

Song Meter (SM2) Maintenance Protocol

Bioacoustic Unit

October 2019



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1 Bioacoustic Unit

The Bioacoustic Unit (BU) is a partnership between the Alberta Biodiversity Monitoring Institute (ABMI) and the University of Alberta. The BU is a full-service organization that provides everything a client requires for wildlife acoustic studies. We provide advice, supply standardized protocols, provide equipment, conduct fieldwork, process audio recordings, and report on the results. Our team is actively conducting leading-edge research to improve methods and to understand acoustic wildlife communities better.

The recording equipment most commonly used for BU studies are manufactured by Wildlife Acoustics (Song Meters SM2+, SM3 and SM4 models, www.wildlifeacoustics.com). We are branching out to try other units as well such as the Swift made by The Cornell Lab (<http://www.birds.cornell.edu/brp/swift/>) and Bioacoustic Audio Recorder made by Frontier Labs (<https://frontierlabs.com.au/>).

Clients regularly collaborate with us to assist with their wildlife monitoring needs. Our involvement varies from client to client and spans the full range of services from simply providing information to conducting a full research project on their behalf.

Suggested Citation: Lankau, H.E. 2019. *Bioacoustic Unit SongMeter (SM2) Maintenance Protocol*. Bioacoustic Unit, University of Alberta and Alberta Biodiversity Monitoring Institute. Edmonton, Alberta.

2 Protocol Overview

The Autonomous Recording Units (ARUs) used for remote monitoring should be fully checked over at least once every year. There are a number of sources of potential problems such as:

- Physical damage to the unit
- Recording problems
- Microphone damage or breakage
- Memory card issues

Before deployment, the timer batteries should be checked, the firmware updated and the correct setting file loaded. The following sections will walk you through how to check one specific type of ARU, the Song Meter SM2, made by Wildlife Acoustics.

The best time to give an ARU a full once-over is after the field season is over and before storing it for the winter. That way, broken units can be identified and sent for repair so that they are returned before being needed in the spring (or the next deployment). We recommend reviewing the manual provided by Wildlife Acoustics along with following the instructions in this protocol. The BU_SM2_ARU_Checklist in Appendix I can be printed off and used to keep track of inspection for each individual ARU. Users may

Brackets: Check that the metal brackets are not bent and that they are securely attached. If brackets are bent, remove them and straighten them. If straightening the brackets is not possible, replace the bent bracket with a new one. If the screws holding the brackets are loose, use a screwdriver and a small wrench to tighten them (hand tighten only) once you have opened the lid of the unit.

Left and Right Microphone Ports: Make sure all microphone/power ports are intact, if they are loose you can tighten the hex nut by hand to re-secure the port. If this does not work, a closer look from the inside will be needed.

Pressure Vent: Check that the pressure vent is securely screwed into the casing so that water cannot get into the inside of the ARU. If the pressure vent is broken, replace it with a new one if possible.

Cable Port: Check that the cable port is intact. The most frequently found damage is from rodents chewing holes in the port. This makes it possible for water to get into the unit. Units with damaged cable ports should be sent to the company for repair or you can replace the cable port with a ¼ inch hole plug and some silicon glue.

Lid screws: Check that the Lid screws are not worn out or stripped. Lid screws should be replaced if they can barely be turned with a screwdriver. Use a pair of pliers to pull the metal O-ring off of the original screw, insert the new screw into the lid, then push that metal ring onto your replacement screw. New screws are available for purchase from Wildlife Acoustics.

Seal on lid: While taking off the lid, check the gasket seal around the edge to ensure there is still a water-tight seal.

4 Physical Check Interior

There are multiple internal components that require checking (Figure 2 to Figure 5), including the following:

Battery Compartment: Check that the battery compartment is attached and secure. If the screws are loose and hard to tighten, a plastic washer can be used to keep the screw from pulling through. Now is a good time to put in batteries if there are none in it yet. If the unit will not turn on, your first step should be to check if both battery terminals are in contact with their receivers. Rotating the batteries in place can also help.

Motherboard: Check the motherboard for cracks, broken pieces, corrosion and any other damage. If there is any damage, the unit should be sent for repair.

Screen: When turning on the unit, check that the screen displays all information correctly. Send the unit for repair if any parts of the screen are not working.

Time and Date: Check that the time and date are correct. If not, correct the time. This needs to be checked again before deployment.

