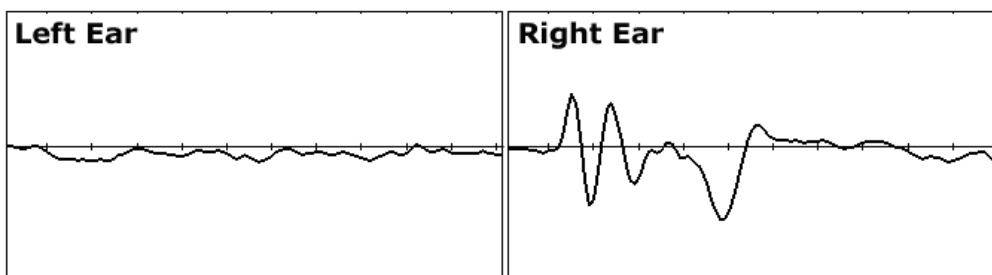# UFI *BAERCOM* ™

and *BAERCOM-PC* Software Version 2.1

User Instruction Manual 2.1a

January 2014

BAERCOM traces from one-year-old Dalmatian with unilateral hearing loss in left ear.
Test time: less than 5 minutes.

Legal Disclaimer

If you are an individual interested in purchasing the BAERCOM, please check with your local veterinarian to see if there are any legal issues involved. In many locations, you can probably do anything you wish with your own animals, including BAERCOM testing. However, if you charge a fee for BAER testing of another person's animals, you are likely required by local law to be a licensed veterinarian -- a point on which we fully agree. We urge complete and full compliance with any local laws relating to BAER Hearing Testing in your area !!!

BAERCOM User Due Diligence

When used correctly, the BAERCOM can easily show the EEG/BAER tracing for normal hearing on the selected Ear of an animal. Like most EEG/BAER instruments, the successful use of the BAERCOM requires both a substantial familiarity with the meaning and appearance of the EEG BAER signal, as well as a methodical "attention to detail" approach to instrumenting and testing an animal. Thus a certain amount of "due diligence" is required of the BAERCOM user in order to successfully use the BAERCOM. Failure to master either or both of these two key areas can result in poor data that is incorrectly interpreted, but this should not be taken as the fault of the BAERCOM system.

Radiated Noise Caution

We recommend that you disconnect the BAERCOM from the PC computer (by disconnecting the USB cable from the USB connector on the top panel of the BAERCOM) before actually collecting BAER data from an animal. The gain of the EEG signal conditioner in the BAERCOM is very high, and power supplies (especially external supplies used with Notebook computers) can introduce a substantial amount of electrical interference, that can easily distort or mask the actual EEG/BAER signal that the BAERCOM is designed to measure.

UFI Interpretation Requests

UFI continues to work with a number of licensed DVM's in both the development and support of the BAERCOM. However, UFI does not have a licensed DVM on staff. As a result, we are not able to interpret your BAER data for you. We may, at times, ask that you send us some of your BAER data, but this is only for evaluation regarding connection and signal quality issues.

Directional Consistency

These instructions repeatedly use the designations **right** and **left**. You can understand these directions as viewed from either the front of the animal, or from the back of the animal. **Whatever approach you choose, use it *consistently*.**

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BAERCOM™ Overview

The BAERCOM system was conceived in 1999 as a low cost, "field-friendly" Brainstem Auditory Evoked Response (BAER) testing system. The complete system draws on areas where UFI has extensive expertise. These fields include physiological signal conditioning electronics, microprocessor-based data collection, PC software development, and user-friendly packaging for small instruments.

The main component of the BAERCOM system is the BAERCOM unit itself. This compact instrument generates audible "clicks" that are used to stimulate the acoustic nerve, initiating the BAER data response. (For details on this process, see Section 1, "An Introduction to the BAER Process.") The BAERCOM also incorporates EEG signal conditioning circuitry to filter and boost the weak EEG signal, as well as analog-to-digital and data handling circuits.

The heart of the BAERCOM unit is a microprocessor. The microprocessor generates carefully timed sets of 100 clicks that are sent to an earphone in one of the animal's ears. The BAERCOM User can adjust the click volume level if desired. For 11 milliseconds after each click, the microprocessor supervises collection of the amplified and filtered EEG auditory response to the click stimulus.

The BAERCOM microprocessor then compiles the digitized BAER data for each of the 100 stimulus-response sets (we refer to these 100-click data compilation passes as "scans"), and then sums this set data with the overall BAER response data received previously. As the scans accumulate in the BAERCOM's working memory, they evolve into a complete BAER signal -- you can actually watch the BAER signal take shape on the graphical display. Also, up to 23 individual BAER data sets can be stored in memory "pages" inside the BAERCOM.

The BAERCOM-PC software rounds out the simple functionality of the BAERCOM system. The BAERCOM unit can send the BAER data through a standard USB cable to your PC, where the BAERCOM-PC software reads it and plots it on the display for easy review. The BAER test data can now be annotated, saved to a file, printed, and/or moved to the clipboard for other applications to use. Finally, the BAERCOM-PC software can load previously saved BAER data files back into the software for additional review.

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BAERCOM Vision Statement

Our vision for the BAERCOM is a simple, affordable alternative to regional BAER test centers for *basic* animal auditory testing. The BAERCOM was not, and is not, meant to replace the rigorous BAER testing capabilities of the regional centers. Instead, the BAERCOM permits an individual owner, breeder or small veterinary practice (our main customer base) to *screen* for hearing abnormalities. A "positive BAER test," meaning one that shows no hearing impairment, can be clearly evident with the BAERCOM. Should issues with hearing be surfaced by the BAERCOM, these animals can be re-tested at a later date, referred to a regional test center, or both.

The expensive audiological testers at the regional centers usually provide multiple click-stimulus frequency options and a very wide amplitude range. Instruments at the centers often offer "bone stimulation" capabilities, among other things. By contrast, the BAERCOM supplies just one stimulus frequency option, a simple wideband click with an adjustable amplitude (SPL) up to about 80 dB. Also for simplicity's sake, the gain and pass band of the BAERCOM EEG signal conditioner are fixed.

The magnitude of the BAER response from your subject depends on how many "scans" (sets of 100 data collection passes) you allow the BAERCOM to make before you stop the test. For most small animals, 20 scans are usually sufficient to distinguish a positive BAER outcome.

The BAERCOM unit is packaged in a durable ABS plastic case just 1.4" x 5" x 7" in size (35mm x 125mm x 180mm). It features an easy-to-read LCD display, and storage capacity for up to 23 separate BAER tests in internal memory. A 9V alkaline battery provides the power, making the BAERCOM truly portable. A standard USB connection simplifies interfacing to a PC computer for later data retrieval and printing.

These features permit animal hearing evaluation and research in locations where more expensive testers would be impractical or even impossible. A few of our outback customers in Australia, hundreds of miles from testing centers, offer an extreme example of situations where the BAERCOM is invaluable.

Simple, portable, affordable animal hearing screening – that's the BAERCOM!

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How to use these instructions

How should you use these instructions? Before doing <u>anything</u> with the BAERCOM, you should block out a 2-3 hour period of undistracted time to carefully read through this instruction manual, start to finish. The BAER process is complex. Acquiring a good EEG signal is challenging on a good day, requiring substantial attention to details. The BAERCOM is a totally new instrument to you, and you will need to develop new skills or hone existing ones to master its use.   And your task is to determine if the squiggles you see are noise from electrode issues, or are the correct BAER peaks and valleys. And you need to develop a totally new work-flow within your practice to accommodate the BAER testing process. Carefully taking in the details in these instructions will go a long way to help you to quickly be able to use the BAERCOM effectively.

These instructions are intended to follow a natural progression from exploring the scientific phenomenon being evaluated (the BAER signal in the animal's EEG, section 1), to the use of the BAERCOM unit by itself (section 2) to observe this phenomenon, followed by installation (section 3) and a discussion of the BAERCOM-PC software that extends the capabilities of the BAERCOM system (section 4). All these details are pulled together in the last section (5) where two different overall approaches are supplied to familiarize you with the use of the BAERCOM.

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Section 1: An Introduction to the BAER Process

By: D. Colette Williams, PhD candidate
        Veterinary Medical Teaching Hospital
        University of California, Davis

In the late 1960s, Jewett used signal averaging to record the brain electrical activity that resulted from auditory stimulation in felines.[1] A series of positive peaks were identified and attempts were made to correlate these with specific anatomic structures. Further studies led to this generally accepted model (Figure 1).

Commonly referred to as the Brainstem Auditory Evoked Response (BAER) test, in some publications the R is replaced by a P (for Potential). Other aliases include, ABR and BSER. The peaks are designated by Roman numerals but their appearance varies with electrode placement.[2] In most of the veterinary literature there is agreement on peaks I, V, V_N (a trough appearing after peak V), as well as, VI and VII (when present), but there are some discrepancies in the labeling of the remaining peaks.[3]

In veterinary medicine, the BAER is most often used to screen dogs for congenital deafness. Numerous breeds are at risk for this disorder and in the vast majority it is related to coat color, or lack thereof.[a,b] It is a sensorineural deafness which results from cochlear hair cell degeneration. On BAER all peaks should be present and at the appropriate latencies upon testing of ears deemed normal while those considered deaf should have flat tracings (Figure 2). On occasion, there may be residual hearing in some young puppies which will appear as small, late peaks. These are thought to represent a degenerative process that is not quite complete. Retesting a few weeks later will usually result in flat tracings.[4] In rare cases, results may not be clear cut. BAERs may be asymmetrical when comparing ears or both may be abnormal for no apparent reason.

The BAER can also be used to examine hearing in patients suspected of having conductive deafness. Debris in the canal, thickening or perforation of the tympanic membrane, sclerosis of an ossicle or fluid in the middle ear can result in this condition. On BAER this is demonstrated by decreased amplitudes and prolonged latencies (if severe, they may be flat). If this is the case, repeating the test with increased stimulus intensities should result in improvements in the BAER (higher amplitudes and shorter latencies). Fortunately, many cases of conductive deafness can be treated, so the prognosis of return of function is often favorable, in contrast to sensorineural deafness which is incurable. Some medications are ototoxic and can cause sensorineural deafness if they reach the inner ear.

Presbycusis is an age-related deafness that is seen in older dogs. Primarily considered a sensorineural deafness, in some dogs it may also have a conductive component so BAER results can vary.

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A few other uses for the BAER are to help differentiate peripheral from central vestibular disease and to test brainstem function in comatose patients (though it is important to keep in mind that many insults can result in cochlear hair cell death so if no peaks are present, it won't provide this information).

In canines, the variability in the size of the cranial vault and the thickness of the temporalis muscle will impact the appearance of the BAER. The BAERCOM's MEDIUM resolution setting is ideal for most patients but in some small and/or young dogs for optimal peak amplitudes it may be necessary to use LOW (less gain), whereas HIGH (more gain) is often better for large adults. In contrast, peak latencies, the time (in milliseconds) at which each peak appears, tend to be fairly similar with the exception of very large breed dogs (i.e. Great Danes), where they are delayed. Publications give reference values for normal dogs but when comparing data it is important to note the method of stimulus delivery. In some makes of insert earphones, a length of tubing separates the sound source from the site of delivery, this results in about a 1 msec delay in all peak latencies when compared to data acquired via headphones or other types of earphones, such as those included with the BAERCOM, where the sound generator is positioned near the external auditory canal. Subtle changes in latency are difficult to see on the small BAERCOM screen but can be better appreciated after downloading the data to a PC. With printouts, the latency values can be calculated using a ruler to measure the distance to each peak and dividing that value by the distance between a pair of msec marks on the x-axis (i.e. for wave I in Figure 2 it is 18.5 mm X 1 msec/11.5 mm = 1.61 msec). Exact measurements of peak latencies and interpeak intervals are helpful when trying to assess brainstem function in vestibular or cerebellar disease cases.

One condition that is necessary for obtaining a diagnostic BAER is patient cooperation. Good electrode and earphone placement is critical. Movement and muscle artifact can sometimes appear similar to the peaks of a BAER, leading to a false positive or it can interfere with detection of the BAER, resulting in a false negative. Thus, it is important to get recordings that are fairly free of artifact. In most cases, this can be accomplished without the use of sedation. Getting the dog to relax to the point of sleeping through the procedure is ideal. Some litters of puppies can even be tested while curled up with their littermates in an exercise pen. For cases that are undergoing additional diagnostics (i.e., imaging, CSF tap, etc.), the BAER can be done while the patient is under general anesthesia. Duplicate recordings for each ear should always be performed to insure that the results are reproducible. This is an OFA requirement for all dogs entered in the congenital deafness registry.[c] Additional tests with increased stimulus intensities are recommended if abnormalities are found on routine examination. In some cases repeat tests at a later date may be warranted.

At this time the BAER is considered the gold standard for hearing testing in veterinary medicine. When performed correctly, it is a reliable test that breeders can use to help them try to reduce the incidence of congenital deafness in their breeds.[4] It also has other uses, though the limited capabilities of the BAERCOM unit make it less practical in these applications where subtle changes are the key to detection of neurological abnormalities.

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FAR-FIELD RECORDING OF AUDITORY BRAIN STEM RESPONSES
LATENCIES MEASURED IN HUMAN SUBJECTS
PROPOSED FUNCTIONAL– ANATOMICAL CORRELATIONS
CHART 5
EEG SERIES
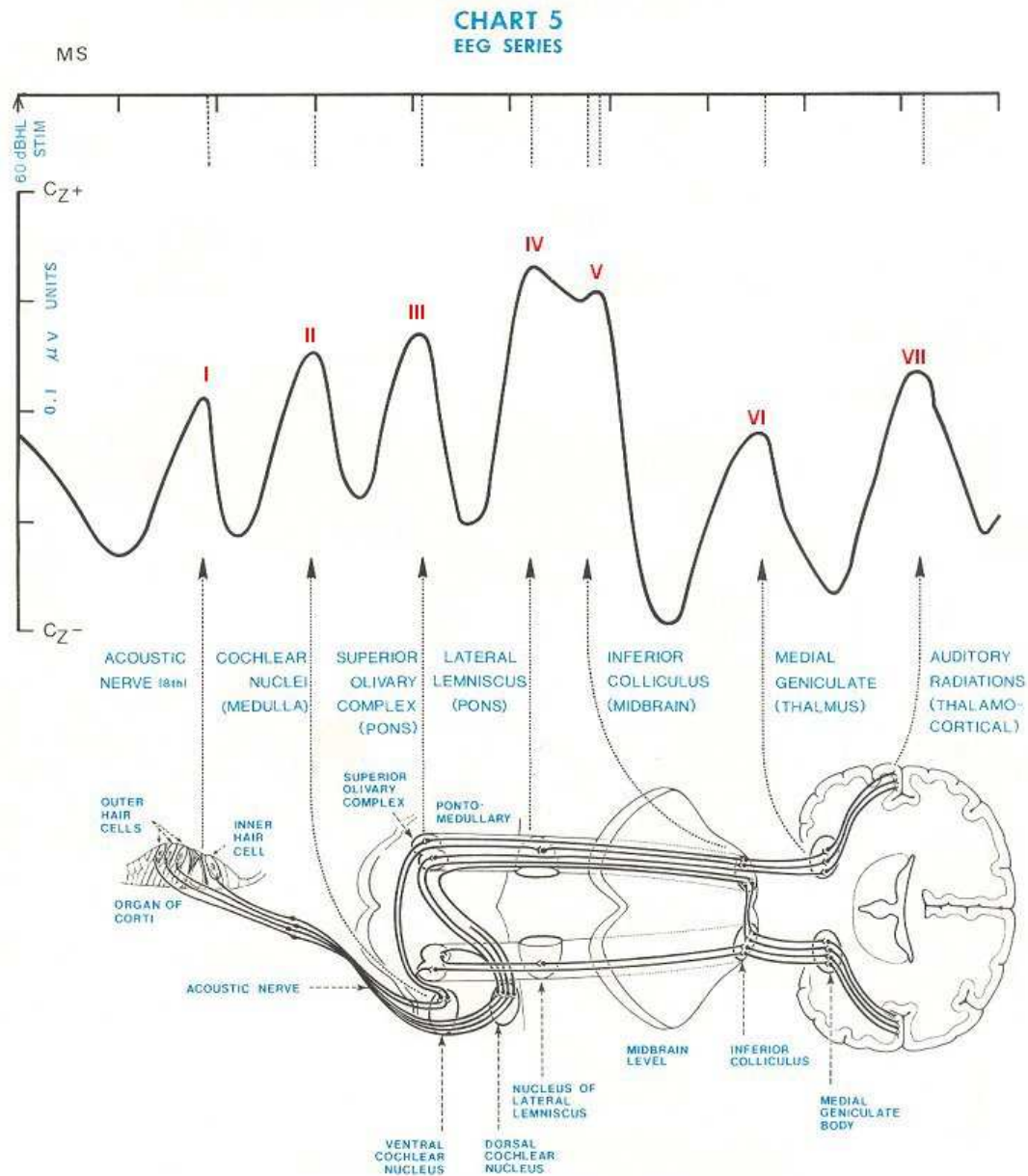
Figure 1 - diagram of the proposed generators of BAER peaks. From Stockard JJ, Stockard JE and Sharbrough FW. *Mayo Clin Proc* 52:761-769, 1977, used with permission.

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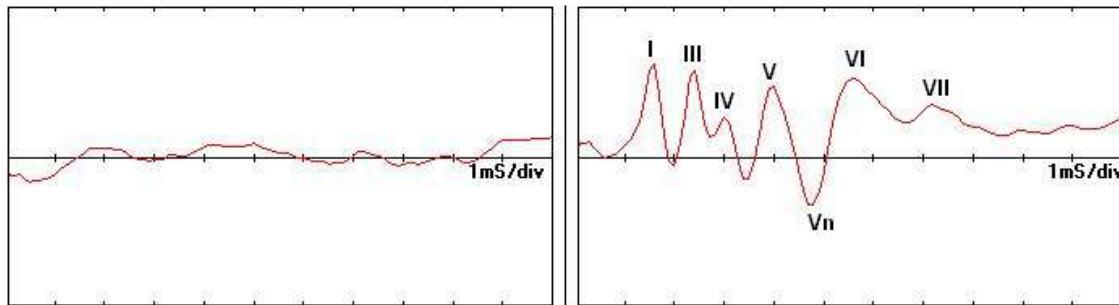
Figure 2

Figure 2 – BAER results from a six year old unilaterally deaf Australian Cattle Dog. Peak labeling is consistent with that outlined in reference 2.

[a] http://www.lsu.edu/deafness/deaf.htm

[b] http://bowlingsite.mcf.com/Genetics/ColorGen.htm

[c] http://www.offa.org/deafinfo.html

1. Jewett DL, Volume-conducted potentials in response to auditory stimuli as detected by averaging in the cat. *Electroencephogr. Clin. Neurophysiol.,* 28:609-618, 1970.

2. Holliday TA, TeSelle ME, Brain stem auditory-evoked potentials of dogs: wave forms and effects of recording electrode positions. *Am J Vet Res* 46(4): 845-851, 1985.

3. Kawasaki Y and Inada S, Peaks of brainstem auditory evoked potentials in dogs. *Vet Res Comm* 18:383-396, 1994.

4. Holliday TA, Nelson HJ, Williams DC, Willits N. Unilateral and bilateral brainstem auditory-evoked response abnormalities in 900 Dalmatian dogs in the *J Vet Intern Med* 6(3):166-174, 1992.

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Section 2: Using the BAERCOM Unit by itself

2.0 🐏 Using the BAERCOM unit

The "Brain-stem Auditory Evoked Response" (BAER) signal shows up as a sub-microvolt signal during the first 10-15 milliseconds after an audio "click" stimulus is presented to the ear under test. This small signal is superimposed on a fairly random background EEG signal. The EEG/BAER signal is normally taken from active electrodes placed at the top of the head and near the ear under test, with a reference electrode placed adjacent to the other ear.

As discussed in the "Overview" above, the BAERCOM is a microprocessor-based data collection and reduction module that is specifically configured to record the EEG/BAER signal. The BAERCOM includes the circuits needed to generate the click stimulus; present it to the ear; collect, amplify, and filter the EEG/BAER response, and digitally sample it. EEG data from multiple passes are rapidly collected and summed together, and the resulting BAER data are plotted on an LCD display. BAER data can also be sent to a PC through one of the computer's USB ports. The computer need not (and probably should not) be connected during BAER data collection, and up to 23 compiled BAER data sets can be stored in BAERCOM internal memory.

Note: As mentioned above, these instructions repeatedly use the designations **right** and **left**. You can understand these directions as viewed from either the front of the animal, or from the back of the animal. **Whatever approach you choose, use it** *consistently*.

2.1 🐕 BAERCOM block diagram and theory of operation

Every effort has been made to keep the BAERCOM circuitry as simple and compact as possible. Figure 1 shows a block diagram for the BAERCOM, and the general function of each block is discussed in the following sections.
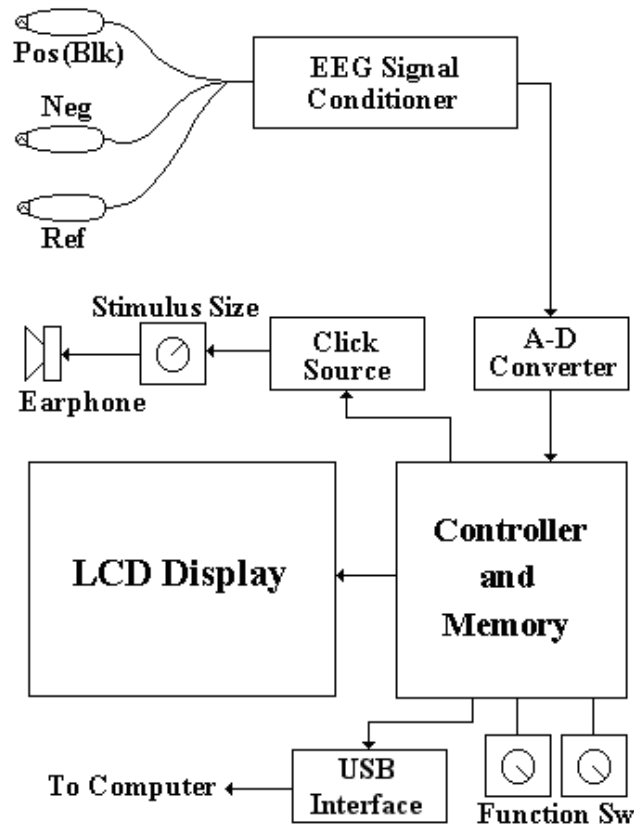
Figure 1. BAERCOM™ block diagram

2.1.1 🐎 Click source and earphone

In order to collect the BAER response, an audio "click" must be presented to the ear under test. The click source circuit generates this signal, and is precisely timed by the controller. You can also adjust the **"click" stimulus size** control on the BAERCOM front panel to set the amplitude of the click signal, which is calibrated in dB. We have found that a setting of between 60 and 70 dB is generally sufficient to produce a good BAER response. The click signal is supplied to the three-pin "**out**" connector on the left side of the BAERCOM bottom panel.

