

BrainMaster[™] System
Type 2E Module & BMT Software for Windows[™]

Installation and User's Manual

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U.S. Patent Number 5,899,867

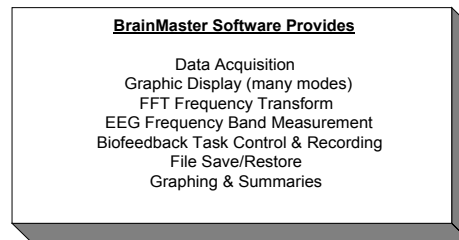
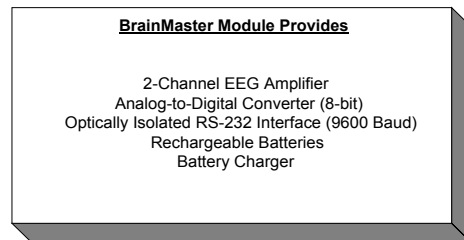
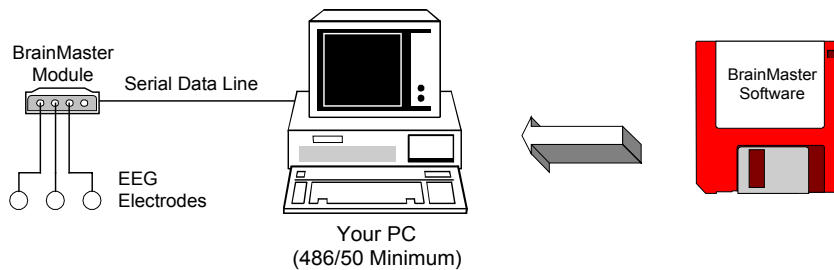
Installation and User's Manual

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1. Introduction

The BrainMaster is a scientifically sound and accurate instrument designed for the recording, analysis, and display of EEG signals (electroencephalograms). It will perform functions similar to typical digital EEG systems, and certain devices such as the Lexicor NRS-2D, Lexicor POD, BrainTracer, NeuroCybernetics, or ProComp. When used with the “BSetup” program module, it can be used for general EEG biofeedback (Neurofeedback) training. This manual will provide the information needed to operate the BrainMaster, ensure that it is working correctly, and to acquire and work with records. For information regarding EEG biofeedback training, refer to the “Bsetup” software section of this manual.

The BrainMaster System consists of three major parts: The BrainMaster Module that connects you to the computer, some form of EEG electrodes, and the BrainMaster (Windows) Software.



The BrainMaster System

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It is first necessary to connect the BrainMaster to your computer, and ensure that the two can communicate with each other. You will then need to connect a minimum of 3 electrodes in an appropriate manner, generally by attaching one to each ear, and one to a location on the head. Then, by using the BrainMaster software, you will be able to record, view, analyze, and display EEG brainwaves in realtime, in a variety of ways.

NOTE: With the 2.0SE software a minimum of a 450 MHz Pentium II is recommended. A faster computer will allow you to use more windows and additional features, as well. BrainMaster software will run on Windows 98, ME, 2000, XP, NT.

1.1 What this manual covers

This manual will explain how to install and use the BrainMaster software, and how the training screen operates. There is a separate section of the manual that will explain the details of the "Bsetup" program that controls and starts up the "master.exe" program. After installing the software, please refer to the "Bsetup" section for details on setup and operation.

1.2 A note on scope

This manual is not intended to teach you the basic principles of EEG or neurofeedback. This manual is like the user's guide that comes with an automobile or an oven, that teaches you the specifics necessary to use that product. However, this manual does not provide you with the actual driving lessons or cooking lessons. Similarly, this manual will not teach you how to "drive" or to "cook" with your BrainMaster. This information must be obtained from other sources including biofeedback certification courses, published literature, videos, training classes, or individual instruction. BrainMaster Technologies can help you to find and gain access to such training sources.

1.3 Special Note about Batteries

Your BrainMaster operates with internal, rechargeable batteries. When you receive your unit, the batteries should be well charged. You can install and test your BrainMaster as soon as it is received, using the procedure in the next sections. But before extended use, make sure the batteries are fully charged, by following the following recommended procedure:

(1) **Charge the unit** by plugging the charging module into a 110V outlet, and inserting the minijack into the receptacle in the rear of the module, leaving it for at least 24 hours. Leave the unit turned off. This will charge the unit sufficient for setup and testing.

(2) When not using the unit, **keep the batteries charged**. Leave the unit turned off, but plugged in, to keep them charged.

(3) **The best operating cycle** for regular use is to have the BrainMaster turned on for eight hours per day, and then turned off, but plugged in (recharging) for 16 hours. With this operating cycle, the BrainMaster should operate continually, without problems, for many years.

(4) If you are a foreign user, follow the above instructions, but use the foreign adapter ("travel adapter") provided by BrainMaster. **DO NOT ATTEMPT TO USE ANY CHARGER EXCEPT OUR OWN.** If you try to substitute another charger, it will probably not work correctly, and will void your warranty.

1.4 Power

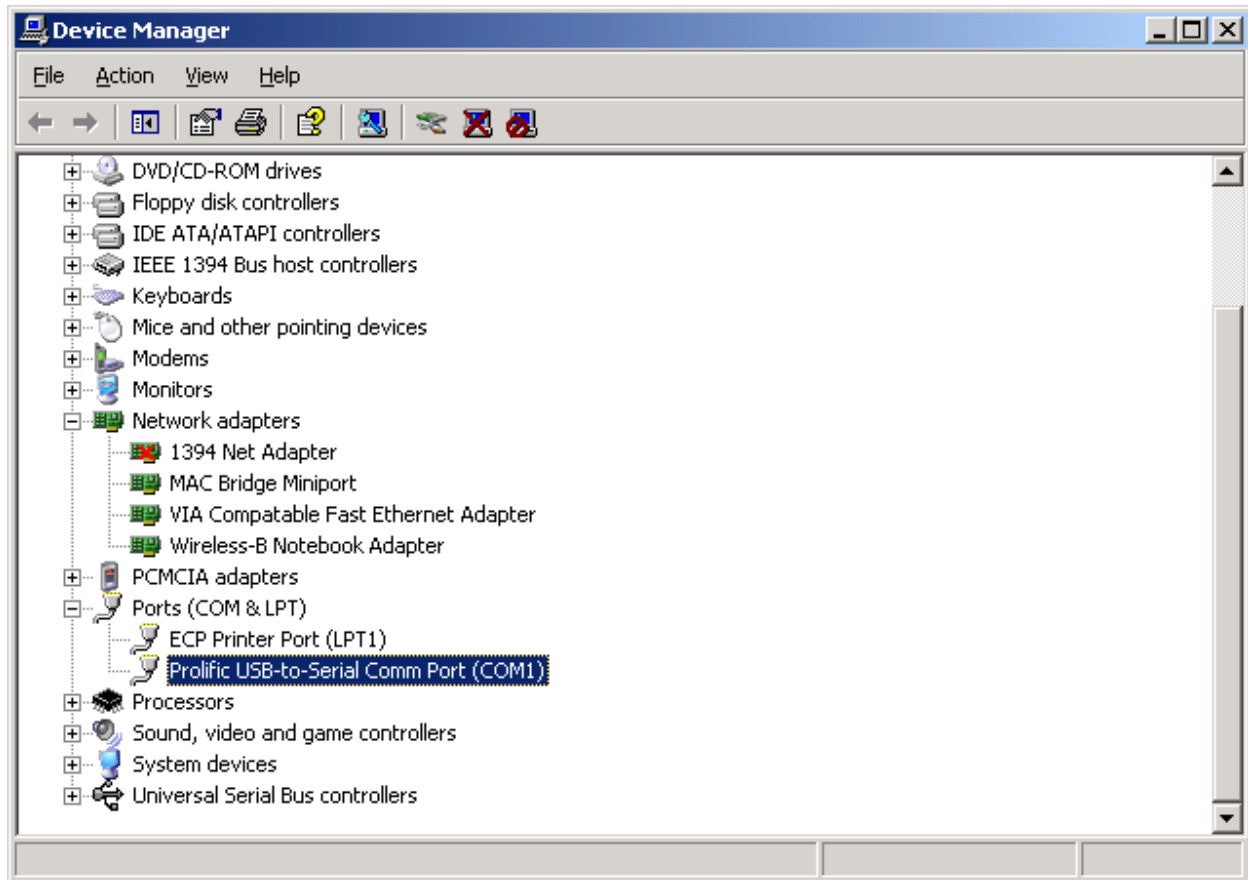
Your BrainMaster contains rechargeable batteries, and was supplied with a charger power module. (A small, wall-mounted adapter that is used to charge the internal batteries). Insert the “mini-phono” plug at the end of the adapter cable into the receptacle next to the power switch on the back of the unit, and then plug the module into a 110V AC power source. The power switch on units above serial number 1000 has two positions: <INWARD> (towards center of device) for on, and <OUTWARD> for off. ON units below serial number 1000, the switch goes up or down. <UP> turns the unit **on**, <DOWN> turns the unit **off**, and <DOWN> is also used for **charging the batteries**. When the unit is on, the front LED will light up. To recharge the batteries, leave the unit plugged in, with the switch **OFF** overnight, or permanently. Once the batteries are fully charged, a nightly 16-hour charge will allow the unit to operate for at least 8 hours.

