User Manual

Echo Meter EM3+

wildlife
A C O U S T I C S
BIOACOUSTICS MONITORING SYSTEMS

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Rev. 4/22/13

Electromagnetic Interference

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

Use of ferrite clamped headphone and microphone cables are required to comply with the Class B limits in part 15 of the FCC rules. A Fair-Rite 0431173951 ferrite clamp (or equivalent) must be placed on the headphone and/or microphone cables with the ferrite residing within one loop of the cable. This ferrite clamp is included with Wildlife Acoustics microphone cables.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment under FCC rules.

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Introduction

The Echo Meter EM3 Handheld Ultrasonic Recorder was designed from the ground up specifically for active ultrasonic handheld monitoring. It includes several technologies for monitoring bats in real-time and to simultaneously record bats using both full spectrum and zero crossing technology. Additionally, using state of the art digital signal processing techniques, the Echo Meter features the first ever real-time spectrogram in a handheld unit.

The recorder is designed for outdoor use and can handle extreme hot or cold temperatures as well as high humidity. It is not, however, designed for use in precipitation.

The EM3+ has a new face with improved look and glow in the dark buttons to help you locate the proper buttons while operating in the dark. A wrist strap is also now included with the unit

The EM3+ is shipped ready to use. Included in the box with the EM3+ you will find:

> (1) Manual

> (4) Rechargeable Batteries

> (1) AC Charger (will charge batteries in the unit)

> (1) 4GB SDHC flash card

> (1) Wrist strap

> (1) Soft Carrying Case

The optional GPS accessory automatically logs your position for walking or driving transect surveys and accurately sets the EM3+'s internal clock to the correct time.

The EM3+ can be used as a short-term passive recorder using a simple scheduling option. For complex schedules or long-term passive recording in any environment, the Wildlife Acoustics Song Meter SM2BAT+ is a more appropriate detector.

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Getting Started

Layout

The layout of the EM3+ inputs and buttons can be seen below. The subsequent sections of this User Manual will discuss the functionality behind the buttons in detail.

Buttons and Ports

Internal Microphone

External Microphone Input

Gain Switch

Headphone Input

AC-DC Charger Input

Power
Record
Stop
Play — Buttons

X/Y
Up
Down
Left
Right — Buttons

Real-time Spectrogram

GPS Input

Compress/ Expand Button

Fraction Buttons

Letter Buttons

Plus
RTE/het — Buttons
Minus

Display and Volume Buttons

Wrist Strap

Display

Card Capacity

Trigger Indicator

Mode

Battery Indicator

Compressed/Expanded Axis Indicator

Optimal het Freq.

Waveform

Monitoring Mode

1/ 32GB(0%)   STOPPED◆■ᵚX(47) 37.0

Freq. Ref. Line

45

Monitoring Mode

10ms/div 19:56:40¢30.26205N '97.744⁵⁸W

X Scale

Time

GPS Status

GPS Location

het Freq

Buffer Location Indicator

Powering Up

To power on the unit, press the Power button until you see the Wildlife Acoustics splash screen. After a few seconds you will see the spectrogram. The first time you power up the unit, it will be in monitoring mode. When the unit is powered down it will remember its last mode for the next power up. To turn off the EM3+, just press and hold the power button until you see "Shutting Down" on the top of the display. The spectrogram history buffer and the settings are preserved and present when you turn the unit back on.

Settings

Press and hold the X/Y button to enter the settings menu.The default settings are shown below.

```
Time:      2000-00-00 00:00:00    0.00 UTC
Sample rate:  256K  Prefix:
Format:       WAV/ZC      Max dur: 00:10
Trigger:      12kHz  18dB  1.0s RTE:SIG
Schedule:     00:00 - 00:00 Enabled?  No
Buttons:   A: TAG              B: TAG
           C: TAG              D: TAG

Save and exit?         No
Erase all files?       No
Set factory defaults?  No
```

Use the Left and Right Arrow buttons to navigate to a setting field and the Up and Down Arrow buttons to change the setting. When positioned at a left most settings field, the Up and Down Arrow buttons will go to the previous and next settings row.

Time

Set the time and date as well as the UTC (Universal Time Coordinated) time zone offset. The UTC setting is necessary to assure the correct time display when using the GPS. If the batteries are removed from the EM3+ for longer then about 30 seconds, the clock will cease to keep time. If the clock has been reset due to extended removal of batteries or batteries that have been fully discharged, the clock setting will blink ??:??:?? on the spectrogram display so you know it is incorrect and needs to be set.

Sample Rate

Set 256kHz or 384kHz sample rate. Each can record frequencies up to a maximum of half the selected sample rate (i.e. 128kHz and 192kHz respectively). The 384kHz setting will consume card space faster and the echolocations displayed on the spectrogram will be less smooth. At the higher 384kHz sample rate, the spectrogram display is not

"overlapped" as with the 256kHz sample rate so the echolocations shown will appear more pixelated.

Prefix

Here you can specify a filename prefix of up to 12 characters that will be prepended to the recordings filename. This can be used to uniquely label recordings made by each Echo Meter (e.g. to designate a location and/or project). Use the Up and Down button to scroll through the letters, numbers and hyphen. Use the Right button to advance to the next character space.

Format

There are three recording formats that can be selected; WAC, WAV or WAV/ZC. In WAC mode, recordings are made in Wildlife Acoustics' proprietary lossless WAC compression format (WAC0 for those familiar with Wildlife Acoustics' Song Meter passive recorders). WAC files are intended to be set for long durations, several minutes to 30 minutes. Triggers are embedded in the WAC file instead of creating an individual file for each trigger.

