User's Manual
SD375 Dynamic Analyzer II
Part Three

Legacy Manual

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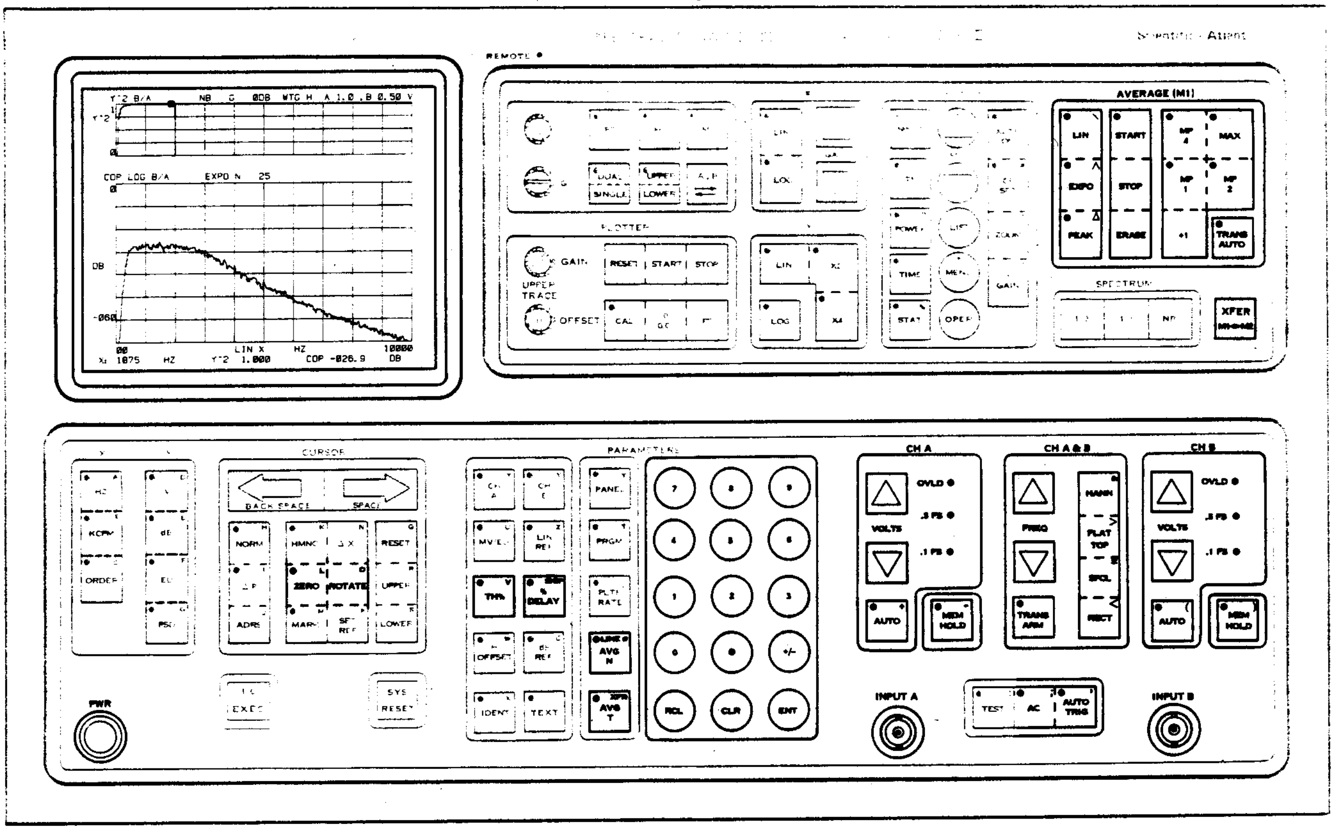
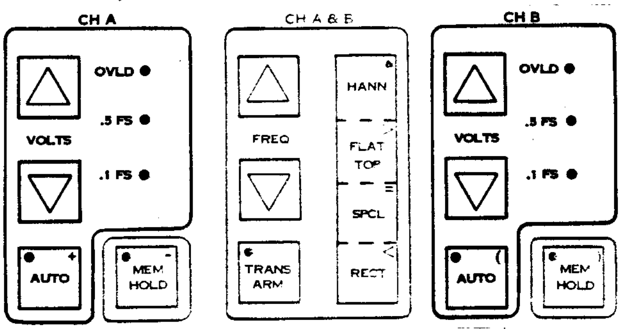
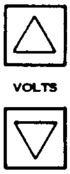
3.4.2 Control of Data Acquisition — The CH A, CH B, and CH A & B Groups, the ZERO and ROTATE Touch Controls, the TRANS AUTO, AUTO TRIG, TH % and % DELAY Touch Controls, the AVERAGE (M1) Group and AVG N and AVG T Touch Controls, the AC Touch Control and the PARAMETERS Group Keypad.



3.4.2.1 Input Level Selection — CH A and CH B Groups

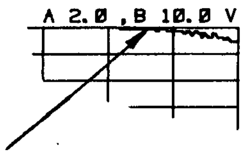


Both the CH A and CH B touch controls are identical. The following description will apply to both groups.

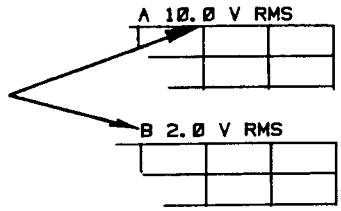
VOLTS  Touch Controls

These touch controls select the rms input signal level from 10mV to 20V in a 1, 2, 5 sequence as follows: 10mV, 20mV, 50mV, 100mV, 200mV, 500mV, 1V, 2V, 5V, 10V and 20V (the 10mV, 20mV and 50 mV levels are not used when the 100 kHz analysis range is selected). When the △ touch control is pressed, the input level is stepped in an increasing direction. When the ▽ touch control is pressed, the input level is stepped in a decreasing direction. The selected input level will appear in the upper right-hand corner of the display in either of two formats (depends on the type of display) as shown below.

The selected input level will appear as alphanumerics on the display like this



or, like these



LED Level Indicators

These LEDs indicate the rms level of the input signal as compared to the full scale (FS) input level selection. When the input signal exceeds 10% of full scale, the .1 FS LED will light. When the input signal exceeds 50% of full scale, the .5 FS LED will light. When the signal exceeds the selected full scale input level, the OVLD LED will light. At this point, the A/D converter is clipping the input signal.

CAUTION

These LEDS indicate input level *after* low-pass filtering. For example, if you attempt to light the OVLD LED with an input signal whose frequency is beyond the selected frequency range, the A/D circuit card could be damaged without the OVLD LED ever lighting. Remember, *maximum* input level is 50 Vrms.

AUTO  Touch Controls

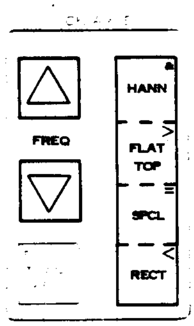
Pressing the AUTO touch control lights the LED located in the upper left-hand corner of the touch control, and causes the SD375 to automatically select the proper input level without overload. When the proper level is reached, the AUTO function stops and its LED will go out.

The most practical use of this feature is with a continuous input signal such as noise or harmonics. It is not recommended to use AUTO when performing analysis of transient signals. For instance, you don't want the instrument changing the input level while performing a transient capture.

NOTE

Use the AUTO feature on one channel at a time.

3.4.2.2 Analysis Frequency Range Selection and Weighting - The CH A & B Group



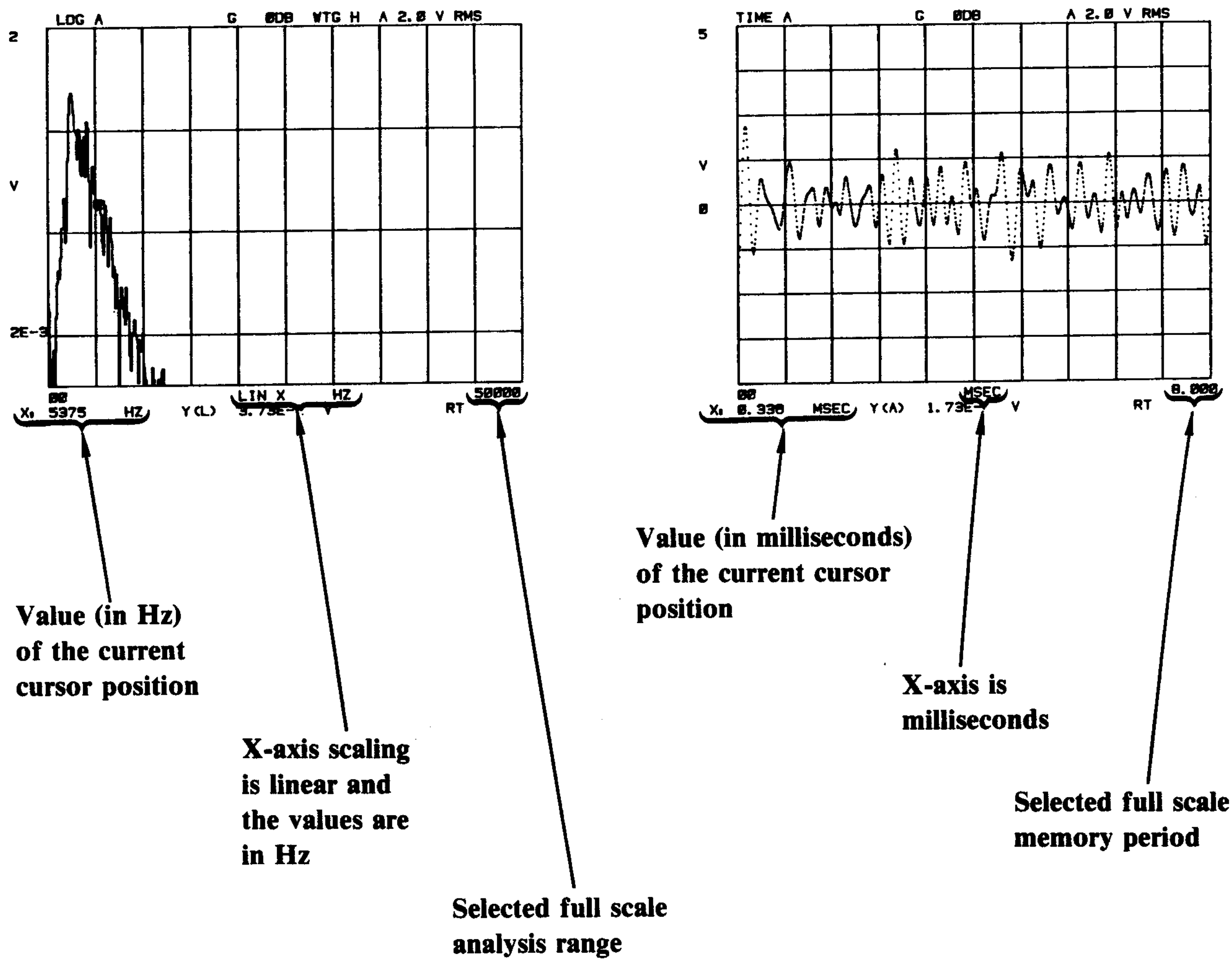
FREQ [△] FREQ [▽] **Touch Controls**

The SD375 has 21 full scale analysis ranges from 1 Hz full scale to 100 kHz full scale in a 1, 2, 4, 5 sequence as follows:

1 Hz	Each with a 10 Hz low pass filter	400 Hz
2 Hz		500 Hz
4 Hz		1kHz
5 Hz		2kHz
		4kHz
10 Hz		5kHz
20 Hz		10kHz
40 Hz		20kHz
50 Hz		40kHz
100 Hz		50kHz
200 Hz		100kHz

Each analysis range has a separate low pass (anti-aliasing) filter except the 1 Hz, 2 Hz, 4 Hz and 5 Hz ranges. Each of these analysis ranges is preceded by a 10 Hz low pass filter. Selection of an analysis range is as follows: Pressing the [△] touch control increments the analysis range one step each time the touch control is pressed. Pressing the [▽] touch control decrements the analysis range one step each time the touch control is pressed. Note that if the input memories are in the Hold mode (LED's lit on the MEM HOLD touch controls) or averaged data is being displayed (LED lit on the M1 touch control in the DISPLAY group) or an average is in progress (AVERAGE (M1) group), the selected analysis range cannot be changed until both of the input memories is released (press the MEM HOLD touch controls once to extinguish the LED) or a real time display is selected (press RT in the DISPLAY group) or the contents of the average memory are erased (press ERASE in the AVERAGE (M1) group).

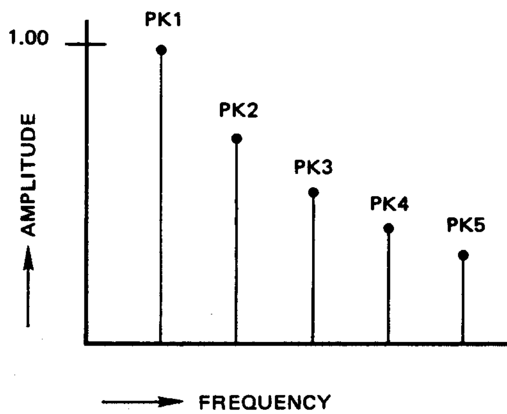
The following example shows where the selected full scale analysis range appears on the display. Typically, this value will be in Hz. However, if data is being displayed in the time domain, this value will be the corresponding memory period that relates to the selected full scale analysis range (this value will be in seconds or milliseconds, depending upon the full scale analysis range; i,e., in the following examples a 50 kHz analysis range is selected and the corresponding memory period is 8 milliseconds. For the 5 kHz analysis range, the full scale memory period is 80 milliseconds. As the full scale analysis range decreases, the full scale memory period increases). Also, this value can be changed to KCPM (Kilocycles Per Minute) or ORDERS (harmonic measurements) simply by pressing the KCPM or ORDERS touch controls.



