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

Display Screens
for Master.exe

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1. Introduction

1.1 Update Notice

This software is in the continual process of being updated. The screen displays that are shown are from the latest available version of the BrainMaster program, but as the software is updated, they may not look exactly the same as you will see in the current distribution. Nonetheless, the basic appearance and operation of the screens will be the same.

1.2 Using the display

The BrainMaster screen is normally divided vertically into two sides, denoted "left" and "right." These two areas usually reflect the EEG activity from the respective sides of the head. The work area consists of "tiled" regions that provide the various types of displays.

1.3 Two sets of windows

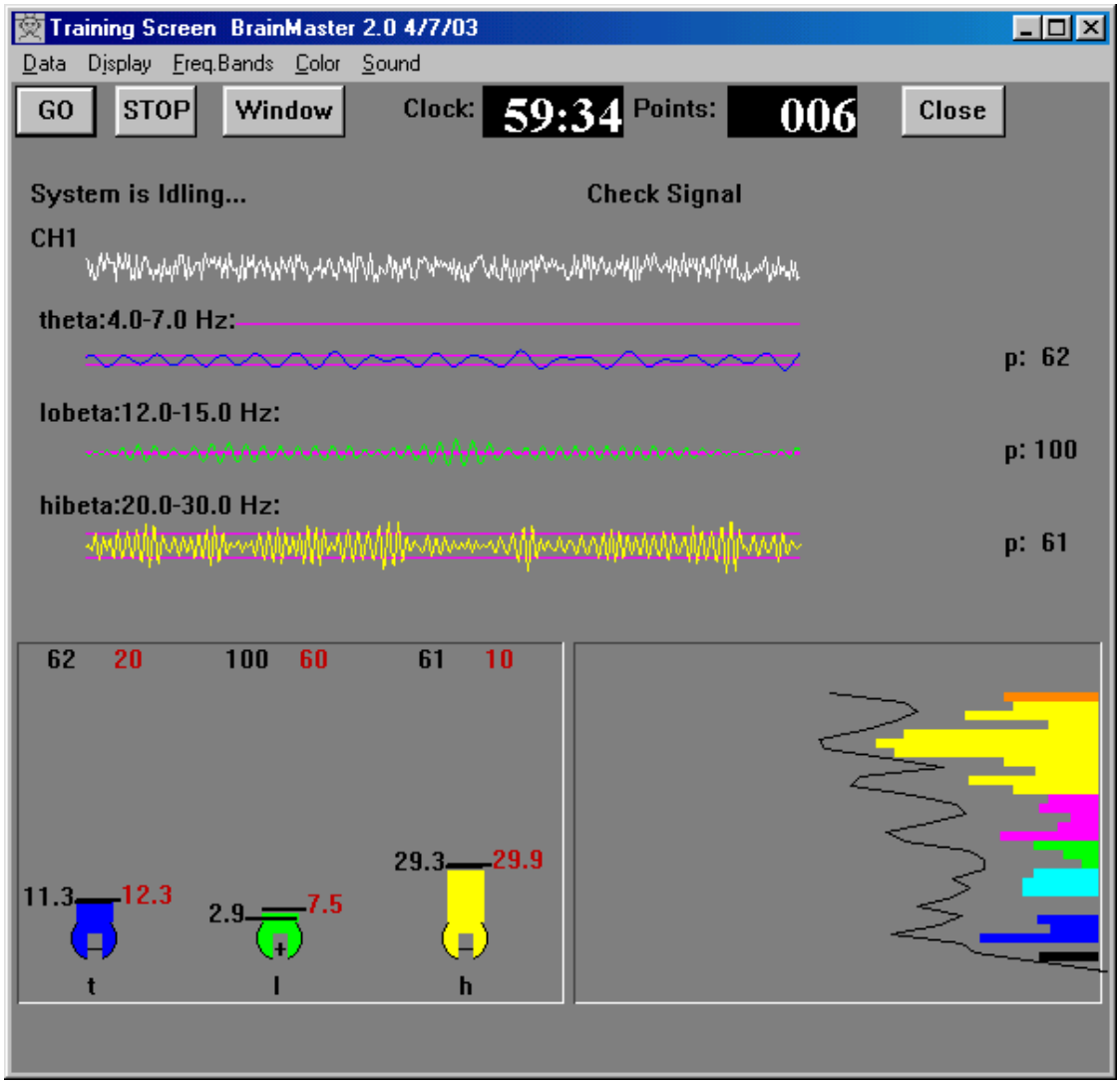
There are two sets of displays in the BrainMaster. The first set comprise the “panes” that are selectable within the training screen. These automatically “tile” to fill the screen. Panes are turned on and off using the menu items at the top of the Training Screen, under the “Display” menu item. When a pane is selected (visible), its corresponding menu item will have a checkmark visible beside it. Any number of panes can be used. However, as more panes are used, they will need to occupy space at the bottom of the training screen. If your computer display does not have sufficient room (or pixels) to display them, they will not be visible.

The second set is comprised of the “windows” that pop up when the corresponding pushbutton in the “Windows” dialog is pressed. These windows are standard Microsoft Windows windows, and have all the associated Windows properties. They can be resized, moved, minimized, and selected using the mouse. Each such window will also have an associated pushbutton appear on the “task bar” which is usually visible on the bottom of your Windows display.

In many of the windows, text displays provide additional information. When appropriate, letters are used to identify EEG components. These are as follows: “d” for Delta, “t” for Theta, “a” for Alpha, “l” for LoBeta, “b” for Beta, “h” for High Beta, “g” for Gamma, and “u” for User. These are also the keyboard keys that can be used to adjust thresholds. Typing a lower-case letter will raise the corresponding threshold, and typing the upper-case letter will lower it.

1.4 Typical Training Screen Display

The following is a typical Training Screen display. It contains raw and filtered waveforms, the thermometer pane, and the FFT BrainMirror pane. In addition, the timer clock and points display are visible.

