

# SongMeter (SM3) Maintenance Protocol

Bioacoustic Unit

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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](http://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.

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## 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. These are:

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

Before deployment, the firmware needs to be updated and the correct setting file loaded. The following sections will walk you through how to check the SM3 model of Song Meter from Wildlife Acoustics. Note that the SM3 models are less user repairable than the SM2 and SM4 models.

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 provided by this protocol. The

BU\_SM3\_ARU\_Checklist in Appendix I can be printed off and used to keep track of inspection for each individual ARU.

## 2.1 Tools and spare parts for ARU maintenance

Here is a short list of tools and items needed for SM3 maintenance checks (Figure 1).

- SD card
- Batteries (these may still be in the unit from the field)
- Snap ring pliers (for removing and replacing windscreens on microphones)
- Pulse load battery tester (good to check batteries when removing them from units)
- Spare wind screens
- Extech 407744 Sound Level calibrator (no adapter needed)
- Waterproof membranes
- New pressure vents (discuss any warranty related restrictions with Wildlife Acoustics before trying to install them.)
- New microphones (discuss any warranty related restrictions with Wildlife Acoustics before trying to install them.)



Figure 1: Tools for SM3 maintenance.

## 2.2 Going through the checklist

**Metal Casing:** This casing is incredibly durable and likely won't be damaged, but be sure to give it a quick once over. Check the metal casing for signs of wear, cracks or tampering. Make sure that the mounting brackets are still intact.

**Left and Right Windscreens:** Check that the windscreens are intact. Very small bits of foam missing (less than 5 mm across) are probably not a concern unless there is a hole all the way through the wind

screen. Screens with any larger holes should be replaced. Use the snap ring pliers to easily remove and replace the screens without risk of damaging the mics.

**Left and right Microphones:** make sure all microphones and waterproof membranes are intact. If the microphones are loose, simply turn them clockwise to tighten them: they are screwed into the metal casing and need to be tight to keep the water out. There is a black, water-resistant membrane across the front of the microphones. When wildlife chews on the microphones, this can get scraped off. Check this membrane for holes that could let water into the microphone interior. Replacement waterproof membranes are available from Wildlife Acoustics on request. Simply remove the damaged membrane, clean the edge of the microphone and stick on a new membrane.

**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.

**External Ports:** There are 4 external ports on the SM3: these should be checked to make sure they have their covers and are not otherwise loose or damaged. The covers are not very secure and are easy to lose. Whether to replace them or not is up to the user. Make sure the ports are not cracked or chipped. Any damaged ports need to be repaired by Wildlife Acoustics.

**LCD Screen Cover:** Check that the LCD screen cover is intact and will keep water out. It can be damaged by hail or other sharp object/heavy impacts. These screens will often be dented, without need of repair. For minor damage, clear tape can be used to help reinforce the affected area. If it is broken, the unit should be sent for repair because it is no longer waterproof.

**Keypad:** Use all 8 of the buttons on the keypad to ensure that they respond to pressure and can be used to navigate the menu.

**Battery Compartment:** Check that batteries fit in the battery compartment and that the covers fit securely.

**Time and Date:** Check that the time and date are correct. If not, correct the time (Instructions in Section 6.2). 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 clicks into place securely. If any of the slots do not work, the unit should be sent for repair. It is possible to test this with only 1 card, shifting the card between slots without the need to shut off the unit in between (as long as the unit is not recording when the card is switched).



Figure 2: External image of an SM3 unit showing 1) built in brackets, 2 & 6) left and right microphones with windscreens, 3) LCD screen cover and keypad, 4) pressure vent, 5) battery bays, 7) metal cover and SD card slots, 8-11) external ports. (Image taken from Wildlife Acoustics SM3 User Manual)

### 3 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. For SM3 units that have built in microphones, unit and microphones are tested in one step.

