Operator's Manual
SD380 SATURN
Signal Analyzer
Part One

Legacy Manual

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SERIAL _____

OPERATOR'S MANUAL

SATURN
Signal Analyzer

P/N 22183800
02-89-09-3001

Spectral Dynamics
A Scientific-Atlanta Division

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Addendum

The Saturn family consists of 2 analyzers – the SD380-C and the SD380-Z. The analyzers are identical in all operating specifications except the following items.

1. The SD380-C has a 7" color display tube.
2. The SD380-Z has a 9" monochrome display tube and has a grid intensity control knob.

Please note that where the word "color" appears in the Saturn manual, it only applies to the SD380-C.

Sept 1989

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MANUAL CHANGES

Originator Tom Stettler **Date** 1/29/90

Manual Title Saturn Operator's Manual **Manual P/N** 22183800

Manual Version No. 02-89-09-3001 **ECO/AR** 7050

Page 1 of 1

Changes:

Octave Analysis

The "-5" Octave Band Analysis Option is now standard in all instruments as follows:

SD380Z (Monochrome Monitor) S/N 5041 and above.

SD380C (Color Monitor) S/N 3064 and above.

All information referring to Octave Band Analysis is valid including the "-5" Appendix located at the back of this manual.

MANUAL CHANGES

Originator Tom Summerville **Date** 8/2/89

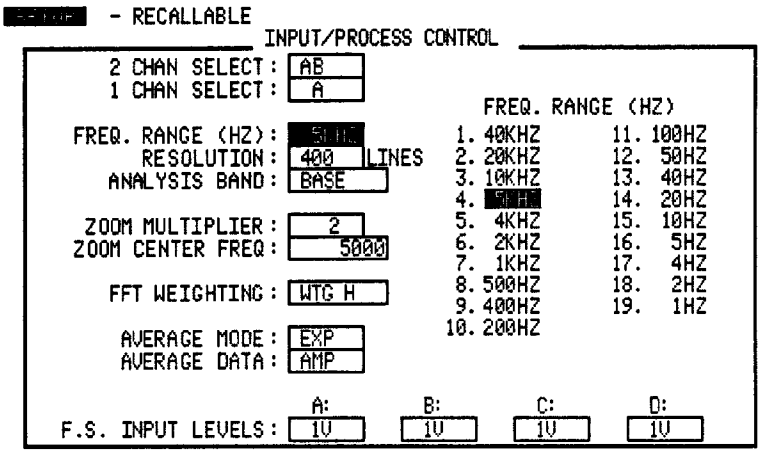
Manual Title Operator's Manuals SD380Z/C **Manual P/N** 22088500/22183800

Manual Version No. 01-86-04-0561/01-88-12-3001 **ECO/AR**

Changes:

Page 3.SETUP 2-3

FREQ. RANGE (HZ):



Menu for selecting the full scale analysis range.

Menu selection is accomplished using the SCROLL group UP/DOWN buttons, or the ENTRY keypad. ~~The 40KHZ analysis range *cannot* be selected for any four channel function.~~

THE 40KHZ ANALYSIS RANGE IS NOW AVAILABLE FOR ALL FOUR CHANNEL FUNCTIONS

MANUAL CHANGES

Originator Tom Summerville **Date** 8/2/89

Manual Title Operator's Manuals SD380Z/C **Manual P/N** 22088500/22183800

Manual Version No. 01-86-04-0561/01-88-12-3001 **ECO/AR**

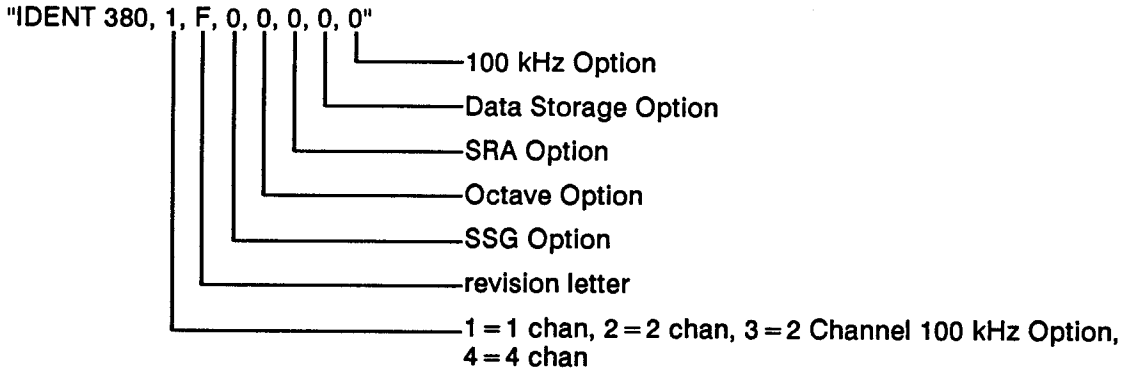
Changes:

Page A-55 of Appendix A (IEEE Interface)

Page RS232.A-37 of Appendix A (RS232 Interface)

A.4.5 "IDENT?" Identify

"IDENT?" will cause the SD380 to output a stream of codes that identify the number of channels, firmware revision, and options installed. The resultant output will look like this:



Option = 0 - Option not installed

Option = 255 - Option installed

Section I

General Information

1.1 INTRODUCTION

This manual contains unpacking, initial checkout and operating instructions for the Spectral Dynamics SATURN Color Signal Analyzer. The manual is divided into three sections. Each section covers a specific aspect of the instrument. This section contains a general description of the instrument, and other available documentation, an introductory TOUR and equipment specifications.

1.1.1 Equipment Description

The SATURN (SD380C) is a third generation microprocessor based, 1, 2 or 4 channel signal analyzer. It measures the signal(s) present at one, two or four BNC connectors located on the rear panel and, in the case of the two and four channel options, the relationship *between* two signals. All four input BNC connectors are provided, regardless of the number of channels available in your instrument. If you have the single channel option, only the A BNC connector (J1) is active. If you have the two channel option, BNC connectors A (J1) and B (J2) are active. If you have the four channel option, all four BNC connectors are active; i.e., A (J1), B (J2), C (J3) and D (J4).

Measurement results are displayed on a raster scan crt. The measurements are controlled from displayed Setup Pages via the front-panel buttons.

There are two main parts to measurement display; a scaled trace and a cursor readout. The trace is an X-Y array of measured values, graphically represented with data points or lines, scaled to units and distributions by the operator from the Setup Pages. The cursor readout is, typically, a three-place accuracy numerical reading on a trace data point that the operator indicates using the front-panel cursor controls.

The operator can adjust the range of the displayed trace controls for linear and logarithmic traces on both the X and Y-axis and apply a certain amount of output gain on the trace. Times two (X2) and times four (X4) expansions on the X-axis are available. In addition, X-axis ZOOM is available, providing increased baseband resolution from 2 to 256 times the normal baseband resolution.

In order to store, retain and smooth data, the instrument is provided with an Averager Memory and a Storage Memory where Frequency, Time and Amplitude domain data can be averaged and then stored. If your instrument has the two or four channel option, each channel has its own Average and Storage Memory.

In addition to the standard signal analysis capabilities, the instrument is equipped with a built-in Waterfall feature, a 56K word Input Memory, an IEEE interface and the ability to perform single/double integration/differentiation. These are also standard features in the SD380C.

1.1.2 SATURN Options

Two Channel (−2 Option)

This option expands the instruments capabilities to include the cross-channel functions; i.e., Transfer Function, Power and IFFT (Inverse Fast-Fourier Transform). Also the Spectrum, Time and Statistical functions are now capable of two-channel acquisition.

Four Channel (−4 Option)

This option provides four-channel acquisition capability for the Spectrum, Time and Statistical functions. In addition, the cross-channel functions (Transfer Function, Power and IFFT) are now capable of performing triple cross-channel calculations.

1/3 and 1/1 Octave (−5 Option)

This option adds 1/3 and 1/1 Octave analysis capabilities to the instrument. One-third octave data can be acquired on any channel and processed to meet ANSI Class III Filter Specifications. Selectable acoustic weighting, shaping, trace math and complete listing capabilities are provided as post-processing operations.

Signature Ratio® (−6 Option)

This option provides speed compensation for easy interpretation of machine signatures and eliminates the need for any external tracking adapter and tracking filter to remove aliasing errors from the measurement. The ability to accommodate a wide variety of tach signals and the standard Waterfall display makes it ideal for rpm tracking analysis of machine run-up and coast-down measurements.

