754
United States of America



Declares that the following product:

Product Name: Song Meter
Product Model Number: SM4
Product Type: Bioacoustics Recorder

Conforms to the appropriate country standards and governing regulations listed below and/or on the following page. As the manufacturer, we are fully responsible for the design and production of the above-mentioned equipment.

Federal Communications Commission Rules Part 15, Class A

AS/NZS CISPR 11, 2011, Industrial, scientific and medical (ISM) radio-frequency equipment – electromagnetic disturbance characteristics – limits and methods of measurement, Class A

EN 55011, 2009/A1, 2010, Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement, Class A

ICES-003, 2012, Industry Canada, Interference-Causing Equipment Standard, Digital Apparatus, Class A

EN61326, 2013 Electrical Equipment for Measurement, Control and Laboratory use EMC Requirements

EN61000-4-2 Electrostatic Discharge

EN61000-4-3 Radiated Electromagnetic Fields

Tested at operating temperatures of -20C to +55C. Testing included 24-hour soaks at both extremes plus 6 cycles for one hour each.

Tested at operating humidity of 95% relative humidity at +40C. Testing included 24-hour soak.

Tested for vibration as per the MIL-STD-810G Method 514.6, category 4 standard.

IEC 60529 IPX5 (Water Jet Test) (tested exclusive of microphone)

IEC 60529 IPX6 (Powerful Water Jet Test) (tested exclusive of microphone)

IEC 60529 IPX7 (Temporary Immersion) (tested exclusive of microphone)

This product was tested in a typical configuration.

A handwritten signature in black ink, appearing to read 'Ian Agranat', written in a cursive style.

Ian Agranat, President
Wildlife Acoustics, Inc.
January 10, 2016

ELECTROMAGNETIC INTERFERENCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by Wildlife Acoustics, Inc. could void the user's authority to operate the equipment.

Note: Use of ferrite clamped cables are required to comply with the Class A limits in part 15 of the FCC rules. A Fair-Rite 0431164181 ferrite clamp (or equivalent) must be placed on each cable near the recorder with the ferrite residing within one loop of the cable. This clamp is provided with all cables sold by Wildlife Acoustics.

PROHIBITION AGAINST EAVESDROPPING

United States law (Federal Communications Commission Part 15 Section 15.9) states "Except for the operations of law enforcement officers conducted under lawful authority, no person shall use, either directly or indirectly, a device operated pursuant to the provisions of this Part for the purpose of overhearing or recording the private conversations of others unless such use is authorized by all of the parties engaging in the conversation."

You are responsible for complying with all applicable laws within your jurisdiction

PRODUCT DOCUMENTATION

©2015-2019 Wildlife Acoustics, Inc. All Rights Reserved.

This documentation may not be reproduced or distributed in any form or by any means, graphic, electronic, or mechanical, including but not limited to photocopying, scanning, recording, taping, e-mailing, or storing in information storage and retrieval systems without the written permission of Wildlife Acoustics. Products that are referenced in this document such as Microsoft Windows® may be trademarks and/or registered trademarks of their respective owners. Wildlife Acoustics makes no claim to these trademarks. While every precaution has been taken in the preparation of this document, individually, as a series, in whole, or in part, Wildlife Acoustics, the publisher, and the author assume no responsibility for errors or omissions, including any damages resulting from the express or implied application of information contained in this document or from the use of products, services, or programs that may accompany it. In no event shall Wildlife Acoustics, publishers, authors, or editors of this guide be liable for any loss of profit or any other commercial damage caused or alleged to have been caused directly or indirectly by this document.

Song Meter SM4

BIOACOUSTICS RECORDER

User Guide

©2016-2019 Wildlife Acoustics, Inc. All Rights Reserved.

Wildlife Acoustics and Song Meter are registered with the U.S. Patent and Trademark Office.

SM4 is a trademark of Wildlife Acoustics, Inc.

SDHC and SDXC Logos are trademarks of SD-3C, LLC.

All other trademarks are the property of their respective owners.

The Song Meter is patented (U.S. Pat. No. 7,782,195).

Additional U.S. and international patents and trademarks are pending.

Wildlife Acoustics, Inc.

3 Mill and Main Place, Suite 210

Maynard, MA 01754

(978) 369-5225 or toll-free in the U.S. (888) 733-0200

www.wildlifeacoustics.com