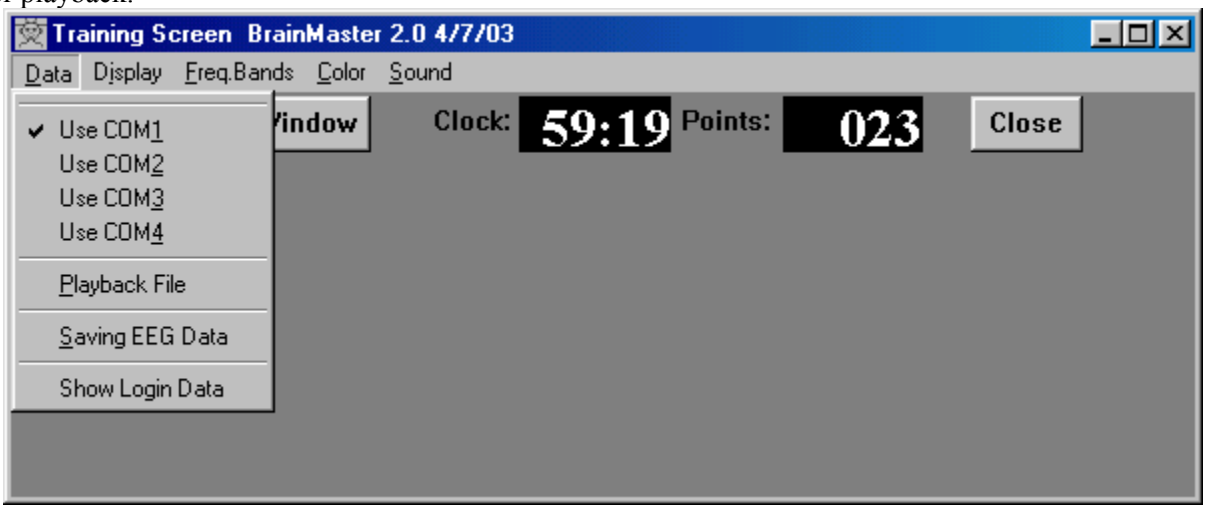


2. Using Menus

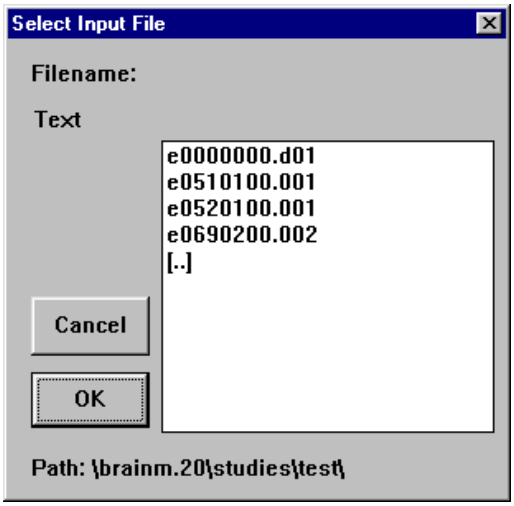
It is intended that all on-screen displays have corresponding menu items. These menu items can be accessed using the mouse, in the conventional Windows manner, or can be accessed using the keyboard, by pressing the **<Alt>** key along with the key letter. The key letters are identified by their being underlined in the menu listing. Selected menu items have a checkmark to indicate that they are currently "active."

2.1 Data Menu

This menu allows you to select the data source. The choices are a COM port (COM1, 2, 3, or 4), or a file for playback.

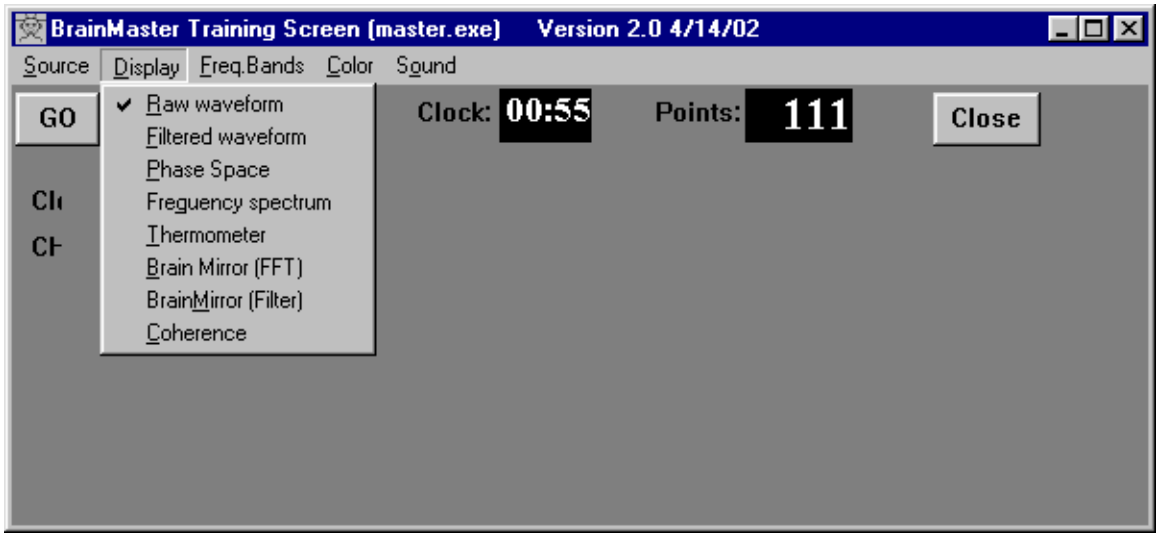


If you select Playback File, you will see a dialog box that shows the available files. Select the desired file and click on "OK" to begin the playback.