Synchronous Signal Generator — SSG (−7 Option)

This option provides a self-contained random noise, band-limited and zoom-limited synchronous noise, and a sine wave analog output generator for the excitation of systems or networks for performance evaluation. Bandwidth of the noise output is controlled by the analyzer and guards the external system from excitation frequencies that are beyond the full-scale analysis range of the analyzer.

Data Storage (– 8 Option)

This option provides permanent storage of digital data or processed results for archival purposes or subsequent review. The storage media is a removable 3.5 inch micro floppy disk with 500 kbyte capacity.

Setup data, Time domain data from regular or extended memory, Frequency domain data or Waterfall files can be stored or recalled. Full high-resolution data is stored for recall and used for other post-processing operations such as math manipulation or modal analysis.

100 KHz (– 13 Option)

The – 13 Option expands the single-channel frequency range to 100 KHz. This option can be installed only in SD380C units.

1.1.3 Other Documentation

Spectral Dynamics produces two basic manuals for its equipment; an Operator's Manual and a Service Manual. The Operator's Manual is shipped with each instrument; the Service Manual, with engineering drawings, may be ordered separately.

The Service Manual contains a detailed theory of operation, calibration procedures, maintenance information, parts lists, engineering drawings and wire lists. The manual is written for technical personnel with experience in analog and digital circuits. Manual contents will provide the maintenance engineer with information that will enable the maintenance technician to repair and/or calibrate the instrument.

Technical papers are available from Scientific-Atlanta which provide user oriented background information. For a list of this material, contact either your local sales/service office or the San Diego Group.

1.2 GUIDE TO THE MANUAL

The purpose of this manual is to provide the operator with the information needed to properly configure and operate the SD380C.

This section (Section I) contains a brief description of the instrument, information concerning other documentation, this guide, a "TOUR" and equipment specifications. Section II covers installation, unpacking and safety precautions. Section III covers each function of the instrument and is organized by Setup Pages, followed by a description of the front and rear panels which is organized by Button Groups. Appendix A covers operation of the IEEE interface. Appendix B contains the option manuals.

The "TOUR" that follows this guide takes you through the instrument controls sequentially to demonstrate the major features of the instrument and how to operate them. After you complete the Tour, Section III begins with an Operational Overview that briefly explains what you just did.

Setup Page 7 — WATERFALL PARAMETERS

This Setup Page covers the numerical entry Control Fields for the selected Waterfall acquisition modes and the numerical entry Control Field for entering the time of day.

Setup Page 8 — IEEE COMMUNICATION

Operation of the IEEE feature is covered in Appendix A. However, when the IEEE bus is being used, this Setup Page allows the user to assign a device address, designate the data format and to assign input/output terminators.

Setup Page 9 — DIGITAL PLOTTER PAGE

A digital plot is initiated by pressing the front-panel PLOT button. This Setup Page allows the user to designate what is going to be plotted and how the plot is to be accomplished.

Setup Page 10 — SSG/OCTAVE/SRA OPTIONS

This Setup Page contains the control menu for the SSG (Synchronous Signal Generator) Option, data configuration menus for the Octave Option (the Octave Option is enabled via the ANALYSIS BAND menu located on Setup Page 2) and the numerical entry Control Fields for the SRA (Signature Ratio Adapter) Option (the SRA Option is enabled via the SAMPLING SOURCE menu located on Setup Page 1). Information for these three options is located in Appendix B.

Setup Page 11 — DATA STORAGE — OPTION

This Setup Page contains the control menus for the Data Storage option. Information for this option is located in Appendix B.

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1.3 SATURN TOUR

The objective of this tour is to familiarize the new user with the features of the SD380 and its associated controls. This TOUR is designed to require only the SD380 and an audio signal oscillator.

Each section is organized to allow the single channel user to skip the two channel and four channel information. The two channel user can skip the four channel information.

Before continuing, connect a BNC TEE to the output of the oscillator. Connect two BNC cables from the TEE to the Channel A (J1) and Channel B (J2) BNC connectors located on the rear panel of the SD380. Do not energize either instrument. Adjust the oscillator for minimum output and a frequency of approximately 5 kHz.

1.3.1 Basic SD380 Control Concepts

Energize the SD380 and the oscillator. The SD380 will emit an audio signal (a 'beep') and, after a few seconds, a message, similar to the one shown in Figure 1-1 will appear. The number of channels, revision letter and options installed may differ. Note the message at the bottom of the screen: PRESS FIELD, DATA, OR HELP TO CONTINUE.

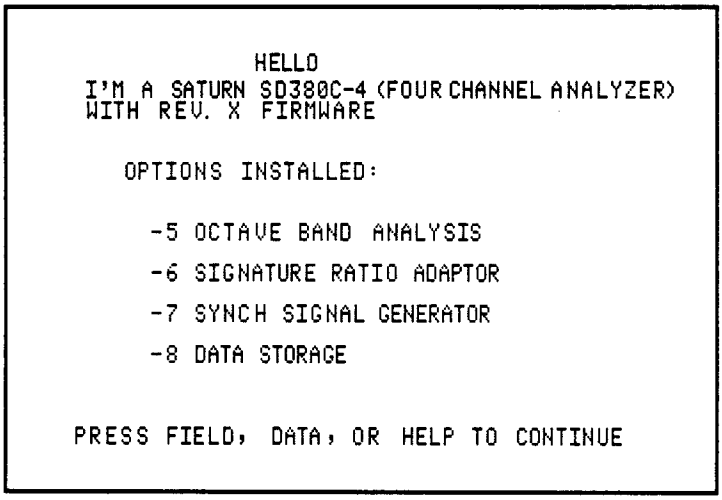

Figure 1-1. Introductory Statement

The HELP button is in the group of buttons located in the lower right corner of the front panel. The FIELD and DATA buttons are in the CURSOR group located in the upper left corner. Press the DATA button and look at the display screen. Depending on the configuration the analyzer was in when last turned off, there should be one or more sets of grids. Data may or may not be displayed.

Located in the upper right corner is the ENTRY group buttons. Press, in sequence: PANEL, 0 and RCL. This automatically places the analyzer in a factory determined configuration.

Adjust the output of the oscillator for 1 Vrms. The display should be similar to the one shown in Figure 1-2.

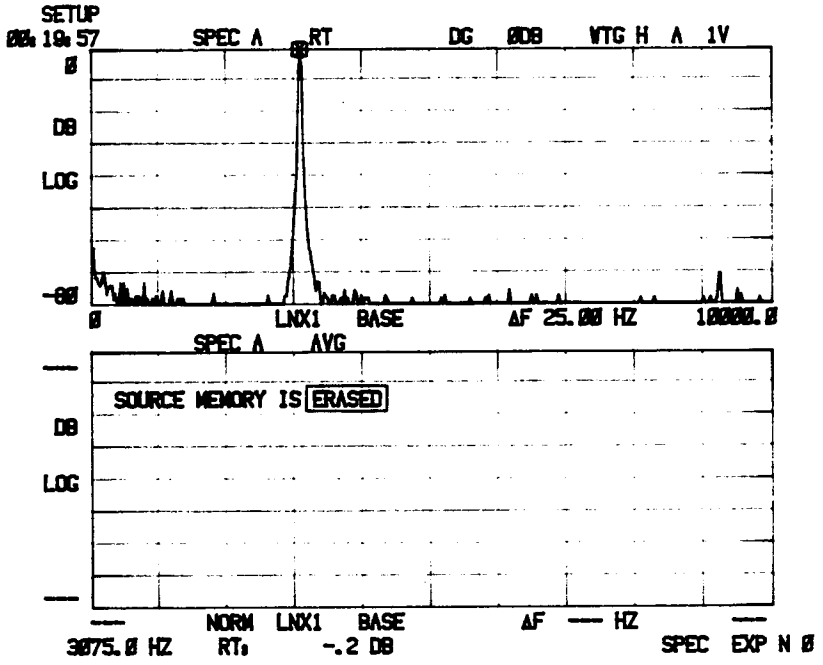

Figure 1-2. The PANEL-0-RECALL Display

The annotation surrounding the display supplies information on the settings of the various menus. These menus, located on setup pages, are used to change functions and configurations of the SD380. There are, above each grid, three important pieces of information: the selected function, the channel being displayed, and the memory the data was stored in. Note the message displayed in the lower grid, SOURCE MEMORY IS: ERASED. As the instrument has been just turned on, the memory selected for the lower trace (AVG for Average Memory) is empty, or erased. The lower trace has dashes in various positions around the display. Again, this is due to no data in the Average Memory.