The Weighting  **Touch Controls — HANN, FLAT TOP, SPCL, RECT**

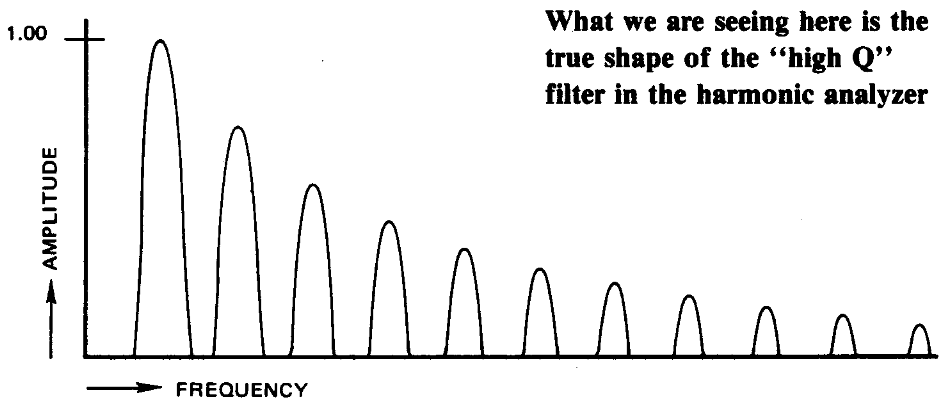
The earliest spectrum (or harmonic) analyzers consisted of tunable high Q filters with a frequency dial and a standard voltmeter needle-type output connected to the output of the filter. As the operator swept the dial across the frequency band of interest, the needle would "peak" at various frequencies. The operator, typically, would plot (by hand) the frequency and magnitude of the peaks.

Perhaps, he would plot them thusly:



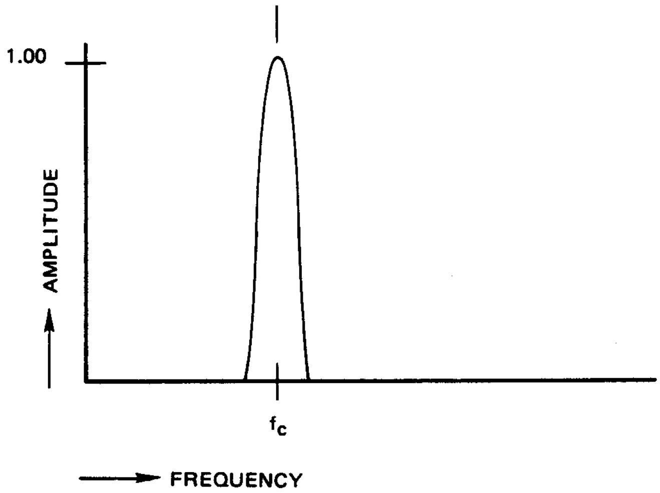
This is a fair picture of the true spectrum measured by our operator.

However, the previous plot is the analyzer output translated by the human brain into a "perfect" spectrum plot. If we were to connect the dial reading and voltmeter reading of the analyzer to the X and Y axes of an X-Y recorder, we would obtain a plot more like this:



What we are seeing here is the true shape of the "high Q" filter in the harmonic analyzer

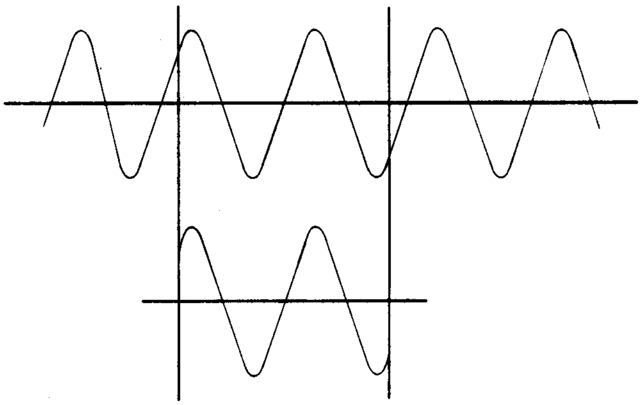
The harmonic plot of the previous sketch is the result of sweeping a filter of this shape over a stationary signal with more than one frequency component. If you were to leave the filter at some frequency and sweep the signal through that frequency, the filter response would be:



A digital spectrum analyzer carries the spectrum analysis concept even farther; it displays the output of 400 such *digital* filters, equally spaced, simultaneously. This is done with a high speed discrete Fourier Transform called the FFT. FFT analysis allows the rapid transformation of discrete time domain data into the frequency domain. The end result is 400 values representing the simultaneous output of 400 high Q filters.

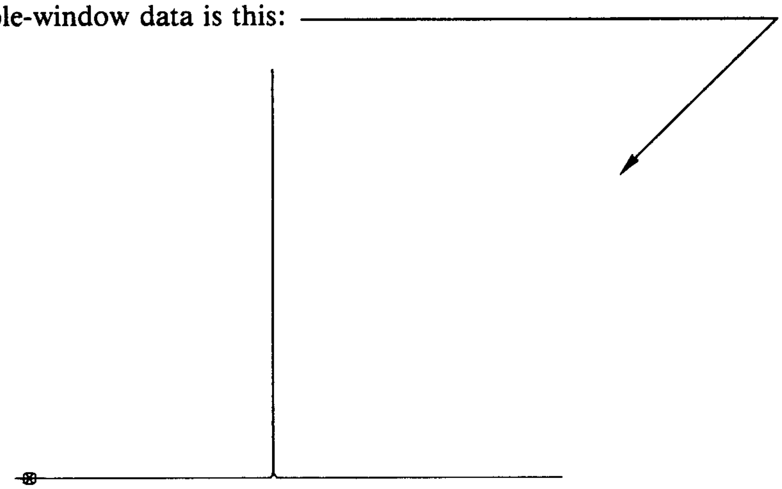
Weighting is a technique for treating the data in the time domain, before the FFT, in order to reduce the affect of side lobes, etc. This is required because the FFT is performed on a finite sample.

For example, the FFT of the signal shown in the following sketch is performed on the data in the sample window.

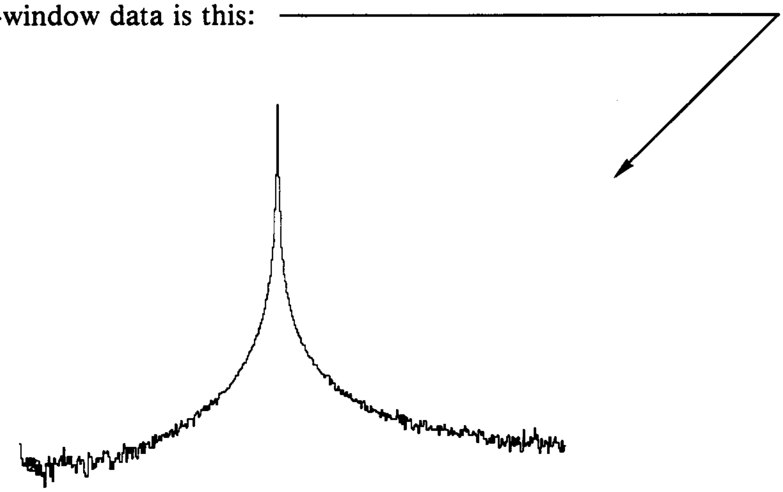


Sample Window

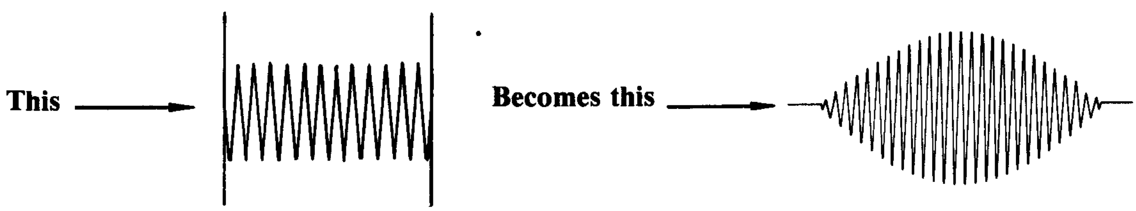
The true spectrum of the sample-window data is this:



The actual FFT of the sample-window data is this:



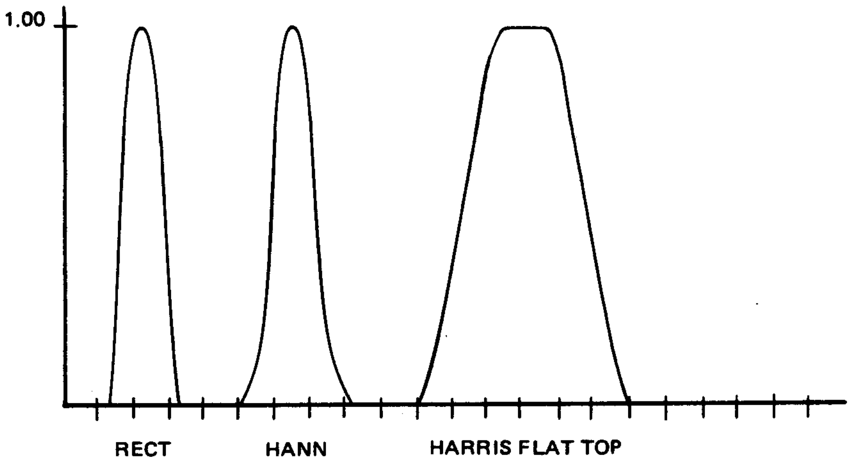
This phenomenon is called "flaring" or "skirting" and is frequently referred to as "Rectangular" weighting and actually entails no weighting at all (the data is FFT'd as is). Weighting cleans this up by making the "ends" of the time sample smoothly go to zero.



Sample Window **Weighting "Envelope"**

An effect of the different weighting functions (on the data) is the effective *shape* of the digital filters (they overlap) that yield the 400 point (line) display.

The filter shape could be measured in the same way as our "harmonic analyzer"; slowly sweep a signal through the filter and measure the response. Doing so yields the following filter shapes for Rectangular, Hanning and Harris Flat Top, three of the four weighting functions available (SPCL will be discussed later) with the SD375.



A "swept sine" plot of a single filter would, in fact, yield plots such as these.

Of course, there are 400 filters overlapping each other on the SD375 display and what you see are the vectors between the output data points at the applied input frequency. For example, the following sketch uses a signal measured with Hanning weighting to illustrate just what you see on the display.

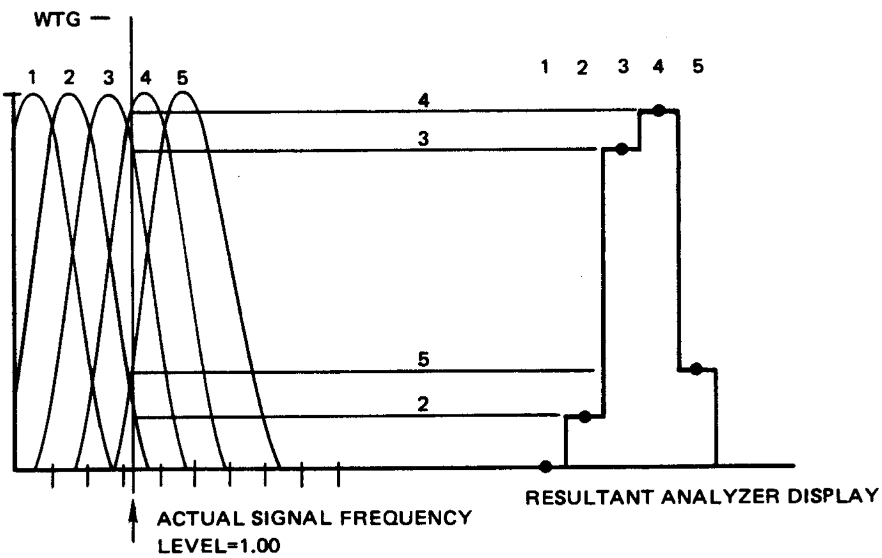


Figure 3-9 gives an example of each of the three weighting filter shapes (Hanning, Flat Top and Rectangular) as they appear on the SD375 display. The plots were taken using "times four" (X4) X-axis expansion to emphasize the differences in filter shape. The applied input signal was identical for all three weighting functions.

Note that there are no LED indicators on the Weighting touch controls. The selected weighting function will be applied to the input data immediately upon pressing the desired weighting touch control. The type of weighting selected will appear on the display as shown in Figure 3-9.

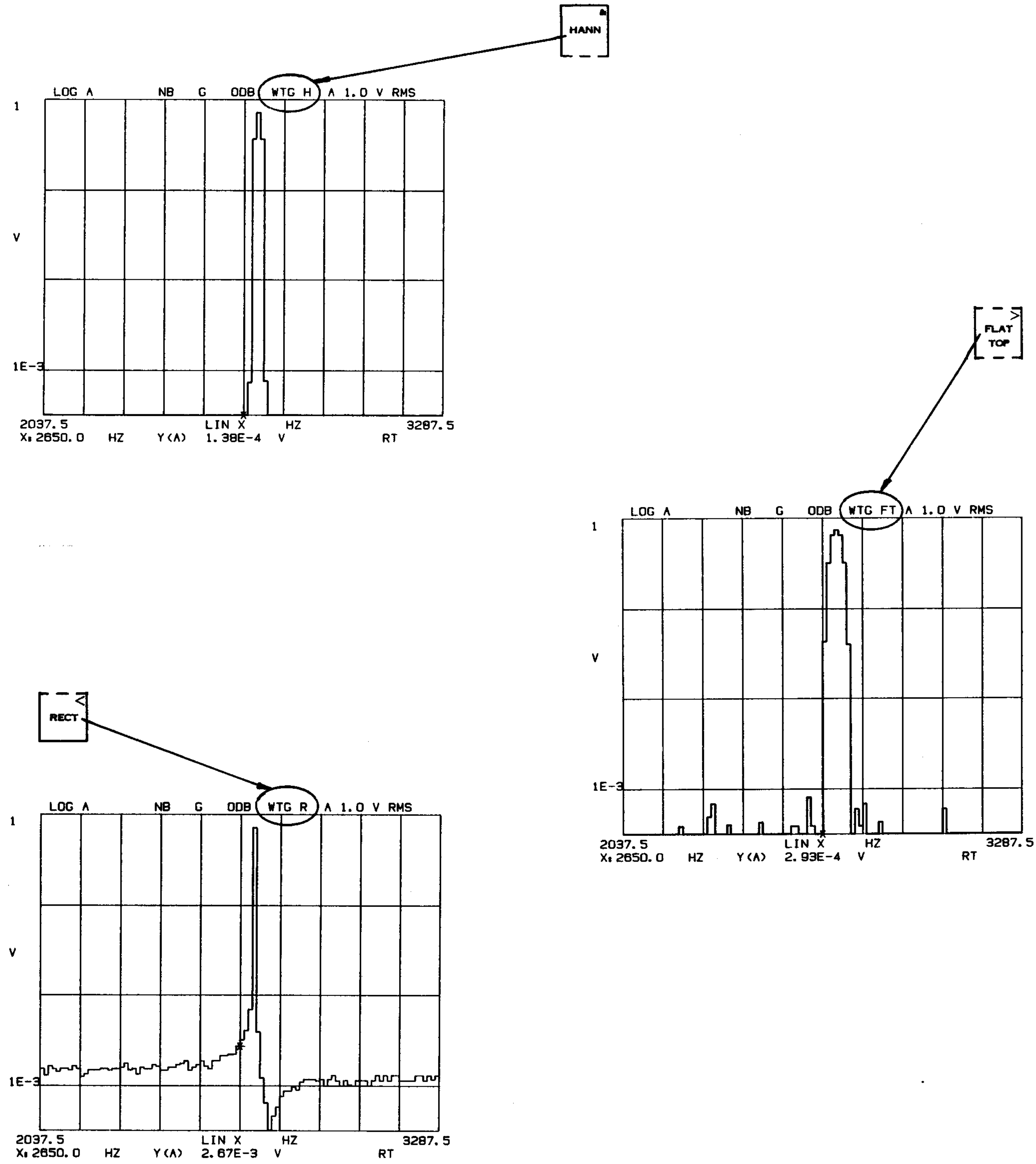
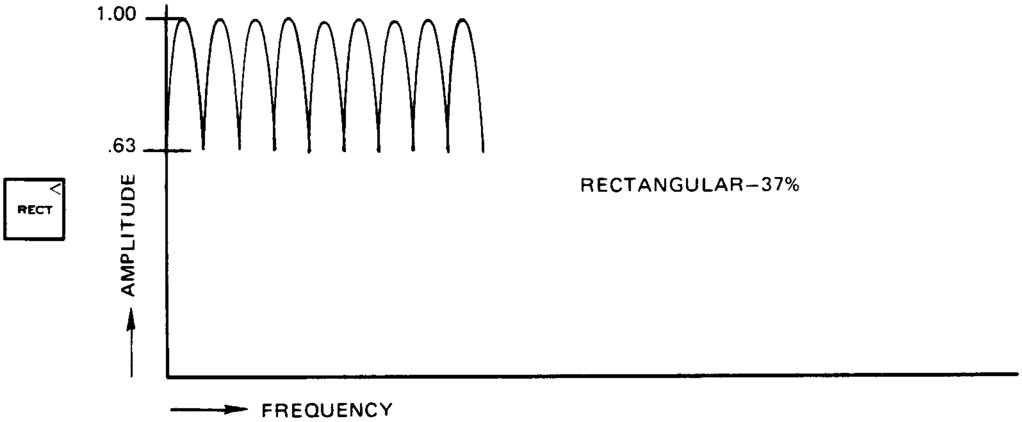