1.5 Connecting to the PC

To operate the BrainMaster, first connect it to a serial port of a standard PC (Pentium II or better). This is done in exactly the same manner as connecting a modem or other serial device. The BrainMaster module provides a DB-25 (female) connector. You will use a cable that will connect this to the serial port of your PC, depending on the type of connector it provides. A cable is supplied with your BrainMaster.

Note: ***You must use COM1, COM2, COM3, COM4, COM5, COM6, COM7, or COM8.*** Do not use the parallel port. The parallel port generally has a 25-pin female connector on the back of the PC. The serial port will have a male connector, either 25-pin or 9-pin. The BrainMaster has a FEMALE DB-25 connector. It requires a MALE connector on the cable. Your PC will have a MALE DB-25 or DB-9 (in laptops and some desktops) connector. The cable requires a FEMALE connector to mate to it. Therefore, you need a MALE DB-25 to FEMALE DB-25 or DB-9 cable. We normally provide a MALE DB-25 to FEMALE DB-9 cable with the BrainMaster. If you require a different cable, you can contact us.

When you connect the BrainMaster to the serial port, you must determine whether it is COM1, COM2, COM3, COM4, COM5, COM6, COM7, or COM8. You will use this information later, when first configuring the software. If you use a USB to serial converter, you will need to find out which COM port number it is using. To do this, use the following controls: My Computer/Control Panel/System/Hardware/Device Manager, for example, as shown:



1.6 Installing the Software

If you have the CD distribution, simply insert the CD and follow the instruction screen that will appear. You may ignore the following floppy disk instructions.

NOTE: Do not install the software using winzip, or any other install software. You must only *use the "install.bat" program* that is included on the software disk. To install the software you must have a hard drive which must be c:, and a 3-1/2" floppy drive. Place the distribution disk in the floppy drive of your PC (3-1/2"). Then, do one of the following:

1.6.1.1.1 Windows 95/98/ME/NT/2000/XP

If you have Windows 95/98/NT or 2000, use the standard procedure to create a folder and shortcut on the desktop. This is detailed in the next section, for users who are not already familiar with how to do so.

1.6.2 Instructions to create a shortcut on your desktop

Here are detailed instructions for Windows 95/98/NT/2000 users:

- Install the software as directed above
- Double Click on “My Computer”
- Double Click on “C:” or “Local Disk (C)”
- Double Click on “Brainm.20”
- Find the icon for “Bsetup” or “Bsetup.exe”
- Single Right Mouse Click on Bsetup
- Select (single left mouse click) the menu item “Send To”
- Select (single left mouse click) the menu item “Desktop (Create Shortcut).”
- The BSetup exe. icon should now be on your desk-top and from this point on all you have to do is double click on this icon to open your BrainMaster program.

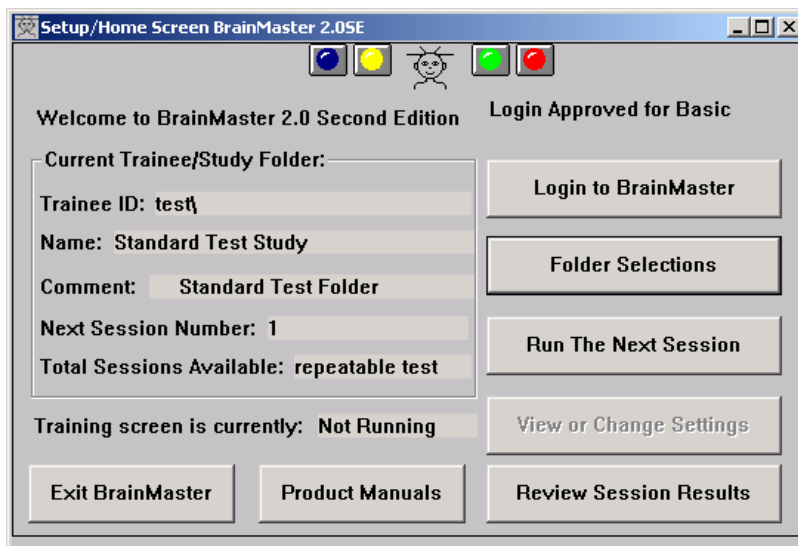
1.6.3 Multiple Monitors with Windows 98/ME/2000/XP

If you use Windows98, you can use multiple monitors, and gain the benefits of simultaneous displays. This requires additional graphics adapters (PCI type) to be installed in the PC, and an additional monitor to be connected to each adapter. Windows will automatically detect the additional graphics adapters and monitors, and activate them for you. They extend the “desktop” to provide area to run and view program windows. When these are used, you can run different BrainMaster screens on the different monitors. For example, the “Master.exe” training screen can run on one monitor, the “Xwing” or “BrainMan” game can run on another, the “BReview” screen can run on another to show the session progress, and the “BSetup” screen can be run on still another monitor. Typically, two monitors are used in order to run one monitor for the operator, and another monitor for the trainee. However, it is also useful to use two monitors for the trainee, so that they can see more information of different types, for example, a game screen, and a summary screen.

Many newer laptops also support a second monitor. To see if your laptop supports this, right mouse click on the “desktop” and select “Properties”. Then click on the tab “Settings”. If you see two monitors in the displayed window, then your system will support two monitors. Select the item “Extend my Windows Desktop onto this Monitor” and attach a second monitor to the rear connector, and you will have a dual-monitor system.

