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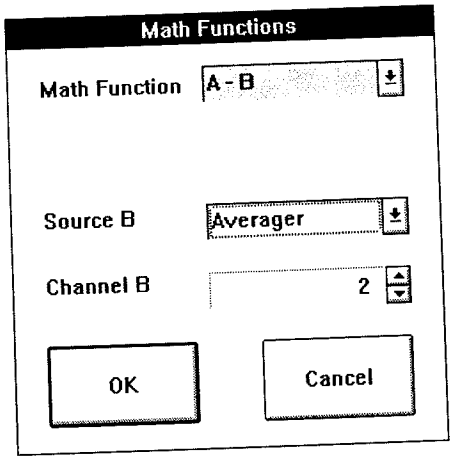
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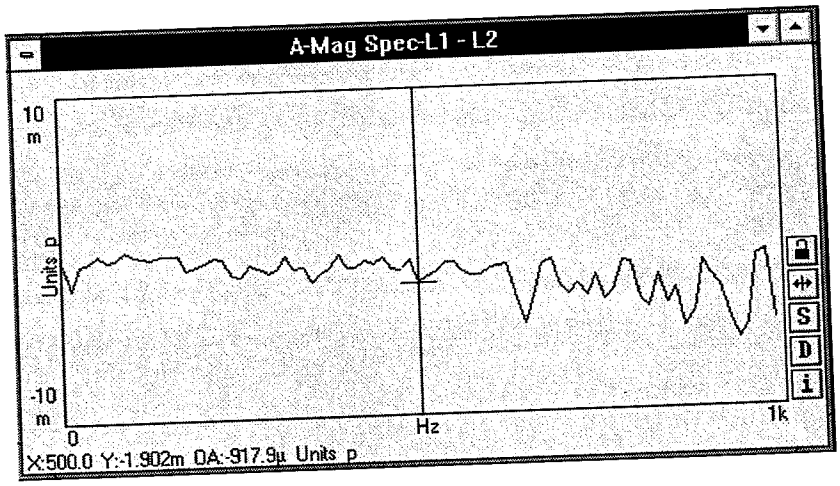
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Find the *Signal Processing Systems SPS390* at our website: ***Click HERE***

A typical selection is shown below.



The following figure shows a sample **A–B** display. Note that the window title bar identifies the display as a subtraction function of two live traces.



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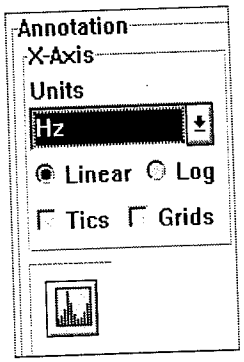
Table 2. X-Axis Units vs. Display Function

Display Function	Linear	Log
Compressed Time	Seconds	
Time Trace	Seconds	
Orbit	V, EU	
Magnitude Spectrum	Hz, CPM*	Hz, CPM*
Transfer Function Magnitude	Hz, CPM	Hz, CPM
TF Magnitude Accelerance	Hz, CPM	Hz, CPM
TF Magnitude Mobility	Hz, CPM	Hz, CPM
TF Magnitude Compliance	Hz, CPM	Hz, CPM
TF Magnitude Stiffness	Hz, CPM	Hz, CPM
TF Magnitude Mech Impedance	Hz, CPM	Hz, CPM
TF Magnitude Dynamic Mass	Hz, CPM	Hz, CPM
Transfer Function Phase	Hz, CPM	Hz, CPM
TF Phase Accelerance	Hz, CPM	Hz, CPM
TF Phase Mobility	Hz, CPM	Hz, CPM
TF Phase Compliance	Hz, CPM	Hz, CPM
TF Phase Stiffness	Hz, CPM	Hz, CPM
TF Phase Mech Impedance	Hz, CPM	Hz, CPM
TF Phase Dynamic Mass	Hz, CPM	Hz, CPM
Transfer Function Coherence	Hz, CPM	Hz, CPM
Transfer Function Real	Hz, CPM	Hz, CPM
Transfer Function Imaginary	Hz, CPM	Hz, CPM
Nyquist Function	V/V, EU/EU	
Cross Spectrum Magnitude	Hz, CPM	Hz, CPM
Cross Spectrum Phase	Hz, CPM	Hz, CPM
Cross Spectrum Real	Hz, CPM	Hz, CPM
Cross Spectrum Imaginary	Hz, CPM	Hz, CPM
Octave Spectrum (Option)	Hz (logarithmically distributed by band)	

*Orders if SRA option is installed

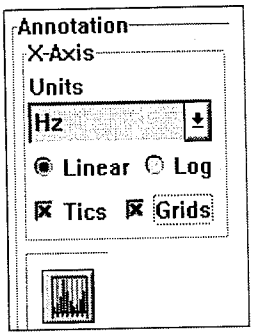
Scaling (X-Axis)

The **Scaling** radio buttons determine whether the scale for the axis is linear or logarithmic (base 10). If one of the scaling functions is invalid for the selected display type, the scaling defaults to the valid scaling function and the control corresponding to the invalid scaling function is grayed.



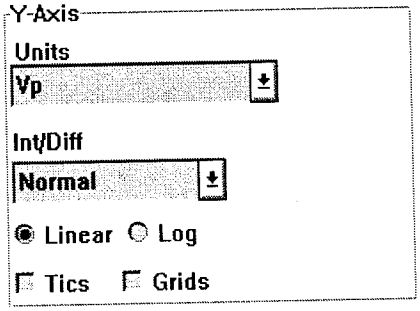
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Grids and Tics—select both the grid and tic options



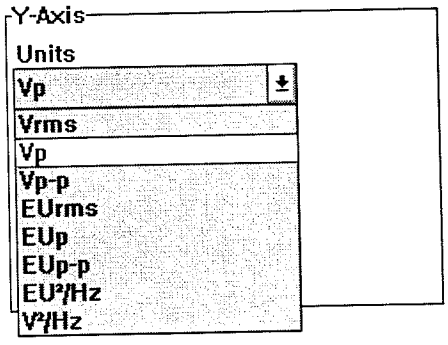
Y-Axis Controls

The Y-**Axis Controls** are used to control the annotation and scaling of the display Y-Axis.

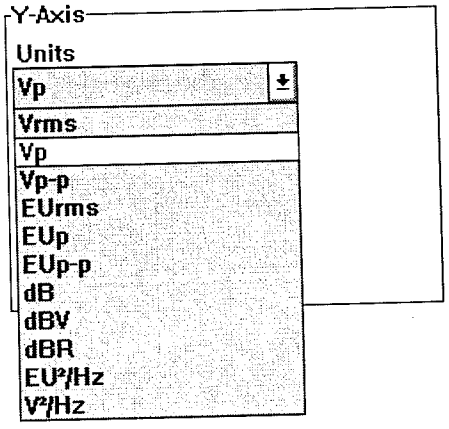


Units (Y-Axis)

The **Units** combo box allows you to select which units will be used on the Y-Axis of the display. These units depend upon the display function and the axis scaling. Tables 3 and 4 how which units are available for the Y-Axis based on display function and axis scaling (blank entries denote invalid combinations of display function and scaling):



Y LIN



Y LOG

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Figure 4 Y-Axis Units vs. Display Function (Logarithmic)

Display Function	Logarithmic
Time Trace	
Compressed Time	
Orbit	
Magnitude Spectrum	Vrms, Vp, Vp-p, EUrms, EUp, EUp-p, V^2/Hz, EU^2/Hz, dB, dBV, dBR
Transfer Function Magnitude	V/V, EU/EU, dB, dBV, dBR
TF Mag Accelerance	G/lb, G/Newton
TF Mag Mobility	IPS/lb, m/Newton*sec
TF Mag Compliance	inches/lb, m/Newton
TF Mag Stiffness	lb/inch, Newton/m
TF Mag Mech Impedance	lb/IPS, Newton*sec/m
TF Mag Dynamic Mass	lb/G, Newton/G
Transfer Function Phase	
TF Phase Accelerance	
TF Phase Mobility	
TF Phase Compliance	
TF Phase Stiffness	
TF Phase Mech Impedance	
TF Phase Dynamic Mass	
Transfer Function Coherence	
Transfer Function Real	
Transfer Function Imaginary	
Nyquist Function	
Cross Spectrum Magnitude	V^2rms, V^2p, V^2p-p, EU^2rms, EU^2p, EU^2p-p, dB, dBV, dBR
Cross Spectrum Phase	
Cross Spectrum Real	
Cross Spectrum Imaginary	
Octave Spectrum (Option)	Vrms, EUrms, dB, dBV, dBR

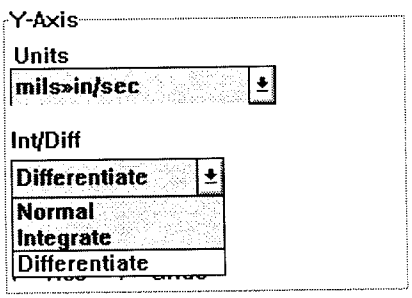


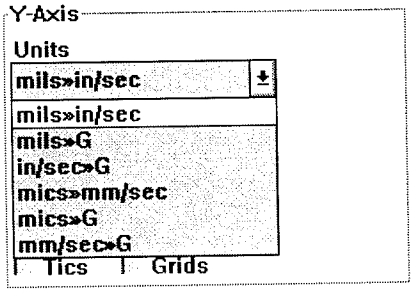
Note that the six calculated mechanical Frequency Response Functions can be automatically scaled in metric as well as English units. When selecting Accelerance, for example, magnitude can be shown as G/lb or G/Newton. The correct scale factor for mV/Newton must be entered on the Acquisition dialog for metric conversion.

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Units	English/Metric	Operation
g's >>n/sec	English	Integration
g's >>mils	English	Double Integration
in/sec >>mils	English	Integration
g's >>mm/sec	Metric	Integration
g's >>mics	Metric	Double Integration
mm/sec >>ic	Metric	Integration

When **Differentiate** is selected, the following illustration and table show the choices of units that appear in the **Units** combo box, and their meaning:





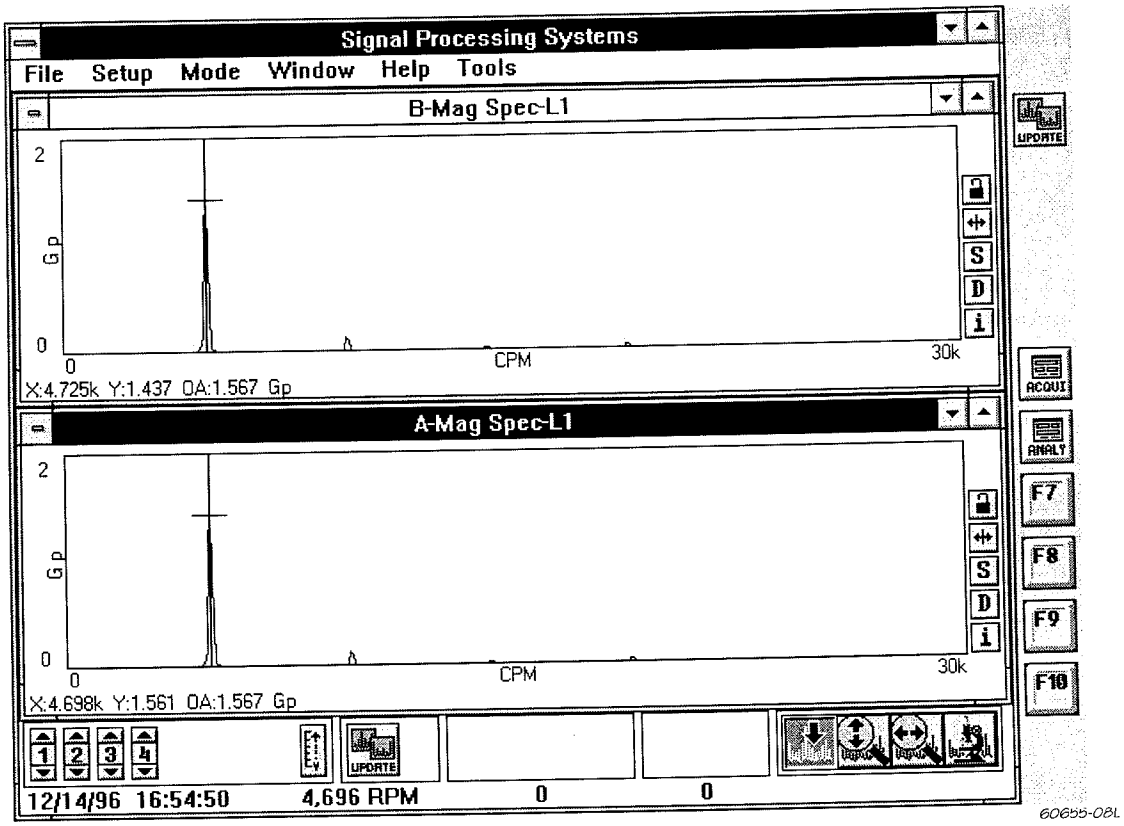
Units	English/Metric	Operation
mils >>in/sec	English	Differentiation
mils >>'s	English	Double Differentiation
in/sec >>'s	English	Differentiation
mics >>m/sec	Metric	Differentiation
mics >>'s	Metric	Double Differentiation
mm/sec >>'s	Metric	Differentiation



Integration and differentiation are accomplished by dividing or multiplying the data by $2\pi f$ or $(2\pi f)^2$ and by applying the appropriate units scaling and conversion factors.