Figure 3-9. Examples of Hanning, Flat Top and Rectangular Weighting.

If we were to plot the measured signal peak versus input frequency across the weighting filters, we would notice an affect 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 affect are shown in Figures 3-10, 3-11 and 3-12 (Figure 3-10 is the Rectangular weighting example, 3-11 Hanning and 3-12 Flat Top). The sample displays shown in these Figures are digital plots of a single tonal approximately 1.5 volts in amplitude at a frequency of 2700 Hz. The analysis range is 5000 Hz (keep in mind that the resolution of the instrument is 1/400 of the selected analysis range and the distance from filter center to filter center is this resolution; i.e., resolution of the 5000 Hz analysis range is 1/400 of 5000 or 12.5 Hz), Y-axis scaling is linear, Y-axis values are in volts, X-axis scaling is linear with X4 expansion (you-re looking at 1/4 of the display, *centered* on the *cursor*). The frequency of the tonal was increased from 2700 Hz to 2712.5 Hz. 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 as shown in the accompanying sample "filter plot."

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 SD375 uses) is very efficient since it is only the necessary 1.5 or so filters wide (as opposed to 2.5 to 3 filters wide for other methods of Flat Top weighting). This gives you the necessary flat response without sacrificing any more frequency resolution than necessary.



Sample "Filter Plot"

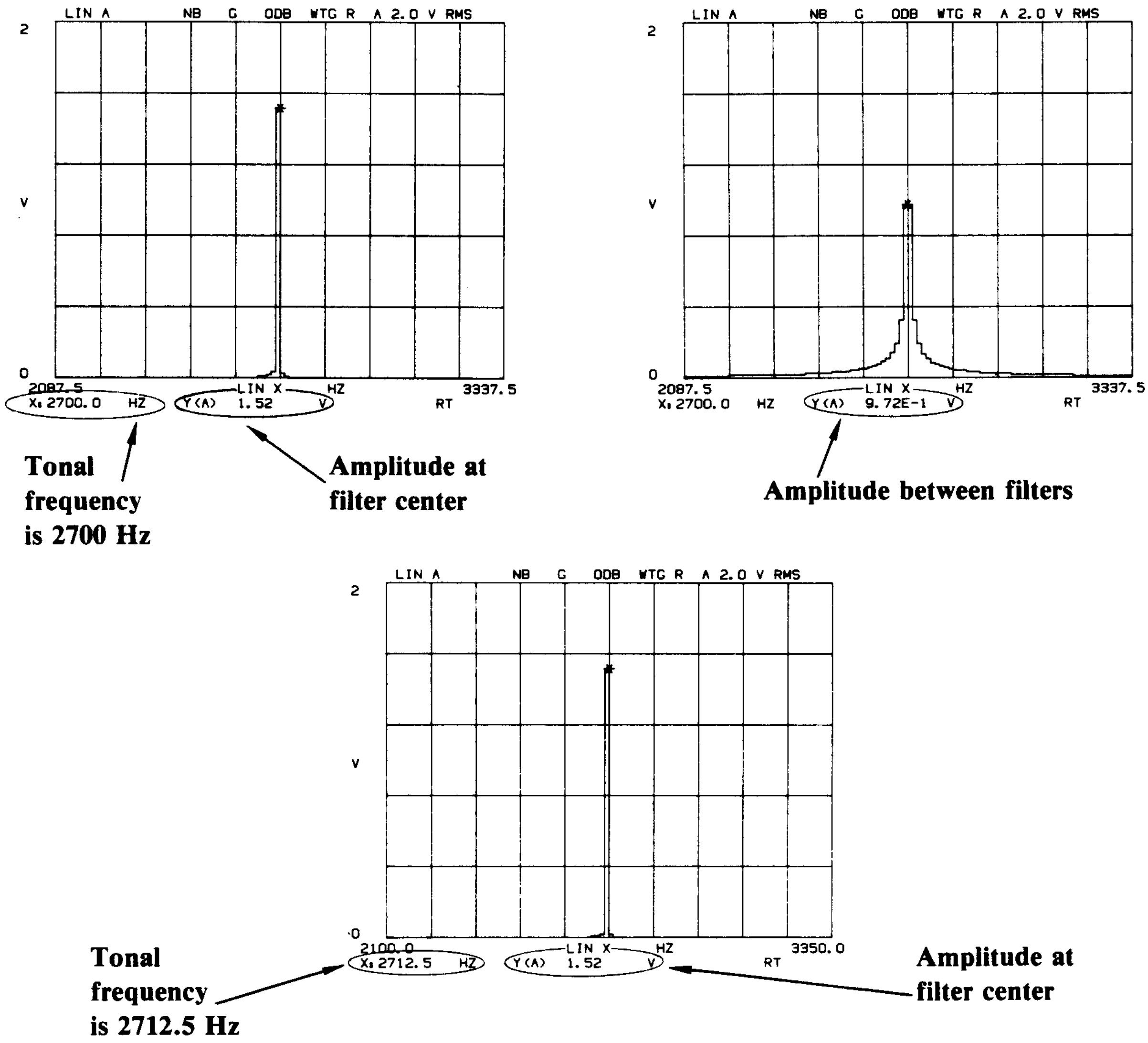
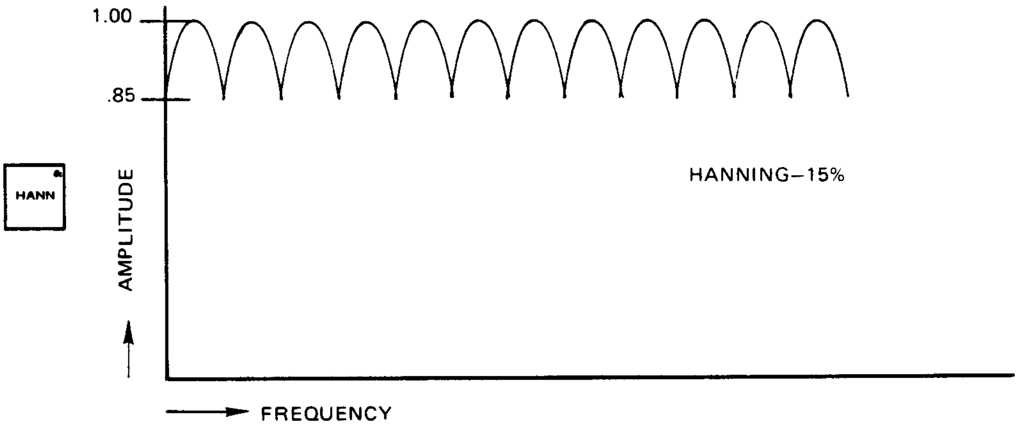


Figure 3-10. Scalloping Example - Rectangular Weighting



Sample "Filter Plot"

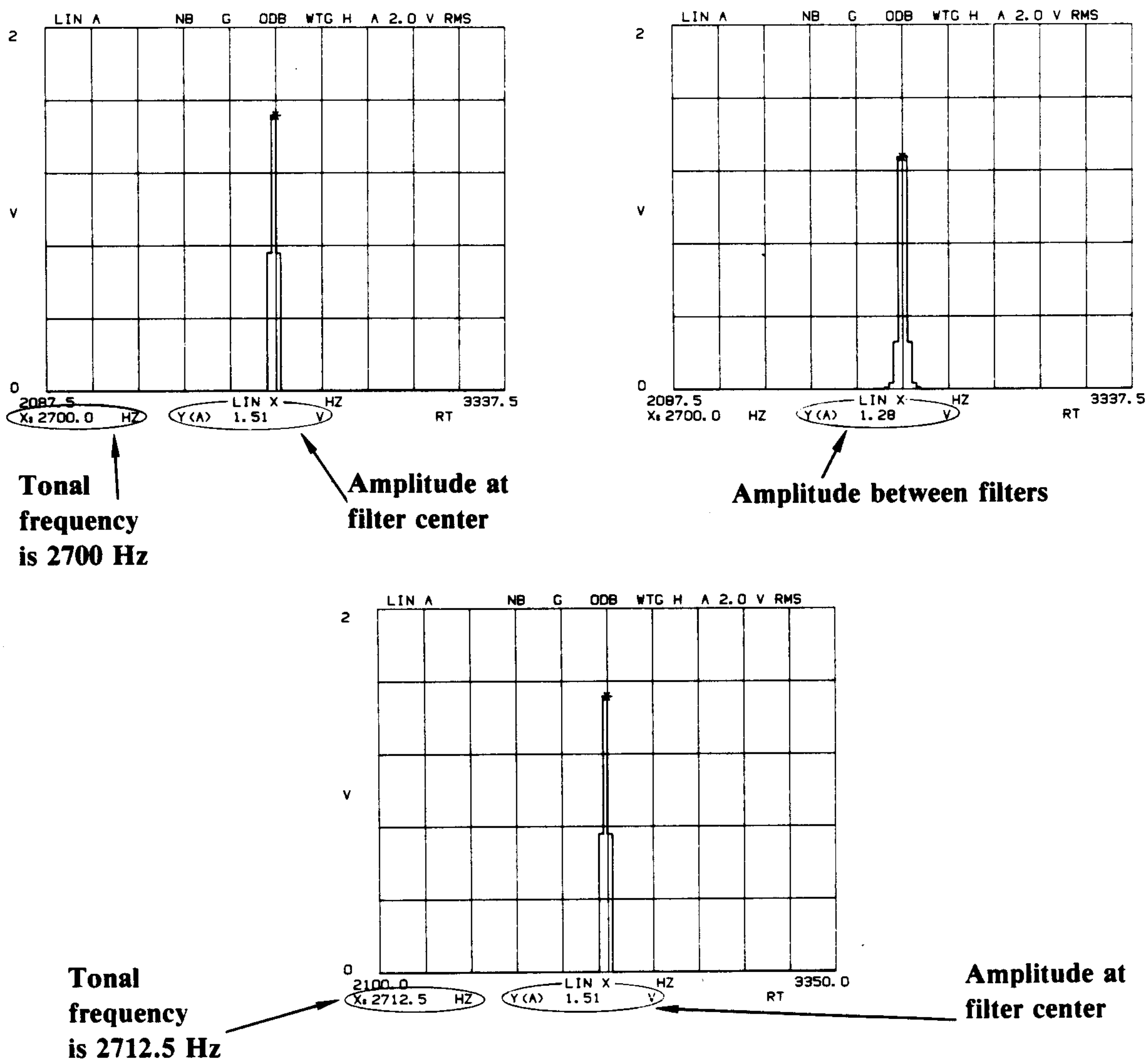
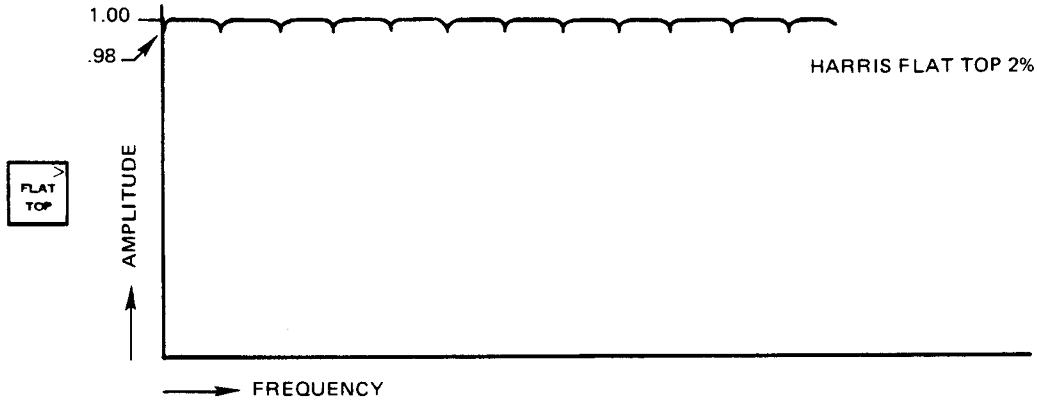


Figure 3-11. Scalloping Example - Hanning Weighting



Sample "Filter Plot"