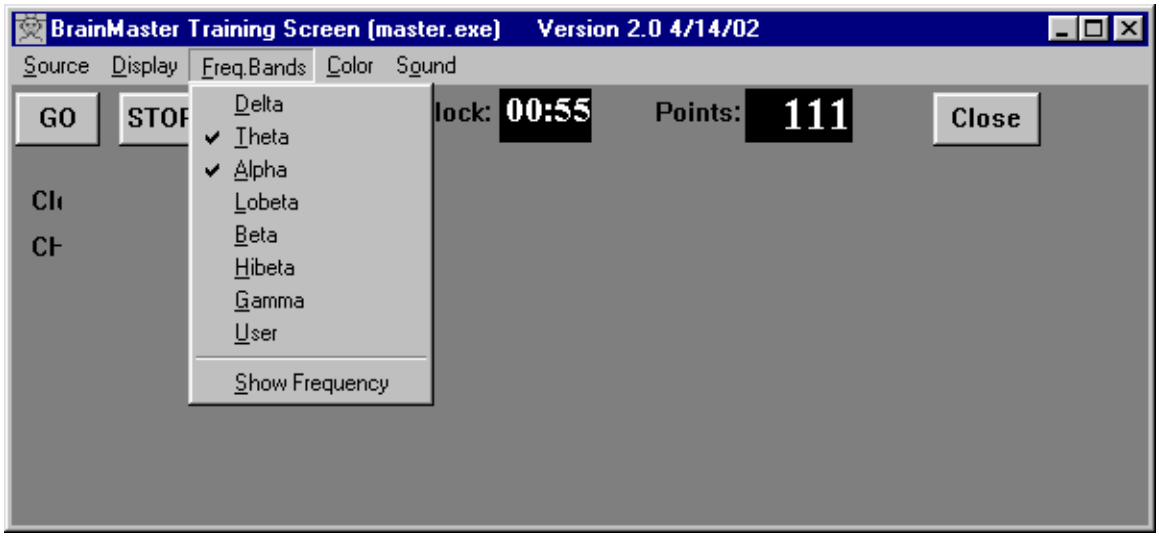
2.2 Display Menu

This menu allows you to select which panes are visible.



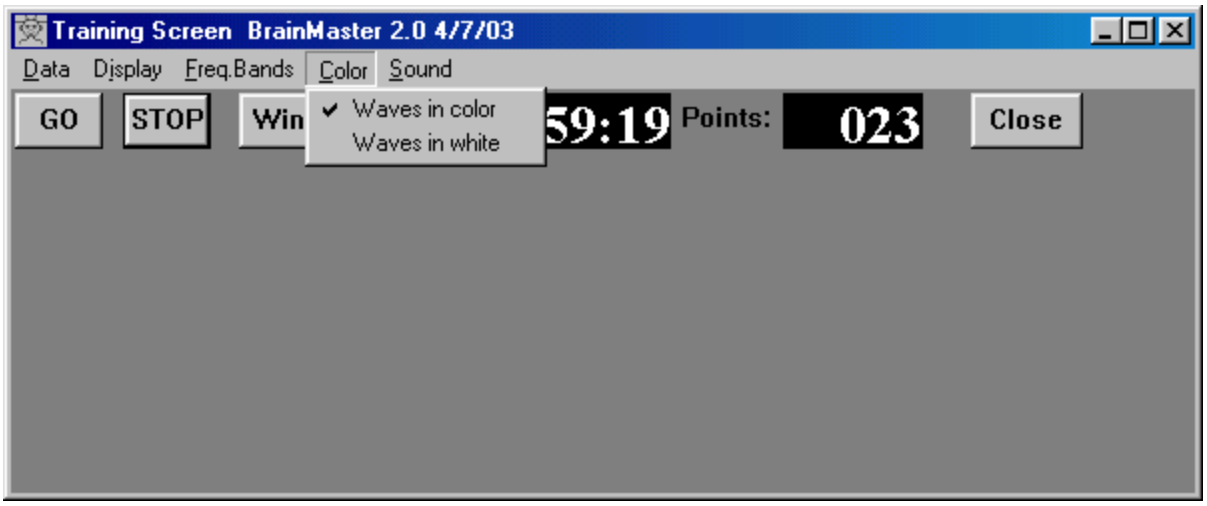
2.3 Frequency Bands Menu

This menu allows you to select which frequency bands ("components") are visible.



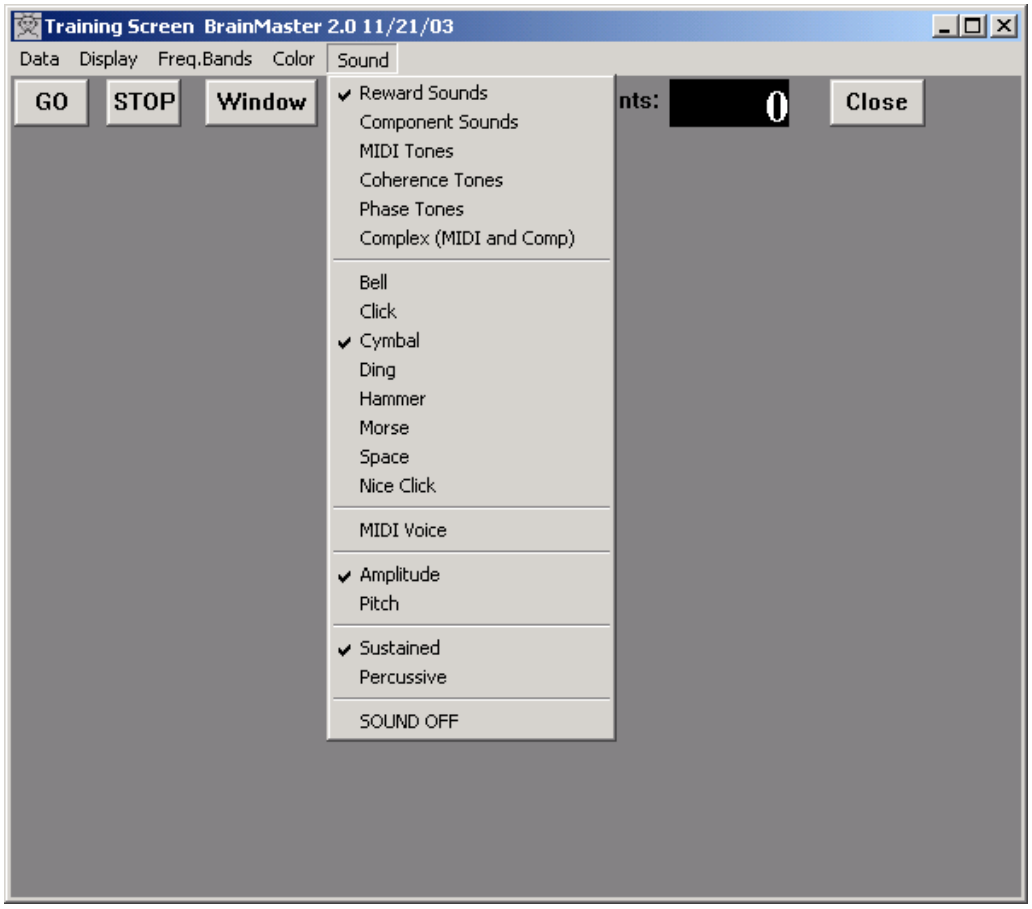
2.4 Color Menu

This menu allows you to make some changes to the colors used in the training screen.