SD card slots: Put cards in all 4 slots while the unit is on and check that the unit reads the cards correctly and that the cards click into place securely. If any of the slots do not work, the unit should be sent for repair.

Buttons: Make sure that all buttons respond to being pressed. If any consistently do not respond, the unit needs to be repaired.

Switches: Make sure that the white switches are configured correctly. The correct configuration for all standard recording schedules is:

- Row 1: On
- Row 2: On
- Row 3: Off
- Row 4: On
- Row 5: Off
- Row 6: Off
- Row 7: On
- Row 8: Off
- Row 9: Off

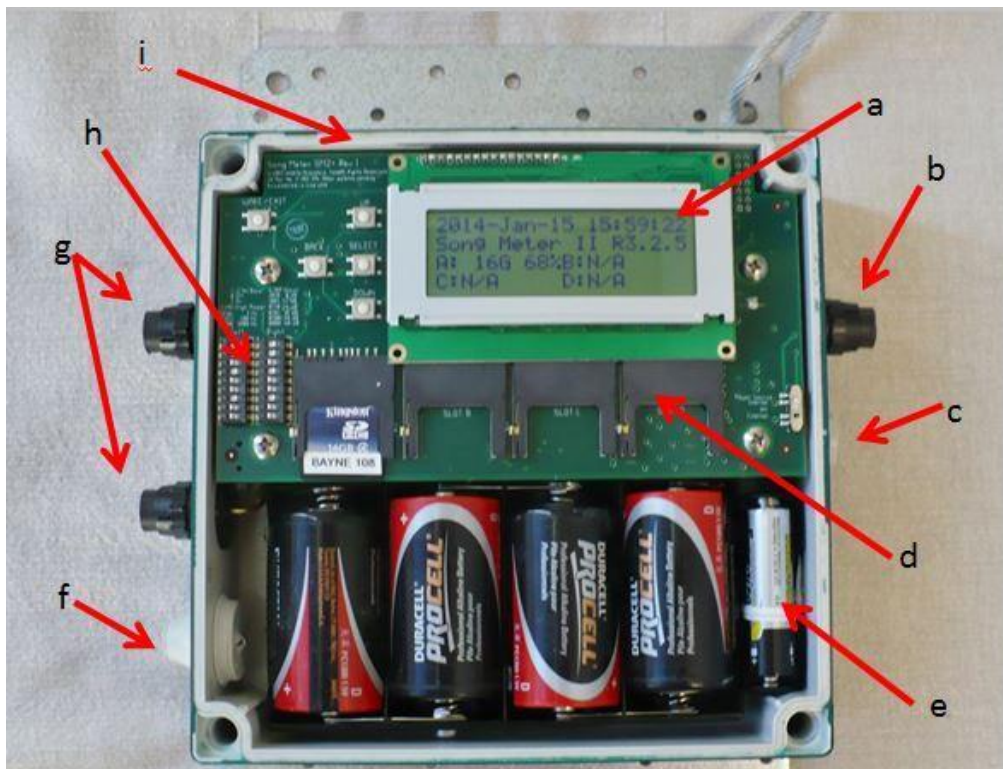


Figure 2: Check the following: a) Date and time, b) Right microphone port, c) Pressure vent, d) SD card slots, e) Timer batteries, f) Cable port, g) Left side ports, h) Switches and buttons, and i) Gasket.

The following photos show some examples of physical problems.



Figure 3: Examples of caps screws in good condition (left) and damaged condition (right).