In WAV mode, a discrete WAV file is created for each trigger. In WAV/ZC mode, an Anabat sequence file is additionally created. For ZC output, the division ratio used is either 8 in RTE or het monitoring mode (details on those later), or twice the division ratio selected when using FD monitoring mode.

The best recording format is dependent on your particular needs. WAC does have a few advantages over WAV/ZC. In WAC, files will be about 60% the size of WAV files. Additionally, in WAC mode, the unit records continuously until the max duration is reached. There is no pause time between triggers, it is always ready to record. Another advantage is that you can monitor uninterrupted in WAC mode whereas in WAV mode, RTE output and the spectrogram will pause during the save and prepare file process, which takes under a second after each triggered recording.

WAC files can be opened directly in Wildlife Acoustics' Kaleidoscope software but they can also be converted to WAV or ZC files using the Kaleidoscope Conversion Tool, a free component of Wildlife Acoustics' Kaleidoscope software. This process is usually better than

native ZC recordings because Kaleidoscope can create ZC files using a full spectrum recording of weak signals that would be missed by a native ZC recording. More details about Kaleidoscope can be found in the Managing Recordings chapter of this manual as well as the Wildlife Acoustics website where you can also download the software from the downloads page.

Max dur

Maximum duration sets the maximum recording time in any recording mode. This can be set from 1 second to 30 minutes. In WAV or WAV/ZC mode, this will set the maximum trigger length. This can be used to specify a max recording size to assure compatibility with your analysis software. In WAC mode this is used to set the maximum WAC recording time. It will not affect trigger length. Max trigger length for WAC files can be adjusted in post processing using the Kaleidoscope software.

It is important to note that when the batteries die during a recording, that recording cannot be written to the card and is lost. For this reason, you may want to set the max duration setting lower in WAC so as to prevent data loss. There will be a couple of seconds in between each WAC file where data will not be recorded.

Trigger

These are the r settings that determine what the EM3+ considers a triggered event for recording. Triggers allow significant reductions in file size by only recording when there is bat activity. Note that these settings have no effect on what will be displayed on the spectrogram or presented in the speaker/headphone audio.

The EM3+ monitors the spectral noise across the frequency spectrum. When a signal is detected that is both above the specified trigger frequency (in kHz) and is at least the specified level threshold (in dB) above the ambient background levels, a trigger is detected and the unit will begin recording. The recording will continue until no trigger is detected for the specified trigger window period of time or until the maximum duration (see above) has been reached.

To enable a recording trigger, first set the frequency threshold in kHz. This is the setting directly to the right of "Trigger:" and should be set

lower than the frequency of any echolocation of interest. Note that lower values may result in false triggers from low frequency noise sources. Next set the amplitude threshold for the trigger. This is directly to the right of the frequency threshold. Higher values are less sensitive and lower values are more sensitive. 18dB is recommended as a good starting point. Next, set the trigger window in seconds. This is directly to the right of the amplitude threshold. A triggered event will continue as long as there is activity that exceeds these amplitude and frequency thresholds and then will continue for the specified trigger window after the last trigger. In other words the recording will continue as long as there is activity, and then will continue for the trigger window after activity has no longer been detected or until the maximum duration is reached, whichever comes first.

When the EM3+ is triggered and recording, a circle appears to the right of "RECORD" on the display. The circle also appears when monitoring so you can get a sense of trigger function and adjust settings accordingly.

The last setting of the trigger line, directly to the right of the Trigger window, is Real Time Expansion (RTE). This setting controls the audio output of the EM3+ unit only. There are 3 different RTE modes that can be selected here. The default is "SIG" or signal activated so the RTE speaker output is only enabled when some signal is detected sufficient to paint pixels on the spectrogram display. The other modes are "TRG" which will activate the audio output when a recording trigger is active, and "ON" for which the audio output is always activated. Note again that this setting on the Trigger line has no effect on the recording, it will only change the real time audio output.

Schedule

Set the start and stop time for scheduled recordings. You also must enable the feature here. Details can be found in in "Scheduled Recording" on page 23.

Buttons

This sets the functionality of the Letter buttons. These buttons can function as heterodyne frequency presets or can "tag" a recorded file name with the button letter pressed during the recording.

The Letter buttons will act as tags unless a heterodyne preset has been set in the settings menu. Details on tag functionality can be found in "Tags and Voice Notes" on page 23. If a heterodyne preset is set, that Letter button will immediately tune to that frequency when in heterodyne monitoring mode (but will not tag). When in Real Time Expansion or Frequency Division mode, and a Letter button configured as a heterodyne preset is pressed, the EM3+ will switch to heterodyne mode and tune to the preset frequency.

Save and exit

To save all settings, select Yes and then press the X/Y button to exit the settings menu. You may exit without saving the modified the settings by pressing and holding the X/Y button.

Erase all files

This will erase all files on the flash card. If you select Yes and then press the X/Y or RTE/het button, all files will be erased and the EM3+ will exit the settings menu.

Set factory defaults

This will return all settings to the factory presets. If you select "Yes" and then press the X/Y button, all settings will be returned to factory defaults and the EM3+ will reboot. Factory default settings include the settings found in the settings menu as well as contrast, brightness, display view mode, zoom levels, volume and several other parameters such that the EM3+ will be in the same state as new (except the time settings, which are retained). Alternatively, holding down the Left button while removing and reinstalling a battery will also restore all factory defaults. This process is also useful to correct any operational anomalies so it is an excellent trouble shooting technique to try if the EM3+ is not operating properly.

Gain

Gain is set with a three-way switch on the left side of the EM3+. Available gains are 36dB, 30dB and 24dB. The settings positions are not in that order. Positions are shown on the label on the bottom of the unit.