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CPM is displayed, giving 150 CPM bin resolution. The actual machine speed, measured with a 1/rev tachometer, is also shown (4696 RPM).



In the top trace, the nearest bin is at 4725 CPM. The bottom trace interpolates the actual frequency of the peak to 4698 CPM and also interpolates the peak amplitude. Note that this is about 0.1 g higher than the uninterpolated value. Both spectra were measured with a Hanning window.

The interpolation feature can mean an improvement in frequency resolution of orders of magnitude, without the typical loss of time associated with longer block lengths or zoom (methods sometimes used to accomplish the same objective). With the improved frequency resolution there is no attendant loss of amplitude accuracy, since the correct peak is also interpolated based on the characteristics of the Hanning window.

3–11.1.6 Shorthand Notation

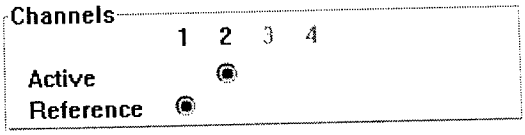
Cursor readouts on spectrum displays are used to show magnitude and frequency values at selected points. In standard notation, the X-Axis cursor readout is typically limited to four digits plus a multiplier (k for kilo-, m for milli-, M for mega-, etc.). Magnitude values are also shown with a multiplier that permits four digits to cover the entire dynamic range of the analyzer.

However, when **Shorthand Notation** is selected, by clicking on the **Shorthand Notation** check box just above the **OK** button, real numbers up to nine digits are used for both X- and Y-Axis cursor readouts.



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Reference Channels



The **Reference** channels radio button group allows you to select one active channel to be used as a reference channel when displaying transfer function or cross spectrum traces.

☞ *For ORBIT Traces, the reference channel is the X-Axis Channel.*

3–11.2 Acquisition Setup

The **Acquisition Setup** Dialog is used to set up the channel, trigger, a sampling parameters. These include:

- **Channels Coupling**
- **Channels FS rms** (Full Scale)
- **Channels mV/EU** (mV to EU conversion factor)
- **Channels EU Name** (1 to 6 characters)
- **Channels dB Ref** and **V Ref** (dB and voltage reference factors)
- **Trigger Source**
- **Trigger Source Channel Delay**
- **Trigger Slope**
- **Trigger Threshold**
- **Frequency Span**
- **Zoom Center Frequency**
- **RPM Readout**



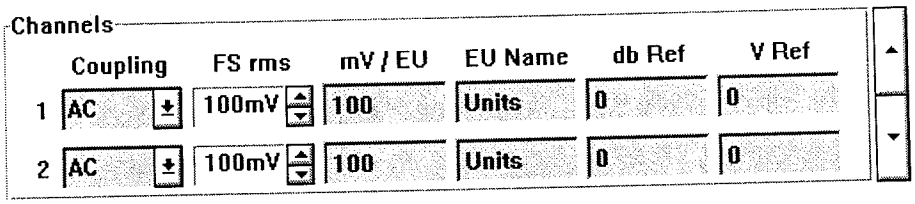
All acquisition parameters are global to the SPS390. Changing them may cause incompatibility between live data being collected and data currently in the averager. If such incompatibility is detected, the averager will cease averaging and you will not be able to resume averaging. The averager must be explicitly restarted (thus clearing the current averager contents) to perform averaging with the new acquisition parameters.

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➲ ***SPS390 HINT**: When beginning a data acquisition/analysis task, the acquisition parameter should be set up first and remain in effect until the task has been completed.*

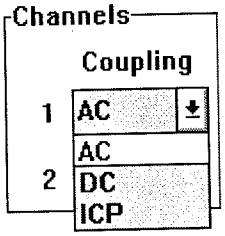
3–11.2.2 Channels Group

The channels group is used to set up the SPS390 channel parameters. Channels are configured here, but are activated on the **Analysis Setup** dialog. The SPS390 can have up to eight channels installed, two channels per card, and it will "recognize" how many cards are installed.



Each channel has its own parameters. Two channels at a time appear in the channels scroll box, and the next group of two channels can be selected by pressing the up/down arrow buttons on the right.

Channels Coupling



Coupling is selected on a channel-by-channel basis using the **Coupling** combo box. There are three choices for channel coupling:

- **AC** Alternating current signal source. The dc component is rejected.
- **DC** Direct current signal source. Both the ac and dc components are accepted.
- **ICP** Integrated Circuit Piezoelectric power source (transducer) 4 mA at 24 Vdc.

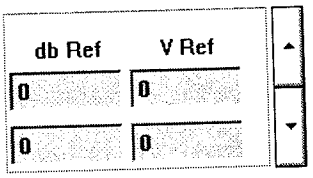
Note: I.C.P. .™ is a registered trademark of PCB Peizotronics, Inc.

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reference channel and "Output" as the data channel, the displays will be correctly annotated as "Output/Input" rather than the default "Units/Units".

dB Ref (dB Reference) and V Ref (Reference Voltage)

For acoustic measurements, a reference voltage (V Ref) can be equated to a dB Reference value by entering these two quantities in their appropriate text boxes. These values are used to calculate the dB amplitude in relationship to the entered quantities when the DBR Y UNITS Selector is chosen for a display.

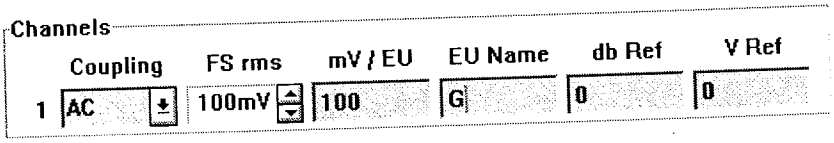


☞ *A dB reference can be entered independently from, or in addition to, the calibration factor. The default dB reference is 0 dB at 1.0 volts.*

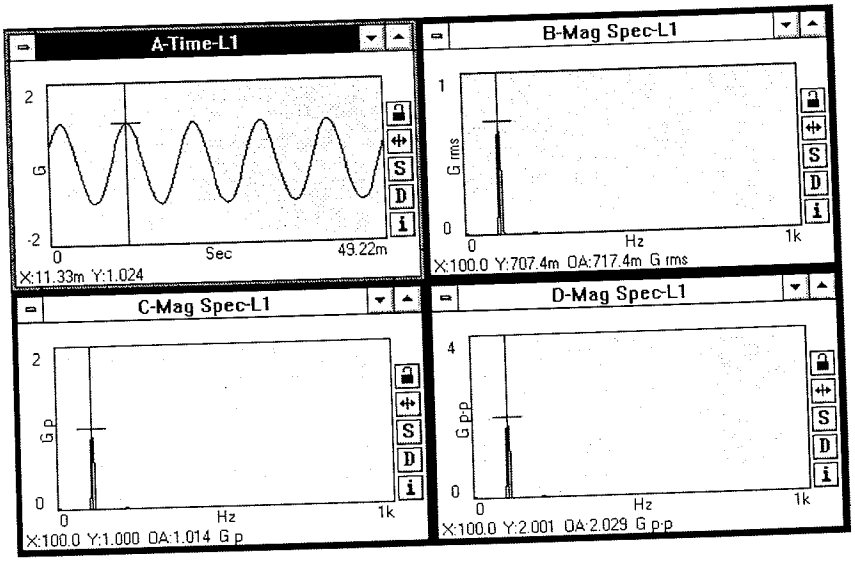
☞ *All entered channels' calibration data is saved when a* ***.cfg*** *file is saved.*

Calibration Examples

Assume an accelerometer transducer sensitivity is 100 mV/g. The **mV/EU** and **EU Name** are entered as shown in the following example:



If a nominal 100 mV 0-p sine wave is generated by the accelerometer, the SPS390 acceleration readouts will be as shown in the following display examples:



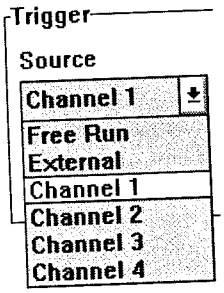
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In triggered data acquisition, the SPS390 does not begin processing data until some event, or trigger, occurs. The amount of data collected is equal to a single block of data set in the input group of the **Analysis Setup** dialog, plus the negative delay number of samples, *or*, the positive delay number of samples. Negative delay samples are included as *part* of the data block. Positive delay samples are *outside* the data block.

You can set parameters to perform sampling only upon the first trigger or to repeatedly collect data upon every trigger. You can also specify the characteristics of the trigger, whether it is a TTL signal coming from an external trigger (tachometer) input or an analog signal coming from one of the channels. You can also control how soon data will be collected after (or before) the trigger occurs.

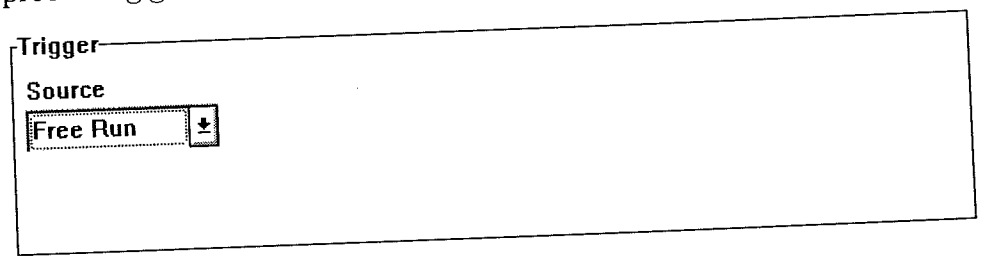
Source

The **Trigger Source** is selected using the Source combo box. There are three choices for trigger source:



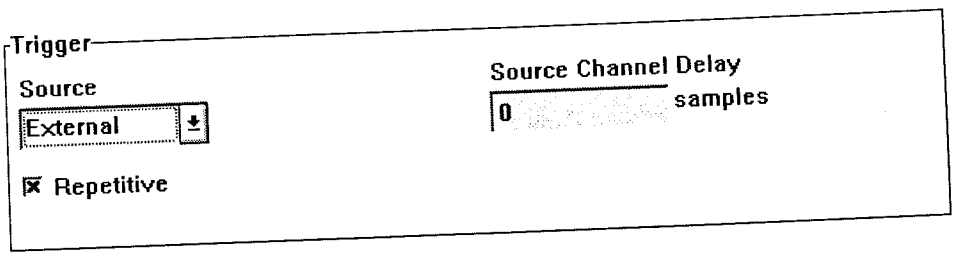
Free Run Source

In **Free Run** mode, data is acquired constantly, at the selected sample rate for processing given the current number of tasks being processed.



External Source

In external triggering, data is acquired time-relative to a TTL input signal on the dedicated EXT TRIG input.



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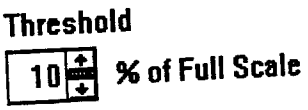
Falling Edge Source

The **Falling Edge** (decreasing voltage) of the signal at the specified threshold level will serve as the trigger.

☞ *Enabled for Channel trigger source only.*

Threshold Source

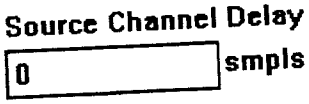
The **Threshold** scroll box is used to set the threshold (in terms of a percentage of the channel full scale voltage) for analog signal triggering. Any signal (with the appropriate slope—see preceding description) exceeding the threshold voltage will be used as the trigger. The threshold is an integer percentage in the range from –99% to 99% selectable in increments of 1%.



☞ *Enabled for Channel trigger source only.*

Source Channel Delay

The **Source Channel Delay** textbox is used to set the delay, in sample count, between the trigger and the start of data collection. This delay is for all channels and is an integer in the range not to exceed the **Extended Recorder Memory** size per channel.



A positive delay causes post-triggering. The data block is collected *after* the trigger. A negative delay results in pre-triggering. Data is retained *before* the trigger event.

☞ *Enabled for* ***External*** *and* ***Channel*** *trigger sources only.*

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Zoom Mode



The **Zoom Mode** checkbox is used to toggle between the baseband and zoom modes when spectral processing modes are enabled. If the box is not checked, baseband mode is in effect. If it is checked, the SPS390 is in zoom mode. The baseband/zoom modes affect the operation of the frequency span and center frequency scroll boxes on this dialog and the frequency control indicator in the display windows.