The annotation along the left hand edge of the screen gives information about the Y-axis of the trace: the Y-units being displayed (linear or logarithmic), the full scale Y-amplitude, and the Y-amplitude at the bottom of the grid.

At the bottom of the screen is annotation providing information on the X-axis: the X-units being displayed; the value of the left and right side of the grid in those units; and the value, in X-units, of each X-axis step (the ΔF, or resolution).

The bottom line of the display contains cursor information. Located at the left edge of the trace is a bright square dot, this is the cursor. The numbers in the cursor readout line are the X and Y-axis values of the cursor position. The position of the cursor is controlled by the rotary cursor wheel located in the lower right corner of the front panel or, in the Data Mode *only*, by the CURSOR group directional buttons. Using the rotary wheel, position the cursor on the signal displayed on the upper trace. Note the vertical line that appears when the cursor is being moved. This makes it easier to see the cursor as it is moving. The cursor information line should now read the exact frequency and amplitude of the oscillator signal.

In the CURSOR group there are four buttons marked with arrows. When in the Data Mode, pressing the LEFT or RIGHT button will move the cursor one ΔF increment to the left or right. Keeping a button depressed will enable the silent sweep. The instrument will single step the cursor three times, and sound four beeps before the silent sweep commences.

The START button, located in the AVERAGE group, initiates data input to the Average Memory. Press the START button and observe the lower trace. The SOURCE MEMORY IS: ERASED message will disappear and trace calibration data will be displayed as shown in Figure 1-3. Push the CURSOR group DOWN button to position the cursor in the lower trace (movement of the cursor from one trace to another can be accomplished in the Data Mode *only*). The cursor information line now contains AVG trace information.

The right-most button in the AVERAGE group is labeled ERASE. Press that button and watch the display. The lower trace is once again empty and the cursor has returned to the upper trace. The lower display calibration information is replaced with dashed lines and the SOURCE MEMORY IS: ERASED message appears.

Observe the upper trace and notice the signal activity at the baseline. This is low level shifting of the signal and inherent noise. Adjust the output frequency and level of the oscillator while observing the upper trace.

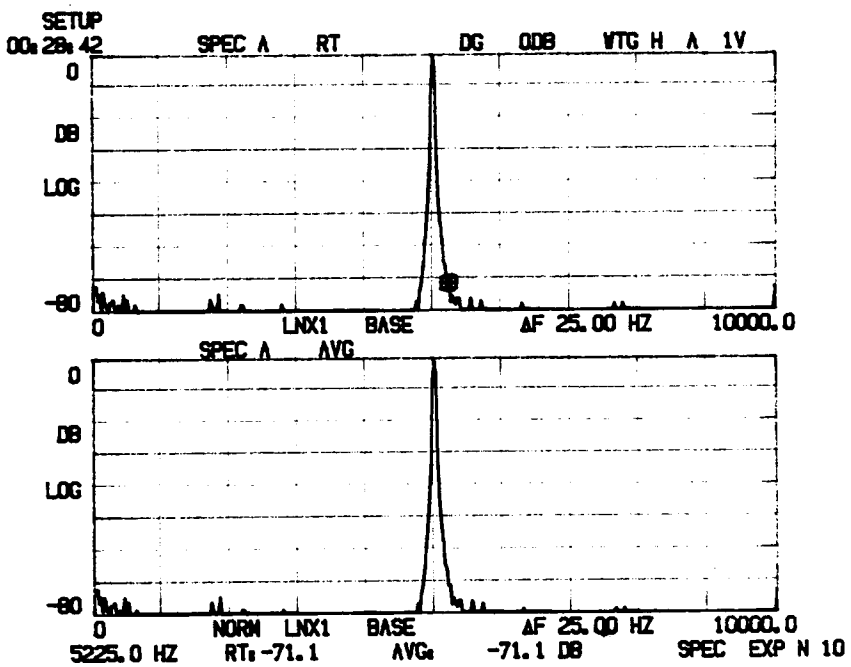

Figure 1-3. Average Memory Display

The group of buttons located below the AVERAGE group is the INPUT MEMORY. Two of these buttons are labeled UPDATE and HOLD. These buttons allow data to be loaded into memory, or retention of current data, respectively. Push HOLD and, while watching the upper trace, adjust the frequency and level of the oscillator. Data in the Input Memory is no longer being updated. The data displayed on the screen is retained until the UPDATE button is pressed. Press the UPDATE button and notice the upper trace shows movement of the signal.

The FIELD button is located in the CURSOR group. When the instrument is placed in the Field Mode, a Reverse Video Control Field will appear on one of the display annotations. The setting highlighted by the Reverse Video Control Field can be changed by pressing the SCROLL group UP or DOWN buttons. Throughout the remainder of this tour, this process of changing a setting via the SCROLL buttons will be referred to as 'selecting'.

Press the FIELD button and note the annotation SPEC is replaced by the word SPECTRUM, and another line of annotation appears at the top of the screen as shown in Figure 1-4. This top line of annotation contains settings that are frequently changed. Press the SCROLL group DOWN button, this will select the ZOOM & SPEC function. Press the SCROLL DOWN button again, and the 2 CH SPECT function will be selected. Press the SCROLL UP button twice to return to SPECTRUM.

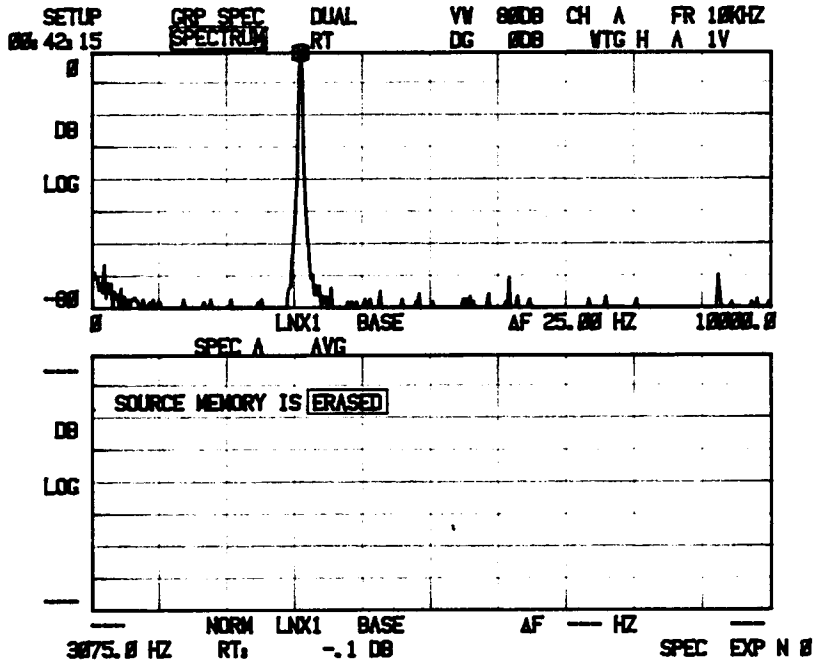

Figure 1-4. The Field Mode Display

In the Field Mode, the CURSOR directional buttons are locked out from moving the cursor. Instead they are used to position the Reverse Video Control Field on the various control annotations surrounding the display. Press the CURSOR RIGHT button twice to position the Reverse Video Control Field on DG 0DB. This is the DISPLAY GAIN field. Press the SCROLL DOWN button to select – 10 dB as the top reference of the display. Observe the effect this has on the trace. Figure 1-5 shows all of the display screen annotations that are fields. Use the CURSOR directional buttons to position the Reverse Video Control Field on these various controls.

The block of 6 buttons, located in the bottom of the CURSOR group, are FIELD LOCATORS. They position the field in a fixed place. This avoids having to press the directional buttons many times.

Push each of the 6 FIELD LOCATOR buttons and observe where the Reverse Video Control Field is placed. Figure 1-6 shows which fields are accessed by the FIELD LOCATOR buttons. Press the AVG locator button.