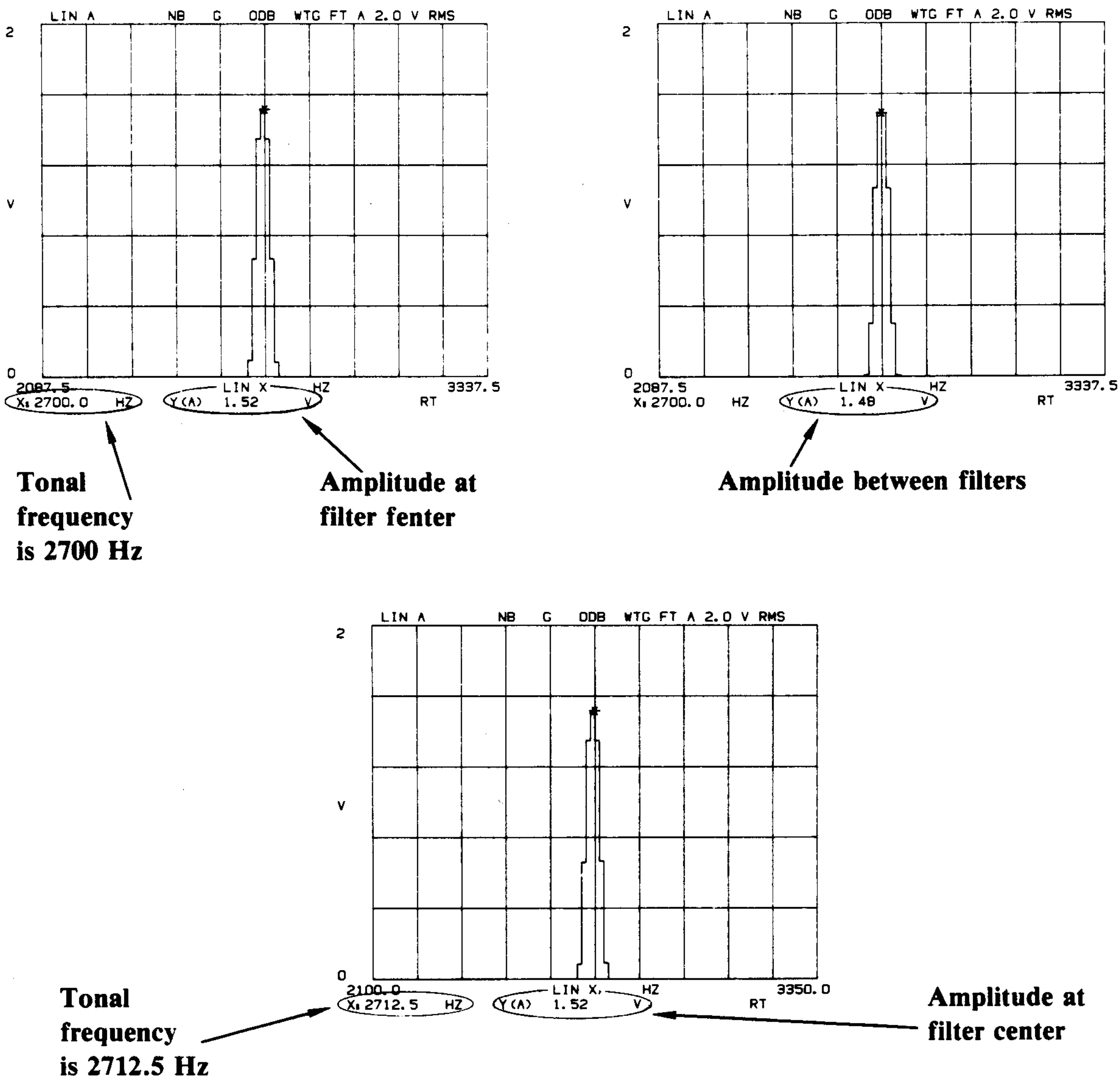


Figure 3-12. Scalloping Example - Flat Top Weighting

Figure 3-13 is provided to compare the differences in filter shape. The numerical values (.98, .85 and .63) are the crossover points for the next filter.

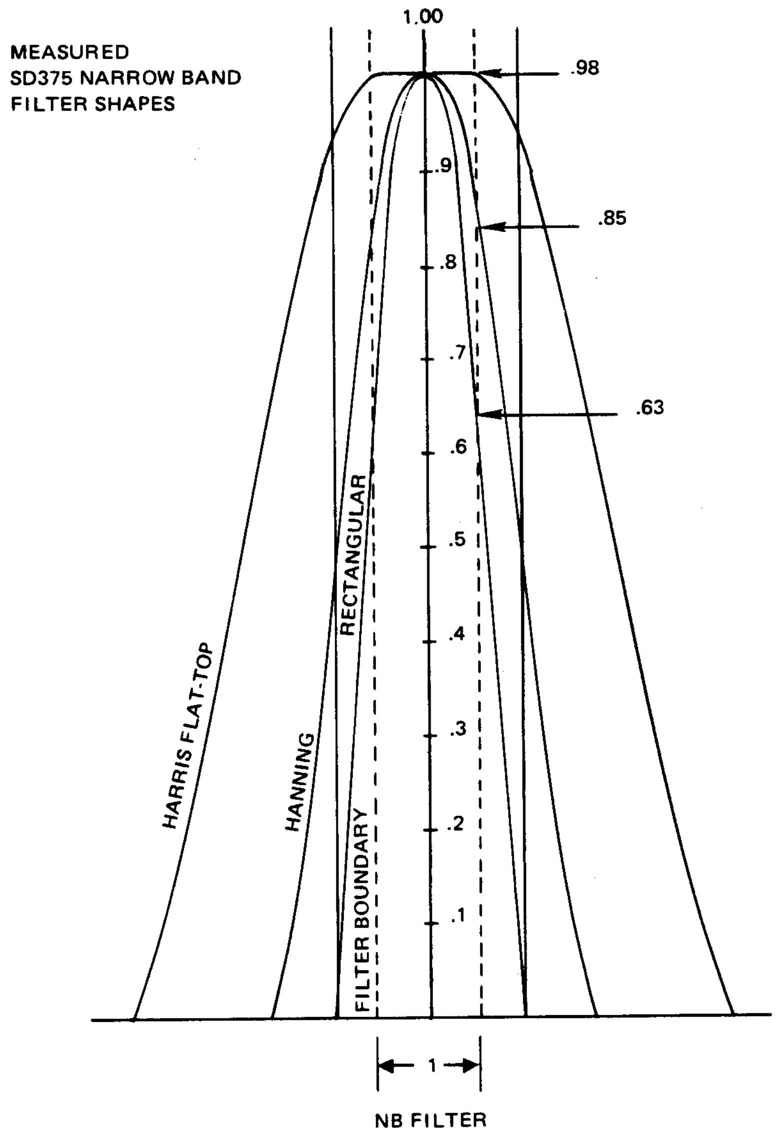
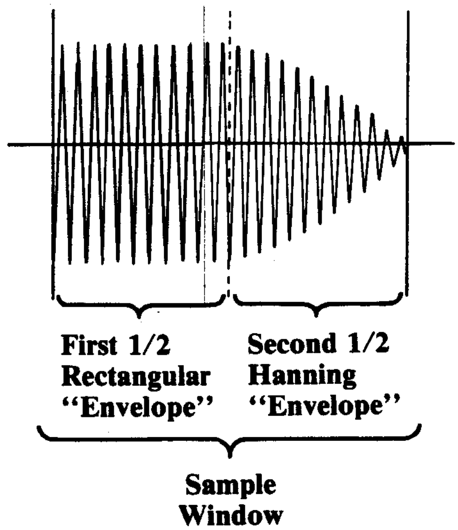


Figure 3-13. Measured SD375 Narrow Band Filter Shapes

The weighting touch control labeled SPCL is a "specialized" type of weighting for transient analysis. The resultant weighting "envelope" is Rectangular in the first half of the window and Hanning in the second half. For example:



This weighting method optimizes the analysis of Transfer Function data that is initiated with an impact or short duration stimulus.

When SPCL weighting is selected, the letters TR (for Transient analysis) will appear on the display as shown in Figure 3-14.

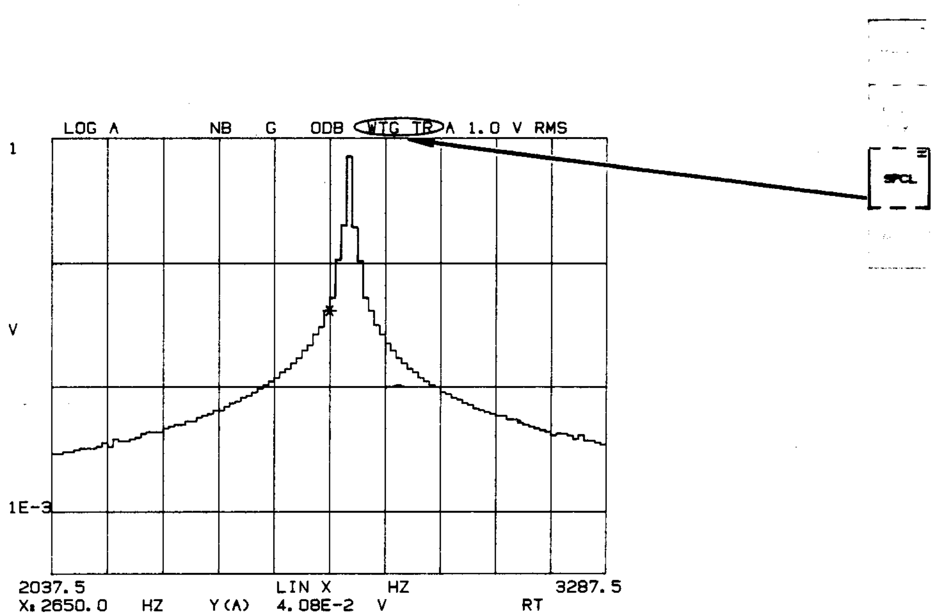
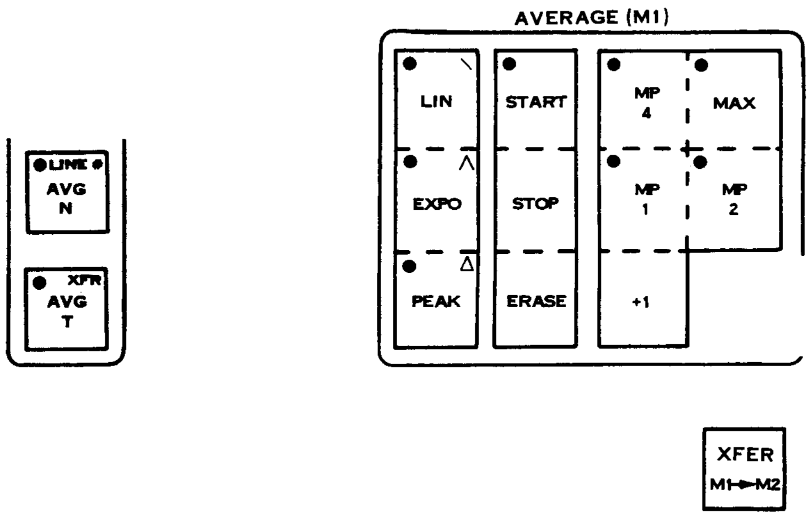


Figure 3-14. Example of SPCL Weighting

3.4.2.3 Averaging — The AVERAGE (M1) Group, the AVG N, AVG T and XFER M1→M2 Touch Controls



When the operator of the SD375 presses Average START he is, fundamentally, telling the analyzer "accumulate signal data in the averager memory" (M1). If the operator has enabled auto trigger (AUTO TRIG) or transient auto (TRANS AUTO), this accumulation is qualified by "when the designated signal level has occurred". (AUTO TRIG and TRANS AUTO are covered in subsection 3.4.2.4.)

Pressing Average START tells the analyzer to accumulate current signal data in the averager memory. The average *mode* (LIN, EXPO, PEAK) tells the analyzer *how* to accumulate that data.

In Linear (LIN) averaging the analyzer sums the measured signal levels over N "ensembles" (N being the number of operator selected ensembles to be averaged) and divides by N when the data is read and used for display in the M1 display mode. The average will automatically stop when N ensembles have been taken.

In Exponential (EXPO) averaging the analyzer treats each new ensemble of data as the Nth ensemble and the current contents of M1 as the summation of N to N-1. The result is rise and decay time on data *changes*, e.g., a "time constant integrator". The time constant is determined by the selected N.

In Peak (PEAK) averaging the analyzer compares the amplitude of new signal data, at each location, with the old (in M1). The larger value is kept in M1, the smaller value is discarded. This is done for each individual cell, hence, some 800 tests would occur on each pass for two-channel (A & B) spectra.

Average Selection and Display Indications — The LIN, EXPO, PEAK, AVG N and AVG T Touch Controls

Although the DISPLAY group touch controls haven't been covered, in order to display the Averager Memory, touch control M1 in the DISPLAY group has to be pressed (LED lit). When you select M1, you will notice the absence of display data. This is because you are now displaying the contents of the Averager Memory and, providing a previous average hasn't been performed, only the display grid and the display annotation will be present. If you have selected Transfer Function or Power, the display is automatically forced to M1. In either case, display data will not be present until an average is initiated by the operator. The following information tells you how to do this and what display annotation indications you will encounter.

How the annotation appears and where it appears, on the display, depends upon three things; Average Mode, Type of Averaging and Type of display.

