HEWLETT PACKARD

OPERATION MANUAL

HP 70700A
DIGITIZER

SERIAL NUMBERS

This manual applies directly to HP 70700A Digitizers with serial numbers prefixed 2709A and below.

FIRMWARE VERSIONS

This manual applies directly to HP 70700A Digitizers with firmware versions of 870501 and earlier.

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Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SAFETY SYMBOLS

The following safety symbols are used throughout this manual and in the instrument. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

Instruction manual symbol. The instrument will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the instrument against damage. Location of pertinent information within the manual is indicated by use of this symbol in the table of contents.

Indicates dangerous voltages are present. Be extremely careful.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

GENERAL SAFETY CONSIDERATIONS

WARNING

BEFORE THIS INSTRUMENT IS SWITCHED ON, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

WARNING

There are voltages at many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.

CAUTION

BEFORE THIS INSTRUMENT IS SWITCHED ON, make sure its primary power circuitry has been adapted to the voltage of the ac power source. Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS, Continued

HP 70000 MODULAR MEASUREMENT SYSTEM DOCUMENTATION OUTLINE

Instruments and modules of the HP 70000 Modular Measurement System are documented to varying levels of detail. Modules that serve as masters of an instrument require operation information in addition to installation and verification instructions. Modules that function as slaves in a system require only a subset of installation and verification information. Service documentation is available for every module of the HP 70000 Modular Measurement System family.

USER MANUALS, SUPPLIED WITH MODULE

Installation and Verification Manual

Topics covered by this manual include installation, specifications, verification of module operation, and some troubleshooting techniques. Manuals for modules that serve as instrument masters will supply information in all these areas; manuals for slave modules will contain only information needed for slave module installation and verification. Master module documentation may also include some system-level information.

Operation Manual

Information in this manual usually pertains to multiple- and single-module instrument systems. The Operation Manual describes manual operation of the module, with explanations of softkeys and their use.

Programming Manual

Information in this manual usually pertains to multiple- and single-module instrument systems. The Programming Manual defines commands that enable remote operation of the module, and describes remote command syntax.

SERVICE MANUAL, AVAILABLE SEPARATELY

Technical Reference

This manual provides service information for a module, including performance verification, adjustments, troubleshooting, replaceable parts lists, replacement procedures, schematics, and component location diagrams. For ordering information, contact an HP Sales and Service Office.

Chapter 1
GENERAL INFORMATION

HOW TO USE THIS MANUAL

The HP 70700A Digitizer Operation Manual provides the necessary information required to operate a digitizer system manually. It is not necessary to read this manual from cover to cover. However, it may be useful to note what is in each chapter:

Chapter 1, General Information, provides descriptions of the digitizer system, the HP 70700A Digitizer module, and front- and rear-panel features of an HP 70700A Digitizer module.

NOTE

Before any manual operations are performed with your digitizer system, it must first be installed and configured properly. Refer to the HP 70700A Digitizer Installation and Verification Manual for detailed instructions on correct installation and configuration information.

Chapter 2, Functions, prepares the digitizer system for initial operation and describes general concepts that pertain to the functional softkeys. This chapter also provides a complete and detailed description of all the digitizer functions that are available. Figure 2-2, HP 70700A Digitizer Softkeys, outlines the menu structure and indicates the functional softkey locations.

DIGITIZER SYSTEM OVERVIEW

A single-channel digitizer system consists of an HP 70700A Digitizer master module, an HP 70205A or 70206A Display, and an HP 70001A Mainframe. Additional digitizer modules may be slaved to the master module to provide a multiple-channel digitizer system. See Figure 1-1.

The digitizer system measures repetitive or transient waveforms with improved accuracy, resolution, and dynamic range over other measurement techniques. With the use of the internal analog-to-digital converter (ADC) combined with digital memory, a computer can be used to analyze the data, providing better results and allowing automation. Simultaneous digitization and memory access are available (i.e., as data is being measured, the results may be accessed immediately with the use of a controller). Multi-channel operation may be achieved by slaving multiple digitizer modules together, with the slave digitizer module synchronized to the master digitizer module with the "clock out" and "sync out" signals.

Data is always digitized at a 20 MHz rate and then a digital detection algorithm is applied to "reduce" the data before it is stored. The four detection modes that are available for selection are sample, peak, pit, and alternate.

Interpolation may be used to provide a better visual display of high-frequency waveforms.

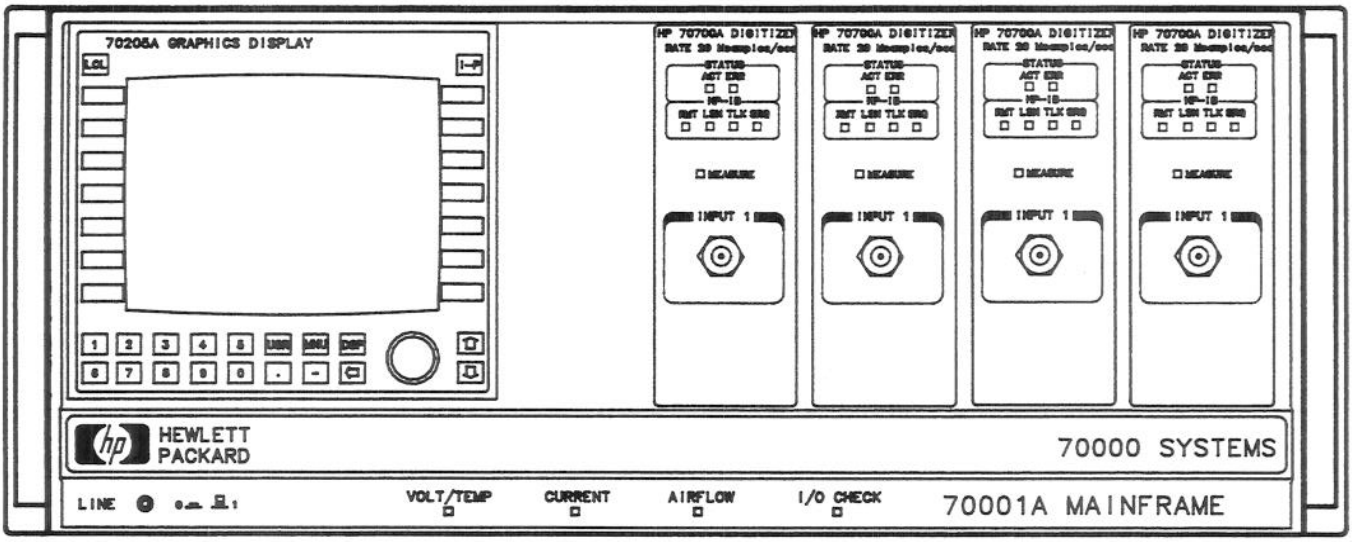

Figure 1-1. Multiple-Channel Digitizer System

The digitizer system has triggering capabilities which are especially necessary when measuring single-shot transient waveforms. These triggering capabilities are the functions of EITHER EDGE, ABOVE LEVEL, BELOW LEVEL, or OUTSIDE RANGE. Additionally, hysteresis may be used to adapt the triggering to match the input signal.

The Random Event Capture mode retains up to 1000 trigger events of a measurement with a guaranteed amount of pre- and post-trigger data for each event. There is no dead time between events, the time of the event is always stored, and the event time may be queried from a controller without outputting the event data. The memory is dual ported so that captured events may be examined while the measurement is still proceeding.

The Equivalent Time Sampling mode provides a technique for looking at stable, periodic, repetitive signals by using multiple trigger events to form a composite waveform. It will allow rise-time measurements of less than 10 ns.

HP 70700A DIGITIZER MODULE OVERVIEW

The HP 70700A Digitizer is a 1/8-module with a 20 MHz sampling rate designed to work in an HP 70000 Series mainframe. It has both HP-IB (Hewlett-Packard Interface Bus) and HP-MSIB (Hewlett-Packard Modular System Interface Bus) communication capabilities. The HP 70700A Digitizer can function in the following configurations:

- Single-channel digitizer system (consisting of one module)
- Multiple-channel digitizer system (with one HP 70700A Digitizer functioning as a master to other HP 70700A Digitizer modules)
- Slave to an HP 70900A Local Oscillator when configured in an HP 70000 Series Modular Spectrum Analyzer System

- Single-channel digitizer instrument configured with an HP 70000 Series Modular Spectrum Analyzer System (When the HP 70700A Digitizer is used in this configuration, it is *not* a slave of the spectrum analyzer but is used to view the spectrum analyzer video output.)

The last configuration described above is essentially the same as a single-channel digitizer system. The disadvantage of this configuration is that the spectrum analyzer and digitizer operate independently, so sweep-time coupling and amplitude calibration are lost. However, the advantage of this configuration is that it allows all the digitizer features, such as the Measure ALL function and the Random Event Capture mode, to operate on the video output of the spectrum analyzer. Refer to the HP 70700A Digitizer Installation and Verification Manual for diagrams of correct digitizer system configurations.

HP 70700A DIGITIZER FRONT-PANEL FEATURES

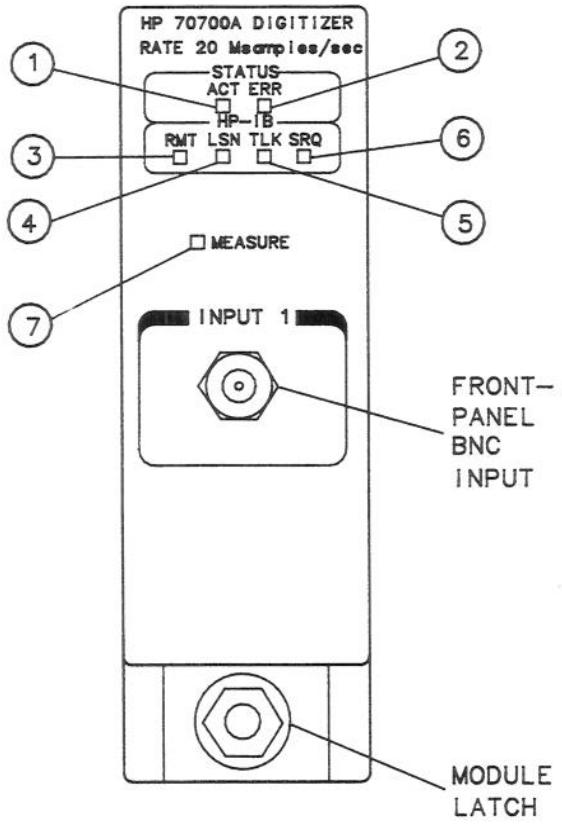

Figure 1-2. HP 70700A Digitizer Front Panel

LED Indicators

1. STATUS ACT indicates that the HP 70700A Digitizer is active. The ACTIVE LED lights when:

   a. the keyboard of the display is allocated to the digitizer.

   b. any Display function indicates the digitizer (e.g., when the cursor of the Display Address Map is at the HP-MSIB address of the digitizer).

c. a digitizer is a slave to another digitizer that is designated as a master module, and it is being used by that master digitizer.

2. STATUS ERR indicates errors. (Refer to Chapter 5, Troubleshooting, in the HP 70700A Digitizer Installation and Verification Manual.)

3. HP-IB RMT indicates that the module is being remotely controlled and local control is disabled.

4. HP-IB LSN indicates a state in which the module is ready to accept information from the controller.

5. HP-IB TLK indicates a state in which the module is ready to send information to the controller.

6. HP-IB SRQ indicates a condition requested or set by the user (e.g., errors, operation complete status, power-on condition). Refer to Chapter 2 in the HP 70700A Digitizer Programming Manual, Programming Fundamentals, for more information on the Service Request LED and the Standard Status Data Structure.

7. MEASURE indicates that the module is making a measurement.

Inputs

INPUT 1 (type BNC connector) can be utilized only when the HP 70700A Digitizer is used in a digitizer system. Refer to Table 1-1 for more information about input selection and input impedance.

Table 1-1. HP 70700A Digitizer Input Selection and Input Impedance

HP 70700A Digitizer used in a digitizer system, or as a digitizer instrument in a non-digitizer system:	
Preset Input	INPUT 1
Softkey-Selected Input	INPUT 2
Preset Input Impedance	DC Coupled 1 MΩ
Softkey-Selected Input Impedance	AC Coupled 1Ω, or DC Coupled 50Ω
HP 70700A Digitizer used as a slave to a non-digitizer master:	
Preset Input	INPUT 2
Softkey-Selected Input	none
Preset Input Impedance	DC Coupled 1 MΩ
Softkey-Selected Input Impedance	none

Module Latch

The module hex-nut latch is used for installing the module in an HP 70000 Series mainframe. An 8 mm hex-ball driver is required to turn the hex-nut latch.

HP 70700A DIGITIZER REAR-PANEL FEATURES

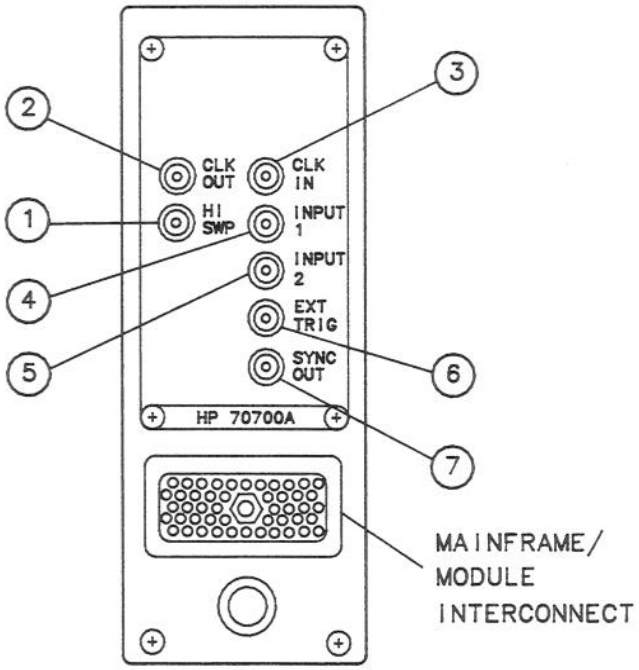

Figure 1-3. HP 70700A Digitizer Rear Panel

Rear-Panel SMB Connectors

1. HI SWP (High Sweep) is an input/output that is connected to HSWP of the HP 70900A Local Oscillator when an HP 70700A Digitizer is used as a slave to an HP 70900A Local Oscillator in a spectrum analyzer system. This connection is necessary to synchronize the digitizer and local oscillator and their starting and stopping of measurements.

2. CLK OUT (Clock Out) provides a TTL-level 20 MHz clock output. In a single-channel digitizer system, the CLK OUT is connected to the CLK IN on the same module. In a multiple-channel digitizer system, the CLK OUT of the master HP 70700A Digitizer module must be connected to both its own CLK IN and the CLK IN of all of its slaves. (Refer to the HP 70700A Digitizer Installation and Verification Manual, Chapter 2, for detailed instructions on correct installation and configuration information.)

3. CLK IN (Clock In) requires a 50% duty cycle, TTL-level clock input with a 10 MHz to 20 MHz frequency. (See CLK OUT, above.)