The **earphone**, which plugs into this connector and is inserted into the subject's ear canal, converts the electronic click signal into an acoustic stimulus. The earphone ends in a soft plastic cone to help contain the click within the ear canal.

2.1.2   🐕   EEG input assembly

The EEG signal is normally measured using two "active" connections (positive and negative), with a third Reference connection. This means that 3 connections / electrodes are required on the subject for a single EEG channel. In order to minimize the number of electrodes placed on the animal, the BAERCOM uses just 3 connections for BOTH ears / channels. While not shown in the above block diagram, the BAERCOM does this by allowing you to switch two of the 3 EEG channel connections between a Reference connection and an Active Input connection.

The BAERCOM EEG **Input Assembly** has a four-pin plug on one end and a molded plastic block with three labeled and color-coded **safety jacks** on the other end. The jacks can be used with either alligator-clip leads connected to disposable hypodermic needles as electrodes, or reusable needle electrodes. (See Section 2.3.2.)

The BAERCOM ships with a matching set of three, 8-inch (20cm) alligator-clip leads plugged into the safety jacks. The plastic covers for these clips are also color-coded. ***Make sure the cover color of each alligator-clip lead matches the color shown on the label fastened to the molded block.***

An Ear Select toggle switch (mentioned above), is labeled "**ear left/right**" and placed on the right side of the BAERCOM bottom panel. This switch permits you to select the desired ear to test, and routes the EEG Inputs and Reference connections accordingly, based on the position of this switch. For valid connections, you must place the alligator clips on the ***disposable*** needles as follows:

- ***Black clip*** on (positive) needle on the ***crown (top)*** of head;
- ***Yellow clip*** on (negative/reference) needle near ***left ear***.
- ***Red clip*** on (negative/reference) needle near ***right ear***;

Note that three ***reusable*** needle electrode leads are also included with your BAERCOM. Since these needle electrodes are re-usable, they should be sterilized between each use. The needles at the ends of these leads are placed on the subject as discussed in Section 2.3.2.2, and are similar to the connections indicated above, except that the color of the ***reusable*** needle electrode leads **may or may not** match the colors shown on the molded block label. ***Rather than go by the lead colors***, make sure each reusable needle lead connects the proper safety jack to the proper electrode ***location*** on the animal. Electrode locations are marked near each safety jack on the molded block label. See section 2.3.2 for more information about this.

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Note that the [a] placement and connection of the electrodes, the [b] setting of the Ear Select switch, and the [c] placement of the Earphone in the Ear Canal, MUST ALL AGREE in order to correctly sense the BAER signal for the specific ear being tested!!!

2.1.3   🐕   Internal circuits

The EEG signal conditioner block substantially amplifies the very low level EEG signal and also filters it using characteristics that favor the BAER response frequencies and minimize others. In the next block, the A-D converter transforms the analog EEG/BAER signal into digital data at very high speed. This conversion process is carefully timed to output digital data during the entire 11 milliseconds – one pass **--** following the start of each stimulus click.

The microcontroller triggers the audio click and supervises high speed collection of the evoked EEG/BAER response data. The microcontroller also averages together (compiles) successive EEG/BAER data passes to generate the BAER plot. The controller outputs the BAER data that is plotted on the LCD display and can also transmit it to your PC through the BAERCOM USB connector. The controller also manages the optional saving of BAER data sets to "pages" in non-volatile memory inside the BAERCOM.

Finally, the microcontroller scans the three BAERCOM control switches frequently to check for any settings you change. This allows you to control the BAERCOM, for real-time data viewing, data collection and showing, or saving data and reviewing it. Section 2.4 goes over all these functions in detail.

The LCD graphics display permits the BAERCOM to work as a stand-alone instrument. The LCD display can show raw EEG data from the signal conditioner so that you can evaluate initial electrode setup and make adjustments if necessary before you start collecting data. The LCD also shows the BAER data, both during and after the BAER collection process. While the BAERCOM is collecting BAER data, the display updates after every 100 passes (together called a "Scan") to show the cumulative BAER response of all passes so far. You can also view previously recorded BAER data sets on the LCD as well. The LCD also posts various text messages that allow you to interact with the BAERCOM unit and manage the data saving process. (Note that the BAERCOM-PC program can significantly extend the capabilities of the BAERCOM system, see sections 3 and 4 for more information.)

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2.2 🐏 BAERCOM battery, controls, connectors and display

The case and control layout of the BAERCOM was designed with ease of use in mind. A simplified drawing of the BAERCOM case is shown in Figure 2 below, and the location and function of each item is then discussed.
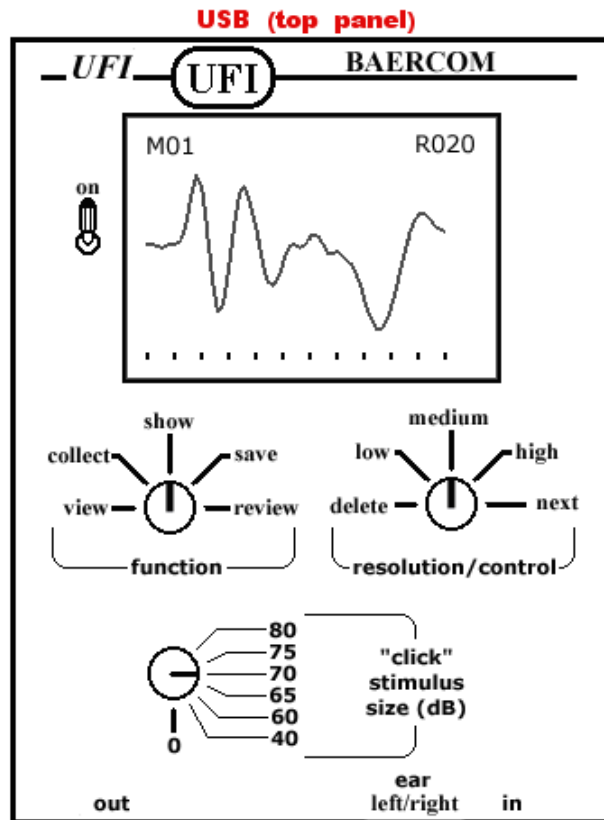
Figure 2. BAERCOM™ case front panel (simplified)

2.2.1 🐏 Battery pocket and battery replacement

A "battery pocket" is inset into the back panel of the BAERCOM. You can open the pocket by locating the short side of the cover door with the 3 raised ribs, and pulling this end of the door AWAY from the BAERCOM back panel. Once freed, the cover should swing open revealing the 9V battery.

The BAERCOM checks the battery level whenever you change the **Function Switch** position. When the level of the battery drops below about 6.0 volts, the BAERCOM stops operation and posts a "Low Battery" message on the display.

Follow this procedure to replace the BAERCOM 9V battery.

1. Be sure the BAERCOM **power switch** is turned to OFF.

2. Carefully turn the BAERCOM face down, locate the door to the **battery compartment** on the back panel, then pull the short edge with the 3 raised ribs away from the back panel to uncover the battery.

3. Hook a fingernail or other pointed object under the edge of the battery and gently pull it out of the compartment with the snap connector still attached. (If you carefully and briefly turn the BAERCOM face up the battery will often fall out on its own.)

4. Unsnap the connector from the battery by placing your thumb on a long side of the connector, then pressing the connector away from the top of the battery. **DO *NOT* REMOVE THE BATTERY CONNECTOR BY PULLING ON THE WIRES!**

5. Snap a fresh, *good quality* 9-volt alkaline battery (Duracell MN1604 or equivalent) to the connector. (Many batteries marked "Heavy Duty" have significantly less power capacity than the MN-1604, and will not last as long.) Carefully rotate the battery if necessary so that the snaps on both connectors will mate (small to large) then push the connector onto the battery.

6. Insert the new battery with connector back into the battery compartment, making sure that the battery lead is able to lay flat along the floor of the battery pocket, and is NOT all bunched up at one end. The wired side of the connector will be facing down.

7. Snap the battery door closed, making sure no wires are pinched as you do so.

2.2.2 🐎 BAERCOM Control Switches

Three rotary switches and two toggle switches allow the user to interact with and control the BAERCOM. The following five sections outline the use of these controls.

2.2.2.1 🐎 Power Switch

The BAERCOM power switch is a "locking toggle" switch located on the front panel to the left of the BAERCOM display. The shaft of this switch must be pulled *away* from the BAERCOM front panel in order to toggle the switch from one position to the other. This locking mechanism prevents accidentally turning the power on or off. Toggling the switch *up* turns the BAERCOM *on*.

2.2.2.2 🐎 Function Switch

The BAERCOM **Function Switch,** on the left side of the front panel below the LCD display, allows you to choose one of the five BAERCOM main *functions*. These functions are as follows:

- **VIEW:** The BAERCOM continuously plots the raw EEG signal acquired by the BAERCOM with no audio stimulation. The simple "scope" display with this function lets you evaluate the electrode connections and make changes if needed.

- **COLLECT:** The BAERCOM generates audio clicks and collects EEG data for 11 milliseconds following the start of each click. BAER data from each 100 passes are rapidly compiled into scans, summed with previous data, and plotted. The ear being tested, as well as the number of scans so far, is shown in the upper right corner of the display. The COLLECT function allows plots to be made with three vertical resolutions; low, medium and high, selected with the **Resolution/Control Switch** (next section), but we recommend using medium for data collection.

- **SHOW:** The BAERCOM stops collecting and plots the cumulative compiled BAER data. You can choose different screen resolutions with the Resolution/Control Switch in SHOW, too. BAER data is also sent to the host PC through the BAERCOM USB connector during the SHOW function.

- **SAVE:** When you move the Function Switch from SHOW to SAVE, you can place the compiled BAER data as shown on the display into BAERCOM internal memory. Up to 23 such BAER data sets may be saved in "pages" in internal memory for later reference and/or downloading.

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- **REVIEW:** This function allows you to move BAER data sets already stored inside the BAERCOM back to the BAERCOM LCD for further evaluation or downloading. Stored data sets can be erased as well as displayed using REVIEW.

2.2.2.3 🐐 Resolution/Control (R/C) Switch

The operation of this secondary control switch, located on the right side of the front panel below the LCD display, depends on the Function Switch position:

- **VIEW:** The R/C Switch is inactive.

- **COLLECT and SHOW:** Use the R/C Switch to select the plot display resolution, LOW, MEDIUM, or HIGH. Other R/C switch settings are inactive while the Function Switch is set to COLLECT or SHOW.

- **SAVE and REVIEW:** Use the R/C Switch in saving BAER plots, navigating through saved plots and for deleting plots.

2.2.2.4 🐐 "Click" Stimulus Size Switch

Located at bottom left of the front panel, this control sets the click amplitude (audio volume) level. Levels include 0 dB (no click), 40 dB, and then range from 60to 80 dB in 5 dB increments. You can generally start with 70 dB and then adjust as needed to start "growing" a discernible BAER plot.

2.2.2.5 🐐 Ear Select Switch

Located toward the right end of the bottom panel, this switch connects the electrode leads on the animal to the proper EEG signal conditioner inputs for the ear being tested. This switch also tells the BAERCOM which ear is currently being tested, information that is added to saved BAER data sets.

2.2.3 🐕 Connectors

The BAERCOM is equipped with three connectors, two that support the BAERCOM unit itself and one for connection to your computer. The next three sections describe connector use.

Both the "**in**" and "**out**" connectors use the Switchcraft EN3 family of keyed, locking connectors. These connectors require proper alignment of both the key-way and (usually) the locking collar, before full insertion can be made. Pulling on the leads during connector removal can damage the connector wiring, and so should be avoided. Note also that for older BAERCOMs, the key-way was <u>towards</u> the BAERCOM front panel, and for current BAERCOMs the key-way is <u>away from</u> the BAERCOM front panel.

2.2.3.1 🐕 Input Assembly connector

The *four-pin* "**in**" **connector** for the Input Assembly is located on the right side of the BAERCOM bottom panel. The mating and locking plug on the end of the EEG Input Assembly should be inserted here.

A key on the input assembly plug requires proper orientation before the plug can be inserted into the "**in**" jack. The *collar* on this *four-pin* plug must also be rotated properly before the plug will insert fully into the jack. Once fully inserted, rotate the collar *clock-wise to lock* the plug into the jack. Rotate the collar *counter-clockwise to release* the plug.

2.2.3.2 🐕 Earphone output connector

The *three-pin* "**out**" **connector**, located on the left side of the bottom panel, accepts the *three-pin* plug on the earphone. Insert, lock and release this plug as described above for the Input Assembly plug.

2.2.3.3 🐕 USB connection to computer

The standard **USB jack** is located roughly centered on the BAERCOM *top* panel. This jack allows you to connect the BAERCOM to a PC USB port using the standard **USB cable** provided. The BAERCOM supplies BAER data via USB to the host PC whenever the SHOW or REVIEW function is selected.

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The BAERCOM incorporates an industry-standard digital isolator -- the Analog Devices ADuM-1201 -- between the microcontroller and the USB interface. With a maximum rated isolation voltage of 2500 VACRMS, this isolator can enhance animal safety. This isolation can also help minimize PC and power line noise injected into the EEG signal conditioner when the BAERCOM is used while connected to a PC. Note that, in order to maximize this isolation capability, please try to keep the USB cable away from the animal, other BAERCOM cables, and the BAERCOM unit itself.

However, as mentioned above, we still **recommend** that you always **disconnect** the BAERCOM from the PC computer (by disconnecting the USB cable from the USB connector on the top panel of the BAERCOM) before actually collecting BAER data from an animal. The gain of the EEG signal conditioner in the BAERCOM is very high, and power supplies (especially external supplies used with Notebook computers) can introduce a substantial amount of electrical interference, that can easily distort or mask the actual EEG/BAER signal that the BAERCOM is designed to measure.

🐕 LCD Display

The BAERCOM graphical LCD display is prominent in the top half of the front panel. The display shows BAER data both as it is being compiled and as completed BAER plots. The character posting in the upper right of the display indicates the ear tested as well as the number of scans (sets of 100 passes) the plot represents. The character posting in the upper left of the display shows what internal memory "page" the data will be saved to, should you direct the BAERCOM to save the compiled BAER data. Tick marks along the bottom of the display mark off one-millisecond intervals in the evoked response plot.

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2.3   🐕   Connecting the BAERCOM to your subject

In order to acquire good BAER data, you must carefully and conscientiously establish two good quality communications channels between the BAERCOM and the animal you are testing: one for the audio stimulus (supplied by the earphone), and one for the tiny EEG response sensed by the electrodes and connected to the BAERCOM EEG signal conditioner by the Input Assembly.

Note that the [a] placement and connection of the electrodes, the [b] setting of the Ear Select switch, and the [c] placement of the Earphone in the Ear Canal, MUST ALL AGREE in order to correctly sense the BAER signal for the specific ear being tested!!!

2.3.1 🐕   Earphone insertion

The BAERCOM delivers the audio stimulus to the animal's ear with a small earphone. Inserting the Earphone is easy:

1. Gently push the soft, clear plastic Earphone tip deep into the ear you wish to test. Try to ***seal the ear canal completely with the tip*** during actual BAER data collection so the clicking sound does not leak out and cause the subject's other ear to respond as well.

2. Plug the Earphone lead connector into the matching three pin "**out**" jack on the left side of the bottom panel of the BAERCOM.

2.3.2 🐕   Electrode connection

***Mastering the information and techniques in this section
are a crucial part of the successful use of the BAERCOM,
or any other BAER instrument!***

The BAER response is generated by both the ear and the brain, and appears in the subject's EEG signal in the first approximately ten milliseconds after the click stimulus. The BAER response is *very* small, less than one microvolt, and so must be sampled repeatedly in order to build up a detectable response.

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In addition, the BAERCOM's EEG signal conditioner is configured to **greatly amplify** this signal, and in the process, will also greatly amplify any **unwanted** electrical noise as well.

*The **ONLY WAY** to minimize unwanted electrical noise and interference is to use some type of "needle" electrode, placed "subcutaneously", i.e. under the skin, in direct contact with the "live tissue" underneath the skin.* **Failure to achieve a good quality sub-cutaneous "live tissue" connection for all 3 electrode connections can result in noisy or otherwise indistinct BAER data !!!**

(Note that the skin of animals is substantially less sensitive than human skin, and so the use of needle electrodes is not as much of a "bother", so carefully make sure that each needle extends into the sub-cutaneous, live tissue. Even though light sedation may be required on some animals, careful and calming animal handling is usually sufficient to allow collection of the BAER data from most animals.)

There are two common, readily available means to achieve the required sub-cutaneous connection. One approach is to use the small stainless steel needles used with hypodermic syringes. A simple "Alligator Clip" connector then makes the required electrical connection with the needle shaft. The other approach involves the use of actual "Needle Electrodes" specifically built for sub-cutaneous use. These electrodes already have an attached lead that takes care of the electrical connection. Either way works well, and the instructions below cover both

Note that the detailed connection instructions that follow cover two key aspects: the **quality** of the sub-cutaneous connection to "live tissue", as well as the correct **signal routing** required for correctly connecting electrodes to the proper inputs of the BAERCOM. **BOTH** aspects are crucial for the proper use of the BAERCOM!!!

Correct **signal routing** for the 3 BAERCOM input connections should begin with the three **safety jacks** on the Input Assembly molded block. The text labeling of the 3 jacks is both color-coded and descriptive to show where on the subject each of the electrodes should be connected.

- The top jack is marked **CROWN** (in *black* lettering, which corresponds to the *black* alligator clip) and should be connected to the electrode on the **TOP** of the animal's head.

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- The middle jack is marked **LEFT** (in *yellow* lettering, which corresponds to the *yellow* alligator clip) and should be connected to the electrode next to the animal's **LEFT** ear.

- The bottom jack is marked **RIGHT** (with *red* lettering, which corresponds to the *red* alligator clip) and should be connected to the electrode next to the animal's **RIGHT** ear.

As indicated, the "Crown" electrode should be placed at the top of the animal's head. The two electrodes adjacent to the Ears should be placed where convenient directly below the Ear Canal, at approximately the level of the bottom of the flap of loose skin that is normally referred to as the "Ear". (As pointed out previously, you need to decide what Right and Left actually means; front view or back view, just be consistent!)

As mentioned above, the BAERCOM Input Assembly can be used with the two most common types of needle electrodes:

- *Disposable hypodermic needles (see Section 2.3.2.1)*
A set of 8-inch safety jack leads is provided with your BAERCOM. Each lead has a color-coded alligator clip on one end that clips securely to a standard *stainless steel* hypodermic needle placed on the subject. Hypodermic needles are very common, and most are disposable, so sterilization is not a concern.

- *Reusable needle electrodes (see Section 2.3.2.2)*
Your BAERCOM comes with a set of three reusable needle electrode leads as well. The needle electrodes at the ends of these leads are a smaller gauge (diameter) than most hypodermic needles, so animals may tolerate them better. In addition, if you do a lot of BAER testing, the reusable electrodes may prove more cost effective than disposable hypodermic needles. However, needle electrodes *must be sterilized* between each use.
As mentioned in Section 2.1.2, the reusable electrode lead colors **may or may not match** the colors shown on the molded jacks, so extra care is necessary to make sure the electrode leads are properly connected to the correct locations on the animal!

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As already discussed, we have designed the BAERCOM with a 3 electrode connection in mind, in order to minimize the number of electrodes that need to be placed on the animal. This approach involves using the electrode for the ear *not* being tested as the reference for the EEG signal generated by the ear under test. The BAERCOM has a switch on the bottom panel (Ear Select switch) to correctly connect the electrode from the ear not being tested to the reference input of the amplifier.

Whichever electrode type is used, carefully follow the guidelines discussed below. ***This aspect of the BAERCOM connection process is very important!***

2.3.2.1 🐎 Disposable hypodermic needle use

Disposable stainless steel hypodermic needles are commonly available and have been found to work well with the BAERCOM. When BAER testing on a particular animal is finished, the needles can simply be removed and thrown away and a new set used for the next subject. We recommend using these electrodes at first. Follow these steps to use disposable hypodermic needles as the electrodes for the BAERCOM.

1. Plug the three color-coded alligator clip leads – black, yellow and red – into the correct jack on the Input Assembly molded block labeled with the matching color.

2. Gently "bunch" the animal's skin at the desired electrode site, then insert the first of the three needles <u>subcutaneously</u> through the skin fold so that 1/4" to 3/8" (6mm to 10mm) of the needle's length protrudes out the other side (Figure 3). **MAKE SURE** that the needle goes **BELOW** the skin tissue to allow the needle to contact the sub-cutaneous "live tissue" under the skin!
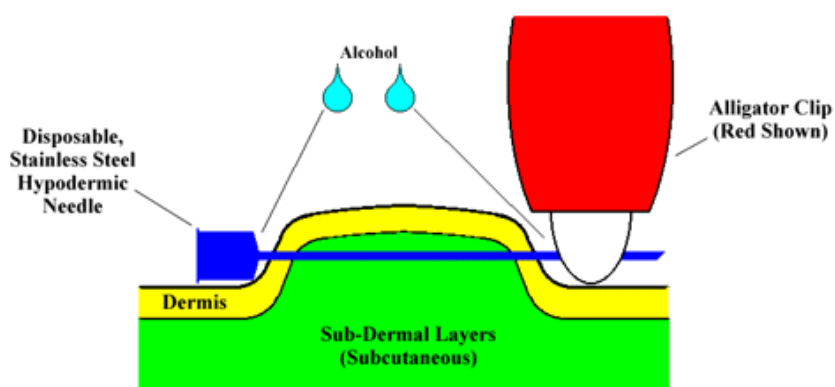

Figure 3. Electrode insertion using disposable hypodermic needle

3. Fasten the correct alligator clip over the exposed, *pointed* end of the needle. This approach provides a fairly secure mechanical attachment, as well as a good electrical connection. ***Be sure the alligator clip color corresponds to the correct electrode location on your animal***.