#### 3.1 Recording Test: Field Version

The microphones on an SM3 unit are sensitive, so 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. Follow these steps to do a test recording:

1. Put batteries in the unit and turn the power on (power switch is located in the same compartment as SD card slots).
2. 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 before switching to the menu screen.
3. Navigate to the "Calibration" option of the utilities menu. The display will show the response for the left (0) and right (1) channels at two difference frequencies, 1 kHz and 40 kHz. The gain in dB

under the 1 kHz column gives you the results for regular acoustics microphones (40 kHz is only for bat recording units).

4. Test the responsiveness of the microphones by talking to the recorder. The dB values should fluctuate with the volume of your voice. Snapping your fingers near the left or right microphone should cause them to peak on that side.



Figure 3: Calibration results showing balanced left and right channels.



Figure 4: Calibration results showing unbalanced channels. A 2 dB to 4 dB difference between channels is common due to the variation between microphones. Units need to be repaired if there are extreme differences between channels (>6 dB) or if one channel is not responding to sound.

### 3.2 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 detect issues (see Figure 5 through Figure 8 for examples). Audacity is available free online (<http://audacityteam.org/>).

The SM3 units do not have an option to manually initiate a test recording (unlike SM2 and SM4 units). To get a short instantaneous recording, it is necessary to load a program that starts when the "Program Start" button is pressed. You can use either a) the built-in 24 hours a day program, or b) build one that does an instantaneous 1-minute recording. In either case, be sure that the correct data collection program is loaded before the unit is deployed again.

1. Put an SD card in the unit
2. Load the test recording program

3. Press "Program start"
4. Play test tones or speak into the microphones.
5. Press "Program Stop"
6. Take out the SD card and save the recordings to a folder labelled with the serial number of the unit.
7. 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.

If you have any doubt about whether a unit is recording evenly, you can send the test recording to Wildlife Acoustics for evaluation.