4. INPUT 1 can be utilized only when the HP 70700A Digitizer is used in a digitizer system. The front-panel INPUT 1 and rear-panel INPUT 1 are connected together and are electrically the same. Refer to Table 1-1 for more information about input selection and input impedance.

5. INPUT 2 can be utilized when the HP 70700A Digitizer is used in any type of configuration. When the HP 70700A Digitizer is used in a digitizer system, INPUT 2 is preset "open" (i.e., no connection). Refer to Table 1-1 for more information about input selection and input impedance.

6. EXT TRIG (External Trigger) allows an external input signal to be used to trigger the digitizer module externally. The input signal must be TTL with a pulse width of at least one clock period, typically 50 ns. (See SYNC OUT, below.)

7. SYNC OUT (Synchronizing Output) provides a TTL-level signal used to synchronize the HP 70700A Digitizer slave modules of a multiple-channel digitizer system. In a multiple-channel digitizer system, the SYNC OUT of the master HP 70700A Digitizer must be connected to the EXT TRIG inputs of the HP 70700A Digitizer slave modules. (Refer to the HP 70700A Digitizer Installation and Verification Manual, Chapter 2, for detailed instructions on correct installation and configuration information.)

MAINFRAME/MODULE INTERCONNECT

The mainframe provides the power supply, HP-MSIB connections, and HP-IB connections for the HP 70700A Digitizer module through this mainframe/module interconnect.

Chapter 2
DIGITIZER FUNCTIONS

This chapter describes the functions of the HP 70700A Digitizer that perform all digitizer operations. These functions are accessed through softkeys via the display module.

The organization of this chapter first prepares the user for operation of the digitizer system. Then the Softkey Overview presents general concepts that apply to the softkey menu structure and also briefly describes the display screen status and annotation. Finally, for convenience, the softkeys are divided into five groups according to their function: Measurement Control Functions, Display Functions, Marker Functions, Measure Functions, and Utility Functions.

For each functional group, the Overview provides a listing of each softkey in that group with a brief one-line functional description. After the Overview section, more detailed functional information follows for each softkey. A brief summary of each section in this chapter is listed below.

Preparation For Digitizer Operation describes how to prepare the digitizer system for initial operation.

Softkey Overview describes general concepts that pertain to the softkeys and their functions.

Measurement Control Functions set up the parameters of a measurement. This group includes the functions of the Channel 1, Timebase, Trigger, and Single or Continuous Sweep softkeys.

Display Functions format the display screen graticule, and determine trace length and number of averaged traces.

Marker Functions enable time and voltage marker measurements.

Measure Functions enable automatic measurement of waveform parameters (e.g., duty cycle, frequency, period, etc.). The source of a signal may also be determined. AUTO SCALE and trace manipulation functions (WAVEFORM SAVE and WAVEFORM MATH) are also included in this group.

Utility Functions enable calibration and self-testing of the digitizer. The SAVE and RECALL STATEs are also covered in this group.

Multiple Digitizer Functions describes how the softkey functions interact when more than one digitizer module is configured in a system.

PREPARATION FOR DIGITIZER OPERATION

The display front-panel keys are necessary to access the functions of the digitizer system.

- The **[DISPLAY]** key accesses the entire Display Main Menu, which enables all the display functions.
- The **[MENU]** key accesses the functions of the selected master module, which access other softkeys at a second-level menu, depending on their function.
- The **[USER]** key is not used in a standard digitizer system at this time.

The digitizer system must be properly installed and configured prior to performing any manual operations. Refer to the HP 70700A Digitizer Installation and Verification Manual for correct installation and configuration instructions for a digitizer system. Use the following procedure to prepare the digitizer for operation.

1. Press the **[DISPLAY]** key on the display front panel to access the Display Main Menu.
2. Press the *SELECT INSTR* softkey until the HP 70700A Digitizer is selected as the master module.
3. Press the **[MENU]** key to display the Main Menu of the digitizer, which consists of 13 softkeys.

NOTE

The INSTRUMENT PRESET [IP] key on the display front panel may be used at any time to return the instrument to a power-on state where all operating parameters are reset.

To return to the Main Menu from the second-level menu structure, press the [MENU] or [←] key on the display front panel.

SOFTKEY OVERVIEW

The HP 70700A Digitizer softkey Main Menu is shown in Figure 2-1. All softkeys on the Main Menu, except for *SINGLE SWEEP*, *CONT SWEEP*, and *AUTO SCALE*, are designated by lower-case letters. Lower-case letters indicate that a sub-level softkey menu exists for that particular softkey. Upper-case letters indicate that there are no further sub-level softkey menus for that particular softkey.

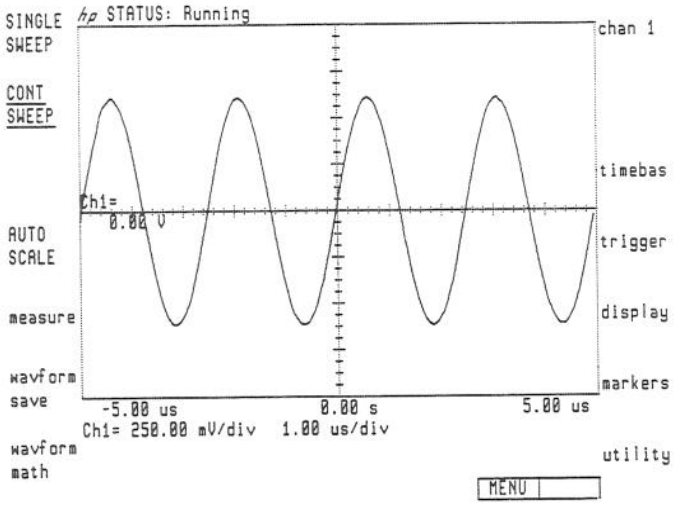

Figure 2-1. HP 70700A Digitizer Softkey Main Menu

Generally, an underlined softkey indicates that that function has been enabled.

Softkeys are displayed depending on which menu level they reside in and whether the softkeys are applicable to the currently defined measurement parameters. For example, the *ABOVE LEVEL* softkey of the TRIGGER function only appears in the INTERNAL CHANNEL 1 trigger mode. When the *EXTERNL* or *LINE* trigger softkeys are selected, the *ABOVE LEVEL* softkey is not displayed.

For some softkey functions, data values are required. These may be entered using three methods: the numeric key pad, the step up/down keys, and the RPG (rotary pulse generator) knob. If applicable, the use of each method is described in the Data Input section following each softkey description.

NOTE

When the RPG knob is turned, its rate of change is determined both by the measurement range and the speed at which the knob is turned, unless otherwise noted.

The active function block, located at the upper right-hand corner of the graticule, indicates which function is enabled. The status function block, located at the upper left-hand corner of the graticule, indicates the measurement status of the digitizer (e.g., Running). Annotation at the bottom of the display screen and

below the graticule reflects the status of parameters related to the state of the digitizer or to some measurement function.

A graphic representation of all the HP 70700A Digitizer softkeys and how they relate to the overall Main Menu of the digitizer is shown in Figure 2-2. Corresponding remote commands are described in the HP 70700A Digitizer Programming Manual.

MEASUREMENT CONTROL FUNCTIONS

Measurement Control Functions establish the overall parameters of a measurement and include the functions of the Channel 1, Timebase, Trigger, and Single or Continuous Sweep softkeys. These functions may be accessed through the *chan 1*, *timebas*, *trigger*, and *SINGLE SWEEP* or *CONT SWEEP* softkeys on the Main Menu of the digitizer display screen.

The Channel 1, Timebase, Trigger, Single Sweep, and Continuous Sweep softkey functions are briefly described below, and in more detail following the Overview section.

OVERVIEW

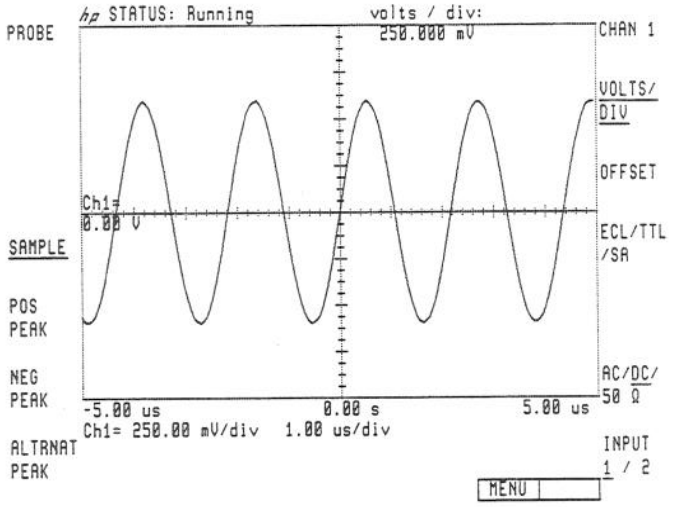

Figure 2-3. CHANNEL 1 Softkey Menu

chan 1 accesses other softkeys that control the measurement parameters of a selected channel that pertain to the amplitude (voltage) of a waveform.

CHAN 1 indicates the selected digitizer channel.

VOLTS/DIV sets the vertical axis range (amplitude) in volts.

OFFSET sets the level (amplitude reference, in volts) of the display midscreen.

ECL/TTL/SA automatically presets the OFFSET, VOLTS/DIV, and TRIGGER functions for taking measurements of the ECL (emitter-coupled logic) and TTL (transistor-transistor logic) families or for a spectrum analyzer.

LOG/LIN displays the trace data in either logarithmic or linear mode only when the SPECTRUM ANALYZER mode is selected.

AC/DC/50Ω selects the input port coupling to the digitizer to be ac-coupled or dc-coupled into 1 MΩ, or dc-coupled into 50Ω.

INPUT 1/2 selects the input port connector to the digitizer to be either INPUT 1 or INPUT 2.

PROBE allows entry of the divide ratio of the divider probe being used.

SAMPLE enables the SAMPLE detector mode and retains the last digitized value (conversion) of each sample interval.

POS PEAK enables the POSITIVE PEAK detector mode and retains only the highest digitized value of each sample interval.

NEG PEAK enables the NEGATIVE PEAK detector mode and retains only the lowest digitized value of each sample interval.

ALTRNAT PEAK enables the ALTERNATE PEAK detector mode and alternately retains the highest and lowest digitized value of alternate sample intervals.

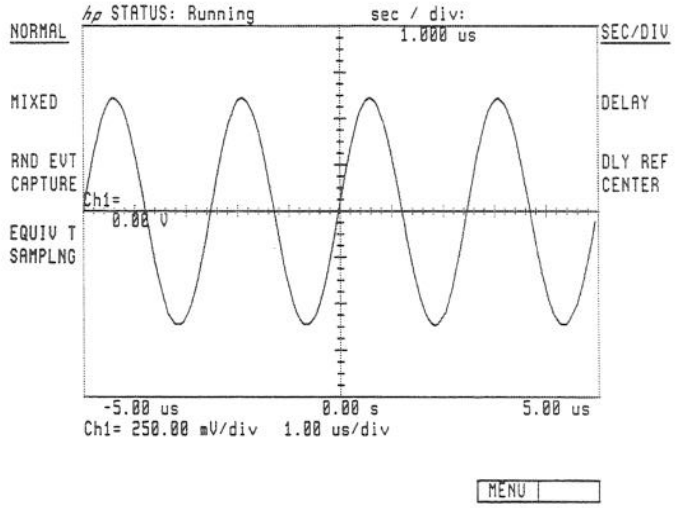

Figure 2-4. TIMEBASE Softkey Menu

timebas enables access of the softkeys that control the horizontal axis.

SEC/DIV sets the horizontal axis format when operating the instrument in either the time or frequency domain.

DELAY sets the position of the trigger event with respect to the reference point defined by the DELAY REFERENCE function.

DLY REF CENTER/RIGHT/LEFT sets the delay reference point at the center, right, or left graticule edge.

NORMAL enables standard operation of the timebase mode.

MIXED enables the waveform to be swept first at one sweep rate, and then at a second sweep rate, with both sweep rates appearing on the display screen.

1st SEC/DIV and *2nd SEC/DIV* sets the sweep rate of the first and second portion of the signal, respectively, when in the MIXED timebase mode.

DELAY POS. sets the point at which the second sweep rate begins, when in the MIXED timebase mode.

RND EVT CAPTURE "captures" each trigger event of a measurement, in sequential order, as long as the predefined parameters are met. Each event (consisting of pre- and post-trigger data) is stored in memory until memory is full.

TRIGGER EVENT enables each trigger event that was saved in memory in the RANDOM EVENT CAPTURE mode to be recalled and displayed.

REL/ABS TIME indicates the time elapsed since the last trigger event when RELATIVE TIME is enabled. In ABSOLUTE TIME, the time elapsed is indicated with respect to a reference trigger event.

EQUIV T SAMPLING uses multiple trigger events to form a composite waveform, when very fast repetitive signals are viewed.

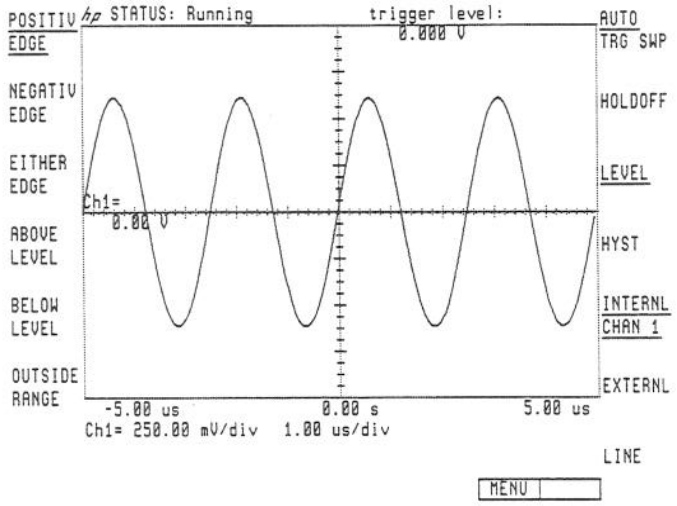

Figure 2-5. TRIGGER Softkey Menu

trigger accesses softkeys that determine the criteria that must be met in order to trigger a measurement.

AUTO/TRG SWP When AUTO trigger is enabled, a sweep is initiated if no trigger criteria have been met within a certain time. In TRIGGER SWEEP, only a trigger initiates a sweep.

HOLDOFF sets the amount of time that triggers will be ignored after a measurement is begun.

LEVEL/LEVEL 1 sets the level (in volts) at which the measurement will be triggered.

HYST sets a window that is a percentage of full-scale amplitude to prevent false triggering of an event.

INTERNL CHAN 1 selects the input signal as the trigger source.

EXTERNL selects a separate external signal as the trigger source.

LINE selects the ac line as the trigger source.

POSITIV EDGE selects the positive-going edge of the trigger source for triggering.

NEGATIV EDGE selects the negative-going edge of the trigger source for triggering.

EITHER EDGE selects either a positive- or negative-going edge of the trigger source for triggering.

ABOVE LEVEL sets a level in volts and specifies that the measurement will be triggered at any value above this level.