4. Place a couple drops of alcohol on the exposed ends of the needle, using a cotton ball, to improve signal quality and further disinfect the needle site.

5. Repeat Steps 2 through 4 for the other two electrodes.

2.3.2.2 🐎 Reusable needle electrode use

Your BAERCOM includes three <u>reusable</u> stainless steel needle electrodes on leads. Each electrode lead has a plug to allow insertion into one of the three jacks on the Input Assembly molded block. If you need to test a large number of subjects, reusable needle electrodes may be a more cost-effective approach than disposable ones.

As opposed to the method using disposable electrodes, reusable electrodes offer *no mechanical means to hold the needles under the skin*. Subject motion can easily dislodge electrodes, so you may need to anchor the Input Assembly molded block to the animal to keep it from pulling the electrodes out.

For this reason, we recommend that at first, you use disposable hypodermic needles with the alligator clips. Once you have come up to speed with the use of the BAERCOM, you can then switch to Needle electrodes, and work through the issues they bring.

REUSABLE NEEDLE ELECTRODES MUST BE STERILIZED BETWEEN ANIMALS.

Follow these steps to place and connect reusable needle electrodes:

1. Gently "bunch" the animal's skin at the desired site, then insert the needle electrode <u>subcutaneously</u> into the skin fold. As opposed to the disposable needle method, ***do not push the needle out the other side of the bunched skin*** (Figure 4). However, you must still **MAKE SURE** that the needle goes **BELOW** the skin tissue to allow the needle to contact the sub-cutaneous "live tissue" under the skin!
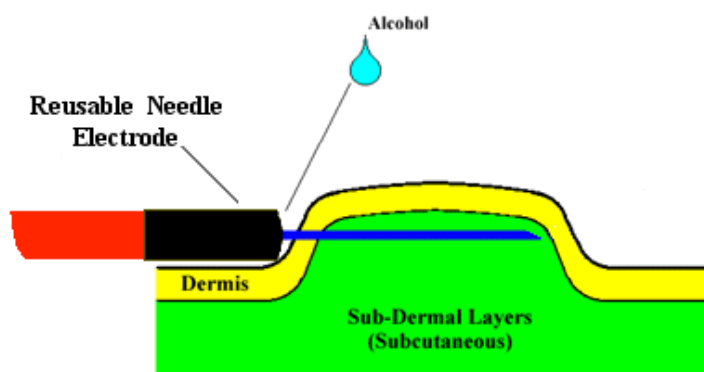
[Illustration on next page]

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Figure 4. Electrode insertion using reusable needle electrode

2. Plug the electrode lead into the appropriate jack on the Input Assembly block.

MAKE SURE TO CORRELATE THE *LOCATION NAMES — "CROWN," "LEFT," AND "RIGHT" -- ON THE MOLDED INPUT ASSEMBLY LABEL* **WITH THE PROPER SUBJECT LOCATIONS. *REUSABLE ELECTRODE LEADS THEMSELVES MAY OR MAY* NOT *BE CORRECTLY COLOR-CODED.***

3. Place a couple drops of alcohol on the exposed portion of the electrode, using a cotton ball, to improve signal quality and further disinfect the needle site.

4. Repeat Steps 1 through 3 for each of the other electrodes.

Note that "Reusable" electrodes will not last indefinitely, but will need to be both carefully inspected, and if necessary replaced, at regular intervals. Normal use will slowly erode the needle body, and repeated bending can weaken the needle causing breakage, so this should be avoided. Exercise care when using the thinner Needle electrodes, and inspect them frequently for signs of excessive wear or cracking, and replace them as required. You can purchase replacement needles from UFI, so contact us if you need more.

2.3.2.3 🐎 Connections and Actual BAER Testing

As mentioned, the BAERCOM incorporates a toggle type **Ear Select switch** on the right end of the bottom panel. This switch ensures that the electrode connections are routed correctly for the ear being tested. ***The Ear Select switch permits the three electrode leads to be connected to the animal just once, then left in place for the duration of BAER testing.***

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In addition to correctly connecting the EEG electrodes on the animal to the correct EEG Inputs of the BAERCOM, the BAERCOM also reads the Ear Select switch setting so the BAERCOM can annotate both the saved BAER data sets, as well as any BAER data set sent to the PC, with the actual EAR being tested.

Also, note that before actually performing BAER testing as described below, you will need to connect the black 4 pin plug at the end of the Input Assembly lead, to the "**in**" connector on the right end of the BAERCOM bottom panel. This connects the electrodes on the animal to the EEG signal conditioner inside the BAERCOM.

The actual mechanics of performing the BAER test with the BAERCOM is discussed in section 2.4 below. However, as an introductory overview, the general procedure for performing a BAER test on both ears of an animal is shown below.

1. Attach your disposable (Section 2.3.2.1) or reusable (Section 2.3.2.2) electrodes to the subject using the connections/locations specified below and shown in Figure 5:

Disposable electrodes	Reusable electrodes	Electrode location
Black alligator clip	Lead from CROWN jack	Crown (top of head)
Red alligator clip	Lead from RIGHT jack	Near right ear
Yellow alligator clip	Lead from LEFT jack	Near left ear

Figure 5. Example electrode placement

2. Connect the black connector at the end of the Input Assembly lead to the "**in**" connector on the right side of the BAERCOM bottom panel.

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3. Insert the earphone (Section 2.3.1) into the ***left ear***, ***then set the Ear Select Switch to the LEFT position***. (The electrode near the right ear acts as a reference; the electrode near the left ear is the active one.)

4. Perform a BAER test on the animal's left ear as described below in Section 2.4. You can start by collecting 15 Scans, and have the Click stimulus size set to 70 dB.

5. Remove the earphone from the left ear, ***insert it into the right ear, then set the Ear Select switch to the RIGHT position***. (The electrode near the right ear becomes the active one, while the electrode near the left ear becomes the reference.)

6. Perform a BAER test on the animal's right ear, again using the same number of Scans and the same Click Stimulus size.

Note that you can easily test and re-test either ear during this process as you wish. However, when you are done testing, you should gently remove the earphone and electrodes from your subject.

2.3.3 🐎   Animal tolerance: some suggestions

We have found that most animals easily tolerate the BAERCOM electrodes and wires. Animal age and past experiences help determine how well the procedure is tolerated. Careful and sensitive handling during BAER testing usually helps calm the animal. However, you may encounter animals that require mild sedation during testing.

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2.4 🐕 Using the BAERCOM to perform BAER testing

Simplicity of use has been an important design goal for the BAERCOM system since its inception. Actual BAERCOM operation can be broken down into the following three main tasks:

- *Collecting and compiling a BAER data plot*
  This important procedure covers the basic BAER data collection and plotting process. The steps included in Section 2.4.1 show this most basic use of the BAERCOM.

- *Saving and reviewing compiled BAER data plots*
  Up to 23 compiled BAER data sets can be stored in "pages" in non-volatile memory *inside* the BAERCOM for review whenever desired. See Section 2.4.2 for more information about saving and reviewing BAER data.

- *Sending compiled BAER data plots to a computer*
  After the BAERCOM has been used to collect a BAER data set, the SHOW function is used to display the resulting BAER data plot. A previously recorded BAER data set can be posted in the SHOW position as well. After the data is displayed, the BAERCOM may be connected to a PC so that the BAERCOM-PC software can be used for data download. And after downloading, you can print, save, or review the BAER data as desired. See Sections 2.4.3 and especially Section 4 for details on the use of the software.

2.4.1 🐕 Collecting and compiling a BAER data plot

After correctly connecting the BAERCOM to an animal (as described in section 2.3 above), there are three basic steps involved in using the BAERCOM to collect a BAER data plot. These three steps correspond to the three major *FUNCTIONS* of the BAERCOM, which in turn map to BAERCOM Function Switch settings.

- *VIEWing* the EEG signal to check the electrode-animal connection
- *COLLECTing* the BAER data through a series of scans
- *SHOWing* the compiled BAER response

If your goal is to actually collect BAER data from an animal at this point, be sure that your BAERCOM is *already* properly connected to an animal as described above.

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2.4.1.1 🐕 VIEW the EEG signal (after power-up)

The VIEW function is provided to allow a basic check of the animal connections and EEG signal path prior to collecting BAER data. Since the VIEW process is likely the first function you will select, this discussion includes the actual "power on" process for the BAERCOM as well.

1. Set the switches on the BAERCOM as follows before turning on the power:
   - Set the **Function Switch**, below the lower left corner of the display, to the VIEW position;
   - Set the **Resolution/Control Switch**, below the lower right corner of the display, to MEDIUM;
   - Set the **Click Stimulus Size Switch,** below the **Function Switch**, to 70 dB;
   - Set the **Ear Select Switch** at the right end of the bottom panel as follows: set to LEFT to check the left ear, and to RIGHT to check the right ear;

2. *Now* power up the BAERCOM by pulling the **Power Switch** handle out to unlock it, then up to the ON position. The following screens appear on the BAERCOM LCD display in sequence, as the BAERCOM boots up:

Startup screen 1

Startup screen 2

Startup screen 3

Startup screen 4

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3. The BAERCOM will now start to plot the EEG signal it is receiving from the animal through the electrodes and Input Assembly. At this point there is no audio stimulus, and the "raw" EEG signal display should resemble Figure 8: a nearly flat line in the center of the display with some noise visible. If the EEG plot looks extremely noisy (large peaks), or has an erratic baseline, recheck all electrodes and connections between the BAERCOM and the animal.
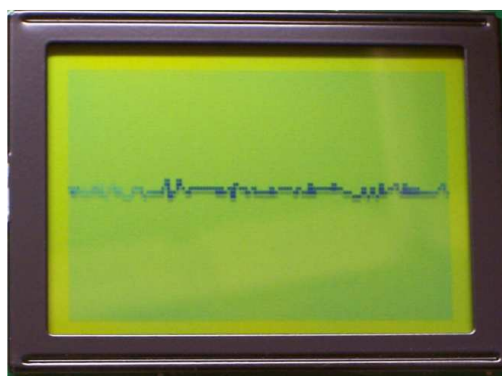

Figure 8. EEG signal while VIEWING

By the way, at this point you may want to check the position of both the Ear Select switch and which ear has the Earphone inserted, just to make sure everything is set up correctly.

Also, note that you can turn the BAERCOM power <u>on</u> with the Function switch set to any position. However, the BAERCOM will post a message prompting you to set the Function switch to VIEW, and will ignore any other switch settings until this is done. This behavior only happens when the BAERCOM is first turned on. You can also turn the BAERCOM function switch to the VIEW position at any point to again re-check the signal, which will interrupt any operation currently in process.

2.4.1.2 🐕 COLLECT the BAER data

Next, set the Function switch to "Collect". The BAERCOM will begin generating the audio stimulus (a staccato clicking sound from the earphone), and then gathering the evoked response in the EEG signal, from the electrodes on the animal. Beginning with the click onset and lasting for the next 11 milliseconds – one **pass** -- the BAERCOM records the subject's EEG response to the Click stimulus. The BAERCOM repeats this stimulus-response cycle 100 times, for one complete **Scan**.

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After each approximately three second Scan, the BAERCOM stops collecting the response data long enough to generate a plot on the display. This plot averages together the *cumulative BAER data for all Scans since the Function Switch was last turned to the COLLECT position.*

Follow this procedure to collect your BAER data:

1. Leave the switches where they were for the VIEW function (Section 2.4.1.1).

2. Turn the **Function Switch** to the COLLECT position. (This may be done not only from VIEW, but from the other switch positions as well.) You will see a display similar to this one.
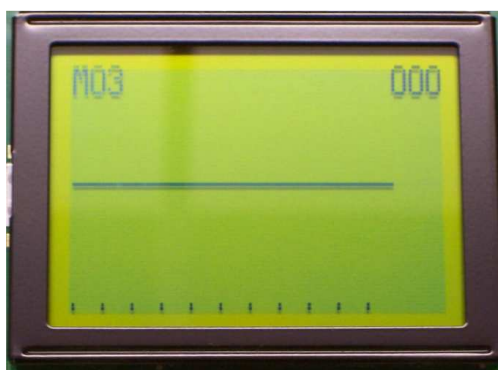

The "M03" in the upper left corner indicates that BAERCOM internal memory Page 3 is the first one available for BAER data set storage out of the total of 23 writable pages. (Page 24 is reserved for sample data from an actual BAER test on a canine subject.)   If you decide to save the data set now being collected (as described in section 2.4.2), it will be stored in Page 3. The "000" in the display's upper right corner indicates that no Scans have been completed yet.

You may hear the clicking sound of the audio stimulus coming faintly from the earphone. If the clicks are loud, check to be sure the earphone is snugly inserted the animal's ear canal, and re-start the testing (View then Collect again). Note that the animal's other ear can respond to the Click as well if it is not very quiet.
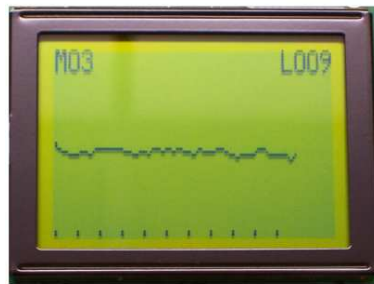
3. As the first Scan of 100 passes is completed, the BAER data from the first Scan will appear on the display (top left image below, where we are assuming that the **Ear Select** switch is set to LEFT). As you continue data collection, you'll see the display evolve as further Scan data are averaged in with the data of the previous display.
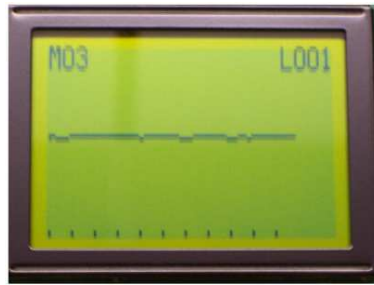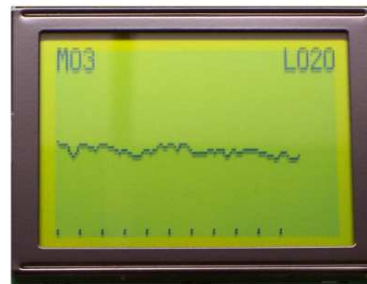

After one scan
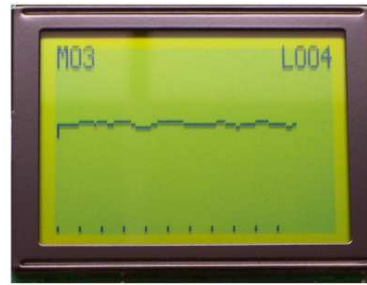
After four scans
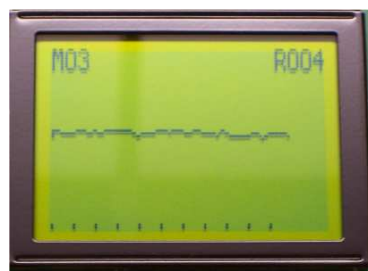

After nine scans

After twenty scans

(Note that there is no animal connected for these samples, we are focusing mainly on the mechanics and activities of the BAERCOM during normal use.)

The BAERCOM continues scanning as long as the Function Switch remains set to COLLECT. The upper limit is 999 scans, or 99,900 total passes. Despite this high capacity, *you can usually discern a BAER response after just 10 to 20 Scans* for small animals.

4. If you had set the **Ear Select Switch** to the RIGHT position rather than to LEFT, you would see a similar evolution of the BAER test data, except that an "R" precedes the three digits showing the number of Scans in the upper right corner, indicating the Right ear is currently being tested.

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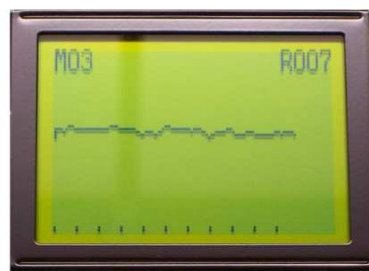
After four scans   **After seven scans**

Note that you should **not** change the position of the Ear Select switch while the function switch is in the "Collect" position. If you realize the switch is set incorrectly, or the Earphone is place incorrectly, simply turn the function switch back to the "View" setting, correct the Ear Select switch setting or Earphone placement, check the resulting VIEW signal, then move the function switch back to "Collect" and start BAER data collection again. (The BAERCOM will allow you to change the Ear Select switch as desired during use, but this will just add incorrect data to the overall summed BAER plot, which makes it invalid, and so should be avoided.)

Also, if, in Step 2 above, "M24" is displayed in the upper left corner, then *all writable BAER memory pages inside the BAERCOM are being used. **While Page 24 is displayed, BAER data cannot be saved to BAERCOM memory** (Section 2.4.2 below). The sample BAER data plot stored in Page 24 *cannot* be erased.

The whole goal of the "Collect" process is to collect BAER data until an easily discernible BAER signal is posted on the BAERCOM LCD display. Assuming that the subject connection is good, and the animal can hear, this should happen after between 10 and 20 Scans for small animals.

2.4.1.3 🐕 SHOW the BAER data

Turning the Function Switch to the SHOW position halts both the audio stimulus and BAER data collection, immediately stopping the Scan that may be in process. The display now simply plots the BAER data averaged from all the complete Scans compiled together up to this point; for your examination, for saving, or for transmission to your PC running the BAERCOM-PC software.

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Using SHOW is very simple:

1. Move the **Function Switch** from the COLLECT to the SHOW position when you can clearly discern the BAER response. As already mentioned, this usually takes 10 to 20 scans for small animals. You should already know what you are looking for; the typical BAER response. The shape of the BAER signal has been discussed in Section 1. In addition, an actual small animal BAER sample tracing is shown in the BAER data in "Page 24" permanently saved in the BAERCOM memory.

2. Earphone clicking stops as soon as the **Function Switch** is turned to SHOW, and the display freezes to show the final BAER data plot. The characters in the upper right corner of the display indicate the **Ear Select** switch setting – L for left or R for right – and the total number of Scans made.

3. In the upper left corner of the display, the characters "M##" begin blinking about once a second to show what memory page will be used to store the BAER data set, if you go on to use the SAVE function (Section 2.4.2).

4. Finally, the BAERCOM USB port begins sending the displayed BAER data to your PC if you have connected the USB cable. (If you don't want or need a printed record of the test, or to save it on your computer, there is no need to connect the BAERCOM to your PC.) The **Ear Select** switch position and number of Scans in the test are sent along with the BAER data shown on the display.

2.4.1.4 🐂 Comments about BAER data collection

The VIEW-COLLECT-SHOW steps encompass the overall BAER data collection process that is at the heart of the functionality that the BAERCOM supplies. This process is typically performed twice, once for the left ear and once for the right ear, and these two BAER tracings together supply an overall understanding of the animal's hearing capability at this point.

a. We indicate that it generally takes between 10 and 20 Scans to collect an easily discernible BAER response from small animals. Your experience with the use of the BAERCOM will give you a better handle on exactly what to expect in this area, across the breeds and animal ages involved in your practice.

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b. You should attempt to use the **SAME** number of Scans and click stimulus size for **BOTH** Left and Right ears as you test each animal. This will make it easier to highlight any hearing abnormalities that you encounter.

c. The BAER signal, and the testing used to display it – is a **REPEATABLE PROCESS**. If, <u>on the one hand,</u> you are unsure of your results, DO NOT HESITATE to repeat the COLLECT-SHOW process. Feel free to check electrodes, leads, and Earphone, then perform the BAER signal collection again, maybe for more Scans than before. <u>On the other hand</u>, if the final plot is substantially different each time you collect BAER data on the same ear, and for the same number of Scans, then it is not the BAER signal you are seeing. You are probably seeing noise, which usually points to problems with the electrodes not all actually making contact with subcutaneous "live tissue".

We recommend "coming up to speed" with the BAERCOM by working calmly and patiently with one or more "known hearing" animal(s) first. This approach will help you develop the instrumenting skills necessary to acquire good quality BAER data with the BAERCOM, in a more relaxed "trial and error" manner, before actually testing other animals. The first time you encounter a "Uni" or an animal that supplies non-hearing indication, it is this previous experience and understanding that will help you discern the difference between hearing abnormalities and some sort of setup or connection problem.

Also, if you use the BAERCOM infrequently, we recommend the same "hands on" testing on a known good animal ahead of actually testing animals, as a refresher course in the mechanics of using the BAERCOM.

2.4.2 🐎 Saving and reviewing BAER data plots

Up to 23 BAER data sets can be stored permanently in "Pages" in the BAERCOM internal memory. The following sections describe how to manage saved BAER data sets in the BAERCOM.

- SAVE (2.4.2.1) collected data sets in the BAERCOM
- REVIEW (2.4.2.2) recorded data sets with the BAERCOM
- DELETE (2.4.2.3) recorded data sets from the BAERCOM

2.4.2.1 🐕 Saving BAER data sets in the BAERCOM

As we've noted before, the SAVE function allows you to store up to 23 BAER data sets to internal BAERCOM memory, one such set to each of the 23 memory "pages". *Each page holds the compiled BAER data set for one ear (not both ears).*

Here's how to perform the SAVE function.

1. Assuming that you have just used the COLLECT function to compile a BAER plot, and then moved the Function switch to the SHOW position, start the Saving process by moving the **Function Switch** from SHOW to SAVE, and the following appears on the display:

2. Turn the **R/C Switch** to MEDIUM if it is not set there already. Then turn the **R/C Switch** two positions clockwise to the NEXT position then back to MEDIUM.

3. The display changes to one similar to the following, where "M04" indicates that the plot data – nine scans averaged together with the **Ear Select** switch at LEFT -- will be stored to Page 4 (again this is not animal test data).

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4. Turn the **R/C Switch** back to the MEDIUM position (if not already done) to confirm the save. *The SAVE function is now disabled until you collect new BAER data.* Finally, move the **Function Switch** back to SHOW to finish the sequence.

5. If, after Step 3, you decide you *do not want to save* the displayed BAER data, just move the **Function Switch** away from SAVE to another position.

6. If *while trying to save data* you see a display with "M24" posted at upper left like Figure 9, then *no more writable BAER memory pages are available*. You are looking at the sample BAER data in permanent internal memory.

Figure 9. Sample BAER data from normal canine subject

You can store no more BAER data in BAERCOM memory at this point; the SAVE function is disabled. You will need to DELETE (Section 2.4.2.3) at least one saved BAER data set before you can again save compiled BAER data to BAERCOM memory. (However, you need not discard the data plotted on the display if you have a PC with BAERCOM-PC installed. Just move the BAERCOM **Function Switch** to SHOW, hook up the USB cable from the BAERCOM to your PC, and then download the data to it. This is described in Section 4.4).