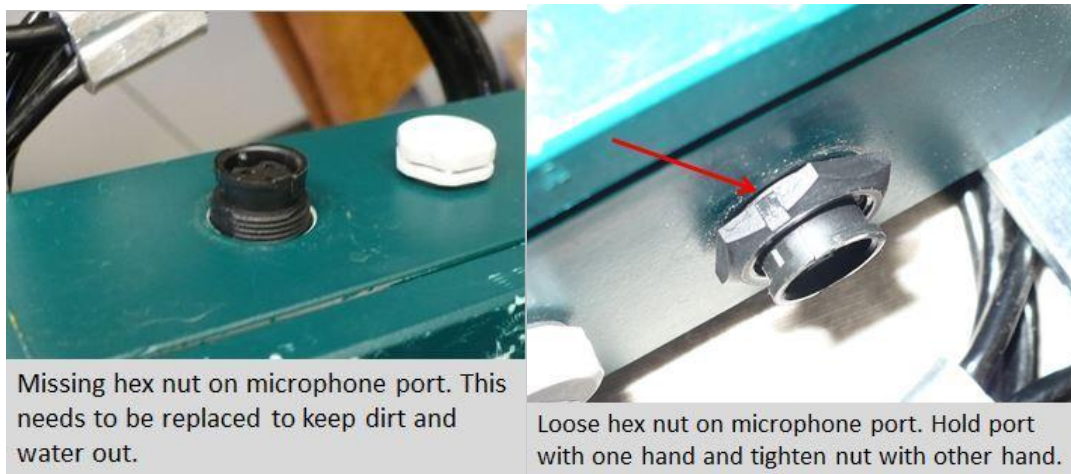


Figure 4: Examples of missing (left) and loose (right) hex nuts.



Damaged seal on cable port. The ARU is no longer waterproof. The cable port can be replaced with a 3/4 inch hole plug or sent to Wildlife Acoustics for a new cable gland.

Figure 5: Example of a damage seal on the cable port.

5 Recording Check

One of the most important things to check is that an ARU is recording correctly in both channels. This means recording at an adequate volume (gain) and at an even gain between both the right and the left channel. Recording issues can be caused by either damage to the unit or to the microphones. Both issues can be checked by doing test recordings.

5.1 Recording Test: Field Version

Recording tests should always be done in the quietest environment possible. Loud sounds like motors or having a louder sound on one side of the room than the other will make testing the recording quality of an ARU difficult. The following instructions are the simplest way to test if an ARU is recording and whether there are problems with one or both microphones (see Figure 6 and Figure 7).

1. Put a memory card in slot A
2. Put batteries in the unit and turn the power on.
3. The LCD screen should show that the unit is waking up and display the date, time, firmware version and the status of the SD cards
4. Use WAV format for the test recording so that you don't have to convert the files to look at them (see Appendix II for instructions on how to set the file format).
5. Do a test recording: manually initiate recording by pressing the UP and DOWN buttons at the same time. Once the unit is recording, press the SELECT button to toggle to the screen showing the gain levels. The gain bars (stars) and numbers should be similar for both channels, as they are just recording the ambient noise in the room and one microphone is not closer to any sound source than another. If the left or right side is consistently higher, this could indicate an imbalance in the channel or the microphones.
6. Test the responsiveness of the microphones by talking to the recorder. The stars and number should change with the volume of the voice. Talking into the left or right microphone should cause them to peak on that side.
7. Stop the test recording by pressing the BACK button.

8. Switch left microphone to the right and the right to the left and do a second recording. If the microphones are unbalanced, the channel that is higher or lower will be opposite that of the first test. If there is a problem with the unit itself, switching the microphones will not have an effect.

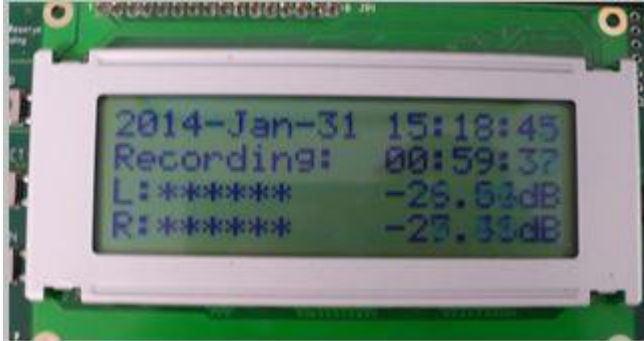


Figure 6: Test recording showing balanced left and right channels. Both the number of stars on the left and the dB numbers on the right are equal.

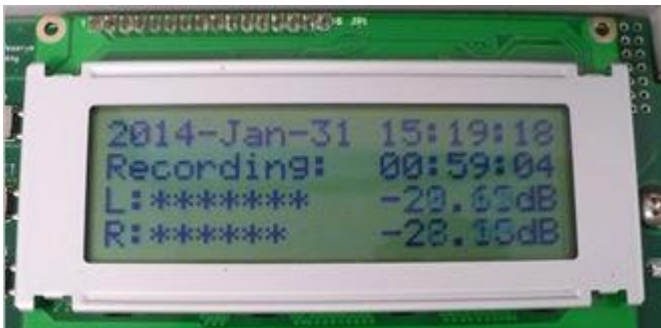


Figure 7: Test recording showing unbalanced channels. Only be concerned if one channel is consistently more than 4 dB different from the other. Always switch microphones to opposite channels and redo the test recording. If the side that is higher switches when you switch the microphones, it is a microphone issue. If the side that is higher stays the same after switching microphones, it is a unit issue.