BELOW LEVEL sets a level in volts and specifies that the measurement will be triggered at any value below this level.

OUTSIDE RANGE sets two levels in volts and specifies that the measurement will be triggered at any value outside of this range.

LEVEL 2, in addition to LEVEL 1, sets the level (in volts) at which the measurement will be triggered when the OUTSIDE RANGE function is enabled.

SINGLE SWEEP arms the trigger for a single measurement with the currently-defined setup parameters (e.g., VOLTS/DIV, trigger LEVEL, etc.).

CONT SWEEP continuously arms the trigger for repetitive measurements with the currently-defined setup parameters (e.g., VOLTS/DIV, trigger LEVEL, etc.).

CHANNEL X FUNCTIONS

CHANNEL X accesses softkeys that control the measurement setup parameters that pertain to the amplitude (voltage) of a waveform. When only one digitizer is configured in a system, CHANNEL X is automatically indicated as CHANNEL 1. Thus, the CHANNEL 1 softkey menu is accessed when *chan 1* is pressed. See Figure 2-6.

When the *chan 1* softkey is pressed for the first time, the VOLTS/DIVISION function is the default active function. If another softkey is selected and enabled at this time (e.g., *OFFSET*) and then other upper-level softkeys manipulated, returning to the CHANNEL 1 softkey menu will then display the last active function (*OFFSET*) as the default active function.

When two digitizer modules are configured in a system, the CHANNEL Y softkey is also available. The CHANNEL Y softkey is automatically indicated as CHANNEL 2 and its softkey menu may be accessed when *chan 2* is pressed on the Main Menu. The CHANNEL 2 softkey menu is the same as the CHANNEL 1 softkey menu, but the softkey functions and input connector ports apply only to the corresponding channel.

When more than two digitizer modules are configured in a system, refer to Multiple Digitizers in this chapter for detailed information on displaying more than one digitizer channel.

NOTE

A maximum of four channels are available in a digitizer system that is controlled from a display front panel.

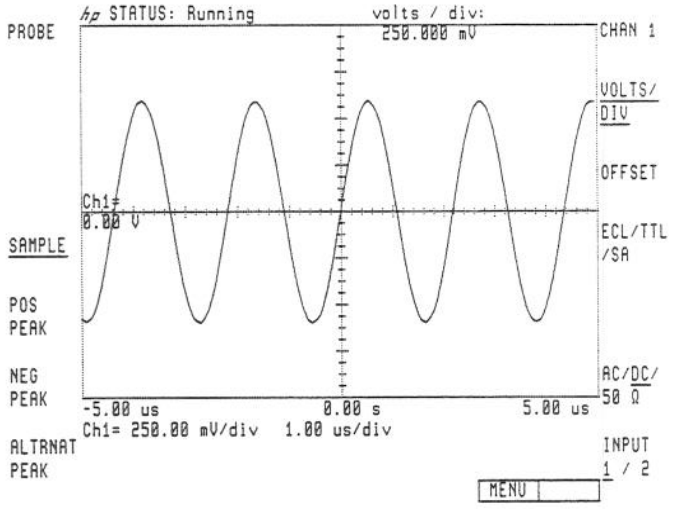

Figure 2-6. CHANNEL 1 Softkeys

CHANNEL 1 or CHANNEL 2

When either one or two digitizer modules are configured in a system, *CHAN 1* in the CHANNEL 1 softkey menu indicates that Channel 1 is being viewed, and *CHAN 2* in the CHANNEL 2 softkey menu indicates that Channel 2 is being viewed.

When three or more digitizer modules are configured in a system, the *CHAN 1* and *CHAN 2* softkeys may indicate any combination of two different channels. This may be achieved by repeatedly pressing the *CHAN 1* softkey until the desired digitizer channel that is available is selected. Then the *CHAN 2* softkey can be pressed repeatedly until the second desired digitizer channel is selected. To display the selected channel, the Display Functions must be used. (Refer to the Display Functions section in this chapter for more detailed information on displaying channels.)

For example, if four digitizer modules are configured in a system and the desired channels are 3 and 4, press *CHAN 1* until Channel 3 is selected, and then press *CHAN 2* until Channel 4 is selected. Now channels 3 and 4 are available for accessing the softkeys that control the measurement setup parameters that pertain to the amplitude of the waveforms on those channels.

Hints:

- No single channel can be dedicated to both CHANNEL function softkeys at the same time (e.g., Channel 3 may not be displayed on both channels at the same time).
- Regardless of the number of digitizer modules configured in a system, only the master module CHANNEL 1 is displayed at instrument preset.

VOLTS/DIVISION

VOLTS/DIV sets the vertical scaling (amplitude) of the display in volts. When the CHANNEL 1 softkey menu has been selected for the first time, the instrument is preset with this function active. Refer to Figure 2-6.

When *VOLTS/DIV* is enabled, the displayed units may either be V or mV. The preset value is 250.00 mV/div.

Data Input

The numeric key pad directly enters any number which must be terminated with the *V* or *mV* softkey.

The step up/down keys change the value of the VOLTS/DIVISION setting in a 1, 2, 5 step sequence.

The RPG knob changes the VOLTS/DIVISION setting in 5% increments.

OFFSET

The OFFSET function sets the level (amplitude reference) of the display midscreen in volts. The OFFSET value is indicated midscreen at the left-hand side (or right-hand side, depending on system configuration) of the graticule in volt units.

When the OFFSET function is enabled, the preset value is 0.00V.

Data Input

The numeric key pad directly enters any number which must be terminated with the *V* or *mV* softkey.

The step up/down keys change the OFFSET value in one-division increments.

The RPG knob changes the OFFSET value in 1% increments that depend on the VOLTS/DIVISION setting.

In Figure 2-7, an example of a waveform that has been offset 500.00 mV from midscreen is displayed.

ECL / TTL / SPECTRUM ANALYZER

The *ECL/TTL/SA* softkey automatically presets the OFFSET, VOLTS/DIVISION, and TRIGGER LEVEL for taking measurements of the ECL (emitter-coupled logic) and TTL (transistor-transistor logic) families. When SPECTRUM ANALYZER is enabled, the OFFSET, VOLTS/DIVISION, and INPUT coupling to the digitizer are preset to display trace data as found on a spectrum analyzer.

NOTE

The TRIGGER LEVEL is only affected for Channel 1.

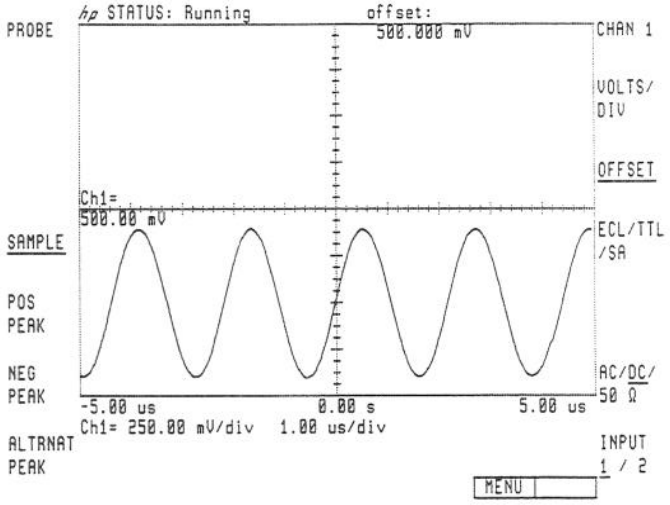

Figure 2-7. OFFSET Mode Example

When ECL is selected, the VOLTS/DIVISION value is set to 200 mV/div and the OFFSET and TRIGGER LEVEL values are set to −1.0V.

When TTL is selected, the VOLTS/DIVISION value is set to 1.0 V/div and the OFFSET and TRIGGER LEVEL values are set to 1.6V.

When SPECTRUM ANALYZER is selected, the VOLTS/DIVISION value is set to 250 mV/div, the OFFSET value is set to 1.0V, and the input coupling to the digitizer is set to dc into 1 megohm.

The SPECTRUM ANALYZER preset mode is used when the VIDEO OUTPUT signal from a spectrum analyzer is the input signal to the digitizer.

LOGARITHMIC / LINEAR

LOG/LIN displays trace data in either logarithmic or linear units without changing the reference level value, when the SPECTRUM ANALYZER preset mode is selected via the *ECL/TTL/SA* softkey.

When the SPECTRUM ANALYZER preset mode is selected for the first time, trace data is displayed logarithmically in which the top graticule is the spectrum analyzer reference level and the bottom graticule is equal to reference level −100 dB. In a display of LINEAR units (unlogged data), the top graticule remains the reference level, but the bottom graticule becomes 0V.

The *LOG/LIN* softkey is only available when the *ECL/TTL/SA* softkey is in the SPECTRUM ANALYZER preset mode.

AC / DC / 50 Ω

AC/DC/50Ω selects the input port coupling to the digitizer to be ac coupled into 1 megohm, dc coupled into 1 megohm, or dc coupled into 50 ohms.

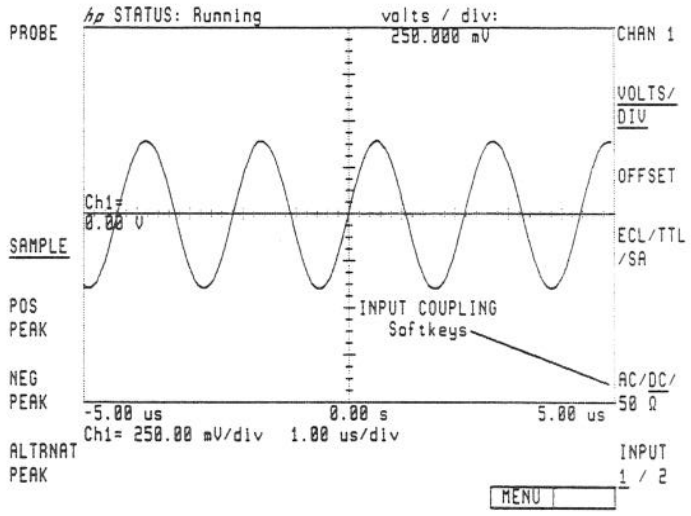

Figure 2-8. INPUT COUPLING Softkeys

INPUT 1 / 2

INPUT 1/2 selects the input port connection to the digitizer to be either INPUT 1 on the front or rear panel or INPUT 2 on the rear panel.

At instrument preset, INPUT 1 is preset.

PROBE

The *PROBE* softkey function allows entry of the divide ratio value of the divider probe being used.

Data Input

The numeric key pad directly enters any number which must be terminated with the *ENTER* softkey.

The step up/down keys change the divide ratio in a 1, 10, 100 step sequence.

The RPG knob also changes the divide ratio in a 1, 10, 100 step sequence.

SAMPLE, POSITIVE PEAK, NEGATIVE PEAK, and ALTERNATE PEAK Detector Modes

Four detector modes for sampling a waveform are: SAMPLE, POSITIVE PEAK, NEGATIVE PEAK, and ALTERNATE PEAK. The mode that is active is underlined. See Figure 2-9.

In normal operation, the SAMPLE mode is enabled.

The detector modes help display the frequency and number of occurrences of a waveform when using slower sweep rates.

To determine the sample interval when using any of the detector modes, the waveform is divided into regularly-spaced intervals based on the TRACE LENGTH. When the timebase has been set up so that more than one 20 MHz conversion (digitized value) occurs in a sample interval, the detector mode may be selected to specify which conversion is stored in memory. Refer to the four detector-mode softkey descriptions below for more detailed information on how each mode operates.

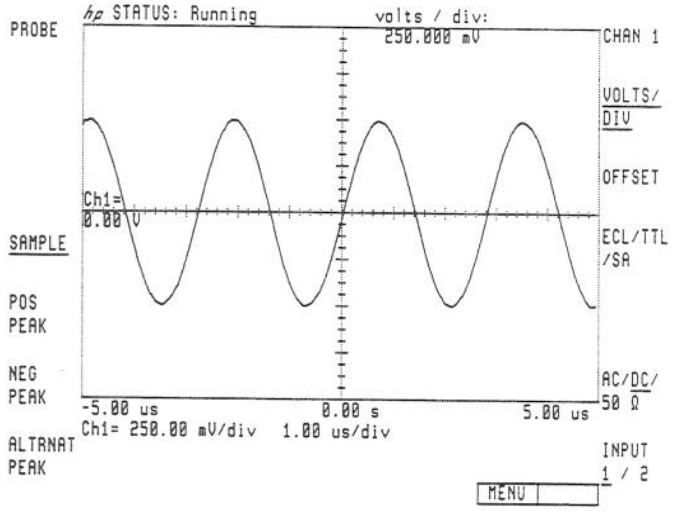

Figure 2-9. Detector Modes

SAMPLE retains the last conversion in each sample interval.

POS PEAK retains only the highest value of data in each sample interval.

NEG PEAK retains only the lowest value of data in each sample interval.

ALTRNAT PEAK alternately retains the highest and lowest values of data within the sample interval. The highest value consists of the highest value since the last POSITIVE PEAK was kept; likewise, the lowest value consists of the lowest value since the last NEGATIVE PEAK was kept.

The sample interval for the ALTERNATE PEAK mode is twice as large as those for each POSITIVE PEAK and NEGATIVE PEAK sample interval, but overlaps them by half. This is to ensure that no information is overlooked as the POSITIVE PEAK and NEGATIVE PEAK values are retained alternately.

Hints:

- In general, it cannot be determined whether a POSITIVE PEAK or NEGATIVE PEAK value occurs first when using the ALTERNATE PEAK detector mode.
- Viewing a displayed waveform in the ALTERNATE PEAK detector mode may cause it to appear unstable. The waveform may be stabilized by using the *DELAY* and *DLY REF CENTER* softkeys to set the left-hand graticule to 0.00s.

Example:

The waveform displayed in Figure 2-10 can be viewed very easily at a sweep rate of 2.00 µs/div.

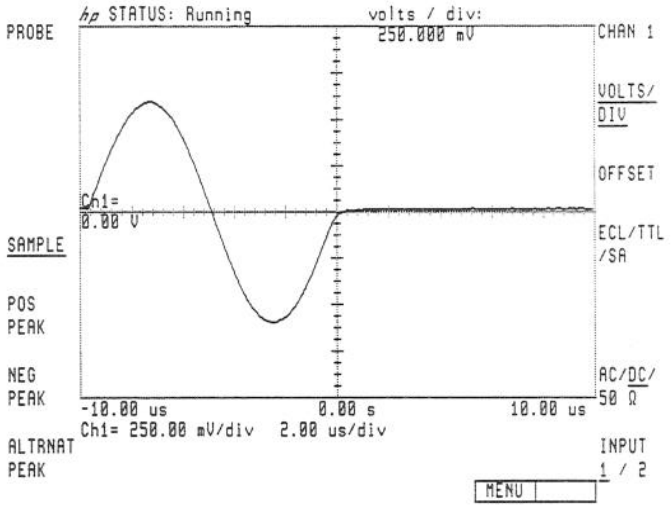

Figure 2-10. Waveform Example

To view more than one complete cycle of the waveform and to determine how often the cycles occur, the sweep rate must be decreased. Figure 2-11 displays the waveform swept at a rate of 50.00 ms/div.