The EM3+ ships with 36dB set as a default and this is optimal for most cases. If a loud bat echolocates very close to the microphone, clipping may occur and the gain should be set lower for better recording quality.

SM2BAT users note that these gain settings do not equate to the same settings on an SM2BAT as the EM3+ microphone has a different circuit and is more sensitive than an SMX-US.

Monitoring and Playback

The EM3+ can convert ultrasonic bat echolocations to audible frequencies in real time using heterodyne (het) technology, or Wildlife Acoustics' Real Time Expansion (RTE). Regardless of which monitoring technology is selected, the unit can simultaneously record in full spectrum and optionally zero crossing to the flash card. Echolocations can also be made audible using time expansion playback.

Volume and Output source

Sounds can be monitored through the speaker on the back of the unit or through headphones via the standard stereo headphone connector on the left side of the unit. Inserting headphones will mute the speaker. To adjust volume for either, press the Speaker button and then press either the Plus/Minus buttons or the Up/Down buttons to adjust the volume. Pressing any other button or waiting 5 seconds exits the volume adjustment mode. The adjustment level is displayed on the bottom of the screen.

Starting and Stopping Monitoring

To enter monitoring mode from stopped mode, press the RTE/het button. You will see MONITOR on the top line of the display. This indicates that the unit is monitoring but not recording. During a recording you will see RECORDING on the top line of the display indicating that the unit is both recording and monitoring.

To stop monitoring or recording press the Stop button. In recording mode, the Stop button will stop both recording and monitoring. Recording is covered in a subsequent chapter. In stopped mode the spectrogram does not update and you will see STOPPED on the top line. To restart monitoring, press the RTE/het button.

If no button is pressed for a few minutes while the EM3+ is in stopped mode, the unit will power down to conserve batteries.

Monitoring Modes

The RTE/het button toggles between Real Time Expansion (RTE) broadband monitoring and het monitoring. Broadband monitoring allows you to hear bats at all frequencies, whereas het monitoring will only play bats around a tuned frequency. This allows you to monitor in broadband

(while viewing the spectrogram), then you can "zoom in" acoustically on the echolocations using the het mode if you prefer.

Real Time Expansion (RTE)

Real Time Expansion is a patent pending method of acoustically delivering the maximum amount of spectral and temporal information of the bat echolocation in real-time. This allows you to hear a close approximation of what a bat would hear. The ultrasonic signal is expanded in sub-millisecond scales, such that the echolocation is actually expanded into the silences between the echolocations.

In RTE mode the Fraction buttons can be used to select the division ratio that will be applied to the bat echolocations

The audible output of the bat echolocation will be a fraction of the original frequency dependent on this selection. For example a 32kHz echolocation would be heard at 2kHz if the 1/16 division was selected. The division ratio is shown to the right of the monitoring mode RTE at the top right corner of the display.

It is important to note that only a brief push is required to toggle between broadband and het monitoring whereas holding the RTE/het button down for approximately 2 seconds will toggle the broadband monitoring mode type between RTE and Frequency Division (FD).

FD broadband monitoring mode can be used check the proper zero crossing sensitivity threshold which is set for recording. This will be described in further detail in the "Recording" chapter later in this manual. When "FD" is displayed before the division ratio at the top right corner of the display the unit is in this mode and can be returned to RTE mode by pressing and holding the RTE/het button

Heterodyne Monitoring

Heterodyne (het) is a narrow-band method that lets you tune to a narrow range of ultrasonic frequencies (about 8kHz range on the EM3+). Het uses a tunable carrier wave to play the difference in frequency between the carrier wave and the echolocation. This allows the frequency to be shifted to an audible frequency range.

Using this technology, small differences in the frequency of the echolocation can sound quite dramatic in the audible output signal. For

example, if the het is tuned to 50kHz and a bat echolocates at 51kHz, the EM3+ will play back at the difference of 1kHz. If another bat echolocates at 55kHz it will be heard as 5kHz. Even though the frequencies of the actual echolocation are only 10% different the sound played for the user is 500% different. Because of this effect, het can be a useful tool to differentiate species with similar echolocations at similar but different frequencies. Also small variations in the echolocation frequency are sometime indicative of species and are exaggerated by this effect.

Het mode has three methods of tuning the frequency: auto, preset and manual. When you press the RTE/het button to enter het mode, the EM3+ automatically calculates the optimal het frequency for that bat pass and tunes the het frequency to that value. To re-tune to a new frequency of a new bat pass, double click the RTE/het button (this is really switching the EM3+ into broadband mode and then back again to het). This estimated optimal frequency is displayed in parentheses in the top right of the display and is shown in all monitoring modes. The tuned het frequency is shown to the right of that with a .1 Hz resolution and is only shown in het mode. There is also a triangular indicator on the Y axis indicating the tuned frequency.

You can also go to het mode by pressing one of the Letter buttons if you have configured the button as a het preset in the Settings menu. If in het mode, pressing a Letter button will simply tune the EM3+ to that frequency. If in broadband mode (RTE or FD), pressing a Letter button will switch to het mode at that frequency in one step.

Additionally, the detector can be fine-tuned manually using the Plus and Minus buttons.

In het mode, the Fraction buttons have no effect.

Playback

You can also play back the bat echolocations using time expansion. First press the Stop button to stop recording and monitoring, then scroll back in time in the spectrogram using the Left Arrow button to the area you would like to play and press the Play button. You will see PLAYBACK on the top line of the display and the visible portion of the spectrogram will be played back, slowed down by the selected division ration on the Fraction buttons. You can also use the Up and Down Arrow buttons to zoom out the X scale (in X mode) to include a larger portion of the buffer in the playback. It is better to be in compressed

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mode for playback, as the space in between the echolocations will be quite long otherwise.

