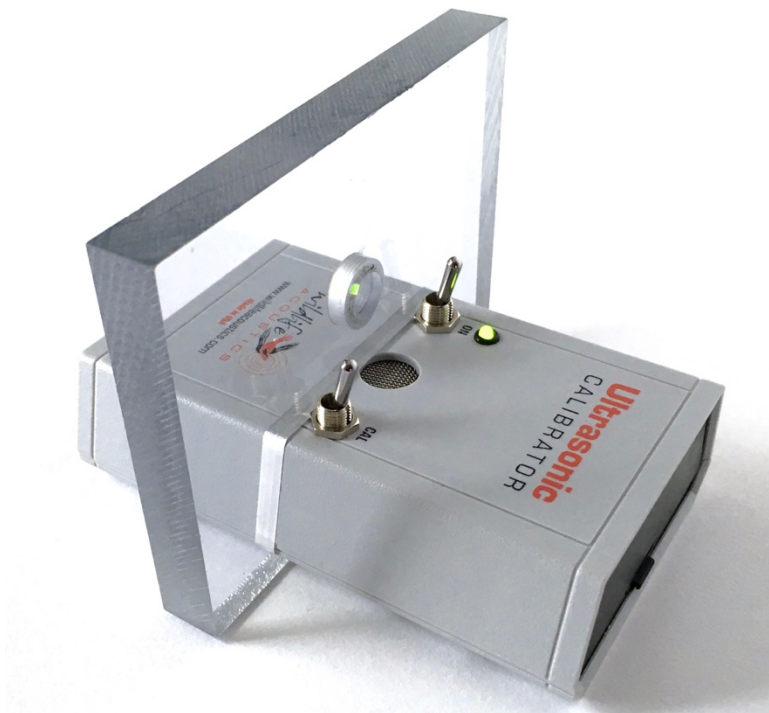

Ultrasonic Calibrator User Guide (updated 1-20-2016)

Instructions for use with:

- SM2BAT(+) with SMX-U1, SMX-US or SMX-UT microphones
- Echo Meter EM3(+) with built in or external SMX-US or SMX-UT microphone
- Echo Meter Touch

NOTE: Instructions for the SM3BAT and SM4BAT with SMM-U1 or SM3-U1 microphone or the SMZC with built in or external SMM-U1 or SM3-U1 microphone are in the respective User Guides of those products.



Introduction

Since ultrasound is beyond the range of human hearing, verifying proper system and microphone performance can be a challenge. The Ultrasonic Calibrator allows testing of both the microphone and the full recorder system performance of all of our bat recording products.

The Calibrator has two modes of operation, “CALIBRATION” and “CHIRP”. Calibration mode is used to test the microphone at close range. To test a microphone, the Calibrator generates a calibrated 40kHz tone, the microphone is placed in the calibrator microphone adapter and the recorder is used to display the received signal level which can then be compared to the microphone specification. The chirp mode emits a very loud 40kHz “chirp” and is used to test the entire system at a greater distance.

Battery

The Calibrator requires a 9V alkaline battery and one is included with the unit. The battery ships installed but not connected. The battery is located behind the hinged door at the top of the unit. The LED will no longer illuminate when the battery is depleted and can no longer provide a calibrated tone. While the unit may still emit sound at this point, it cannot be used as an accurate calibrator if the LED is not illuminated.

Calibrating Instructions for SM2BAT+ Models

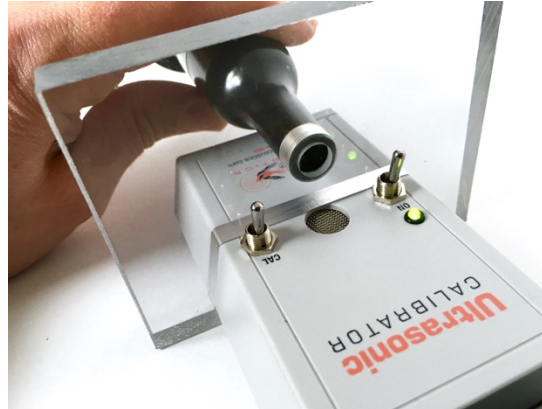
NOTE: The instructions for SM2BAT and SM2BAT+ units are slightly different. Make sure you follow the correct instructions for your model.