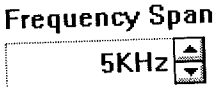
Real-time zoom (i.e., no data gaps) can be performed up to a range of 10 kHz, providing that (center frequency + 1/2 Frequency Span) does not exceed 10 kHz. Above this range, pseudo-real-time processing is in effect. This means that enough data to perform the zoom transform is first acquired to XRec Memory, the data is processed (and optionally averaged and/or displayed), and then more data is acquired. Therefore, there are data gaps proportional to the time it takes to perform the zoom transform on each channel. At very deep levels of zoom, this time can approach 5–10 seconds. The displays and averager will not update until a complete zoom transform is performed.

The level, or frequency span, of zoom above 10 kHz is directly proportional to the amount of available XRec memory selected on the analysis dialog. The default setting of 32768 samples is sufficient for a zoom of 20:1 at 20 kHz with a resolution of 400 lines. For deeper zoom factors, you must increase the amount of available XRec memory. The minimum zoom span is enforced by the SPS390, but is configurable by changing the amount of available XRec memory.

➲ ***SPS390 HINT:*** *If you need to select zoom above 10 kHz, set XRec memory to the maximum available to obtain the deepest zoom factor possible. Other methods include decreasing the number of channels and selecting a different analysis mode.*

Frequency Span

The **Frequency Span** scroll box allows you to select the frequency span for spectrum (FFT-based) and octave (digital filter-based) analysis.



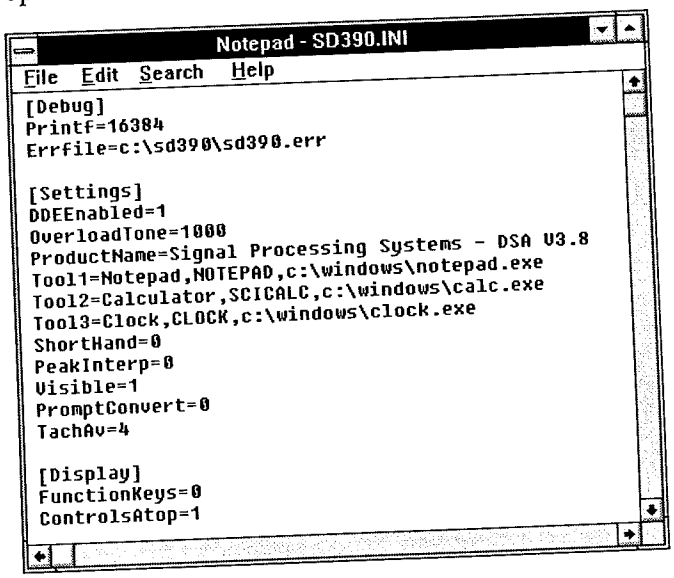
For spectrum analysis, the **Frequency Span** can be set to any frequency range from 1 Hz to 100 kHz (for two-channel operation), or 1 Hz to 40 kHz (for 3–8 channel operation) in a 1, 2, 4, 5 sequence. Clicking on the up arrow increases the frequency to the next higher range, while clicking on the down arrow decreases the frequency to the next lower range.

In real time **Zoom Mode**, the frequency span can be set to any frequency range from 5 Hz to 10 kHz (as long as the new frequency span is in the range [5 Hz, min(center frequency, 10 kHz – center frequency). In pseudo-real time zoom, the minimum frequency span is limited by the amount of available XRec memory.

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The SPS390 uses the number of pulses per rev of the tachometer signal over a period of time to calculate the RPM and therefore present a live tach RPM readout, allow RPM triggering, and waterfall loading. Normally the tachometer is very responsive to the pulses and the distance, in time, between pulses. However, noisy tachometer signals can result in erratic RPM calculations and RPM readouts.

The SPS390 has a tachometer averaging technique to will smooth out irregularities in the tachometer readout. The default setting of this feature is 4. If your tachometer reading is unstable and it is desired to average the tachometer, you must change the initialization **SD390.ini** file to reflect the desired average. In the .ini file there is an entry TachAv=4. You may change this number to any desired number to smooth tachometer operation. An entry of 10 (TachAv=10) would mean that ten tachometer readings would be averaged together to present an averaged RPM reading for that period. This averaged RPM will be used in all subsequent operations. The following Windows Notepad shows the SD390.ini file.



It is important to note that the larger the TachAV= number is in the .ini file, the longer the time constant for responding to an RPM change and become less responsive to rapid speed changes. If Delta RPM loading is taking place with a small RPM increment between records with a large TachAV number, then the possibility exists for missed records in the waterfall. Conversely, if the number is 1, then no averaging takes place and the readout is more susceptible to erratic readings.

When RPM readout is activated and tach data is available, it is stored along with the channel data in the extended recorder files (.XRC) files. When the extended recorder files are recalled, so is the analyzer setup configuration that was used to acquire that data. Because the TachAV= number is resident in the sd390.ini file, it is independent of any analyzer setup configuration. Thus it is possible to replay the extended recorder data with a different TachAv= number and re-analyze the data with a smoother RPM readout. This smoothing effect will only be observed if the raw tach signal was slightly noisy or erratic.

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All analysis parameters are global to the SPS390. Changing them may cause incompatibility between live data being collected and data currently in the averager. If such incompatibility is detected, the averager will cease averaging and the instrument will not be able to resume averaging. The averager must be explicitly restarted (thus clearing the current averager contents) to perform averaging with the new acquisition parameters. Changing the Active Channel List will invalidate all data in the Extended Recorder Memory, thus invalidating all live displays.

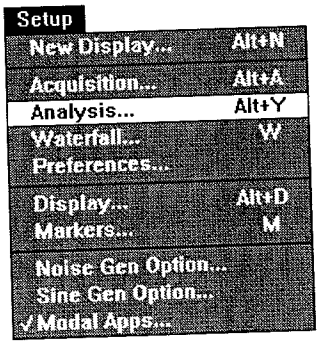
3–11.3.1 How To Invoke Analysis Setup

To invoke the **Analysis Setup** Dialog box:

- Use the trackball to:

  Select the **Setup** menu

- Select Analysis



- Or use the keyboard:

  Hold down the **ALT** key and press the **Y** key,

  or

  Press the **ANALY** function button

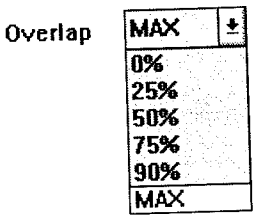
Analysis parameters are not set until the **OK** button at the bottom right corner of the dialog is pressed. Selecting **Cancel** causes the dialog to disappear without affecting the analysis parameters.

- The parameters discussed in the following sections are valid when the SPS390 has one of these three analysis modes enabled:
- Sync Spectrum
- Spectrum
- Cross Properties

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Overlap

The **Overlap** combo box is used to determine how much of the initial portion of a new data block is copied from the final portion of the previously collected data block. The percentage of overlap can be any of the following:



0%
No overlap. The data trace update rate is the same as the block processing rate.

25%
The first 25% of the new block is a copy of the last 25% of the old block; the last 75% of the new block consists of new data.

50%
New block: Last 50% old block, 50% new data.

75%
New block: Last 75% old block, 25% new data.

90%
New block: Last 90% old block, 10% new data.

MAX
For live analyses, the maximum overlap available is dependent upon the selected frequency span (see Acquisition Setup).

For data played back from the recorder memory, the maximum overlap is 90%. This technique is used primarily to improve the statistical average at low sampling frequencies.

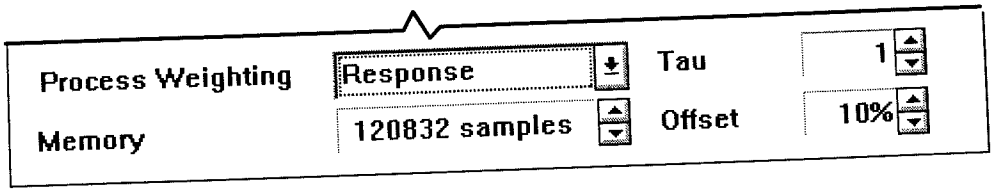
☞ *Overlap is ignored (set to 0%) for triggered data.*



Since traces are displayed on a block-by-block basis, the display update rate can be limited by the rate at which blocks are produced. By using overlap, a new block is partially filled in with values from the previous block, thus speeding up trace display. Trace update and display refresh may not occur at the same rate.

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Tau



The **Tau** scroll box controls the rate of exponential decay for response weighting. Tau is an integer in the range (1 → 15), and can be set in increments of 1. Higher values result in more pronounced signal damping (thus reducing the effects of object ringing in the force/response test).

The decay is given in the equation:

DECAY = 1 - e^{-Tau} (for amplitude attenuation within a data block)

☞ *Enabled for Response process weighting only.*

Tau	Decay
1	63.21205588%
2	86.46647168%
3	95.02129316%
4	98.16843611%
5	99.3262053%
6	99.75212478%
7	99.9088118%
8	99.96645374%
9	99.98765902%
10	99.99546001%
11	99.99832983%
12	99.99938558%
13	99.99977397%
14	99.99991685%
15	99.99996941%

Offset

The **Offset** scroll box controls the delay offset between the trigger and the beginning of signal damping to suppress ringing for response weighting. Offset is an integer percentage in the range (10% → 80%) and can be set in increments of 1%. Higher percentages result in greater delays between the trigger and the beginning of signal damping.

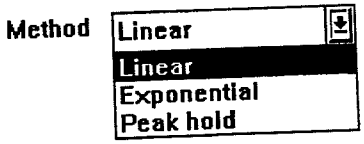
☞ *Enabled for Response process weighting only.*

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The availability of certain trace displays is affected by the current average domain. The factory default Domain is set for Cross Properties. See the table in the description of the Display Setup Dialog's display type control.

Method



Ensemble averaging is analogous to averaging numbers and involves the summation of a sequence of ensembles to produce a trace which is an "average" of the sequence. One ensemble represents one spectrum computation in the frequency domain or one time block in time domain averaging.

Averaging can be used to "even out" variations in the signal spectrum in order to determine mean or average signal behavior. In a similar manner, Time Domain averaging can also help eliminate the effects of random signal noise. During Time Domain averaging, the meaningful component of the signal will tend to reinforce itself while the noise component will tend to cancel itself out, using a **Triggered Acquisition** mode.

There are several different types of averaging, differing in the manner in which each ensemble contributes to the average of the ensembles as a whole. For example, all ensembles could contribute evenly to the average. Alternatively, new ensembles might contribute more to the average than ensembles acquired in the past. Each type of averaging has its own set of applications.

The SPS390 supports three different methods of averaging. Use the scroll arrows to select the desired method from the **Analysis Setup** dialog box.

➢ **Linear**

In linear averaging, each ensemble contributes equally to the average. The value at any point in the linear average is given by the equation:

AVG = (SUM OF ENSEMBLES)/(# OF ENSEMBLES)

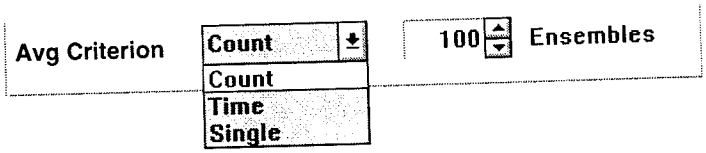
The advantage of this averaging method is that it is fast to compute. However, this method is suitable only for analyzing shorter signal records or stationary signals, since the average tends to stabilize due to the finite resolution of the analyzer. The contribution of new ensembles eventually will cease to change the value of the average no matter how great or small the magnitude of the ensemble components.

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Averaging Criterion

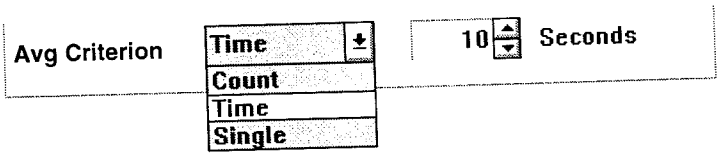
The **Avg Criterion** combo box is used to select whether the averager will stop on the basis of elapsed time or number of ensembles collected, or if single (manual) averaging will be performed.

➢ **Count**



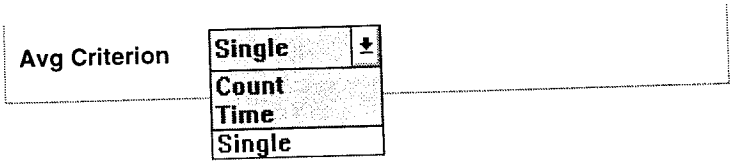
Averaging will stop after a specified number of ensembles have been collected. This is the preferred method when the time data is continuous or when the measurement size is defined.

➢ **Time**



Averaging will stop after a specified number of seconds have elapsed. This is the preferred criterion where the interval over which to collect the data is known (e.g., taped data).