Saving BAER data sets in the BAERCOM internal BAER data memory, requires that you carefully document which saved data set and "page" goes with which animal!!! The saved data will include the Ear Select switch setting, but your records need to connect saved data pages with the animals the BAER data was taken on!!!

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2.4.2.2 🐎 Reviewing data saved in the BAERCOM

The REVIEW function lets you find and display both the BAER data sets that you have stored in BAERCOM internal memory, as well as the sample data set permanently saved in Page 24. *Unless you use REVIEW, any data displayed is always the data you've just collected*. Here's how to display a stored BAER data set.

1. *Be sure the display does not show any unsaved data that you want to save.* If it does, follow the steps in Section 2.4.2.1 to store this data in a memory page before you proceed with REVIEW.

2. Set the **R/C Switch** to LOW, MEDIUM or HIGH. Then turn the **Function Switch** to the REVIEW position. The contents of the current memory bin are displayed. If , for example, you have just saved a BAER data set to Page 6, a test consisting of two scans with the **Ear Select Switch** at LEFT, your display would look like this:

If Page 6 is still empty, you would see this "flat-line" display instead:

3. To display the contents of the *next page* – an empty Page 7 in this example – turn the **R/C Switch** to NEXT until you see the data set plotted, then back to LOW, MEDIUM or HIGH.

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4. To find and plot a BAER data set in a *higher-numbered page*, simply turn the **R/C Switch** to NEXT *and let it remain there until the data set you want is displayed*. As soon as you see the desired plot, turn the **R/C Switch** to LOW, MEDIUM or HIGH to stop the forward progression through the memory pages. (If you keep the switch set to NEXT, the display continuously cycles through all 24 pages.)

5. To *download any plot* (Section 4.4), turn the **R/C Switch** to MEDIUM if it is not already there, then turn the **Function Switch** to SHOW. The BAERCOM sends the displayed data through its **USB port** to a connected PC running the BAERCOM-PC software.

2.4.2.3 🐕 Deleting data from the BAERCOM

The DELETE function allows you to remove BAER data sets from BAERCOM internal memory, one page at a time. Here's how to do it.

1. Find the BAER data set you want to delete and post it to the display using the REVIEW function as explained above. If you want to *delete a series of sets (pages), start by displaying the one in the lowest-numbered page* to minimize the time required to delete the whole series. As an example, we'll delete the contents of Page 2, displayed here.
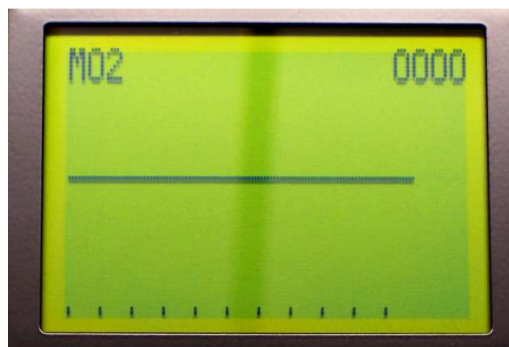
[Picture included on next page.]
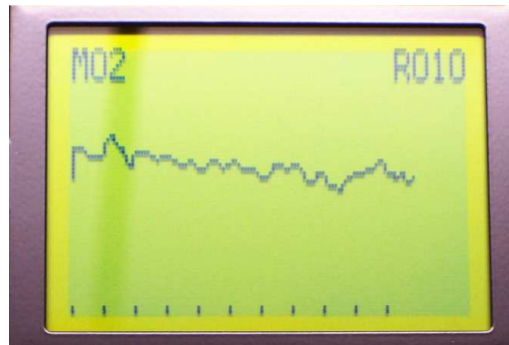
2. *With the **Function Switch** still at REVIEW*, turn the **R/C Switch** to DELETE. The following screen is displayed:

3. ***To make the deletion***, turn the **R/C Switch** to MEDIUM, then to NEXT. In just a moment, this screen confirms that Page 2 is indeed now empty:

4. ***If this is the only BAER data set you want to delete at this time*** – Page 2 in our example -- turn the **R/C Switch** back to MEDIUM the moment the delete is confirmed with the above display.

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5. *If you want to make further deletions*, however, keep the **R/C Switch** set to NEXT until the next desired plot appears on the display. Then turn the **R/C Switch** quickly back to MEDIUM to stop the display from cycling through consecutive memory pages. Finally, turn the switch to DELETE to begin the sequence of Steps 2 through 4 or 5 as described above. *Repeat the sequence until you have cleared all desired memory pages.*

6. *If, after Step 2, you decide that you do not want to delete the BAER data set after all*, just move the **Function Switch** away from the REVIEW position, then turn the **R/C Switch** away from DELETE. The BAERCOM memory contents remain unchanged.

2.4.3   Sending BAER data plots to a computer

You can use the BAERCOM-PC software to download BAER data plots from the BAERCOM unit to your PC computer. You can then perform a full suite of software functions with your data, including pairing two ear data sets, annotating your plots, printing them out, and saving them to a hard disk drive or other memory device.

Section 3 of this manual takes you through the software installation process; Section 4 shows you how to use the BAERCOM-PC features. Refer there for more details about the use of the BAERCOM-PC software.

2.4.4   Tips and tricks for using the BAERCOM

While we have sought to make the BAERCOM as easy to use as possible, the successful acquisition of the BAER signal requires the development of new skills and practices. The suggestions below can help ease the "learning curve" required for this process.

2.4.4.1   Making the learning curve a little easier

Please do *not* try to learn how to operate the BAERCOM in a pressured situation, with a paying client for example. Taking time out to practice with the BAERCOM in relaxed circumstances will pay for itself many times over.

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We recommend that you *take your time* in acquainting yourself with the functioning and use of the BAERCOM:

- Start with a well-mannered young animal with *known good* hearing, then work through this manual in a relaxed way.
- Carefully connect the electrodes, then collect several BAER data plots.
- Experiment with the various controls; practice saving and deleting data plots.
- Compile different numbers of scans into separate plots to see what effect this has on plot quality.
- Try different electrode locations to see how this changes the plots.
- Practice switching data collection back and forth between the two ears.
- Exercise the BAERCOM-PC software functions to become quick and adept.
- If using the BAERCOM is your first experience with BAER testing, we recommend that you find a "mentor" who is familiar with the process, if possible. Help from someone who has more experience will go a long way toward bringing you up to speed.

2.4.4.2 🐕 Suggestion for reviewing BAER results

As a BAERCOM novice, it might be best to collect and save two plots for each ear, making the same number of scans for each plot. Set Stimulus Size set to "0" – *no* click stimulus -- for the first plot. Set Stimulus Size to 60, 65 or 70 dB – clicks that *should* be audible to your subject – for the second plot.

Now *compare the two plots* (for each ear) to identify the presence or absence of a normal BAER response for that ear. With a little experience, you will soon become familiar with the series of successive peaks that form a normal BAER response. That said, *do not hesitate to repeat a BAER test if the first result seems ambiguous.*

2.4.4.3 🐕 Adjusting BAER display resolution

You can adjust the BAERCOM to display your data at three different vertical scales to accommodate greater or lesser spread in the data. The MEDIUM setting is most often best; when the data are very noisy, or the EEG signal is unusually strong, you may have to switch to the LOW setting; when the data show very little shape at all, the HIGH setting will help you better see features that are present (although in this case taking more Scans is a better solution).

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Switching among the three resolutions *will not disturb the actual data* stored inside the BAERCOM – only the data *display* is changed. Here's how to change the resolution.

1. Turn the **Function Switch** to COLLECT or SHOW to enable resolution changes. (The display resolution cannot be changed at other switch settings.)

2. Then set the **R/C Switch** to LOW, MEDIUM or HIGH to provide the best data display. Here's how the display of one BAER data set, in this case the sample test in Page 24, varies with the resolution setting.
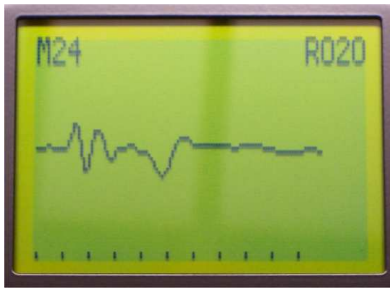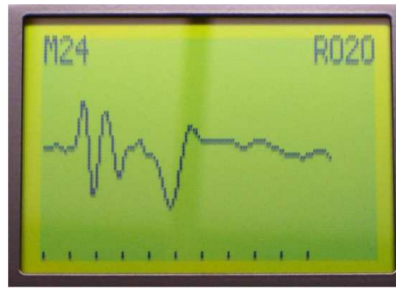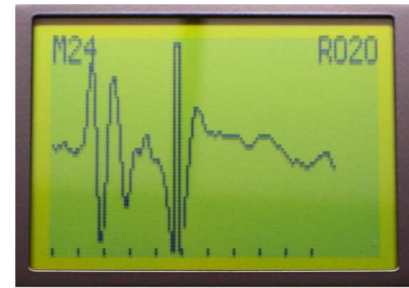
| LOW | MEDIUM | HIGH |

The HIGH setting shows the most detail, but will also include more noise. Setting the **R/C Switch** to MEDIUM, or especially HIGH, may also "clip off" the top or bottom of the BAER data so that it cannot be viewed completely on the display. Should this occur, set the switch to MEDIUM or LOW, and you may need to do this as more scans accumulate in the plot. MEDIUM resolution usually works well up to 20 to 50 scans.

2.4.4.4 🐐 Some Troubleshooting suggestions

While we have sought to make the BAERCOM system components as robust as possible, you probably will encounter problems over time as you use the BAERCOM. Rather than being surprised by them, you need to be for-warned about how various problems will impact the use of the BAERCOM.

a. When you run into indistinct data problems, your FIRST STEP should ALWAYS be to check the routing of the electrode leads, then the placement of the Earphone (which ear) followed by the setting of the Ear Select switch. Setup problems like this are very easy to make!

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b. Note also that if you can hear the "Click" fairly loudly, then the animal's other ear probably can as well. You will need to gently re-insert the Earphone so that the stimulus remains confined to the ear canal under test.

c. Failure to achieve a sub-cutaneous (live tissue) connection for all 3 EEG electrodes is the primary cause of indistinct BAER data from any BAER instrument. If you are seeing noisy or non-repeatable data plots, you should carefully check the electrodes, and re-insert as necessary to make sure you have a sub-cutaneous connection. As mentioned above, animal's skin is much less sensitive, and most animals should tolerate this fairly well. And by the way, if the compiled data plots show a lot of noise, the data shown in the VIEW position will probably show a lot of noise as well. This can be your first indication that there is an electrode problem.

d. As mentioned above, the Click stimulus is responsible for the initiation of the BAER signal in the animal's EEG signal. As a result, you can compare the BAER plot with the Click Amplitude set at (say) 70 dB, with the BAER plot with the Click Amplitude set at 0 dB, which is no click stimulus. (This test assumes same Ear Select switch setting and same number of Scans.) The difference between the two plots will be the contribution of the BAER signal to the animal's EEG signal.

e. Over time, and as the result of normal use, connection problems in the Input Assembly may surface. You can easily test the BAERCOM Input Assembly by inserting the Alligator Clip cables into the molded plastic header, and then clipping all 3 alligator clips to each other. Plug the black plug at the other end of the Input Assembly into the "**in**" connector on the lower right of the BAERCOM bottom panel as usual. Now, turn the BAERCOM on, and set the Function switch to VIEW. The BAERCOM will display the signal being sensed from the Input Assembly and should show a basically flat line with very little noise. You can now move the Input Assembly lead around, from one end to the other, and try the same with the Ear Select switch in either position. If for any positions, movements, or Ear Select switch setting you see a substantial amount of noise, there is a bad connection in the Input Assembly, and this should be repaired before any more BAER testing is performed. You may decide to do this simple test **as standard practice** at the **beginning** or **end** of any BAER testing. It may also prove helpful to have a "spare" Input Assembly on hand, since repair or replacement will take some time.

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f. Should the Earphone stop supplying the clearly audible Click stimulus, or of the Earphone otherwise becomes physically damaged, you should contact UFI about repair or replacement.

Section 3: Installing the BAERCOM-PC Software

3.0 🐃 BAERCOM-PC Software Installation

The previous section (2) discusses the use of the BAERCOM unit by itself to acquire BAER data from your animal subjects. The BAERCOM unit allows you to collect, view and review a single BAER data set, and also supplies a limited amount of internal storage for BAER data. The BAERCOM-PC software program was created to extend the overall capabilities of the BAERCOM system.

The BAERCOM-PC software can download BAER plots from the BAERCOM unit (one at a time), and further supplies both the pairing of the BAER data from 2 ears into a single animal format, and also allows extensive annotation opportunities. The resulting, annotated single animal data set can be both saved as a file, and also printed out with several data "print-out" options. A few Clipboard functions are supplied as well. The actual use of the BAERCOM-PC software with the BAERCOM unit is covered in section 4 below.

However, before the BAERCOM-PC software can be used with the BAERCOM unit on your computer, this software must first be correctly "installed" on your computer. The overall installation process includes both the installation of the BAERCOM-PC program, as well as the installation of the required USB Interface Drivers that allow the BAERCOM unit to communicate with your computer over a USB cable. This actual "software installation" process is the subject of this section.

3.1 🐎 System requirements

The BAERCOM-PC (v2.1) software program was written using the "VB.Net™" programming environment for use under the Windows™ XP and newer operating systems. It is also likely that the BAERCOM-PC software may run on a MAC computer hosting a Windows™ session, but we do not have any experience with this configuration.

Aside from a free USB port, and whatever printer you might wish to use, the BAERCOM-PC software makes few other demands of your computer system. Most of the PC computers on sale and in use today should run this program easily.

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3.2 🐐 BAERCOM-PC Software Installation Overview

As mentioned above, the overall installation of the BAERCOM-PC software includes two separate installation processes. The installation of the <u>BAERCOM-PC program</u> is discussed first in section 3.3 below. The installation of the <u>USB drivers</u> to allow the BAERCOM-PC software to access the BAERCOM unit over a USB connection is discussed in section 3.4 below.

**Note that BOTH of these two installation processes MUST BE SUCCESSFULLY COMPLETED before you can access
the BAERCOM unit with the BAERCOM-PC software !!!**

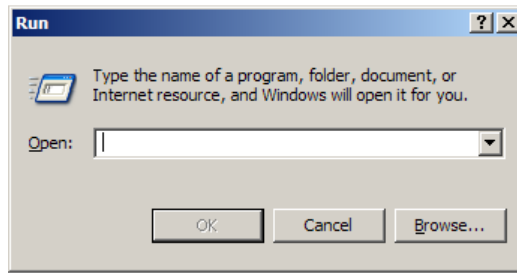## 3.3 🐐 Installing the BAERCOM-PC Program

The installation of the BAERCOM-PC software on the hard drive of your computer essentially involves copying the BAERCOM-PC Program (Baercom21.exe) and any other necessary files from the software CD to a folder on your computer hard drive. In addition, this installation process should create a Start Menu shortcut for the BAERCOM-PC software to make it easier for you to start the program.

The installation instructions for the BAERCOM-PC software are included below for some versions of the operating system. While the particulars vary slightly, overall the same process is similar for most versions.

3.3.1 🐐 Installing on Windows™ XP

Follow the step-by-step instructions below to install the BAERCOM-PC v2.1software to your Windows™ XP computer.
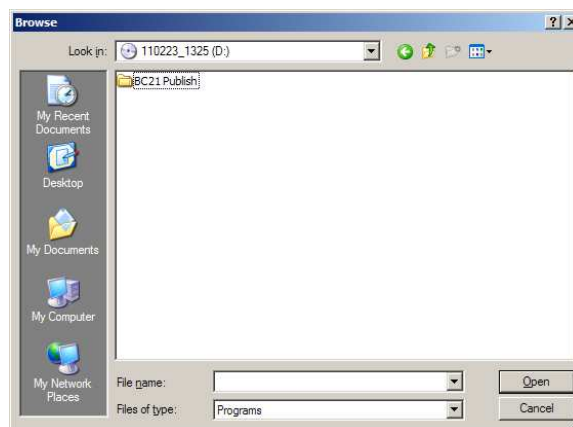
1. We recommend that you shut down any unnecessary applications during the installation process.

2. Insert the BAERCOM Software CD into the CD drive on your computer. Click on the Start menu, then click select **Run…**. The "Run" dialog box opens; click the **Browse…** button:

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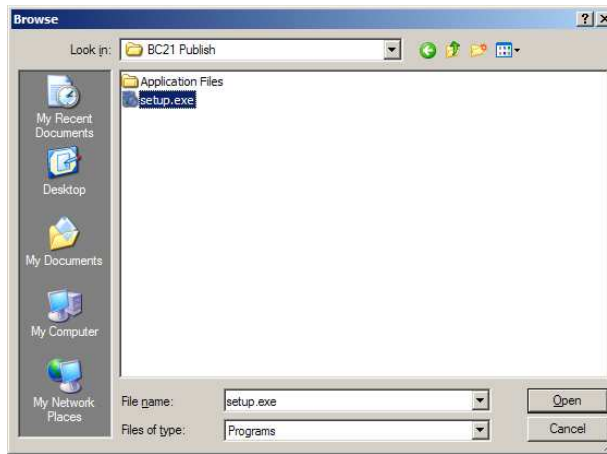
3. In the "Browse" window that appears next, choose **My Computer** and then select your CD drive, very often labeled "(D:)" , then click **Open**:
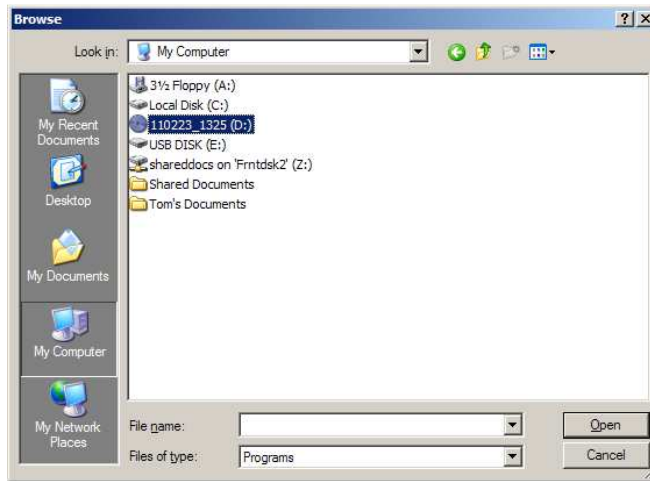

4. In the next "Browse" window, choose the **BC21 Publish** folder, then click **Open** again:

5. In the following "Browse" box, select **setup.exe**, then click **Open** once more:

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6. The "Browse" window disappears; the "Run" window should now be filled in. (The setup.exe program copies the program files included in the install package on the CD to your computer and places them where they belong.)
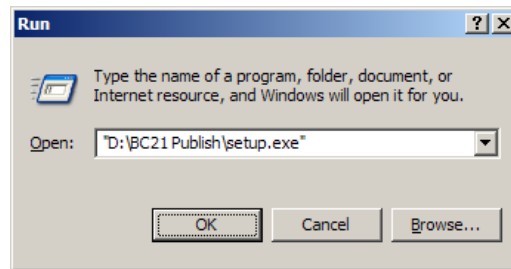
7. The "Browse" window disappears, and the "Run" window should now be filled in. Click **OK**:
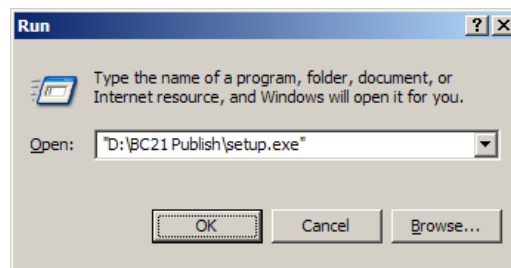
8. After a brief pause, you should see quick messages similar to the following:

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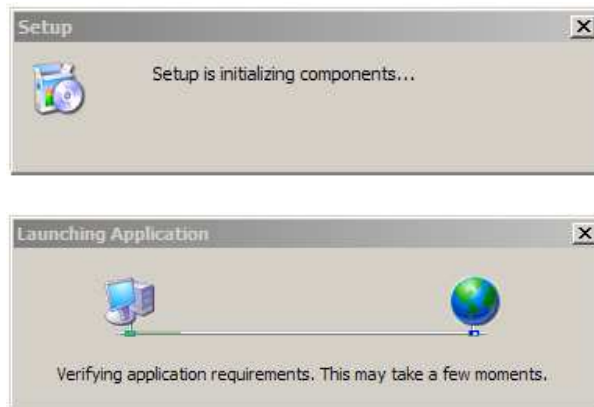
9. If you see this message, go ahead and click **Install** (the "publisher" is UFI):

10. An install progress window like the following now appears. Despite the caution about "several minutes" for installation, it should take only about 5-15 seconds if your computer is a reasonably fast one, since the BAERCOM-PC software is not a large application:

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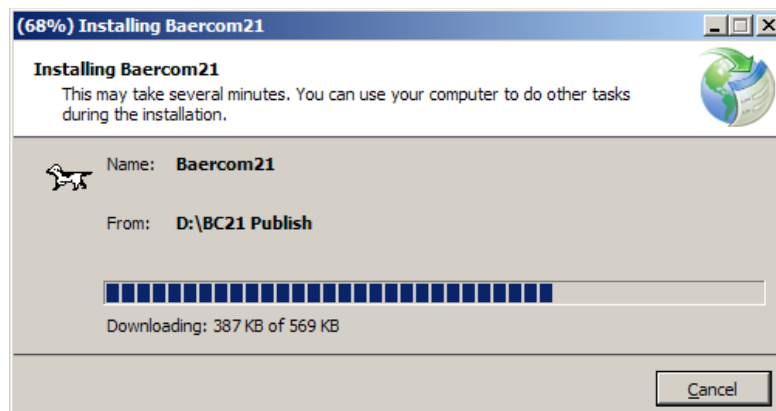
11. If all goes well, the next thing you'll see is the BAERCOM-PC software **welcome window**, which is your starting point for actually putting the software to work, which is described in Section 4:
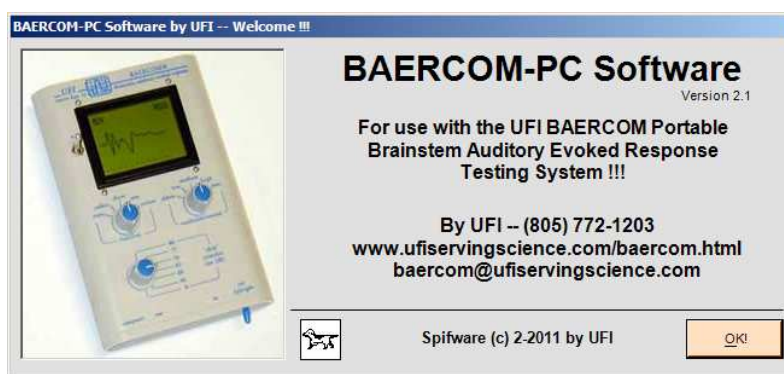
12. If the install fails for any reason, note what any error messages say, then go back over the installation process described here to make sure you have not skipped any steps. Also make sure you have installed all the current Windows Updates for your operating system. If you still have issues, <u>contact UFI</u> for support.