A progress bar at the bottom of the display will be shown during playback of echolocations from the history buffer. To continue monitoring, press the RTE/het button, or press the Record button to begin recording.
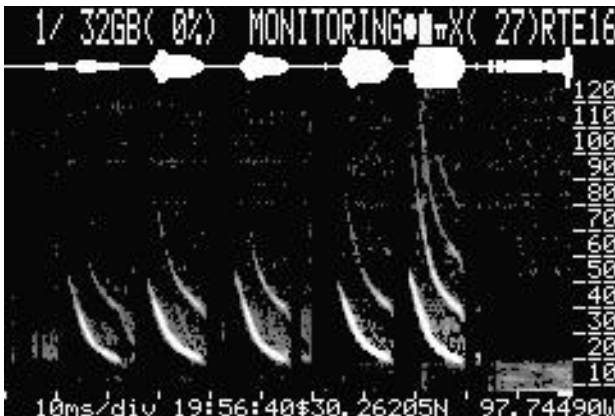
Spectrogram Display

The EM3+ has an integrated real-time spectrogram. This allows you to see important characteristics of bat echolocations as they are happening. The spectrogram is updated even while monitoring or recording.

Viewing Modes and Adjustments

The default view mode for the spectrogram is "black on white" as shown below.
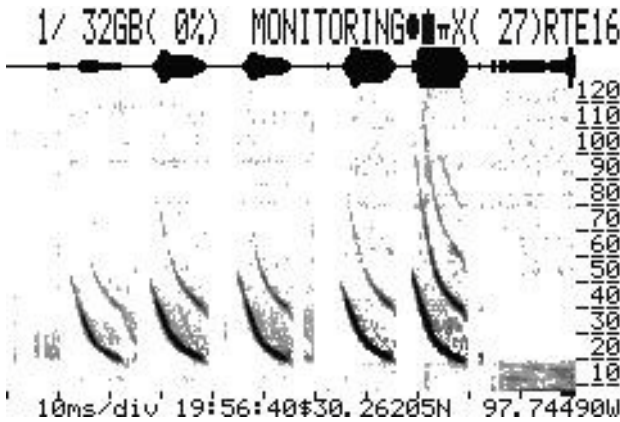
If you press and hold the Display button the display will switch to "white on black mode" as shown below. This mode might be preferred for use in the field as it is easier on the eyes in the dark.
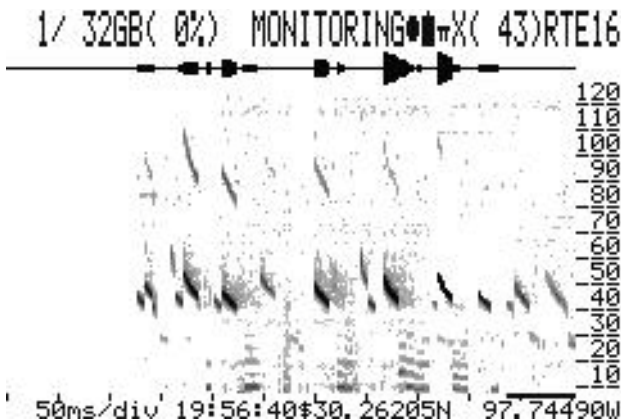
If you momentarily press and release the Display button, you can then adjust brightness using either the Plus and Minus buttons or Up and Down buttons. The contrast is adjusted using the Right and Left Arrow buttons. The adjustment levels are displayed on the bottom of the screen. Pressing any other button or waiting 5 seconds exits the display adjustment mode.
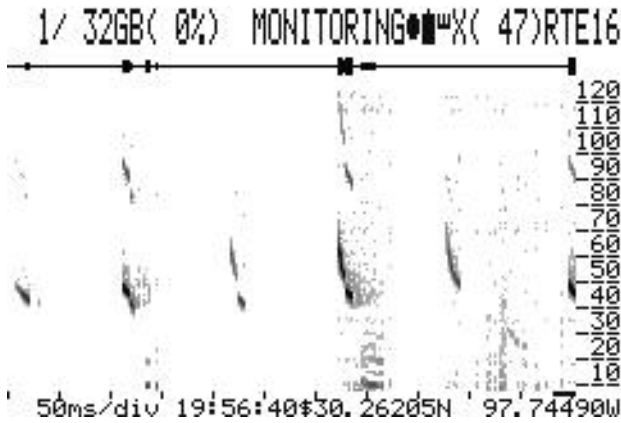
The backlight can be easily turned off by double clicking the Display button. This is useful if you are monitoring without watching the screen and want to conserve power or do not want the display interfering with night vision. From this state, any button will restore the backlight.

Compressed and Expanded Views

Two viewing options are available, compressed view and expanded view. You can toggle between these options using the Compress/Expand button. The icon symbol to the right of the battery capacity symbol on the top line of the LCD display shows which view you are in. Compressed view is shown as two straight lines and expanded view as three straight lines.

The compressed view removes the silent intervals between bat echolocations in the spectrogram so you can see more echolocations on the display. Expanded view shows the echolocations in "real-time". This is useful to understand inter-echolocation timing. In expanded view the window might display just the empty space between bat echolocations, so in this view it is better to zoom out. Zooming is described below. The same bat pass is shown in the two screenshots below. The first screenshot shows compressed view and the second expanded view.

