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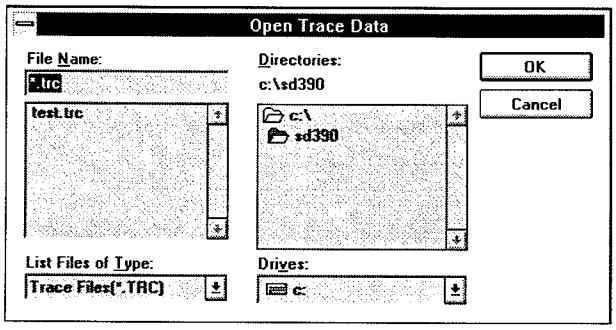
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3–11.9.1 Open Trace Data



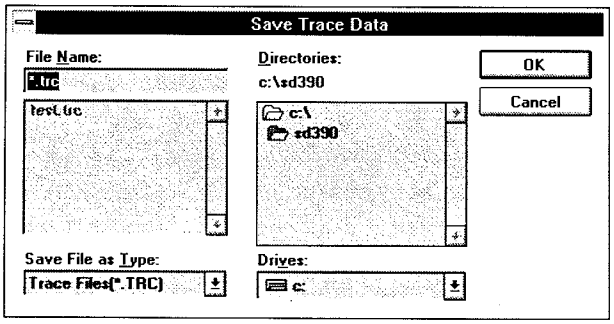
The wildcard file name template is displayed in the **File Name** entry box, which causes a list of current data files to be displayed in the **Files** box. All data files have the default extension **.trc**. You can select one of the existing data files by selecting a file in the **Files** box, then pressing **OK**.

If you have saved a data file with a different extension than **.trc**, you can modify the wildcard search, or directly enter the desired filename in the **File Name** entry box by entering the filename from the keyboard.

The disk drive and directory from which the file will be read can also be changed by selecting the desired drive and directory from the **Directories** entry box.

☞ *This operation can be canceled by clicking on the* **Cancel** *button.*

3–11.9.2 Save Trace Data



The wildcard file name template is displayed in the **File Name** entry box, which causes a list of current data files to be displayed in the **Files** box. All data files have the standard default extension **.trc**. You can select an existing file to which to save the current data by selecting a file in the **Files** box, then pressing **OK**. You will then be reminded that the data previously stored in the existing file will be replaced by the new data, and will have the chance to cancel the operation.

You can modify the wildcard search, or directly enter the desired filename in the **File Name** entry box by entering the filename from the keyboard.

The **.trc** extension will automatically become part of the filename.

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☞ *This operation can be canceled by clicking on the* ***Cancel*** *button.*

☞ *The removable floppy diskette is drive* ***A:*** *and can be used for transporting Export files to other systems.*

➲ ***SPS390 HINT:*** *For more information on wild cards, disks, directories, and files, see the Microsoft Windows Users Guide provided with this system.*

3–11.10 LOAD/SAVE EXTENDED MEMORY

There are two dialogs which allow you to save and load data from/to the SPS390 extended recorder memory:

- Load Extended Recording
- Save Extended Recording

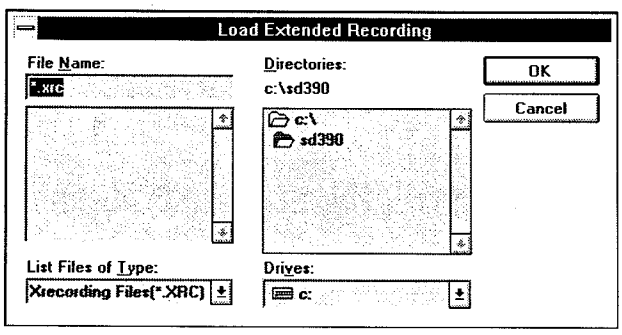
These options are accessed from the **File** menu. You are prompted to supply named files which contain the extended recorder memory data.

The number of files that can be saved is limited by the available disk storage.

3–11.10.1 Load Extended Recording

The wildcard file name template is displayed in the **File Name** entry box, which causes a list of current XRec data files to be displayed in the **Files** box. All XRec data files have the default extension, **.xrc**.

You can select one of the existing XRec files by selecting a file in the **Files** box, then pressing **OK**.



If you have saved an XRec data file with a different extension than **.xrc**, you can modify the wildcard search, or directly enter the desired filename in the **File Name** entry box by entering the filename from the keyboard.

The disk drive and directory from which the file will be read can also be changed by selecting the desired drive and directory from the **Directories** entry box.

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Storing 500k samples of extended recorder data takes 1.5 minutes and uses 1,000 kbytes of disk storage

Remember that **Save Extended Recording** is a global command that saves the extended record from all active memories, not just the "hot" compressed time trace windows.

3–11.11 Load/Save Averager Data

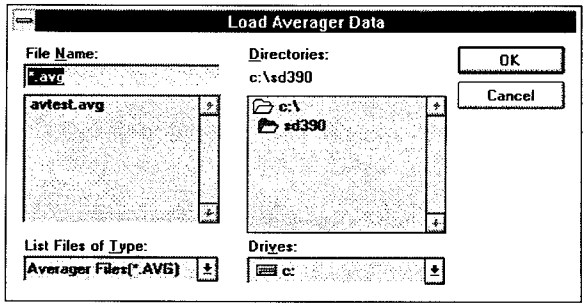
Two Dialogs allow you to load and save data to/from the SPS390 averager memory:

- Load Averager Data
- Save Averager Data

These options can be enormous time-savers, as they allow the user to save all components of a frequency response function to disk for later display and analysis, without having to display and save each one individually. The options are accessed from the **File** Menu. You are prompted to supply named files which contain the averager data.

The number of files that can be saved is limited by the available disk storage.

3–11.11.1 Load Averager Data



The wildcard file name template is displayed in the **File Name** entry box, which causes a list of current averager data files to be displayed in the **Files** box. All averager data files have the default extension, **.avg**.

You can select one of the existing averager files by selecting a file in the **Files** box, then pressing **OK**.

If you have saved an averager data file with a different extension than **.avg**, you can modify the wildcard search, or directly enter the desired filename in the **File Name** entry box by entering the filename from the keyboard.

The disk drive and directory from which the file will be read can also be changed by selecting the desired drive and directory from the **Directories** entry box.

☞ *This operation can be canceled by clicking on the **Cancel** button.*

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The **.avg** extension will automatically become part of the filename.

The disk drive and directory from which the file will be read can also be changed by selecting the desired drive and directory from the **Directories** entry box.

☞ *This operation can be canceled by clicking on the **Cancel** button.*



Remember that **Save Averager Data** is a global command that saves the averager data from all active memories, not just the hot average display window.

3–11.12 Load/Save Waterfall Memory

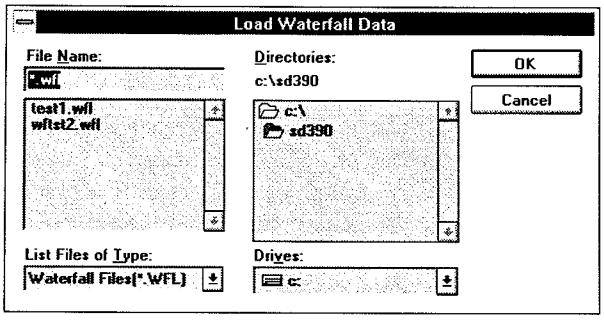
There are two Dialogs which allow you to Save and Restore data from/to the SPS390 Waterfall Memory:

- Load Waterfall Data
- Save Waterfall Data

These options are accessed from the **File** Menu. You are prompted to supply named files which contain the Waterfall Memory data.

The number of files that can be saved is limited by the available disk storage.

3–11.12.1 Load Waterfall Data



The wildcard file name template is displayed in the **File Name** entry box, which causes a list of current waterfall data files to be displayed in the **Files** box. All waterfall data files have the default extension, **.wfl**. You can select one of the existing Waterfall data files by selecting a file in the **Files** box, then pressing **OK**.

If you have saved a Waterfall data file with a different extension than **.wfl**, you can modify the wildcard search, or directly enter the desired filename in the **File Name** entry box by entering the filename from the keyboard.

The **.wfl** extension will automatically become part of the filename.

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SPS390 HINT: *For more information on wild cards, disks, directories, and files, see Microsoft Windows Users Guide provided with this system.*



Data from a waterfall data disk file can be loaded at any time. However, all current data and acquisition and analysis parameters are replaced by the saved data and saved parameters. These parameters may not be compatible with the current settings, and may invalidate the current averager and waterfall memory and associated displays. Therefore, it is good practice to stop acquisition before Loading this data, although this function will automatically stop all acquisition functions if active.