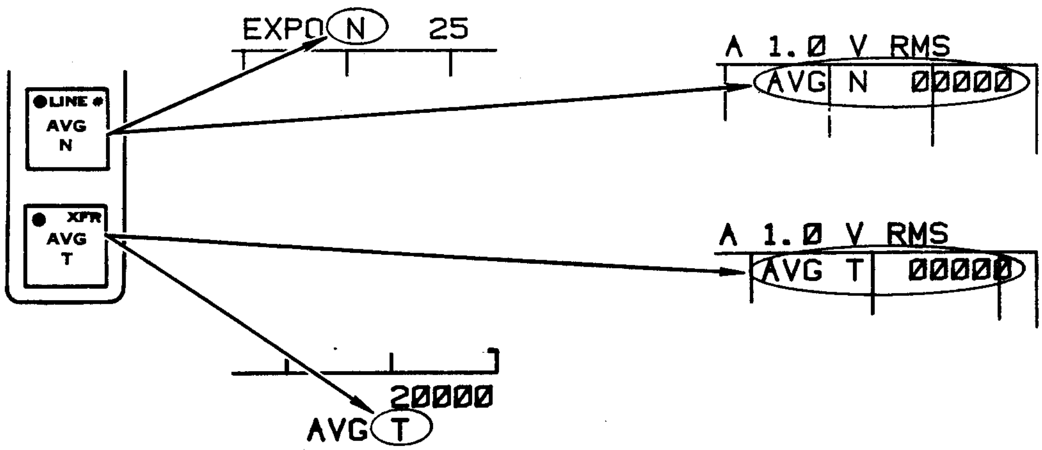
1. **The Average Mode:**

If LIN is selected (LED lit), the annotation is → AVG N 5Ø

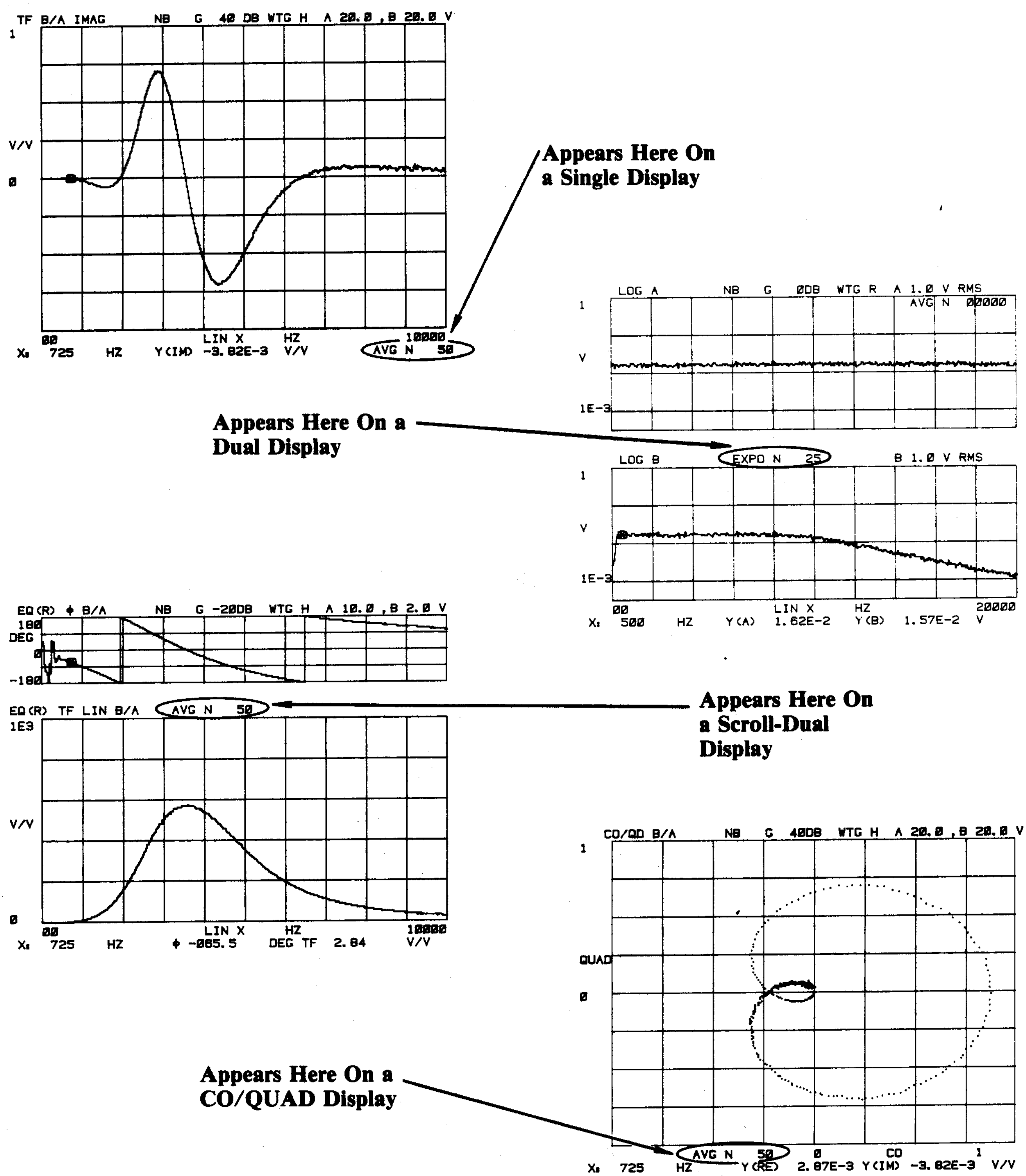
If EXPO is selected (LED lit), the annotation is → EXPO N 25

If PEAK is selected (LED lit), the annotation is → PEAK

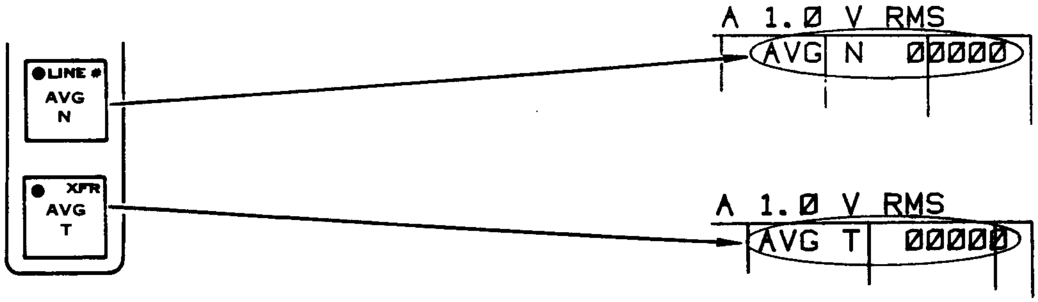
2. **The Type of Averaging:**



3. The Type of Display.



To select the number of ensembles to be averaged or averaging time, in seconds, press AVG N (ensemble averaging) or AVG T (averaging over a selected time interval) in the PARAMETERS group. The following annotation will appear in the upper right-hand corner of the display grid:



Next, select the number of ensembles (from 1 to 2048) or the average time (from 1 to 9999) on the PARAMETERS group keypad. As you press each number on the keypad, the number will appear in place of the zeros as shown in the previous example. Finally, press ENT on the PARAMETERS group keypad. Once the ENT touch control is pressed, the selected number is entered and the annotation will remain for a few moments, then disappear from the display. If you want to recall a selected value, press AVG N or AVG T, then press RCL on the PARAMETERS group keypad. The annotation and selected number will re-appear in the upper right-hand corner of the display grid, remain a few moments for your perusal, then disappear once again.

Averaging — The START, STOP and ERASE Touch Controls

To initiate an average, first select the number of averages or average time as previously described.

NOTE

There is a default value assigned to both ensemble and time averaging if no value is selected and entered by the operator. This value is 10.

Next, press ERASE. This clears the averager memory. Now, press START. This initiates the averaging process. If you have selected LIN averaging, the averaging process will terminate when the selected number of averages is reached. If you have selected EXPO averaging, a linear average is performed until the selected number of averages is reached, then averaging continues exponentially with a selected time constant (the selected N). Exponential averaging will continue indefinitely until terminated by pressing the STOP touch control. If you have selected PEAK averaging, peak input data is updated every 100 milliseconds for single channel operation and every 200 milliseconds for dual channel operation. This process will continue indefinitely until terminated by pressing the STOP touch control.

NOTE

During and after the averaging process, the operation of certain front-panel touch controls will be locked out such as frequency range, input level and weighting. Operation of the locked out touch controls cannot be resumed until the averaging process has been terminated and erased.

The +1 Touch Control

During the averaging process, each new ensemble of data is automatically processed every memory period. However, in the +1 Mode, ensembles can be processed manually. The +1 Mode is initiated by pressing the STOP, ERASE and +1 touch controls in that sequence. This averaging process can be used with all of the average modes (LIN, EXPO and PEAK). Each time the +1 touch control is pressed, a new ensemble will be processed. In the LIN averaging mode, each time the +1 touch control is pressed, a new ensemble will be processed, up to the number of averages selected via the AVG N or AVG T touch controls.

Now that you know how to select averaging, it would be a good idea to know what data *can* be averaged and, in certain cases, how the average is performed. Table 3-2 lists each Primary Function menu item (refer to subsection 3.4.1) and what data can be averaged, if any, for each item. The terms in the "Comments" column of Table 3-2 are as follows. The term "Single Ch Avg in Single Disp" refers to the fact that an average is performed on a single channel of data in half the time that it takes to average two channels of data. If you are in a dual display mode, and you wish to perform an average on a single channel, you can select a single display of either channel and perform an average only on the selected channel. This is true only for certain dual display modes, and is noted in the "Comments" column of Table 3-2, opposite the appropriate Primary Function. The term "Cross Product Average" relates to the cross spectrum calculation described in subsection 3.4.1.3. The term "Fill 0" is a complex cross product average with the second half of the input data zeroed and is used in the correlation functions only.

Figure 3-15 is an example of the averaging process showing the same data both Real Time (RT) and averaged. The input is random noise, externally filtered on channel A and unfiltered on channel B. The display on the left is the real time data display, the one on the right is averaged data after taking a Linear average of 50 ensembles.

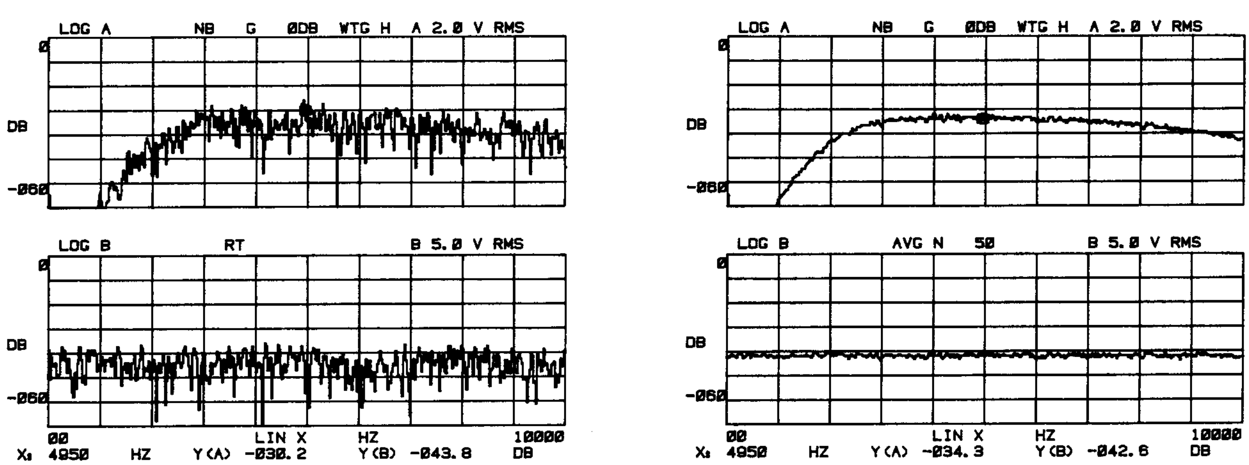


Figure 3-15. Examples of Real Time and Averaged Data.

Table 3-2. Table of Averages

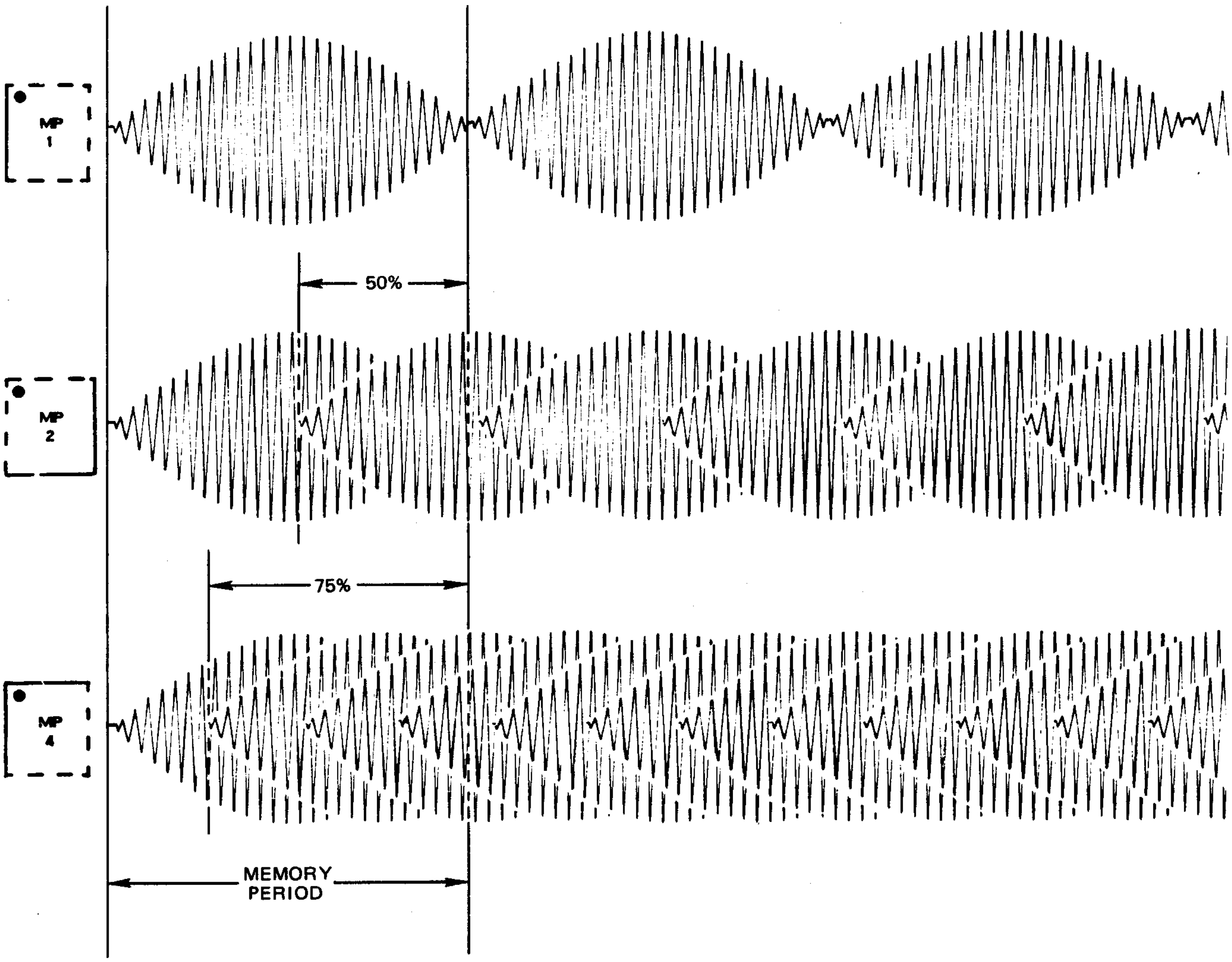
Primary Function Menu Items	M1 CH A (Upper)	M1 CH B (Lower)	Comments
SPECT			
1. SPECT A & B	G_{AA}	G_{BB}	Single Ch Avg in Single Disp
2. G_{AA} & G_{BB}	G_{AA}	G_{BB}	Single Ch Avg in Single Disp
3. RATIO	G_{AA}	G_{BB}	
4. SPECT B-A	G_{AA}	G_{BB}	
5. G_{BB}-G_{AA}	G_{AA}	G_{BB}	
6. SPECT B+A	G_{AA}	G_{BB}	
7. G_{BB} + G_{AA}	G_{AA}	G_{BB}	
8. SPECT A & ZOOM A	G_{AA}	G_{AA} (ZOOM)	Single Ch Avg in Single Disp
9. SPECT B & ZOOM B	G_{BB}	G_{BB} (ZOOM)	Single Ch Avg in Single Disp
10. SYNC SPECT A & B	Time A	Time B	Single Ch Avg in Single Disp
11. SYNC SPECT A & ϕ	Time A	-NA-	
12. SYNC SPECT B/A & ϕ	Time A	Time B	
13. EQUALIZED RATIO	G_{AA}	G_{BB}	
TRANSFER FUNCTION			
1. All menu items	G_{AA}	G_{BB}	G_{BA} real and G_{BA} imaginary in top part of M1 (cross product average)
POWER			
1. All menu items	G_{AA}	G_{BB}	G_{BA} real and G_{BA} imaginary in top part of M1 (cross product average)
TIME			
1. TIME A & B	-NA-	-NA-	
2. SYNC TIME A & B	Time A	Time B	Single Ch Avg in Single Disp
3. TIME A & SPECT A	-NA-	G_{AA}	
4. TIME B & SPECT B	-NA-	G_{BB}	
5. R_{AA} AND R_{BB}	NOTE →		Fill 0
6. R_{BA}	NOTE →		Fill 0
7. IMPULSE RESPONSE			Cross product average
STATISTICAL			
1. PDH A & B	PDH A	PDH B	Single Ch Avg in Single Disp
2. PD A & B	PDH A	PDH B	Single Ch Avg in single Disp
OCTAVE			
1. OCTAVE A & B	G_{AA}	G_{BB}	Always single channel average
2. OCTAVE B/A	G_{AA}	G_{BB}	Always single channel average
3. OCTAVE B-A	G_{AA}	G_{BB}	Always single channel average
4. OCTAVE B+A	G_{AA}	G_{BB}	Always single channel average