5.2 Recording Test: Office Version

The Field Version of the Recording test (Section 5.1) is generally sufficient and will reveal most issues. If you have access to software such as Audacity or Adobe Audition, you can take the test recordings and view them on your computer to assess the test recordings further (see Figure 8 through Figure 11 for examples). Audacity is available free online (<http://audacityteam.org/>).

1. Take out the SD card and save the recordings to a folder labelled with the serial number of the unit.
2. Look at the recording on sound software such as Audacity that allows you to see both the waveform and spectrogram displays. The waveform should show the same amplitude (dB) on both sides except for when exposed to directional sounds such as talking into the left and right microphones separately. The spectrogram display should show the same amount of background static for each side and this should be similar between recorders. Any substantial differences from the averages indicate an issue with the microphone connection or the wiring or switches.

3. If you have any doubt about whether a unit is recording evenly, you can send the test recording to Wildlife Acoustics and let them look at it.

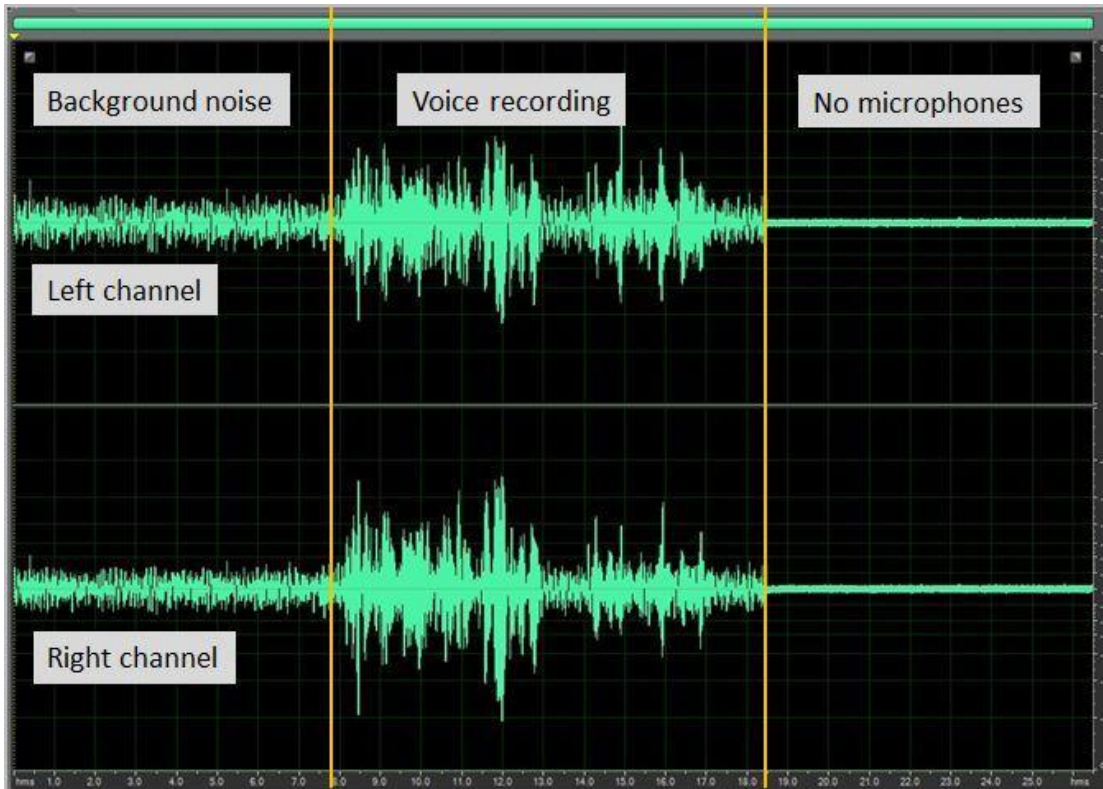


Figure 8: Example of a good recording seen in waveform view in recording software. Both sides (channels) are the same indicating that there are not differences.