1/ 32GB(0%) MONITORING●■ᵐX(47)RTE16
120
110
100
90
80
70
60
50
40
30
20
10

50ms/div 19:56:40$30.26205N 97.74490W

Viewing Spectrogram History

While continuing to acquire new bat echolocations, you can scroll back in time to review recent bat activity by pressing the Left Arrow button. Pressing and holding the Right or Left Arrow buttons will allow you to scroll more quickly through the spectrogram. The system can store about 5 seconds of continuous bat signals, but by compressing the silent intervals between bat echolocations, the actual time can be up to a few minutes depending on bat activity. The buffer is saved when the EM3+ is powered off, so when it is turned back on, past echolocations are preserved. Note that when scrolled back to the back of the buffer to view past echolocations and still monitoring, the end of the buffer is moving with the new data being monitored, as it is finite in length. When what you are viewing at the end of the buffer is overwritten, the display will start to scroll forward in time with the new data. This can give the impression that you are viewing real time data, when in fact you are viewing old data that is scrolling. After reviewing past echolocations you can jump to the front of the buffer to display real time data by double clicking the X/Y button.

A scrollbar indicator shown as a black horizontal line on the X axis of the spectrogram indicates where you are in time as you scroll back through the spectrogram buffer. The width of the bar shows how much of the buffer you are viewing and the location shows the relative location in the buffer. If zoomed all the way out such that you were viewing the entire buffer on the spectrogram, the black bar would cover the entire width of the X axis. In expanded mode, the behavior might seem odd, as the relative width changes

as you scroll back. This is because the silent spaces between echolocations are stored efficiently; thus the amount of the buffer shown on the display is dependent on the percentage of silent space on the display.

Frequency Reference Line

A frequency reference line is available to aid in determining the exact frequency of a bat echolocation. The Plus and Minus buttons move the reference line in RTE mode. In het mode, however, the Plus and Minus buttons control the tuning frequency, therefore the reference line cannot be adjusted while in het mode. The reference line will still display in the location it was last set before entering the het mode, but to adjust it, you must switch back to RTE mode.

To hide the reference line, adjust it down and off the screen using the Minus button. Press the Plus button to scroll it back to visibility
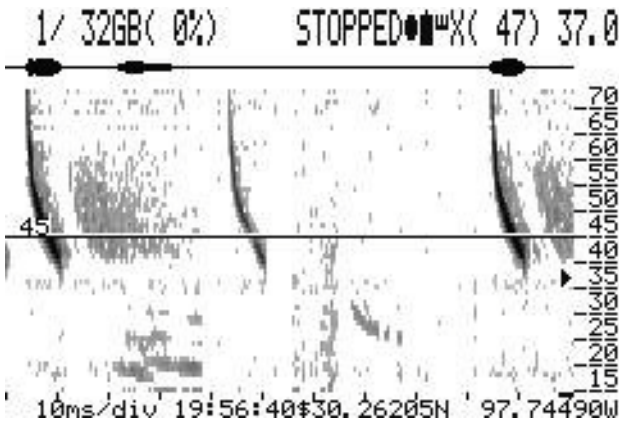
Zooming in the X and Y Axes

In addition to allowing you to review the spectrogram by scrolling through the buffer, the Arrow buttons and X/Y button allow zooming in on regions of interest. The X/Y button toggles the Arrow buttons between X mode and Y mode. The currently selected mode can be seen in the top line of the LCD display to the right of the Compressed/Expanded icon.
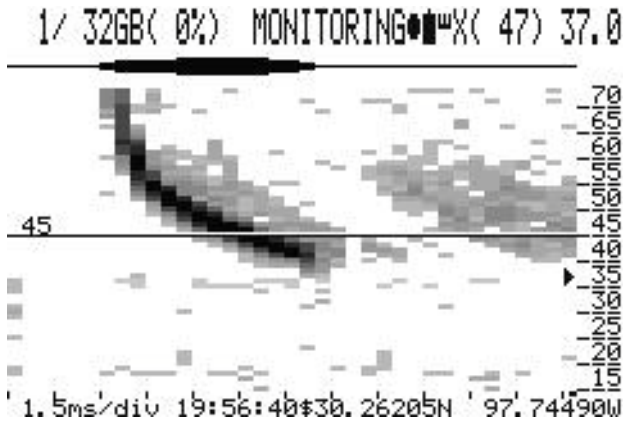
In X mode the Left button scrolls back in time, the Right button scrolls forward in time, the Up button zooms in and the Down button zooms out. Note that everything zooms from the right edge of the screen. The X axis scale is shown in the lower left corner of the display as ms/div (milliseconds per division or tick mark). For the 384kHz sample rate setting, the available divisions are 250ms, 100ms, 50ms, 20ms, 10ms, 4ms, 2ms and 1.5ms. For the 256kHz sample rate setting, the available divisions are 250ms, 100ms, 50ms, 20ms, 10ms, 3ms, 1.5ms and 1ms. If you are scrolled back in time and want to view the present, just double click the X/Y button.

In Y mode, the Right button zooms the Y-axis zoom (frequency) and the Left button restores it. While zoomed in, the Up and Down buttons let you scroll the Y-axis so you can center in on the narrower frequency band of interest. There is only one zoom level on the Y axis. Since the X mode will be used more commonly, if left in Y mode the EM3+ will revert back to X mode after a few seconds.

The simulated screenshots below show the same bat echolocations in different modes of operation. The first is shown with the default zoom level, the next with Y zoom and finally with Y zoom and full X zoom.

```
1/ 32GB( 0%)  MONITORING●▮ᵂX( 47) 37.0
                                          70
                                          65
                                          60
                                          55
                                          50
   45                                     45
                                          40
                                        ▶ 35
                                          30
                                          25
                                          20
                                          15
'1.5ms/div 19:56:40$30.26205N ' 97.74490W
```

 In all three screenshots, you can see the frequency reference line and in the last two you can also see the triangular het frequency indicator. All of the above screenshots show the display with the EM3+ set to a sample rate of 256kHz. At this sample rate you will see a maximum frequency on the Y scale of 120kHz. If the 384kHz sample rate is selected the Y-axis scale will go to a maximum of 190kHz.