Overlap Processing — The MAX, MP 1, MP 2 and MP 4 Touch Controls

Certain measurements, such as impact excitation, that employ analysis ranges of 2 kHz and below, can encounter problems related to the length of the SD375's memory period (block length). Should a response signal extend beyond the instrument's block length, serious truncation errors could result.

In order to get the best possible dynamic range from a measurement using impact excitation, it is desirable to allow the response signal to decay away completely. Although there is a tradeoff between total dynamic range of measurement and filter spacing or analysis resolution, it is nevertheless desirable to perform an analysis using impact excitation in such a way that the response signal can decay away to virtually zero. Anything short of zero can decrease the measured dynamic range, thus making it difficult or impossible to accurately define frequency response functions. For this reason, it is often necessary, especially when dealing with slightly damped structures, to process acceleration response signals over more than one block of data.

The processing time of the SD375 is the total amount of time required to calculate a desired parameter, such as a transfer function, once the loading of input memory or memories has been accomplished. If the time required to process and display the results is equal to or less than the time required to sample the data signals and load input memories, the processing is said to be performed on a real time basis. If the processing can be performed significantly faster than the time required to sample and load signal inputs, it is possible to perform multiple analyses of the input signals on a segmented basis. The concept of performing a new analysis on a segment of data in which only a portion of the signal has been updated (some old data, some new data) is referred to as overlap processing. The touch controls labeled MAX, MP 1, MP 2 and MP 4 are for overlap processing. These touch controls are frequency range dependent. MP 1 cannot be selected at frequency ranges above 2 kHz, MP 2, 1 kHz and MP 4, 500 Hz. Note that when overlap processing is selected averaging time will vary depending upon the amount of overlap selected. Figure 3-16 shows examples of each of the MP selections using the weighting envelope to describe what is actually taking place in the instrument.



MAX

With this selection, the instrument doesn't look at memory period. Overlap takes place automatically in the lower frequency ranges and the amount of overlap is dependent upon the specific selected frequency range.

Figure 3-16. Memory Period Overlap Examples

Peak Averaging in the Cross Products Mode for Swept Sine Analysis

The SD375 is a dynamic analyzer, and vibration information is, typically, channel A is excitation and channel B is response.

With this type of PEAK averaging, a user can sweep a tonal through a specimen and measure the response. However, in the Transfer Function or Power modes, the average of the signal data being taken includes the cross products of channel A and channel B, resulting in four components:

G_{BA} real
G_{BA} imaginary } Cross products: two parts of a complex value.
G_{AA}
G_{BB}

Since G_{BA} is averaged and stored in order to preserve the phase relationship between A and B, the magnitude of either part is a function of the product of two values, $B(j\omega) \bullet A^*(j\omega)$ and the phase between them. Independent PEAK averaging of these four components would result in unrelated values. For example, G_{BA} real stored on a random pass, G_{BA} imaginary on the ninth pass, G_{AA} on the fifth pass and G_{BB} on the fourth. The results would be meaningless.

As a convenience for users who wish to use a sine sweep excitation for data gathering, we have enabled PEAK averaging in the cross products mode and slightly redefined its meaning. When using PEAK averaging in the cross products mode, the storing of data for all four components will be based on the single test of the level of G_{AA}. In other words, if the level of G_{AA} on *this* pass (at *this* cell) is greater than what is currently in M1, all four values (for *this* cell) are stored (G_{BA} real, G_{BA} imaginary, G_{AA} and G_{BB}). If not, all four values are rejected.

For example, Figure 3-17 shows a typical filter shape at the top of the illustration and sample plots of the filter using PEAK averaging both in the Power and Transfer Function modes.

PEAK averaging in the cross products mode is a data acquisition mode that stores all four components on the basis of a single test for PEAK excitation. Thus the user ends up with related data, taken when the excitation was at its maximum at any given frequency. This allows you to use the SD375 as a swept sine analyzer if proper control of the sine sweep is used as well.

For best results, full analysis range sweep should take about 200 seconds, This is a sweep rate of $2\Delta f$/seconds. For example, the 10 kHz analysis range has a Δf of 25 Hz. The sweep should be on the order of 50 Hz/second.

NOTE

The Coherence function is nominally 1 (unity) for all values when in the PEAK average mode. It will be otherwise only if the energy measured is so close to the FFT noise floor of the analyzer that zero clamping of the (random) data produces a G_{BA} radically different from $G_{AA} \bullet G_{BB}$. Nonunity coherence measurements typically indicate, when in the PEAK average mode, that no data was measured at that frequency. Also, operators that use this feature for sine sweep will notice a "spiky" Coherence characteristic until the tonal actually sweeps through an area.

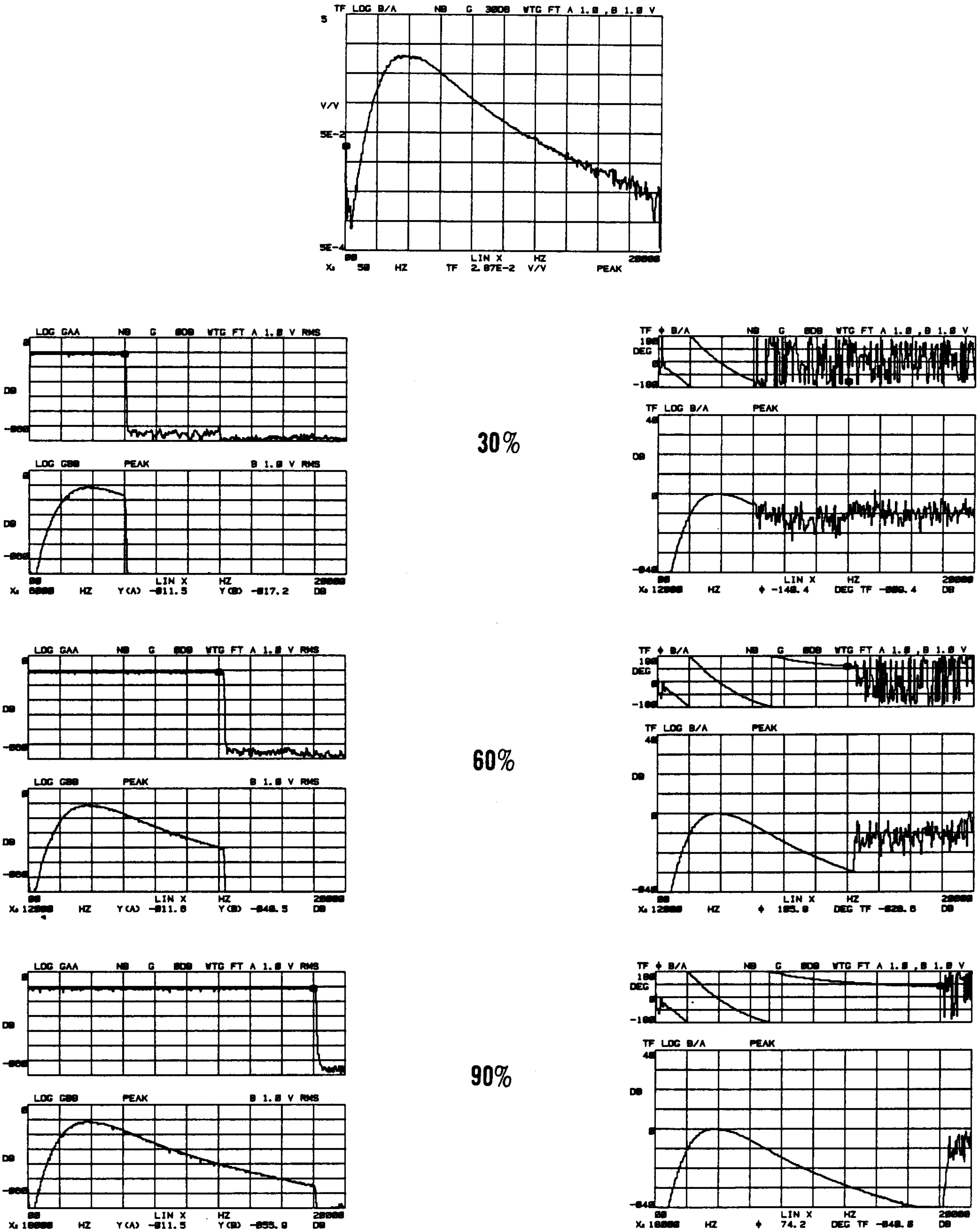


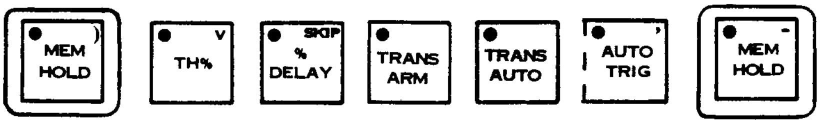
Figure 3-17. Example of Swept Sine Analysis

The Storage Memory — The XFER M1→M2 Touch Control

When you press this touch control, the contents of M1 (the Averager Memory) are transferred to M2. In *addition*, the entire front-panel setup (all touch control selections) is transferred as well.

To display the contents of M2, you have to press the M2 touch control in the DISPLAY group. There are two important things to keep in mind when using and displaying the Storage Memory. First of all, when you press the M2 touch control, you are actually performing (as described in subsection 3.4.6, Panel Storage and Recall) a "PANEL, 9, Recall." This means that each time the M2 touch control is pressed, not only the stored display data will appear, but the entire front-panel configuration that was present when the transfer to M2 was made will drive your present front-panel selections to the front-panel selections stored in M2. Also certain Primary Function menu items such as SPECTRUM MENU selection 13 and TRANSFER FUNCTION MENU selection 5 use, as a part of the display calculations, the contents of M2. To guard against erroneous data, it would be a good idea to know just what is in M2. If you're not sure, you can refer to subsection 3.4.6 and *store* your present front panel setup, first, before pressing the M2 touch control

3.4.2.4 Transient Capture — The MEM HOLD, TH%, % DELAY, TRANS ARM, TRANS AUTO and AUTO TRIG Touch Controls



MEM HOLD Touch Controls

When either of these touch controls are pressed, the LED in the upper left-hand corner of the selected touch control will light indicating the input memory is in the HOLD mode. This means the input memory will cease updating and the display data will freeze. Since both channel A and channel B have their own MEM HOLD touch controls, you can place a single channel in the HOLD mode without affecting the update status of the other channel. However, certain Primary Functions use the input data from both channels to calculate the resultant display data. Placing a single channel in the HOLD mode under these circumstances could cause erroneous results. Also note that certain front-panel touch controls are locked out in the HOLD mode such as Input Level and Frequency Range. To exit the HOLD mode, press the MEM HOLD touch control once to extinguish the LED. When this is accomplished, the input memory will resume updating.

NOTE

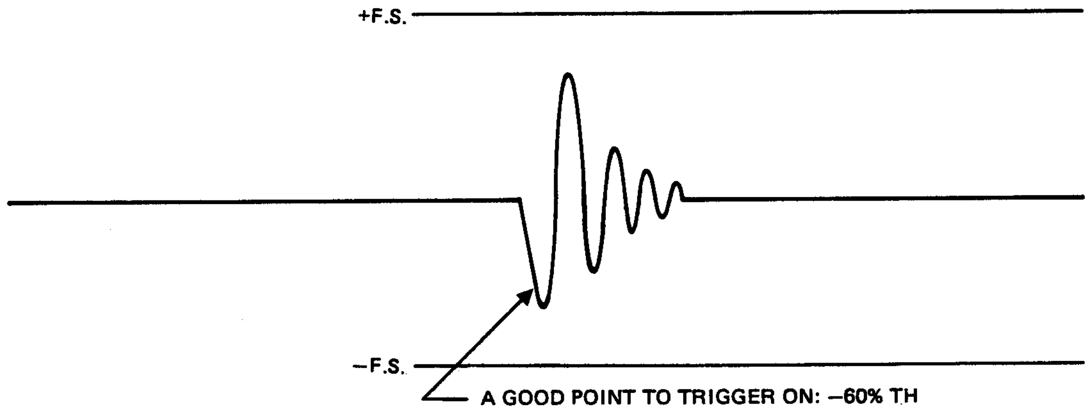
Certain functions and touch controls, such as the Transient Capture Function and the ZERO and ROTATE touch controls, will place the input memories in the HOLD mode and cause the LEDs on the MEM HOLD touch controls to light automatically.