2. Configuring and running the software

To start using the BrainMaster software, you run “BSetup”, either by clicking on the Desktop Icon labeled “BrainMaster 2.0 Setup.”



Then, click on and “**Run The Next Session**” to bring up the “master.exe” training screen.

Turn on the module by putting the switch into the proper position. The red front-panel LED will turn on.

You must first select the communications port that the BrainMaster is connected to. This can be selected in the “Data Channels” screen of Bsetup. Or, use the appropriate menu selection “**Data / Use COM X**” where “X” is the port you are using. You need only do this once and the system will store this setting for future use.

When first testing the software, it is helpful to have a “background” recording to test the system. Touch three electrodes together, to provide a short circuit, and then insert the electrode connectors into the blue, yellow, and black input jacks.

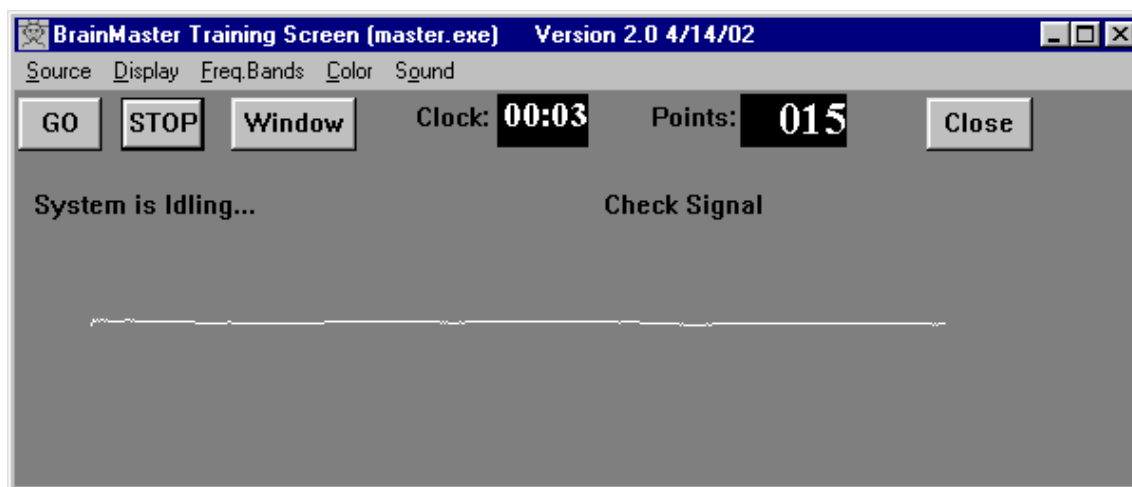
Press the “Go” button and follow the dialog boxes, pressing “OK” as appropriate. The software will communicate with the Module, set it up to acquire data, and begin to take recordings. You should see a signal on your display, similar to Screen 1. If there is any problem starting up the module, you will see a message, telling you what is wrong. If the system works properly, you will see a “flat” signal, indicating that recordings are being made.

Note: If the BrainMaster software cannot open the desired COM: port, there will be a message “**Error opening COM**” in the text area on the top left of the screen. In this case, it is possible that your computer is not configured correctly. Ensure that you have the correct COM: port selected, and that it is properly configured in your system (consult your owner’s manual if necessary).

Note: If you are using “WinModem” or a similar modem control program, or a Palm Pilot, it may interfere with your BrainMaster software. **You may have to turn off or disable such software to use the BrainMaster.**

If the BrainMaster software says “**Module not responding,**” then you know that the software has opened the COM: port, but it still may not be the correct COM: port. It is also possible that the cable is incorrectly connected or defective, or that the module batteries have died down. Check the cable, recharge the BrainMaster module overnight, and repeat the test. **Refer to the separate troubleshooting manual at the end of this book (531-021) if difficulties persist.**

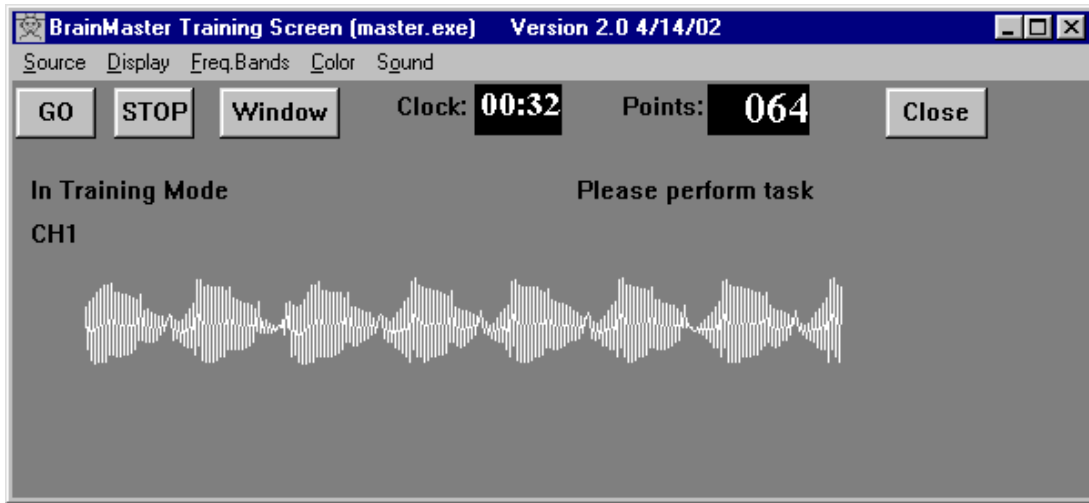
In the example shown, the duration of the screen is 4 seconds. This shows the signal you should see when the electrodes are connected together. The line will move across the screen, and repeat itself every 4 seconds.



Screen 1. - Background signal with electrodes connected together (“shorted”)

If you then unplug the electrodes and leave the inputs “open”, you will see any of a wide range of “noise” patterns, for example, like the following. This is called the “fish” pattern because it looks like fish across the screen. When this appears, the system is operating correctly. This indicates that either there are no electrodes connected, or the electrodes are not properly connected. Do not worry about exactly what your “open inputs” pattern looks like.

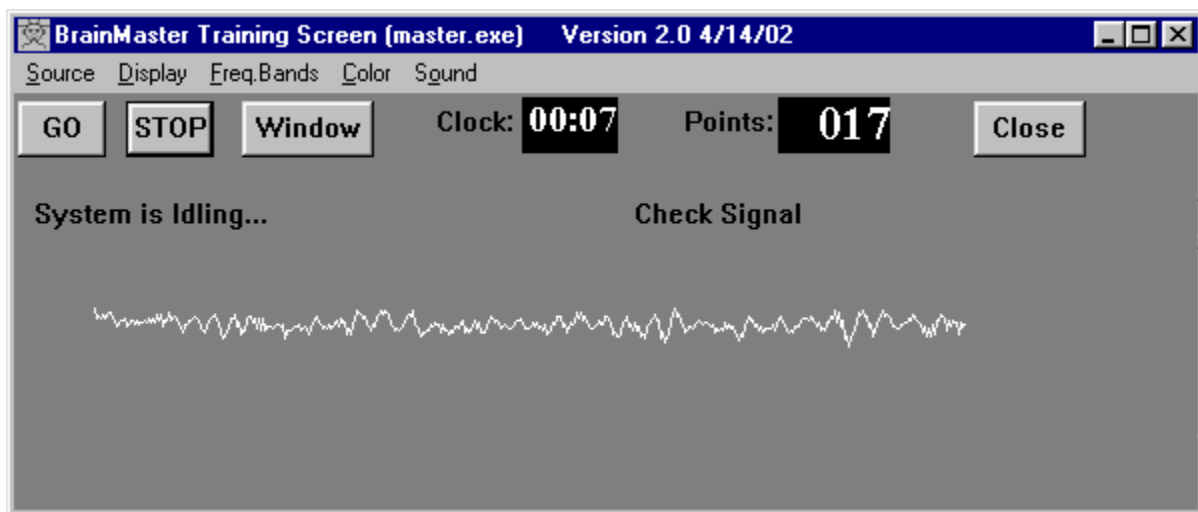
Since it is picking up noise from the room, it can look like almost anything. **This can provide an automatic electrode checking capability.** Whenever you see your “noise” pattern, there is likely a problem with the electrode contact, and you are not seeing real EEG.