Remember that **Save Waterfall Data** is a global command that saves the waterfall data from all active waterfall memories, not just the hot waterfall display window.

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3–12 DISPLAY WINDOWS

3–12.1 Description

Display windows are used to display traces. In addition to displaying the trace, they also display information about the type of trace, the channels involved in the trace and the X- and Y-axis units. Display windows also have a built-in standard cursor mechanism that can be used to display the value of a trace at a particular point or spectral line, in the case of a spectrum trace.

Display windows can be individually manipulated (moved and resized) or grouped together (cascaded or tiled). They can be iconized — shrunk to a small picture — temporarily to reduce screen clutter or maximized to fill most of the screen.

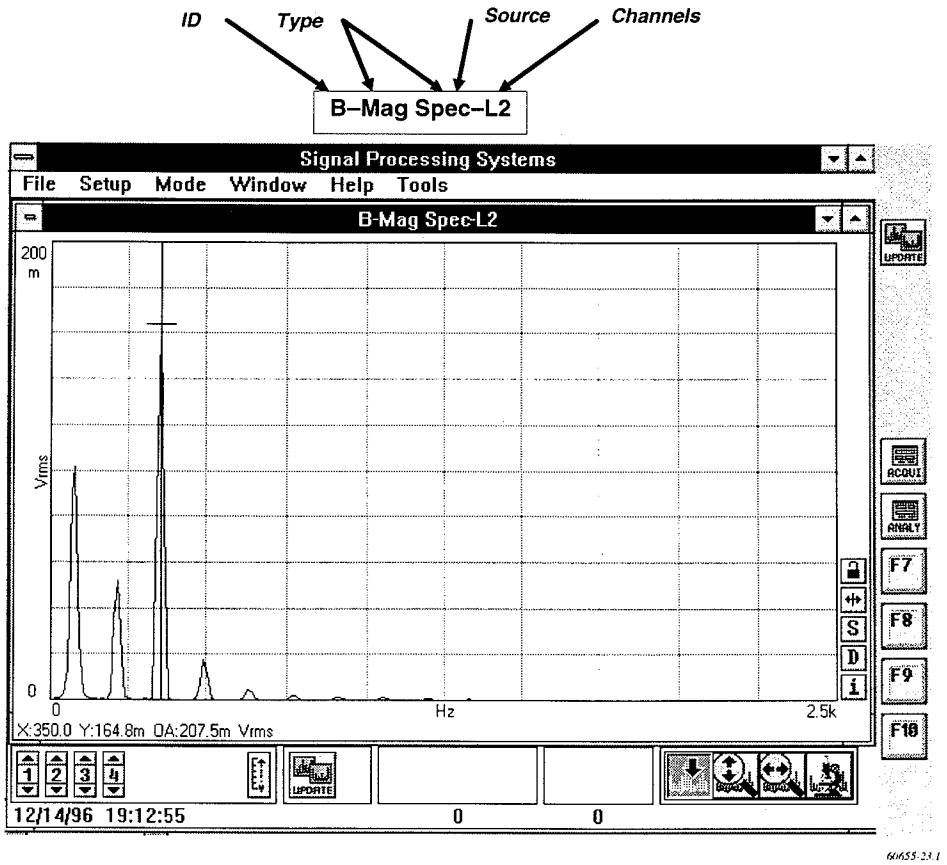
In most circumstances, data is being processed in accordance with the specified analysis parameters even if it is not being displayed.

3–12.2 Display Window Features

Every display window has certain features that provide you with important information about the trace being displayed.

Title

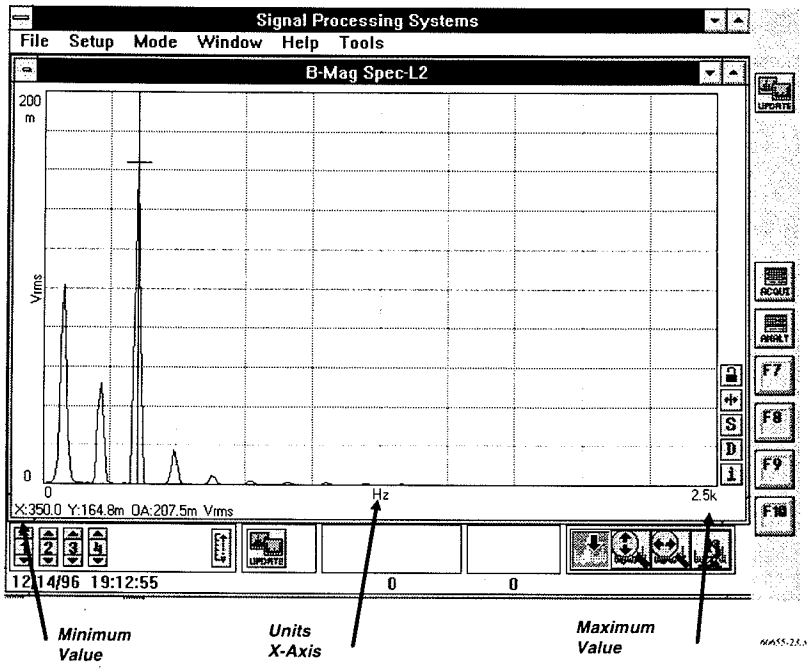
The title for each display window appears in the window title bar. The format for each display window title consists of four fields, separated by hyphens as follows:



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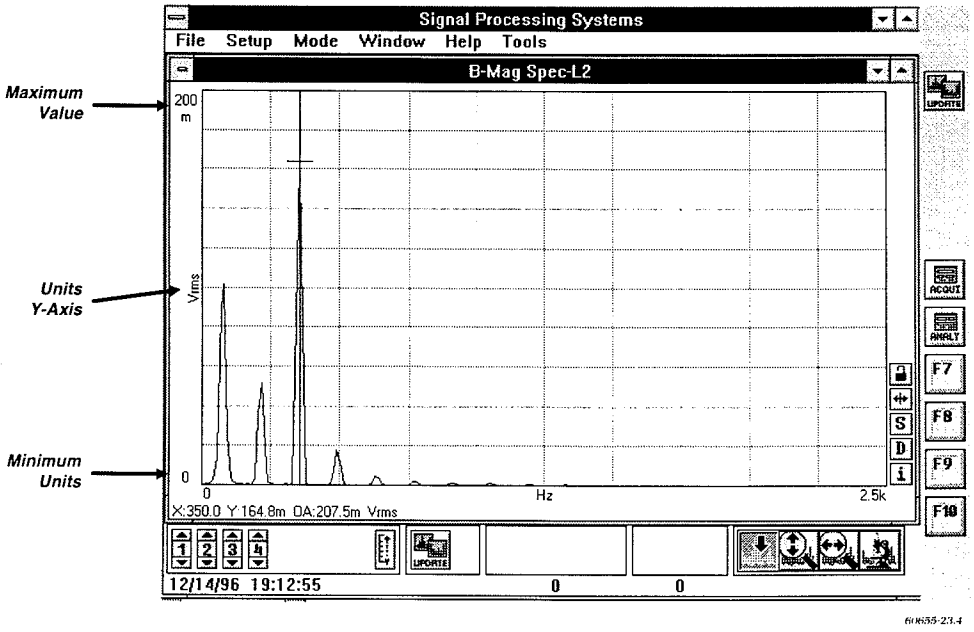
X-Axis Annotation

The X-axis units, minimum value, and maximum value are written at the bottom of the trace rectangle. Values are expressed in exponential notation, unless "Shorthand Notation" is selected.



Y-Axis Annotation

The Y-axis units, minimum value, and maximum value are written at the left side of the trace rectangle.



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$$\text{AO Level} = \sqrt{\sum_{i=a}^{b} V_i^2 / (\text{Wtg Fcm Factor})}$$

a = left display edge bin #
b = right display edge bin #
H Wtg Fcn Factor = 1.5
FT Wtg Fcn Factor = 3.386

NOTE: EU values can be substituted for V.

Total Harmonic Distortion

If harmonic markers are invoked on a magnitude spectrum, a fourth value is presented on the cursor line. The value that is computed and displayed is the total harmonic distortion. The total harmonic distortion is the percentage of amplitude of the fundamental that is distorted by the total harmonic content measured. A precise alignment of the harmonic markers to the peaks of the harmonic signals is required for an accurate measurement of total harmonic distortion.