TH% and % DELAY Touch Controls

Whenever the SD375's Transient Capture feature (TRANS ARM or TRANS AUTO) is used, two settings, *interacting with the signal*, determine the performance of the analyzer. These two settings are:

TH% — Trigger level in % of full scale voltage
% DELAY — Acquisition delay in % of memory period

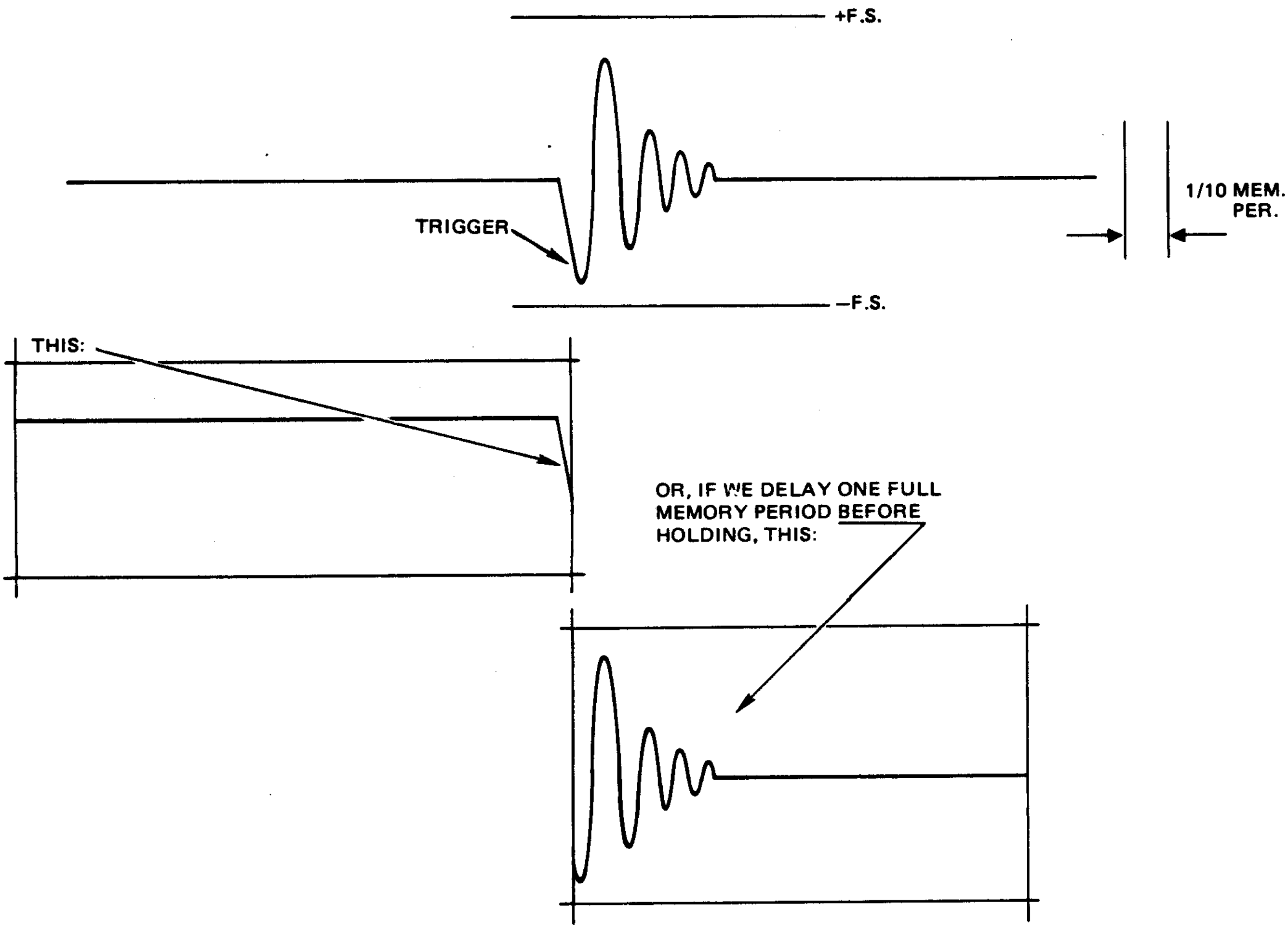
TH% (Threshold percentage) is a user-entered figure that allows the user to determine a specific voltage level to *trigger* the acquisition of data. If the signal to be analyzed is appearing intermittently, it can be captured and *held* for analysis. For example, the data to be analyzed is a "ring" shown in the following sketch.



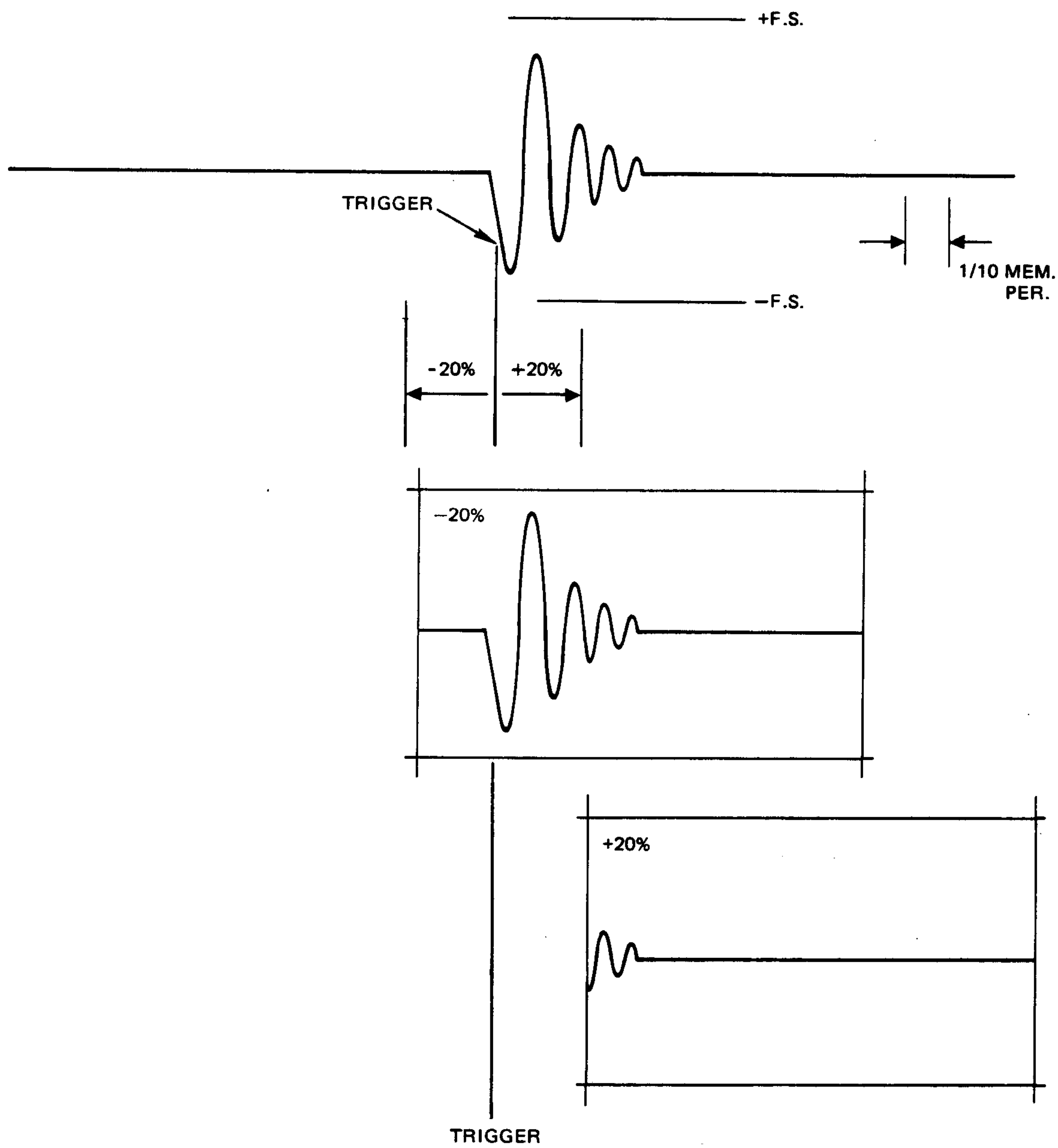
When this signal level is detected by Transient Capture circuitry, the input memory is placed in the HOLD mode.

Suppose, with the signal shown in the preceding sketch, the input memory were to be placed in HOLD *immediately* upon detection of the required trigger voltage level. The user will see all the data taken up to the time the input memory was place in HOLD, exactly one memory periods worth. Remember, the time-length of a memory period is determined by the selected frequency range.

Using the "ring" shown in the previous sketch, the user would see this:



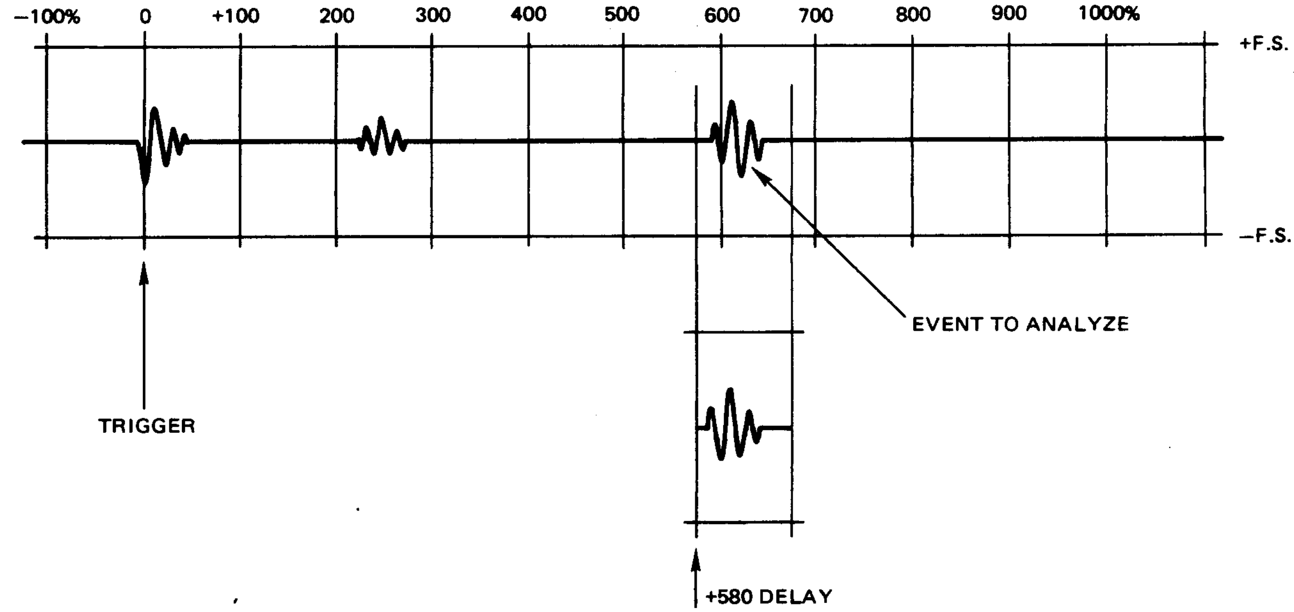
% DELAY is a user-entered figure that determines the amount of delay, in % of memory period, *from* the trigger detection to the beginning of the actual held data. For example, our "ring" using + 20% and − 20% delay would look like this:



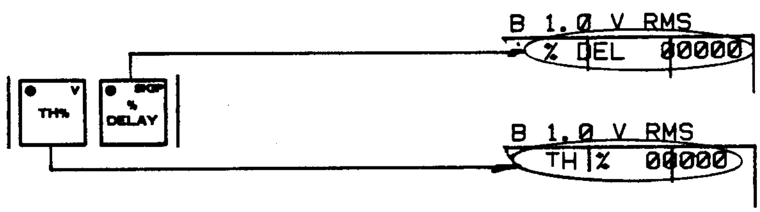
Notice that any % DELAY greater than zero (+ %) will cause the actual trigger not to be among the data held for analysis.

Because of the hardware nature of the SD375's input memory, any data signal which occurred more than one memory period ago is "gone forever," hence the permissable negative percent delay is − 100%. This would place the trigger voltage at the *end* of the held data, and the 1023 samples *preceding* the trigger would comprise the rest of the data to be analyzed. A delay of 0% would cause the 1024 samples *immediately following* the trigger to comprise the data to be analyzed.

The limitation on positive percent delay is + 9000%. This yields a total of 108 memory periods, around the trigger, from which the user may choose to take a single memory period sample for analysis. It is entirely possible, to select for analysis, signal data which occurs, say, six memory periods *after* the trigger signal. For example:



To select the threshold percentage (TH%) or percent of memory period delay (% DELAY), press TH% or % DELAY in the PARAMETERS group. The following annotation will appear in the upper right-hand corner of the display grid:

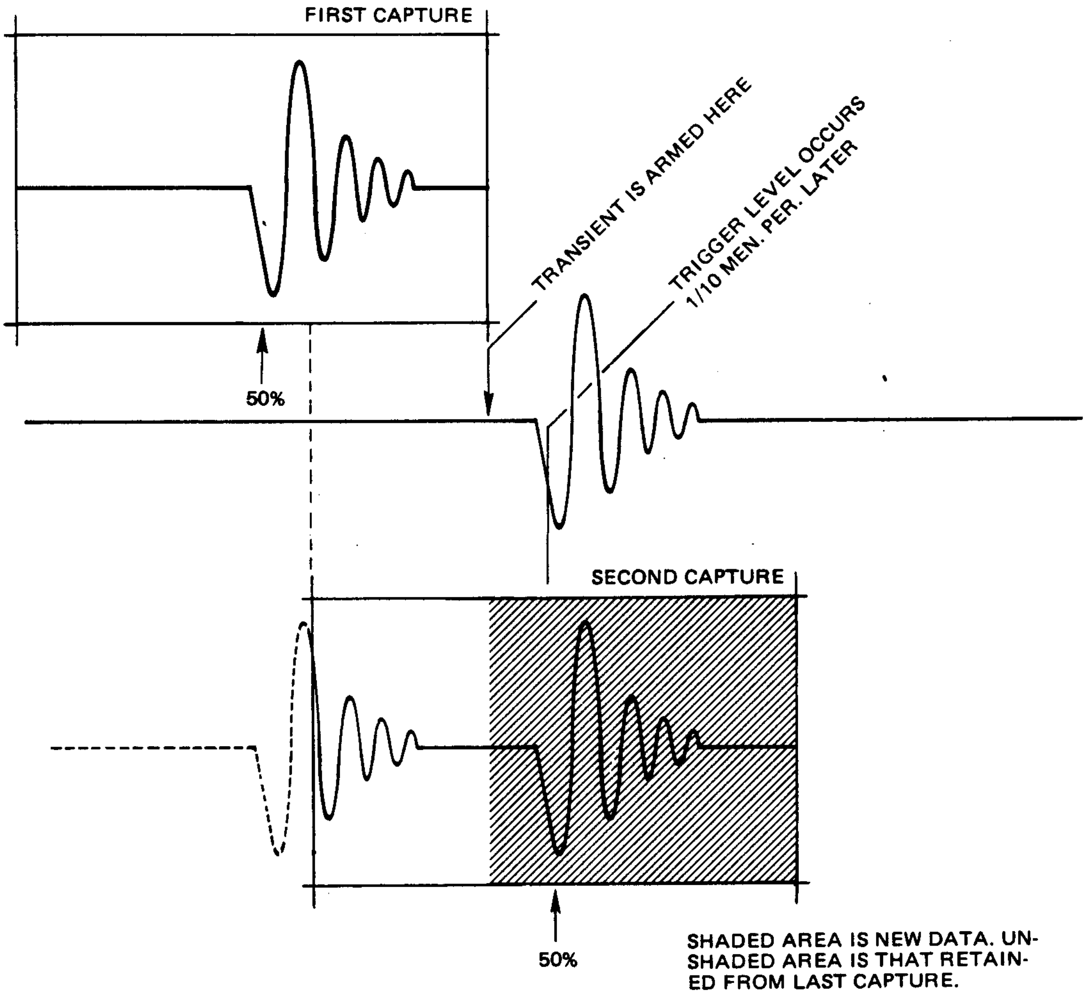


Next, select the threshold percentage (from — 100% to + 100% in 1% increments) or percent of memory period delay (from — 100% to + 1000% in 10% increments) on the PARAMETERS group keypad. As you press each number on the keypad, the number will appear in place of the zeros as shown in the previous example. If the assigned value is to be negative, press the + / − touch control on the keypad and a minus sign will appear in front of the assigned value. Finally, press the ENT touch control on the keypad. Once the ENT touch control is pressed, the assigned value is entered and the annotation will remain for a few moments, then disappear from the display. If you want to recall an assigned value, press TH% or % DELAY, then press RCL on the keypad. The annotation and assigned value will re-appear in the upper right-hand corner of the display grid, remain a few mements for your perusal, then disappear once again.