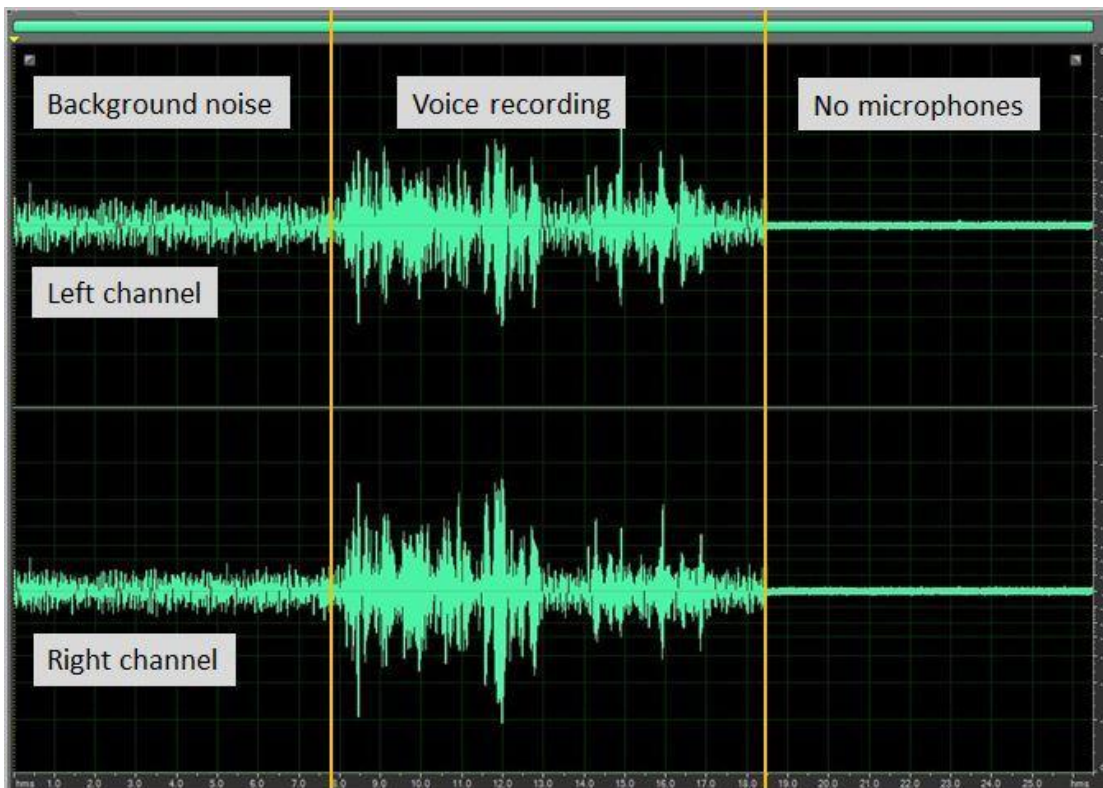


Figure 5: Example of a good recording seen in waveform view in recording software. Both sides (channels) are the same, indicating that there are not differences. This means that all wiring, microphones and switches are working and correctly configured.



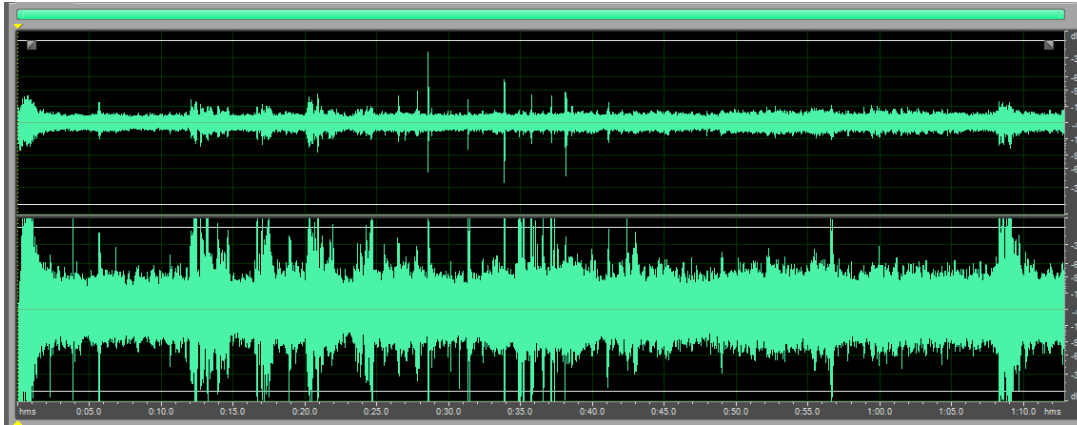


Figure 6: Example of a problem recording. Waveform view of a recording with a left channel issue (the top waveform). This also may be detected by looking at the gain levels.