The sample rate has changed, resulting in the sample points' "missing" the waveform. Therefore, the high and low data values that define the waveform are not displayed because they occur between the actual data values being sampled.

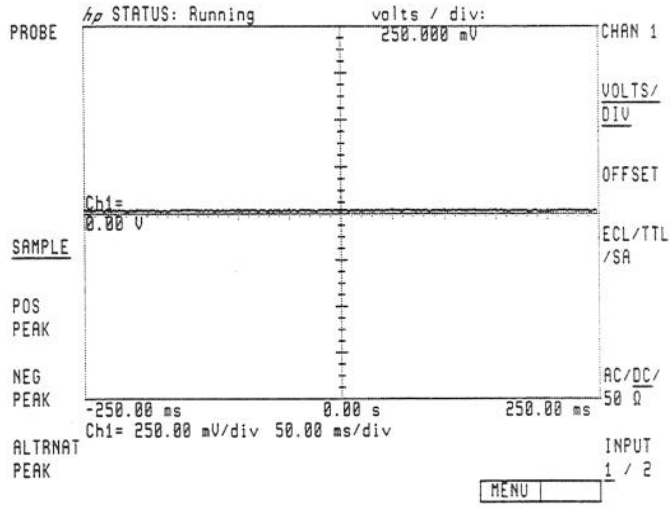

Figure 2-11. SAMPLE Mode at 50.00 ms/div

Since it is known that there is a positive-going portion of the waveform, using the POSITIVE PEAK mode indicates the top half of the waveform and the frequency of the cycles. See Figure 2-12.

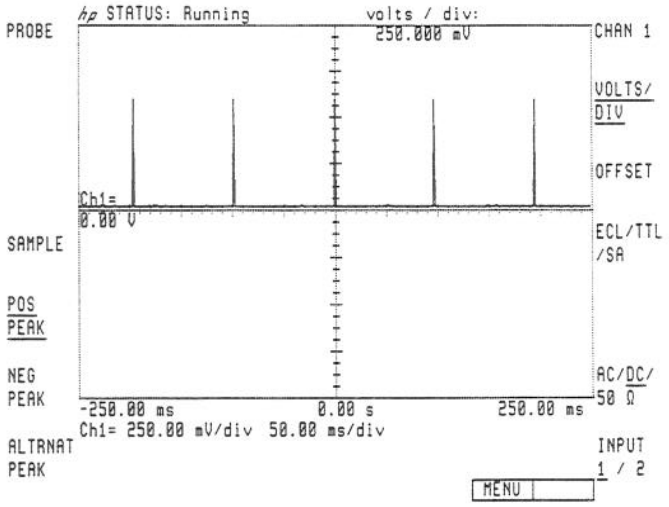

Figure 2-12. POSITIVE PEAK Mode at 50.00 ms/div

Since it is known that there is a negative-going portion of the waveform, using the NEGATIVE PEAK mode indicates the bottom half of the waveform and the frequency of the cycles. See Figure 2-13.

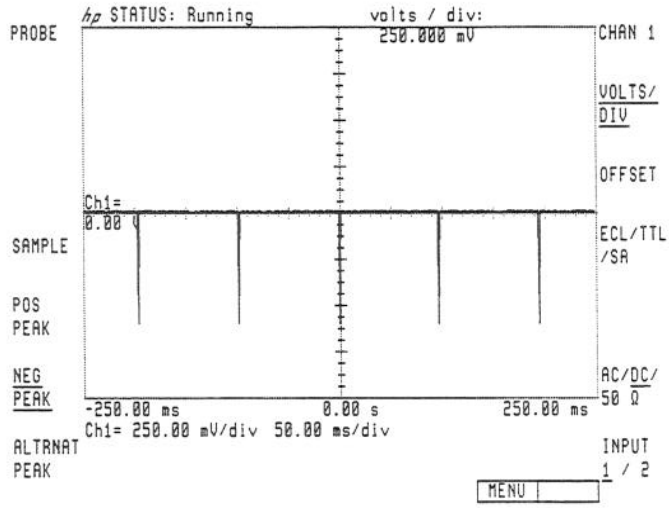

Figure 2-13. NEGATIVE PEAK Mode at 50.00 ms/div

Using the ALTERNATE PEAK mode will indicate both the upper and lower portions of the waveform. See Figure 2-14.

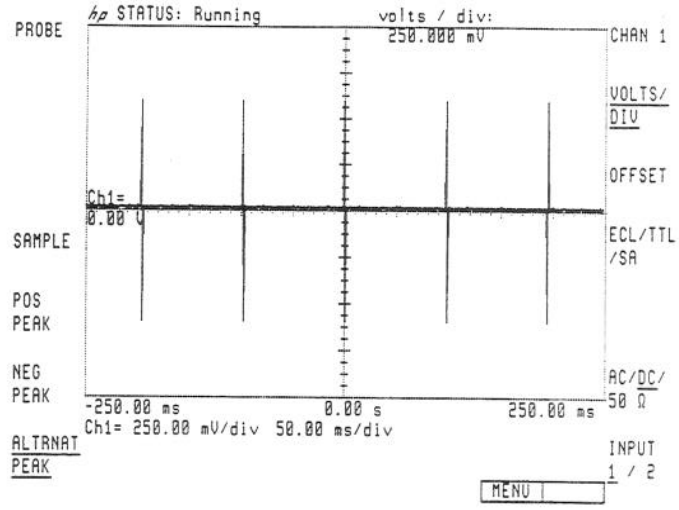

Figure 2-14. ALTERNATE PEAK Mode at 50.00 ms/div

TIMEBASE FUNCTIONS

The TIMEBASE function accesses softkeys that control the horizontal axis. The TIMEBASE softkey menu is displayed when *timebas* is pressed.

When the *timebas* softkey is pressed for the first time, the SECONDS/DIVISION function is the default active function. If another softkey (e.g., *DELAY*) is selected and enabled at this time and then other upper-level softkeys manipulated, returning to the TIMEBASE softkey menu displays the last active function (*DELAY*) as the default active function.

The TIMEBASE function is preset to operate in the time domain at instrument preset.

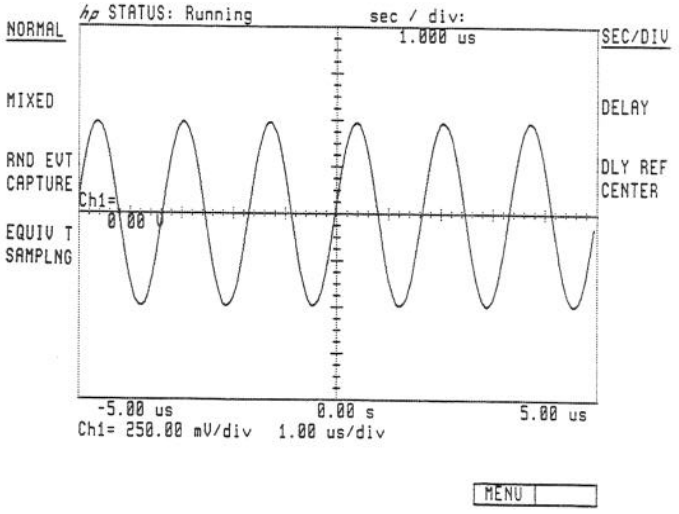

Figure 2-15. TIMEBASE Softkeys (Time Domain)

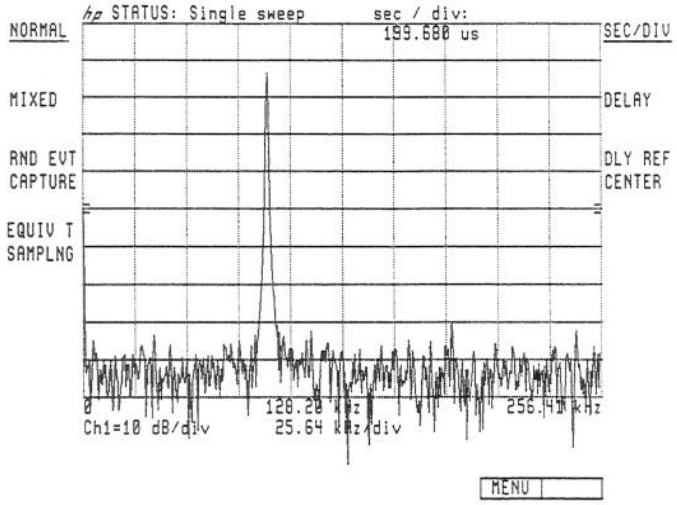

Figure 2-16. TIMEBASE Softkey (Frequency Domain)

SECONDS/DIVISION

NOTE

The setting of the SECONDS/DIVISION function is the same for all channels and is only available when not in the MIXED timebase mode.

SEC/DIV sets the horizontal axis (time) in seconds when operating the instrument in the time domain. The instrument is preset with this function enabled when the TIMEBASE softkey menu has been selected for the first time. Refer to Figure 2-15.

When *SEC/DIV* is first enabled in the time domain, the preset value is set to 1.000 µs/div and the displayed units may be in s, ms, µs, or ns. Also, the annotation below the graticule is time-related with respect to the time domain.

When operating the instrument in the frequency domain, the *SEC/DIV* softkey can be used to change the frequency span. The frequency span is determined indirectly by the following:

sampling rate = TRACE LENGTH ÷ (10 × SECONDS/DIVISION)

The frequency span is then determined as one-half the sampling rate, which is the same as the stop frequency. The frequency span can therefore be changed by entering the appropriate SECONDS/DIVISION value to achieve the desired stop frequency.

When *SEC/DIV* is first enabled in the frequency domain, the stop frequency is preset to a maximum of 10 MHz (frequency span), which is equivalent to a sampling rate of 20 mega-samples/second. The annotation below the graticule is frequency-related with respect to the frequency domain.

NOTE

When operating the instrument in the frequency domain, the stop frequency preset value is set to 10.00 MHz only if the internal clock or an external clock of 20 MHz is used.

Data Input

The numeric key pad directly enters any number which must be terminated with the *s*, *ms*, *us*, or *ns* softkey.

The step up/down keys change the value of the SECONDS/DIVISION setting in a 1, 2, 5 step sequence.

The RPG knob changes the value of the SECONDS/DIVISION setting in 5% increments.

Hint:

- Viewing a displayed waveform at a slower sweep rate may cause it to appear unstable. The waveform may be stabilized by using the *DELAY* and *DELAY REF CENTER* softkeys to set the left-hand graticule to 0.00s.

DELAY

The *DELAY* softkey sets the position of the trigger event with respect to the reference point defined by the DELAY REFERENCE function.

DELAY is set to 0.000s at instrument preset.

See Figure 2-17 for an example of a delayed trigger event.

NOTE

The DELAY function is available in any mode except the MIXED timebase mode.

Data Input

The numeric key pad directly enters any number which must be terminated with the *s*, *ms*, *us*, or *ns* softkey.

The step up/down keys change the DELAY value in increments of one-division steps that depend on the SECONDS/DIVISION function.

The RPG knob changes the DELAY value in increments of one-point steps that depend on the TRACE LENGTH function.

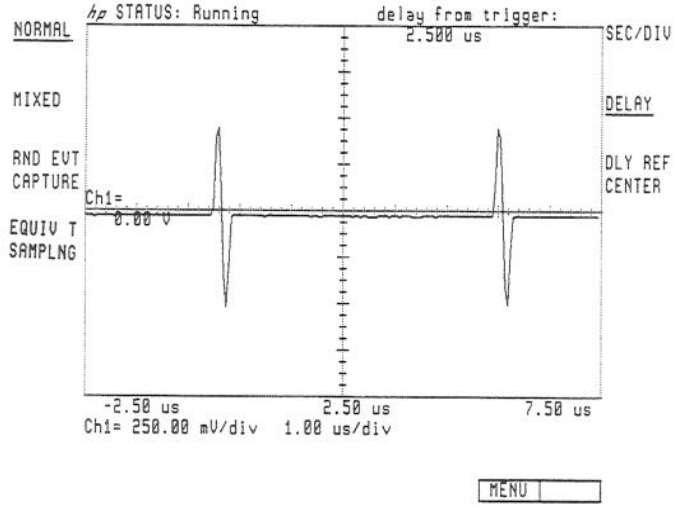

Figure 2-17. DELAYed Trigger Event

DELAY REFERENCE CENTER / RIGHT / LEFT

The *DLY REF CENTER* softkey sets a trigger event delay reference with respect to the center, right, or left graticule edge. This function can be operated in conjunction with the DELAY function above.

The three selections of DELAY REFERENCE may be accessed by pressing the *DLY REF CENTER* softkey repeatedly. The current status of this function is indicated by the softkey selection.

NOTE

The DELAY REFERENCE function is available in any mode except the MIXED timebase mode.

NORMAL Timebase Mode

The *NORMAL* softkey function enables a signal to be swept at one sweep rate for the entire sweep time. Also, this softkey function must be used to disable the MIXED, RANDOM EVENT CAPTURE, and RANDOM REPETITIVE SAMPLING timebase modes.

The instrument is preset with the NORMAL timebase mode active.

MIXED Timebase Mode

The *MIXED* softkey function enables the first portion of the signal to be swept at one sweep rate and the second portion of the signal to be swept at a second sweep rate with both sweep rates appearing on the same display screen.

When the MIXED mode is enabled, the sweep rates of the first and second portions of the waveform can be set independently of each other by using the *1st SEC/DIV* and *2nd SEC/DIV* softkeys. The DELAY POSITION function indicates the point in time on the horizontal axis at which the second sweep rate begins. This point is indicated by the "switch at" annotation near the bottom of the display screen.

The time annotated at the lower-right graticule edge indicates the sum of the two sweep rates, which is determined by:

(1st SEC/DIV × # of divisions of 1st portion) + (2nd SEC/DIV × # of divisions of 2nd portion).

See Figure 2-18 for an example of a waveform displayed in the MIXED timebase mode.

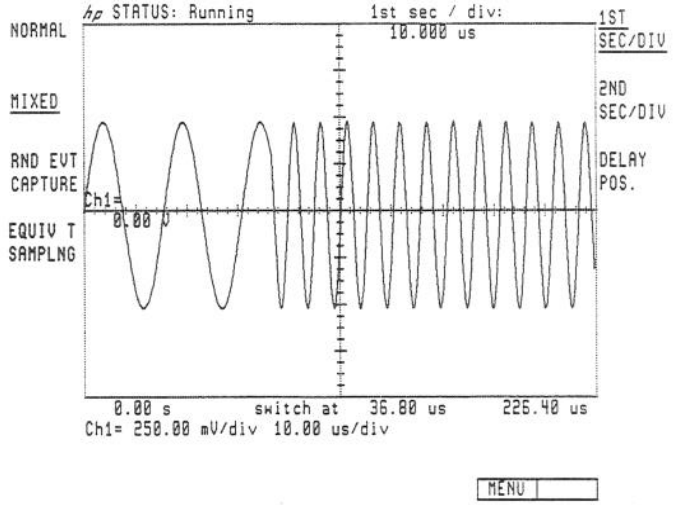

Figure 2-18. MIXED Timebase Mode

FIRST SECONDS/DIVISION and SECOND SECONDS/DIVISION

The *1st SEC/DIV* and *2nd SEC/DIV* softkeys set the sweep rate of the first and second portions of the displayed signal independently of each other. Similar to the SECONDS/DIVISION function, these two softkeys set the horizontal axis to seconds. See Figure 2-18.