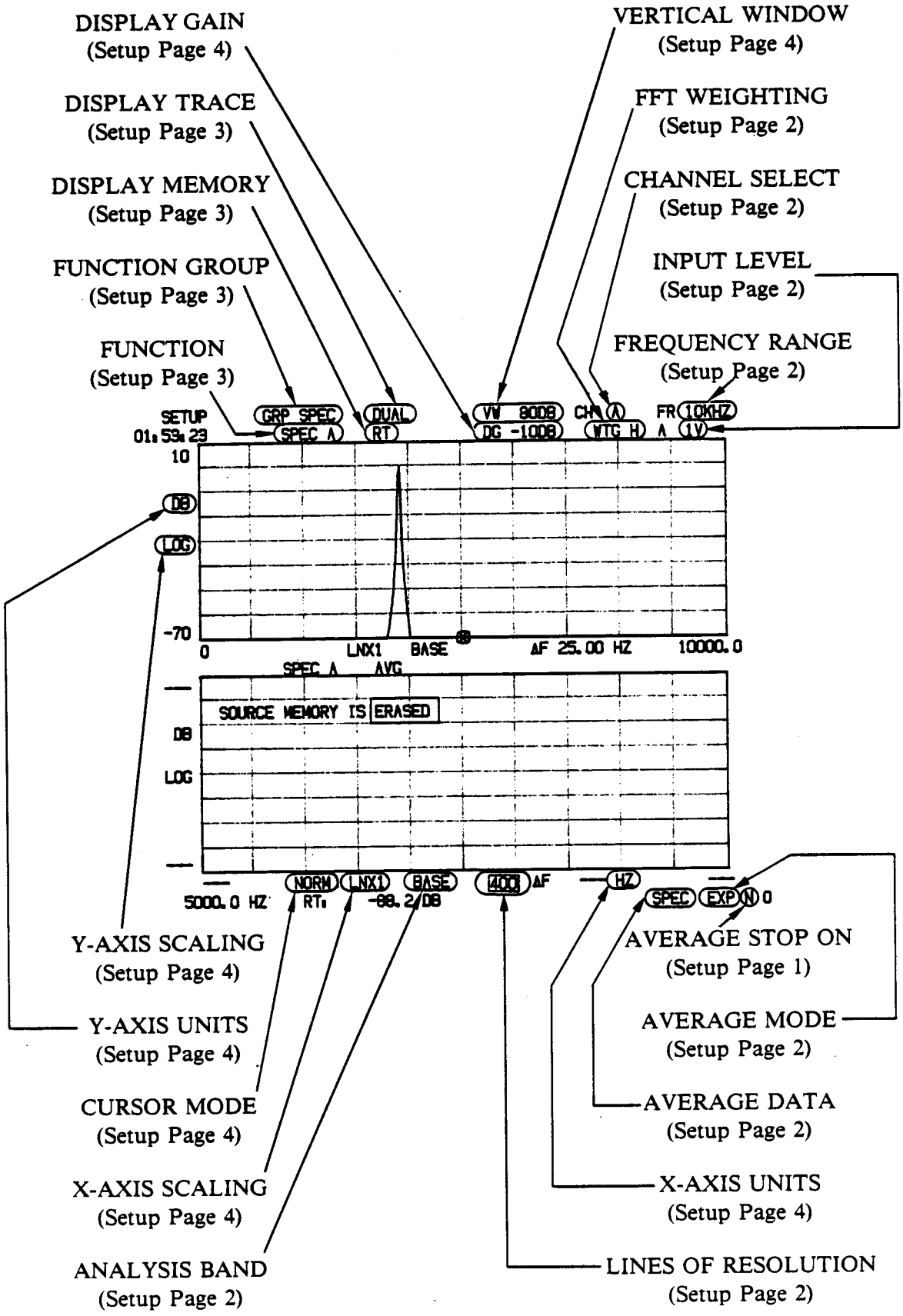

Figure 1-5. Display Settings Accessed by the Reverse Video Field in the Field Mode

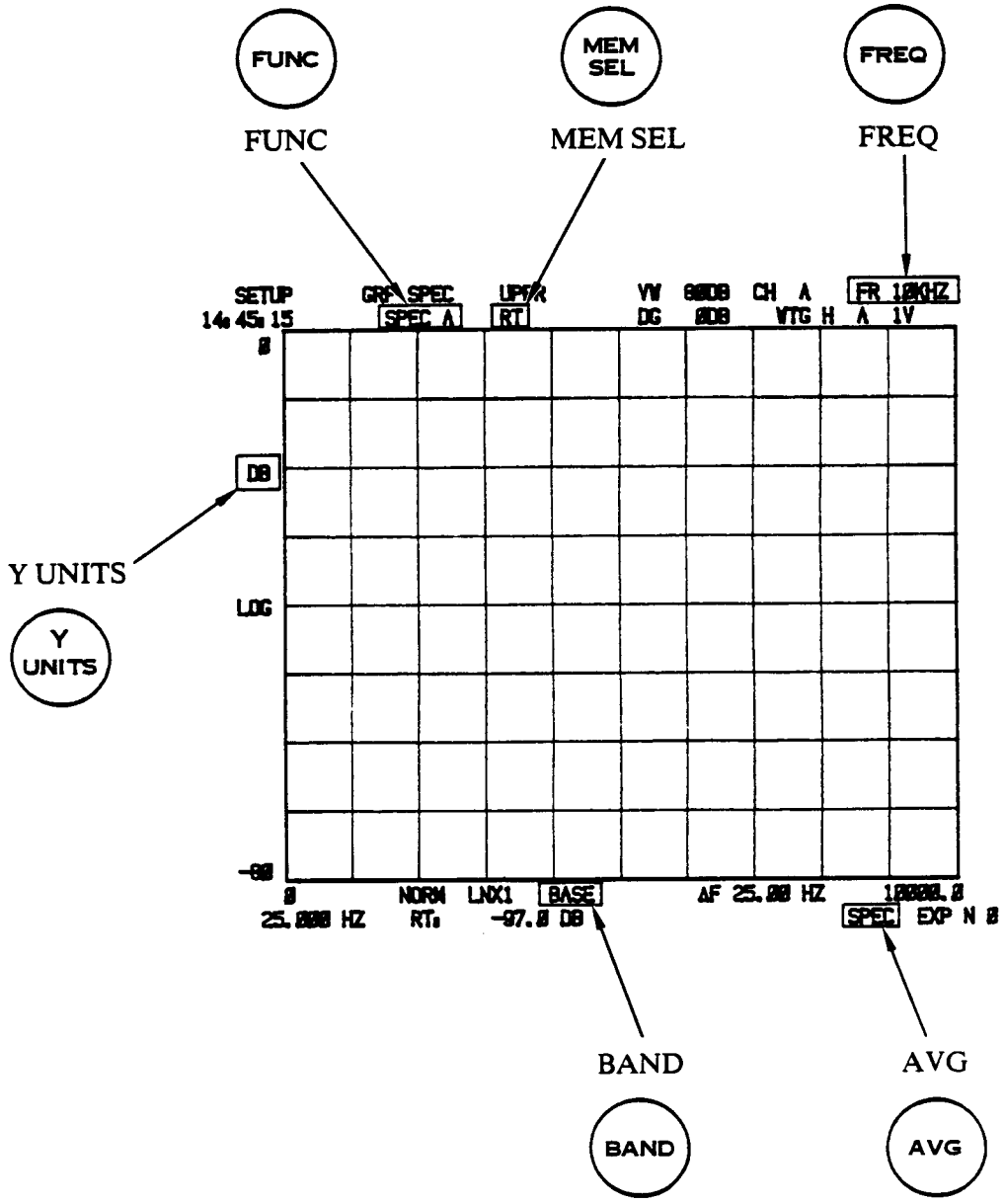

Figure 1-6. Control Fields Accessible by the FIELD LOCATOR Buttons

The instrument is provided with two features to aid in learning more about these controls, MENU and HELP. Press the SCROLL group MENU button and notice the grid lines on the right side of the display are replaced with a menu as shown in Figure 1-7. This menu lists the variations available for the field on which the Reverse Video Control Field is placed. The current selection is highlighted with reverse video and is controlled via the SCROLL group UP/DOWN buttons.