Screen 2. – “Fish” signal with nothing plugged into electrode sockets (“open”)

NOTE: If you do not see an exact “fish” pattern, this is not a problem. You can get any kind of waveform with the inputs unconnected (“floating”). As long as the waveform is “wiping” across the display and the clock is progressing one second at a time, the system is working correctly. Especially in Europe or Asia, the noise signal may look very different from that shown.

Now that your system is acquiring data, it is time to connect electrodes, and obtain a real recording. This is described in the next section. The following is an example of what good EEG will look like, once you correctly apply electrodes:



Screen 3 - Real EEG

The use of the display screens and eeg audio option is detailed in the Display Screens and EEG Audio manual. Please refer to that manual for details of selecting and using display screens, and using the EEG Audio option.

3. Electrodes

3.1 Choice of electrodes

For the scalp electrode, several options are available:

- 1) A **conventional disk electrode, and "10-20" conductive paste**. This paste attaches the electrode to the scalp, and provides an electrical conductor. The neatest way to use these electrodes is to scoop some 10-20 paste into the cup of the electrode, and then pressing it into place using a cotton ball. The paste can be cleaned off of the electrode and the skin with warm water after the recording session is finished. With care, disk electrodes can be re-used many times, providing many sessions of use.
- 2) A **commercial electrode hat or cap**. These can be used to locate electrodes anywhere on the head. They work well, and are used by professionals.
- 3) A **saline sponge electrode**. This is among the most economical and effective means. It is especially suitable when a small number of electrodes are being used. Various configurations and mounting arrangements are available. BrainMaster Technologies can provide **FlexTodes** and accessories for these applications.

You must always be careful to **properly clean and prepare the skin surface**, before applying electrodes. This can be done using the prep gel supplied with your BrainMaster. Use a cotton ball or swab to mildly clean the skin with a small amount of prep gel, then wipe the area clean before applying electrodes.

For the ear electrodes, ear clips may be used. These are *optional*, and are not provided with the standard system. For a good ear connection, a **"mastoid" is recommended**, which is to stick the gold cup electrode onto the bony area behind the ear. If this is not possible or is not desired, the connection may be made by sticking the gold cup electrode onto the bony area above the ear.

For more information regarding electrodes, refer to the special section "Electrode Selection, Location, and Application."

3.2 Connecting electrodes

3.2.1 Electrode Preparation

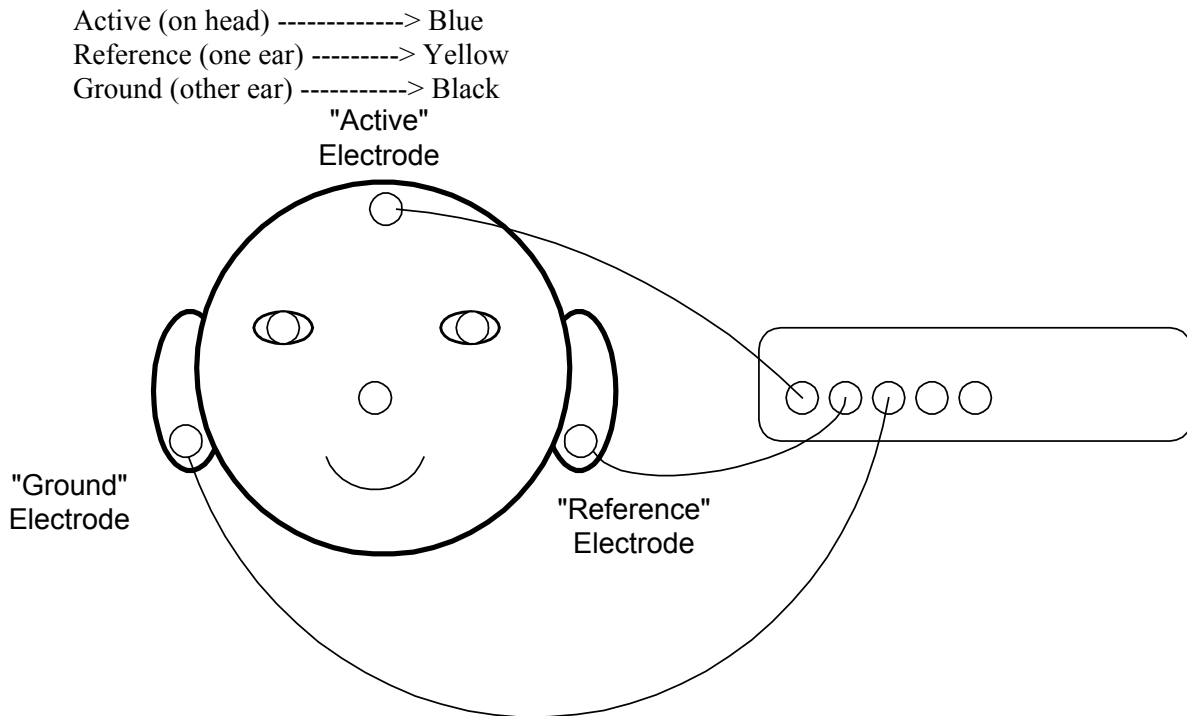
It is always recommended to clean the electrode location with prep gel, and to use an approved electrode paste. This is described in detail in other parts of the BrainMaster documentation, and in the video tape, and can also be learned from training sessions. If you are not familiar with the basic principles of using EEG equipment, it is recommended that you obtain some training before you attempt to record and use EEG's.

3.2.2 One-channel connection

This section details how to connect for simple one-channel recording and training. The BrainMaster requires a minimum of three electrodes, designated as follows:

"Active"	Blue
"Reference"	Yellow
"Ground"	Black

Generally, the Active electrode will be attached to the head in a specific location (frontal, parietal, occipital, etc.), and the Indifferent and Ground electrodes will be attached to or near each ear. The best way to get started is to connect one channels, which will require three electrodes. To do this, plug one electrode jack (for the "Active") into the Blue socket, another ("Indifferent") electrode jack into the Yellow socket, and a third ("Ground") electrode jack into the Black socket:



If you wish to do "bipolar" EEG, then put the reference electrode anywhere you desire. For example, to do a bipolar C3 - Fz recording, connect C3 to the blue input, Fz to the yellow input, and connect the ground (forehead, ear, or wherever you prefer) to the black input.

If you do not have earclips, you may use the "mastoid" connection, which is made by connecting the electrode to the bony area behind the ear. Electrodes may be attached by scooping a dab of "10-20" paste into the cup, and pressing the cup onto the head using a cotton ball.