3.3.2 🐕 Installing on Windows™ Vista or newer

Follow the step-by-step instructions below to install the BAERCOM-PC v2.1 software to your Windows™ Vista computer. Windows™ 7 and 8 will be similar.

1. We recommend that you shut down any unnecessary applications during the installation process.

2. Insert the BAERCOM-PC disk into the CD or DVD drive on your computer. A window similar to the following should open automatically. Click on the icon for the media – in this case the CD drive -- that contains the "BC21 Publish folder." This folder holds all the installation files for the BAERCOM-PC software.

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3. Now click on the "BC21 Publish" folder, opening it to show file "setup.exe:"
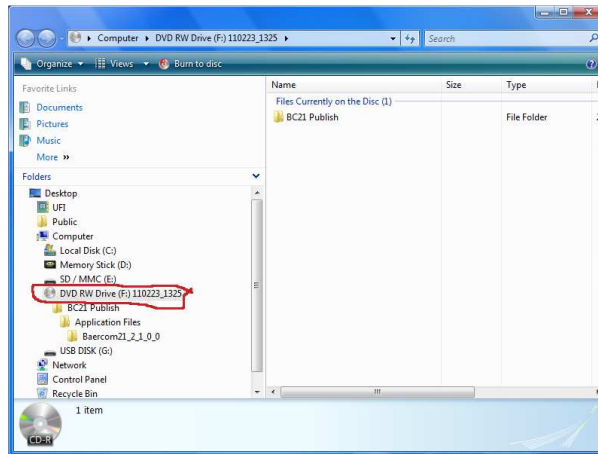

4. Right-click on **setup.exe**, then click **Open** in the drop-down menu:
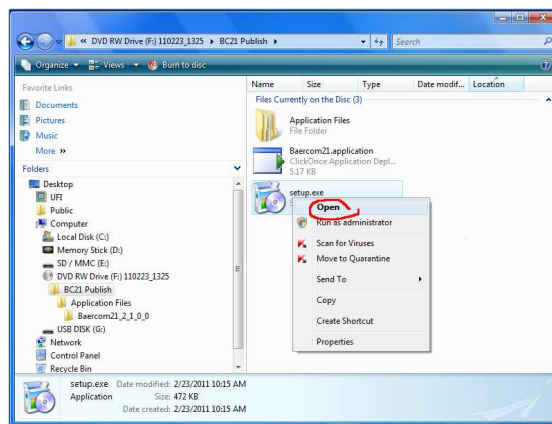
5. After a brief pause and perhaps a couple quick messages, you may see this window. Go ahead and click **Install** (the "publisher" is UFI):

6. After another rapid message or two advises you on installation progress, the BAERCOM-PC software **welcome window** should appear. This is the starting point for actually putting the software to work, which is described in Section 4:

7. If the install fails for any reason, note any error messages, then go back over the installation process above to make sure you did not skip any steps. Also ensure that you have installed all current Windows Updates for your operating system. If you still have issues, contact UFI for support.
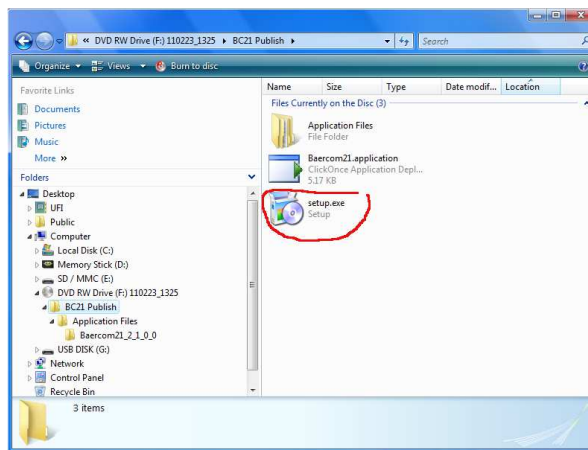
3.4 🐕 Installing the USB Drivers

Installation of the USB drivers allows the BAERCOM-PC software to access the BAERCOM unit through the USB interface built into the BAERCOM. These drivers MUST BE INSTALLED or the BAERCOM-PC software will NOT be able to communicate with the BAERCOM !!!

A folder named "Drivers" is also included in "BC21 Publish" on the CD. This folder contains the information needed to install the correct USB Interface driver files on your computer. How you proceed with this process depends on which operating system you will be using with the BAERCOM-PC software.

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3.4.1 🐐 Windows™ Xp and previous versions

A second "setup" program has been included on the BAERCOM-PC software CD (in the Drivers folder) that performs the installation of the USB Drivers required by the BAERCOM USB Interface. The name of this USB "setup" program is "CDM20814_Setup.exe".

This program must be "run" in order to install the USB Drivers. The easiest way is to use the Explorer (sometimes My Computer or Computer) to locate the file, and then "double-click" over it to direct the operating system to "execute" or run it. The actual time required by this program is very short.

After the drivers have been installed, the USB Setup program will open a window indicating successful completion. On some operating systems, it may just close. After closing any message windows, you are ready to operate the BAERCOM-PC software to access the BAERCOM data from the PC.

3.4.2 🐐 Windows™ Vista and newer versions

Under these operating systems, you can't force the installation of the USB Drivers. You must wait until the first time you connect the BAERCOM to one of the USB ports of the PC Computer. The BAERCOM does NOT need to be turned ON for this process to work.

AT THIS POINT, the operating system will attempt to install the drivers for the the BAERCOM USB interface.

a. For some computers, the operating system will NOT know where this information is located, and will open a window asking you for the LOCATION of the driver information for the BAERCOM USB Interface. You will need to direct the operating system to look in the DRIVERS FOLDER on the BAERCOM-PC software CD for the information it needs to correctly install the drivers for the BAERCOM USB interface. Once the operating system has this information, it should pull the drivers from the CD, install the necessary information, and complete the driver installation process.

b. For other computers, especially if your computer is connected to the Internet, your computer may simply go online, locate, download then install the necessary drivers, requiring no other action on your part.

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Note that small "balloon" messages may show up in the lower right corner of your computer as this process takes place, regardless of the approach taken by the operating system.

3.5 🐐 Notes about the installation process

The overall software installation process required by the BAERCOM system should prove relatively straight-forward. However, there are a few comments that might prove helpful.

3.5.1 🐐 Target Folder Note

Especially with newer versions of the operating system, there seems to be an increasing variability as to WHERE the BAERCOM-PC software will be installed, and WHERE your saved data files will be located.

The actual location on your computer's hard drive where the operating system installs the BAERCOM-PC software is not that important. However, you can easily use the "Search" function of the operating system to find the program file, named "Baercom21.exe".

More importantly, various versions of the operating system may try to save your BAER data files in a "My Documents" folder. Locating your data files buried in the "My Documents" hierarchy after they are saved, can be a very frustrating task! However, this seems to increasingly be the location of choice. Also, if you wish, you can create a folder on your hard drive specifically for your BAER data files, and always direct the BAERCOM-PC software to save the files there. You can also use the operating system Search function to locate the BAERCOM-PC program file, and then direct the BAERCOM-PC program to save your data files there. Whichever approach you take, make sure that you know where to look for your data files!

3.5.2 🐐 Com Port assignment doesn't matter

Previous versions of the BAERCOM-PC software required that you check, and adjust if necessary which "Com Port" the operating system assigned to the BAERCOM unit. For version 2.1, this requirement is no longer valid, since the Com Port setting is ignored by the BAERCOM-PC v2.1 program.

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Section 4: Using the BAERCOM-PC Software

4.0 🐾 Using the BAERCOM-PC Software

This section discusses the use of the BAERCOM-PC software. In order to follow the instructions below, your computer should already be booted up and the BAERCOM-PC software and USB drivers should already be installed. Please perform these two tasks as described in section 3 if you have not completed the software installation process.

Also, if you plan on using the BAERCOM system with a live animal subject, then you will need to follow the directions in section 2 to connect the animal to your BAERCOM, and to actually work through the BAER data set collection process. If you will just be downloading and reviewing BAER data from the BAERCOM unit saved previously, you do not need to worry about an animal subject. The BAERCOM-PC software can also be used simply to review, annotate and/or print previously downloaded BAER data sets, and the BAERCOM unit need not be connected to your computer for these tasks.

The BAERCOM-PC software main window arrangement focuses on the collection of a set of two data plots, customarily one for the left ear and one for the right. This set of two plots constitutes the measured hearing capabilities for a particular animal. However, you can also make a set of two plots for one ear: one plot for data *without* the click stimulus and one plot for data elicited *with* the click stimulus. While this may be helpful as you come up to speed on the use of the BAERCOM system, this approach is generally not used for reporting however.

Also, the BAERCOM-PC software does not allow you to assign "left" and "right" labels to your downloaded data. This is because the software automatically detects the actual ear tested at the time a BAER data plot was collected and saved inside the BAERCOM. However, as mentioned above, these instructions repeatedly use the designations **right** and **left**. You can understand these directions as viewed from either the front of the animal, or from the back of the animal. **Whatever approach you choose, use it** *consistently***.**

These instructions cover version 2.1 of the BAERCOM-PC software. The software version number can be found in the upper right corner of the welcome window displayed when the software starts up. (To access this window *after* startup, click once on the BAERCOM "dog icon" in the upper left corner of the software main window.) The left end of the main window title bar also includes version information.

4.1 🐕 Keyboard and mouse use

The BAERCOM-PC software includes a number of software "buttons" that respond to standard operating system controls and actions. To initiate the action a particular control represents you can usually do one of the following.
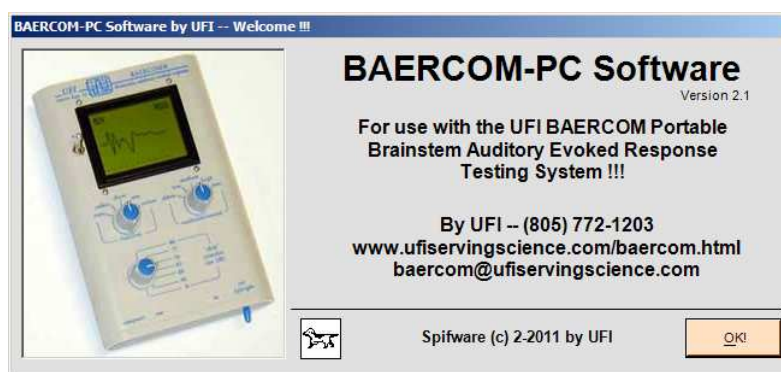
- *click* (or double-click) the control with a mouse or other pointing device
- for controls labeled with an underlined letter, *press the ALT key* at the same time as the underlined letter
- for the text-entry fields in the main window and above the plot areas, *press the TAB key* to cycle through these text fields, or click the Mouse over the desired field.

Note also that this software generally enables and disables controls as appropriate for a particular task. For example, the download data functions cannot be accessed while reviewing previously recorded BAER data.

4.2 🐕 Starting the BAERCOM-PC software

Starting the BAERCOM-PC software is simple:

1. Click the BAERCOM-PC software "Start Menu" item. (See section 3 if you have not yet installed the software.)

2. The software should open with an initial welcome window. Click **OK** to continue.

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3. The BAERCOM-PC main window opens, giving you access to the main software functions.
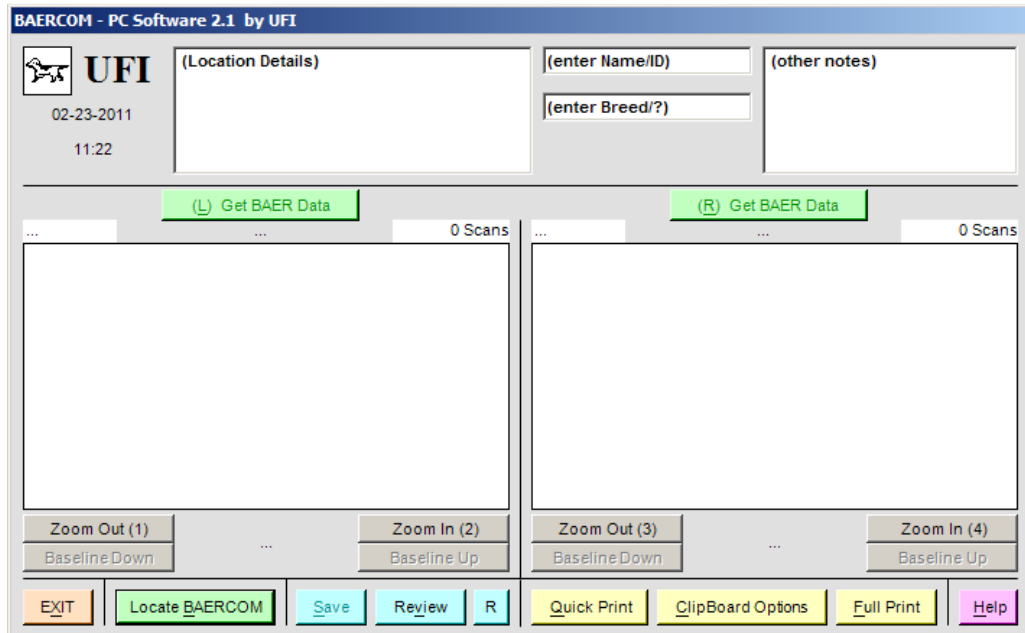
There is **no Menu Bar** in the BAERCOM-PC software main window. You simply click on buttons (labeled here in **bold Arial font**) or type into the text boxes to perform all desired actions.

4. To close the software, click the **Exit** button at lower left on the main window or press the ALT key and "X."

4.3 🐕 Locating the BAERCOM unit with the software

Before the BAERCOM-PC software can communicate with the BAERCOM unit, the software needs to open up a communications channel to the BAERCOM unit through one of the computer's USB ports. (Note that this requires that the USB drivers are already installed on your computer as described in section 3 above.) The software uses the "Locate" process to discover and open this channel. Follow the steps below to work through this process.

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1. If not already done, connect a standard USB cable from the BAERCOM unit USB jack (Section 2.2.3.3) to an available USB port on your computer.

2. If you have *just finished collecting* data and wish to download *this data*, (you can first save this data to a BAERCOM internal memory page as described in Section 2.4.2.1 if you like), then make sure that the BAERCOM **Function Switch** is set to the **SHOW** position. Go on to Step 4.

3. If the data set you want to download to the software was collected previously and stored to BAERCOM internal memory, you will need to "bring up" that data set to the BAERCOM unit display before you can download it.

   Toggle the **Power Switch** to **ON** if the BAERCOM is not already powered up. Then find the data page you want to download using the BAERCOM **Function Switch** and its **REVIEW** position and the **R/C Switch** with **NEXT** as explained in Section 2.4.2.2.

   Once the display shows your desired data, set the **Function Switch** to **SHOW**, then continue with to Step 4.

4. Click **Locate BAERCOM**, a green button in the bottom row of buttons.
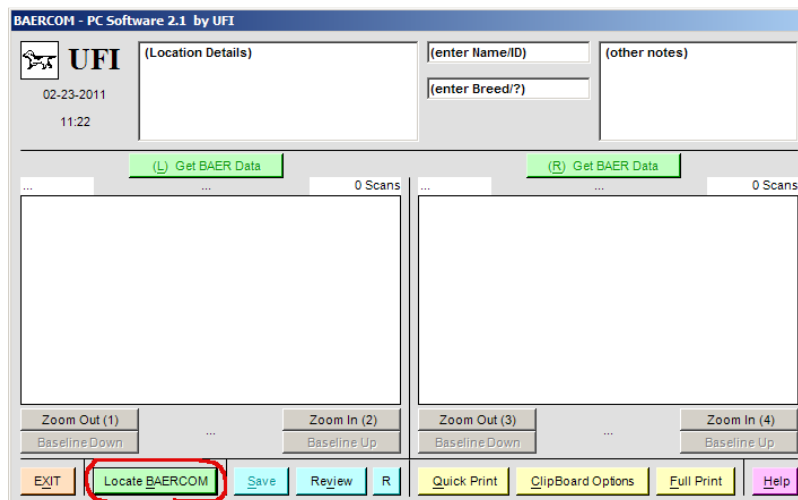
The BAERCOM unit sends the current BAER data set continuously out the USB port when the BAERCOM function switch is in the SHOW position. The Locate process is simply looking for this continuous stream of BAER data.

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5. Double-check that the BAERCOM **Function Switch** is turned to **SHOW**, then click **OK** on the next message.

6. The following message appears, indicating that BAERCOM-PC is checking the USB link for the data sets from the BAERCOM unit:
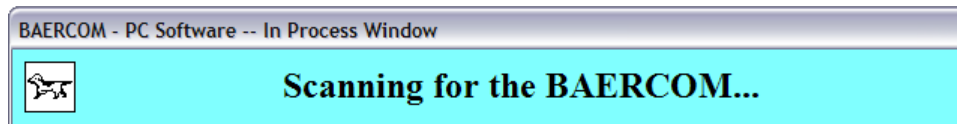
7. Normally the scanning process takes just a few seconds, followed by this message:

You can now download BAER test data from the BAERCOM to your computer as explained in Section 4.4.

8. *If, however, you see the following message*, then BAERCOM-PC did *not* find the BAERCOM via the USB link:
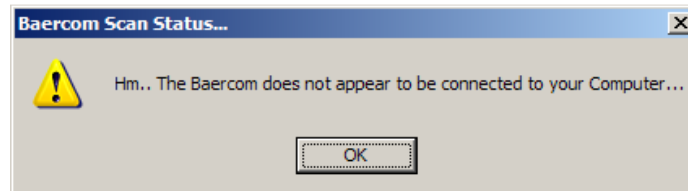
Verify that the BAERCOM **Function Switch** is actually set to **SHOW** and carefully re-check the USB cable to make sure the plugs on the ends are fully inserted into the jacks. Then click **Locate BAERCOM** again on the software main window to repeat the search for the BAERCOM unit over the USB link.

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Locating the link to the BAERCOM unit needs to be done once, and then you can download as many BAER data sets as you like. However, you will need to repeat the "Locate" process if you do any of the following actions.

a. Close the BAERCOM-PC software then open it again.

b. Stop accessing the BAERCOM unit and using the REVIEW function to load in previously saved BAER data sets from your computer hard drive, and then desiring to download more data sets from the BAERCOM unit.

c. Disconnect then re-connect the USB cable between the BAERCOM unit and a USB port on your computer.

This last action is worth highlighting. We recommend that you disconnect the USB cable from the BAERCOM unit USB connector during BAER data collection, to help minimize noise injected into the BAERCOM from the computer. If you follow this recommendation, you will need to work through the "Locate" process after each time you plug the USB cable back into the BAERCOM.

4.4 🐎 Downloading BAER data to your computer

Once the BAERCOM-PC software has located the BAERCOM, the software buttons labeled **(L) Get BAER Data** and **(R) Get BAER Data** are activated. The "L" and "R" in these labels simply indicate which of the two data plot areas will receive the downloaded data plot, and nothing more. The actual "Ear" data is taken from the downloaded data set and is posted as downloaded regardless which plot window the data is directed too.

Customarily, you will want to download a plot labeled Lxxx on the BAERCOM unit LCD display to the left plot area in BAERCOM-PC software, and a plot labeled Rxxx to the right plot area, and these instructions assume this approach. This is not required however, if you prefer different arrangements.

Follow these steps to download a BAER data set from the BAERCOM unit to the BAERCOM-PC software.

1. Be sure that the plot (BAER data set) you want to download is visible on the BAERCOM unit LCD display, and that the **Function Switch** is set to **SHOW**.

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2. Assuming your BAERCOM unit display shows *left-ear data* (display shows Lxxx), click the BAERCOM-PC **(L) Get BAER Data** button:
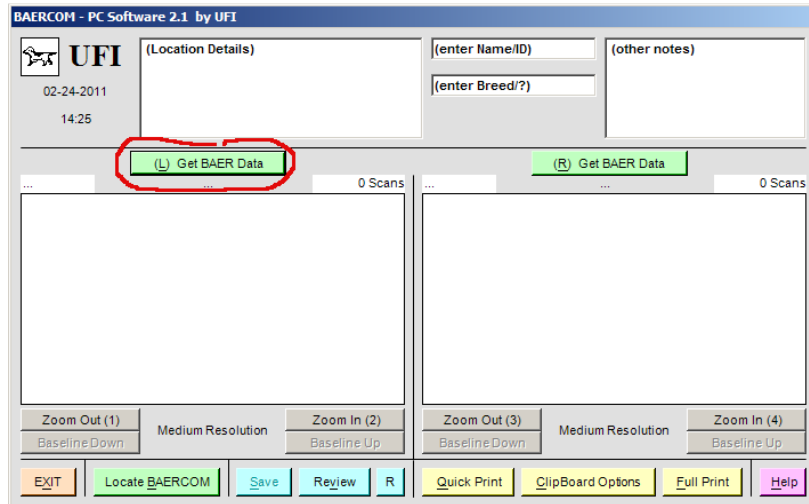
3. This message appears. MAKE SURE you don't mind <u>over-writing</u> any data already present, then click **Yes**. (Click No if you realize you want the data currently posted!)
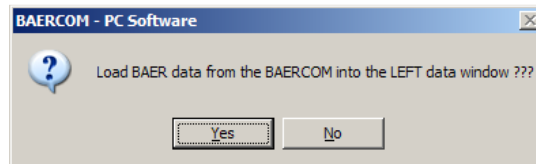
4. Click **OK** on the next message, which reminds you to set the **Function Switch** to **SHOW**:
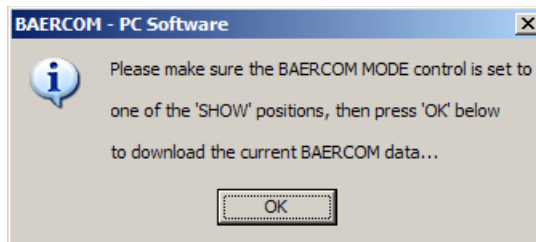
5. An in-process window should post briefly, while the software accesses the USB link and waits for the complete BAER data set from the BAERCOM.