The total time the measurement takes is indicated by the end-time. The end-time is the sum of the two sweep rates and is annotated at the lower right-hand graticule edge.

The *1st SEC/DIV* and *2nd SEC/DIV* softkeys are only available in the MIXED timebase mode of operation.

Data Input

The numeric key pad directly enters any number which must be terminated with the *s*, *ms*, *us*, or *ns* softkey.

The step up/down keys change the value of the FIRST and SECOND SECONDS/DIVISION functions in a 1, 2, 5 step sequence.

The RPG knob changes the FIRST and SECOND SECONDS/DIVISION functions in 5% increments.

DELAY POSITION

The DELAY POSITION function indicates the position on the display screen at which the second sweep rate begins when the instrument is being operated in the MIXED timebase mode. The DELAY POSITION range is set so that the left-hand graticule edge is 0 and the right-hand graticule edge is 1.0. The delay position status is annotated as "switch at" located at the lower center graticule edge. Refer to Figure 2-18.

The preset value of the *DELAY POS.* softkey is set to 0.50.

The DELAY POSITION function is only available in the MIXED timebase mode of operation.

Data Input

The numeric key pad directly enters any number which is rounded off to the nearest appropriate value every eighth point in the trace length.

The step up/down keys change the value of the DELAY POSITION setting in increments of one-division steps.

The RPG knob changes the DELAY POSITION setting in increments of 0.01, or eight points/trace length, whichever is larger.

Hint:

- It may be difficult to use the DELAY POSITION softkey to inspect a trigger event more closely. The steps required to "zero in" on a particular portion of the waveform may not be available because of the coarse tuning that occurs with eight-point steps. Better stepping resolution may be achieved by increasing the trace length. However, when increasing the trace length, the SECONDS/DIVISION function is affected proportionally; therefore, the use of faster sweep rates is restricted.

RANDOM EVENT CAPTURE

RND EVT CAPTURE "captures" every successive trigger event of a measurement, sequentially, as long as the predefined parameters are met. Each event (consisting of pre- and post-trigger data) is stored in memory until memory is full.

The number of trigger events that may be saved in memory is determined by the trace length, pre-trigger data, post-trigger data, and spacing of the trigger events. The "trigger event" number displayed in the active function annotation indicates which event is being displayed. All trigger events are saved in memory, in sequential order, until memory is full. Memory is full when "Measurement done" appears in the status function block at the upper left of the graticule.

The "dTrg" (delta trigger) time located in the lower right-hand corner of the display screen indicates how much time has elapsed since the last event (i.e., the time between two adjacent trigger events).

When *RND EVT CAPTURE* is enabled, the TRIGGER EVENT softkey function is automatically enabled and preset to 1. The *TRIGGER EVENT* softkey recalls and displays any specific trigger event for viewing. Refer to the TRIGGER EVENT softkey description below for further information.

Example:

The waveform displayed in Figures 2-19, 2-20, and 2-21 demonstrates the RANDOM EVENT CAPTURE mode. As indicated in the sequence of figures, each trigger event is saved and may be recalled for viewing by using the *TRIGGER EVENT* softkey function.

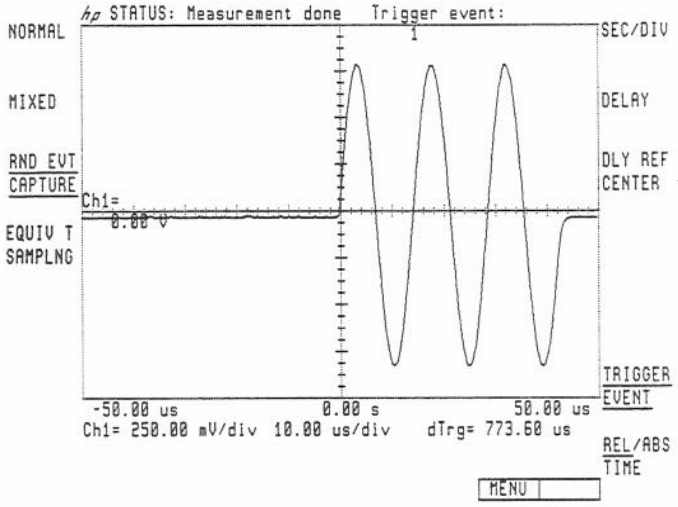

Figure 2-19. Trigger Event #1

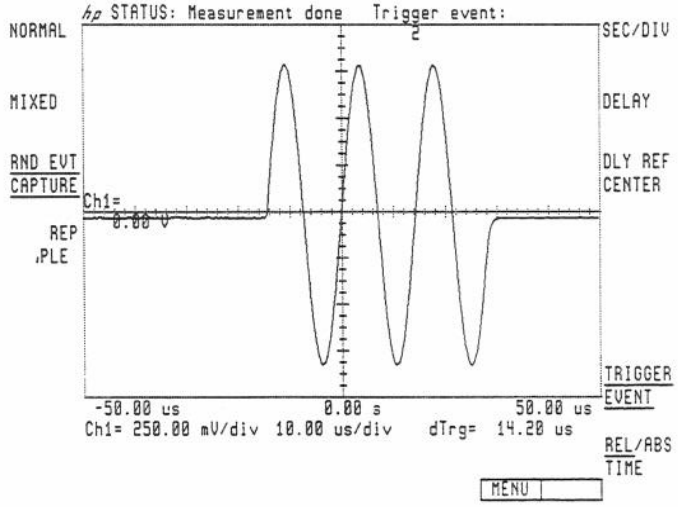

Figure 2-20. Trigger Event #2

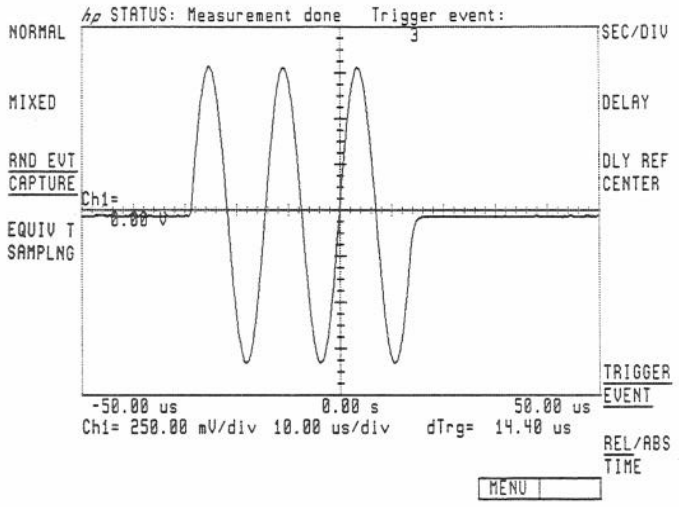

Figure 2-21. Trigger Event #3

NOTE

The TRIGGER EVENT and RELATIVE / ABSOLUTE TIME functions are only available when operating the instrument in the RANDOM EVENT CAPTURE mode.

TRIGGER EVENT

TRIGGER EVENT recalls any trigger event that was saved in memory in the RANDOM EVENT CAPTURE mode. The trigger event number, located in the active function annotation, indicates which trigger event is displayed.

Since the number of trigger events stored is affected by the TRACE LENGTH and DELAY POSITION functions, a specific trigger event may never occur; hence, if the selected trigger event has not occurred, the display screen is blanked. For example, Trigger Event #265 may be entered for display. However, depending on the TRACE LENGTH and DELAY POSITION settings, the digitizer memory may become full before Trigger Event #265 is acquired. If this occurs, the display screen will be blanked even though the active function annotation indicates that Trigger Event #265 should be displayed.

TRIGGER EVENT is automatically enabled and preset to 1 only when the RANDOM EVENT CAPTURE mode is selected.

Data Input

The numeric key pad directly enters any trigger event number that is to be displayed and must be terminated with the *ENTER* softkey.

The step up/down keys change the trigger event number by one with each step.

The RPG knob changes the trigger event number by one.

RELATIVE / ABSOLUTE TIME

RELATIVE TIME mode indicates how much time has elapsed since the last trigger event (i.e., time between two adjacent trigger events). ABSOLUTE TIME mode indicates how much time has elapsed with respect to a specific trigger event. The time elapsed is indicated by the "dTrg" (delta trigger) annotation located near the bottom right-hand corner of the display screen.

RELATIVE TIME mode measures the elapsed time between the currently-indicated trigger event and its previous trigger event.

ABSOLUTE TIME mode indicates the elapsed time as either positive or negative with respect to a specific trigger event. If a new trigger event is desired as a reference, the ABSOLUTE TIME mode must first be disabled by switching to the RELATIVE TIME mode. While in the RELATIVE TIME mode, the desired trigger event must be selected and then the ABSOLUTE TIME mode re-enabled. This allows the "dTrg" time annotation to be reset to 0.00s as a reference for the new trigger event.

The *REL/ABS TIME* softkey function is only available when in the RANDOM EVENT CAPTURE mode.

Refer to Figure 2-22 for an example of the RELATIVE TIME mode which displays the elapsed time between Trigger Events 3 and 4.

Refer to Figure 2-23 for an example of the ABSOLUTE TIME mode which indicates the time elapsed from the reference, Trigger Event 2, to Trigger Event 5.

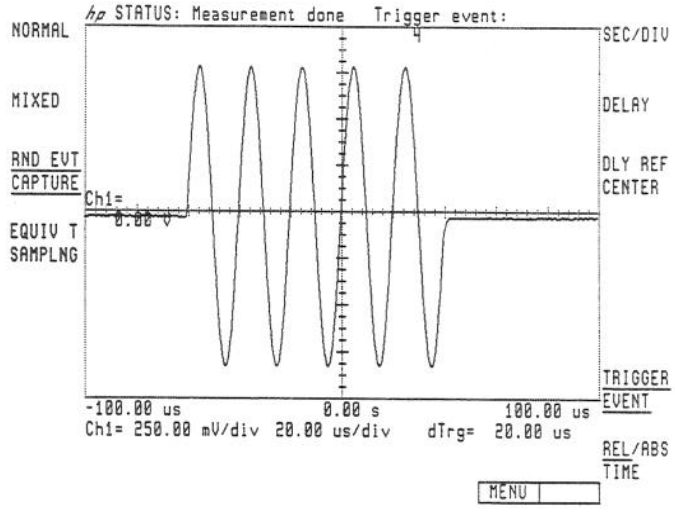

Figure 2-22. RELATIVE TIME Mode

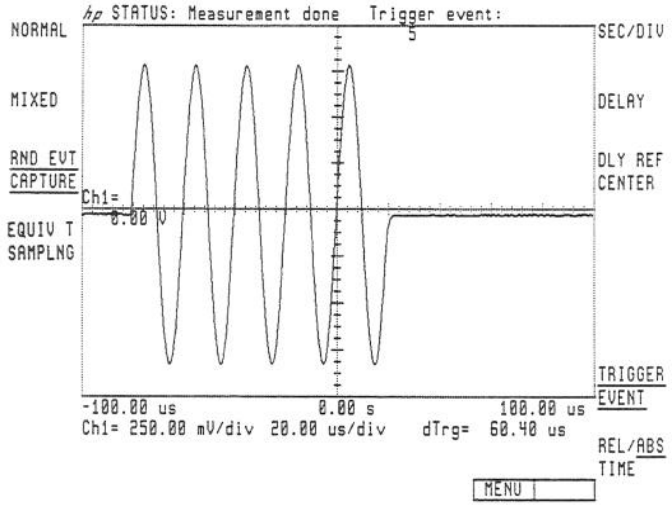

Figure 2-23. ABSOLUTE TIME Mode

EQUIVALENT TIME SAMPLING

The *EQUIV T SAMPLING* softkey function provides a technique for looking at stable, periodic, repetitive signals (typically at very high frequencies) by using multiple trigger events to form a composite waveform.

For each trigger event in the sequence, the sample points are determined with respect to the moment at which the trigger event occurs. These sample points are then accumulated to display the composite waveform of the signal.

For this function to operate properly, the following conditions must be met: the signal must be repetitive, the trigger events must be equally spaced in time, the fundamental must be less than 10 MHz, the waveform phase jitter must measure less than approximately one-half of the SECONDS/DIVISION setting over the measurement time, and the input frequency cannot be within approximately 1% of a sub-multiple of the sample clock.

After the EQUIVALENT TIME SAMPLING measurement is complete, the composite waveform can be used by the Measure Functions or the Marker Functions for evaluation.

NOTE

SINGLE SWEEP mode must be used to capture a single and complete composite waveform for manipulation by other functions.

Hints:

- To use the Measure or Marker Functions effectively, the EQUIVALENT TIME SAMPLING measurement must be performed in the SINGLE SWEEP mode.

- If the TRACE LENGTH function is in AUTOMATIC, the range for the SECONDS/DIVISION setting is from 10.00 ns to 100.00 ns. It should also be noted that if the TRACE LENGTH is MANUALly set to smaller values, the SECONDS/DIVISION setting decreases accordingly.

- Video filtering may be applied by using the *BRICK INTERP* or *GAUSS INTERP* softkeys to reduce high frequency noise and small amounts of phase jitter.

Example:

Figure 2-24 displays a waveform that is periodic and repetitive at a sweep rate of 20 ns/div. Using the EQUIVALENT TIME SAMPLING function can provide a better representation of the signal. See Figure 2-25.

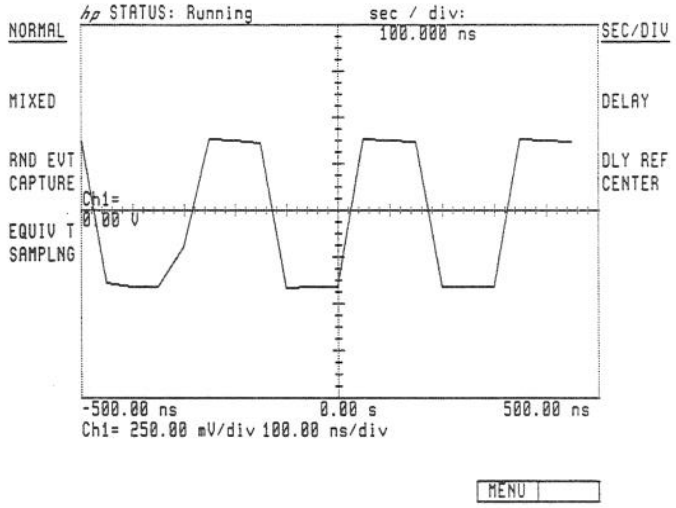

Figure 2-24. Periodic and Repetitive Signal

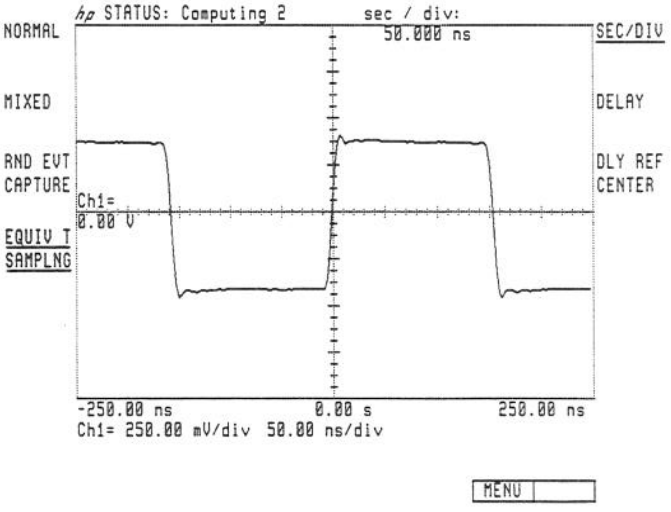

Figure 2-25. EQUIVALENT TIME SAMPLING Enabled

TRIGGER FUNCTIONS

The TRIGGER function accesses softkeys used for determining the criteria that must be met in order to trigger a measurement. The TRIGGER softkey menu is displayed when *trigger* is pressed. See Figure 2-26.