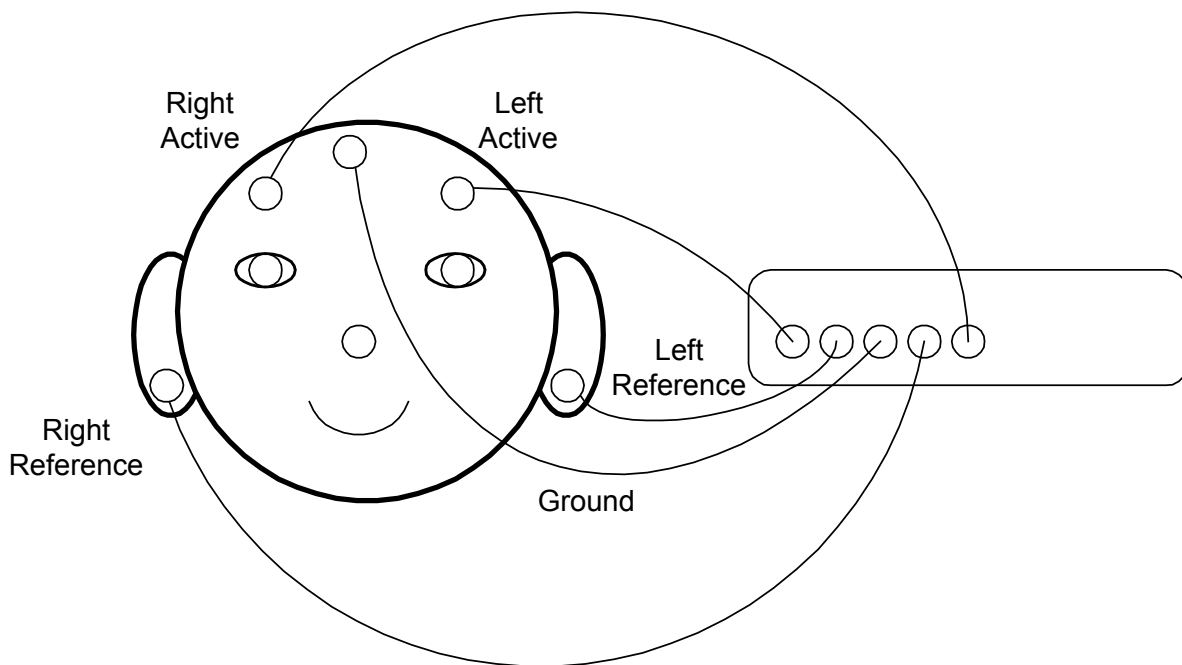
This configuration will record the EEG as measured between the head and the left ear as a reference, with the right ear being used as the module "ground."

3.2.3 Two-channel connection:

There are many ways to connect for two-channel recording and training, depending on your application and needs. This manual cannot teach you all the principles involved. It is assumed that you understand what you are trying to record and train. This manual will give you the basic information necessary to use the BrainMaster for your application, based on your existing understanding.

To get a two-channel recording, of the left and right sides of the brain, you can use a connection such as the following:

Left Active (on head) ----->Blue
Left Reference (left ear or mastoid)----->Yellow
Ground (forehead or ear or mastoid)----->Black
Right Reference (right ear or mastoid)----->Green
Right Active (on head)----->Red



This figure shows a typical manner of connecting electrodes, using two scalp electrodes as "active" sites, two earclips as "reference" sites, and a ground on the forehead. Note that the ground connection can be made anywhere on the head, so the choice of this location is very flexible.

This provides the most basic information about how electrodes can be connected. For further details, it is necessary to refer to other resources such as published literature, training classes, or certification programs.

3.2.4 Verifying the Connections

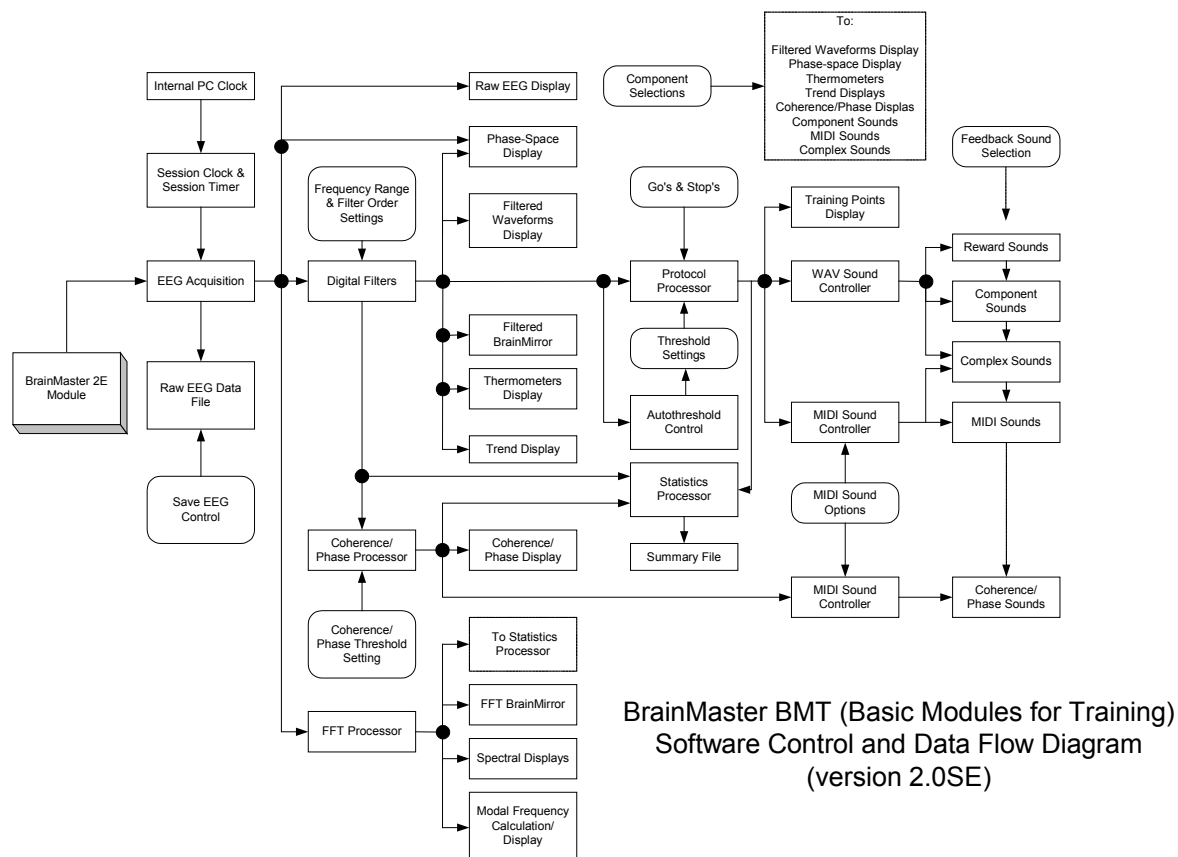
Having connected the electrodes, *examine the waveform display* to ensure that the system is acquiring good EEG signals. It takes some experience to recognize “clean” eeg. You can use the frequency bands in the “Brain Mirror” and “FFT” windows to help you judge this. The eeg contains frequencies from 1 Hz, up to about 30 Hz. There are two main types of noise to watch out for. One is low-frequency noise, in the form of baseline shifts, that take the signal to the limits of the display window, causing distortion. Another form of noise is high-frequency noise, such as muscle artifact, 60 cycle interference, or other interference. These show up as jagged, or sharp, signals, and you should recognize them as being non-eeg.