TRANS ARM and TRANS AUTO Touch Controls

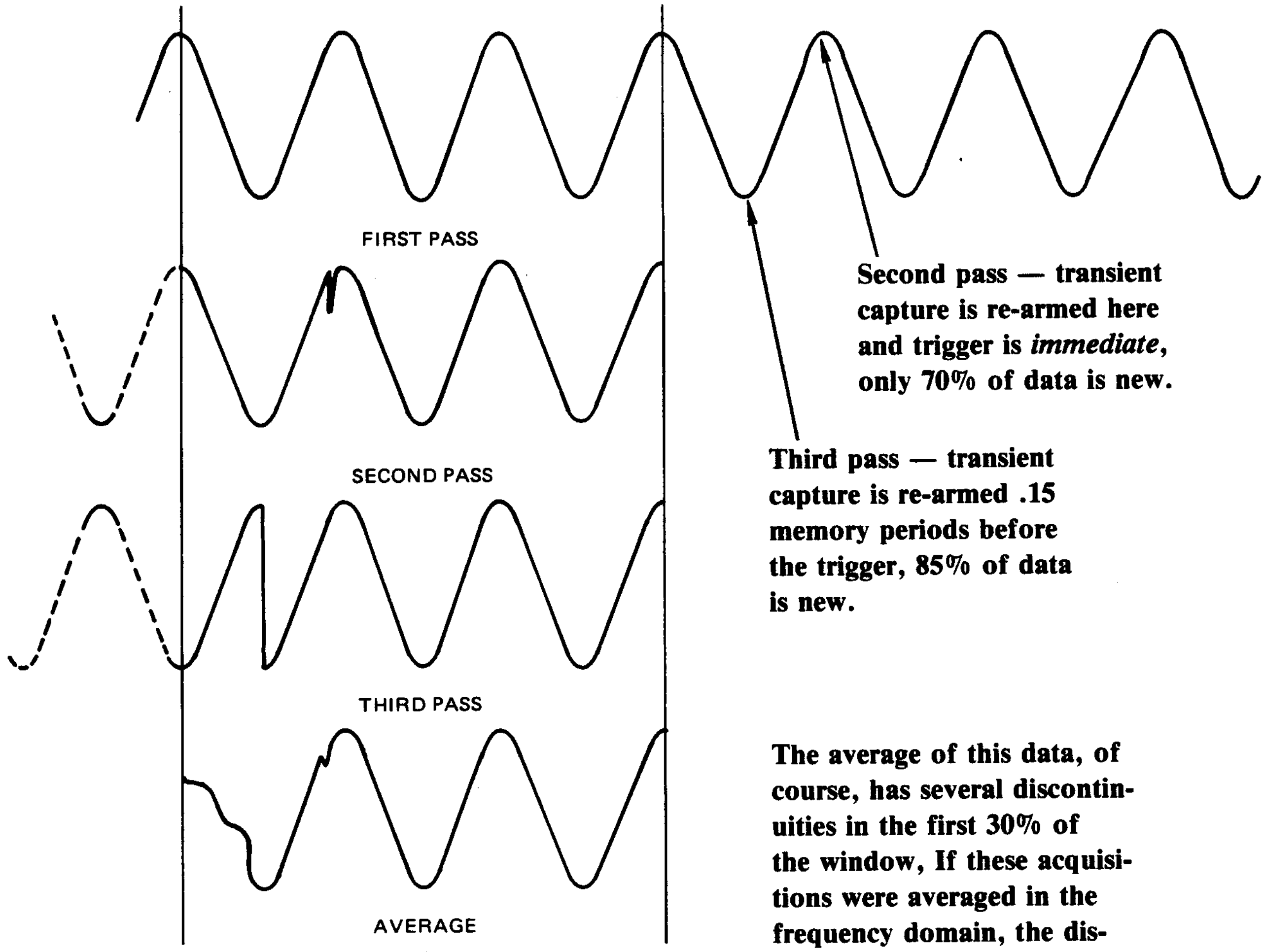
Once you have selected and entered threshold percentage and memory period delay, the transient capture feature can be armed, manually, by pressing the TRANS ARM touch control, or automatically by pressing the TRANS AUTO touch control. When using TRANS ARM, the feature has to be armed by pressing the TRANS ARM touch control each time a transient capture is performed. When using TRANS AUTO, the feature is armed automatically for each capture. However, the TRANS AUTO feature will not start until the Average START touch control is pressed.

Whenever the SD375's transient capture feature is armed, either manually or automatically, the input memory, if in HOLD, is taken out of HOLD. New signal data is written into the input memory until the occurrance of the trigger voltage. At this point, the input memory is again placed in HOLD. It is possible, if the trigger level occurs soon enough after the arming of the transient, and a negative percent delay is being used, for some of the preceding data held to actually be that of the previous capture. For example, let's take our "ring" from the previous example, capture it once at — 50% delay, and then see what happens if we re-arm the transient capture 1/10 of a memory period before a trigger occurs.



When you manually operate the transient capture feature you can bypass this corruption of the current transient by the previous transient, by simply re-arming the capture.

In TRANS AUTO, the SD375 is capturing and processing transients as fast as it can, throwing away overloaded signals before averaging. In this mode a frequent trigger combined with negative percent delay can cause corrupted data to be averaged. For example, a Linear SYNC TIME average of a sine wave with an AVG N of 3, — 30% delay and 50% threshold using TRANS AUTO.



Second pass — transient capture is re-armed here and trigger is *immediate*, only 70% of data is new.

Third pass — transient capture is re-armed .15 memory periods before the trigger, 85% of data is new.

The average of this data, of course, has several discontinuities in the first 30% of the window, If these acquisitions were averaged in the frequency domain, the discontinuities in the second and third passes would show up as flairing of the spectrum.

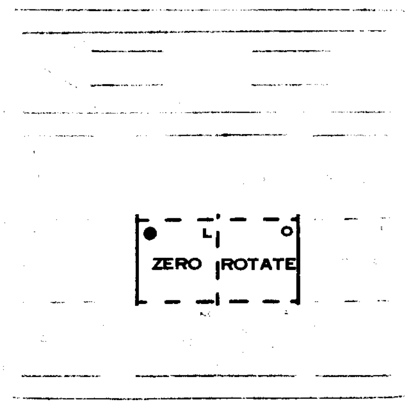
When using negative percent delay with the TRANS AUTO feature, you should make sure that the signal data is really *transient*, both in relationship to the effective memory period associated with the selected analysis range *and* with the cycle time of the SD375 (typically 250 to 350 milliseconds). Transients that occur more often than once every (350ms + [memory period × negative percent delay]) will, with varying degrees of constancy, cause this sort of data corruption.

This problem will not affect the results when in the AUTO TRIG mode, regular SYNC TIME averaging mode (with an externally applied sync pulse) or with positive percent delay.

AUTO TRIG Touch Control

Pressing this touch control enables (LED goes on) or disables (LED goes off) the AUTO TRIG feature. When in the AUTO TRIG Mode, the analyzer will synchronize the loading of new signal data into the input memory with a specific signal level determined by the threshold percentage. If the selected threshold level does not occur, no signal data acquisition and calculations will occur either. The display may freeze if the level is not detected.

3.4.2.5 Input Memory Manipulation — The ZERO and ROTATE Touch Controls



The ZERO touch control, when pressed, enables the operator to manually load zeros into any location of either input memory. This function requires both input memories to be in the memory hold mode. Therefore, when the ZERO touch control is pressed, both input memories will automatically be placed in the HOLD mode, and the LED's on both MEM HOLD touch controls will light. Zeroing can now be accomplished by moving the cursor in either direction. It's a good idea to place the cursor on the data to be zeroed before the ZERO touch control is pressed, because the cursor will zero out all the data points it passes over.

The display shown in Figure 3-18 was accomplished by pressing the ZERO touch control with the cursor initially placed on the left of the upper trace. The cursor was then moved to the right to an undetermined point, the LOWER touch control was pressed to place the cursor on the lower trace and moved in the same direction until the right side of the lower trace was reached. The trace data on the example is irrelevant as zeroing can be accomplished on any TIME domain data, either in a single or dual trace mode of operation.

The ROTATE touch control enables the operator to selectively rotate, left or right, the time domain data in either or both input memories. If the instrument is in a dual display mode, both displays will rotate simultaneously. When this touch control is pressed, both input memories will automatically be placed in HOLD mode, and the MEM HOLD LED's will light. Rotation is accomplished by moving the cursor left or right as desired.

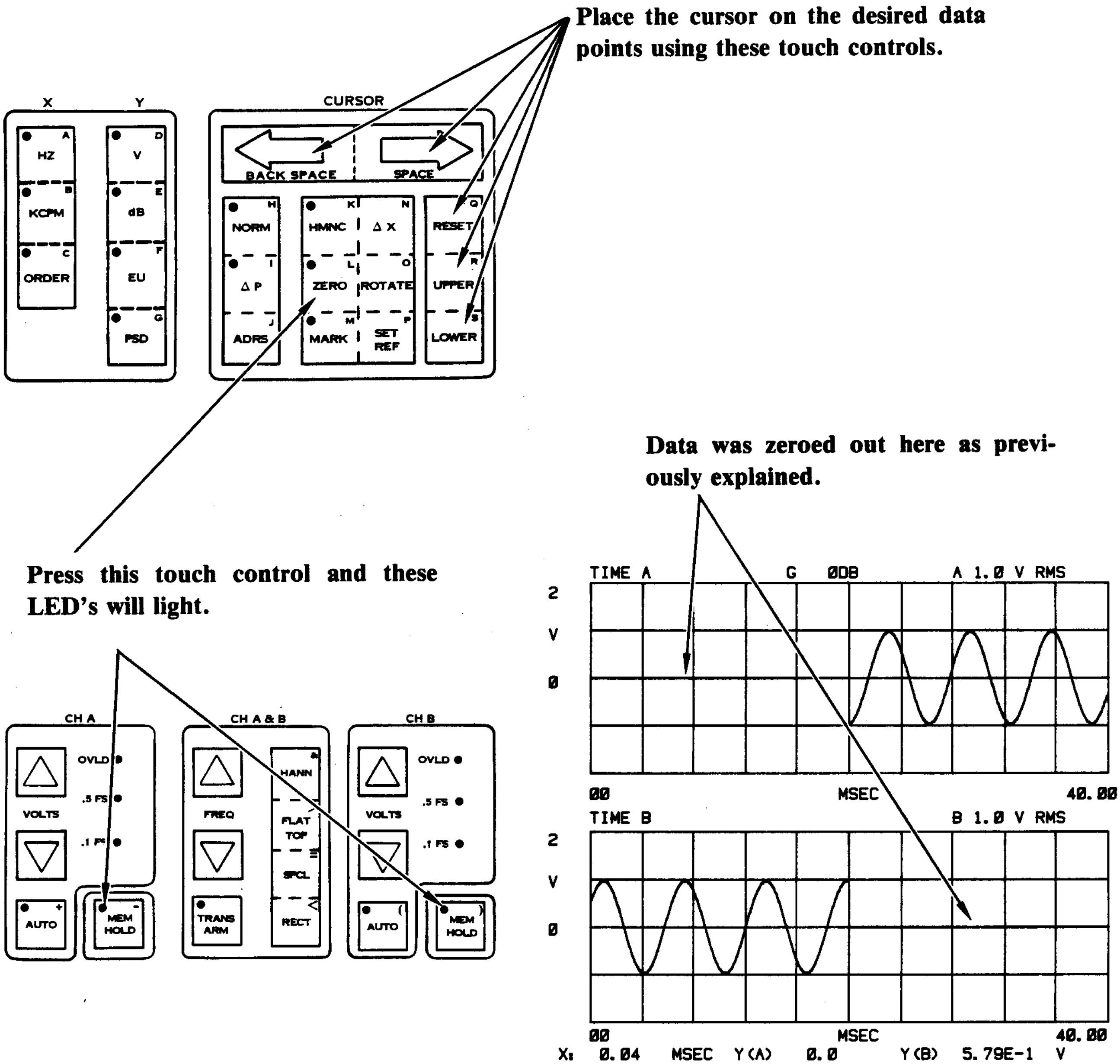
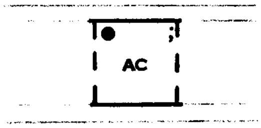


Figure 3-18. Description of the ZERO Touch Control

3.4.2.6 The AC Touch Control



This touch control is for selecting input coupling. When the LED in the upper left-hand of the touch control is LIT, AC coupling is selected. When the LED is *not* lit, DC coupling is selected. When input levels of 50 mV and below are selected, coupling is forced to AC.