Recording

Active Recording

To begin a recording, press the Record button. This starts a recording in WAC, WAV or WAV/ZC mode depending on the format selected in the settings menu. Once the recording has started, the elapsed time of the recording will be shown on the top line of the display as mm:ss RECORD. The recording takes under a second to start, during this time you will see PREPARING on the top line of the display. Note, EM3+ is always in Monitoring mode while in Recording mode.

Recording Modes

In WAC mode, triggered WAC files will be made back-to-back based on the Max Duration value in the settings menu.

In WAV or WAV/ZC mode, each trigger will be written as an individual file. At the end of each trigger you will see SAVING at the top of the screen as the file is saved and PREPARING as the next file is readied. When ready, you will see WAIT TRIGGER as the EM3+ waits for a triggered event. The process of saving a file and opening a new file in between each recording takes under a second.

It is important to adjust the zero cross threshold before recording in ZC mode. The threshold must be set such that only higher amplitude waveforms result in a "zero crossing". If the crossing was truly zero, the output would be only white noise and no bats would be heard. The default threshold setting is quite high and the EM3+ is unlikely to record any zero cross data at that setting so it must be adjusted. If no zero crossings are detected in ZC mode, the file will not be written.

The ZC threshold can be set by entering the frequency division adjust mode by pressing and holding the volume button until FDADJ is displayed in the upper right corner of the display. Now the Plus and Minus buttons can be used to adjust the threshold while you listen to frequency division output. You want to set the threshold a couple levels above the point that constant white noise is heard. Note that this threshold has no effect on the RTE mode which does not require any adjustment.

(Note that zero cross is synonymous with Frequency Division in this application where usually FD refers to monitoring and ZC refers to recording)

Stopping and Restarting

To end a recording, press the Stop button (pressing and holding the Power button will also stop the recording before powering down). Stop will terminate any active recording and write the file. Stop will also stop the monitoring mode and STOPPED will show on the top line of the display. After stopping a recording, you can press the RTE/het button to resume monitoring mode. Or press Record to start a new recording and simultaneously initiate monitoring mode.

Trigger Display

When the EM3+ is triggered a circle appears to the right of "RECORD" on the display. The circle also appears when monitoring so you can get a sense of trigger function and adjust settings accordingly.

Time Stamps

WAC recordings are saved in a "Data" folder on the flash card and have names of the form Prefix_YYYYMMDD_hhmmss.wav, where Prefix is the prefix specified in the settings menu, YYYY is the year, MM is the month, DD is the day, hh is the hour, mm is the minute, and ss is the second. In WAC mode, Echo Meter maintains the proper time so that when the triggers are viewed in Song Scope, Wildlife Acoustics' licensed analysis software, the appropriate space is shown between triggers.

When WAC files are converted to WAV or ZC files using Kaleidoscope, the files will be time-stamped in the filename with a 1 ms resolution. Kaleidoscope will prepend the tag letter (see next section) to the filename if "split triggers" is selected.

In WAV or WAV/ZC mode, the files are saved to the "Data" folder and the filenames follow the same convention as above but prepend __ in front of the year and add A_/B_/C_/D_ or N_ if tagged using the tagging feature explained in the next section.

Tags and Voice Notes

The Echo Meter has the ability to "tag" a recording to aid in organization of your files. The Letter buttons are used to tag the individual triggers. This allows you to efficiently sort tagged recordings during analysis. If in WAC mode, pressing a Letter button will save that information in the WAC file such that when the WAC is converted to WAV or ZC files with "split trigger" selected in Kaleidoscope, the tag letter will be prepended to the filename of the resultant WAV or ZC files. If in WAV or WAV/ZC mode, the letter will be prepended to the respective recording file name on the card.

Additionally, holding down any Letter button will extend the trigger window until the button is released. If you speak while holding down the Letter button, your voice will be recorded along with the ultrasonic signal, so you can effectively record a voice note with the bat echolocations inside the trigger recording. When listening in the bat analysis software of your choice at real speed you will hear your voice and no bats. If the recording is played slowed down, you will hear the bats, but your voice will be shifted to the infrasonic range and will not be audible.

As there are four options available you can develop any "key" for the tags that make sense to you. For example, "A" might mean that it was possibly a very interesting echolocation which you want to analyze later, "B" might mean that it is definitely not an important recording and can be discarded, etc. Or you can just use one letter as a voice note button to indicate that any recording tagged with that letter includes important voice notes.

A file that is not manually tagged by the user may be automatically tagged with the letter "N". The EM3+ unit has an intelligent feature that is constantly analyzing the recordings. If a recorded file is unlikely to contain recorded bats (e.g. appears to only contain noise), then the EM3+ will prepend "N" (for noise) to the file name. However, the tag buttons (A,B,C,D) will take precedence and will override this automated feature when pushed regardless of whether the EM3 determines the recording is unlikely to contain Bats.

Scheduled Recording

Scheduled recordings are enabled in the Settings menu. If "enabled" is selected and the unit is shut down, the EM3+ will auto-wake at the specified

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start time, disable the monitoring output, turn off the display backlight, and start a recording in the selected mode (WAC, WAV or WAV/ZC). It will continue to make back-to-back recordings until the specified end time is reached.

While recording, the user can interrupt and stop recording or initiate monitoring, but the Echo Meter will still power off at the specified end time unless the scheduled recording setting is disabled in the Settings menu.

Note that if scheduled recording is not enabled, schedule start and end times are ignored even if set.