Time Domain Displays

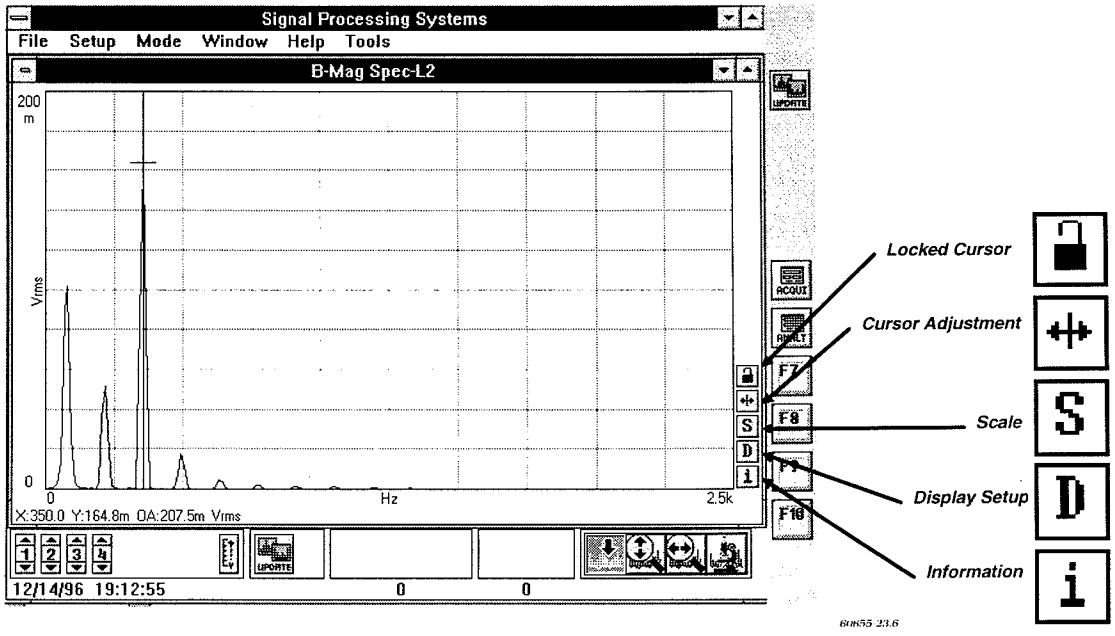
On time domain displays, the values are the actual sample point measured by the A/D converter.

Other Cursor Readout functions

Many other functions can be invoked with the use of the cursor. These functions become active when used in conjunction with the Marker functions. For more information on cursor readout see section 3-11.7.1, How to Invoke Markers

Display Controls

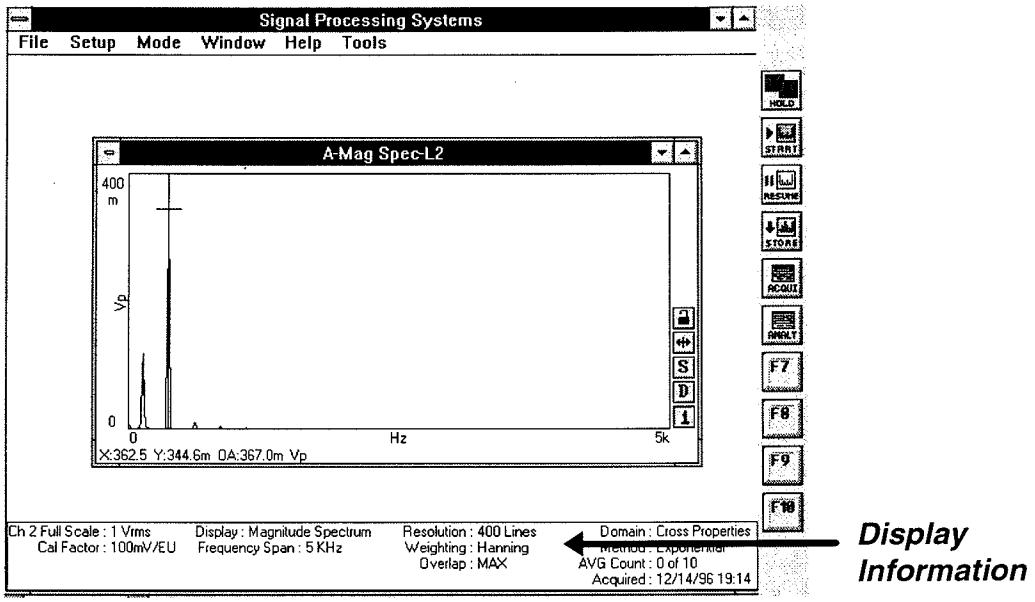
There are five display controls available for all display windows:



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➢ **Information Control**

With the display cursor arrow on this icon and the trackball button held down, display information will appear on the screen as shown in the following example.



For compressed time displays, there is an additional limits control when the SPS390 is in **HOLD** and data is available in the extended recorder memory for Playback. For waterfall displays, a Waterfall Record/Profile Selection control is available. For waterfall cascade displays, Z–Axis controls are also available.

☞ *Depending upon the size of the display, all or some of these controls may be visible.*

3–12.3 How To Create a Display Window

Display windows are created by using the **New Display** command (**Alt+N**)in the **Setup** menu.

The SPS390 allows up to nine display windows. After nine displays have been created, you cannot create more without first disposing of some of the existing display windows.

Before discussing modification and removal of display windows, it is necessary to introduce the concept of the active display window.

3–12.4 The Active Display Window

There is always a "privileged" display window at all times, unless there are no display windows at all. This window is called the *active* or "hot" display window. Any display window may be made active by clicking anywhere on it with the trackball cursor. The active display window can be distinguished from other display windows by its highlighted title bar and is always completely visible ("on top of") all the other display windows.

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 Maximize icon

 Restore icon

3–12.9 How To Group a Display Window

Display windows can also be organized as a group using the **Window** Menu options **Tiles** and **Cascade**. See that section for details on grouping display windows.

3–12.10 How To Move a Display Window

Display windows can be moved independently of one another by clicking and holding on their title bars, then dragging the outline of the display window to the desired position. You cannot drag a display window outside the boundaries of the frame window.

3–12.11 How To Resize a Display Window

Display windows can be resized by clicking and holding on one of their four sides or four corners and dragging in the direction of the cursor until the outline is the desired size. When the trackball button is released, the display window will expand or contract to the size of the outline.

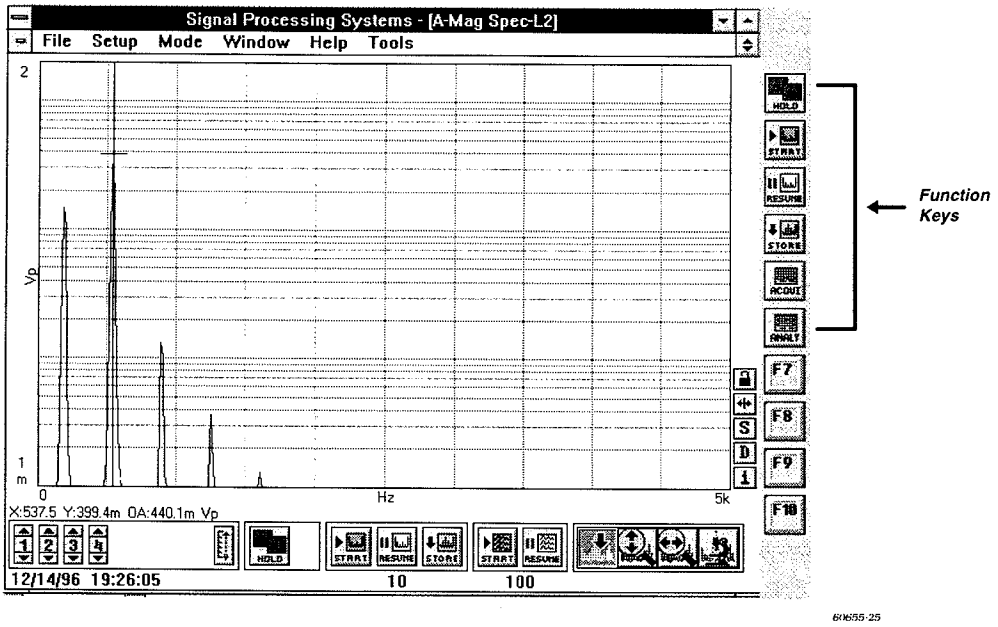
Display windows have a minimum allowable size and cannot be made smaller than this size using the resizing cursors. If an attempt is made to make the display window smaller than this minimum size, the display window will "bounce back" to the minimum size.

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3–13 FUNCTION KEY AREA

3–13.1 Function Key Controls

There are six controls located in the Function Key Area. These keys are "short-cuts" to the acquisition parameters and analysis parameters. You can click on the control in the Function Key Area just as if it were the control in the control area or a menu selection.