➢ **Single**



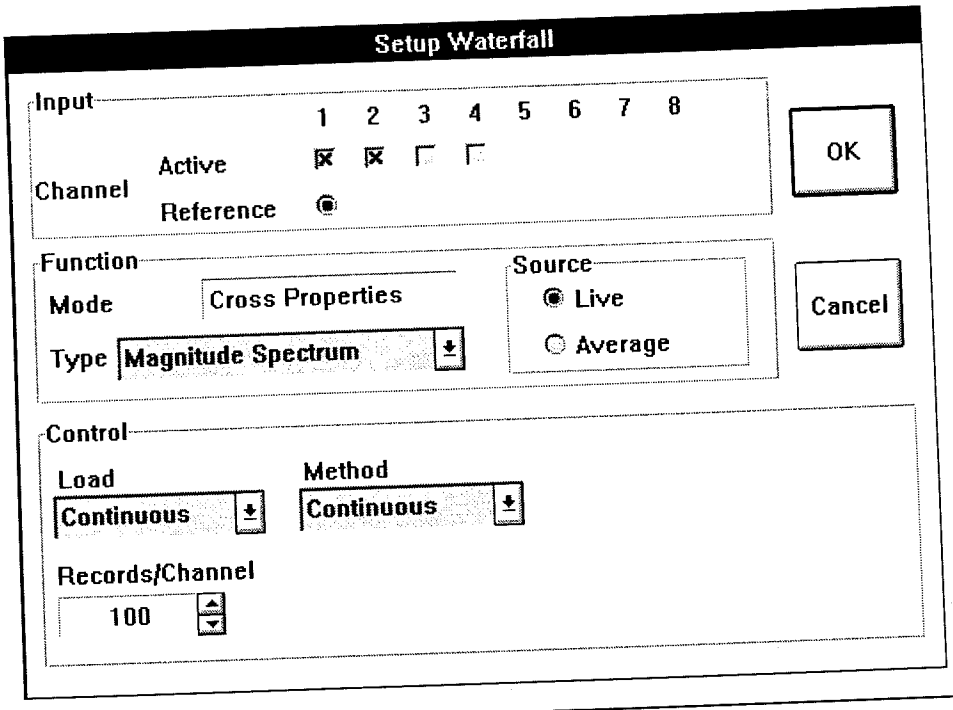
Averaging is performed manually, on a trace-by-trace basis, via the averager **Single** control, located in the averager group of the screen control area. This is the preferred method for interactively selecting the ensembles based on more complex criteria.



Single averaging must be used with repetitive trigger or free run acquisition.

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3–11.4 Waterfall Setup



3–11.4.1 How To Invoke Waterfall Setup

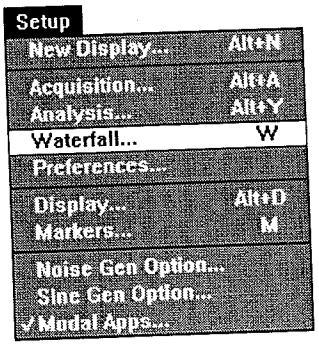
The **Waterfall Setup** dialog box is only available when waterfall is enabled from the **Mode** menu. This dialog is used to set the analyzer's waterfall load parameters.

To invoke the **Waterfall Setup** dialog to set waterfall Load parameters:

➢ Use the trackball to:

Select the **Setup** menu

Select **Waterfall**

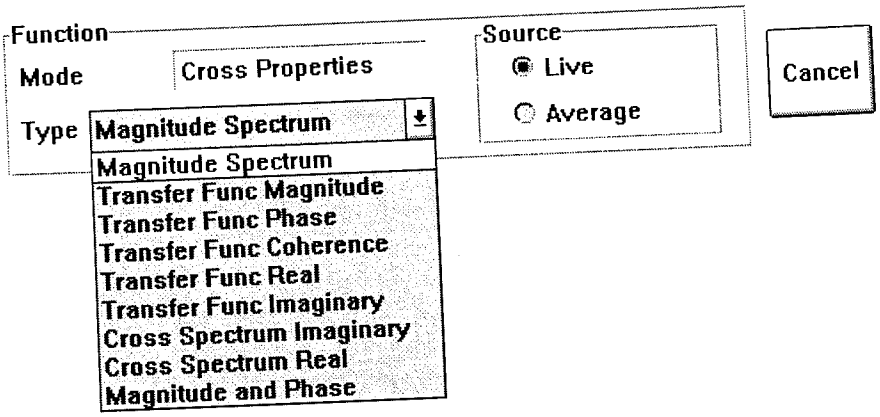


➢ Or use the keyboard:

Press the **W** key.

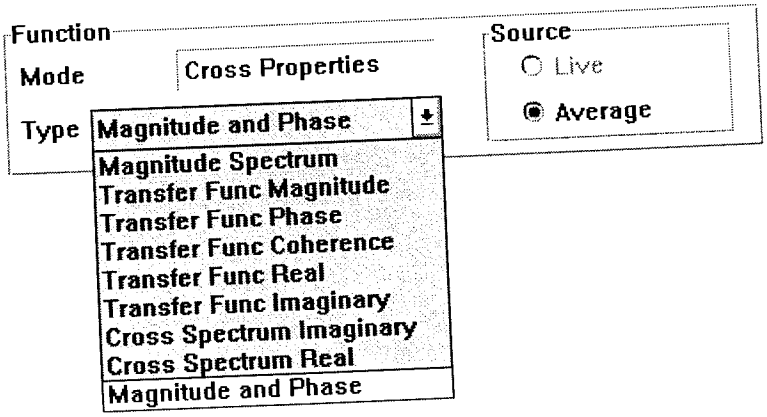
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Type



This is a pull-down combo box displaying the types of functions that can be loaded into waterfall memory for the selected mode. Only one function can be selected. The selected function applies to all active channels selected in the **Setup Waterfall Input** group. If a **Magnitude Spectrum** waterfall is selected for **Channel 1**, then other active channels for which a waterfall display is selected must also display a magnitude spectrum waterfall.

The exception to this rule is the **Magnitude and Phase** selection. When this function type is chosen, both the spectrum magnitudes of all active waterfall channels and the phase values between the active waterfall channels and the designated reference channel are simultaneously stored into waterfall memory.



For example, if four active waterfall channels are present and **Channel 1** is the reference, selecting **Magnitude and Phase** as the waterfall function type produces a waterfall memory array of:

- Channel 1 Spectrum Magnitude
- Channel 2 Spectrum Magnitude
- Channel 3 Spectrum Magnitude
- Channel 4 Spectrum Magnitude

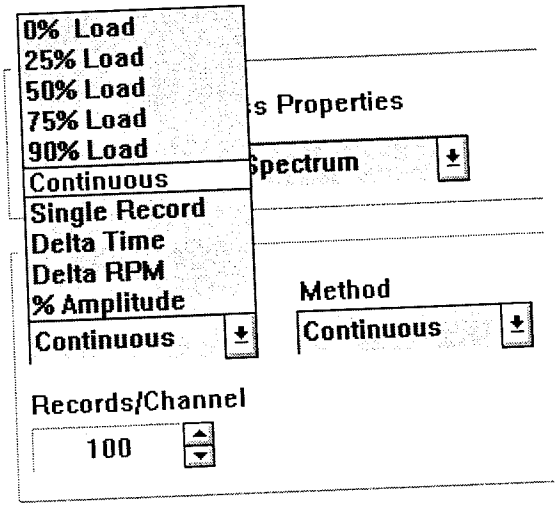
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Figure 5. Valid Trigger Source and Waterfall Load Control Combination

Trigger Source and Waterfall Load Control Combinations		
Trigger Source	**Waterfall Load Control**	**Waterfall Source**
Free Run	0% Load	Live
Free Run	25% Load	Live
Free Run	50% Load	Live
Free Run	75% Load	Live
Free Run	90% Load	Live
Free Run	Continuous	Live
Free Run	Delta Time (increment)	Live
Free Run	Delta RPM (increment, start, stop)	Live
Free Run	% Amplitude	Live
Free Run	Continuous	Avg
Free Run	Avg Recycle	Avg (linear method)
Free Run	Single Record	Avg
Free Run	Delta Time	Avg (expo method)
Free Run	Delta RPM	Avg (expo method)
External	Continuous	Live or Avg
Ch1–Ch8	Single Record	Live or Avg
Note::If External Trigger is used with SRA Sampling, the Delta RPM selection for Waterfall Load Control is located in the Trigger Control box on the Acquisition Setup Menu.		

Load Control (Live Data Source)

The **Load Control** pull-down combo box determines how waterfall memory will be loaded when the **Source** menu selection is **Live**.



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➢ **Continuous**

This control has two different functions, based on the data source.

➢ **Live**

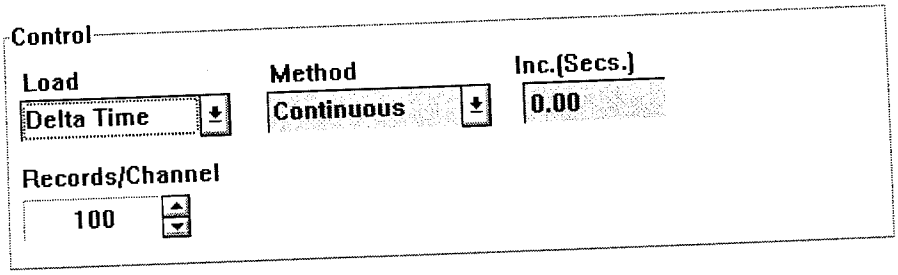
Data is transformed into the desired function and transferred to waterfall memory as fast as the analyzer can collect and process the data. The rate of processing is dependent upon the function, selected number of channels, and the number of active displays. Data is always processed with Max Overlap for this load criteria.

Single Record

This control allows manual load of the waterfall memory. Each time the Waterfall Start or Single (+1) load control button is pressed, data from the selected source is transformed and transferred to waterfall memory.

Delta Time

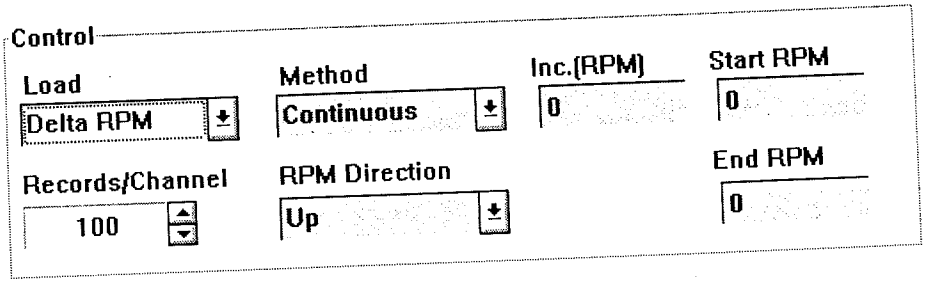
When **Delta Time Control** is selected, the time **Inc (Secs.)** (Increment) field appears to allow the time increment (in seconds) to be entered. When the time increment elapses, data in the source memory will be processed and transferred to waterfall memory. The resolution of the time increment is 0.10 seconds.



☞ *This load control is only available when the Trigger Source is Free Run on the Acquisition Setup dialog.*

Delta RPM

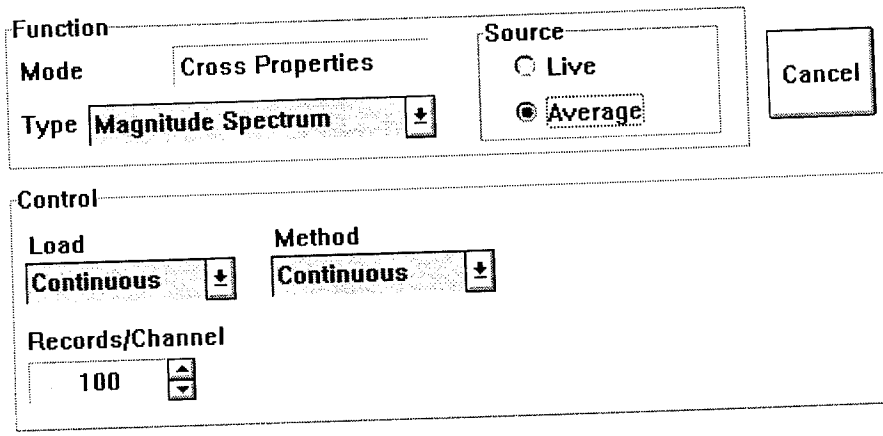
Data can be loaded into waterfall memory at specific RPM intervals, while accelerating, decelerating, or both accelerating and decelerating. Additional parameter fields appear when **Delta RPM** is selected:



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Load Control (Average Data Source)

This pull-down combo box determines how Waterfall Memory is loaded when the Source menu selection is Average.



Continuous

This control has two different functions based on the data source.