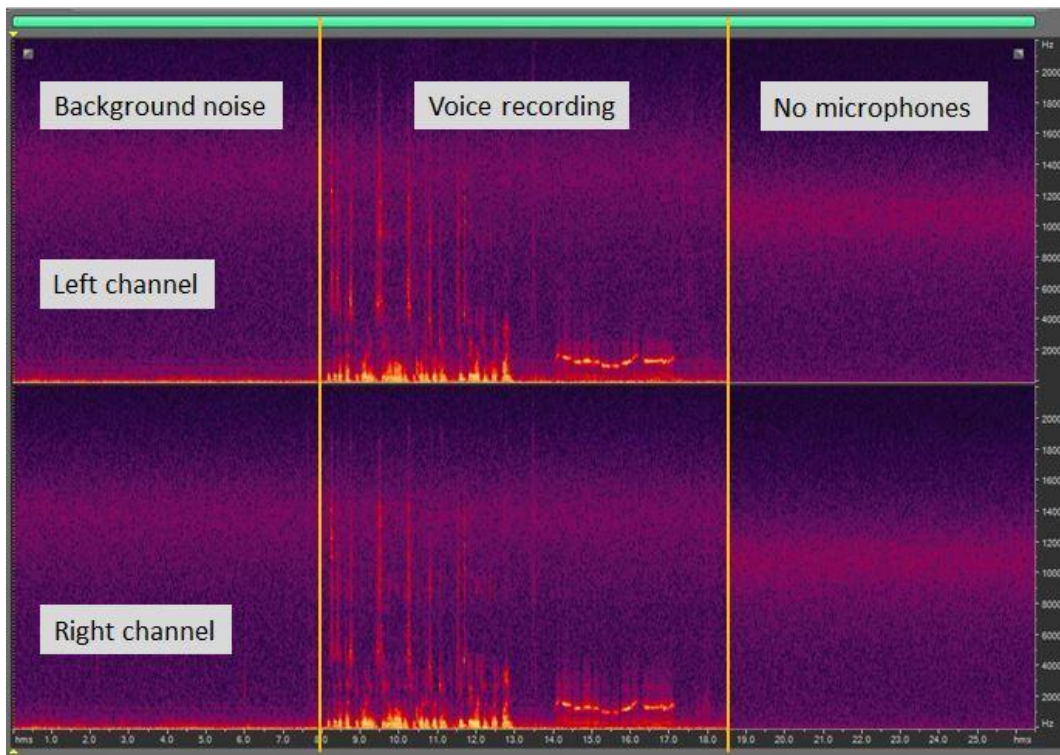


Figure 7: Example of a good recording showing an even amount of background noise and a clear recording of a human voice.

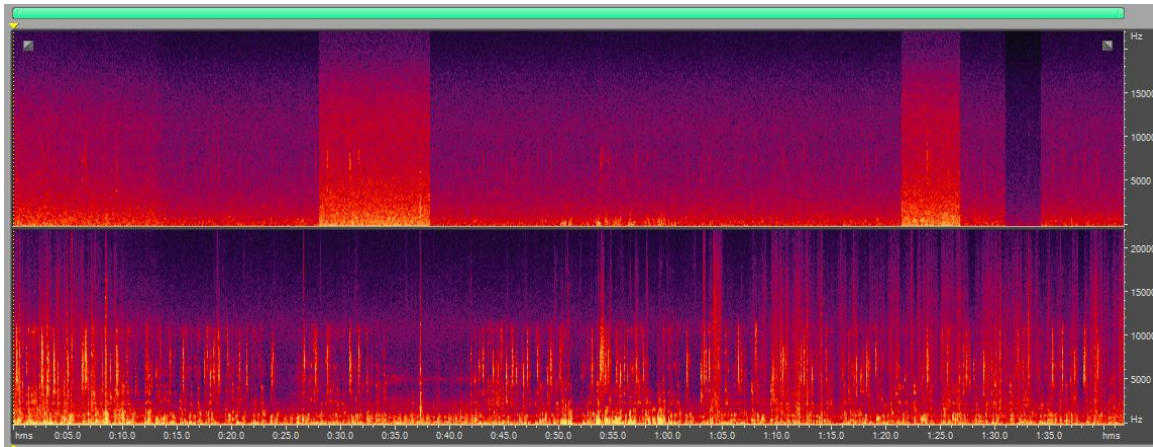


Figure 8: Example of a problem spectrogram showing a recording with a left channel issue (the top spectrogram in the panel). Note that the left channel is recording (top) but looks very different from the right channel (bottom panel).

### 3.3 Recording Test using Calibrator

To get the most accurate measurements of the SM3's recording ability, use a commercially available calibrator such as the Extech 4078744 recommended by Wildlife Acoustics. Over time the microphones on the Song Meters may wear out and lose sensitivity. Microphones with lower sensitivity will have a smaller sample radius and record fewer birds. Yearly calibration will help catch faulty microphones and units.

The calibration procedure is as follows:

1. Find a quiet room (e.g., not near engines or large refrigerators and does not have noisy fans)
2. Remove the microphone windscreens (be careful not to twist/loosen microphones) using snap ring pliers (Figure 10)
3. Put batteries in SM3 unit (if necessary)
4. Remove the SD card slot cover (the power switch is located in this compartment)
5. Turn on SM3 unit and allow 1 min to initialize
6. Navigate to Utilities>>Calibrate Mics
7. Put SM3 on felt pad (use a notebook or thin wood to raise unit to be level with calibrator)
8. Place the calibrator over the microphone end (about 1 cm over—there is an O-ring in the calibrator that will stop the microphone; Figure 10)
9. Turn on the calibrator and play the tone for 30 to 60 seconds
10. Read and record the value for that channel (0 is left channel, 1 is right channel)
11. Repeat the test tone on the second channel
12. Record the results in a database or Excel spreadsheet. Use these values to identify any microphones that are not working.
13. Turn off the SM3 unit or proceed to other stages of unit setup
14. Use snap ring pliers to replace the windscreen on the microphone. Ensure there is space between the tip of the microphone and the windscreen. Again avoid rotating the microphones.