NOTE: *If the electrodes have too high an impedance, you may see the "Fish" pattern* previously described. If you see this pattern, it is necessary to check the electrode connections, and you should remove and carefully reattach the electrodes if this pattern persists.

NOTE: *Do not attempt to connect your body to any other "grounded" devices* such as appliances, water pipes, equipment chassis, etc. The BrainMaster is optically isolated from your computer, and should be kept separate from any other electrical sources or devices.

4. Internal Software Data Flow Diagram

The following diagram shows the internal data flow in the BrainMaster software. This should be helpful when setting up training protocols, and when interpreting the functions and data when operating the system.



5. Viewing raw and filtered waveforms

The BrainMaster can display both the *raw EEG, and the output of up to 8 digital filters*. Select the digital filters for viewing by pressing the control button that shows the colored waveform lines, or selecting the “Display/Filtered Waves” menu item. The filtered waveforms are valuable for visual inspection, to confirm that the system is working properly, and can also be used as a visual feedback for EEG training.

It is also possible to select from options for the color plan for the waveform displays. This is available under the “Color” menu. This will allow you to change the display for the waveforms, threshold lines, and screen background.

5.1 Channel Selection

The BrainMaster can use either 1 or 2 channels of EEG. This is selected using the BSetup program. Refer to the Setup manual for details of setting up this mode.

5.2 Sum-Channel Mode

When two channels are being recorded, the BrainMaster can operate in “sum-channel” mode, in which the data from the two channels are combined, in order to be sensitive to the relative phase between the two channels. To enter (or exit) sum-channel mode, use the pushbutton marked with the “+” sign. The label on the waveform display will reflect this mode, by showing “CH1 + CH2”, and “CH1 - CH2” in display channels 1 and 2.

In this mode, the first display channel is calculated as the SUM of the two input channels, and the second display channel is calculated as the DIFFERENCE between the two input channels. In this way, signals that are in-phase between the two channels will reinforce, causing a larger signal in channel 1. Display channel 1, in sum-channel mode, is thus sensitive to signals that are in-phase between the two input channels. Display channel 2, in this mode, will reflect signals that are out-of-phase between the two input channels. This mode is very useful if you want the BrainMaster to respond to the degree of synchrony, or coherence, between the two input channels.

For example, if the two channels represent the left and right hemispheres, then display channel 1 (in sum-channel mode) can be used to respond to the degree of synchrony between the two sides of the brain. All of the calculations, displays and control functions become responsive to the display channels thus defined. Thus, if you use display channel 1 for control, in sum-channel mode, it will be able to control the computer based upon the amount of common or in-phase energy between the channels, in whatever frequency band is used. Similarly, display channel 2, the difference, can be used to train EEG asymmetry.

5.3 Digital Filtering and component controls

The BrainMaster software contains 8 digital filters, used to calculate and display the EEG energy in the respective frequency bands. Each of the filters measures an EEG “component,” e.g. alpha, beta, etc. These frequency bands can be set up using the “BSetup” program, but they have built-in settings as explained below. The digital filters are used for all EEG training and control protocols and functions. The nominal settings are as follows:

Component	Low Frequency	Upper Frequency
Delta	1	3
Theta	4	7
Alpha	8	12
Lobeta	12	15
Beta	15	20
Hibeta	20	30
Gamma	38	42
User	30	35

NOTE: DO NOT use a delta low cutoff below 1 Hz, or a bandwidth (Upper – Lower) less than 1 Hz. The usable frequency range is from 1 to 45 Hz, and the minimum filter bandwidth is 1 Hz.

The digital filters use a method known as “quadrature” filtering. This is an extremely fast method, because it calculates the waveform energy in a very efficient manner, and avoids the need for “envelope detection” required with conventional filters. See the cited references for more details.

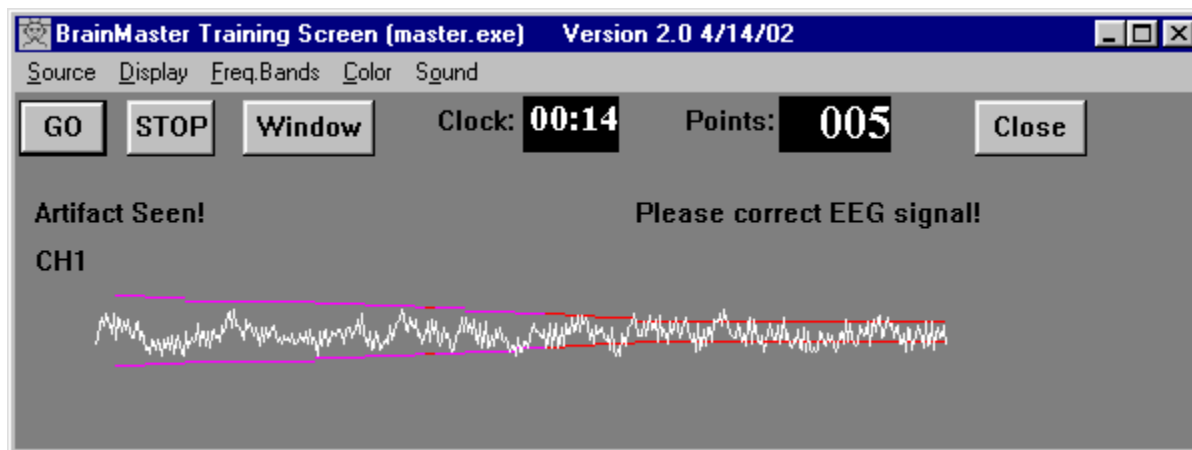
There is a control button for each EEG component (delta, theta, alpha, lobeta, beta, hibeta, gamma, and user). Each button has the Greek symbol for that component on it. Pressing that button will "toggle" the display and processing of that component. This will affect any of the display windows that can show the components. These include the waveform, phase-space, thermometer, counter, 1-D graphs windows. The corresponding component display items will appear or disappear, as you select or deselect a component.

The control protocol for each component is set up using the “BSetup” program (See manual for Bsetup). The mode of each component is designated by the appearance of a "0", "+", or "-" on the corresponding thermometer bulb.

It is possible to define a protocol that uses more than one component for “+” or for “-”. Any combination of components may be used. If two components are assigned "+", then they must both be above threshold for a reward; similarly, two "-" components must both be below threshold.

5.4 Artifact Rejection

There is the ability to detect when the EEG signal is outside of a predetermined bound, and to stop providing data processing and control whenever this occurs. This is very useful to prevent the system from responding to artifacts such as muscle and eye movement, etc, when it should be responding only to brainwaves. The artifact rejection can be turned on from the “Compute/Reject Artifact” menu, and it also goes on when entering Play Mode. The reject threshold begins at 240 microvolts p-p, and can be lowered by using the keyboard key “r”. It can be increased by pressing “R”. It can also be set using the Data Channels screen in Bsetup.



Screen 4 - Adjusting the Artifact Rejection

This example shows the result of lowering the threshold by pressing “r”, until it is so low that the signal is exceeding it. As a result, no computations are made, no rewards are earned, and a message appears on the screen indicating that artifact is seen.