➢ **AVG**

The averager control parameters (overlap, weighting, etc.) are used. When one block of data (according to the Averager overlap factor) is processed, the desired function is transferred to waterfall memory.

Avg Recycle

This load control is only available when the data source is from the Averager. Each time the Averager target count reaches the specified number, the data in the averager is copied to waterfall memory. Each copy produces one record for each selected waterfall channel. The averager is cleared, and the process begins again until the requested number of records has been copied to waterfall memory.

☞ *Avg Recycle forces the Averager to linear averaging, and Count Stop Method.*

Single Record

This control allows manual load of the waterfall memory. Each time the Waterfall Start or Single (+1) load control button is pressed, data from the selected source is transformed and transferred to waterfall memory.

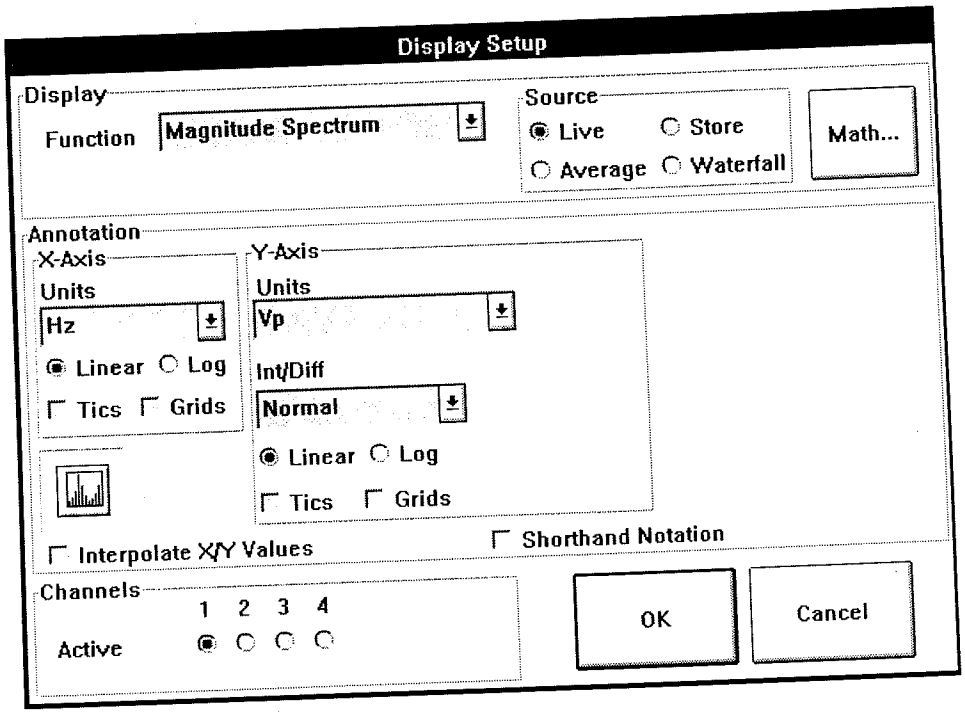
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3–11.5 Waterfall Display Setup

When the **Waterfall** checkbox on the **Mode Configuration** menu is selected, the **Waterfall** radio button on the Display Setup menu will be activated. Selecting **Waterfall** as the display source will allow access to displaying and manipulating data in the waterfall memory.

3–11.5.1 How To Invoke Waterfall Display Setup

There are a number of fields and choices that are particular to Waterfall Displays. In addition to the previously discussed selections on the Display Setup Dialog, when **Waterfall** is selected from the Source group, there are additional display formats and parameters for selecting Z Axis and other waterfall-specific display features.





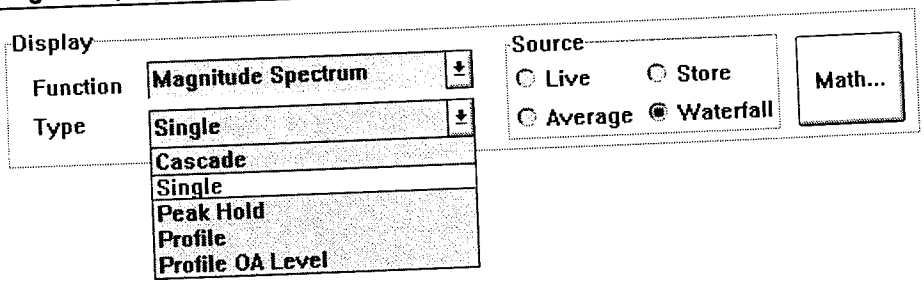
A step-by-step example for setting up a waterfall display can be found in the subsection 3–11.6.

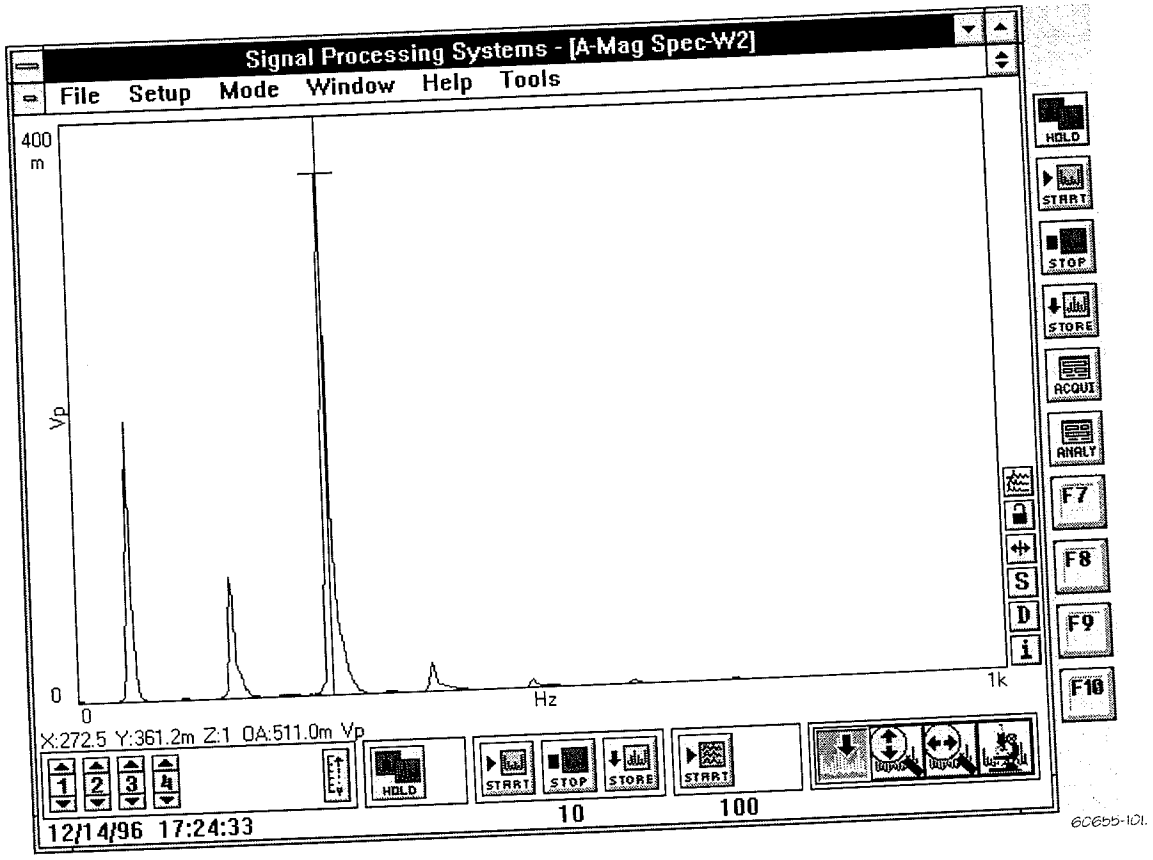
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At fast acquisition rates, every trace that is collected may not be displayed during Live Load (i.e., as data is being collected). When the display is refreshed, all collected displays (within the specified range) will be shown.

Single Display



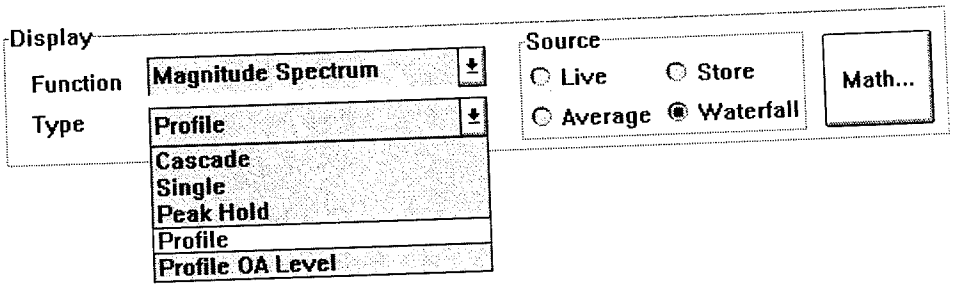


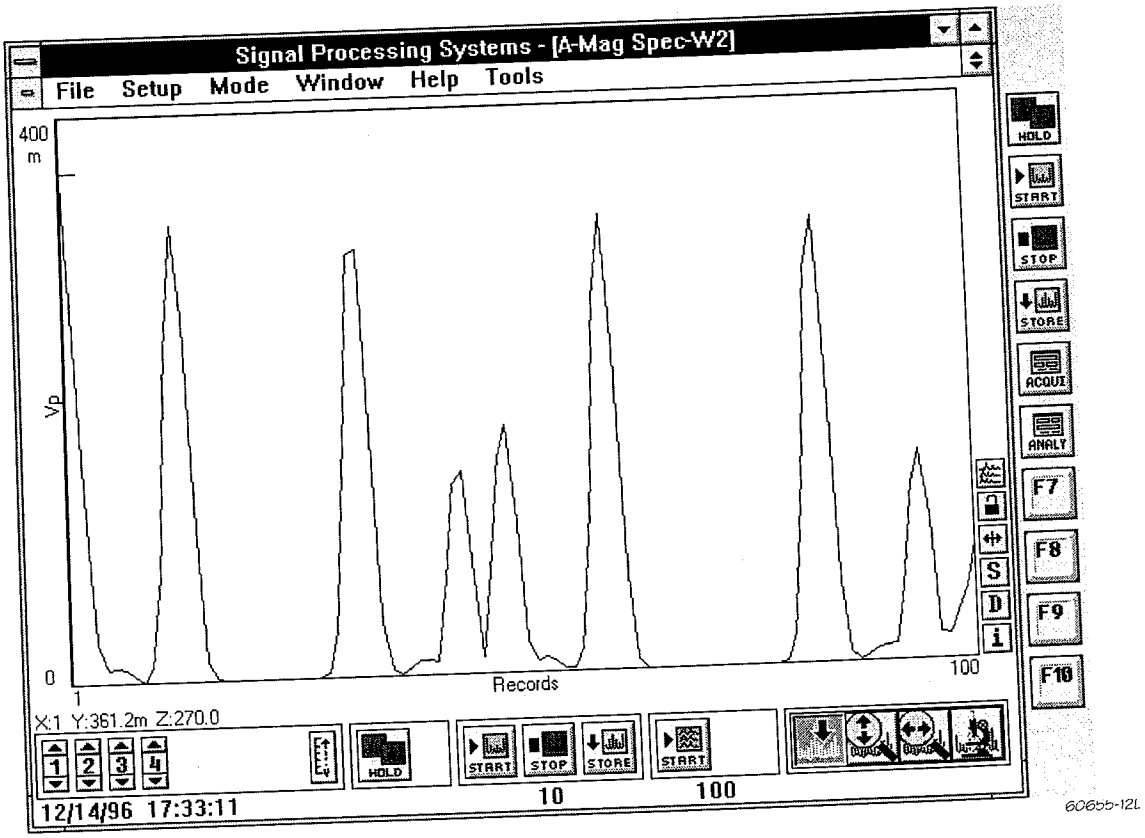
This display type will display a single trace from waterfall memory. It is an accurate representation of the most recent data being loaded into waterfall memory during **Live** load. During waterfall data recall, any individual record can be displayed from waterfall memory by prompting the waterfall icon, located in the display control totem pole to the right of the trace border, and making a record selection.

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Profile Display

The profile of the waterfall data along any bin (frequency or order) can be displayed by selecting the **Profile Display** type. The profile bin and record range are selected using the waterfall record selection feature, by prompting the waterfall icon.

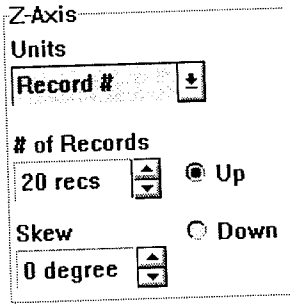




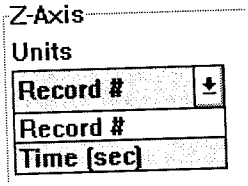
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3–11.5.3 Z-Axis Group

Parameters for the Z-Axis can be modified for Cascade and Profile Displays. The Z-Axis group is used to control the annotation and scaling of the display Z-Axis.