2.5 Sound Menu

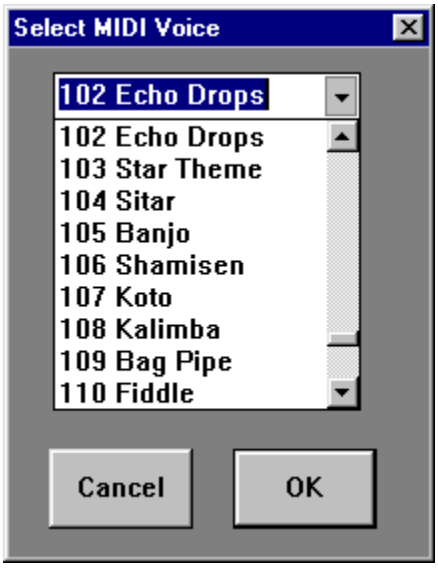
This menu allows you to change the reward sounds, and also to access the MIDI sounds.



This menu allows you choose any of the 6 sound modes, and also to change the sound settings. It is also possible to turn sound feedback off entirely, using the "SOUND OFF" selection.

The MIDI Voice menu accesses the following dialog box. It contains a "combo box" selection list that will show the currently selected MIDI voice. The list has a selector button on the right of the name of the current voice.

When you click on the selector button on the right side of the list, the selector list will pop down as shown:



This list contains the 128 MIDI voices that you can choose from. Use your mouse or the cursor keys to navigate this list, until you see a voice that you want to use. Then click on "OK" to return to the Training Screen and use this voice.

3. Display Panes

3.1 Report Pane

This is the upper left text window. It presents text that explains what the system is doing, such as "Programming Module," "Collecting Data," and so on. It is always available to tell you what is happening inside the logic of the program. The Report Pane is always visible and cannot be deselected.

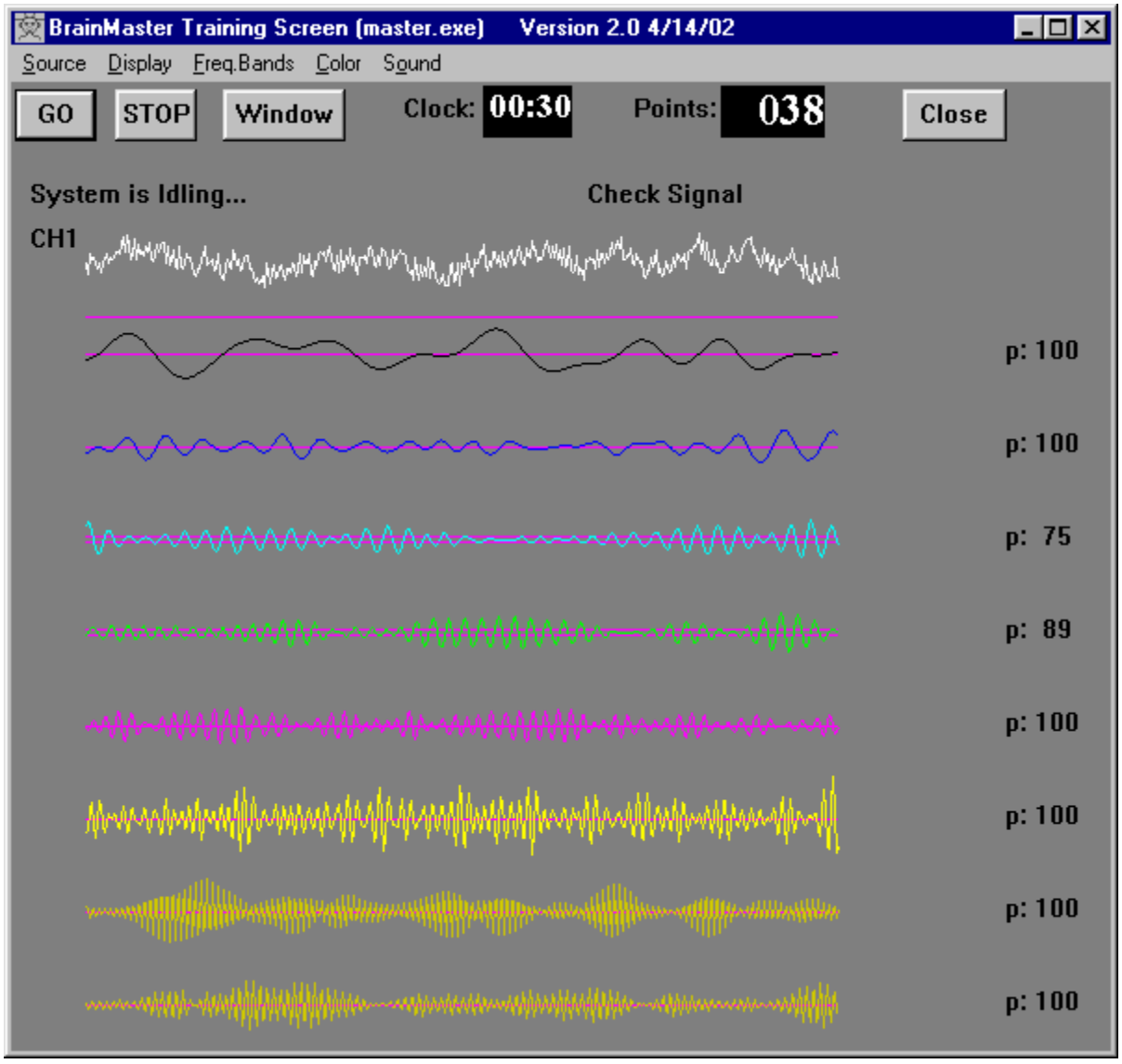
3.2 Command Pane

This is the upper right text window. It presents text that explains what the system wants you to do, such as "Check Module," "Relax for recording," and so on. It is always available to tell you what your actions should be, in order to have the system perform its functions. The Command Pane is always visible and cannot be deselected.