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6. After receiving the data set, the BAERCOM-PC software main window should show, now with your BAER data plot shown in the left data area. Three items are posted along with the plot data, shown directly above the plot area on the main window.

- *Which ear* the data comes from (left in this case)
- the BAERCOM *internal memory page, if any*, in which the BAER data was saved, or "**current data**" if the data was just collected as here
- *how many scans* were made to collect the data (three, here)
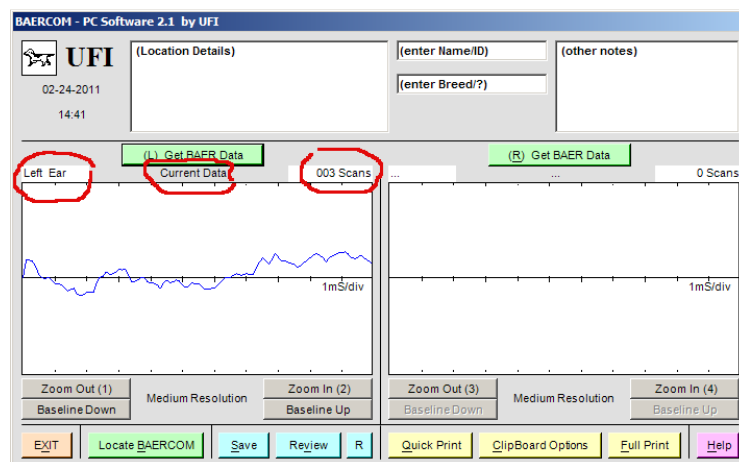
(Note again that this is meaningless test data since we are focusing only on the mechanics of using the software.)

If you now wish to download a *right-ear* plot, perhaps to show a complete test of both a subject's ears, just follow Steps 1 through 6 above. However, before you do this, you will first need to either perform the BAER data collection process to collect the right ear data set, or use the controls on the BAERCOM unit to access and post a memory page that contains right ear data on the BAERCOM unit LCD display. After this is done, you can then follow steps 1 through 6 above. This time, however, click the BAERCOM-PC **(R) Get BAER Data** button in Step 2.

When the right-ear data has been downloaded, your main window will look something like this.
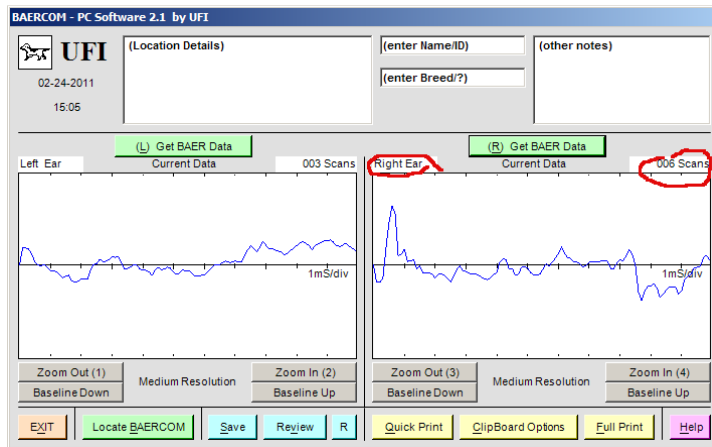
Note that you need not download left-ear data before right-ear. The actual order in downloading does not matter, and the actual information about which ear the data represents, is taken from the data set, and cannot be changed.

The window below shows what happens if you download the sample BAER data saved in page 24 on the BAERCOM unit, into BOTH sides of the BAERCOM-PC data plot areas, and is included as an illustration.

4.4.1 🐗   Comments about the downloading process

Here are a few comments that may prove useful when downloading data from the BAERCOM unit to the BAERCOM-PC software.

- While it is not necessary, it may still be a good idea to save all collected BAER data to memory pages in the BAERCOM unit, so that you have a copy saved in case something happens while downloading. Note however, that the use of the BAERCOM's internal memory requires that you carefully document which memory page goes with which animal.

- BAER data showing on the BAERCOM LCD is continuously sent to your computer *as long as* the BAERCOM *Function Switch* is kept in the *SHOW* position. This means you may download the same plot repeatedly *without* repeating data collection with the electrodes should this prove helpful. For example, if you accidentally download the data to the wrong side of the software main window, just load it into the other side and continue. The data plot being received from the BAERCOM unit will not change until you change the data showing on the BAERCOM unit LCD.

- If there is a USB data link error during downloading (a very rare event), the data in the BAERCOM-PC plot area may look very erratic even when the data looks OK on the BAERCOM display. If this happens, simply click the **(L) Get BAER Data** or **(R) Get BAER Data** button to repeat the download. The downloaded data should look like the data on the BAERCOM unit LCD.

- If you *accidentally download* data to a BAERCOM-PC plot area, any plotted data previously in that area *will be erased*. (This is why the software asks a second time if you wish to proceed.) If this erased data was data you realize you wanted to save, recovery from this mistake can go either of two ways:
    - If the data that you erased came from one of the BAERCOM internal memory pages, just download that data again to the software.
    - However, if you *did not save* the collected data to BAERCOM memory, you will need to *repeat the data collection process* with the electrodes. You might want to then store the new data to the BAERCOM before you again download it to the BAERCOM-PC software.

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4.5 🐐   Working with BAER data

After downloading 2 ear's worth of BAER data from the BAERCOM unit to the BAERCOM-PC main window, you will soon want to save that data. This crucial task is discussed in section 4.6 below.

However, there are other capabilities of the BAERCOM-PC software that may be handy prior to actually saving your data. The following eight sections cover several important BAERCOM-PC software features and functions:

- the "Brief Instructions" window, which provides a quick reference card for the software
- how to document your BAER data with annotations, and the date and time display
- how to make a re-usable template for annotations
- how to redraw the plot data if it disappears
- how to use the **Zoom** buttons to view the plot areas in greater or lesser detail
- how to restore the BAER plot baseline when it becomes offset too far
- how to use the expanded data window
- how to move BAER plots to the Clipboard

Saving, reviewing and printing BAER data merit their own sections; these functions are covered in Sections 4.6, 4.7 and 4.8 below.

4.5.1 🐐   The Help / "Brief Instructions" Window

Press the pink **Help** button in the lower right corner of the main window to view a "Brief Instructions" window with the following headings.
- "BAERCOM Setup," which goes over electrode and Earphone placement
- "BAERCOM Use," which covers data collection procedures
- "BAERCOM-PC Software Use," which details how to download data from the BAERCOM to the PC software
- These Plotted BAER Data, which provides information about the data plots

These four paragraphs serve as reminders and are not intended to replace this instruction manual. Press the pink **Done** button on the "Brief Instructions" window to close it and return to the main window.

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4.5.2 🐕 Annotating BAER data, and the date/time display

The BAERCOM-PC software provides four text-entry boxes just above the data plot areas on the main window for any text notes that you want to save or print out along with the BAER data itself. When the main window first opens, the text boxes look like this:
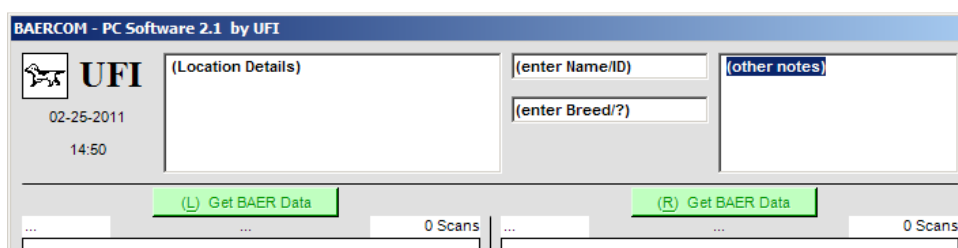
You can use the text boxes for the suggested purposes in documenting your BAER tests, or use them other ways. Just follow these steps:
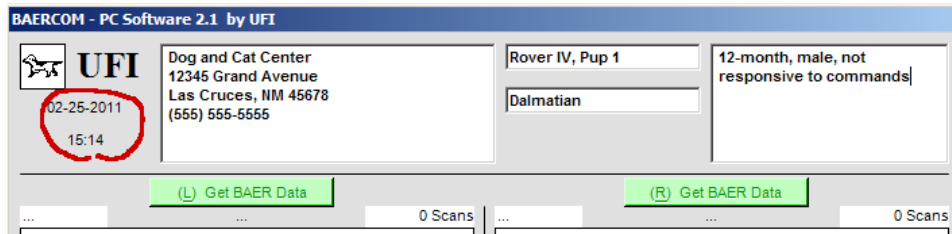
1. Click mouse cursor inside the text box containing "(Location Details)" at upper left of the main window;

2. Delete these characters and then enter your test location and/or whatever other information you like (128 characters maximum);

3. Use your keyboard <Tab> key to move successively through from the "(Location Details)" box through those with "(enter Name/ID)," "(enter Breed/?)" and "(other notes)." You can also simply locate the Mouse over the desired text box, click once, then start typing. In each box, delete the pre-loaded text, if you wish, and enter the suggested information or your own choice of text.

The two small center boxes hold 64 characters maximum; the large right box holds 128 characters. Note that BAERCOM-PC *permits you to type more characters into the boxes than can actually be saved with your data*, so if your notes tend to run long, be sure to *check the saved BAERCOM-PC file later* to see whether the entire text appears. You can make the needed changes if not.

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Here's a filled-in example, using the guideline suggestions for content:

Note also that the calendar date and time of day appear just below the BAERCOM "dog icon" in the upper left corner of the main screen. These indicators serve two functions:

- When the BAERCOM-PC software is open and ready to download data, the date and time increment right along with your computer clock.
- The current date and time is saved to a computer file whenever you save your BAER data (Section 4.6), as part of documenting your test. When you use the BAERCOM-PC software Review Function (Section 4.7) to reload a data file, the time and date information are from the last time the file was saved.

4.5.3 🐕 Making a re-usable template for annotations

You may find it convenient to have a standardized format for your main window text boxes, perhaps something similar to the example in the last section to mark boxes for test location, name, breed, and comments. Here's a way to do this:

1. Type your standardized headings into the text boxes – what you would like to appear for each new test record you make. You might do something like the previous example.
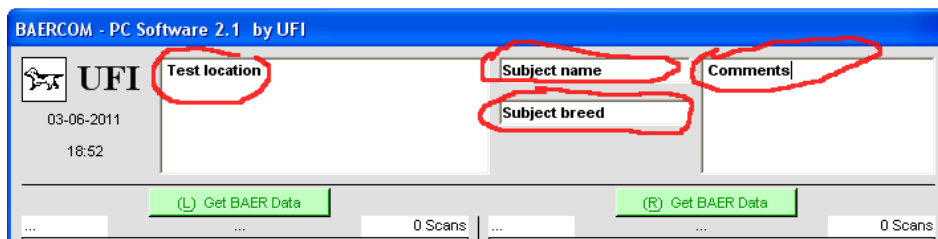
2. Turn the BAERCOM-PC on and allow it to complete the normal start up sequence. Next, switch the function switch to "View" then "Collect" then "Show" with no subject connections made. The BAERCOM unit will be in the Show mode with basically flat-line data, but the data isn't important at this point. Now locate the BAERCOM unit with the BAERCOM-PC software and then direct the software to download the flat-line data to one or both sides. Finally, save this flat-line, basic annotation data set to a file as described in Section 4.6, say as a file named "template.bcd."

3. Whenever you want to use this template with actual test results, simply click the **Review** button (Section 4.7) and load "template.bcd." Now "Locate" the BAERCOM and download "real" BAER data sets from the BAERCOM – *the text fields remain unchanged* until you type in the specifics for your actual tests.

4. Now print or save the annotated data. If you save the data, *be sure to choose a new file name*. If you keep the name, "template.bcd," you will *overwrite* your template and have to make a new one using the above instructions.

4.5.4 🐐   Using the redraw function to restore plot area data

You may find that your BAER data disappears from the main window plot areas when other program windows – say, an internet browser -- are used on top of it. This disappearance is just a graphics rendering artifact. To restore any plot data that was present, press the small blue "R" button along the bottom of the Baercom-PC main window. This should restore your data.

4.5.5 🐐   Using the zoom function with BAER plots

The BAERCOM **R/C Switch** can be set to show one of three plot resolutions – **Low**, **Medium** or **High** – on the display. BAERCOM-PC offers the same three vertical resolutions, plus two more for plots comprised of more than 200 scans ("extended plots").
Here's how to use the BAERCOM-PC zoom controls:

1. Download your test plots into the main screen plot areas (Section 4.4) to get something like the following, where we've simply used the sample data stored in BAERCOM bin 24.

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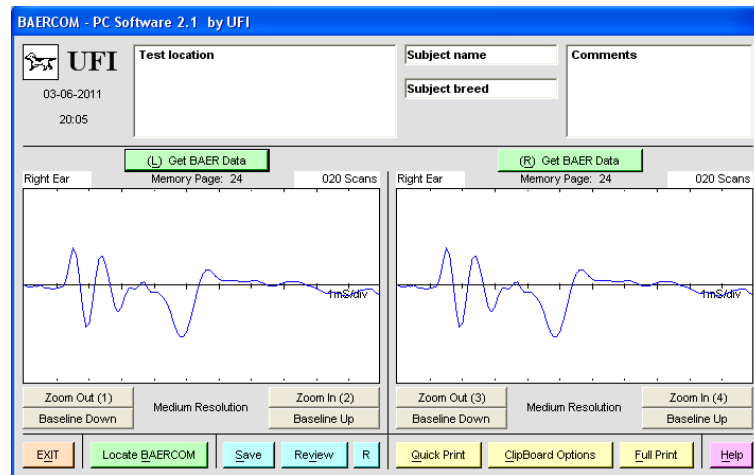
The **R/C Switch** may be set to *any of the three resolutions*, **Low**, **Medium** or **High,** when you download – the switch setting does not change how the data are plotted in the software. In all cases, the data are initially plotted at medium resolution, as shown by the caption centered below each plot area.

2. To enlarge the vertical scale for a plot, click the gray **Zoom In (2)** button for the left plot or the tan **Zoom In (4)** button for the right plot. To reduce the vertical scale for a plot, click the gray **Zoom Out (1)** button for the left plot or the gray **Zoom Out (3)** button for the right plot. Here's how the main screen looks if you zoom in on the left plot and zoom out on the right plot.

Note that the left-plot caption now reads "High Resolution" and the right-plot caption now reads "Low Resolution." Also note that the enlarged scale for the left plot *has pushed data off the plot area* – the bottom of the BAER plot is now clipped and invisible. Section 4.5.6 describes how to fix this problem.

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We recommend that you normally use the *same resolution for both plots*, however, to make comparison easier. Medium resolution generally is optimal for small-animal tests comprised of 10-50 scans.

4.5.6 🐕 Restoring the baseline on BAER plots

BAERCOM test data is sometimes significantly **offset** above or below the central horizontal **baseline**. Here's how to remove offset using the BAERCOM-PC software, whether you have just downloaded the data from the BAERCOM or whether you have loaded in a test file using the **Review** button:

1. Suppose your BAERCOM-PC plots look like the following ones, where offset has been exaggerated to a point you will seldom, if ever, see in real test data:
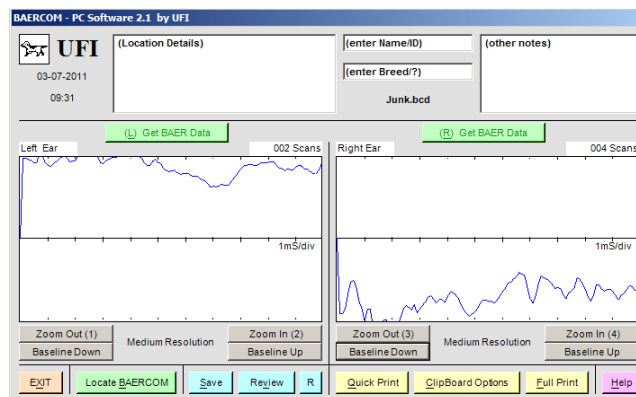
The peaks in the left-side plot data are clipped off severely, while the deepest "troughs" of the right-side data are cut off.

2. To re-center the left-side data around the baseline vertically, click the gray **Baseline Down** button under the left plot area as many times as needed. To re-center the right-side data around the baseline, click the gray **Baseline Up** button under the right plot area as needed:

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3. To retain baseline adjustments with the plot data, **be sure to save** (Section 4.6) -
- or re-save, if you've loaded data from a file -- **your adjusted plots to a file**.

4.5.7 🐐   The expanded data window

The BAERCOM-PC software allows you to enlarge your views of data plots;
follow these instructions to do so:

1. For the left-side plot, move your mouse cursor over the left plot area; it changes
from an arrow icon to a finger pointing up. <u>Double-click</u> to get this new "PC
Expanded Data View Window":
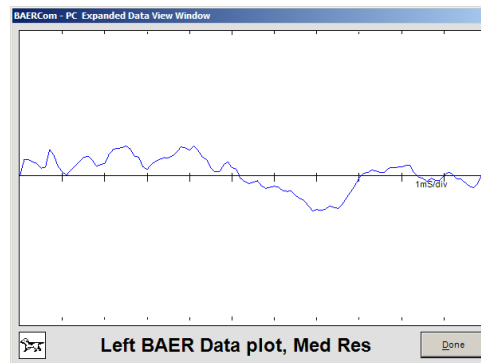
The vertical resolution remains at the setting chosen in the main window,
Medium in this case.

1. Expand the right-side plot the same way by double-clicking over the right plot
area. Click the gray **Done** button in the lower right corner to close the expanded
data window and return to the main screen:

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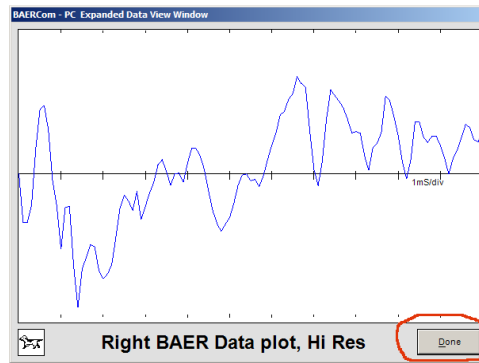
(Here, resolution was set to **High** before opening the expanded window.)

4.5.8 🐕 Moving BAER data plots to the clipboard

The BAERCOM-PC software permits you to export bitmapped graphic images of BAER data plots to the Clipboard for use with other applications. Here's how:

1. Plot on the main window the data that you wish to copy to the clipboard, either by downloading directly from the BAERCOM or by loading in a saved file. Then click the yellow **Clipboard Options** button in the lower right:
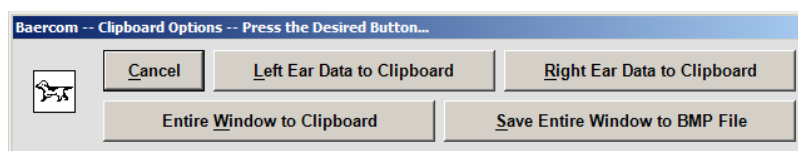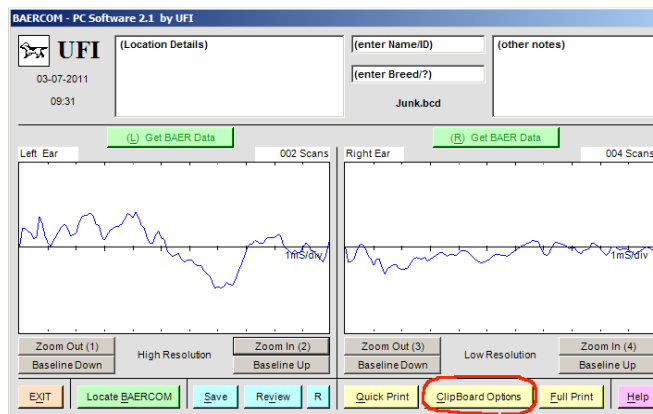
2. The "Clipboard Options" popup menu appears, giving you five options. If you press the **Left Ear Data to Clipboard** button you will see the following.

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After you click **OK** on the confirmation message the following image is put onto the clipboard.
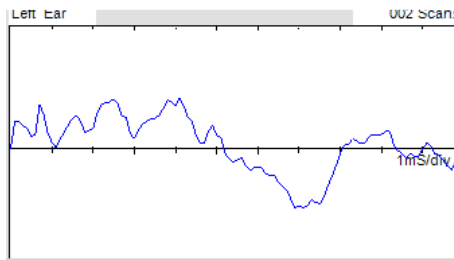
3. If you click the **Entire Window to Clipboard** button on the "Clipboard Options" menu, this is what you'll find an image of the main window in the clipboard.

4. If you click the **Save Entire Window to BMP File** button on the "Clipboard Options" menu, you are asked to specify a file name and a folder as the destination for the BMP file as shown.
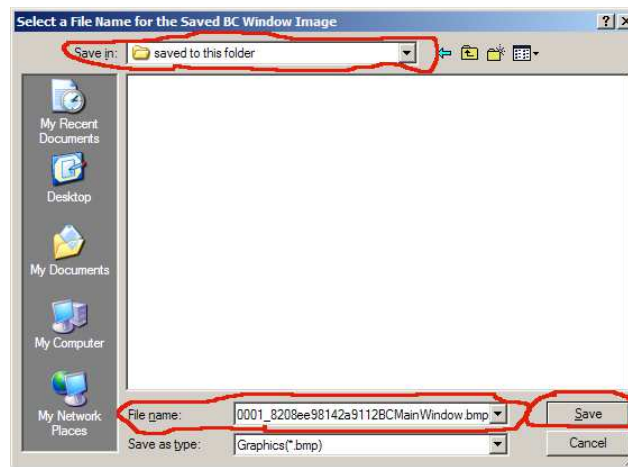
You will probably want to choose a new file name and folder to replace the default ones. After you make any desired changes, click the **Save** button. Now you can retrieve the image under the specified file name, from the specified folder, whenever needed. You can add this image to files created by many veterinary practice-management software packages, or email it as desired, among other uses.