Z-Axis Units

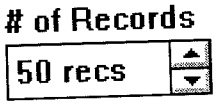


The **Units** combo box allows you to select which units will be used on the Z-Axis of the display. These units depend upon acquisition and waterfall load options that have been previously selected. The Z-Axis is always linear. The possible choices are:

- Record Number
- Time
- RPM (when RPM is enabled during Acquisition)

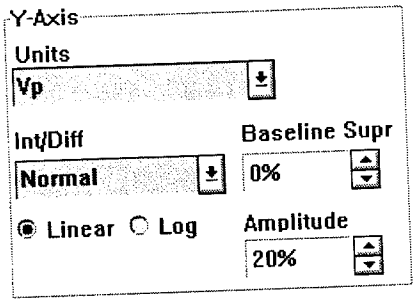
Number of Records (Cascade Only)

For cascade displays, you can specify the number of records (or traces) to show on one display. The size of the display, the Y–Axis amplitude, and the number of records displayed will each affect the clarity of the individual traces. Fewer traces on a large display will provide the best resolution. The range of data (beginning and ending records) can be specified using the Z-Axis number of records field.



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3–11.5.4 Y-Axis Group



There are two additional selections for Y-Axis scaling and presentation that are available for cascade displays. These selections are:

Amplitude

The full-scale amplitude of a single trace relative to the size of the display can be selected from 5% to 50%. The amplitude of a single trace, in conjunction with the number of displayed records and the display size, will affect the ability to discriminate individual traces of the cascade display. A higher amplitude will provide greater resolution of a single trace, but will limit the discrimination among many traces.

Baseline Suppression

Data below a specified amplitude can be visually suppressed on cascade displays. The amplitude is entered in percent of full scale, from 1% to 99%.

The amount of data suppressed is determined by the size of the display, the number of records displayed and the Y-Axis amplitude. The percent of suppression is rounded up to compensate for these parameters. Therefore, more or less suppression can be observed, particularly with small displays or displays with a large number of records.



Whenever a cascade display is moved or resized while waterfall load is not active, all data in the display is refreshed. During refresh, all controls and options are available. During waterfall load, all previously displayed data is erased when the display is moved or resized and new data is added on a fresh display.



When in **Octave** mode, the overall level is not displayed on cascade displays. It is available, however, on the overall profile display.

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Cascade

You can select the starting record (oldest data) by using the up and down arrows. The ending record (most recent data) is automatically determined by the number of records that are to be displayed for this display. The record numbers, times, and RPM (if RPM is available) and RPM readout is enabled on the **Acquisition** dialog box) are displayed for the starting and ending records.

Single

You can select any individual record from all the acquired waterfall data by using the up and down arrows to select the desired record. The record number, time, and RPM (if RPM is available and RPM readout is enabled on the **Acquisition** dialog box) are displayed for the selected record.

Peak Hold

You can select the starting record (oldest data) and ending record (most recent data), by using the up and down arrows to select both the starting record and the ending record. The number of records that are to be displayed is not applicable for this display. The record numbers, times, and RPM (if RPM is available and RPM Readout is enabled on the **Acquisition** dialog box) are displayed for the starting and ending records.

Profile

You can select the bin (or line number) that you wish to profile by using the up and down arrows on the bin select, or by using a cursor value from a similar display by checking the **Cursor** checkbox. When selecting a profile bin, the selected bin number and frequency or order (if SRA is enabled) is displayed. To use a cursor value from a similar display, you must first Lock the cursor in the display from which you wish to use the cursor value, and then check the **Cursor** checkbox on the **Select** dialog box. See the Locked Cursor description for more information on operating Locked Cursors.

You can also select the starting record (oldest data) and ending record (most recent data), by using the up and down arrows to select both the starting record and the ending record. The number of records that are to be displayed is not applicable for this display. The record numbers, times, and RPM (if RPM is available and RPM Readout is enabled on the Acquisition dialog box) are displayed for the starting and ending records.

Profile OA (Overall) Level

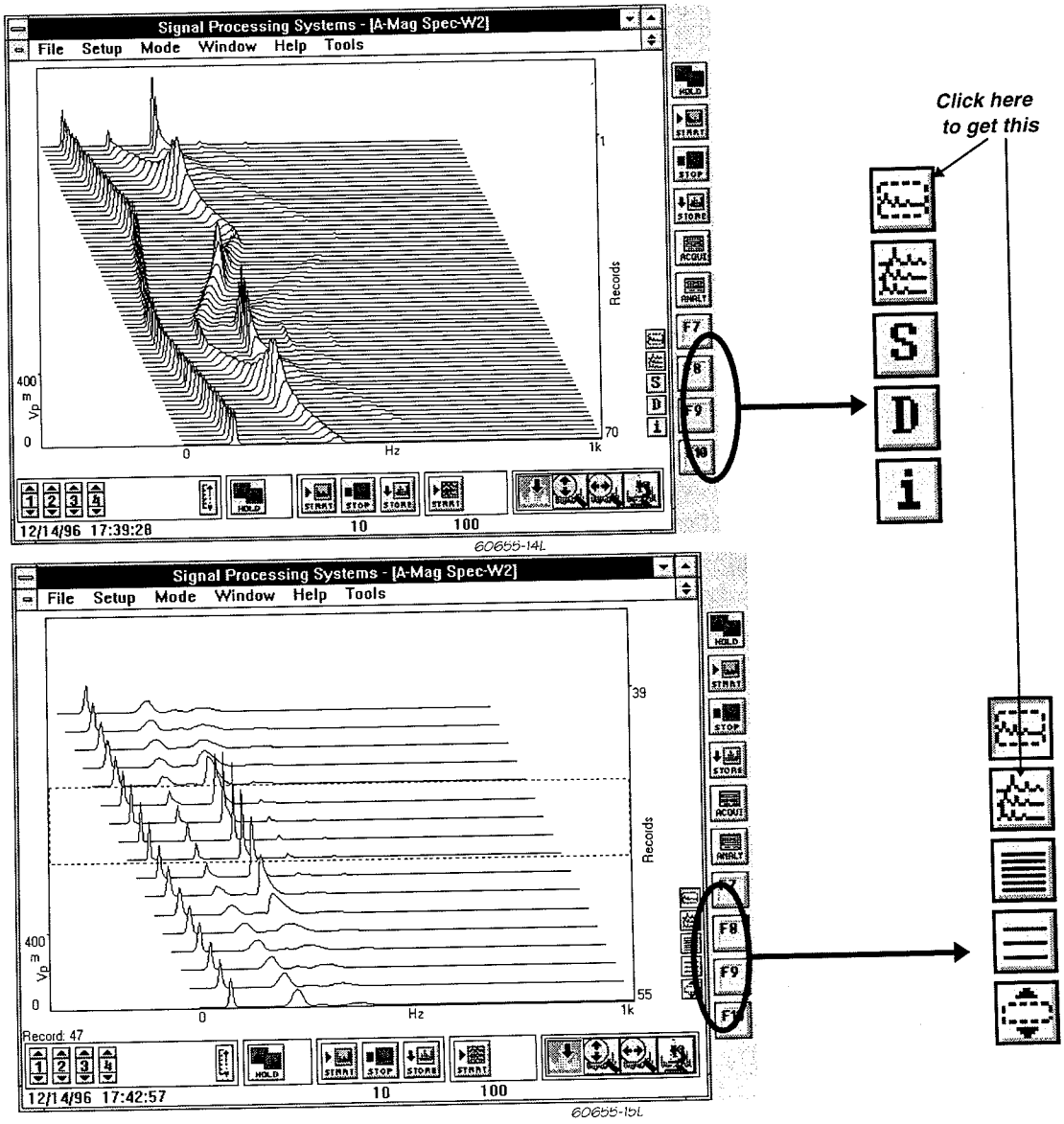
You can select the starting record (oldest data) and ending record (most recent data), by using the up and down arrows. The number of records that are to be displayed is not applicable for this display. The record numbers, times, and RPM (if RPM is available and RPM readout is enabled on the **Acquisition** dialog box) are displayed for the starting and ending records. Z– Axis Display Controls (Cascade Displays Only).

In addition to selecting the **Z-Axis** controls to select which records will be profiled, the operator may also select the **X-Axis** range of the spectrum that will be used in the calculation. This provision is similar to using the scale controls for a normal spectrum display, however it is invoked with the **Record Selection Dialog**. For reference the default **Min** and **Max** X-Axis limits of the waterfall records are shown

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3–11.5.6 Z–Axis Display Controls (Cascade Displays Only)

You can graphically zoom in (contract) or pan out (expand) on a selected range of records on waterfall cascade displays by turning on the Z-Axis display controls. When the Z-Axis cursor is enabled, the standard Information, Display, and Scale Display Controls are replaced by three Z-Axis controls.



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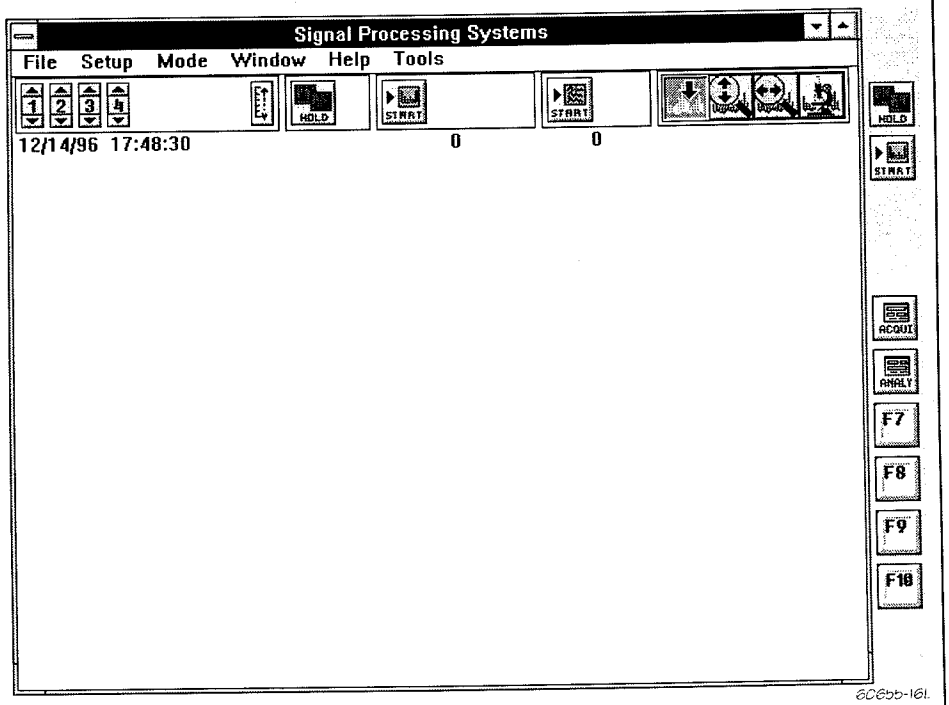
3–11.6 Waterfall Setup

The versatility of the waterfall capabilities in the SPS390 allows for dozens of different displays, and there are almost as many ways of loading the waterfall. However, every waterfall setup begins with these three simple steps:

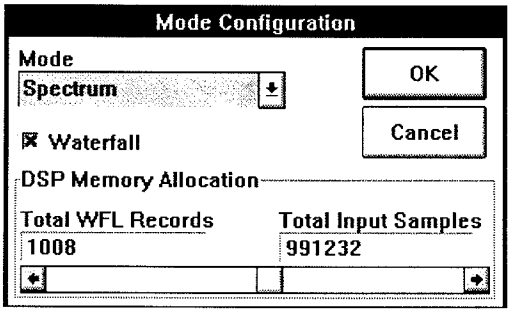
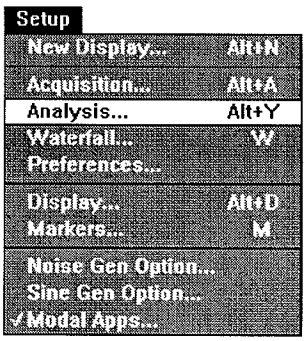
- Enable the waterfall memory;
- Set up the waterfall parameters; and
- Select a waterfall display

3–11.6.1 Enable the Waterfall Memory

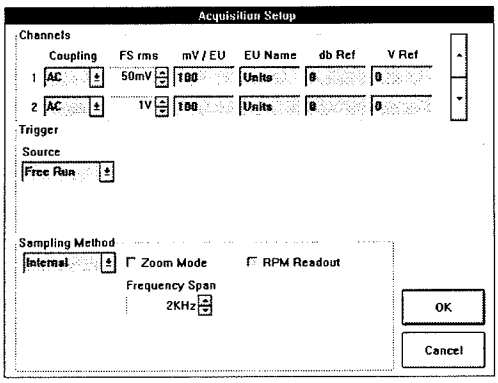
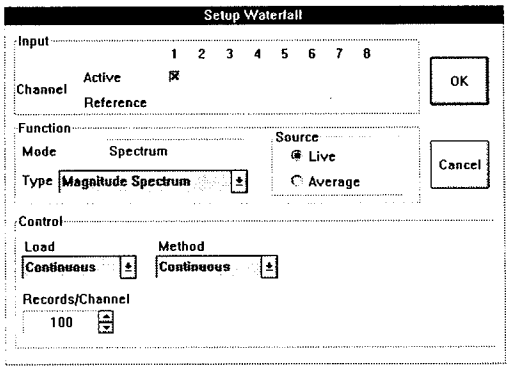
To set up and enable the waterfall memory perform the following steps:

Step	Action
1.	When the analyzer is first turned on, the display will look like the following figure. Note that a waterfall display can be shown on a previously blank screen, such as the following figure, or it can be added to existing displays. ***Typical SPS390 Power-On Default Display***  8C656-161
2.	Roll the trackball (or external mouse) so that the arrow points at Mode and click once. The display will appear as shown in the following figure. Keep in mind that the number of Total Input Samples indicated may vary, depending on the size of the DSP memory installed in the analyzer.