Trigger criteria determine when a measurement occurs. When a defined trigger source satisfies the defined trigger criteria, a trigger event occurs.

The origin of the trigger source is defined as one of the following: INTERNAL, EXTERNAL, or LINE. Examples of trigger criteria are POSITIVE EDGE and NEGATIVE EDGE triggering.

When *trigger* is pressed for the first time, LEVEL is the default active function. If another softkey (e.g., *HOLDOFF*) is selected and enabled at this time and then other upper-level softkeys pressed, returning to the TRIGGER softkey menu will display the last active function (*HOLDOFF*) as the default active function.

An example of a trigger event is displayed in Figure 2-27. The trigger source has been defined as INTERNAL. The criteria for when the trigger event occurs are the POSITIVE EDGE of the signal and a trigger LEVEL of 0.00V.

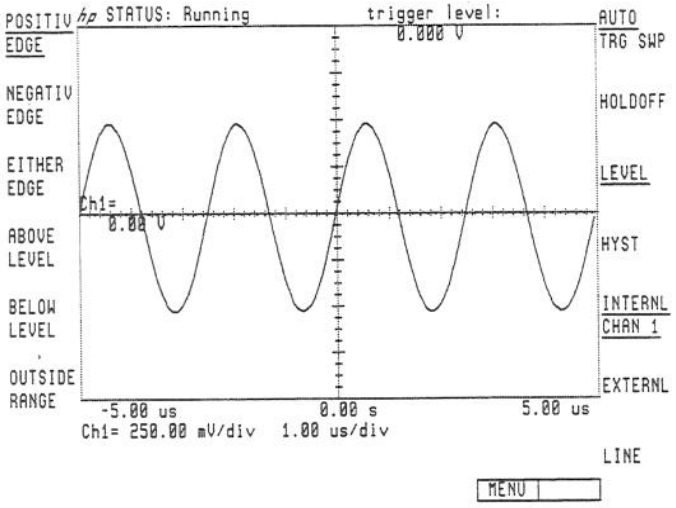

Figure 2-26. TRIGGER Softkeys

AUTO / TRIGGER SWEEP

The *AUTO* / *TRG SWP* softkey determines whether a trigger sweep will be forced if no triggering event occurs within a certain time.

AUTO triggering allows a given amount of time, approximately 150% of the entire sweep-time setting, for a trigger event to occur. If a trigger has not occurred at the end of this time, a trigger is "forced" and a sweep taken.

TRIGGER SWEEP mode waits indefinitely for a trigger event to occur.

The default condition at instrument preset is AUTO triggering. The AUTO / TRIGGER SWEEP function is only available in the NORMAL or MIXED timebase mode.

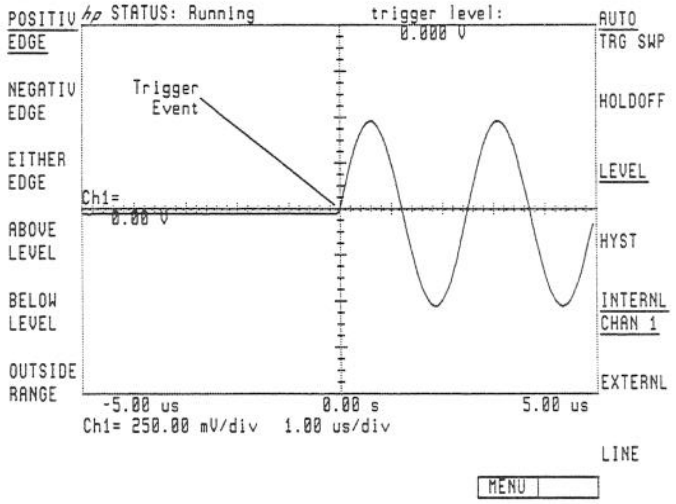

Figure 2-27. Trigger Event Example

HOLDOFF

HOLDOFF sets the amount of time after a trigger during which subsequent triggers will be ignored.

The HOLDOFF function is only available in the NORMAL or MIXED timebase mode.

Data Input

The numeric key pad directly enters any number which must be terminated with the *s*, *ms*, *us*, or *ns* softkey.

The step up/down keys change the HOLDOFF value in increments of 0.1s.

The RPG knob changes the HOLDOFF value in increments of 10 ms.

LEVEL / LEVEL 1

LEVEL sets a level, in volts, at which the measurement will be triggered. The trigger LEVEL may only be set for an internal Channel 1 trigger source.

The value of the trigger LEVEL is indicated by a marker on the display screen.

The preset value of the LEVEL function is 0.00V.

When the OUTSIDE RANGE function has been selected, the *LEVEL* softkey becomes the *LEVEL 1* softkey. The LEVEL 1 function remains the same as the LEVEL function, but it now operates in conjunction with the *LEVEL 2* softkey to set the specified range for the OUTSIDE RANGE function.

Data Input

The numeric key pad directly enters any number which must be terminated with the V or mV softkey.

The step up/down keys change the LEVEL 1 value in increments of one division.

The RPG knob changes the LEVEL 1 value in increments of 1% of the voltage range.

HYSTERESIS

HYST creates a hysteresis window to prevent false triggering.

Figure 2-28 illustrates an example of an occurrence of a false trigger event. Figure 2-29 illustrates an example of correct triggering when using the HYSTERESIS function.

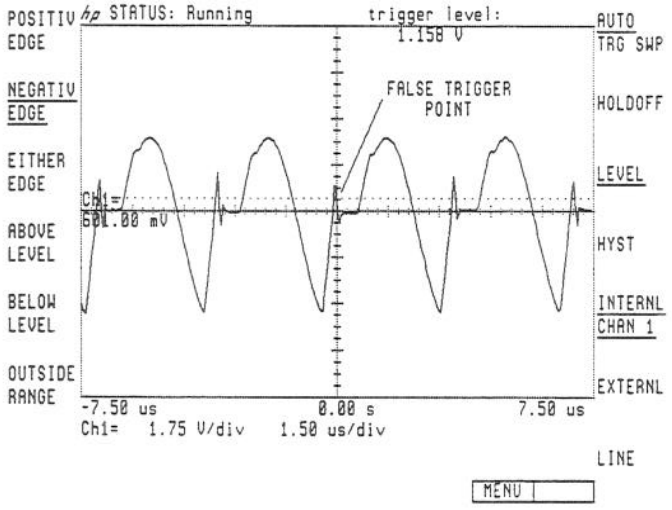

Figure 2-28. False Triggering on a Negative Edge

False triggering potentially occurs when the input signal is noisy. As indicated in Figure 2-28, a false trigger event may occur when a noise spike takes place at the same point as the set trigger LEVEL. Since the noise spike has a negative slope that extends above the trigger LEVEL, the trigger criteria is met and a trigger event occurs.

To prevent false triggering, the HYSTERESIS function may be used as a safeguard. In Figure 2-29, the HYSTERESIS function is used to create a window that must be passed through before a trigger event may occur. To cause a trigger, the signal must first pass through the HYSTERESIS level; therefore, if the HYSTERESIS window exceeds the amplitude of the noise, false trigger events are prevented.

The HYSTERESIS window is determined by a percentage of full-scale amplitude on the display screen. If POSITIVE EDGE triggering is enabled, the HYSTERESIS window is below the trigger LEVEL. This is to ensure that the HYSTERESIS level has been passed through prior to arming the trigger to occur at the next sample exceeding the set trigger LEVEL.

The HYSTERESIS function is only available with POSITIVE, NEGATIVE, or EITHER EDGE triggering and has a preset value of 2%. The HYSTERESIS function, in conjunction with the trigger LEVEL function,

is also the criteria for determining a trigger event, and is only available for an INTERNAL CHANNEL 1 trigger source.

Data Input

The numeric key pad directly enters any number indicating the percentage which must be terminated by the % softkey.

The step up/down keys change the percentage of hysteresis in 5% increments.

The RPG knob changes the percentage of hysteresis in 1% increments.

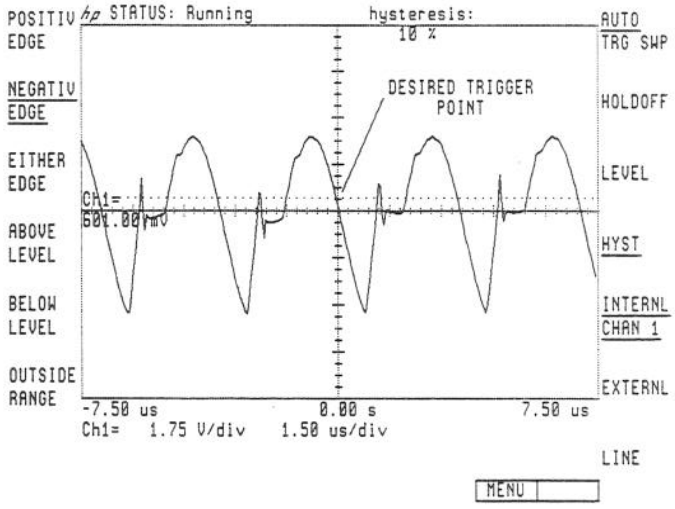

Figure 2-29. NEGATIVE EDGE Triggering with HYSTERESIS

INTERNAL CHANNEL 1

INTERNL CHAN 1 selects the input signal from Channel 1 as the trigger source.

EXTERNAL

EXTERNL selects the signal from the external trigger connector as the trigger source and expects TTL levels.

When the RANDOM EVENT CAPTURE mode is enabled, the *EXTERNL* trigger source softkey is neither displayed nor available.

NOTE

Only POSITIVE and NEGATIVE EDGE criteria are available for an EXTERNAL trigger source.

LINE

LINE selects the ac line as the trigger source.

When the RANDOM EVENT CAPTURE mode is enabled, the *LINE* trigger source softkey is neither displayed nor available.

POSITIVE EDGE

POSITIV EDGE selects the positive slope of the trigger source for triggering a sweep. Both this function and the trigger LEVEL function are the criteria for determining a trigger event. The waveform is then displayed with respect to the DELAY REFERENCE function.

NEGATIVE EDGE

NEGATIV EDGE selects the negative slope of the trigger source for triggering a sweep. Both this function and the trigger LEVEL function are the criteria for determining a trigger event. The waveform is then displayed with respect to the DELAY REFERENCE function.

See Figure 2-30 for an example of a waveform triggered by the NEGATIVE EDGE softkey function.

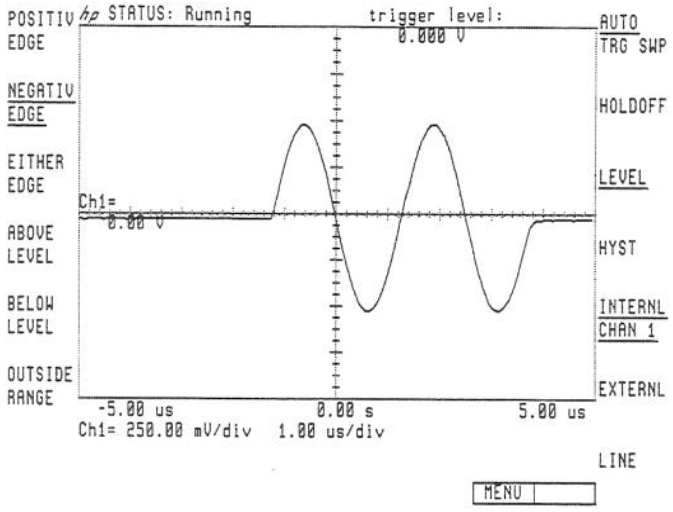

Figure 2-30. NEGATIVE EDGE Triggered Waveform

EITHER EDGE

EITHER EDGE can select either the positive or negative slope of the trigger source for triggering a sweep. Both this function and the trigger LEVEL function are the criteria for determining a trigger event.

The EITHER EDGE function is not available for the EQUIVALENT TIME SAMPLING timebase mode.

NOTE

The following three softkey functions, in conjunction with the trigger LEVEL function, are also the criteria for determining a trigger event, and are only available for an INTERNAL CHANNEL 1 trigger source.

ABOVE LEVEL

ABOVE LEVEL allows a measurement to be triggered at any value above the set trigger LEVEL value for INTERNAL CHANNEL 1 trigger sources only. The minimum level at which a trigger occurs is indicated by the marker. See Figure 2-31.

When *ABOVE LEVEL* is enabled, the preset trigger LEVEL value is 0.00V. To change the trigger LEVEL value, the trigger LEVEL function must be enabled.

The ABOVE LEVEL function is not available for the EQUIVALENT TIME SAMPLING timebase mode.

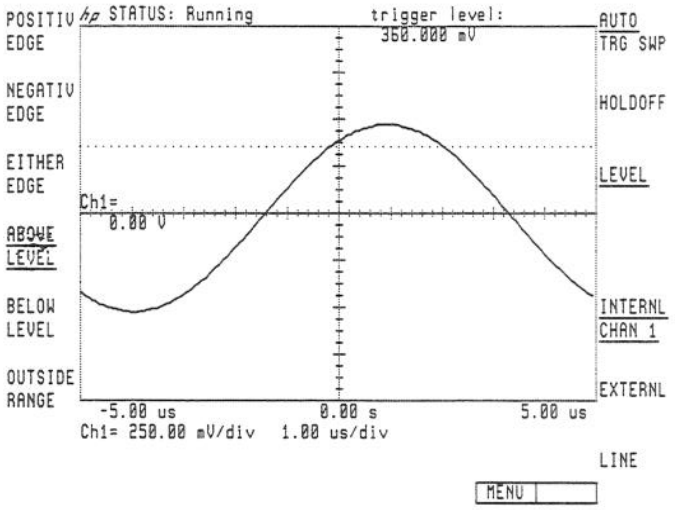

Figure 2-31. ABOVE LEVEL Triggered Waveform

BELOW LEVEL

BELOW LEVEL allows a measurement to be triggered at any value below the set trigger LEVEL value for INTERNAL CHANNEL 1 trigger sources only. The maximum level at which a trigger occurs is indicated by the marker.