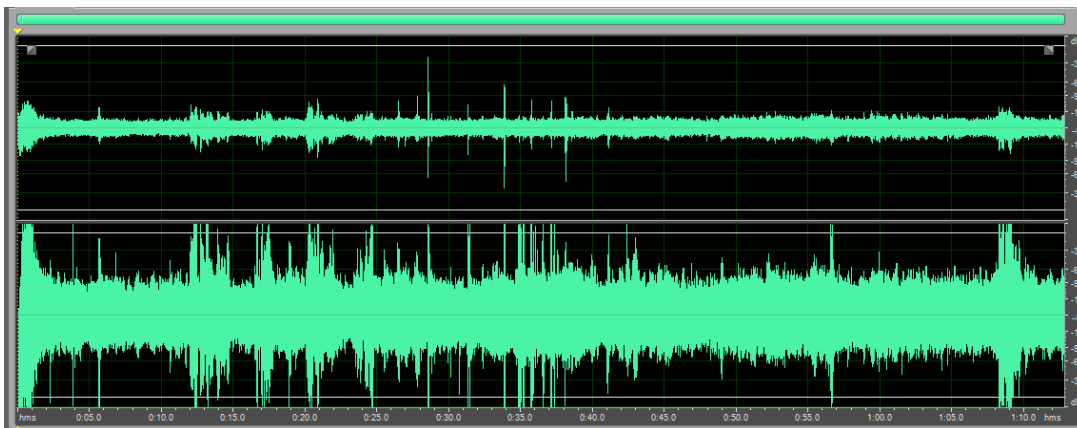


Figure 9: Example of a problem recording. Waveform view of a recording with a left channel issue (the top waveform). This also may be detected by looking at the gain levels. This issue may be caused by microphone issues, wiring issues or incorrect switch configuration.

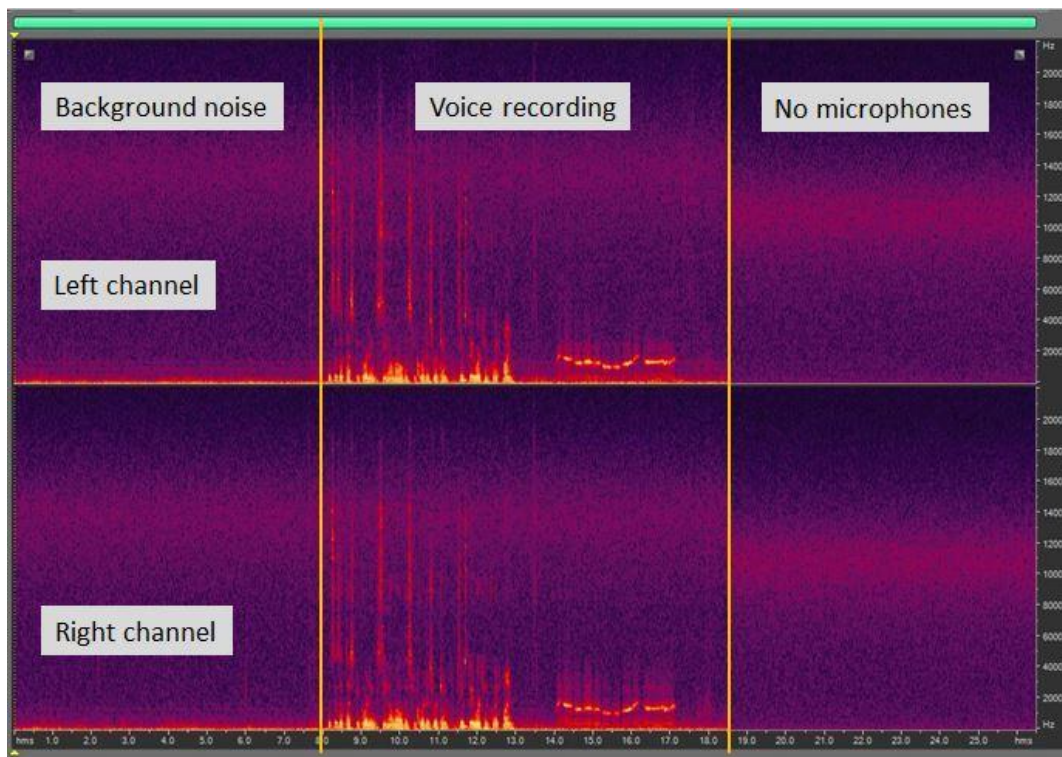


Figure 10: Example of a good recording showing an even amount of background noise and a clear recording of a human voice.