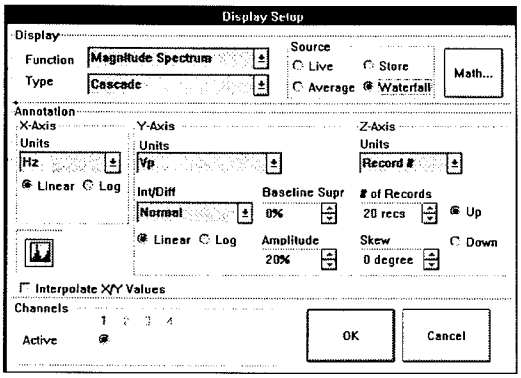
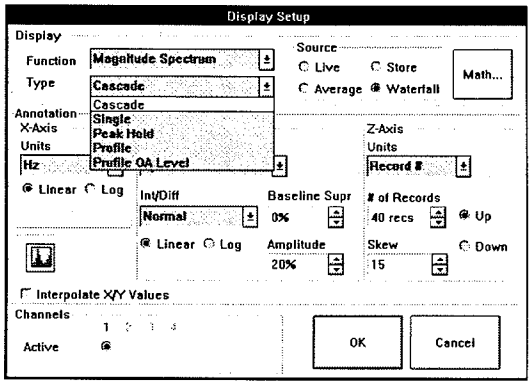
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Step	Action
5.	Drag the horizontal scroll bar left or right to select the desired number of **Total Waterfall Records** that can be stored for this setup. For example, memory space for 1008 records was allocated. Note that this is the aggregate or total memory allocated for all channels. Thus, if four channels of waterfall display were established, each channel could have no more than 252 records in this case. ***Scrolling Right to Read 1008 Total Waterfall Records***  The total number of waterfall records which can be stored depends on several factors. Among these are the size of the DSP memory, the data type (cross properties, spectrum, octave, etc.) and the number of spectrum lines per FFT selected. The rate at which records are recorded into the waterfall also depends on the data type and the number of FFT lines. The fastest transfer will take place with 200 lines and single channel Spectrum selected. This combination will be used here. Click **OK**
6.	Click on **Setup**, along the top row of the SPS390, and click again on **Analysis** (Alt + Y). This will bring up the setup listing shown in the following figure, followed by the analysis template as shown in the next figure. ***Default Listing of Setup Choices*** 

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Step	Action
9.	Click the **Frequency Span** down arrow two times until it reads 2 kHz, or your desired range. On the top row, for **Channel 1**, choose the appropriate **Coupling** and **Full Scale**. The display should appear as shown in the following figure. Click **OK**. ***Acquisition Template Set Up for This Example***  You are now ready to set up the waterfall parameters in terms of general acquisition. This includes how the waterfall is to be loaded (continuous, delta time, etc.), whether it will be continuous or stop when full, and how many records per channel will be loaded.
10.	Click on **Setup** and select **Waterfall**. ***Default Waterfall Setup Template for 1 Active Channel*** 
11.	Increase or decrease **Records/Channel** to the desired number. Select **Load** and stop **Method** from the choices presented. The display should appear as shown in the following figure. There are ten choices given on how the waterfall will be loaded—five direct actions and five overlap factors. In the current example Continuous loading will be used. Examples of other loading techniques will be given later.

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Step	Action
	Default Selections for Waterfall Display Setup 
14.	Click on the desired **# of Records**, **Skew**, **Amplitude**, **Type**, **Lin** or **Log**, etc. Click **OK**. ***Waterfall Display Setup with Display Type Choices Shown***  A display will now be presented with the annotation "No Data in Waterfall." Note that a new START Icon also appears in the top row of the display between the average and Cursor controls. This is the Waterfall START control.

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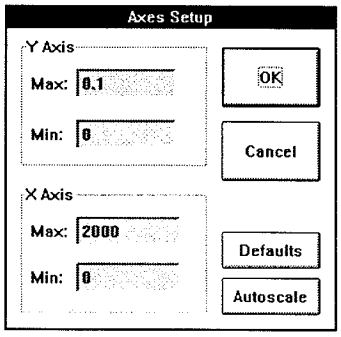
3–11.6.2 Scaling the Waterfall Display

Remember that data stored in the SPS390 waterfall memory is in precision 32-bit floating point format. It can therefore be rescaled after initial display with very little effort. The figures below show the default and rescaled Y-Axis parameters for the current waterfall display.

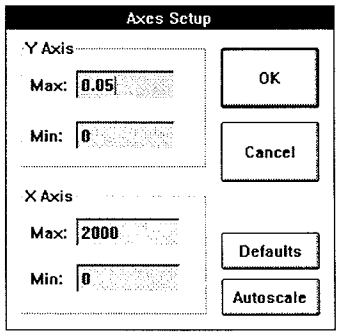
To scale the waterfall display perform the following steps.

Step	Action
1.	Click on the **S** Icon in the Waterfall display "Totem Pole." to optimize the waterfall display. When the **Axes Setup** menu appears, either click on Auto scale or change the Y Axis Max value to a convenient scale. Click **OK**.

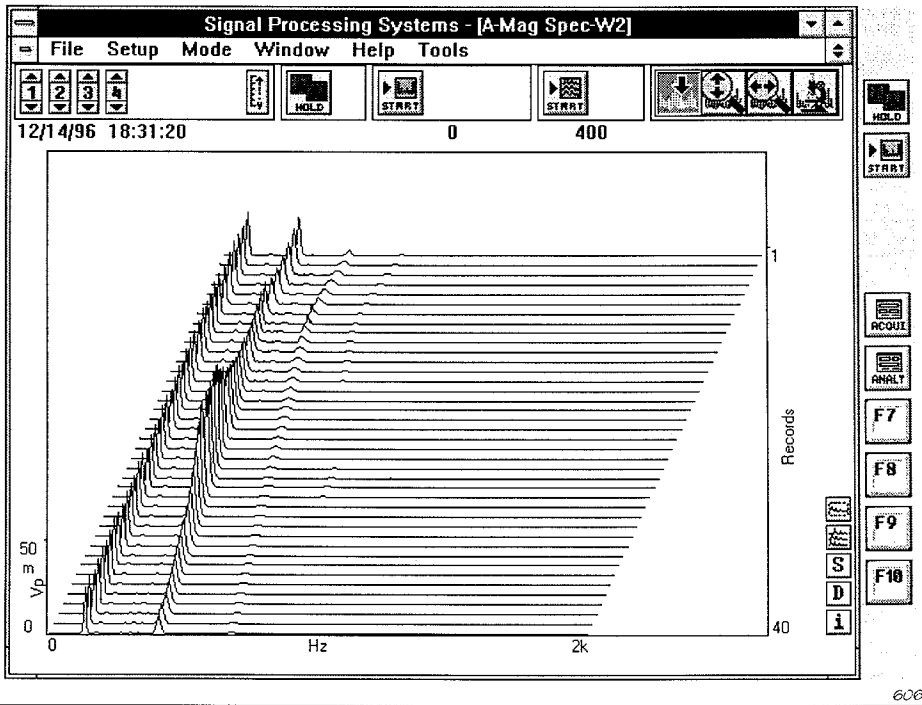
Default Axes Setup



Optimized Axes Setup



Re-Scaled Waterfall Display Shown Over Whole SPS390 Screen



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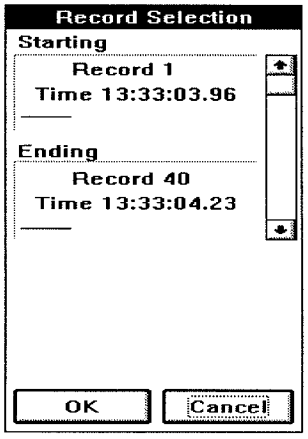
3–11.6.4 Scrolling through the Waterfall Memory

In the preceding steps, 400 spectrum records have been stored in the waterfall memory, but only 40 are being displayed at a time. If you want to change the number of records displayed at one time, there are several methods to choose from. One way is to click on the display setup template and choose a different number of records, such as 33.

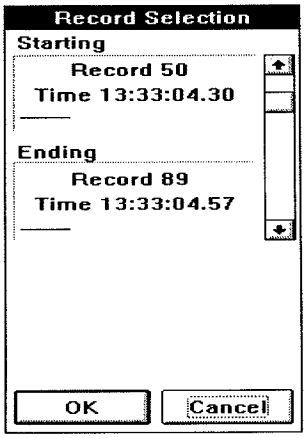
To scroll vertically through the waterfall array perform the following steps.

Step	Action
1.	On the "totem pole" at the side of the display, click on the waterfall symbol just above the S Icon. Roll the scroll bar as shown in the following figures until the desired record numbers appear.

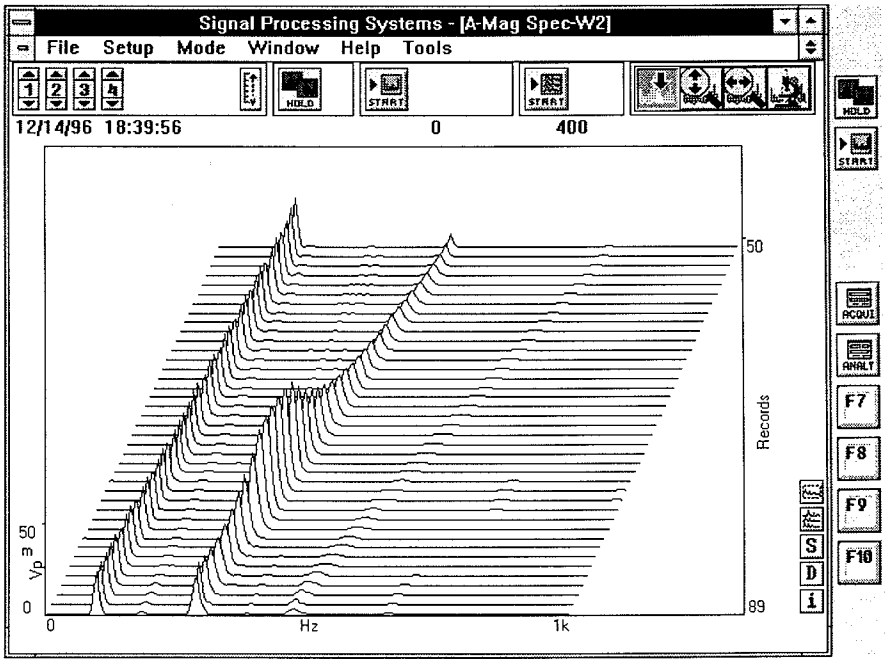
Default Selection Records 1–40



Selection of Records 50–89



Waterfall Display of Records 50-89



6D655-21L

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the OK button at the bottom right corner of the dialog is pressed. Selecting Cancel causes the dialog to disappear without modifying the existing parameters.

3–11.7.1 How To Invoke Markers

When the active window's display type is available, supported display markers can be placed on the display by invoking the **Marker Setup** dialog.