5. Finally, just click the **Cancel** button to close the "Clipboard Options" menu and go back to the main window without taking any other action.

4.6   🐕   Saving BAER data

We've referred more than once to saving the 2 ear BAER data files, and this is a crucial operation. Follow these steps to accomplish this.

1. As soon as you've downloaded BAER data to *at least one BAERCOM-PC plot area*, the blue, bottom-row **Save** button becomes active on the main window.

[Image shown on next page.]

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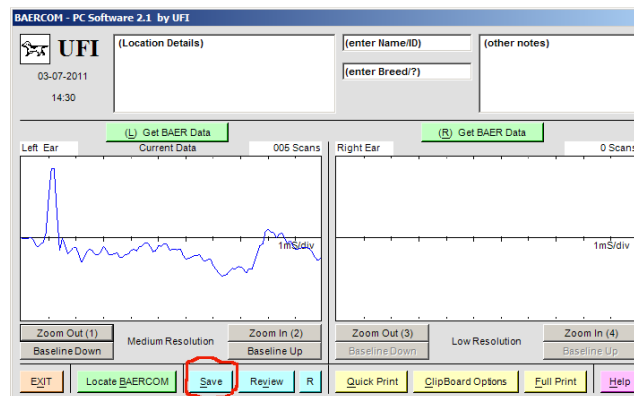
2. Now do any or all of the following:

   - add a second BAER data plot (if not done yet)
   - add annotations in the text boxes (Section 4.5.2) – date and time are added automatically
   - zoom the plot(s) to a different resolution if desired (Section 4.5.4)
   - adjust the plot baseline (Section 4.5.5) if needed

3. Click on the **Save** button, then click **OK** on the following message to confirm your intention to save the plot to a data file. (Often you'll want to download data to *both plot areas* and then annotate before you save to a file.)
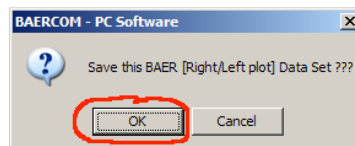
4. A new window opens captioned "Select a File Name for the Saved BAER Data" (image shown on next page). Type a new name into the "File name" box at the bottom, overwriting the default file name supplied, but KEEP THE EXTENSION (".bcd") while you type in the new name in front of it. The "Save as type" box below should still read "BAERData(*.bcd)" and should not be changed.
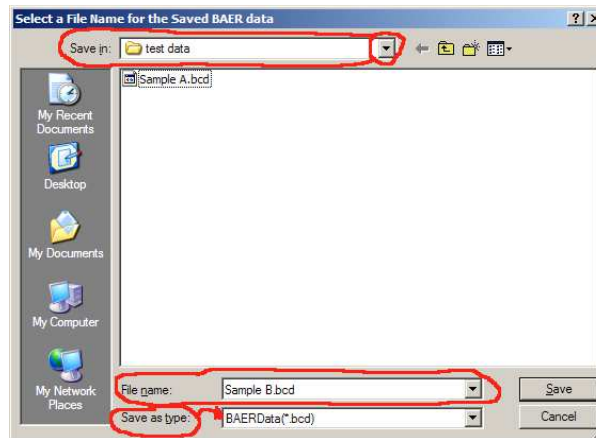
You may select an *existing file name* in the "save as" box, but if you do, the new data *overwrites the old file data*.

Newer operating system versions will supply the extension ".bcd", but some older versions may *not*. If the file name you type into this box *does not* include the .bcd extension, you will have a hard time finding the file later.

Unless the folder to which you want to save your file already appears in the "Save in:" box, click on the ▼ button at the right side of the box to expand the directory tree. (You may need to use the "Up One Level" icon as well.) Then click through the tree until the desired folder shows in the box and/or use the "Create New Folder" icon to do just that.

5. Finally, click on the **Save** button near the lower right corner of the window.

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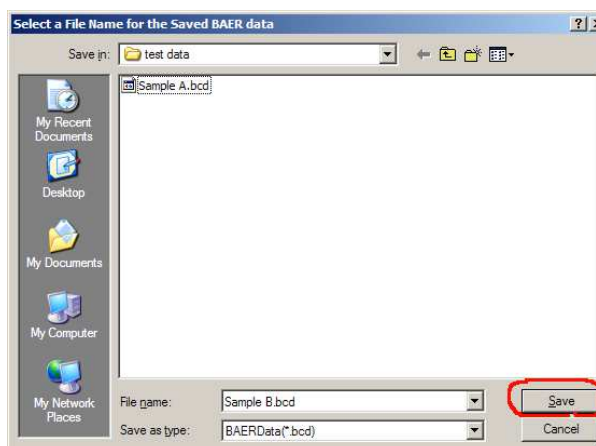
Next, click **OK** on the save confirmation message.

After you save a data file, you may realize that you need to change your annotations, change the zoom level, or adjust the baseline. If so, just reload the *.bcd data file, make the changes, then resave the file with the same name. The modified file will replace the old one.

4.7 🐕 Reviewing previously recorded data

If you would like to examine or modify a saved BAER data file, simply open it in the BAERCOM-PC software.

1. After starting the BAERCOM-PC software (Section 4.2), click the blue **Review** button in the bottom row of the main window.
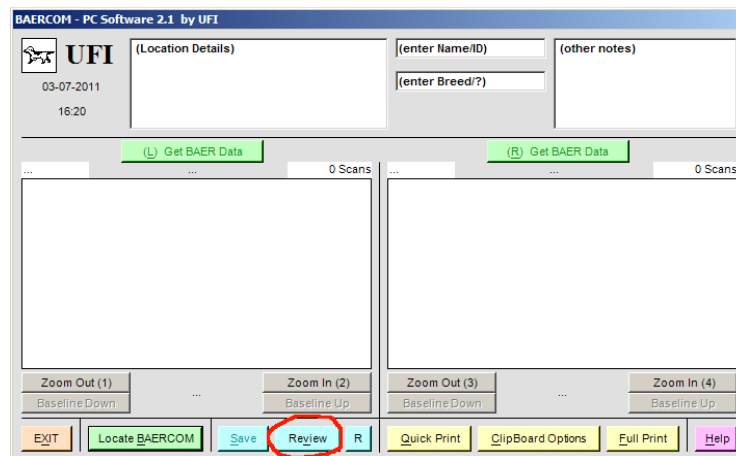
Next click **OK** on the confirmation message.

2. A window opens, captioned "Select a BAERCOM Data File to Review".

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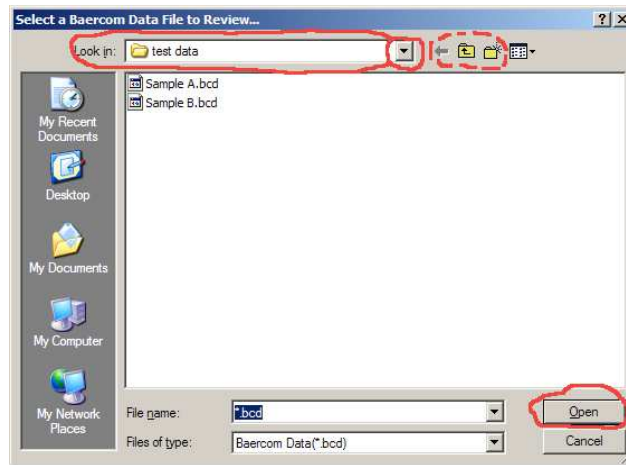
Navigate to the file you wish to open -- simply click on the file name if it is located in the current directory. Otherwise, click on the ▼ button or one of the icons to the right of the "Look in:" box near the top of the window to find the file you wish to open, then click on the file name.

3. When your file appears in the "File name:" box near the window bottom, click the **Open** button in the lower right corner. Your saved file opens in the BAERCOM-PC main window:
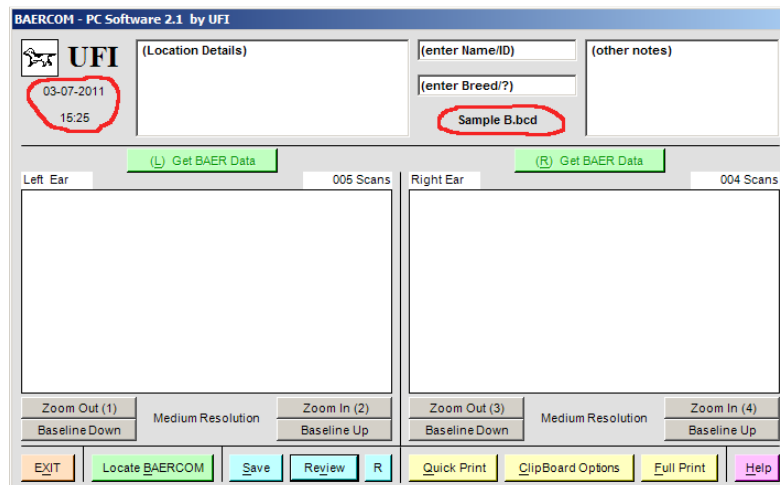
The main window displays the file name, in this case "Sample B.bcd," below the two small text boxes. The date and time of the last time the file was saved are shown under the "dog icon" at the upper left of the screen.   (This file doesn't contain much information, normally your BAER data and annotations would be included.)

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4.8 🐎   Printing BAER data

The BAERCOM-PC software provides you two ways to print a "hard copy" of BAER test data, "Quick Print" and "Full Print." You may print data just downloaded from the BAERCOM or data you saved to a file, then loaded with **Review** (Section 4.7).

4.8.1 🐎   Quick Print method

"Quick Print" permits you to print a modified version of the entire BAERCOM-PC software main window rapidly and without using much printer ink or toner. Some slight re-arrangement of the fields is performed, and a Signature/Date line is added.

Version 2.1 of the BAERCOM-PC software does attempt to rotate the image so that it is printed with Landscape orientation, so that none of the window image is clipped. However, in our experience, some users may need to actually set their printer up (via the Printing Preferences page) for Landscape use ahead of performing the print. You may also need to check to make sure that the "Scaling" preference for your printer is set back to 100%, or that Manual Scaling is disabled, if the image still looks too large for the print window.

1. Turn on your printer, then make sure that the test data you wish to print are displayed on the main window. In the example below, we've used **Review** to load a file called "ExamplePrint.bcd".
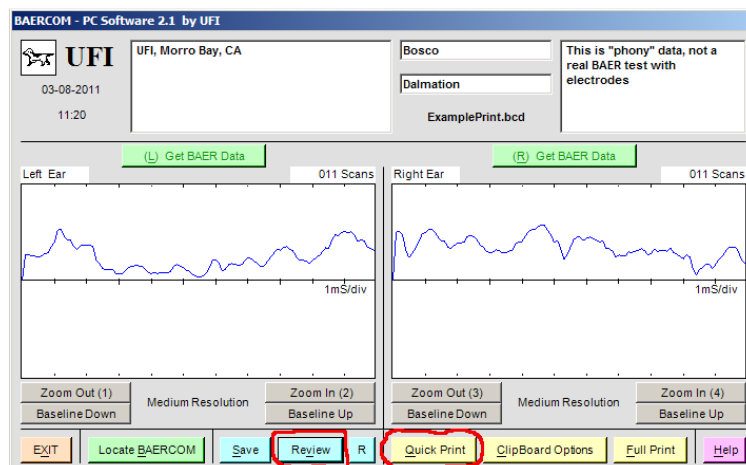
2. Click the yellow **Quick Print** button in the bottom row on the main window to reformat and print your data as shown below.
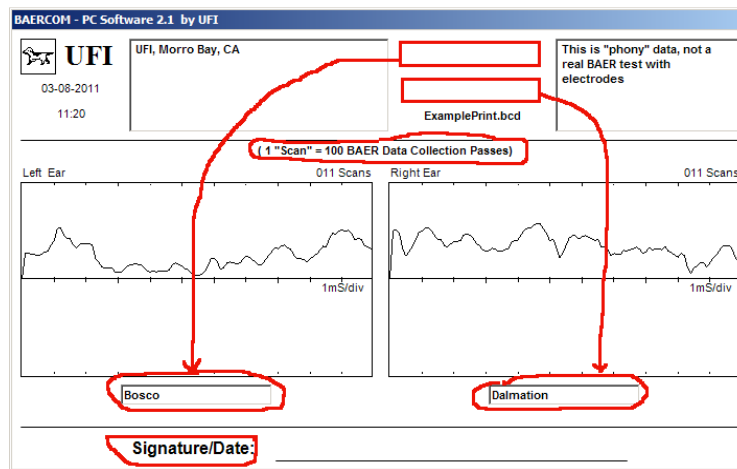
This window is shown only briefly. However, note how this "Quick Print" window differs from the regular main window.

- the gray window shading is gone, replaced by white to conserve your ink or toner;
- the bottom row of buttons is gone;
- the two small text boxes are relocated:
  - the top box is moved under the left plot area;
  - the bottom box is moved under the right plot area;
- a line is added at the bottom for a dated signature for use as a legal document;
- the caption "1 'Scan' = 100BAER Data Collection Passes" appears above the plot areas.

After the contents of this window are printed out, the main window is reformatted to appear as it normally does.

4.8.2 ☞ Full Print method

"Full Print" allows you to print the entire main window *just as it appears on your monitor*.

1. Turn on your printer, then make sure that the test data you wish to print are displayed on the main window. In the example below, we've again used **Review** to load a file called "ExamplePrint.bcd."

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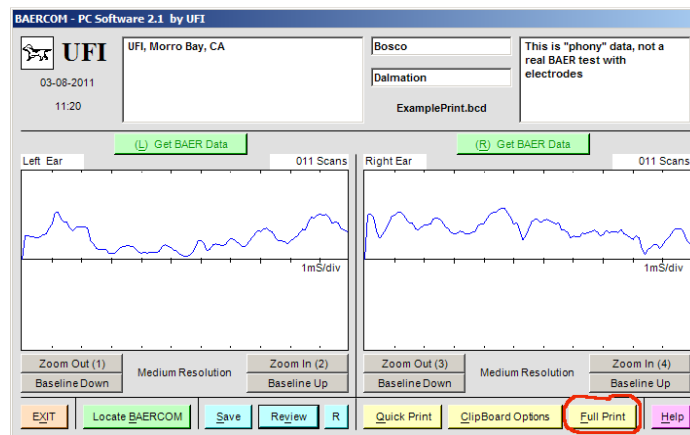
2. Click the yellow **Full Print** button in the bottom row on the main window and you will see a "Printing" progress message.
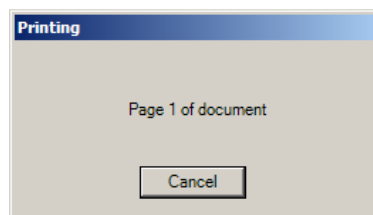
As mentioned above, version 2.1 of the BAERCOM-PC software does attempt to rotate the image so that it is printed with Landscape orientation, so that none of the window image is clipped. However, in our experience, some users may need to actually set their printer up (via the Printing Preferences page) for Landscape use ahead of performing the print. You may also need to check to make sure that the "Scaling" preference for your printer is set back to 100%, or that Manual Scaling is disabled, if the image still looks too large for the print window.

Even though the main window appearance does not change, the software will still send a copy of the window to your printer.

Section 5: BAERCOM Typical Use Overview

This section seeks to pull together the information and activities covered previously in these instructions. Since the contents of this section build on the previous sections, please carefully review previous sections first.

Also, this information should not be viewed as a definitive statement. We anticipate that you will want to carefully adapt these suggestions into a protocol that is best suited for your practice.

5.1 🐎   Suggested initial work-flow

As you grow in your understanding of the capabilities and limitations of the overall BAERCOM system, you will probably come up with a "work-flow" that best suits your practice and needs. However, as a starting point we can offer the following suggestions.

It is probably best to decide on a few basic assumptions before you actually start building your BAERCOM use work-flow.

a. As mentioned a number of times, you need to decide at the outset what Right and Left really means – whether from the animal's view or from your view. This basic assumption needs to be consistently applied.

b. It is probably best to separate the animal oriented tasks (connection and BAER data set collection) from the PC connected tasks of BAER data downloading and final report generation. Arranging tasks this way allows you to focus on one skill-set at a time – first using the BAERCOM, then later, the software. This approach assumes the use of the BAERCOM unit's internal memory, and you will need to always save BAER data sets as you collect them. (Remember however, that you can easily "collect" multiple BAER data sets, and actually "save" one you are happy with.) The use of the BAERCOM unit's internal memory REQUIRES that you carefully document which internal memory PAGES came from which animal. However, this approach incorporates our recommendation that the USB cable NOT be connected to the BAERCOM unit during BAER data collection, and also enforces primary data back-up for your BAER data collection process, which you will appreciate when you need it!

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c. To simplify your record keeping, we recommend that, as you use the BAERCOM unit's internal memory, you ALWAYS save LEFT ear data in ODD pages, and RIGHT ear data in EVEN pages (or vice versa). Consistently applying this basic assumption can substantially simplify the record keeping required when using the internal memory in the BAERCOM unit.

Incorporating the above assumptions, we can suggest the following basic general work-flow for your BAER data collection. Note that this work flow can easily be expanded for multiple animals, but the BAERCOM unit internal memory will only support up to 11 animal BAER (both ear) data sets.

Animal focused tasks
a. Carefully follow the directions in section 2.3 to connect electrodes to and place the Earphone on your animal. Set the Ear Select switch to Left, and place the Earphone in the Left ear.
b. Carefully follow the directions in section 2.4.1 to collect a BAER data set for the Left ear of your animal. Feel free to re-run the collection process if the signal looks noisy or the animal is squirmy, or if you want to try more Scans, or whatever.
c. When you are happy with the BAER data set collected for the Left ear, follow the directions in section 2.4.2.1 to save this BAER data set in the next ODD page of the BAERCOM unit's internal memory (for example "M01").
d. Move the Ear Select switch to Right, and carefully insert the Earphone into the Right ear.
e. Carefully follow the directions in section 2.4.1 to collect a BAER data set for the Right ear of your animal. Again, feel free to re-run the collection process if the signal looks noisy or the animal is squirmy, or if you want to try more Scans, or whatever.
f. When you are happy with the BAER data set collected for the Right ear, follow the directions in section 2.4.2.1 to save this BAER data set in the next EVEN page of the BAERCOM unit's internal memory (for example "M02").
g. When you are done testing a particular animal, carefully remove both the electrodes and the Earphone from the animal.
h. Carefully record in a log book which BAER data pages go with the animal just tested, e.g. "animal1 – M01(L), M02(R)" or something similar.

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i.   You may want to come up with an unobtrusive way of marking the animal just tested, perhaps using an indelible marker to make a mark inside the fold of the ear or something similar. The marking may also include a unique number that can be referenced by any print-outs you make as well. This step will be at your discretion, but marking animals after testing can prevent confusion when testing a large number of animals.

j.   [You can repeat a through i above for additional animals if desired.]

BAERCOM-PC software and computer related tasks

k.   Start your computer, then bring up the BAERCOM-PC software.

l.   Follow the directions in section 2.4.2.2 to direct the BAERCOM unit to post for Review (on the BAERCOM unit LCD) the first saved BAER data set (page) presumably for the Left ear of the first animal whose data you wish to annotate and save. Make sure when you are done with this step that the BAERCOM unit function switch is in the SHOW position.

m. Follow the directions in section 4.4 to now download this (single ear) BAER data set to the BAERCOM-PC software. If the data is for the Left ear, load it into the data area on the Left side of the BAERCOM-PC main window. Quickly verify that the data on the BAERCOM LCD matches the data just downloaded to the BAERCOM-PC software data area.

n.   Follow the directions in section 2.4.2.2 to direct the BAERCOM unit to post for Review (on the BAERCOM unit LCD) the next saved BAER data set (page) presumably for the Right ear of the first animal whose data you wish to annotate and save. Make sure when you are done with this step that the BAERCOM unit function switch is in the SHOW position.

o.   Follow the directions in section 4.4 to now download this (single ear) BAER data set to the BAERCOM-PC software. If the data is for the Right ear, load it into the data area on the Right side of the BAERCOM-PC main window. Again, quickly verify that the data on the BAERCOM LCD matches the data just downloaded to the BAERCOM-PC software data area.

p.   After both ears data has been added to the two data plot areas, you can now follow the directions in section 4.5 to adjust offset and zoom, or especially to add any necessary annotations to the BAERCOM-PC main window.

q.   Follow the directions in section 4.6 to now save the overall BAER data summary to a unique disk file on your computer.

r.   From here, you can print or save as a BMP file for emailing – whatever is required for your use.

s.   [You can repeat k through r above for additional animals if desired.]

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<u>Preparation for your next testing</u>

    t. Prior to performing more testing, you will need to follow the directions in section 2.4.2.3 to Delete previously saved BAER data. Deleting a substantial number of BAER data pages can be a tedious process, but must be done in order to prepare the BAERCOM for your next BAER data collection session.

5.2 🐏 Summary Use Examples

      The 3 "Summary Use" examples below take a different approach to exercising the BAERCOM system. These examples simply walk you through some of the tasks required for the normal use of the BAERCOM. As mentioned, a firm grasp of the information in sections 1-4 is essential background for these examples.