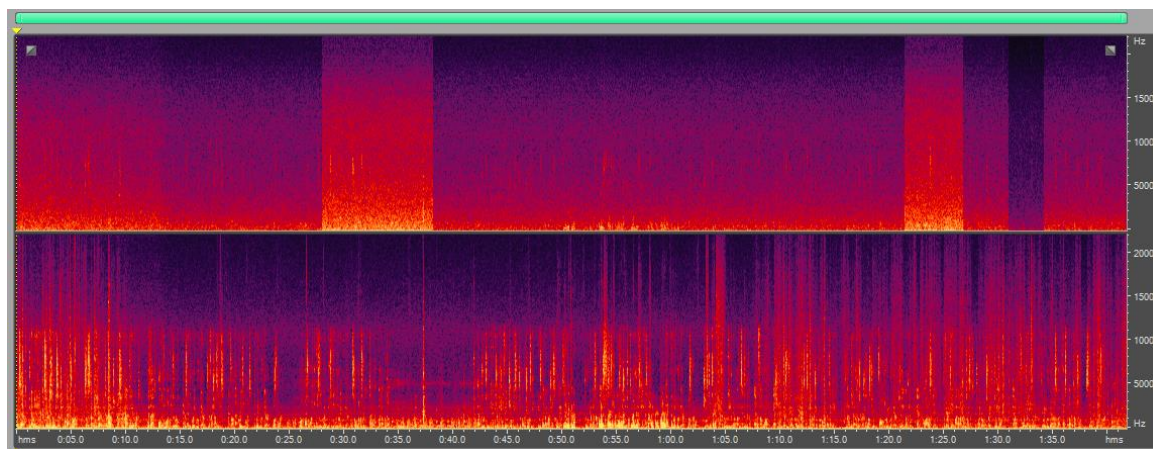


Figure 11: Example of a problem spectrogram showing a recording with a left channel issue (the top spectrogram in the panel). Note that the left channel is recording (top) but looks very different from the right channel (bottom panel).

5.3 Recording Test using Calibrator

To get accurate measurements of the ARU recording ability, use a standardized set of microphones (ones that have already been tested using a calibrator to read -12.3 Db and be within <1.0 dB of each other) to check the left and right channels. Use the same set of microphones to test all units so that any variation in results is due to unit differences and not to microphone differences.

1. Put one microphone on each side (wind screen removed).
2. Initiate a test recording
3. Place the calibrator over the microphone.
4. Play the calibration tone (70 dB) on each side separately and record the number of stars and the reading in dB. The test tone should give a very stable dB reading.
5. Record all dB values in a spread sheet or in a database and look for outliers or channels where there was no response to the test tone. Consider sending units for repair if there is difference between channels

Please refer to the *BU_Calibration_Methods_2015* document for more details on microphone calibration and how to interpret the results.

6 Microphones

Over time the Song Meter microphones will wear out or become damaged (Figure 12). It is very important to use microphones that record evenly on both channels so that we can use the stereo recordings to help us identify how many birds are on a recording. First, inspect the microphones for physical damage. If the windscreen (black foamy part at the end) is damaged, the microphone is likely still good but the windscreen should be replaced. Windscreens normally fade from black to brown from exposure to the sunlight. This is not a problem as long as there are no holes in the screen and the foam is not brittle. If the wiring in the microphone is damaged from wildlife chewing on them, you will have to replace the microphones.



a. Damaged windscreen. Replace windscreen and test microphone.



b. Damaged windscreen. Replace windscreen and test microphone.



c. Broken microphone. Salvage windscreen and discard. Buy new microphone.

Figure 12: Examples of damaged microphones and windscreens.

6.1 Testing Microphones: Field Method

Basic testing of the microphones can be done using the same method as for the Song Meters. This time, use one Song Meter that is known to be functioning correctly and use it to test all the microphones. First, do a test recording with one microphone on the left and another microphone on the right. Then switch them around and do a second test recording. Compare the channels to each other to see if the microphones are the same or different. If they do not make a clear recording, they should be replaced. The more rigorous testing explained below should be used whenever possible.

6.2 Testing Microphones with Calibrator

All microphones should be tested before they go into the field so that non-functional and below par microphones can be removed. The method is similar to testing the ARU except that the test tone is the full 94 dB. To do this take one SM2 unit that is working correctly, attach a short cable to one port and measure all the microphones using the same channel on the same unit. Set the switches on the channel used to 0 gain (see page 7 of the SM2+ Manual). The cable functions to ensure we do not wear out the mic port by repeatedly plugging in and removing microphones any more than necessary.