3.3 EEG Waveform Pane

This shows a "wiping" display of raw waveform (4-second duration). This is set to refresh approximately 20 times per second. The waveform is drawn left-to-right across the display window, and when it reaches the end, the drawing position starts over at the left side, replacing the previous data as it moves across the window. In this way, four seconds of EEG are always visible. The artifact reject lines may also be seen in this window, if they are within the display range.

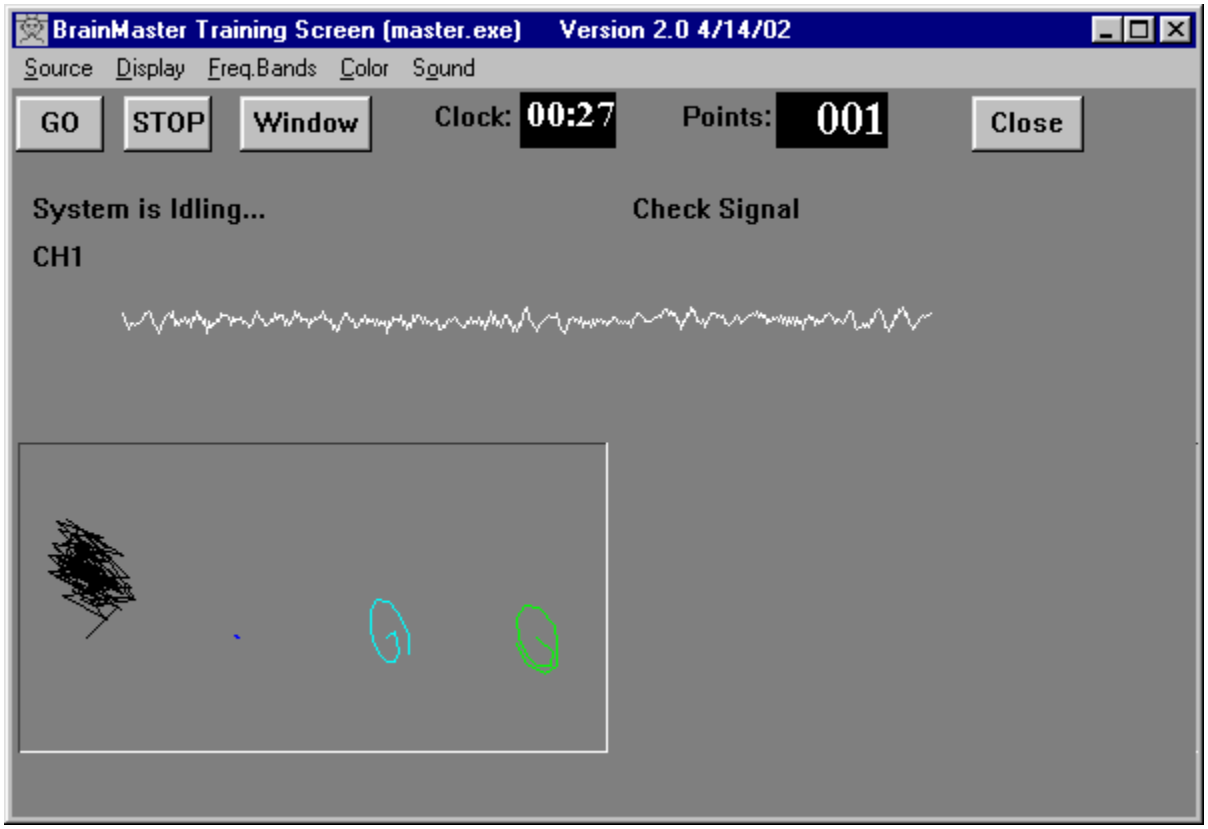
The screen below shows the EEG Waveform Pane, as well as the Filtered Waveforms (described next)



3.4 Filtered Waveforms Pane

This option displays the filtered waveforms in the same window as the raw EEG. This window shows a colored waveform for each component currently being displayed. The "percent time over threshold" number is also seen to the right of each component.