- Verify you are running firmware version 3.3.7 or later
- Attach the microphone to either microphone port using a microphone extension cable
- Install the Calibrator microphone adapter by sliding it onto the Calibrator from the bottom (the end with the Wildlife Acoustics logo) until it is touching the toggle switches. Make sure that the smaller diameter hole is nearer the toggle switches. The adapter will work with the SMX-U1, SMX-US or SMX-UT. The SMX-UT is shown below.



- Physical settings (Switches): The gain must be set correctly or the results of this test are meaningless. Detailed instructions on how to set the gain switches are in your SM2+ manual. Set the gain for the channel your microphone is attached to using the switches inside the SM2+

- SMX-US: 48dB
- SMX-UT: 36dB
- SMX-U1: 0dB
- Choose “Calibrate Mics” from the utilities menu. This will adjust all the programmable settings as required.
- Turn the Calibrator on and set the mode switch to “CAL”
- Look at the value on the screen on the row of the channel (left/right) where your microphone is attached and under the column @40
- Insert the microphone until it rests against the smaller diameter of the adapter hole as shown



- The microphones sensitivity is affected by orientation so the microphone should be rotated very slowly 360 degrees and the largest (least negative number) value noted. Be gentle to avoid damaging the weatherproofing. If the value is less (more negative) than the value below, your microphone has lost some or all of its sensitivity
 - **SMX-US: -17 dB**
 - **SMX-UT: -29 dB**
 - **SMX-U1: -38dB**

A higher (less negative) number indicates a more sensitive microphone, a lower number indicates some loss of sensitivity.

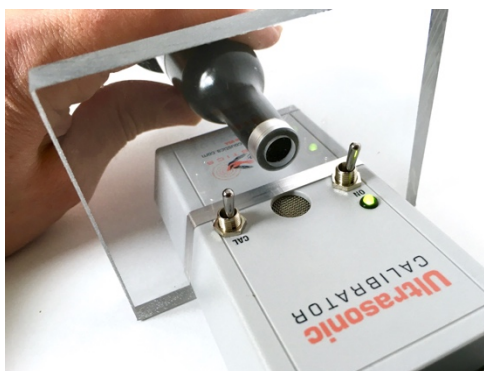
Calibrating Instructions for SM2BAT, SM2BAT 384 and SM2BAT 192X2 Models

NOTE: The instructions for SM2BAT and SM2BAT+ units are slightly different. Make sure you follow the correct instructions for your model.

- Attach the microphone to either microphone port of your recorder using a microphone extension cable
- Install the Calibrator microphone adapter by sliding it onto the Calibrator from the bottom (the end with the Wildlife Acoustics logo) until it is touching the toggle switches. Make sure that the smaller diameter hole is nearer the toggle switches. The adapter will work with the SMX-U1, SMX-US or SMX-UT. The SMX-UT is shown below.



- Settings – Both the physical jumpers and the programmable advanced audio settings must be adjusted or verified before running the test in the next section. The results of the test are meaningless if the settings are incorrect. Detailed instructions on how to adjust these settings are in the SM2 manual.
 - Set the gain for the channel where your microphone is attached using the jumpers inside the unit
 - SMX-US: 48 dB
 - SMX-UT: 36 dB
 - SMX-U1: 0dB
 - Advanced Audio Settings (Programmable) - You must manually set several settings, all in the advanced audio menu. You will have to set them back when you are done with the calibration process, so make sure to note their current values.
 - Turn off the trigger on the channel where your mic is attached by setting it to 0dB
 - Turn off the high pass and low pass filters on that same channel
- Turn the Calibrator on and set the mode switch to “CAL”
- Start an instant recording by simultaneously pressing the “up” and “down” buttons on the SM2BAT+.
- Now press the “select” button and a dB value will be shown for each channel
- Insert the microphone until it rests against the smaller diameter of the adapter hole as shown



- The microphone's sensitivity is affected by orientation so the microphone should be rotated very slowly 360 degrees and the largest (least negative number) value noted. Be gentle to avoid damaging the weatherproofing. If the value is less (more negative) than the value below, your

microphone has lost some or all of its sensitivity

- **SMX-US: -17 dB**
- **SMX-UT: -29 dB**
- **SMX-U1: -38 dB**

NOTE: SM2BAT192x2 and SM2BAT384 models will read 2dB high.