When *BELOW LEVEL* is enabled, the preset trigger LEVEL value is 0.00V. To change the trigger LEVEL value, the trigger LEVEL function must be enabled.

The BELOW LEVEL function is not available for the EQUIVALENT TIME SAMPLING timebase mode.

OUTSIDE RANGE

OUTSIDE RANGE allows a measurement to be triggered at any value outside of the specified ranges of trigger LEVEL 1 and trigger LEVEL 2, which are indicated by markers and is only available for INTERNAL CHANNEL 1 trigger sources.

Both values of trigger LEVEL 1 and trigger LEVEL 2 can be set independently of each other by using the respective softkey functions.

The OUTSIDE RANGE function is not available for the EQUIVALENT TIME SAMPLING timebase mode.

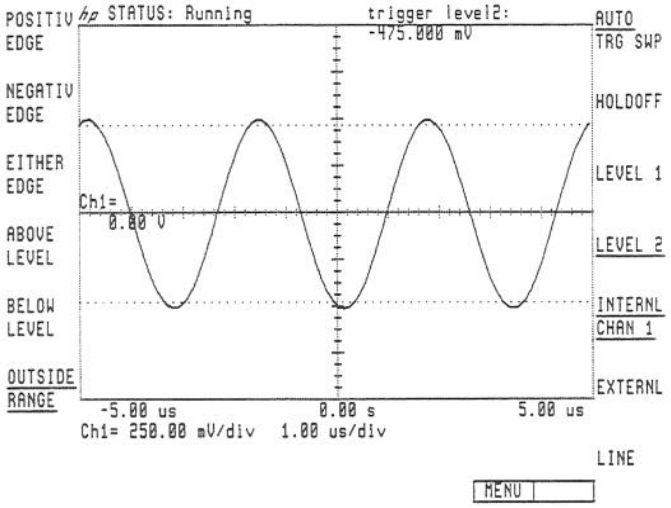

Figure 2-32. OUTSIDE RANGE Triggering

LEVEL 2

The *LEVEL 2* softkey function, in conjunction with the *LEVEL 1* softkey function, sets the specified range for the OUTSIDE RANGE function.

The trigger LEVEL 2 function is only available when OUTSIDE RANGE is enabled.

Both values of trigger LEVEL 1 and trigger LEVEL 2 are preset to 0.00V. Their values may be changed independently of each other by using the respective softkeys. Markers will indicate the values at which these trigger levels are set.

Data Input

The numeric key pad directly enters any number which must be terminated with the *V* or *mV* softkey.

The step up/down keys change the LEVEL 2 value in increments of one division.

The RPG knob changes the LEVEL 2 value in increments of 1% of the VOLTS/DIVISION setting.

SINGLE SWEEP

The *SINGLE SWEEP* softkey arms the trigger for a single measurement with the currently defined setup parameters (e.g., VOLTS/DIVISION, trigger LEVEL, etc.).

When *SINGLE SWEEP* is enabled, the trigger criteria must be met to make the measurement, and then the results are displayed.

CONTINUOUS SWEEP

CONT SWEEP continuously arms the trigger for repetitive measurements with the currently-defined setup parameters (e.g., VOLTS/DIVISION, trigger LEVEL, etc.).

DISPLAY FUNCTIONS

Display Functions allow the user to format the display screen graticule, and to determine trace length and number of averaged traces. The *display* softkey on the Main Menu is used to access the Display Functions softkey menu. See Figure 2-33.

The DISPLAY softkey functions are briefly described below, and in more detail following the Overview section.

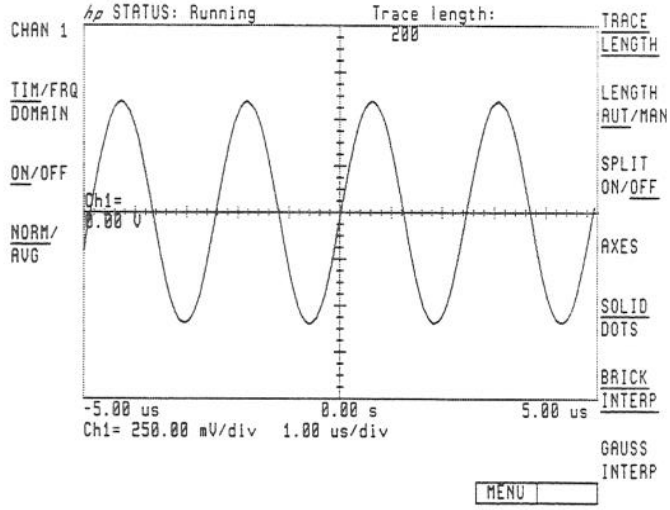

Figure 2-33. DISPLAY Softkey Menu

OVERVIEW

TRACE LENGTH enables the trace length to be entered manually.

LENGTH AUT/MAN couples or decouples the SECONDS/DIVISION and TRACE LENGTH functions.

SPLIT ON/OFF selects a full- or split-screen display.

AXES/FRAME/GRID allows selection of one of three sets of vertical and horizontal lines that format the display screen.

SOLID/DOTS displays a waveform as a continuous solid trace or as discrete dots.

BRICK INTERP selects a brick-wall filter to be used in the interpolation algorithm for reconstructing the displayed waveform.

GAUSS INTERP selects a Gaussian filter to be used in the interpolation algorithm for reconstructing the displayed waveform.

CHAN X/FUNC X/MEM X allows selection of available channels, functions, or memories with previously stored data only.

TIM/FRQ DOMAIN selects either the time or frequency domain for displaying sampled data measurements.

UNIFORM is one window selection used by the FFT (fast Fourier Transform) algorithm, when the FREQUENCY domain is enabled.

HANNING is one window selection used by the FFT algorithm, when the FREQUENCY domain is enabled.

FLATTOP is one window selection used by the FFT algorithm, when the FREQUENCY domain is enabled.

ON/OFF, *TOP/BOT/OFF* turns on or off the displayed trace data of the indicated channel, function, or memory via the CHANNEL X/FUNCTION X/MEMORY X function above, for either a full- or split-screen display.

NORM/AVG enables and disables the trace averaging function and is available only for Channel 1 through Channel 4.

TRACE LENGTH

TRACE LENGTH allows the value of the trace length to be entered manually. If *TRACE LENGTH* is selected, entering a value automatically enables the MANUAL mode of the LENGTH AUTO/MANUAL function.

The TRACE LENGTH function determines the number of data points to be sampled and saved, which can be up to a maximum of the available memory. Only 1024 of these points may be displayed at a time. Therefore, if more than 1024 data points are sampled, the detector mode will determine which data points are used for later display. Refer to the example below.

Data Input

The numeric key pad directly enters any number that is rounded off to the nearest whole number and must be terminated with the *ENTER* softkey.

The step up/down keys change the value of the trace length by 50.

The RPG knob changes the value of the trace length by one.

Example:

If the TRACE LENGTH is set to 15 000, only 1000 points are displayed. To display 1000 points, each sampled interval consists of 15 points.

Using the four detector modes, the number of points that will be displayed are as follows:

SAMPLE: every 15th point is retained to display 1000 points.

POSITIVE PEAK: the highest value out of each group of 15 is retained to display 1000 points.

NEGATIVE PEAK: the lowest value out of each group of 15 is retained to display 1000 points.

ALTERNATE PEAK: alternately, the highest or lowest value out of each group of 30 is retained to display 1000 points.

Refer to Figures 2-34 through 2-37 below for illustrated examples of the above TRACE LENGTH, set using the four detector modes.

For more detailed information on the detector modes, refer to the individual softkey descriptions in the Measurement Control Functions section of this chapter.

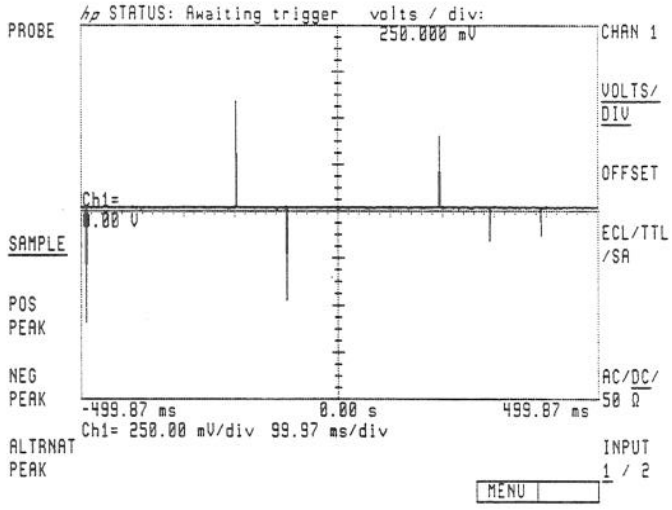

Figure 2-34. SAMPLE Detector Mode

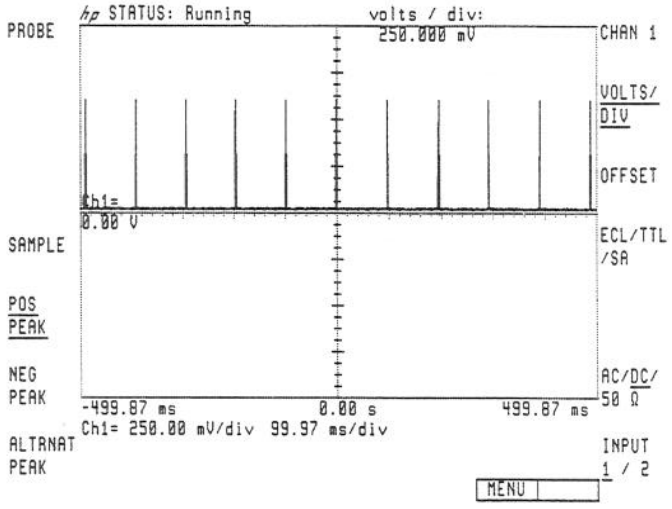

Figure 2-35. POSITIVE PEAK Detector Mode

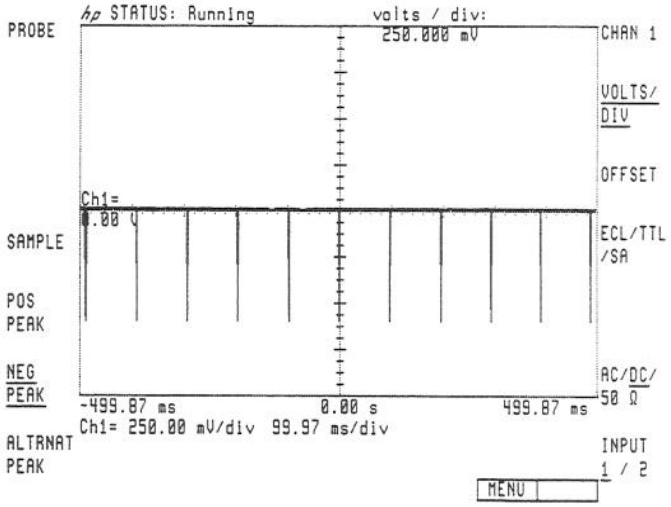

Figure 2-36. NEGATIVE PEAK Detector Mode

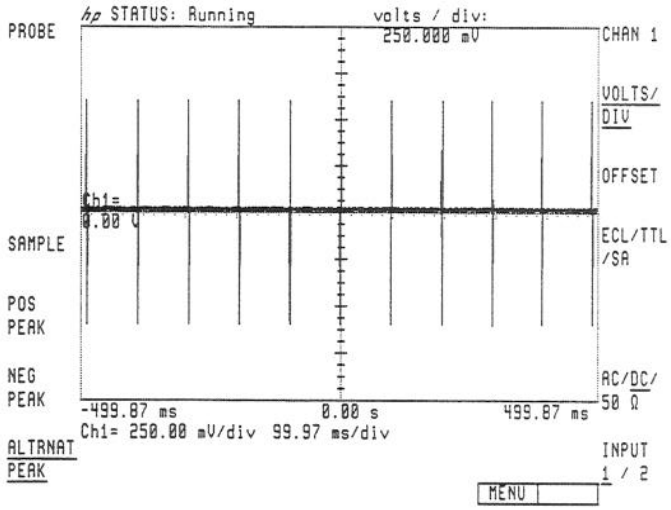

Figure 2-37. ALTERNATE PEAK Detector Mode

LENGTH AUTO / MANUAL

The *LENGTH AUT/MAN* softkey couples and decouples the SECONDS/DIVISION and TRACE LENGTH functions.

At instrument preset, the AUTO mode is enabled and the TRACE LENGTH is directly coupled to the SECONDS/DIVISION function. Therefore, changing the SECONDS/DIVISION function can change the trace length indirectly. Since the SECONDS/DIVISION and TRACE LENGTH functions are coupled, the digitizer attempts to set the trace length points to $500 \leq$ number of points ≤ 1000. If this cannot be achieved, then the digitizer sets the number of points between a minimum of 20 and a maximum allowed by available memory.

If the trace length is greater than 1024, then a "compression" algorithm is used on the data that is sent to the display so that 1024 points or less are displayed. When the trace is queried via a remote controller, all data points are sent.

When the MANUAL mode is enabled, the SECONDS/DIVISION function can be changed without affecting the trace length. If the trace length needs to be changed at this time, the *TRACE LENGTH* softkey must be enabled and the desired value entered. Refer to the TRACE LENGTH softkey description below for more information on setting the trace length.

Hint:

- In the MANUAL mode, there is a restriction on the SECONDS/DIVISION function that is based on the following:

$$\text{SECONDS/DIVISION} = (\text{TRACE LENGTH} \div 10) \times 50\ \text{ns} \times \text{N}$$

Example:

If the trace length is manually set to 250, the SECONDS/DIVISION function defaults to 1.25 µs/division, the restricted minimum sweep rate.

$$\text{SECONDS/DIVISION} = (250 \div 10) \times 50\ \text{ns} = 1.25\ \mu\text{s/division}$$

SPLIT ON/OFF

SPLIT ON/OFF selects a full- or split-screen display.

Either half of a split-screen display can display functions (e.g., CHAN 1 + CHAN 2) or anything saved in MEMORY.

The following restriction applies to either a full- or split-screen display:

> The number of digitizers configured in a system determines the number of channels available for display. In addition, one function and one memory may also be displayed at the same time the channel(s) is displayed.

The SPLIT ON/OFF function operates in conjunction with the ON/OFF, TOP/BOTTOM/OFF function for displaying the available channels, functions, and memory displays.

Example:

Figure 2-38 demonstrates the SPLIT-screen display. In the upper screen, Channel 1 is displayed in normal operation. In the lower screen, trace data that was stored in MEMORY 1 is displayed. Note that the *waveform save* softkey must be enabled to access the MEMORY softkey function that saves trace data, and the *display* softkey on the Main Menu must be enabled to access the softkey functions that display trace data from MEMORY.