Batteries and Charging

The EM3+ includes four high capacity rechargeable NiMH AA batteries. These batteries allow up to 12 hours of operating time.

Charging

The integrated charger allows the batteries to be charged by simply attaching the included charger to the power port on the left side of the EM3+ and plugging the adapter into the wall. The unit will power down during the charge cycle and cannot be used. The LED on the side of the unit will display amber (red plus green) until charging is compete at which time it will display only green. Recharging dead batteries should take 3-4 hours. It is recommended once a year to replace or condition the batteries in a quality charger to maintain optimal operating time.

It is possible to swap batteries in the field for longer life. If the swapping is done within 30 seconds or so, the clock will not reset. All other settings will be preserved regardless of how long the batteries are absent. Removing the batteries does, however, erase the spectrogram buffer.

When plugging in the 9V DC charger while the EM3+ is powered on, the display will show various warning messages regarding safe battery charging. If a button is pushed the unit will power off in 3 seconds, otherwise the unit will continue to display the warnings for about 30 seconds before powering down to begin the charge cycle.

WARNING: Never plug in the included charger when non-rechargeable Alkaline batteries are installed!

WARNING: Charge only rechargeable nickel metal hydride batteries in the EM3+. Charging any other type of rechargeable or non-rechargeable (disposable) batteries may cause them to leak, rupture or explode resulting in risk of fire, property damage, injury or death.

WARNING: Do not use the charger if the LED indicator does not remain continuously red plus green (amber) during the entire charging cycle. If the red light blinks on and off while charging, the EM3+ could be damaged and may cause batteries to leak, rupture or explode resulting in risk of fire, property damage, injury or death.

WARNING: Charge only on a fireproof surface and away from flammable material. The EM3+ battery charger is designed to terminate the charging process when batteries are fully charged, however, in the event of a defect

or damage to the batteries or the EM3+, batteries could become extremely hot resulting in risk of fire, property damage, injury or death.

WARNING: Batteries may become hot to the touch while charging.

Monitoring Battery Life

The top line of the display battery icon shows the battery level in four increments. When the EM3+ calculates that the battery life is nearly over, it will alert the user that the batteries are depleted and the unit is shutting down. If recording, the recording will be saved before shutdown. If the EM3+ is recording and the batteries are removed, the recording in process will not be saved.

If no button is pressed in Stopped mode for a few minutes, the unit will power down to conserve batteries.

Other Power Options

The EM3+ will work with all types of AA batteries, including disposable alkaline AA batteries, however, the battery level indicator is designed for the batteries included with your EM3+ unit and may not be accurate for other types of batteries.

Flash Cards

The 4GB SDHC card included with your EM3+ can be used for recording and is suitable for a night or two of bat recording. A very general rule of thumb for memory consumption with average bat activity using the recommended trigger level settings is 2GB of card use per night in WAC mode and 4GB per night in WAV or WAV/ZC modes.

For longer scheduled recordings, SDHC cards are available up to 32GB and any Class 4 or higher rated SDHC is a suitable choice.

Although the Wildlife Acoustics SM2BAT+ is a better model for long term or complex, passive recordings, the EM3+ unit will accept capacities up to 128GB available in SDXC type cards. Please contact Wildlife Acoustics customer support for further details.

On the display, card status is either xxx/yyyGB(zz%) to indicate xxx used of yyy total GB and zz% full, or one of the following:

- NO CARD   card not present.

- CARD ERROR   problem mounting card

- FILE ERROR   problem while writing file to card.

- NEW CARD   if you remove a card and replace it with a new card, this is the status until you actually start recording.

The flash card is also used to upgrade the unit's firmware. To upgrade, put the EM3+ firmware image on the flash card in your computer. Turn the EM3+ off and insert the card into the EM3+. Now turn the EM3+ on while holding the Up Arrow button. You will see any firmware files that are on the flash drive. Select the newest firmware and press the X/Y button. The EM3+ will upgrade and restart.

Flash Cards

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Managing the Recordings

Transferring the Recordings to a Computer

Simply remove the flash card from the EM3+ and place in a suitable card reader on your computer. You can open the files directly from the card or drag and drop them onto your computer.

Using Kaleidoscope

You will also want to download and install the latest version of Wildlife Acoustics' Kaleidoscope post-processing software from the "Downloads" section of Wildlife Acoustics' website at www.wildlifeacoustics.com.

The free version of this software can convert from WAC, WAV, and Zero Crossing formats to WAV and Zero Crossing formats while filtering out unwanted signals. (Upgrading to Kaleidoscope Pro will add automatic classification of bats from both North America and the United Kingdom)

Optional GPS Antenna

An optional GPS antenna is available to log the GPS location of recordings and to sync the clock to the GPS time base with a less than 1 ms error.

Using the GPS Antenna

The GPS antenna plugs into the port on the right side of the EM3+ and attaches to the back of the device with the supplied fastening "dots". The antenna can be extended if necessary for better placement (during car transects for example) using a standard CAT-5 network extension (male to female) cable.

When the GPS is plugged in, "?" will appear to the right of the time on the bottom line of the display. This indicates that a GPS antenna is connected and recognized but not yet synchronized. When the GPS has acquired satellites and is time synchronized, "?" will be replaced with "$". If the display shows "!", instead, then an error has occurred communicating with the antenna. Check the connection and try again.

The latitude and longitude will be displayed to the right of the time in decimal degrees format. If the GPS has been used recently in the area, the position fix will take under a minute. If a significant amount of time has elapsed or the GPS has been shipped some distance, the GPS must download new tables. In this case the first position fix can take up to 40 minutes, but subsequent fixes should still occur in under a minute.

The GPS uses the WGS-84 coordinate system and uses WAAS mode for increased accuracy in North America and Hawaii.