A higher (less negative) number indicates a more sensitive microphone, a lower number indicates some loss of sensitivity.

Remember to set the unit back to your preferred settings when done!

Calibrating Instructions for internal microphone of EM3 and EM3+ Models

- Verify you are running firmware version 1.2.6 or later
- Verify that the EM3(+) is set with a gain of 36dB. The switch on the side will be in the middle position
- Put your EM3(+) into calibrate mode by pressing the “+” and “-” buttons simultaneously. The upper right of the screen will show a negative value (e.g. -73.5)
- Remove the plastic microphone adapter from the calibrator by sliding it off.



- Turn the Calibrator on and set the mode switch to “CAL”
- Hold your EM3 flat against the calibrator with the microphone centered on the speaker and up against the toggle switches as shown below

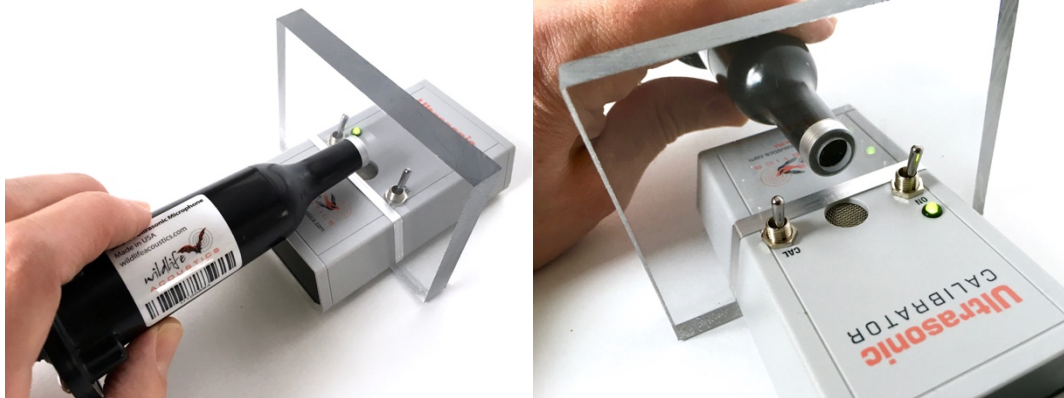


- If the value shown is less than (more negative) **-34 dB** then your EM3(+) has lost some or all of its sensitivity.
- Press any button to exit calibrate mode

Calibrating Instructions for EM3 and EM3+ Models with external SMX-US or SMX-UT Microphone

NOTE: EM3/ EM3+ requires firmware version 1.2.6 or later for accurate dBV measurements in calibrate mode

- Verify you are running firmware version 1.2.6 or later
- Verify that the EM3(+) is set with a gain of 36dB. The switch on the side will be in the middle position. Also verify that the external microphone is attached.
- Put your EM3(+) into calibrate mode by pressing the “+” and “-” buttons simultaneously. The upper right of the screen will show a negative value (e.g. -73.5)
- Turn the Calibrator on and set the mode switch to “CAL”
- Insert the microphone until it rests against the smaller diameter of the adapter hole as shown



- The microphone's sensitivity is affected by orientation so the microphone should be rotated very slowly 360 degrees and the largest (least negative number) value noted. Be gentle to avoid damaging the weatherproofing. If the value is less (more negative) than the value below, your microphone has lost some or all of its sensitivity
 - **SMX-US: -17 dB**
 - **SMX-UT: -29 dB**

A higher (less negative) number indicates a more sensitive microphone, a lower number indicates some loss of sensitivity.