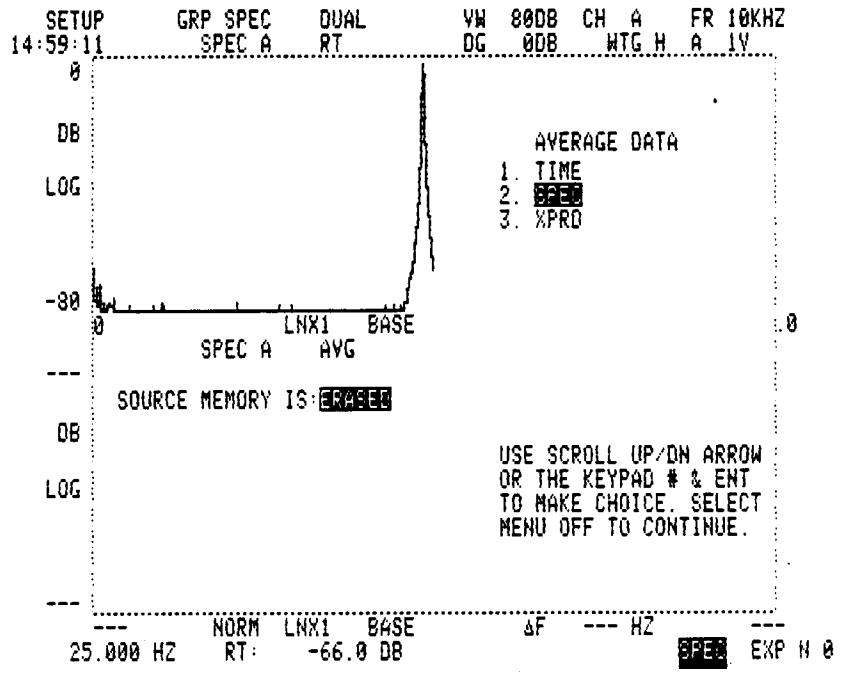

Figure 1-7. Menu Display

Using the CURSOR directional buttons and FIELD LOCATORS, place the Reverse Video Control Field on the various fields.

By selecting various menus and menu items via the CURSOR and SCROLL group directional buttons, the instrument can be set up for many types of signal data acquisition/process/display operations.

Press the HELP button and note the message displayed on the screen as shown in Figure 1-8. This feature provides general information on the various fields surrounding the display when in the Field Mode. Once again, move the Reverse Video Control Field using the CURSOR group directional and Field Locator buttons.

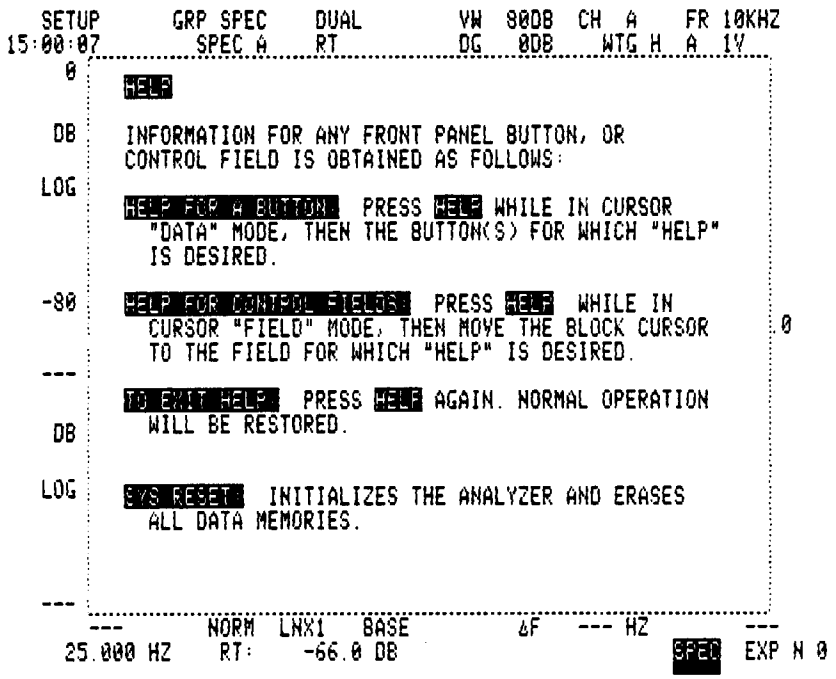

Figure 1-8. The HELP Message

Press the DATA button and review the HELP available for the various front-panel buttons.

When review of the HELP feature is finished, push the HELP and FIELD buttons. This turns off HELP and places the instrument back in the FIELD mode. Press PANEL, O and RCL on the ENTRY keypad.

When in the Field Mode, easy access is provided to the Setup Pages via the SETUP button. This button is located in the center of the SCROLL group. Press it and the PANEL RECALL CONTROL & SETUP PAGE SELECT listing (hereafter referred to as the Setup Page listing) will appear. Figure 1-9 is an example of this page.

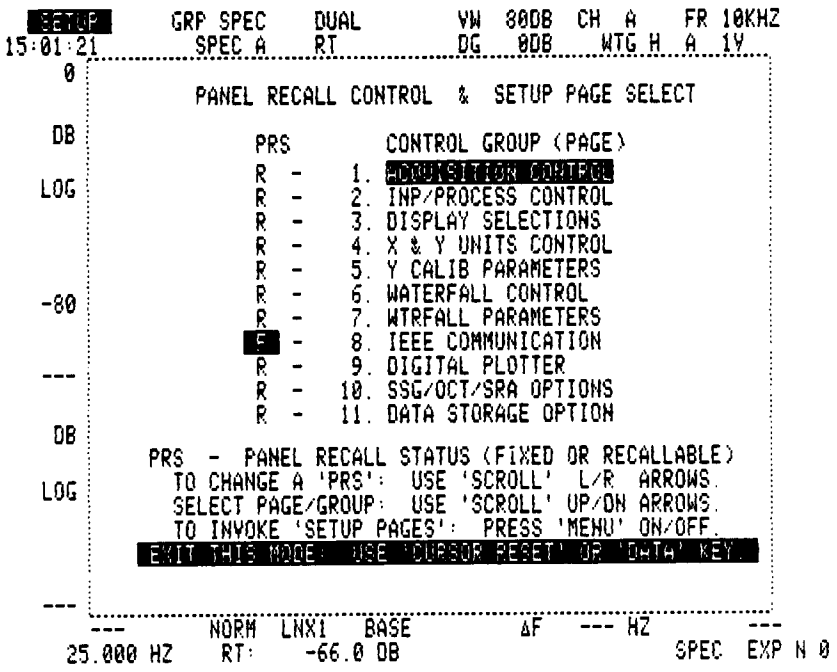

Figure 1-9. The SETUP PAGE Listing

The position of the reverse video (RV), on the Setup Page, is controlled any one of four ways: The SCROLL or CURSOR group UP/DOWN buttons, the SCROLL group SETUP button, or by the entry of the page number via the ENTRY keypad.

Press and hold the SCROLL DOWN button. The RV will "wrap-around" the listed pages. Position the RV on the ACQUISITION CONTROL Page listing. Press the MENU button and look at the display. Each of the titles listed on the right side of the display represents a control or parameter setting. The CURSOR direction buttons control which title, or field, is selected. Press the CURSOR DOWN button, the menu displayed on the right will change with the selected field. Position the RV on INPUT COUPLING/CAL. Menu item 1, (AC), is highlighted with reverse video. This indicates which menu item is selected. Placement of the RV is controlled by the SCROLL group directional buttons. Scroll through the menu items using the SCROLL DOWN button. When finished, select menu item 1, (AC).

Press the SETUP button; the INPUT/PROCESS CONTROL page is now displayed. The SETUP button is used to change setup pages when the Setup Page listing is not being displayed.

Many of the controls on these pages are the same as the controls accessible in the normal Field Mode. The Setup Mode is simply another way to get at those controls (as well as quite a few that are not available in a regular display). Use the CURSOR group buttons to position the RV on FREQUENCY RANGE and the SCROLL group buttons to select 40 KHz.

Position the RV on F.S. INPUT LEVEL. Using the SCROLL and CURSOR buttons, set the input levels for channels A, B, C and D to 2V, 2V, 5V and 10V respectively.

Press the SETUP button and the DISPLAY SELECTION PAGE will appear. Press the SCROLL DOWN button to select TIME.

Press the CURSOR RESET button to exit the Setup Mode. Observe the left-most field in the top line, the 40KHz setting made in the Setup Mode appears in that position. TIME & SPEC information will be displayed on the screen.

The primary method of operating the SD380 requires the analyzer be placed in the Field Mode. Use the CURSOR group buttons to *position* the Reverse Video Control Field when viewing either a data or a Setup Page display, and the SCROLL group buttons to *select* menu items for that control.

1.3.2 SIGNAL DATA ACQUISITION CHANNELS (single channel users can skip to TRIGGER MODE)

Observe the TIME & SPECT display. This is a single channel function. Note the input level for channel A is located at the far right of the annotation line above the upper trace.