5.5 Coherence Display

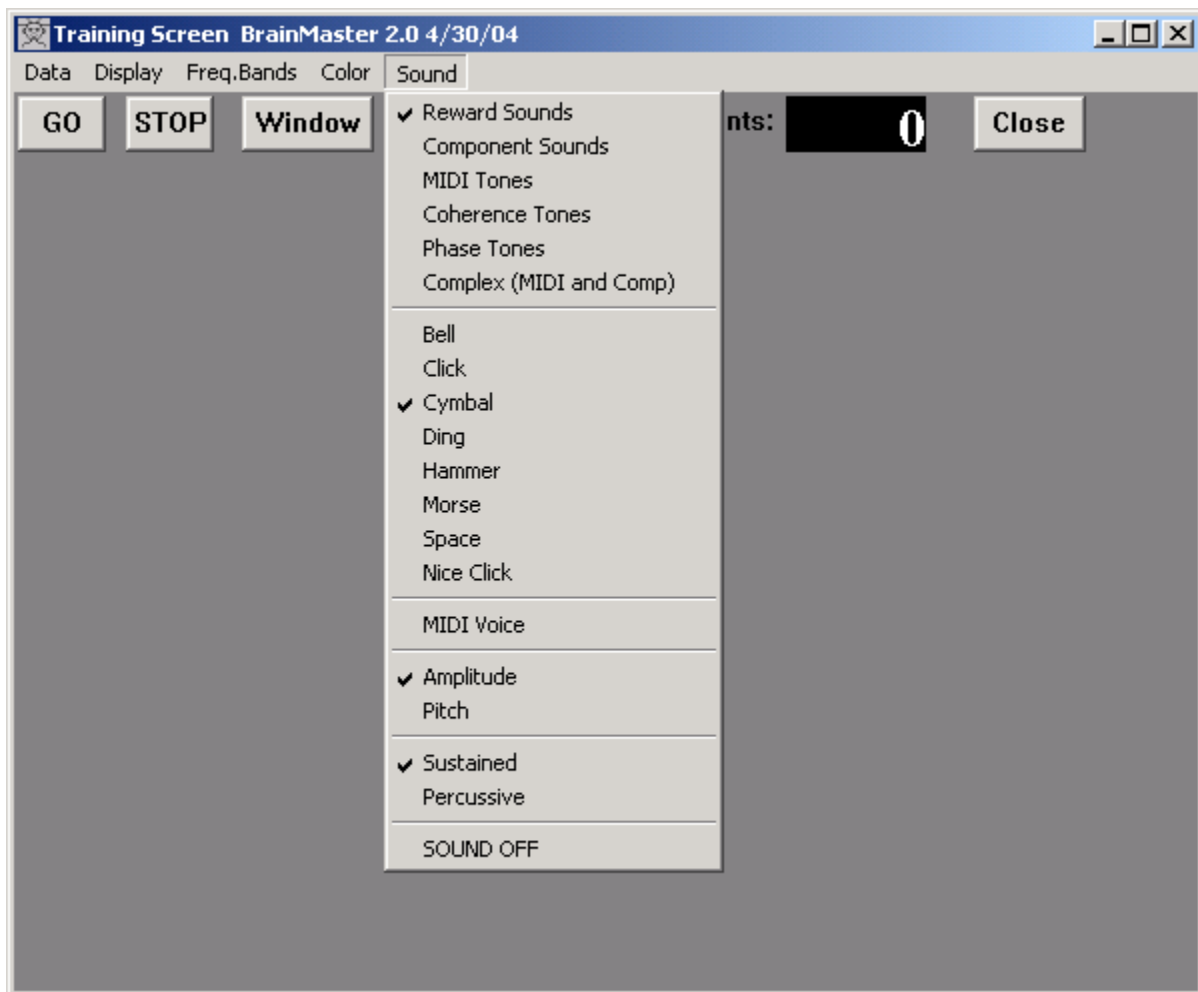
The BrainMaster can process and display the “coherence” between the two channels, if desired. This is accessed using the BSetup program. The program will display the coherence in a series of bars, as described in the Displays manual. This is very useful for observing and training the coherence in the EEG, which is a representation of how similar the frequency energy is in the two channels. Identical signals have a coherence of 1.0. Random signals have a coherence generally between 0.0 and 0.4. When training EEG, coherence values from 0.5 to 0.8 are generally seen.

5.6 Use of Sound

There are six ways to use standard *sound feedback* with the BrainMaster:

1. Pitch Feedback
2. Reward Sounds
3. Component Sounds
4. Coherence Sounds
5. Phase Sounds
6. Complex Sounds

These methods are selected using the “Sound” menu pulldown:



5.6.1 Pitch Feedback

If you select the “Pitch Feedback” menu item, the system will attempt to send sounds to a MIDI-compatible (“wavetable”) synthesizer. To use this mode, you must have a MIDI compatible sound card

installed in the computer. There are 128 selectable sounds available. The selection menu is accessed by using the “MIDI Voice” menu item and selecting the desired voice.

When Pitch Feedback is selected, the system will play tones for each EEG component. Thus, up to 8 tones may be heard. The tones will be heard under the following conditions:

- The component is enabled, i.e. is checked in the “Freq Bands” menu.
- The component is above its threshold (if enhance = “go”).
- The component is below its threshold (if inhibit = “stop”).

The volume or pitch of the sound are proportional to the amplitude of the component. Any or all of the components can be active in this mode, allowing you to play up to 8 “voices” via the EEG.

In this mode, for each component selected (visible in the “thermometer” window), you will hear a tone whenever the component that meets its training criterion. If the threshold is kept at zero for a “go” component, the sound will always be heard. The volume or pitch of the sound is proportional to the value of the component. Thus, when you are training a component, the sound serves both as an audio indicator (that the component is above threshold) and as an indication of the size of the component. If the component is in “stop” mode, then it will be heard when it is below threshold.

If you are processing a component for reward, but do not wish to hear it, simply deselect it from the “Freq Bands” menu so that it is unchecked. It will continue to be used for feedback processing, but you will not hear the proportional pitch sound for that component.

5.6.2 Reward Sounds

When Reward Sounds are selected, the system will play a “.wav” file when all the components meet their combined criterion, e.g. beta is above its threshold and theta is below its threshold. It is possible to select the file that is played, and these files are shown in the pull-down under the mode selection.

Normally, when a reward is registered, the computer will beep or ding, depending on its hardware configuration. The sounds can be changed to any of several available sounds. You may use the “Sound” menu pull-down to change the “.wav” files played when you score a reward, under normal “Play” mode. This menu pull-down lists different sounds. Choose the sound you prefer for feedback training. You may also replace the sounds to provide your own sound. For example, if you have your own sound file, and you name the file “click.wav”, then the sound will be used in place of the built in “click” sound.

5.6.3 Component Sounds

There is a menu item under the “Sound” menu, labeled “Component Sounds”. It causes the system to play a different .wav file when each component is above (in “go” mode”) or below (in “stop” mode) its threshold. The files are “sayalpha.wav,” “saybeta.wav,” and so on. Currently, these files contain short nature sounds. You can put any sound into these files using a sound editor of your choice.

This is desirable when you want to know which EEG component is above its threshold. It is especially useful for relaxation training. The sounds are stored in files named “sayalpha.wav”, “saybeta.wav”, and so on. It is possible to replace these files with desired sounds. The default files play nature sounds and other appropriate sounds for the training.