3–13.2 Keyboard Function Keys

If you have the SPS390 keyboard connected, the controls in the Function Key Area can also be activated by using the keyboard function keys (**F1**–**F6**). F1 corresponds to the uppermost function key control while **F6** corresponds to the lowest. **F5** and **F6** invoke the Acquisition and Analysis dialogs, respectively.

The keyboard function keys are only active when the main SPS390 window is active. If the function keys do not respond, ensure that the SPS390 title bar is highlighted (located above the main menu), indicating that the main window is active. To make the SPS390 main window active, click on the SPS390 title bar.

3–13.3 Summary

To perform one of the functions specified by the function keys, you can either:

- Click on the control in the control area, or
- Click on the control in the function key area.

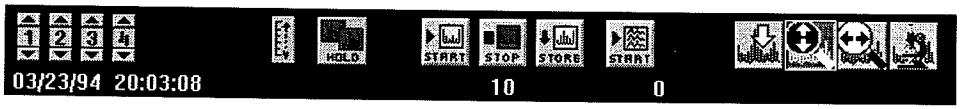
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3–14 SCREEN CONTROL AREA

3–14.1 Screen Control Group

The control group activates the operational functions of the SPS390. The operational functions include:

- Gain selection and overload control/autoranging
- Update and hold
- Averager controls
- Waterfall controls
- Cursor controls
- Frequency control
- Display controls



These functions can be activated by:

- Moving the trackball cursor over the desired function, then pressing the trackball selector button, *or*
- Pressing the designated function keys on the optional keyboard.



The appearance of all SPS390 controls reflects the operation that will be performed upon activating the control rather than on the current mode of the SPS390. For example, when the update/hold control displays "Hold", the SPS390 is in update mode and vice-versa.

3–14.2 Overload Control Group

At the very left of the control area is the overload control group. Each overload control consists of two channel gain controls (one labeled with an up arrow, one with a down arrow), and an overload Indicator (labeled with the channel number). The number of controls indicates the number of channels available with your SPS390. The presence of these controls does not reflect whether the channel is active or inactive.

These controls are used to detect channel overloads and then to adjust the channel gain to remove the overload condition (channel underflow conditions are not indicated by the SPS390). The values of these controls are on the **Acquisition Setup** dialog and listed in the display info box.

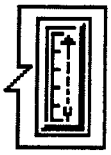
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During free run operation, overloaded signals are added to the averager. When an overload occurs while triggering is enabled, the current data will automatically be rejected from the averager.

☞ *When the SPS390 is put into **HOLD**, the overload signals on all channels are cleared.*

3–14.2.5 AutoRange Control

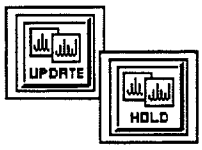


AutoRanging for each active channel can be activated by clicking on the AutoRange selector to the right of the individual channel gain controls. When AutoRanging is activated and acquisition is resumed, the SPS390 will acquire data according to parameters set on the **Acquisition Setup** dialog. The SPS390 will choose the highest gain setting for each channel that will not cause clipping. This value will then be used for the gain until AutoRanging is activated again, or if the gain is manually changed via the channel gain controls or full scale voltage parameter on the **Acquisition Setup** dialog.



AutoRanging requires approximately 500 data points of a continuous signal to determine an accurate setting. Therefore, AutoRanging at low frequencies could take several seconds.

3–14.3 Update/Hold Control



The **UPDATE/HOLD** control is located in the control area between the overload control group and the averager control group. It controls the global data acquisition mode for the SPS390.

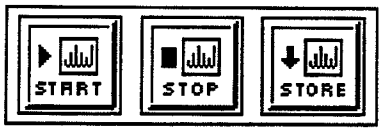
If the **Update/Hold Control** has been selected into the **Hold** condition and the **Signature Ratio Option** (SRA) has been activated a new control appears to the right of the **Update/Hold** button. This button is the SRA replay button. This button allows for recalculations of Signature Ratio held data under different processing parameters, than were used during the initial capture of the SRA data. If an SRA "Replay" of data is in progress the SRA button has a diagonal line through it to

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When the SPS390 is placed in hold mode, the averager automatically stops and all display windows displaying data from the averager display the most recent results of the Averager. To restart averaging, you must use the controls provided in the Averager Control Group to restart the averager, after the SPS390 is placed back in update mode.

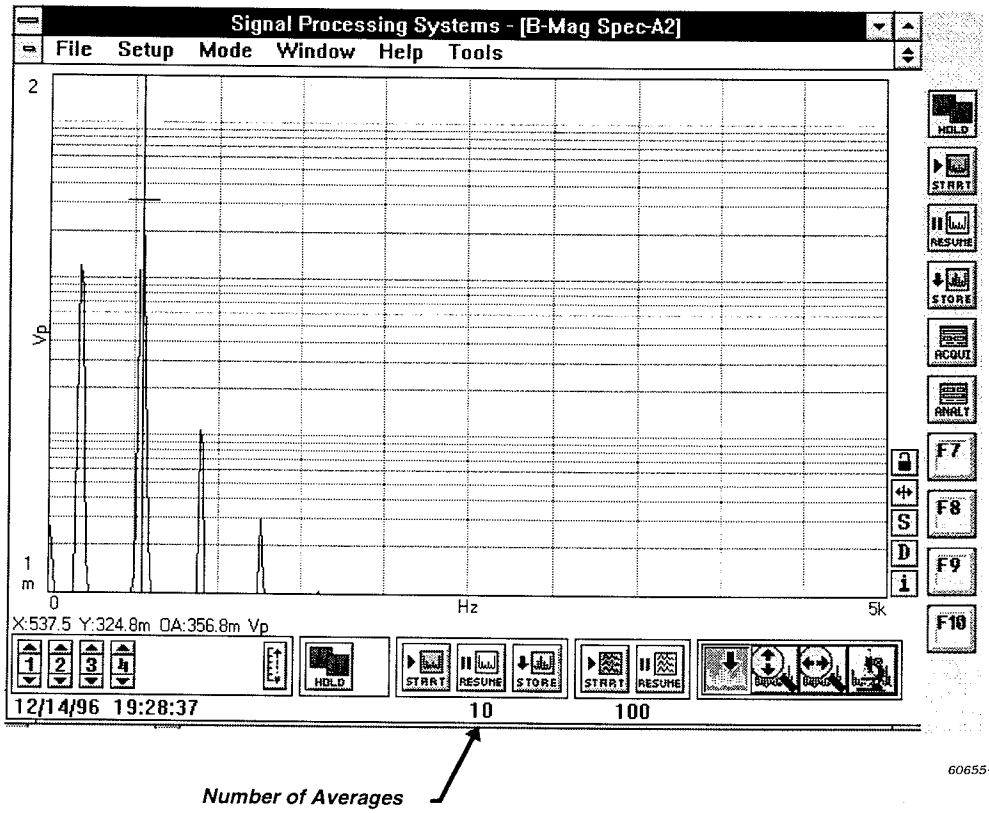
3–14.4 Averager Control Group



The averager control group lies within the control area between the update/hold control and the waterfall control. This group consists of three averager controls: average **START**, average **STOP/RESUME/SINGLE**, and average **STORE**.

The averager controls are dynamic. That is, different controls appear and disappear depending on the current state of the averager. Only valid averager controls are displayed. Thus, it is not possible to perform an invalid averager operation.

The number of averages in the current averager memory is displayed on the screen, near the averager controls, at all times. In the example shown below, 10 averages were taken.



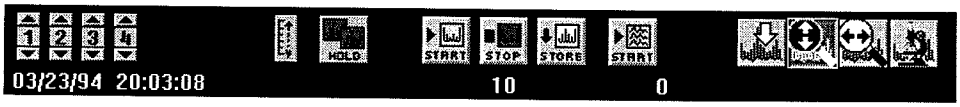
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These functions can be activated by:

- Moving the trackball cursor over the desired function, then pressing the trackball selector button, *or*
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The appearance of all SPS390 controls reflects the operation that will be performed upon activating the control rather than on the current mode of the SPS390. For example, when the update/hold control displays "Hold", the SPS390 is in update mode and vice-versa.

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These controls are used to detect channel overloads and then to adjust the channel gain to remove the overload condition (channel underflow conditions are not indicated by the SPS390). The values of these controls are on the **Acquisition Setup** dialog and listed in the display info box.

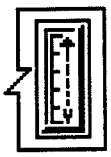
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During free run operation, overloaded signals are added to the averager. When an overload occurs while triggering is enabled, the current data will automatically be rejected from the averager.