3.5 Phase Space Pane

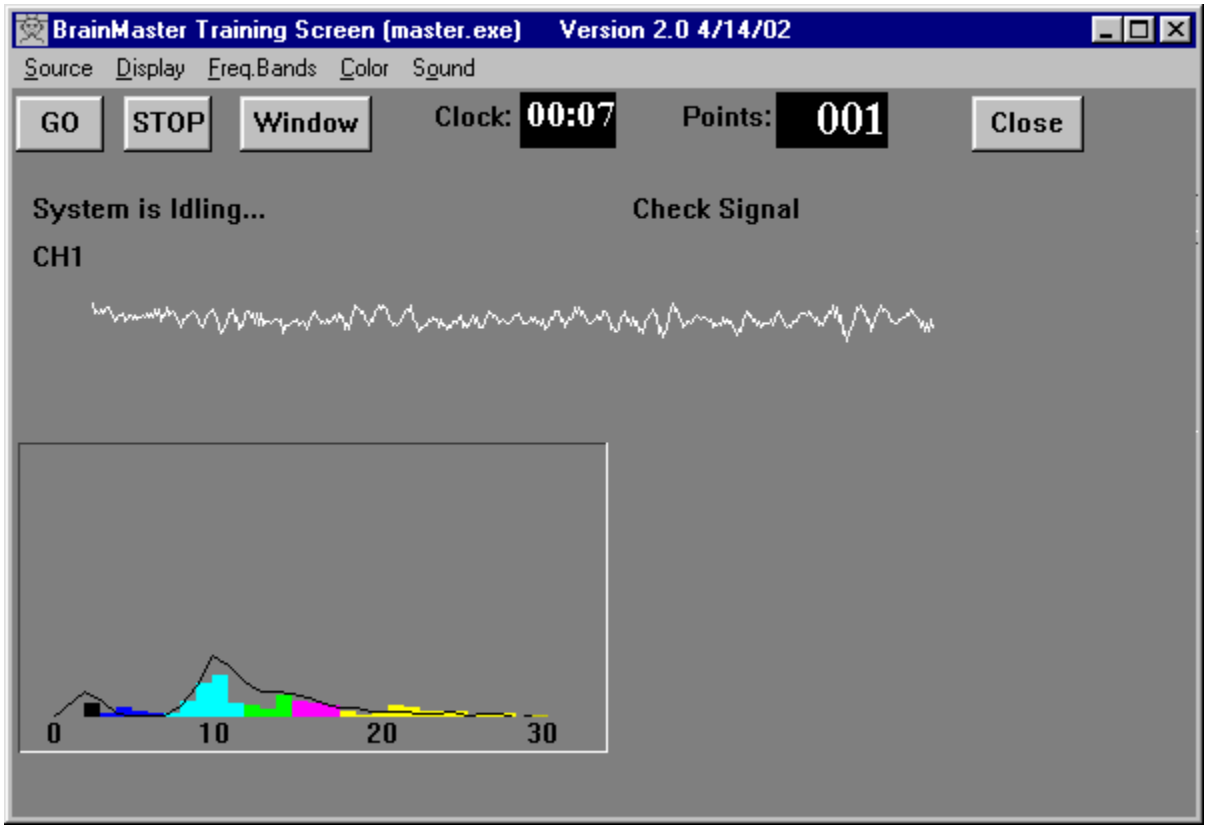


This is a 2-dimensional display using "rate of change" in place of the time axis, common in "chaos" analysis. The vertical axis is exactly the same as in the EEG waveform display, e.g. "amplitude," while the horizontal axis is the "first derivative," or "rate of change" of the EEG signal. This display is interesting because very **smooth, sinusoidal waveforms will appear as rounded, open circles, while fast or irregular activity will produce flatter shapes, with more internal detail**. One use is for training for general EEG amplitude reduction, which will be shown as the "object" becomes flatter, and generally smaller.

Along with the raw waveform, this window can display the phase-space trajectories of any of the 8 EEG components. These can be turned on or off using the "Bsetup" program, or the on-screen selector buttons or menus.

These displays provide an extremely fast indication of changes in the EEG. The size of the phase-space trajectory will respond, within 1/2 wave cycle, to reflect changes. Thus, a change in beta activity can be clearly seen within 20 milliseconds. In addition, the shape of the trajectory provides visual information about the exact frequencies and phases present, and is potentially of great value for biofeedback. This is a new method for visualizing changes in brain dynamics, and promises to be increasingly useful for understanding and managing changes in brain state, brain dynamics, and the temporal flow of brain activity, that is, how brain activity changes over time.

3.6 Frequency Spectrum (FFT) Pane



Displays a frequency spectrum of signal from 1 to 30 Hz. This spectrum is updated 4 times per second, and reflects the last 1-second of EEG data. A slowly-changing "trend" envelope is also superimposed, to show the shape of the spectrum reflecting the last few seconds of activity. This trend line is actually a "weighted" average of the past activity, using a weighting factor of 0.6, so that the value of a point is: 0.4 * (current value) + 0.6 * (previous value), providing a "smoothing" function

This figure illustrates the EEG Waveform, and the FFT window displayed together. This illustrates the appearance of each window, plus shows how the two windows appear when used together.

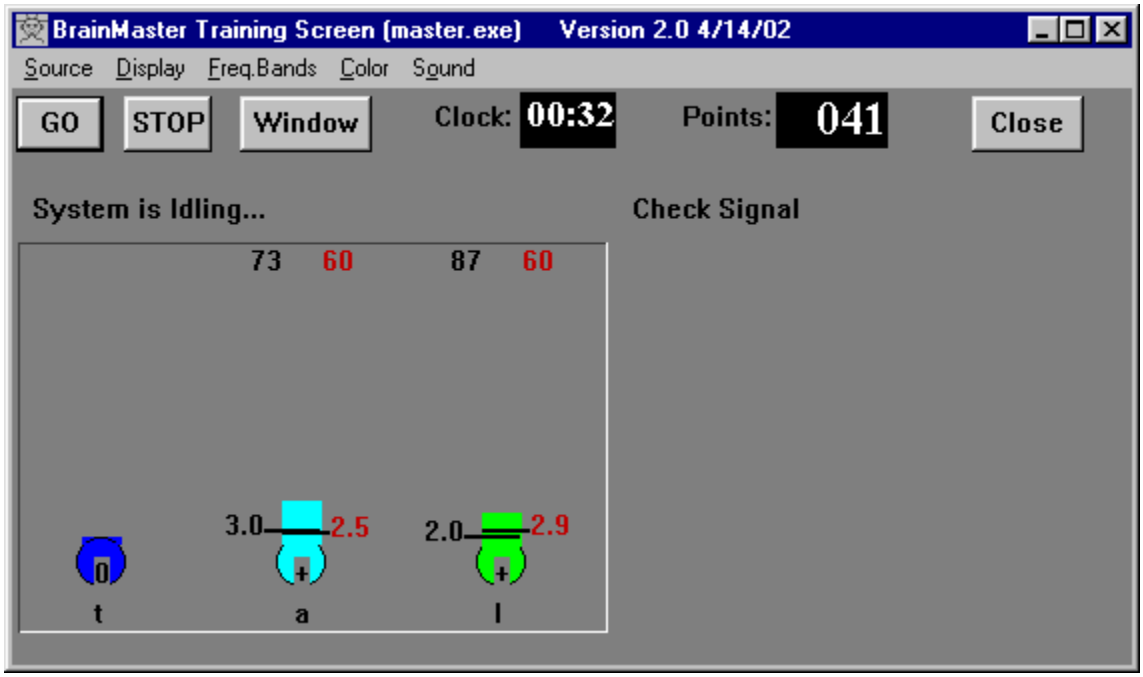
3.7 Thermometer Pane

The Thermometer Pane contains live bargraph displays that show the selected ("enabled") frequency components, along with associated threshold information. They are one the most useful panes to use for controlling EEG training.