1. Take windscreen off microphone (Figure 13)
2. Attach microphone to SM2 unit (Figure 14)
3. Initiate test recording
4. Put the calibrator over the end of the microphone.
5. Play a 94 dB test tone into the microphone (Figure 15)
6. Read and record the gain values in both number of stars and dB values
7. Assess the values once all microphones have been tested and remove/discard the microphones that recorded below expected values.

With a 94 dB test tone values should be around -35 dB +/- 4 dB. Values below -40 are definitely out of the expected range. If microphones drop too low, they should not be used.



Figure 13: Using snap ring pliers to remove a microphone windscreen.

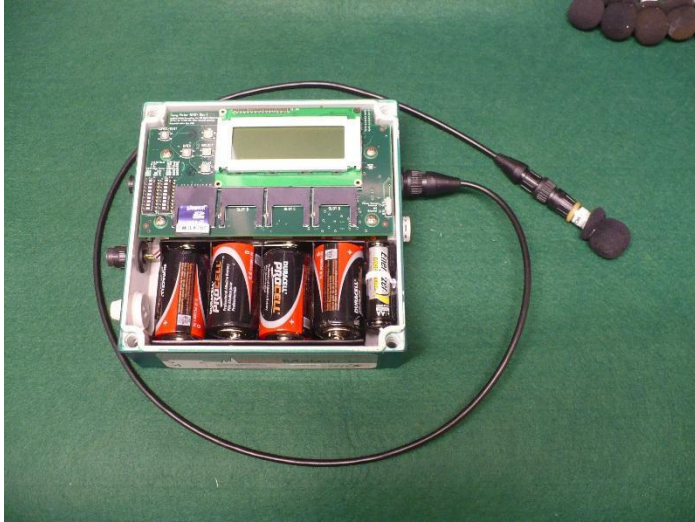


Figure 14: Using a cable to attach microphones to an ARU for testing. The cable is only used when multiple microphones need to be tested because this takes stress off the microphone port on the ARU.



Figure 15: Extech calibrators. The upper one has a custom built adapter to reduce the test tone to 70 dB SPL.

7 Pre-deployment Setup

7.1 Upgrading Firmware SM2

Upgrading the firmware is best done just before deployment so that units go out with the latest firmware loaded. Keeping firmware up-to-date is important since Wildlife Acoustics continues to provide updates to remedy existing bugs or add new functions.

Go to the Wildlife Acoustics website (<http://www.wildlifeacoustics.com/>) and follow these instructions (from their website):

1. Download the most recent firmware file (e.g. SYS3 3 1.SM2).
2. Copy this file to the top level directory of an SD card.
3. Insert the flash memory card into Slot A of the SM2.
4. Press and release the "Reset" button (for SM2) or turn on power switch (for SM2+, NOT THE WAKE/EXIT BUTTON) while pressing the "Up" button. Continue holding the "Up" button until you see the message "Song Meter II Boot".
5. A list of available .SM2 files will be displayed. Use the "Up" and "Down" buttons to scroll to the desired firmware file and press "Select". You should see the following messages:
Upgrading... Upgrading Complete! Press Reset to Boot
6. Press the "Reset" (for SM2) or turn power off and on (for SM2+) to reboot the SM2 with the new firmware.
7. Repeat steps 3 through 6 for any other SM2s you wish to upgrade.

7.2 Changing Timer Batteries SM2

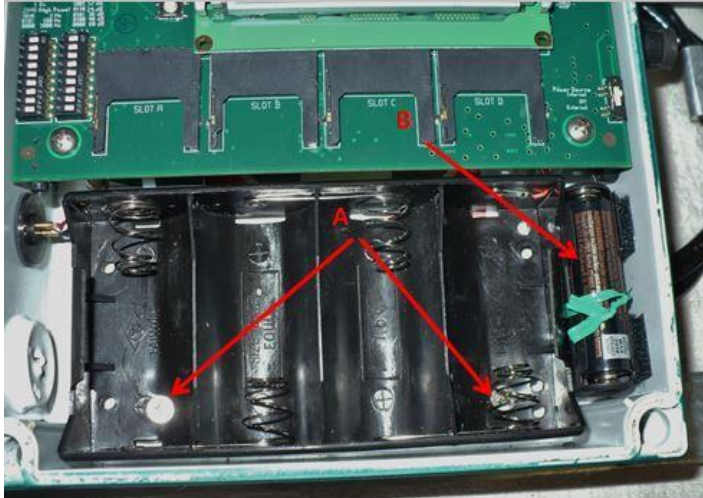
Timer batteries (Figure 16) should be checked within 1 month of deployment to ensure that they have enough power for the upcoming field season. The timer batteries (AA) keep the internal clock running so that the Song Meter keeps time even when it is fully turned off. Run down or disconnected timer batteries result in a number of problems. A unit with dead timer batteries may not keep time or put the correct time stamp on recordings.