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3–14.2.5 AutoRange Control

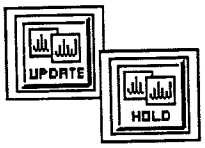


AutoRanging for each active channel can be activated by clicking on the AutoRange selector to the right of the individual channel gain controls. When AutoRanging is activated and acquisition is resumed, the SPS390 will acquire data according to parameters set on the **Acquisition Setup** dialog. The SPS390 will choose the highest gain setting for each channel that will not cause clipping. This value will then be used for the gain until AutoRanging is activated again, or if the gain is manually changed via the channel gain controls or full scale voltage parameter on the **Acquisition Setup** dialog.



AutoRanging requires approximately 500 data points of a continuous signal to determine an accurate setting. Therefore, AutoRanging at low frequencies could take several seconds.

3–14.3 Update/Hold Control



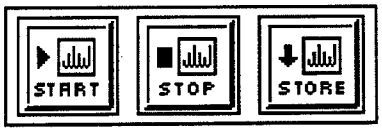
The **UPDATE/HOLD** control is located in the control area between the overload control group and the averager control group. It controls the global data acquisition mode for the SPS390.

If the **Update/Hold Control** has been selected into the **Hold** condition and the **Signature Ratio Option** (SRA) has been activated a new control appears to the right of the **Update/Hold** button. This button is the SRA replay button. This button allows for recalculations of Signature Ratio held data under different processing parameters, than were used during the initial capture of the SRA data. If an SRA "Replay" of data is in progress the SRA button has a diagonal line through it to

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When the SPS390 is placed in hold mode, the averager automatically stops and all display windows displaying data from the averager display the most recent results of the Averager. To restart averaging, you must use the controls provided in the Averager Control Group to restart the averager, after the SPS390 is placed back in update mode.

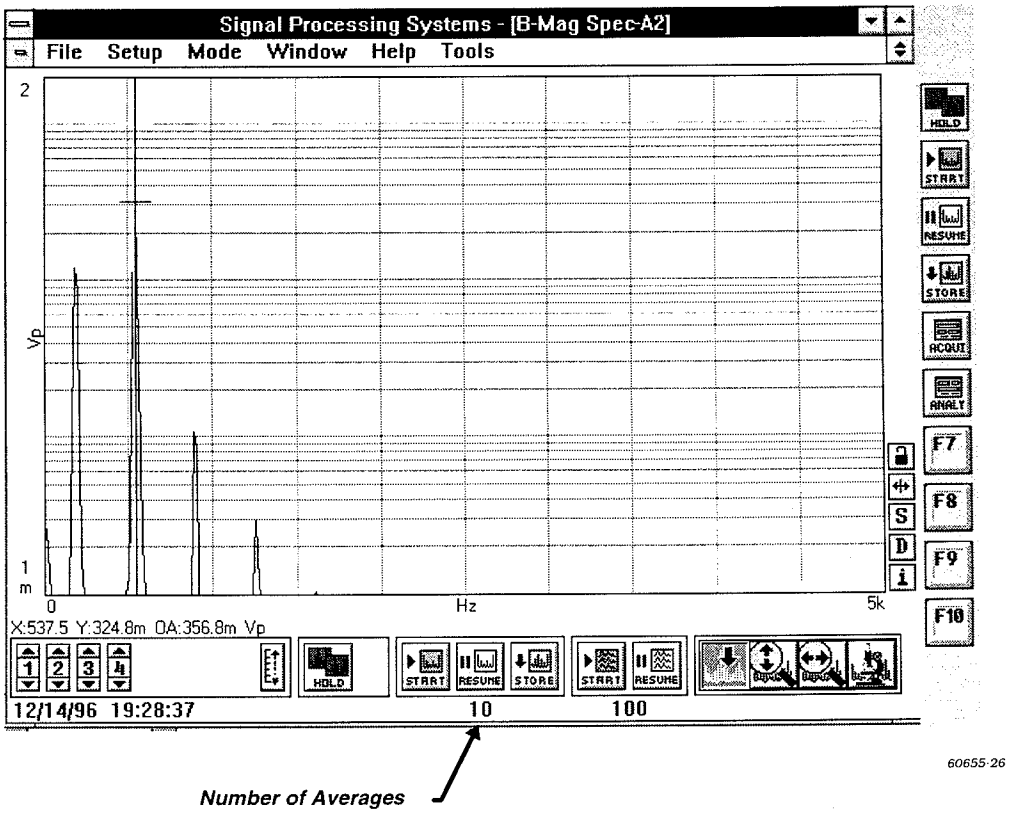
3–14.4 Averager Control Group



The averager control group lies within the control area between the update/hold control and the waterfall control. This group consists of three averager controls: average **START**, average **STOP/RESUME/SINGLE**, and average **STORE**.

The averager controls are dynamic. That is, different controls appear and disappear depending on the current state of the averager. Only valid averager controls are displayed. Thus, it is not possible to perform an invalid averager operation.

The number of averages in the current averager memory is displayed on the screen, near the averager controls, at all times. In the example shown below, 10 averages were taken.



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☞ *Clicking on the **SINGLE** control causes one block of analyzer data to be added to the current average.*

3–14.4.3 Store Control



The **STORE** control is used to store the current averager contents to the averager store memory. The data from the current averager in the selected Domain for each active channel, as specified in the **Analysis Setup** dialog, is stored in the averager store memory.

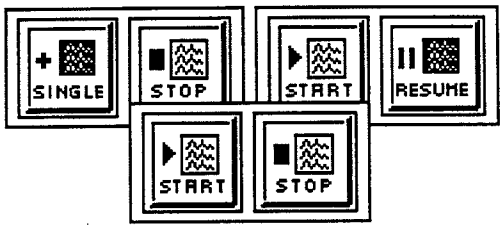


Changing most acquisition or analysis parameters while the averager is active will automatically stop the averager. The averager must then be manually restarted. If the averager is manually stopped, before a target count is reached, the full scale voltage range can be changed and the averager process resumed without invalidating the accumulated average.

The averager operates on normalized data; therefore, the current voltage range is always accounted for. However, the Y-axis amplitude value of the displayed averager trace does not change when the input full scale range is changed. You must use the display expand or autoscale control to change the viewing window scale.

3–14.5 Waterfall Control Group

The waterfall load controls are located in the control area between the averager control group and the cursor controls. This group controls the loading of data into waterfall memory and consists of four waterfall controls: waterfall **START**, waterfall **STOP**, waterfall **RESUME**, and waterfall **SINGLE**.



The waterfall controls are dynamic, that is, different controls appear and disappear depending on the current state of the analyzer. Only valid waterfall controls are displayed. Thus, it is not possible to perform an invalid waterfall load operation.

The number of waterfall records in the current array is displayed beneath the waterfall **START/STOP** controls. This number (the same for all active waterfall channels) shows the total number of records available for display per active waterfall channel.

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3–14.5.2 Waterfall Stop Control



The **STOP** control appears when data is actively being loaded into waterfall memory (except for Single Load). Clicking on this control "pauses" waterfall load procedure to prevent incoming data from entering waterfall memory. When **STOP** is pressed, each active waterfall display is refreshed with the most recent waterfall data.

3–14.5.3 Waterfall Resume Control



The **RESUME** control appears when waterfall load has been stopped by use of the **STOP** control. You cannot resume loading waterfall memory if it has stopped by meeting the number of records to load in **Stop When Full** load method, as specified in the **Waterfall Setup** Dialog. Clicking on the **RESUME** control will restart loading waterfall memory from the state it was in when the **STOP** control was activated, without clearing the previous contents of waterfall memory. This control is not available when waterfall load is set to **SINGLE**.

3–14.5.4 Waterfall Single Control



The **SINGLE** control appears when the waterfall load control is Single (as specified in the **Waterfall Setup** Dialog) and data has been loaded into waterfall memory by the **START** control. Clicking on the **SINGLE** control causes one more block of data to be added to the waterfall memory from the specified data source. The **STOP** control is used to stop single loading and to allow the contents of waterfall memory to be cleared by presenting the **START** control, rather than the **SINGLE** control.



The appearance of the waterfall control reflects the operation that will be performed upon activating the control rather than on the current mode of the SPS390. Thus, when the control displays "Stop," the SPS390 waterfall is in the update mode and vice-versa.

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When the standard cursor is active, the cursor can be moved in two granularities: coarse (general positioning) and fine (specific line or point positioning).

Coarse Positioning



The cursor line indicator appears as a thick downward-pointing arrow. Clicking within the trace rectangle will move the cursor select Line to that location. Use this method to place the cursor in the general vicinity of interest.

Fine Positioning



The position of the standard cursor can be fine tuned (line by line) by selecting the display controls on the desired display window, and moving the trackball (or mouse) right or left.