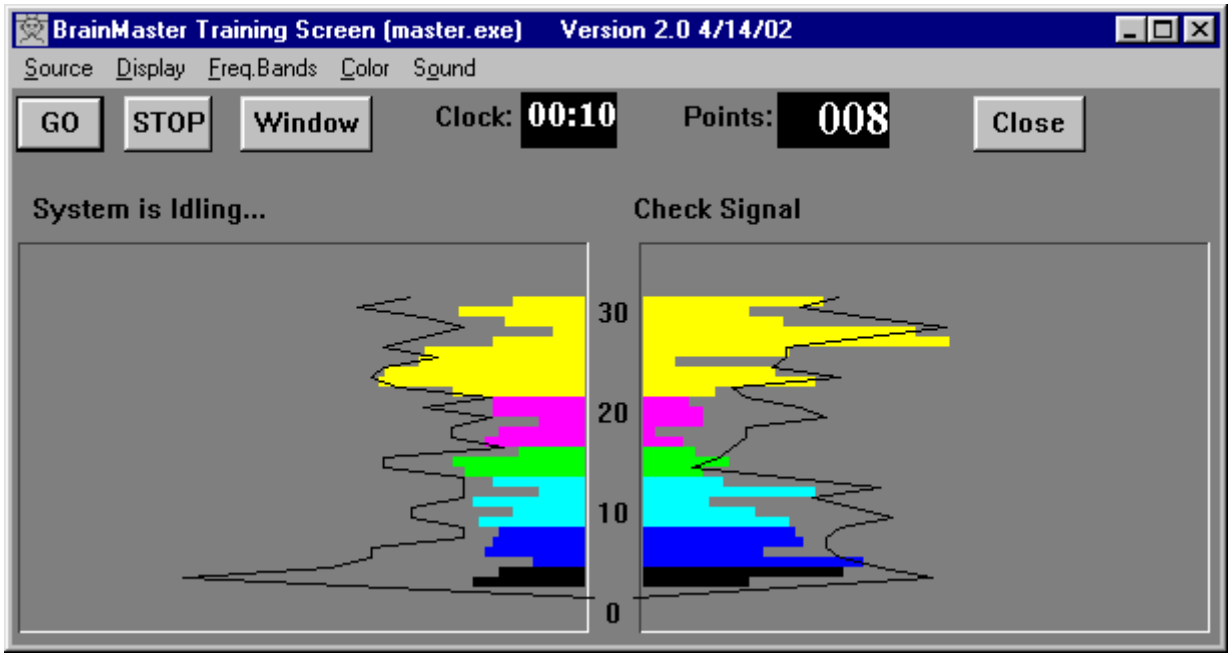
The threshold values shown in black are the current threshold and percent time values. The red values are the autothresholding values. The red percent time is the "target" percentage used to guiding the autothresholding software. The red threshold is the "next" threshold, that the autothresholding system has computed and will use as the next threshold when the thresholds are updated.

In the example below, the current alpha threshold is 3.0, and the current alpha percent time is 73%. The target percent time is 60%, and the autothresholding system has chosen 2.5 as the next alpha threshold, which would be used when thresholds are updated.

Note that when autothresholding is used, the keyboard commands change the targets, not the thresholds. For example, in the screen below, typing "a" would raise the alpha target from 60% to 61%.



3.8 BrainMirror (FFT) Pane



This is similar to the display on the BrainTracer, WaveRider, and HAL devices. Display resembles the "Mind Mirror" (which is a trademark of Biomonitors) but it can be used as an FFT-based or filter-based display, while the Mind Mirror is only a filter-based display.

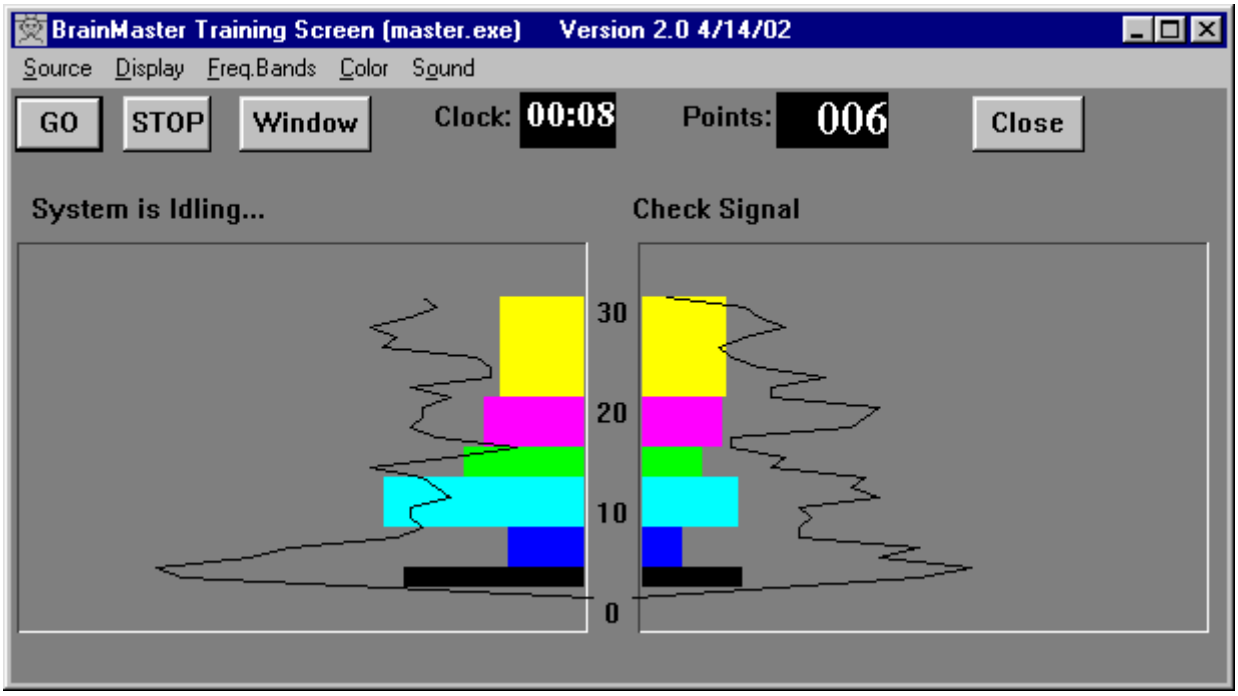
The left side shows the FFT spectrum of Channel 1, the right side shows the FFT spectrum of Channel 2, when available. The numbers in the center of the 2-channel display indicate the frequency axis.