Note that thresholds should be higher for this sound mode than for others. Unless thresholds are kept high, there will be too many (a “cacophony” of) sounds, which is not desirable for feedback. Increase

thresholds (or lower percentage time over threshold if using autothresholding) to limit the amount of sounds that are produced during the training.

5.6.4 Coherence Sounds

This feedback mode works in 2-channel mode, and provides pitch feedback whose loudness or pitch is proportional to the coherence of each component. A tone will be played for each component that is enabled (visible in the coherence window).

5.6.5 Phase Sounds

This mode is similar to Coherence Sounds, except that it uses the phase between the 2 channels as the training variable. Phase is taken as a percentage, so that “0” is “exactly in phase”, and “100” is “exactly out of phase (180 degrees).

5.6.6 Complex Sounds

Complex Sounds plays .wav files as a background sounds, and a MIDI tone as a foreground sound. When doing alpha/theta training, the .wav file will be either “sloalpha.wav” or “slotheta.wav”, depending on whether alpha or theta is larger. The foreground sound will be a MIDI tone (e.g. tubular bell, etc) played whenever a “go” component exceeds its threshold.

5.6.7 Additional Sound Files – Pause and End Session

There are sound files that provide sounds for special times in the session. These are the artifact sound (artifact.wav), the pause sound (pause.wav) and the end session sound (endsess.wav). They are automatically played when there is an artifact, when the system pauses, or when the session ends, respectively. These are provided with appropriate sounds for most users. However, if you wish to replace them with other sounds, this can be done by replacing the files with other sound files, and naming them appropriately. For example, some trainees prefer no sound for artifact or for the end of the session. A file is provided on the CD disk in the directory “contrib\Sound Files” that contains various sounds for these uses, as well as for component sounds. The file “artifact.wav” in this directory is silent, and can be used in place of any file when no sound is desired for that condition.

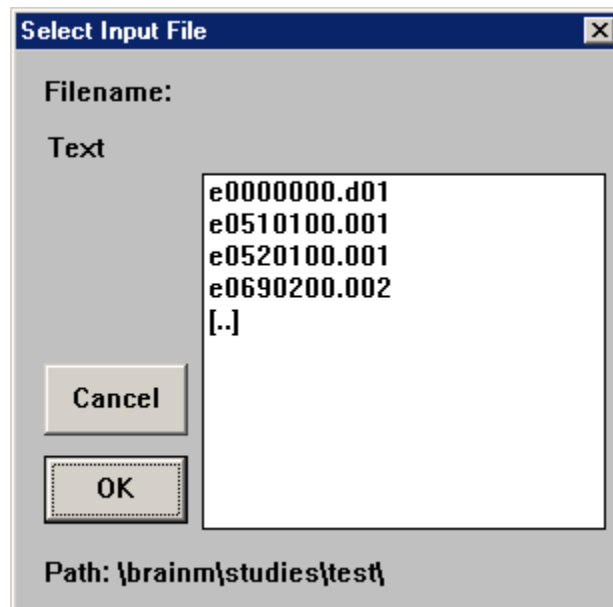
5.6.8 EEG Audio Sounds

EEG Audio is an optional sound component that is included with the “AVI” Audio Visual Interface. For details of this capability, refer to the “Display Screens and EEG Audio” manual.

6. Saving and Playing Back EEG

The BrainMaster can save and play back EEG during any session. To save EEG to disk, press the button that shows a disk with an arrow pointing INTO it, or use the menu item under the “Record” menu. This should be done when data acquisition is already running. The system will automatically store the EEG into a file with a name that the system assigns. The file names generated indicate the session number, the “acquisition number,” and the “save number” of the record. The “acquisition number” goes up every time the START button is pressed, so that it keeps count of the number of times data acquisition has started. The “save number” goes up every time SAVE TO DISK begins, so that it counts up for every piece of EEG recorded. In this way, you can save a series of EEG segments at different times by pressing the SAVE TO DISK button, without having to stop and start the data acquisition.

To play back EEG, first select the record by using the popup box accessed with the “Source/File Replay” menu popup. This will produce the following popup screen:



These filenames indicate the session, the “acquisition number,” and the “save number” of each record. The fields are written in “decimal” notation in the file name. In order to see the details of a file, click on it, and the popup will display the length of that file.

To select a file, simply highlight it with the mouse, and it will become the current record to be played back.

To play back a record, press “OK. This will cause playback to begin. To stop playback, press the “Stop” button.

7. Use of keyboard controls

The following keyboard controls can be used at any time when the BrainMaster is operating:

NOTE: When autothreshold is used, threshold commands change percent target value.

NOTE: Pressing <Tab> switches into “frequency adjust” mode. Pressing “a” for alpha, “t” for theta, etc, will make the frequency band go up or down 0.5 Hz per press.

Key	Function
a	Increase alpha (8-12 Hz) threshold by 0.1uV or target by 1 percent
A	Decrease alpha (8-12 Hz) threshold by 0.1uV or target by 1 percent
b	Increase beta (15-20 Hz) threshold by 0.1uV or target by 1 percent
B	Decrease beta (15-20 Hz) threshold by 0.1uV or target by 1 percent
c	Increase coherence/phase threshold
C	Decrease coherence/phase threshold
d	Increase delta (1-3 Hz) threshold by 0.1uV or target by 1 percent
D	Decrease delta (1-3 Hz) threshold by 0.1uV or target by 1 percent
e	Toggle “Thermometer” display window(s)
f	Toggle FFT “Frequency” display window(s)
g	Increase “gamma” (38-42 Hz) threshold 0.1 uV or target by 1 percent
G	Decrease “gamma” (38-42 Hz) threshold 0.1 uV or target by 1 percent
h	Increase “hibeta” (20-38 Hz) threshold 0.1 uV or target by 1 percent
H	Decrease “hibeta” (20-38 Hz) threshold 0.1 uV or target by 1 percent
i	Toggle “1-dimensional trend” line graph display window(s)
j	Toggle “2-dimensional trend” line graph display window(s)
l	Increase “lobeta” (12-15 Hz) threshold 0.1 uV or target by 1 percent
L	Decrease “lobeta” (12-15 Hz) threshold 0.1 uV or target by 1 percent
M	Toggle “Brain Mirror” between FFT and Filtered Mode
p	Toggle “Phase Space” display window(s)
r	Reduce artifact rejection threshold value by 10 microvolts
R	Increase artifact rejection threshold value by 10 microvolts
t	Increase theta (3-8 Hz) threshold by 0.1 uV or target by 1 percent
T	Decrease theta (3-8 Hz) threshold by 0.1 uV or target by 1 percent
u	Increase user band threshold by 0.1 uV or target by 1 percent
U	Decrease user band threshold by 0.1 uV or target by 1 percent
w	Toggle “Waveform” display window(s)
y	Copy autothresholds into current thresholds (“Autoupdate”)
+	Increase display gain by 20%
-	Decrease display gain by 20%
<Space>	Pause or end pause
1	Set mode so keys (d, t, etc) adjust channel 1 only for thresholds, etc.
2	Set mode so keys (d, t, etc) adjust channel 2 only for thresholds, etc.
0	Set mode so keys (d, t, etc) adjust both channels 1 and 2 for thresholds, etc.
3-9	Post live note to records (visible in Breview “report”)

8. References

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