If there is no movement of the trackball within 10 seconds of selecting the display control cursor, cursor movement will revert back to coarse positioning.

When using the standard cursor on a compressed time display when the SPS390 is in **HOLD**, all LIVE displays are updated with the block of data that follows the compressed time cursor. This allows you to enter playback mode and access data that has been acquired to the extended recorder memory.

3–14.6.2 Vertical Display Expand Cursor



The vertical display expand cursor is useful for shrinking and expanding the trace display along the vertical axis. Use of this cursor has no effect on the state of the analyzer; it only modifies the display.

In this mode, there are actually two related cursors available, depending on whether the cursor is within the trace rectangle or not.

Vertical Display Expansion

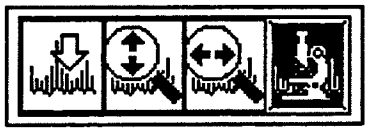
If the cursor is within the trace rectangle, it appears as a magnifying glass with two vertical arrows inside pointing outward. Clicking with this cursor decreases both the minimum and maximum y-axis limits for a bipolar display by one range (ranges

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The standard cursor will not automatically maintain its position when using horizontal display expansion. Instead, the user must manually reset the standard cursor after every expansion operation.

3–14.7 Frequency Control



The frequency control is used to increase or decrease the frequency range when the SPS390 is in spectrum baseband mode or octave mode, or to select the center frequency and frequency span when in spectrum zoom mode. (These modes are set by the analysis mode selector and zoom mode setting in the sampling method group of the acquisition setup dialog.)

Selecting the frequency control deactivates the cursor control modes and displays a frequency indicator in the selected trace window. The frequency indicator is a right or left arrow in baseband mode, or a magnifying glass in zoom.



The frequency control is really just a shorthand method for changing the frequency span and center frequency settings of the acquisition setup dialog. Since these settings are global, it does not matter which display window is used to perform the cursor operations since all display windows are simultaneously affected. Thus, it is not possible to perform one operation (e.g., Zoom In) in one display window and its opposite (Zoom Out) in another display window, or to change the baseband frequency in only one window.

3–14.7.1 Spectrum Baseband and Octave Modes

In these modes, there are two related frequency indicators displayed, depending on whether the indicator is within the left or the right half of the trace rectangle.

Frequency Span Increment



If the indicator is in the right half of the trace rectangle, it appears as a right-pointing arrow with the word "FRQ" inside. Clicking when this indicator is activated increases the frequency span limit up to the next "range" frequency.

Frequency span limits are in the ranges from 1 Hz to 100 kHz for 2-channel operation or 1 Hz to 40 kHz for 3- to 8-channel operation in a 1, 2, 4, 5 sequence.

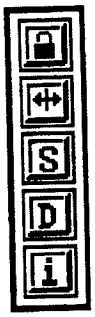
The sequence is 1.25 kHz, 2.5 kHz, 5 kHz, 10 kHz, and 20 kHz for the octave mode.

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3–14.8 Display Controls

There are five display controls available for all display windows:

- Locked Cursor
- Cursor Adjustment
- Scale
- Display Setup
- Information



For compressed time displays, there is an additional limits control when the SPS390 is in **HOLD** and data is available in the extended recorder memory for playback. For waterfall displays, there is a waterfall record/profile selection control which allows further waterfall data selection in waterfall data recall mode. For waterfall cascade displays, Z–Axis controls are also available.

3–14.8.1 Locked Cursors Control

The cursor can be controlled from one display and automatically move to the same X coordinate in "similar" displays. Each display has a padlock icon, which can be opened or closed. A closed padlock indicates that the cursor is locked on this display, and it can either control other "similar" locked displays or be controlled from other "similar" locked displays. An open padlock indicates that the cursor action only affects this trace. You open and close the padlock by clicking on this icon.

"Similar" displays are traces that agree in type (time, spectrum, orbit, Nyquist, compressed time, etc.), resolution (or block size), and frequency. For example, when two time displays and two frequency displays are locked, the cursors for the time displays move in unison, and the cursors for the frequency displays move in unison, but the time and frequency cursors move independently of one another.

3–14.8.2 Cursor Adjustment Control

The cursor adjustment button allows fine tuning of the standard cursor. When the standard cursor is selected from the cursor controls, pressing this button allows you to move the cursor line by line (or point by point) left and right, by moving the trackball left and right. If a keyboard is available, you may move the cursor using the left and right arrow keys. When the desired cursor location is found, press the trackball button to stop the cursor and return to coarse positioning mode.

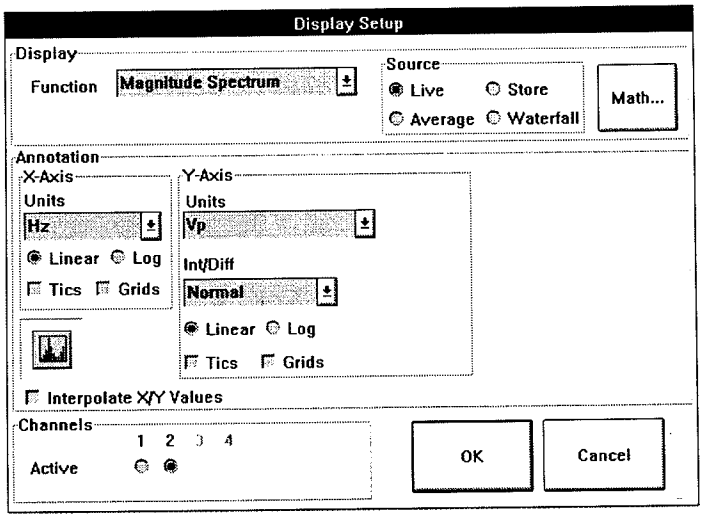


If the fine tune cursor select button is pressed and there is no trackball movement within 10 seconds, the cursor mode returns to coarse positioning.

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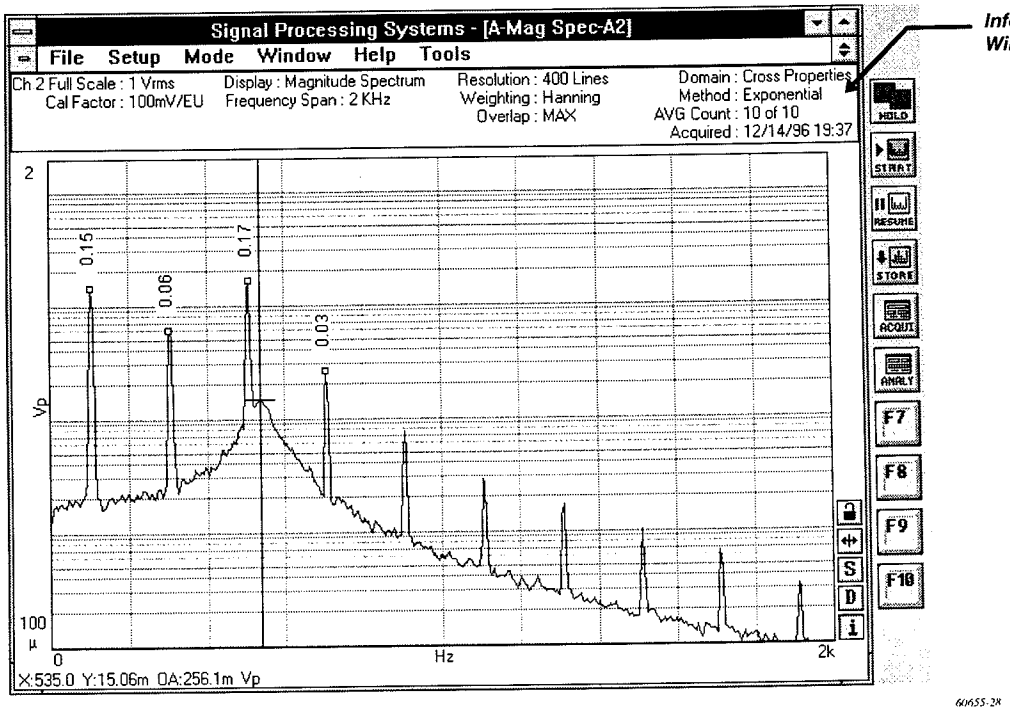
3–14.8.4 Display Setup

The display setup button "**D**" invokes the **Display Setup** dialog to allow you to modify the display parameters of the trace.



3–14.8.5 Information

The "**i**" button is located at the bottom right-hand corner of the display window. Clicking on the button brings up a pop-up window at the top of the screen containing additional information about the trace. In addition, the trace file name is highlighted in the Display Title box.