Viewing the GPS Data

 GPS data is logged once per second. If the recordings are in WAC mode and converted to WAV in Kaleidoscope, you can choose to generate a KML file, which can be opened directly in Google Earth as well as many other applications that can display KML. Alternatively, a gps.txt log file with the GPS coordinates from the end of each triggered event will be generated and stored in the converted recordings destination folder. If converted to ZC, the GPS coordinates will be placed within the file such that they can be natively viewed in compatible zero crossing software. If recording in WAV or WAV/ZC mode, locations of each WAV will be stored in a gps.txt log file and the location will be embedded in the ZC file. Whether created on the EM3+ in WAV or WAV/ZC mode or in Kaleidoscope during conversion, the gps.txt file has the appropriate heading to allow easy conversion to Google Map or Earth files using http://www.gpsvisualizer.com./

Specifications

- Dimensions:
    - 5.7 in (14.5 cm) long
    - 3.6 in (9.1 cm) wide
    - 1.25 in (3.2 cm) high
- Weight: 12 oz (0.34 kg) with included batteries
- Operating Temperature Range: -4ºF to +185ºF (-20ºC to +85ºC)
- Battery Run Time: Up to 12 hours per charge
- Battery Charge Time: 4 hours
- Audio Sample Rate: 256kHz or 384kHz
- Microphone Directionality:
    - Optimal signal is ±30º vertically and ±60º horizontally
- Effective Microphone Bandwidth: 1kHz to 192kHz
- Microphone Frequency response:

Echo Meter EM3 Frequency Response
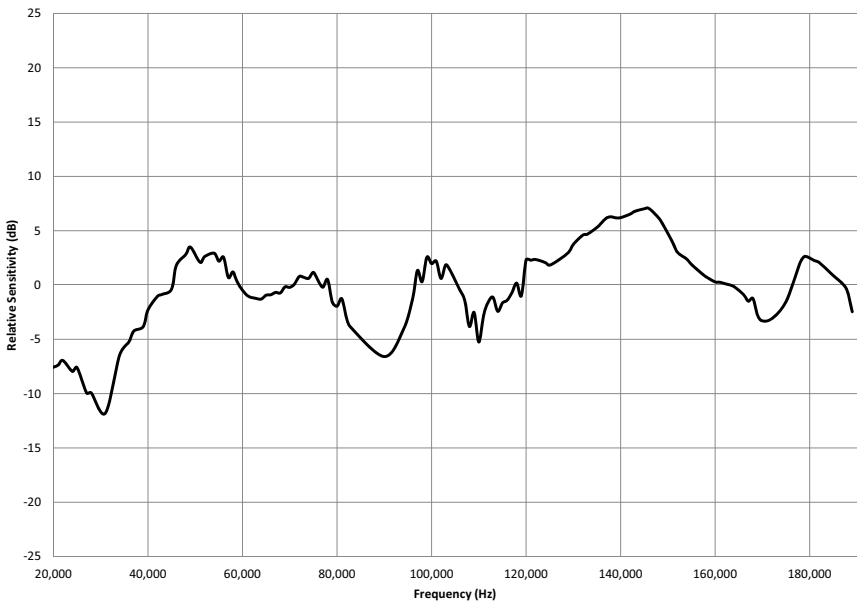
Specifications

Warranty

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, for one (1) year from the original purchase date. 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 program 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.

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 WAI's website at www.wildlifeacoustics.com/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's expense. All products or parts that are replaced become the property of WAI. WAI shall not be responsible for Customer's 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.

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GOVERNING LAW: This Limited Warranty shall be governed by the laws of the Commonwealth of Massachusetts, U.S.A., 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.

Wildlife Acoustics, Inc., 970 Sudbury Road, Concord, MA 01742-4939, United States of America, (888) 733-0200, www.wildlifeacoustics.com

Warranty

Declaration of Conformity (EN 45014)

- Manufacturer:
    Wildlife Acoustics, Inc.
    970 Sudbury Road
    Concord, MA 01742-4939
    United States of America

- Declares that the following product:
    Product Name: Echo Meter
    Product Model Numbers: EM3+
    Product Type: Handheld Bat Detector and Recorder

Conforms to the appropriate country standards and governing regulations listed below. We, as the manufacturer, are fully responsible for the design and production of the above-mentioned equipment.

- FCC Part 15, Class B   Federal Communications Commission Rules Part 15

- ICES-003, Class B   2004, Industry Canada, Interference-Causing Equipment Standard, Digital Apparatus

- EN 55011, Class B   2007, Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement

- AS/NZS CISPR 11, Class B 2004, Industrial, scientific and medical (ISM) radio-frequency equipment - electromagnetic disturbance characteristics - limits and methods of measurement

Declaration of Conformity (EN 45014)

- CISPR Publication 11, 2003/A2, 2006Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement

- EN 61326-1:2006 Electrical Equipment for Measurement, Control and Laboratory Use EMC Requirements

- EN 61000-4-2 Electrostatic Discharge (ESD) 4kV Contact Discharge, 8kV Air Discharge, 4kV Horizontal and Vertical Coupling Planes (HCP and VCP, respectively)

- EN 61000-4-3 Radiated Electromagnetic Fields, 3 V/m, 80 to 1000 MHz; 3V/m, 1.4 GHz to 2 GHz; 1 V/m, 2 GHz to 2.7 GHz

This class B digital apparatus also meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numerique de la Classe A respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

This product operates on 6V DC.

This product was tested in a typical configuration. Note that there may be some undesirable recording quality when subjected to electromagnetic interference with the optional GPS attached..

Ian Agranat, President
Wildlife Acoustics, Inc.
November 1, 2011