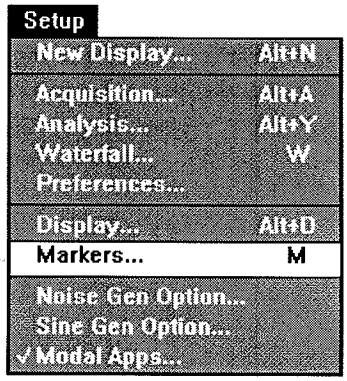
To invoke the **Markers Setup** dialog box for the active window to set specific marker parameters,

- Use the trackball to:

  Select the **Setup** Menu

  and then

- Select **Markers**



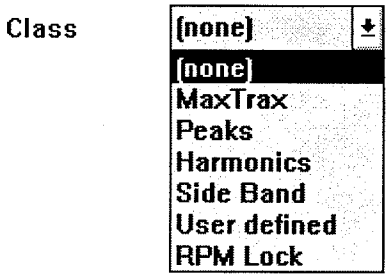
or

Use the Keyboard:

- Press the "**M**" key

3–11.7.2 Class

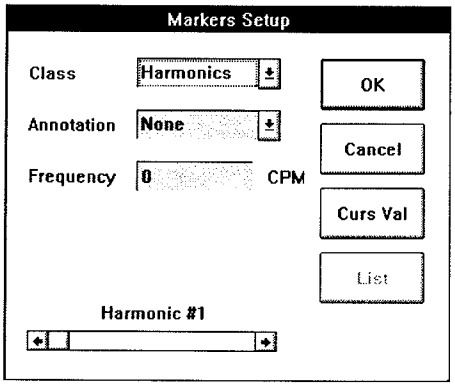
The class of markers defines the type of marker to be displayed. The selections are:



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Harmonics

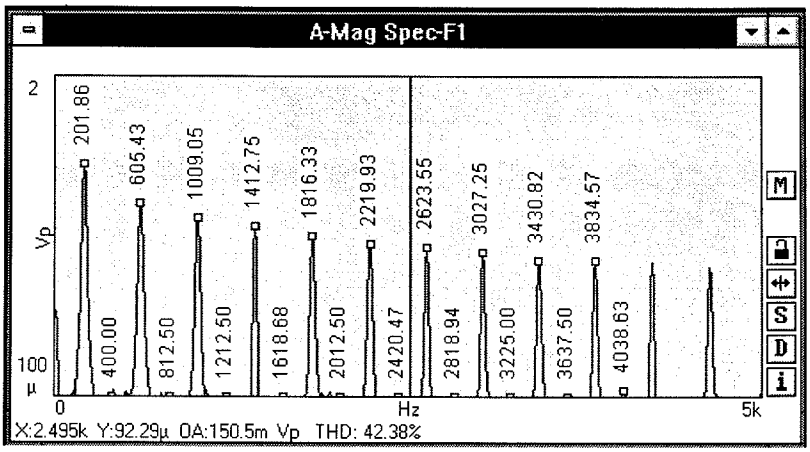
Up to 20 harmonics can be identified by specifying a desired harmonic number and the frequency at that harmonic. Using these two parameters, all other harmonics within the range are calculated and displayed. It is not necessary to identify the first harmonic from which all other harmonics are calculated. In fact, more accuracy can be obtained by selecting a dominant harmonic, and relating all other harmonics to the dominant harmonic. The desired "key" harmonic is selected by sliding the **Harmonic Number** slide bar from 1 to 20. You can then enter the corresponding frequency value in the **Frequency** field by typing the value, or automatically entering the frequency value from the **Cursor Val** field.



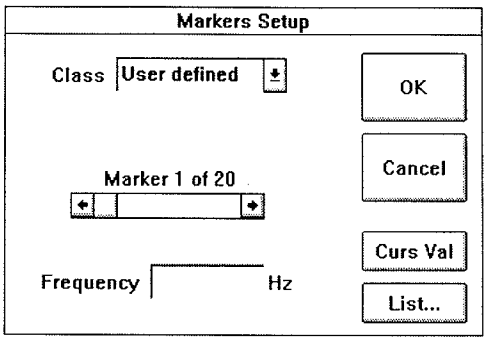
In addition, harmonic markers can be annotated with either frequency, magnitude, or equivalent order values by selecting the desired value type. They can also be listed to the Notepad by clicking on the List button.

As seen in the following display, a new icon appears on the "totem pole" to the right of the display whenever Harmonic Markers are selected .

To activate variable Harmonic tuning, click on this icon. A new icon , appears. When you click on this "arrow" icon, rolling the external mouse or trackball to the right will increase spacing between markers, and rolling it to the left will decrease the spacing.

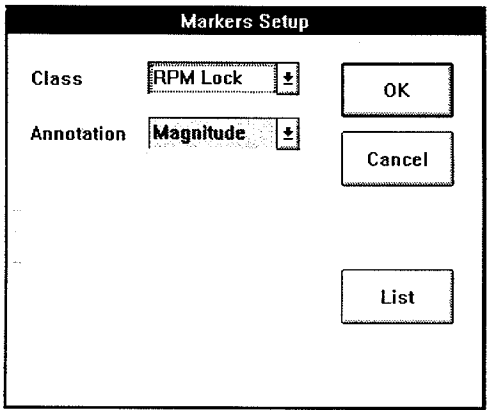


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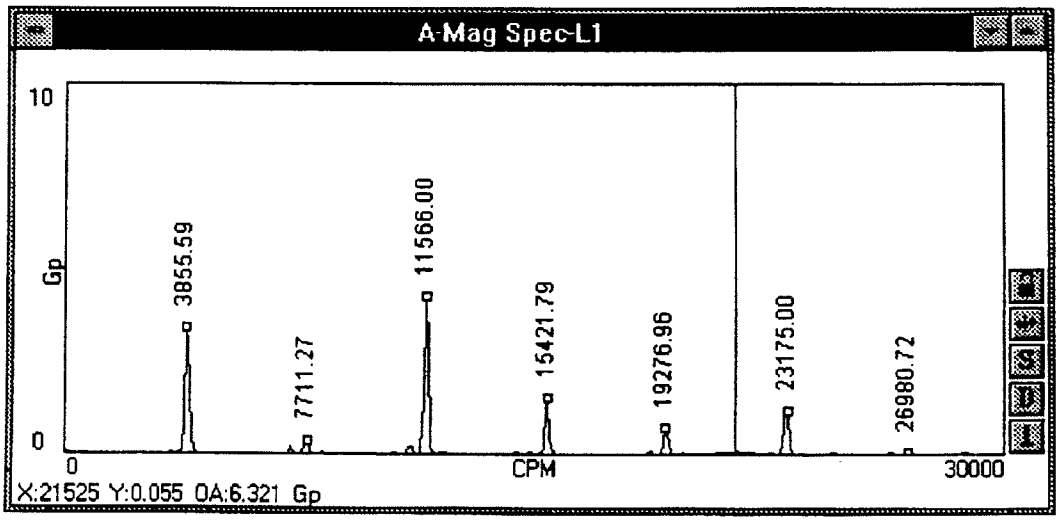


RPM Lock Marker

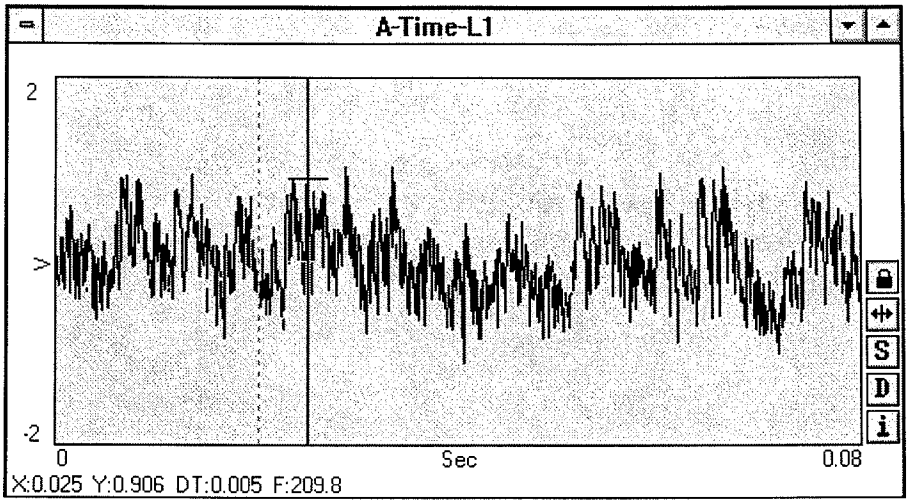
If a Tach signal is present and RPM Readout is selected on the Acquisition dialog, then an additional marker type, **RPM Lock**, appears on the marker menu. This marker is designed to lock onto the frequency of the external trigger (Tach) input and identify the fundamental and harmonics of this frequency in the selected display. The frequencies can also be annotated by selecting **Frequency** in the **Annotation** menu.



A typical spectrum display with **RPM Lock** markers active is shown here.

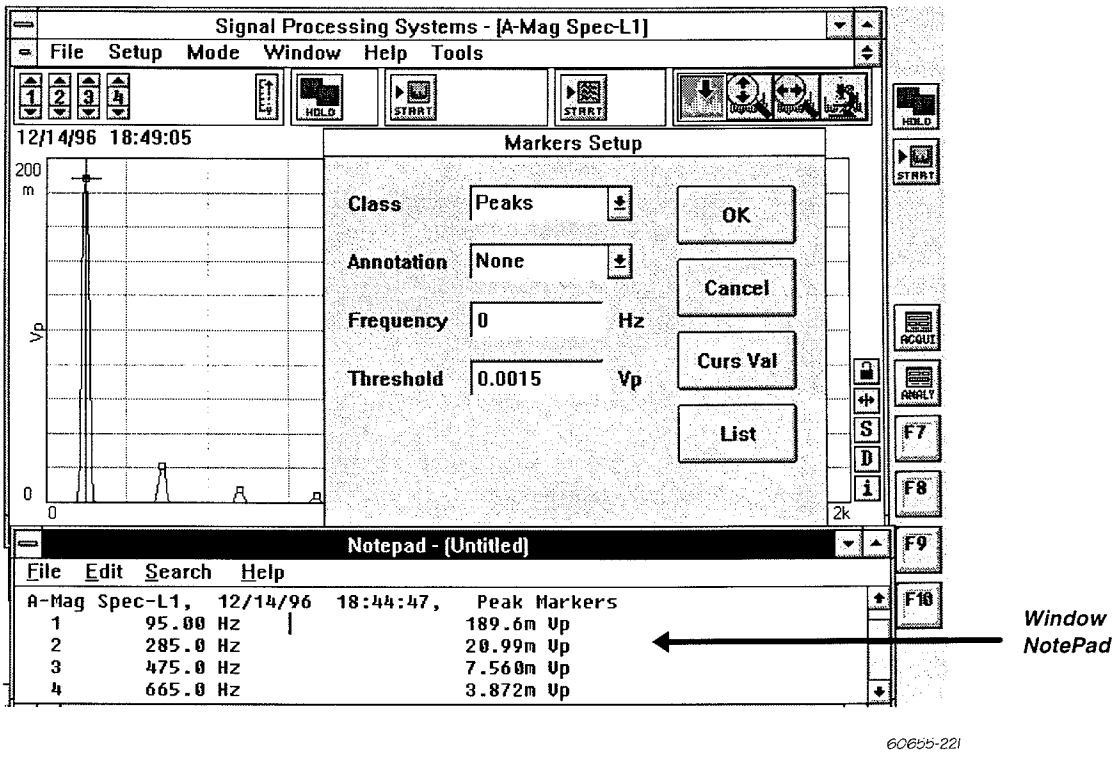


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Marker List

Clicking on the **List** Button will cause the displayed Markers to be listed in tabular format to the windows **NotePad**. The frequency and amplitude of each marker is written to the **NotePad**, along with active window information of the display. Each time you list markers, the information is appended to the list in the **NotePad**. You can then use the **NotePad** file features to save the information in a named file, or to print the information to the attached printer. Other **NotePad** options are available for editing the information or adding more annotation or notes.



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3–11.8 Open/Save Configuration

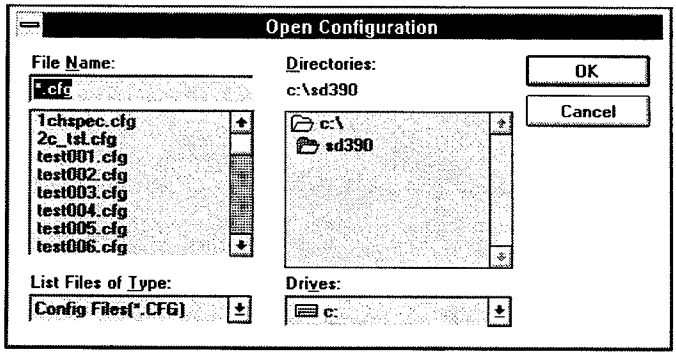
There are two dialogs that allow you to restore and save SPS390 operating configurations.

- Open Configuration
- Save Configuration

These options are accessed from the **File** menu. **Open** and **Save Configuration** prompt you for named files which contain the configuration information.

3–11.8.1 Open Configuration

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



If you have saved a configuration file with a different extension than **.cfg**, 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.

The title of the recalled configuration file is shown just below the cursor Icons. This title remains on the screen until a significant change is made to the Configuration.

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

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