Press the FREQ locator and CURSOR LEFT buttons to position the Reverse Video Control Field on the CH (channel select) field. Press the MENU button to display the 1 CHAN SELECT menu. Press the SCROLL DOWN button to select channel B, C then D. Watch the input level control; it reflects the input level of the selected channel. Press the MENU button again.

Return to channel A. Press the INPUT MEMORY HOLD button and observe the upper trace. Select channel B and press the INPUT MEMORY UPDATE button. Press the CURSOR RIGHT button to position the Reverse Video Control field on the FR 40KHz field. Select 20KHz with the SCROLL DOWN button. Observe the data and press HOLD again. Position the Reverse Video Control Field on the CH (channel) field. Watch the X-axis numbers, return to channel A and press HOLD. Any change made to one channel does not affect other (non-displayed) channels if HOLD is pressed before changing channels.

Trigger Mode

The following will discuss how to select various trigger modes. Changing the trigger mode requires accessing Setup Page 1, ACQUISITION PAGE. This can be accomplished by pressing the SETUP and MENU buttons, in that order, to display the Setup Page listing. Press 1 and ENT on the ENTRY keypad. The RV will be placed on the ACQUISITION CONTROL listing. Press MENU again, and Setup Page 1 will appear on the screen. Position the RV on the TRIGGER MODE field using the CURSOR buttons. Select menu item 2, INT SNGL TRIG (internal single trigger), with the SCROLL buttons. Position the RV on TRIG THRESHOLD and press 2, 0 and ENT on the ENTRY keypad. This selects a 20% threshold trigger level. Any input signal that exceeds 20% of the full-scale display, produces a trigger that initiates data acquisition. The full-scale display is twice the F.S. INPUT LEVEL selected on Setup Page 2. This is because the input level can be expressed as rms when the signal is peak. Since 1 Vrms equals 1.414 Vpk, the display is rounded up to 2 V to avoid clipping. Press the CURSOR RESET button to view the data display screen. Set the output level on the oscillator to minimum and press UPDATE. Slowly bring the output level back up and observe the UPDATE LED. When the LED goes out, signal acquisition occurs and the trace will be updated. The output level of the oscillator is the signal acquisition level. This reading should be approximately 0.8V or 20% of the full scale (2V) times 2.

Another method of changing trigger threshold levels is using the TH% button located in the ENTRY group. Press TH%, 5, 0 and ENT. A 50% threshold is now selected. Press UPDATE and slowly increase the oscillator output level. The trace should update at approximately 1V.

Press the CURSOR RESET button to display Setup Page 1. Select INTERNAL REPEAT TRIGGER (TRIGGER MODE menu item 3) and press the RESET and UPDATE buttons. The UPDATE LED will flash, indicating the trigger is rearmed after each display. A low frequency signal (approximately 200Hz) will demonstrate the phase consistency of this triggering technique.

Decrease the output level to minimum and observe the triggering stops. Press TH%, 1, 0 and ENT. Set the output level of the oscillator to 1V.

1.3.3 Signal Data Processing

Once the data has been acquired (brought into the Input Memory in accordance with the selected trigger mode, etc.) the operator may want to process it further for more informative measurements.

The single channel Function Groups (SPECTRUM, TIME and STATISTICS) contain all the Real Time processing capability of the instrument. (The groups which become available with the 2 & 4 channel options also require Average or Storage memory for their displays).

Press PANEL, 0 and RCL on the ENTRY keypad. Press the UPDATE and FREQ locator buttons. Select the 4 KHz frequency range and adjust the oscillator for an output of approximately 2 KHz. Vary the output frequency and amplitude while observing the upper trace.

Press the FUNC locator, CURSOR UP, and SCROLL DOWN buttons to select the Function Group TIME. Again, change the output frequency and level while noting the differences between this and the previous display.

Press the SCROLL DOWN button to select GRP STAT (Statistics). Again, observe the differences while changing the oscillator frequency and amplitude. Return to the GRP SPEC display.

The preceding has been a basic demonstration of what can be processed in Real Time: amplitude vs. frequency (SPECTRUM), amplitude vs. time (TIME) and sample occurrences vs. amplitude (PDH).

Press the BAND locator and SCROLL DOWN buttons to select the ZOOM feature. Observe the upper trace calibration change. Press the SCROLL group ZOOM button. This enables the selected ZOOM factor to be changed via the SCROLL UP/DOWN buttons. Press the SCROLL UP button twice to select a ZOOM factor of 8. This is indicated by the annotation ZM8 located slightly left of center on the line under the upper trace as shown in Figure 1-10. Press ZOOM again, the LED will go out indicating the ZOOM factor selection has been disabled.

Special circuitry in the instrument samples data around a specified "center frequency." Set the oscillator to 300 Hz. The signal is not seen on the display since it is outside the window defined (3500.0 - 4000.0 Hz).

Located in the ENTRY group is a button labeled CF. This important control is *always* enabled, regardless of the CURSOR mode. Press CF, 3, 0, 0 and ENT (thereby entering 300 Hz for the center freq.). The 300 Hz oscillator signal should now appear at the center of the display. Note the changes in the X-axis calibration.

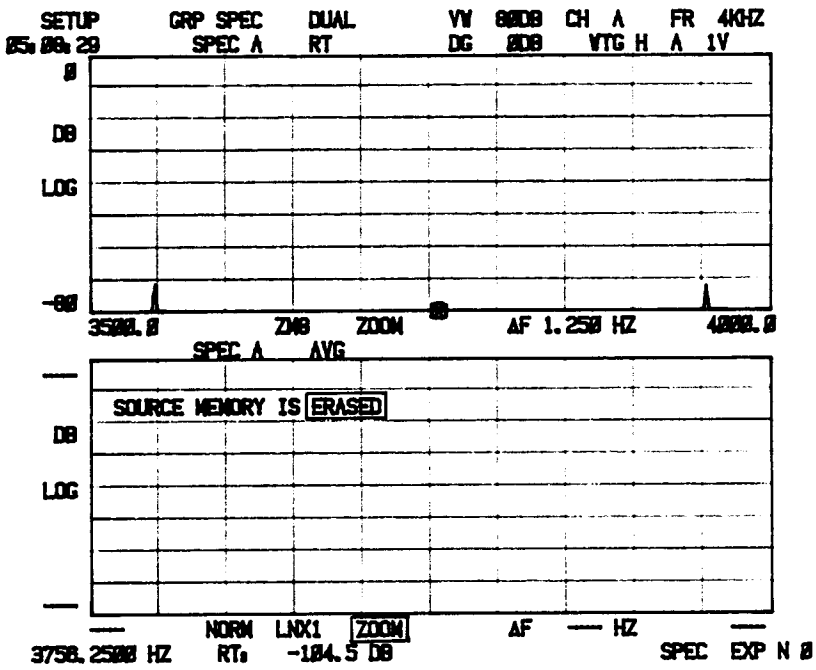

Figure 1-10. The ZOOM Display

Adjust the oscillator for an output of approximately 400 Hz. Position the cursor on the peak of the signal using the rotary cursor wheel. Now press CF again and note that the number in the keypad display field, located in the upper right corner of the display, matches the cursor frequency readout. Press ENT and this number will automatically be used for the ZOOM CF. The signal should once again end up in the center of the display.

Move the oscillator signal back down to 300 Hz. Press CF again and move the cursor toward the signal using the rotary cursor wheel. Note that the CF changes as the cursor is moved; each new frequency reading is automatically entered as the CF. When the signal is positioned in the center of the display, press ENT to exit this operation.

Press the FUNC locator and SCROLL DOWN buttons to select the ZOOM & SPEC function. Note that the lower trace is now a BASE band display, the upper trace ZOOM.

The ZOOM factor may also be changed via the Setup Pages. Display Setup Page 2 and position the RV on the ZOOM MULTIPLIER field. Notice the menu items range from 2 to 256 in power-of-2 steps. Using the SCROLL buttons select 16 and press the CURSOR RESET button.

The ZOOM feature is also available when in the Data Mode. Press the DATA and SCROLL DOWN buttons to position the cursor in the lower trace (this can be accomplished in the Data Mode only). Press the CURSOR UP and FIELD buttons.

Data Averaging & Storing

Averaging of the signal data often reveals much valuable information. Basically, averaging is loading data into the Average Memory. This is initiated by pressing the AVERAGE START button.