One set of AA batteries will last approximately 2 years in SM2 models. You can use a pulse load battery tester to check the remaining battery voltage. At the Bioacoustic Unit, we replace timer batteries at the beginning of the year if they measure 60% or lower. These partially depleted batteries can still be used for cameras or GPS units if desired and practical.

To change the timer batteries, simply pull the small timer battery compartment away from the side of the ARU where it is attached with Velcro. Undo the twist tie (Figure 16), remove the old batteries and replace them with fresh AA batteries. Use professional grade batteries such as Energizer Industrial or Duracell Procell. Replace the twist tie before reattaching the battery compartment to the Velcro. If the twist tie is not in place, then the batteries may come loose during transport and the unit will not keep time.

Note that when you are changing the timer batteries, if you have 4 D cell batteries in the unit at the same time, the time and date will not reset to their default setting.

If you are unable to get the small timer battery compartment out, slide a thin card (like a credit card or piece of ID) between the Velcro so that the timer batteries come out more easily.



Batteries: A) screws that hold D-cell compartment in place.
B) timer battery compartment with green twist tie.
Figure 16: Location of timer batteries.

8 Appendix II: Navigating the Song Meter Menu

This section will provide brief instructions on how to navigate to some of the menu locations. Also read the manual that comes with the Song Meters for information on how to operate the Song Meters. These instructions are written for staff that are already familiar with the basic use of the Song Meters.

8.1 How to download the SET file from a Song Meter SM2

Knowing how to do this is useful if you are trying to save a Setting file from a unit, either to keep it on file or to transfer it to other units.

1. Put an SD card in Slot A
2. Navigate to the utilities menu.
3. Select "SAVE A:SONGMETER SET"
4. This saves a copy of the settings of an existing unit to Slot A
5. Save the SET file to your computer
6. Label the SET file with the unit number and serial number.

8.2 How to change recording from WAC to WAV format and back again

It is easier to do test recordings in WAV format because most acoustic software can read WAV files but is unable to open the compressed WAC files that wildlife acoustics uses. When doing a test recording, is sometimes convenient to switch the Song Meter to WAV recording format and then back to WAC once you are done.

Switching to WAV format

- Press SELECT button
- Select "SETTING" on the menu
- Select "AUDIO" from the menu
- Toggle down to "FILE FORMAT" and press SELECT button
- Toggle down to the option called 'WAV" and press SELECT button
- Use BACK button to navigate back to start up screen

Switching back to WAC format

- Press SELECT button
- Select "SETTING" on the menu
- Select "AUDIO" from the menu
- Toggle down to "FILE FORMAT" and press SELECT button
- Toggle up to the option called "WAC0" and press SELECT button

Use BACK button to navigate back to start up screen

9 ARU Check list (for SM2 model Song Meters)

UNIT# _____ Serial# _____ Model _____ Owner _____

Date: _____ Inspection completed by _____

Outcome: No Issues Minor Damage Major Damage Unit Destroyed

Describe Damage: _____

Described Repairs: _____

Date Repaired: _____

Comments: _____

Inspection

Item	Outcome*	Item	Outcome
Plastic Casing		Wiring	
Brackets		Battery Compartment	
Lid Screws		Switches Buttons	
Seal		Motherboard	
Left Microphone Port		Screen	
Right Microphone Port		Memory Card Slots	
Pressure Vent		Date Correct	
External Ports		Time Correct	
External Port Covers			

*List outcome as 0 = all good; 1 = can be repaired by user; 2 = needs to be sent to manufacturer for repair.

Calibration

Item	Value	Item	Value
Date Calibrated		Calibrator ID	
Left channel gain		Mic Condition	
Right channel gain		Observer	
Tone Volume		Comments:	
Left Test Mic			
Right Test Mic			

Firmware Updated: Yes No Firmware Name: _____

Timer Batteries Checked: Yes No Replaced: Yes No

*Replace timer batteries if they are below 60%.