BAERCOM Summary Use 1: View EEG, Review Sample Data

Test the BAERCOM EEG input, view typical BAER data and adjust display size.
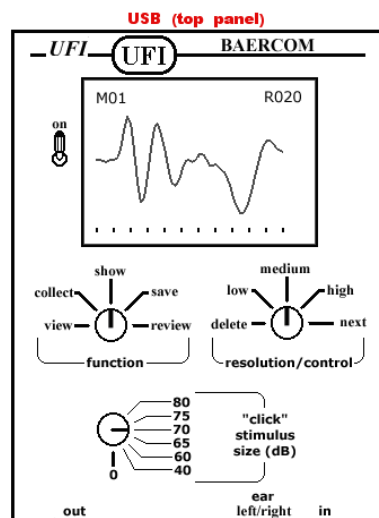
1. Set the BAERCOM switches, turn on the BAERCOM, VIEW data
   - Set the **Function Switch** to VIEW
   - Set the **Resolution/Control Switch** to MEDIUM
   - **Click Stimulus Size Switch** and **Ear Select Switch** can be set to any position
   - Plug **Input Assembly** into the *four-pin* connector on the BAERCOM
   - Connect all three alligator clips on the Input Assembly to each other

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- Pull the *locking- toggle* **Power Switch** away from the panel, then up to ON
- Four initial messages are displayed, followed by the BAERCOM posting the EEG data being sensed. This data should show a continuous nearly flat line since all 3 BAERCOM input leads are connected together

2. Review the sample BAER data stored in the BAERCOM
   - Set the **Function Switch** to REVIEW
   - Set the **Resolution/Control Switch** to NEXT
   - Characters at upper left of **display** count M01, M02, M03…as the BAERCOM steps through the data in its data storage **"pages"**
   - Data displayed in M01 through M23 should appear as nearly flat lines, since no BAER data has been saved yet
   - When M24 appears on **display**, set the **Resolution/Control Switch** to MEDIUM. This posts the sample BAER data saved in page 24 to be posted on the LCD for your review
   - Set the **Function Switch** to SHOW to see the BAER data plot at MEDIUM resolution

3. Adjust resolution (size) of BAER data plot
   - Set the **Resolution/Control Switch** to LOW to *decrease* the sample data size
   - Set the **Resolution/Control Switch** to HIGH to *increase* the sample data size
   - Finally, set the **Resolution/Control Switch** to MEDIUM to finish Lesson 1

BAERCOM Summary Use 2: Acquire BAER Data

Prepare your subject for BAER testing, then collect and save data to the BAERCOM*

1. Attach the electrodes to your animal
   - Identify the correct locations for the needle electrodes as shown below
     - *black electrode*: on *crown* (top of head)
     - *red electrode*: adjacent to *right ear*
     - *yellow electrode*: adjacent to *left ear*

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Earphone (Right Ear) — Black (Crown) Electrode — Red (Right) Electrode — Yellow (Left) Electrode

- Apply the needle electrodes as shown below
  - Use stainless steel hypodermic needles
  - Push needle electrodes through skin so they make *subcutaneous contact*, then emerge 6mm to 10mm out the other side (1/4" to 3/8")
  - Attach alligator clips over *exposed (pointed)* ends of needle electrodes
  - Apply a few drops of alcohol to exposed parts of needles
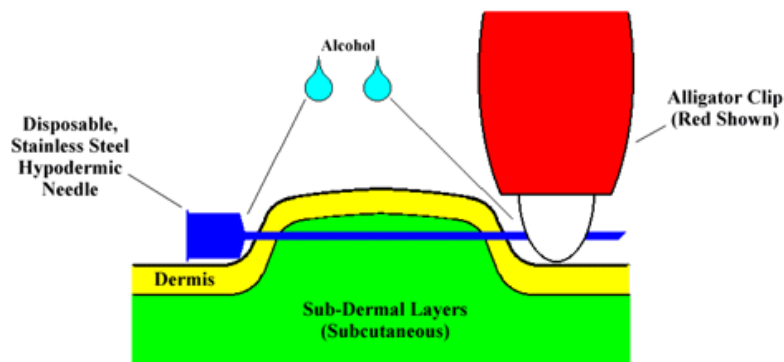
2. Insert BAERCOM earphone *gently* into the *left* ear; try to *seal the ear canal* with the plastic ear-tip.

3. Set the BAERCOM switches, turn on the BAERCOM
   - Set the **Function Switch** to VIEW
   - Set the **Resolution/Control Switch** to MEDIUM
   - Set the **Click Stimulus Size Switch** to 70 DB
   - Flip the **Ear Select Switch** at right end of bottom panel to LEFT
   - Pull the **Power Switch** away from the panel, then up to ON

4. View EEG Data: After the display shows the four startup messages, you should see a *stable, fairly flat baseline* with just a small amount of electronic "noise"

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5. Collect BAER response to click stimulus
   - Set the **Function Switch** to COLLECT
   - Listen for a faint clicking sound from the earphone
   - Watch as the BAER response takes shape on the **display**
   - Wait until the characters "L020" appear at top right of the **display**

6. Show the BAER data on the **display**
   - Set the **Function Switch** to SHOW
   - Listen as the click stimulus *stops*
   - Observe the plot on the **display** – this is the BAER data you *just* collected

7. Save the BAER data to a BAERCOM memory page
   - Set the **Function Switch** to SAVE
   - When "STORE BAER Plot?" appears on **display**, turn **Resolution/Control Switch** to NEXT
   - Set **Resolution/Control Switch** back to LOW, MEDIUM or HIGH to finish Lesson 2

This assumes use of hypodermic needle electrodes. See Section 2.3.2 for full details.

BAERCOM Summary Use 3: BAERCOM-PC Software

Collect right-ear BAER data as well; download data for both ears to your computer; annotate BAER data if you want; save annotated data to a file; then print it out*

1. Complete Steps 1 through 6 (but *not* Step 7) of Summary Use 2 above.

2. Set up a USB connection between your computer and the BAERCOM
   - Check that BAERCOM **Function Switch** is still in the SHOW position
   - Attach one end of a **standard USB cable** (supplied) to the BAERCOM **USB jack**, found at the center of the BAERCOM top panel
   - Plug the other end of the **USB cable** into any USB port on your computer

3. Download *left-ear* BAER data to your computer:
   - Start the BAERCOM-PC software, then click the orange **OK** button in the lower right corner of the welcome window, software main window now appears

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- Click the green **Locate BAERCOM** button at lower left of main screen to allow the software to acquire the USB link between BAERCOM-PC software and the BAERCOM unit
- Click the green **(L) Get BAER Data** button, then wait 3 to 5 seconds until the BAER data collected in Lesson 2, Step 5 appears in the large left plot area
- Disconnect the **USB cable** from the BAERCOM for the next few steps – this will reduce electronic "noise" that could otherwise mar right-ear data collection.

4. Prepare to collect BAER data from *right ear*
   - Gently move earphone to subject's *right ear*, trying for a good ear-canal seal
   - Flip **Ear Select Switch** at right end of bottom panel to RIGHT position

5. *View right-ear* EEG Data: as for the left ear, at this point you should see a *stable, fairly flat baseline* with just a small amount of electronic "noise"

6. *Collect right-ear* BAER response
   - Set the **Function Switch** to COLLECT
   - Listen for a faint clicking sound from the earphone
   - Watch as the BAER response takes shape on the **display**
   - Wait until the characters "R020" appear at top right of the **display**

7. When "R020" shows, *"Show"* the *right-ear* BAER data on the **display**
   - Set the **Function Switch** to SHOW
   - Listen as the click stimulus *stops*
   - Observe the plot on the **display**, this is the right-ear data you just collected

8. Download *right-ear* BAER data to your computer
   - Keep the **Function Switch** set to SHOW
   - Reconnect the **USB cable** to BAERCOM
   - Click the "Locate BAERCOM" button ti establish the link
   - Click the green **(R) Get BAER Data** button, then wait 3 to 5 seconds until the *right-ear* BAER data appears in the large right plot area

9. Enter text as desired to *annotate and document* your test
   - Click mouse cursor inside the text box containing "(Location Details)" at upper left of the main screen
   - Delete these characters and then enter your test location and/or whatever other information you like (128 characters maximum)

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- Tab successively through the text boxes with "(enter Name/ID)," "(enter Breed/?)" and "(other notes)," entering the suggested information or whatever you like (the two small center boxes hold 64 characters maximum, the large right box holds 128 characters.)

10. *Save* your BAER test data along with your notes
    - Click the blue **Save** button at the bottom of the main screen, then click **OK** in the pop-up confirmation box
    - Enter 6 to 12 alphanumeric characters into the "File name:" area of the (save) dialog box, which is labeled "Select a File Name for the Saved BAER data"
    - Make sure that "BAERData(*.bcd)" is shown in the "Save as type:" box
    - Specify a *folder in which to save your file*, using the "Save in:" area at the top of the dialog box
    - Click the **Save** button to create a file called "[YourFile].bcd" in the folder you specified

11. *Print* your BAER data file with notes
    - Click the yellow **Full Print** button at bottom right of the main screen
    - BAERCOM-PC captures the image of the main screen with data and notes, rotates and sizes it to fit the "portrait" format for your printer, and prints

*Assumes BAERCOM-PC software installed (Section 3) and printer available and on.

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Appendix A: BAERCOM Specifications

Number of channels	One
Audio transducer	Custom piezo-electric (drive is not sufficient for bone conduction or inductive earphone use)
Click stimulus	Constant; click duration less than 1 millisecond
Click amplitude	Six settings, range about 40 to 80 dB
Audio output connector	Switchcraft EN3P3F
EEG input	Signals from two active electrodes and one reference electrode. Reusable needle electrodes are provided. Input leads with small alligator clips are also provided for use with disposable hypodermic needle electrodes.
EEG input connector	Switchcraft EN3P4F
BAER data collection	100 stimulus/response passes (one scan), made in about three seconds, are averaged with any previous data. The composite average is then plotted on the liquid crystal display (LCD). This cycle of scan, averaging and display update is continuous up to 999 scans. Data collection can be stopped at any time to finish the BAER test.
Data collection interval	11 milliseconds following each click stimulus
Repetition rate	One stimulus/response pass each 25 milliseconds
BAER data storage	Up to 23 BAER tests can be saved in non-volatile internal memory "pages". Saved BAER data can be reviewed with the BAERCOM itself (stand-alone mode) or downloaded to a PC with the included BAERCOM-PC software.

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BAER data format Two BAER data sets, along with various headers and text information, encoded as decimal ASCII

PC connector USB Type "B" jack

PC computer interface Isolated USB2

Power source 9V alkaline battery, Type MN1604

Supply current <20 mA

Estimated battery life >24 hours "on time"

Enclosure White ABS plastic with blue silkscreen labels

Case size 1.5" x 5" x 7" (35mm x 125mm x 180mm)

Weight 14 ounces (115 grams) with battery

Appendix B: BAERCOM Update History

BAERCOM Firmware
11/2000   Original release.
9/2002   REVIEW function modified to keep current saved BAER data page
           active when switching back and forth between REVIEW and SHOW,
           to allow quicker page data downloading. The VIEW function sets the
           page pointer back to 1. (See Section 1.4.2.2 for more information.)
7/2006   Transparent update to accommodate a different processor in same family
1/2011   Rev D -- Firmware updated for new processor, integrated USB

BAERCOM-PC Software

1.3   Original production release

1.4   BAER data baseline adjustment added. (See Section 4.5.6 for more
      information.)

1.5   The two larger text boxes now use a smaller font, and can handle five lines of
      text instead of four. (See Section 4.5.2 for more information.)

      Added "Quick Print" function, which uses less printer ink or toner and prints
      much faster than the "Full Print" function. (See section 4.8.1 for more
      information.)

1.6   Internal development version.

1.7   Changed COM port scanning to include COM1 through COM8.

1.8   Internal development version.

1.9   Added ability to copy entire BAERCOM screen to clipboard.
      Added ability to save entire BAERCOM screen as an image file.
2.0   Rewrote code in Visual Basic.Net. Added **R** button and redraw function.,
      color-coded many of the main screen buttons
2.1   Changed over to "Direct USB" interface, eliminating need to check or adjust
      Com Port setting.

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Appendix C: BAERCOM Simulator Use

Overview

       The BAERCOM is a sophisticated yet portable device that repeatedly presents a "click" stimulus to the Ear, and then successively collects the EEG signal for a brief period of time following each stimulus, and sums together the successive EEG signal tracings. This is how BAER data is collected, and the BAERCOM uses this approach as well.

       The BAERCOM Simulator is an optionally purchased accessory for the BAERCOM system. It is designed to replace the Ear and EEG Electrode connections, and to mimic the response of the EEG when presented with successive "click" stimuli. The electronics in the BAERCOM Simulator actually detects the "click" stimulus, and then generates a very low level EEG signal corresponding to an actual BAER tracing. This allows the BAERCOM unit to be "exercised" without having to connect an actual animal.

Use

       The BAERCOM Simulator is provided mainly to meet the needs of the following two possible situations.

a. During your usual use of the BAERCOM, you may run into a situation where you suspect a problem for some reason. You can use the BAERCOM Simulator to quickly "check-out" the BAERCOM leads and data collection process to verify whether or not there may be a problem with the BAERCOM or related accessories. The "Quick Test" below can be used for this purpose.

b. Before even connecting an animal to the BAERCOM, it might be helpful to use an "artificial subject" to allow you to focus on the mechanics of the use of the BAERCOM system, as you "come up to speed" with the BAERCOM. You can use the BAERCOM Simulator as this "artificial subject" to help you more easily gain familiarity with the use of the BAERCOM system. The "System Test" below can be used for this purpose.

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BAERCOM Simulator Connections and Controls

1. 9V Battery

The BAERCOM Simulator is powered by a 9V Alkaline battery placed in a "battery pocket" on the bottom panel of the BAERCOM Simulator. This pocket is along one of the short ends of the bottom panel. Sliding the cover of this pocket AWAY from the center of the bottom panel provides access to the 9V Battery and connection.

When replacing the 9V battery DO NOT pull on the wires to remove the battery connector from the battery! Instead, place your thumb against the long edge of the battery connector and pry it away from the top of the 9V battery. Also, when re-installing the battery in the battery pocket, position the battery such that the battery leads lay flat along the bottom of the battery pocket, and are NOT all bunched up at one end!

The BAERCOM Simulator draws approximately 6 mA from the battery. Thus, a high quality Alkaline battery will power the BAERCOM Simulator for over 72 hours of "on" time. While receiving a "click" stimulus, the BAERCOM Simulator actually checks the level of the 9V battery. When the battery voltage drops to approximately 5.0V, the internal beeper will begin to beep every 2 seconds indicating that the battery should be replaced.

2. Power Switch

This red handled toggle switch applies power to the BAERCOM Simulator when the handle of the switch is toggled "up". The BAERCOM Simulator will "beep" twice from the internal beeper, and is then ready to use. To preserve the 9V battery, you should turn the power off when not using the BAERCOM Simulator.

3. BAERCOM Earpiece Audio Input

This round flange is located on the BAERCOM Simulator front panel, above the power switch. This flange is the same size as the white flange used on the BAERCOM Earphone. A short, rubber tube is included with the BAERCOM Simulator that should slide easily over both the audio input flange on the front panel of the BAERCOM Simulator, and the BAERCOM Ear-phone flange.

Note that you will need to first CAREFULLY remove the rubber tip from the Earphone BEFORE sliding the Earphone flange into the rubber tube on the BAERCOM Simulator. Placing finger-nails on opposite sides of the white flange where it mates to the black Earphone body while removing or installing the rubber tip, can help avoid accidentally pulling the flange off of the Earphone speaker body!

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Note that, in order for the BAERCOM Simulator to work correctly, the tube MUST be in place between the Earphone flange and the matching flange on the front panel of the BAERCOM Simulator! This tube supplies the audio path that allows the BAERCOM Simulator to sense the "click" stimulus.

DO NOT LOSE the adaptor tube! As shipped, it is be taped to the front panel of the BAERCOM. We recommend that it be stored in this location between uses. If you lose the tube, contact UFI. We can supply another tube for $10.

Don't forget to re-install the soft rubber tip to the Earphone after your simulator testing is done!

4. EEG Signal Connection

The BAERCOM uses these 3 standard male "snap" connectors to supply the simulated EEG signal that the BAERCOM is to receive. The 3 alligator clips from the BAERCOM Input Assembly should be clipped over these snaps. Note that each snap has a color marked above it -- each color should match not only the color of the alligator clip cover, but also of the color where each alligator clip lead is inserted into the molded multi-connector at the end of the BAERCOM Input Assembly.

5. Ear/Side Select Switch

To minimize the number of connections made to the subject, the BAERCOM uses a 3 lead connection, and actually switches two of the connections depending on which ear is being tested. The Black lead is always the "Crown" connection, which is the top of the head. One of the two Ear connections becomes the Reference, and the other Ear connection becomes the Signal, depending on which ear is being tested.

The Ear / Side Select switch above the EEG Signal Connections on the BAERCOM Simulator front panel is used to properly route the EEG signals to the proper BAERCOM Input Leads. In other words, when the BAERCOM Ear Select switch is in the "Right" position, placing the BAERCOM Simulator switch to the "Right" position correctly routes the two "active" EEG signals to the BAERCOM input circuitry.

Test Procedures

BAERCOM Quick Test with BAERCOM Simulator

This test uses the BBAERCOM Simulator to do a quick test of the overall BAERCOM BAER data collection process.

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a. Setup for test
        -- Verify that both the BAERCOM and the Simulator are turned OFF
        -- Connect the Earphone between the BAERCOM and the Simulator. You will
need to CAREFULLY remove the rubber ear-piece present on the Earphone in order
to slide the Earphone flange into the receiving sleeve on the BAERCOM simulator.
Placing finger-nails on opposite sides of the white flange where it mates to the black
Earphone body while removing the rubber ear-piece, can help avoid accidentally
pulling the flange off of the speaker body!
        -- Connect the Input Assembly between the BAERCOM and the Simulator
electrode clips. Make sure that the alligator clip lead colors correctly match the colors
shown on the input assembly label, and that the colors on the clips match the markings
on the simulator.
        -- Turn the Simulator on -- it will beep twice, then be ready to go.
        -- Set the BAERCOM "Click Stimulus Size" control to 80 dB (straight up)
        -- Turn the BAERCOM on and let it complete its usual start-up process.

b. Simulator Test -- Right
        -- Place both the BAERCOM switch and simulator switch to "RIGHT"
        -- Turn the BAERCOM R/C switch the "medium", and the Function switch to
"view".
        -- Verify that the signal plotted on the BAERCOM LCD is basically a "flat-
line" with a small amount of noise present.
        -- Turn the Function switch to the "collect" position, and collect exactly 10
scans of data. You will see an approximate copy of the "sample data" (page 24)
slowly grow over the course of the 10 scans. (You may note that the signal starts
approximately1-2 mS after the sample data does, but this is just due to delays in the
detection process.) After 10 scans have been collected, turn the BAERCOM function
switch to "show" to conclude the data collection process.
        -- Now set the Simulator switch to LEFT. [This reverses the connections for
the Red and Yellow leads which reduces the SIZE of the BAER data supplied by the
simulator by approx. 50%.]
        -- Turn the Function switch to the "collect" position, and again collect exactly
10 scans of data. You will again see an approximate copy of the "sample data" (page
24) slowly grow over the course of the 10 scans, but it should only be HALF the size
of the previous BAER data. After 10 scans have been collected, turn the BAERCOM
function switch to "show" to conclude the data collection process.

[This concludes the Quick Test.]

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BAERCOM System Test with BAERCOM Simulator

This test uses the BAERCOM Simulator to do an overall test of all the BAERCOM electronics. BAER data is also transferred to the PC + BAERCOM PC Software and reviewed to test the software and PC Link circuitry as well.

a. Setup for test
        -- Verify that both the BAERCOM and the Simulator are turned OFF
        -- Connect a USB cable between the BAERCOM and the PC Computer. Start the BAERCOM PC Software.
        -- Connect the Earphone between the BAERCOM and the Simulator. You will need to CAREFULLY remove the rubber ear-piece present on the Earphone in order to slide the Earphone flange into the receiving sleeve on the BAERCOM simulator. Placing finger-nails on opposite sides of the white flange where it mates to the black Earphone body while removing the rubber ear-piece, can help avoid accidentally pulling the flange off of the speaker body!
        -- Connect the Input Assembly between the BAERCOM and the Simulator electrode clips. Make sure that the alligator clip lead colors correctly match the colors shown on the input assembly label, and that the colors on the clips match the markings on the simulator. (The clips will NOT be moved at all for this test!)
        -- Turn the Simulator on -- it will beep twice, then be ready to go.
        -- Set the BAERCOM "Click Stimulus Size" control to 80 dB (straight up)
        -- Turn the BAERCOM on and let it complete its usual start-up process.

b. Simulator Test -- Right
        -- Place both the BAERCOM switch and simulator switch to "RIGHT"
        -- Turn the BAERCOM R/C switch the "medium", and the Function switch to "view"
        -- Verify that the signal plotted on the BAERCOM LCD is basically a "flat-line" with a small amount of noise present
        -- Turn the Function switch to the "collect" position, and collect exactly 10 scans of data. You will see an approximate copy of the "sample data" (page 24) slowly grow over the course of the 10 scans. (You may note that the signal starts approximately 1-2 mS after the sample data does, but this is just due to delays in the detection process.) After 10 scans have been collected, turn the BAERCOM function switch to "show"
        -- Tell the BAERCOM PC software to "Find" the BAERCOM, then download the data currently being shown, to the RIGHT BAER data area on the software

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-- Now set the Simulator switch to LEFT. [This reverses the connections for the Red and Yellow leads which reduces the SIZE of the BAER data supplied by the simulator by approx. 50%.]

-- Turn the Function switch to the "collect" position, and again collect exactly 10 scans of data. You will again see an approximate copy of the "sample data" (page 24) slowly grow over the course of the 10 scans, but it should only be HALF the size of the previous BAER data. After 10 scans have been collected, turn the BAERCOM function switch to "show"

-- Direct the BAERCOM PC software to download the data currently being shown, to the LEFT BAER data area on the software

-- You can now evaluate the two tracings. The form of the Sample BAER data plot should be fairly well defined. In addition, the LEFT BAER data plot should be approximately HALF the size of the Right BAER data plot

c. Simulator Test -- LEFT

-- Place both the BAERCOM switch and simulator switch to "LEFT"

-- Turn the BAERCOM R/C switch the "medium", and the Function switch to "view"

-- Verify that the signal plotted on the BAERCOM LCD is basically a "flat-line" with a small amount of noise present

-- Turn the Function switch to the "collect" position, and collect exactly 10 scans of data. You will see an approximate copy of the "sample data" (page 24) slowly grow over the course of the 10 scans. After 10 scans have been collected, turn the BAERCOM function switch to "show"

-- Tell the BAERCOM PC software to "Find" the BAERCOM, then download the data currently being shown to the LEFT BAER data area on the software.

-- Now set the Simulator switch to RIGHT. [This reverses the connections for the Red and Yellow leads which reduces the SIZE of the Baer data supplied by the simulator by approx. 50%.]

-- Turn the Function switch to the "collect" position, and again collect exactly 10 scans of data. You will again see an approximate copy of the "sample data" (page 24) slowly grow over the course of the 10 scans, but it should only be HALF the size of the previous BAER data. After 10 scans have been collected, turn the BAERCOM function switch to "show"

-- Direct the BAERCOM PC software to download the data currently being shown to the RIGHT Baer data area on the software

-- You can now evaluate the two tracings. The form of the Sample BAER data plot should be fairly well defined. In addition, the RIGHT BAER data plot should be approximately HALF the size of the LEFT BAER data plot

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