Adjust the oscillator for 200 Hz at 1V, and press PANEL, 0 and RCL. Position the Reverse Video Control Field on the GRP SPEC annotation and select GRP TIME via the SCROLL DOWN button. The analyzer is now in the TIME & SPEC function. Both Time and Spectrum data are presented on the display screen as shown in Figure 1-11. Pressing the AVERAGE START button will result in Spectrum data being averaged. The AVERAGE DATA menu, located on Setup Page 2, determines the type of data to be averaged (Time, Spectrum or Cross-Product.)

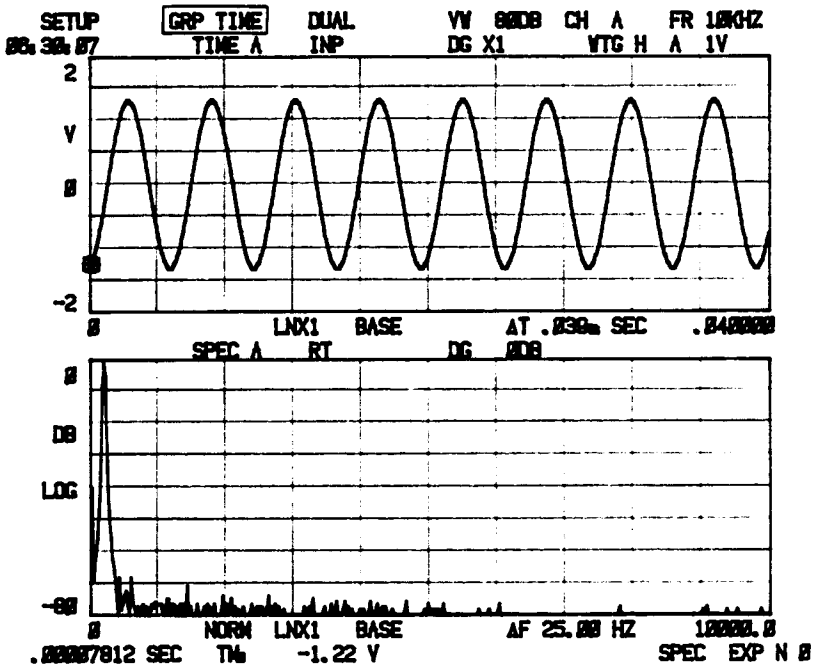

Figure 1-11. The TIME & SPEC Display

Press the AVG locator and SCROLL UP buttons to select TIME data averaging. Notice the function annotation title TIME A has the word SYNC added to it. This indicates time-averaged data are being used for the display. Figure 1-12 is an example of a SYNC TIME display.

Real-time data are being displayed on both traces. The upper trace data are shifting with each update. This is because each data acquisition occurs at different points of the input signal.

Press the MEM SEL locator and SCROLL DOWN buttons to display the contents of the Average Memory.

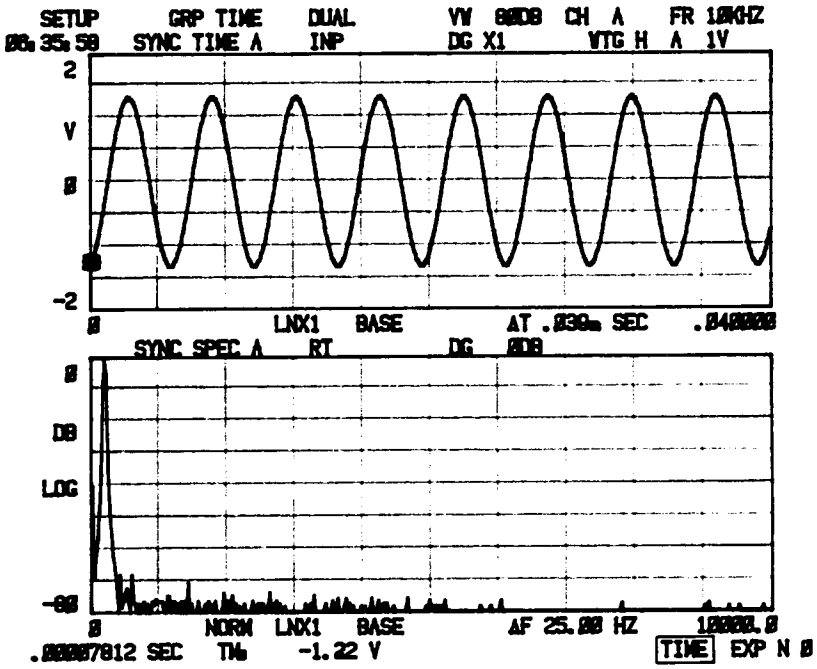

Figure 1-12. The SYNC TIME Display

Press AVERAGE START and observe both traces. The variations in amplitude are caused by non-synchronous data acquisitions. Press SCROLL UP to return to the Input Memory. Display Setup Page 1 and select TRIGGER MODE menu item 3, INT REP TRIG. Press the CURSOR RESET and position the Reverse Video Control Field on GRP TIME. SCROLL UP to select the Spectrum group. Press the AVERAGE STOP, AVG locator and SCROLL DOWN buttons to select spectrum-data averaging. Press AVERAGE START and note the message displayed on the right side of the screen as shown in Figure 1-13. If new data to be entered into the Average Memory are not compatible with data already acquired, this message will appear. The conflict will be highlighted with revese video.

Press AVERAGE STORE to store the time-averaged data, then press AVERAGE ERASE. The suppression message will disappear from the screen. Press AVERAGE START.

Press the FUNC locator, CURSOR UP and SCROLL DOWN buttons to select the TIME function. The time waveform is now steady. This is why SYNC is used to describe the use of time-averaged data. Note that the average continues but that the time trace is the INP (Input) Memory. It is not possible to display time data from an Average Memory containing spectrum data, the only available time data is the current input. The spectrum display is still averaged data, however.

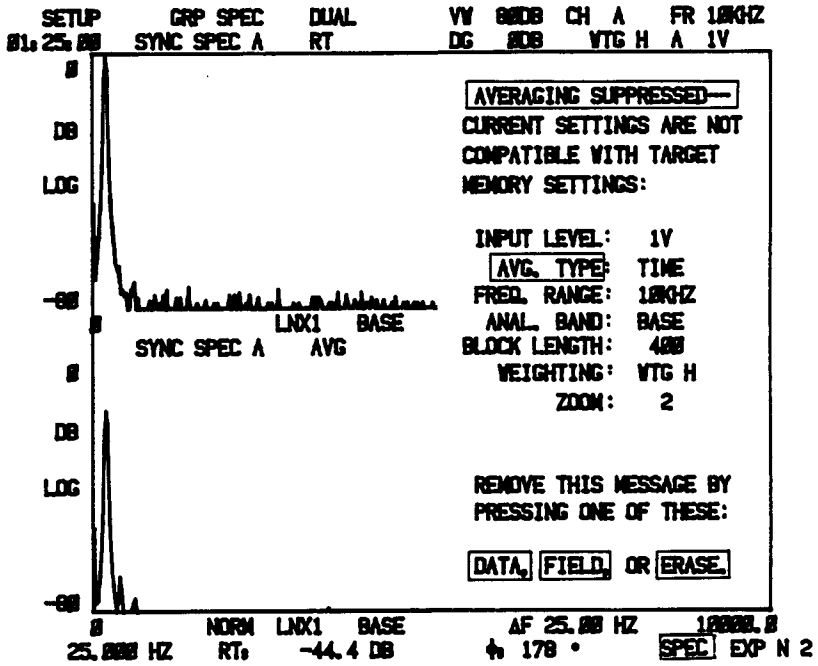

Figure 1-13. Average Error Message

Press SCROLL DOWN to select the STAT (Statistics) function group. The Statistics group requires either a time average or an average of AMPLITUDE DOMAIN (PDH). This function is not compatible with the current contents of the Average Memory. Note the message in the lower trace: SOURCE MEMORY IS: MAG^2. The instrument cannot display Probability Domain Histogram (PDH) data from an FFT source. Press the FIELD button to remove the suppression message.

Press the MEM SEL locator and SCROLL DOWN buttons to select the RT & STO display. The lower trace is a PDH performed on the time-averaged data stored previously. Since time-averaged data are being used, the function title is SYNC PDH. Figure 1-14 is an example of a SYNC PDH display.