Please refer to the *BU\_Calibration\_Method\_2015* document for more details on microphone calibration and how to interpret the results. Consider adjusting gain if 0 and 1 channels on a unit are >4dB apart; differences >6dB will definitely require adjustment or replacement of microphones.

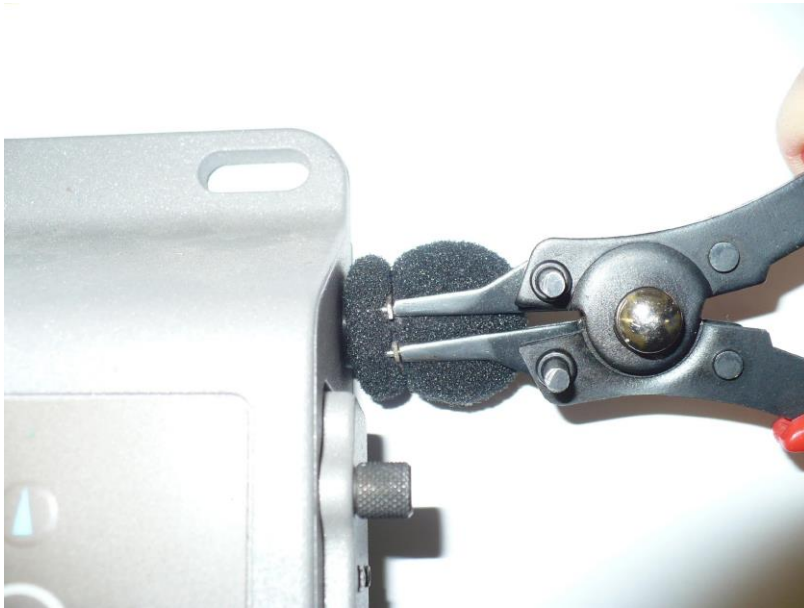


Figure 9: Using snap ring pliers to remove a microphone windscreen.

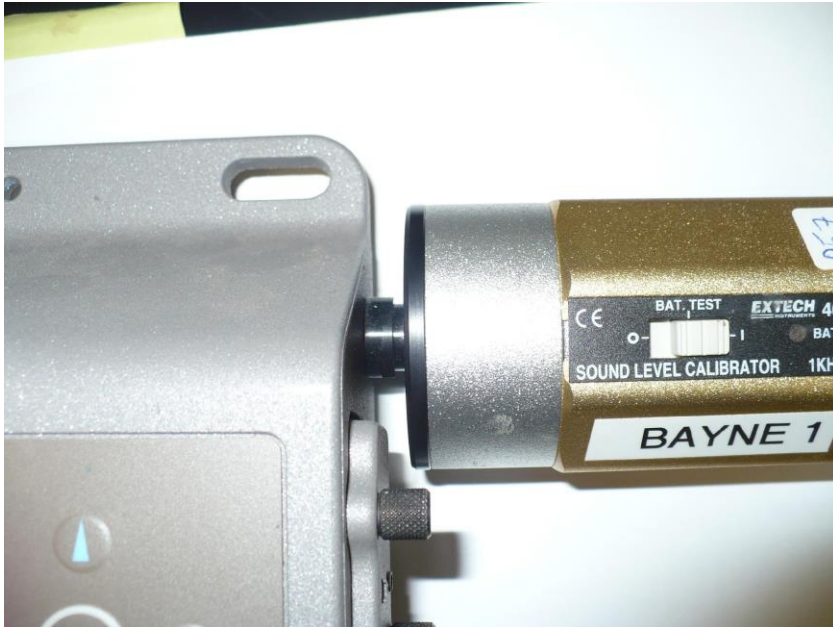


Figure 10: Using calibrator to test SM3 microphones.