Note: Black lines on the display are a "damped" version of the faster-moving bars, providing a quick summary of the frequency profile over approximately the last 10 seconds, as a moving average.

The BrainMirror can be **switched from normal FFT mode, to a digital-filter based display**, by hitting the **"M" key** on the keyboard or by using the pulldown menu "Display". **You may wish to experiment with this**. When the digital-filtered version is showing, you see fewer bars, because the BrainMaster does not digitally filter each 1-Hz band. Instead, you see 8 bars, one for each EEG component. Even though the bars give a coarser display, the response is much faster, because the digital filters respond more quickly to changes in th EEG energy. The black line is the FFT-based spectrum "trend," as before.

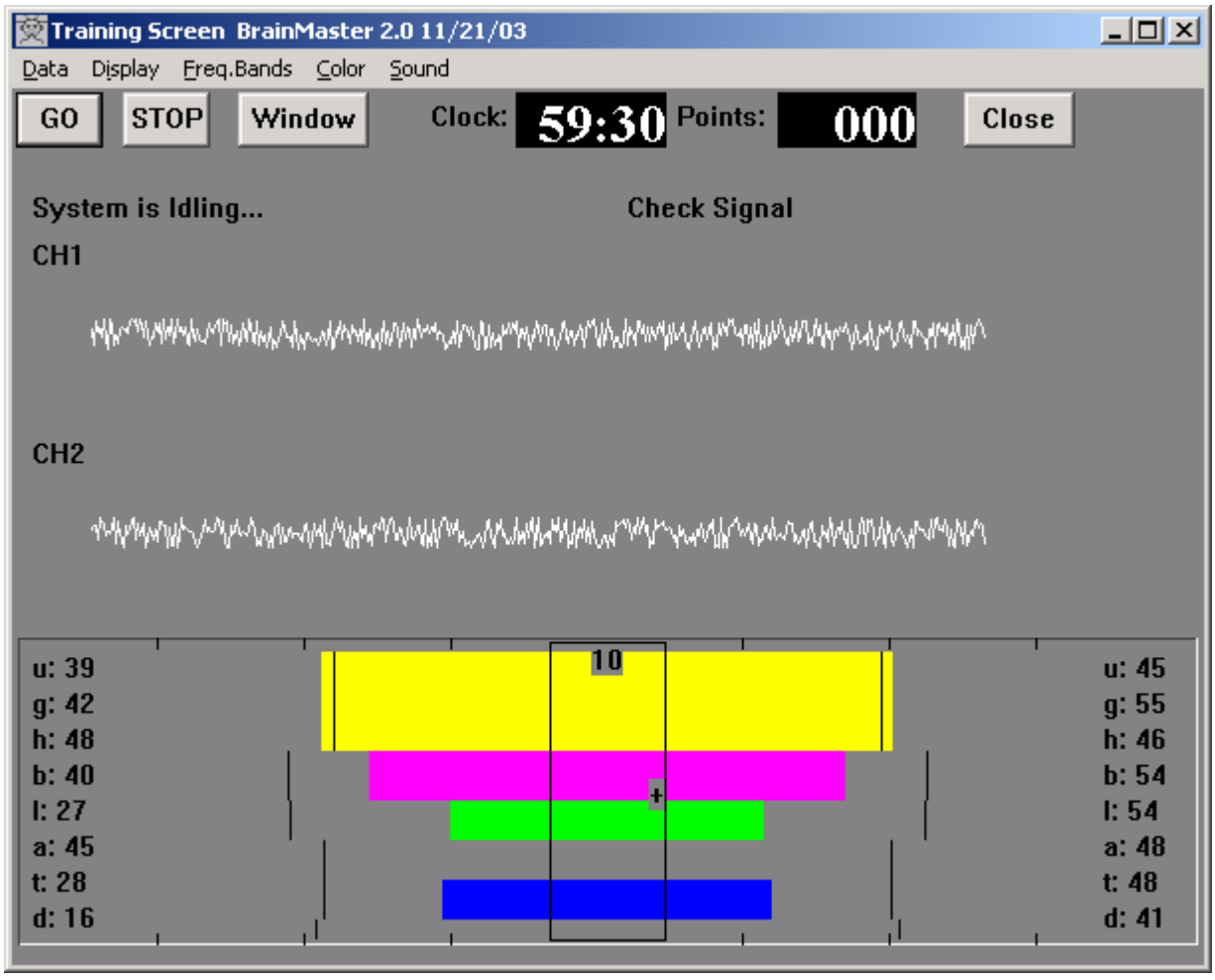
3.9 BrainMirror (Filter) Pane

This pane shows a spectral display that uses the digital filters in place of the FFT. The example shown below is of a 2-channel display.



3.10 Coherence/Phase Pane

This pane shows the current coherence and phase values for any enabled components. It also shows the coherence or phase threshold. There is also an indicator within the threshold box that shows whether coherence or phase are being uptrained ("+") or downtrained ("-"). It is possible to watch the threshold change by watching this box. Coherence threshold is increased by typing "c" on the keyboard. It can be decreased by typing "C" on the keyboard.

Coherence is shown as colored bars, with 100% being full scale. Phase is shown using the small black lines, with 100% (180 degrees) being full scale.

The numbers on the left of the coherence pane show the current coherence values in percent, for each component. The numbers on the right show the phase values, one for each component.