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4–THEORY OF OPERATION

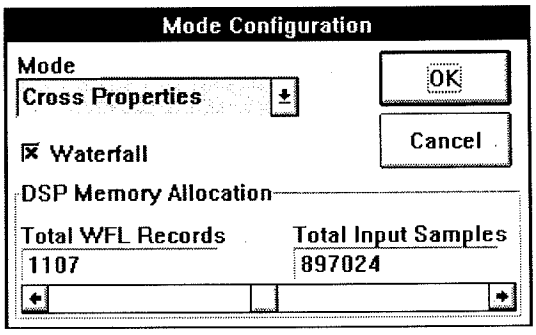
4–1 CONCEPT OF OPERATIONS

This section contains the SPS390 functional block diagram and discussions of analyzer related topics.

4–1.1 Extended Recorder Memory

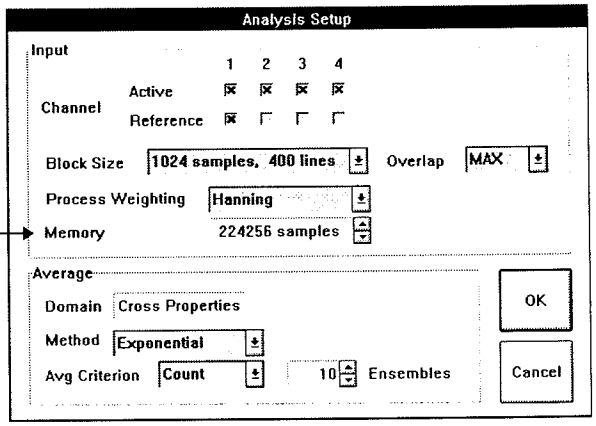
In the SPS390, a minimum of 8192 samples per channel is always allocated for extended recorder memory. The maximum number of samples is dependent upon the system configuration (either 8 MB, 4 MB or 1 MB of DSP RAM) and selected analysis parameters, such as analysis mode, the number of active channels, and FFT resolution.

The *total* amount of memory *available* for the extended recorder can be proportioned using the memory allocation control on the **Mode** Menu.



The maximum number of samples per channel is calculated each time a dependent parameter changes, and can be obtained by pressing the up arrow on the memory control field of the **Analysis Setup** dialog.

Memory





If RPM readout is selected in the acquisition Setup dialog box, the same number of samples will be allocated for the tach buffer as the number of samples per active channel.

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When a nonrepetitive trigger is detected for a positive delay, the number of samples specified as the positive delay is acquired, and then the system stops acquiring data. The last block (or FFT of) is displayed for *live* displays, and all input memory prior to the end of the block is available.

For repetitive triggers, the extended memory is continually filled with new data while the trigger event is in the process of being detected. For frequency ranges of 20 kHz and less, extended memory may contain varying numbers of trigger events (which include the pre– or post–trigger samples), if the trigger event is less than the amount of memory in extended recorder memory.

If this condition exists, the extended recorder memory does not contain discrete events with a specific positive or negative delay number of samples, but also contains data that is acquired while waiting to detect the trigger.

For 40 kHz and greater, extended recorder memory will only contain one trigger event, plus the data acquired leading up to the event if the event is less than the maximum pre– or post–trigger delay.

4–1.1.2 Extended Recorder Memory and Zoom

The extended recorder memory is also used to achieve pseudo-real time zoom above 10 kHz (when center frequency + 1/2 frequency span exceeds 10 kHz). Data is first acquired into the extended memory and then immediately retrieved to perform the zoom spectrum calculation. Therefore, the amount of allocated XRec memory will directly determine the minimum zoom span. If the zoom span is expressed in terms of a zoom factor (e.g., for a 400-Hz span at an analysis range of 40 kHz, the zoom factor is
40 kHz/400 Hz or 100), the amount of memory required is approximately:

(BlockSize + 80) (zoom factor) (2)

samples per channel. From this example, and a blocksize of 1024 (400-line resolution), the amount of XRec memory required is approximately 220,800 samples per channel, which is well within the range of the SPS390.

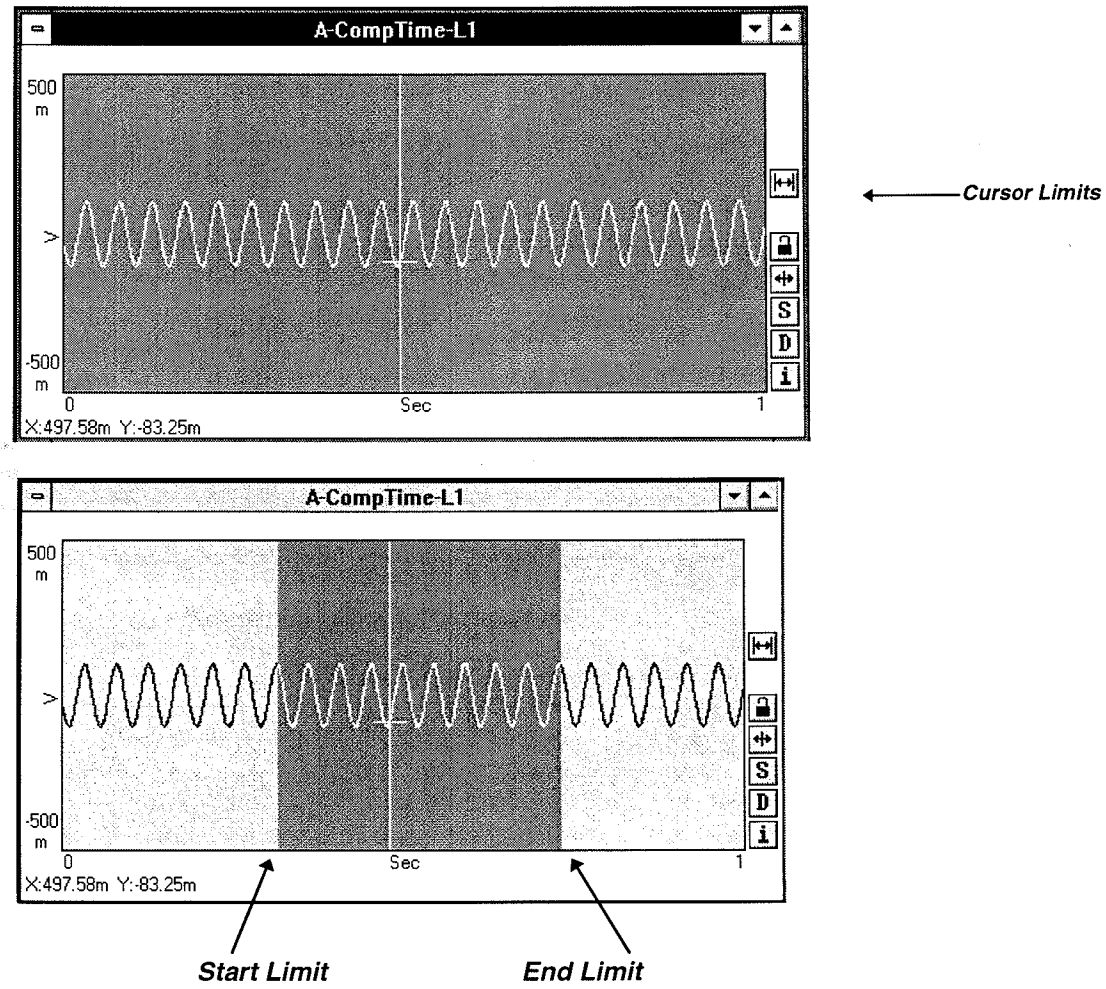
If the required amount of memory is not available, the minimum zoom span will automatically be limited. You can determine this minimum value from the frequency span parameter on the acquisition dialog.

When the prime requirement for using the SPS390 is zoom, it is good practice to set XRec memory to the maximum value. If sufficient memory is not available for the desired zoom, changing the mode, channel, and blocksize parameters will allow further changes in memory size.

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Continuous Averaging from Extended Recorder Memory

You are able to automatically average data in extended memory by selecting start and end limits via the limits cursor. The section of data between the start and end points (rounded to the next lowest blocksize) is displayed inverted, and will be used for averaging when AVG START is pressed while in HOLD. The number of averages will be automatically calculated based on the section of data, blocksize and overlap. This number WILL NOT be reflected on the Analysis Dialog. The Dialog will show the selected "Real Time" target. You must use the INFO box on any real time display (the current Compressed Time display is most convenient) to see the calculated Target count while in playback. The limits can be repositioned, and/or new analysis parameters can be selected, and the averager can be restarted.