Figure 11: Damaged windscreen that needs to be replaced.

## 4 Pre-deployment Setup

### 4.1 Upgrading Firmware SM3

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

Go to the Wildlife Acoustics website and follow these instructions (from the website):

1. Download the [SYS1-2-8.SM3 \[or latest\]](#) firmware file.
2. Copy this file to the top level directory of a flash memory card.
3. Insert the flash memory card into Slot A of the SM3.
4. Go to the "Utilities->Firmware Update" menu.
5. A list of available .SM3 files will be displayed. Use the ▲ **Up** or ▼ **Down** buttons to scroll to the desired firmware file and press "Enter". You should see the following messages:

*"Upgrading... Upgrading Complete! Rebooting..."*

6. Repeat steps 3 through 5 for any other SM3s you wish to upgrade.

## 4.2 Checking the date and time

Always check the date and time before deploying an ARU. It is important to note that the SM3 does NOT automatically adjust for daylight savings time. As you adjust the month and day, the unit calculates and displays the next sunrise and sunset times for your reference.

The following instructions for checking and setting the time are adapted from the SM3 User Manual provided by Wildlife Acoustics:

1. At the **Song Meter Main Menu**, select **Settings**, and press **ENTER/MENU**.
2. Select **Time and Date** and press **ENTER/MENU**. The date and time appear on one line in the following format: YYYY-MMM-DD HH:MM:SS For example: **2015-Oct-22 20:17:45**
3. Press **ENTER/MENU** or **▶ Right**. The cursor flashes on the last digit of the year.
4. To adjust the year, press **▲ Up** or **▼ Down**.
5. Press **ENTER/MENU** or **▶ Right** to proceed to setting the month.
6. Continue this process to set the day, hour, minutes and seconds.
7. After setting the seconds, you have explored all of the options for changing date and time values.
8. (Optional) To go back and make any changes, press **◀ Left** as many times as needed.
9. Press **ENTER/MENU** or **▶ Right** to apply your changes. The cursor moves back to the first digit of the year and then applies your changes.

Occasionally, this menu will once again display the time before you made any adjustments. The best option is to use the **Check Status** to double check if the time and date have actually been updated.

10. Press **◀ Left** two times to return to the main menu.

## 4.3 Loading a custom PGM file

Use this procedure after saving a custom program to the root or top-level directory of an SD card from another SM3 recorder or from the *SM3 Configurator*. You can import a program file (.PGM) from the SD card in slot A.

1. At the **Song Meter Main Menu**, select **Program**, and press **ENTER/MENU**.
2. Select **Import Program** and press **ENTER/MENU**.
3. At the **Select program file** prompt, press **▲ Up** or **▼ Down** to select a program file on the memory card in slot A.
4. Press **ENTER/MENU**.
5. If no warnings or errors exist, the following message appears:

### Program imported

6. If a warning or error exists, the line number and a short notification appear as shown in the following example:

### Program error

Line 14

No GAIN cmd

- a. Press ◀ **Left** to return to the list of available programs and choose a different one.
  - b. Press ◀ **Left** again to exit and go back to the **Program** menu. Edit the program using the recorder or *SM3 Configurator* software. Try the import again. Select **Import Program** when the program is error-free.
7. The program that you select is imported onto the recorder and loaded as the active program. Press ◀ **Left** to return to the **Program** menu.
8. You can perform any of the following actions on the imported active program:
- Edit the program.
  - Export the program to an SD card.
  - Start the program.

## 5 ARU Check list (for SM3 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
Metal Casing		External Port Covers	
Brackets		Battery Compartment	
Left Microphone		Switches Buttons	
Right Microphone		Screen	
Left Windscreen		Memory Card Slots	
Right Windscreen		Date Correct	
Pressure Vent		Time Correct	
External Ports			

\*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:	

Firmware Updated: Yes No Firmware Name: \_\_\_\_\_

Timer Batteries Checked: Yes No      Replaced: Yes No

\*Replace timer batteries if they are below 60%.