Return to the RT & AVG display by pressing the SCROLL UP button. Press the AVERAGE ERASE and START buttons, wait a few seconds, and press AVERAGE STOP. Press the CURSOR LEFT and UP buttons to position the Reverse Video Control Field on GRP STAT. Press the SCROLL UP button twice to select the Spectrum function. Note the message displayed in the lower trace: SOURCE MEMORY IS: PROBAB DENS.

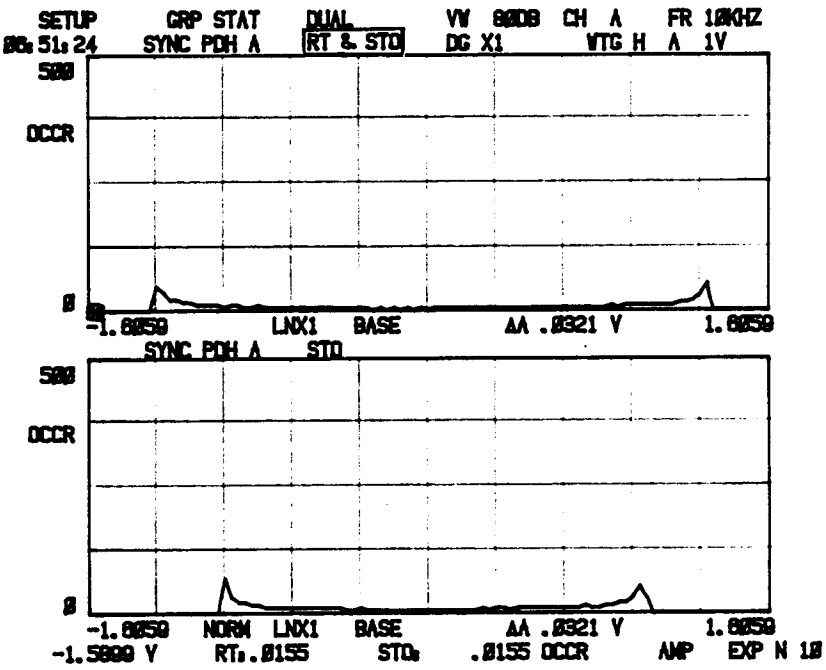

Figure 1-14. The SYNC PDH Display

Multiple Channel Averaging (single channel users can skip to SUM, EXPO and PEAK)

Select channel B by positioning the Reverse Video Control Field on the CH A (channel select) annotation, located in the upper-right corner of the screen, and pressing the SCROLL DOWN button. Press AVERAGE START, wait a few seconds and press STOP. Press the FUNC locator once, and the SCROLL DOWN button twice, to select 2 CH SPECT. Press the MEM SEL locator and SCROLL DOWN buttons to display the Average Memory contents. Note that the Channel A averaged trace is not displayed. This is because the Average Memory for channel A still contains the PDH data. Press AVERAGE ERASE and START, wait about ten seconds, and press STOP. Because this is a two-channel function, both channels of Average Memory have been updated. Press the FUNC locator button once, and the *SCROLL UP* button twice to return to the single channel Spectrum function.

Channel B data are being displayed on the screen. Even though this data was acquired in a two-channel mode, there is no conflict and the unit displays the channel B averaged data. Press AVERAGE ERASE and return to the 2 CH Spectrum display using the SCROLL DOWN button. Note that only channel B is erased. The erase was performed while in a single channel function, with channel B selected. Therefore, only Channel B was erased.

Press AVERAGE ERASE again, and channel A source memory will be erased. Press AVERAGE START, wait ten seconds and press STOP. Position the Reverse Video Control Field on GRP SPEC and, using the SCROLL DOWN button, select the Statistics function group (GRP STAT). The message displayed in the lower trace identifies the memory contents as being MAG^2 data. Transfer Function and Power functions require complex cross-products averaged data. Return to the 2 CH SPECT display by pressing the SCROLL UP button twice to select GRP SPEC. Press the AVERAGE ERASE and AVG locator buttons. Press SCROLL DOWN to select cross-products average (XPRD).

Press AVERAGE START, notice there is no difference in the spectrum display (regular spectrum average is a part of the data averaged for XPRD). However, the averaged data will be suitable for the |TF| & Φ (Transfer Function & Phase) display. Press AVERAGE STOP and position the Reverse Video Control Field on GRP SPEC. Press the SCROLL DOWN button three times to select GRP TF.

It is also possible to cross-product average (XPRD AVG) in the background of a multi-channel time display. This approach (setting the averaged data desired via a separate control) allows the user to view data of interest while performing the needed average. Example: impact triggering to Input Memory for review of the time data while performing a cross-products average for later TF, etc., frequency domain review.

Display the ACQUISITION PAGE and select the FREE RUN trigger mode. Press the CURSOR RESET and BAND locator buttons. Select ZOOM by pressing the SCROLL DOWN button. Press AVERAGE ERASE and START to perform a XPRD of ZOOM data. Press AVERAGE ERASE.

Sum, Expo, Peak

Not only can the operator select which data is averaged, but also how to average it. Press Panel, 0 and RCL to return to the single channel spectrum display. Press the UPDATE, FREQ locator and SCROLL DOWN buttons to select a frequency range of 400 Hz. Press the AVG locator and CURSOR RIGHT buttons to position the Reverse Video Control Field on EXP. Press MENU to display the AVERAGE MODE menu. The following procedures will illustrate these different types of averaging.

Press the MENU button to turn off the menu and press AVERAGE START. Vary the oscillator frequency from 100 to 300 Hz and observe the lower trace. The "old" data will slowly begin to "decay." Press AVERAGE ERASE and the ENTRY group AVG #, 2 and ENT buttons. The number of averages performed is now two instead of ten. Press AVERAGE START and vary the oscillator frequency again. The old data are decaying much faster.

Press AVERAGE ERASE and select SUM averaging by pressing SCROLL UP. Press START, and note that the average stops almost immediately. This is because the average count is 2. Press AVG #, 2, 0 and ENT. Press AVERAGE START again and watch the number at the lower right corner of the screen. When it reaches 20, the average automatically stops again.

Enter an AVG # of 22. Select + 1 AVG by pressing SCROLL UP. This is another version of SUM averaging that adds one "ensemble" of data to the Average Memory for each push of the START button. Push START and note that the count increments once to 21 and then the average stops. Push START and note the count is 22. Push START again, and observe the suppression message: TARGET COUNT REACHED as shown in Figure 1-15.

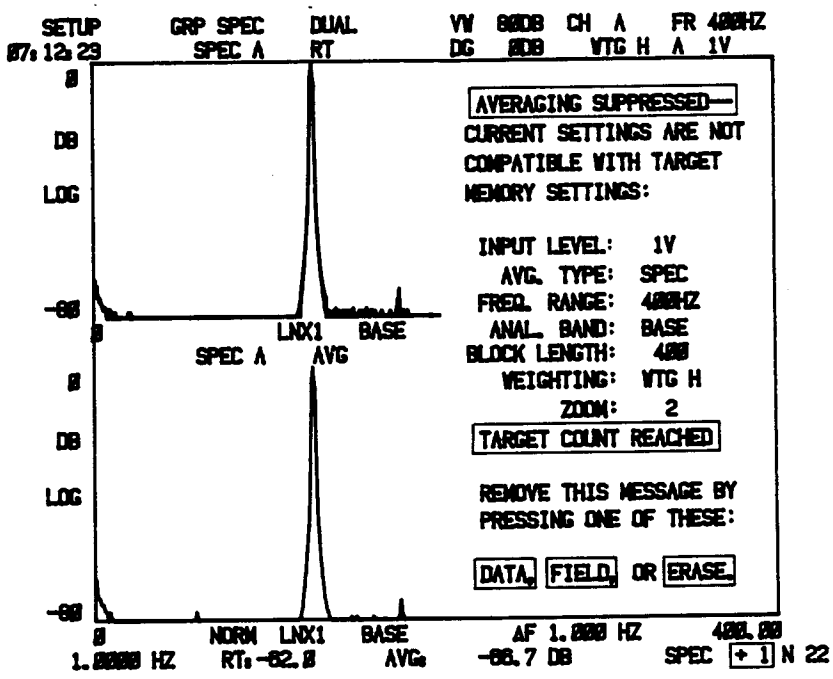

Figure 1-15. Target Count Suppression Message

Press AVERAGE ERASE and select PK (peak) averaging by pressing SCROLL UP. Press START and vary the oscillator frequency. Peak average stores the highest encountered value of each frequency cell in the Average Memory. This is very useful for sine-sweep applications.