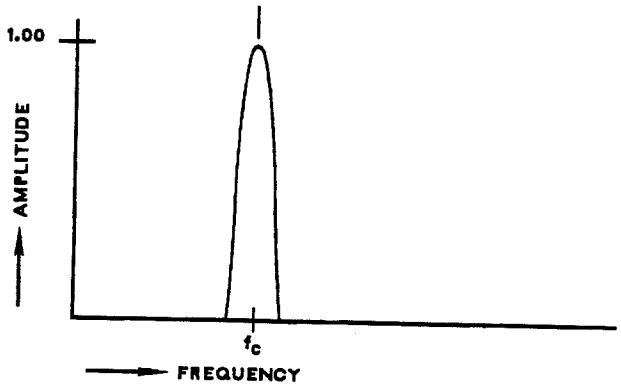


4–1.1.6 Save/Recall XREC Data

The system must be in HOLD when extended recorder memory data is saved or recalled. If not, when the **Save** or **Recall** selection is made, the system is put into **HOLD**. Save XREC will save all extended recorder memory data from all active channels into the named file. The current acquisition and analysis parameters are also saved with the file. When extended recorder memory data is restored from a file, the current state of the machine could change, as the acquisition and analysis parameters that were stored with the data are loaded into the machine.

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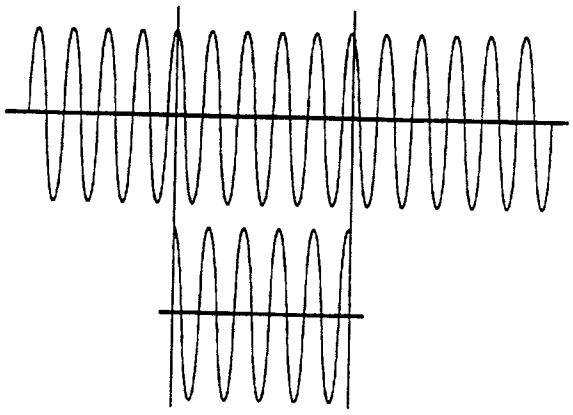
Filter Response of a High Q Filter



A digital spectrum analyzer carries the spectrum analysis concept even further. It simultaneously displays the output of up to 1600 equally spaced, digital filters. This is accomplished by using a high speed discrete Fourier Transform called the Fast Fourier Transform (FFT). FFT analysis allows the rapid transformation of discrete time domain data into frequency domain data. The end result is up to 1600 values representing the simultaneous output of each high Q filter.

Since the FFT is performed on a finite sample, incongruities such as side lobes, spurious noise, etc., can cause false data to be acquired. Weighting is a technique for treating data in the time domain, before the FFT, to reduce the effect of side lobes, etc. The FFT of the signal shown in the following figure is performed on the data in the sample window.

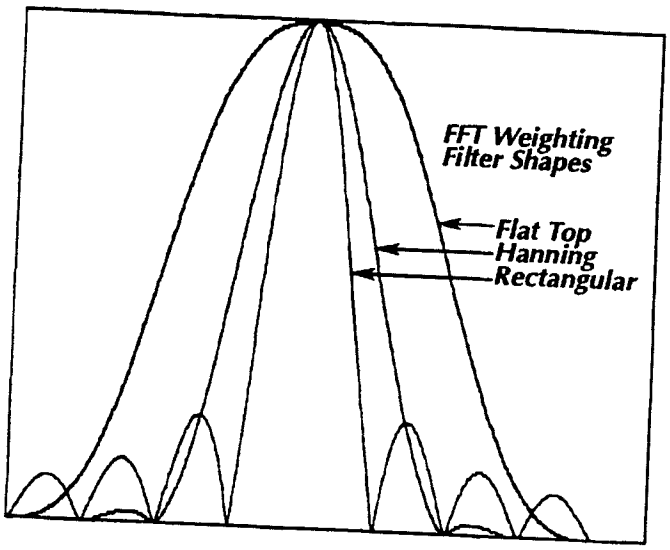
Sample Window



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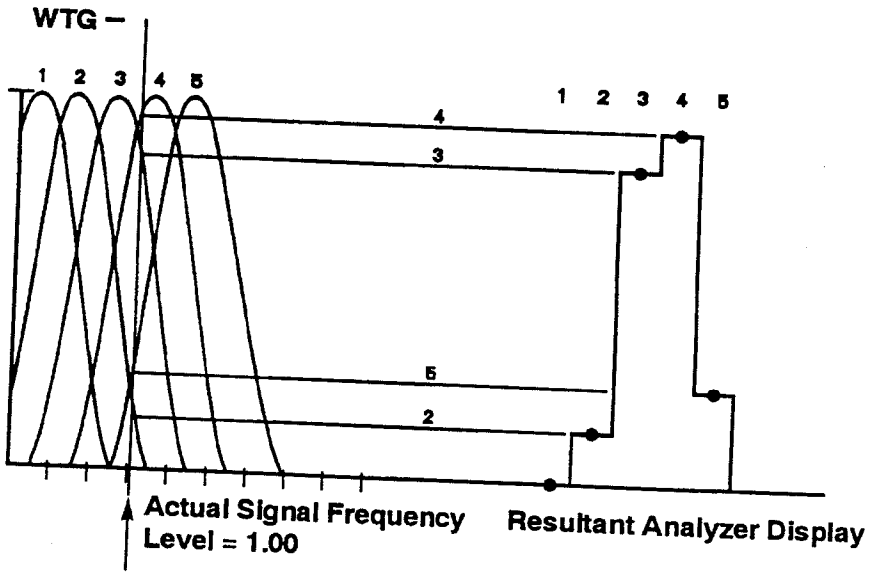
An additional effect weighting has on the data is the effective shape of the digital filters that produce the display. This filter shape could be measured by slowly sweeping a signal through the filter and measuring the response. A "swept sine" plot of a single filter would produce the following filter shapes for Rectangular, Hanning, and Flat Top weighting:

Filter Shapes of the Various Weighting Functions



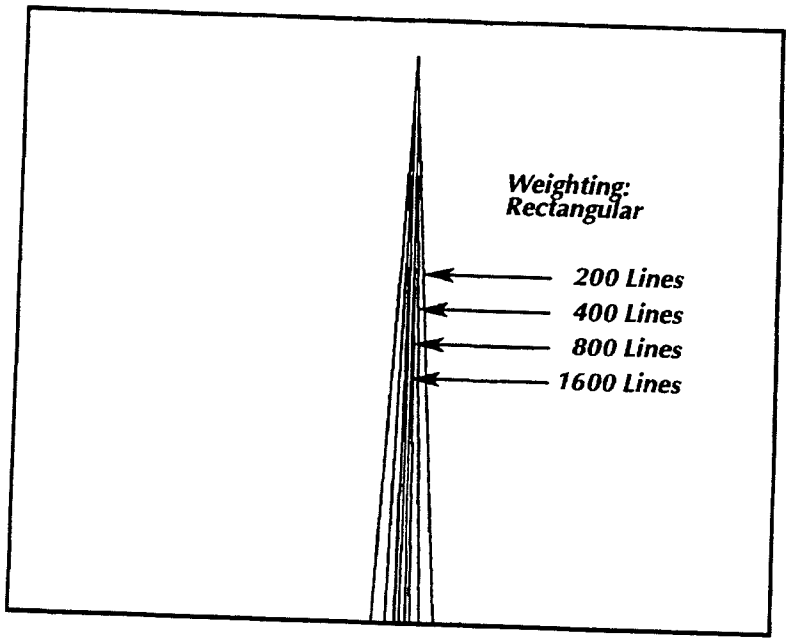
There are up to 1600 filters overlapping each other on the SPS390 display. The displayed data are actually the vectors between the output data points at the applied frequency. The following figure shows the analyzer display of a signal measured with Hanning weighting.

Generation of a Weighted Analyzer Display



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Rectangular Weighting Example



If we were to plot the measured signal peak versus input frequency across the weighting filters, we would notice an effect called "scalloping." It (scalloping) reflects the variation in amplitude of a measured tonal as it passes into and out of the digital filter centers. Examples of this effect are shown in the following figure. Note that as the tonal passes from the center of one filter to the center of the next filter, the amplitude of the tonal will decrease as it passes between the filter centers (the point at which the filters overlap) and then increase as it approaches the next filter center. This variation in amplitude reflects the percentage of scalloping for each weighting-function filter shape.

In an environment where the amplitude of a signal (tonal) is extremely important, Flat Top weighting can insure that filter shape does not affect measured amplitude. For example, if you were to sweep a signal across a particular band, you would notice that the "next filter" would rise to signal strength before the "current filter" started to descend.

Harris Flat Top weighting (the method of Flat Top weighting the SPS390 uses) gives you the necessary flat response without sacrificing any more frequency resolution than necessary.

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