Calibrating Instructions for Echo Meter Touch

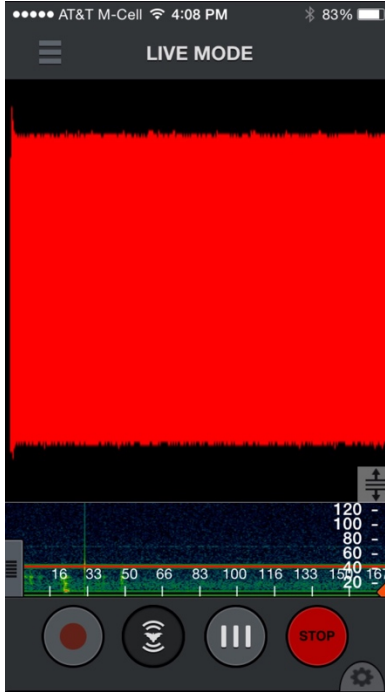
- Install the Calibrator microphone adapter by sliding it onto the Calibrator from the bottom (the end with the Wildlife Acoustics logo) until it is touching the toggle switches. Make sure that the smaller

diameter hole is nearer the toggle switches.

- Turn the calibrator on and switch to CAL.
- Plug in the Echo Meter Touch module and start the Echo Meter app on your iOS device.
- Enter Live mode and press Start to start the spectrogram.
- Verify that it is in expanded view (the button with three vertical bars shows the bars separated).
- Drag the divider between the waveform and the spectrogram to make the waveform as large as possible.
- Hold your Echo Meter Touch with the microphone element centered in the hole of the microphone adapter as shown below.



- The waveform should take up at least 3/4 of the waveform area as shown in the following screenshot. It is OK if the waveform takes up more or all of the waveform area.



Chirp mode (Any recorder)

For a test of the entire recording system, the Ultrasonic Calibrator can emit loud ultrasonic signals to the recorder while it is recording from some distance. These recordings can be analyzed to verify that the recorder settings are appropriate and the system is functioning as expected.

WARNING: In "Chirp" mode, the Ultrasonic Calibrator emits a 40 kHz signal at almost 100dB SPL. Prolonged exposure to high intensity ultrasonic signals may cause permanent hearing loss at audible frequencies. Please do not place the Calibrator close to your ears.

If you wish, remove the microphone adapter from the Calibrator.



Switch the toggle switch to “CHIRP” The unit will emit a pulsed (20% duty cycle) 40 kHz (+/- 10Hz) tone approximately twice per second. The amplitude of the tone is 94dB SPL (+/- 3dB) at 10cm. The signal can be picked up by the SMX-US or SMX-UT microphone or the EM3(+) and seen in the recording at distances up to about 18m. The sound can also be monitored from the SM2BAT+ using the Real Time Expansion (RTE) monitoring feature. This feature is accessed by plugging headphones into the headphone jack under the circuit board under SD slot A. During a recording the RTE mode can be turned on by pressing the select button. You will hear the signal only when the unit is triggered so this can be very useful for checking the efficacy of your trigger settings.

NOTE: The calibrator is somewhat directional, so you may observe up to 10dB signal loss at slight angles off center from a distance.

Detailed Theory of Operation

Measuring ultrasound is difficult for the same reasons that bats are able to use ultrasound effectively to hunt. As the test signal bounces off of small objects and returns an echo, the signal can interfere with itself introducing significant errors into the measurement. The Wildlife Acoustics Ultrasonic Calibrator is a simple and low cost design that, if used with care, can produce consistent results.

The calibrate “Cal” mode emits a weak 48 dB SPL (+/- 3dB) 40 kHz signal when measured at a distance of 30 cm. A deliberately weak signal is used so that interference from echoes off the ceiling or other hard surfaces will be lost in the noise and have negligible effect on the measurement. The fixture and other measurement techniques described above are designed such that the sound pressure wave is free to move past the microphone being measured with minimal interference and the distance between the calibrator’s ultrasonic speaker and the microphone remains predictable.

There is still a lot of room for measurement error due to the freedom of the microphone to move relative to the calibrator speaker, even when using the fixture, the asymmetry of some of the microphones, and “near-field” interference of reflections around the calibrator setup itself. We have found that by moving the microphone around to find the maximum reading yields the most accurate results as the maximum pressure has the least amount of interference.