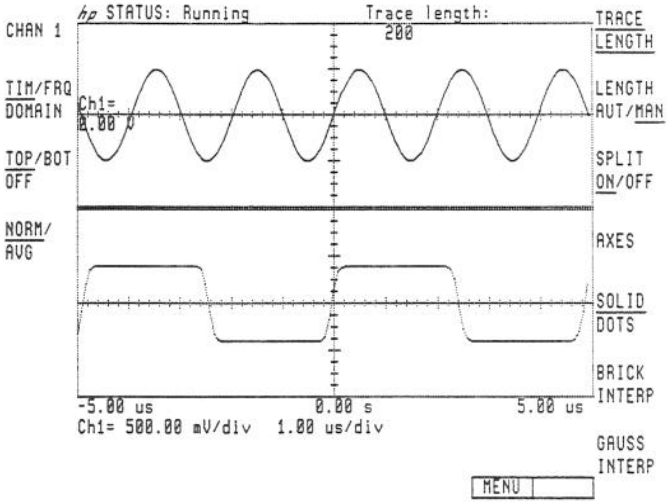

Figure 2-38. SPLIT-Screen Display ON

AXES / FRAME / GRID

The *AXES/FRAME/GRID* softkey function allows selection of three sets of vertical and horizontal lines that format the display screen.

AXES superimposes one set of vertical and horizontal lines on the display screen. FRAME superimposes lines that border the edges of the display screen. GRID superimposes evenly-spaced vertical and horizontal lines on the display screen.

All three sets of display graticule formats are available for use in both the time and frequency domains. However, the GRID display graticule is designated in an 8 × 10 division form when all traces are in the TIME domain, and 10 × 10 divisions when any trace is in the FREQUENCY domain.

Refer to Figures 2-39 through 2-41 for illustrated examples of the three sets of display graticules.

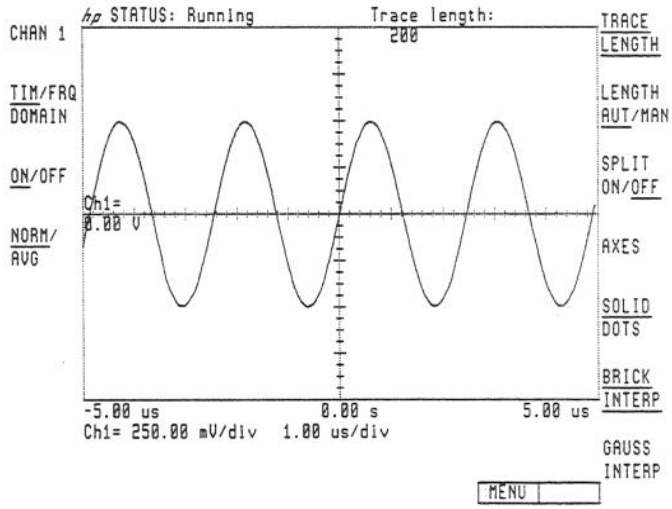

Figure 2-39. AXES Display Graticule

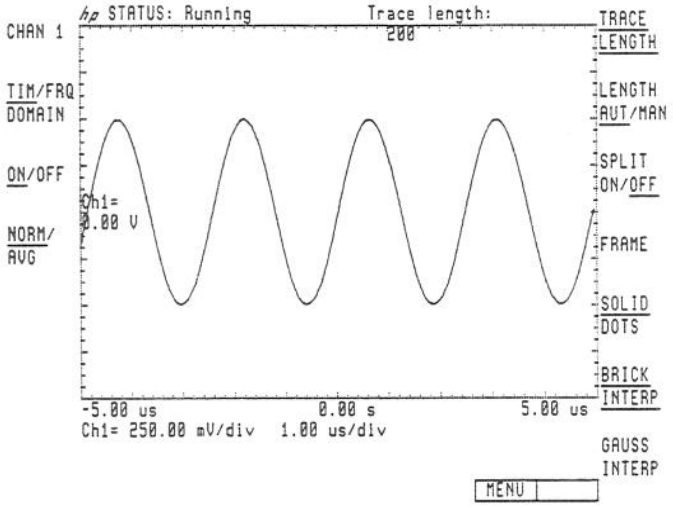

Figure 2-40. FRAME Display Graticule

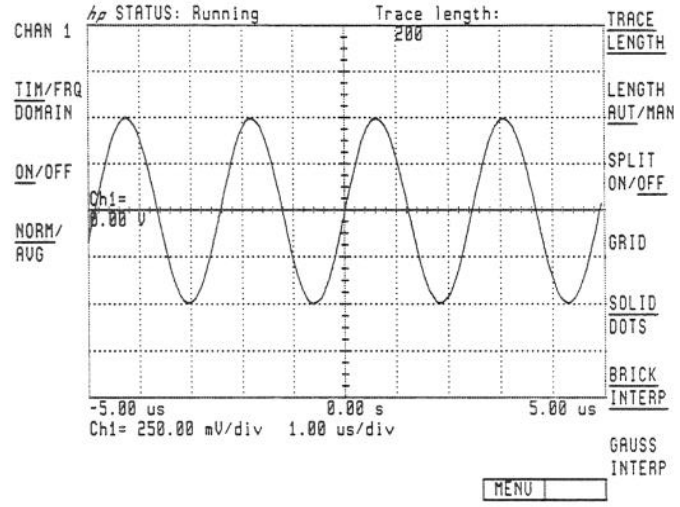

Figure 2-41. GRID Display Graticule

SOLID / DOTS

SOLID/DOTS displays a waveform as a continuous solid trace or as discrete dots. The dotted line represents actual data points that were sampled, while the solid trace results from joining the dots with straight line segments.

A maximum number of available memory data points may be sampled, but only 1024 data points or less may be displayed at any time. Each of the displayed data points corresponds directly to a data point that has actually been sampled. The number of data points for sampling may be selected by using the TRACE LENGTH function. Refer to the TRACE LENGTH softkey description above.

NOTE

Display Dot Generator release 3.2 or later must be installed in the display instrument when using the DOTS mode. To determine the Display Dot Generator release version, press the [DISPLAY] key on the display front panel, then press the *DISPLAY TESTS* softkey, and finally press the *DISPLAY ID* softkey.

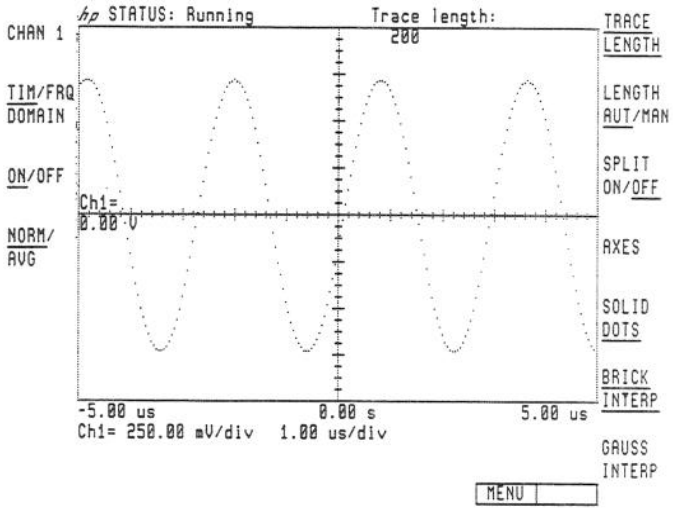

Figure 2-42. DOTS Display ON

BRICK INTERPOLATION or GAUSSIAN INTERPOLATION

The BRICK and GAUSSIAN INTERPOLATION functions provide a more accurate graphic representation of the displayed waveform at faster sweep rates. This is achieved by up-sampling (increasing the sampling density of) the digitized waveform by zero-insertion, then passing the up-sampled waveform through either a brick-wall or Gaussian digital, finite impulse-response filter. The filtering serves to "interpolate" the inserted samples to appropriate values.

To enable either of the interpolation functions, press the desired softkey so that it is underlined. To disable the function, press the softkey again. At instrument preset, the BRICK INTERPOLATION function is

enabled but may not be in operation, depending on the TRACE LENGTH and SECONDS/DIVISION functions. An "i" will be displayed below the bottom graticule line only when one of the interpolators is in actual operation.

When the interpolators are not enabled, the fastest SECONDS/DIVISION setting that may be obtained is 100 ns with a TRACE LENGTH of 20 points. This is based on the following:

$$\text{SECONDS/DIVISION} = (\text{TRACE LENGTH} \div 10) \times 50 \text{ ns}$$

Therefore, a faster sweep rate with a larger TRACE LENGTH may not be obtainable.

For the best display of a waveform without the use of the interpolators, a TRACE LENGTH of 200 points or greater is preferred. But since the displayed waveform is dependent on the above equation, the fastest sweep rate that may be obtained with a 200-point TRACE LENGTH is 1.0 µs. The use of the interpolators offers a solution for displaying waveforms of faster sweep rates and smaller TRACE LENGTHs.

When the interpolators are enabled, another variable enters into the above equation: n ÷ m, which is the ratio of *n* sample points that produce some number of *m* output points. This ratio determines how many points are actually measured, while the TRACE LENGTH determines the actual number of points that are displayed.

$$\text{SECONDS/DIVISION} = \text{TRACE LENGTH} \times 50 \text{ ns} \times (n \div m)$$

$$\text{where } 1 \leq n \leq m \leq 16$$

The interpolator algorithm thus allows a faster sweep rate, and sweep rates that are not integer multiples of the clock, to be obtained for a given TRACE LENGTH.

The *BRICK INTERP* softkey selects an interpolation algorithm that uses a brick-wall filter for reconstructing the displayed waveform. The *GAUSS INTERP* softkey selects an interpolation algorithm that uses a Gaussian filter for reconstruction of the displayed waveform.

Due to the nature of the filters, the brick-wall filter has more usable bandwidth than the Gaussian filter. The sharp cutoff of the brick-wall filter eliminates high-order harmonics of sharp edges which results in ringing on the displayed waveform. When using the Gaussian filter, the gradually increasing attenuation of higher-order harmonics of sharp edges produces smoother and more rounded edges on the displayed waveform.

Example:

Two sets of examples using the two interpolator filters are shown below.

Figures 2-43, 2-44, and 2-45 demonstrate the effects of each interpolator filter on a square wave. Figures 2-46, 2-47, and 2-48 demonstrate their effects on a sine wave. The first figure of each set displays the uninterpolated waveform.

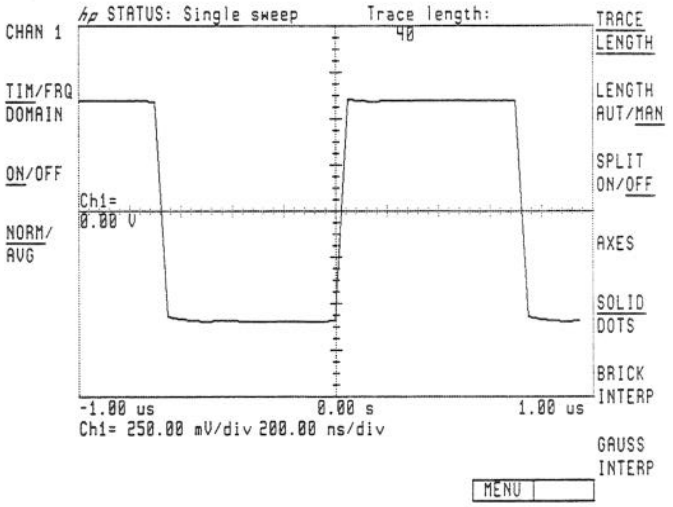

Figure 2-43. Uninterpolated Square Wave

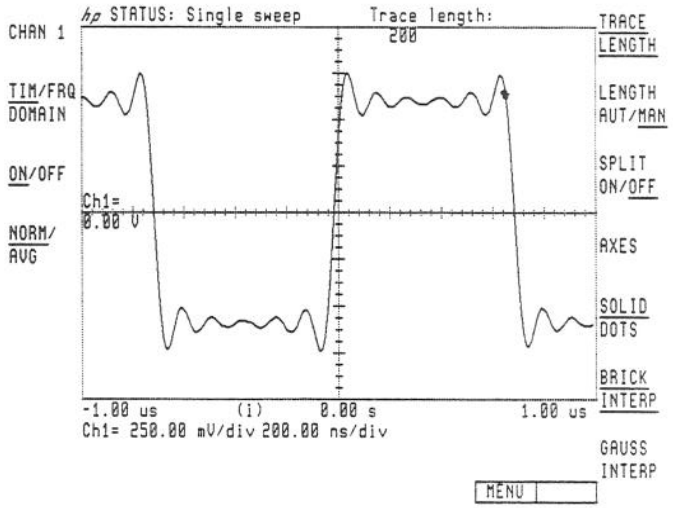

Figure 2-44. Square Wave with Brick Interpolation

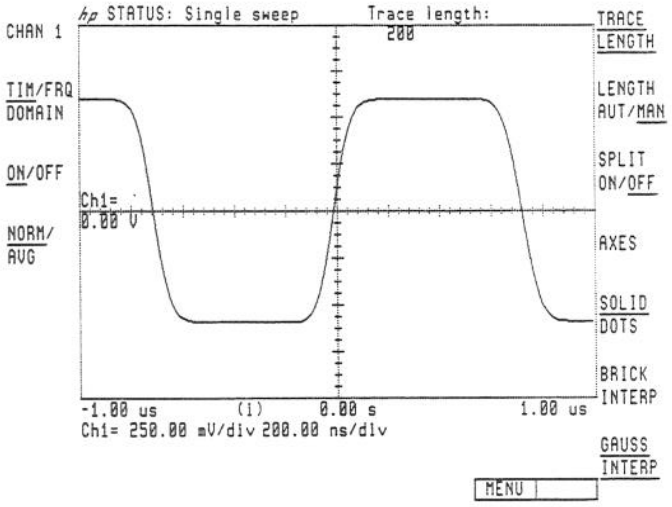

Figure 2-45. Square Wave with Gaussian Interpolation

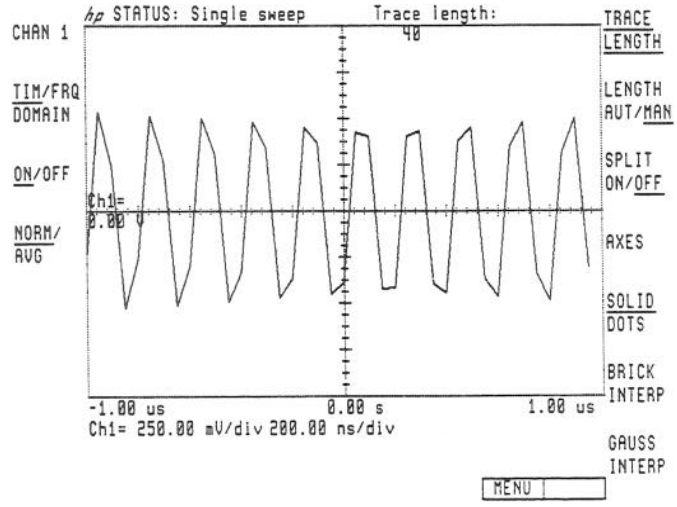

Figure 2-46. Uninterpolated Sine Wave

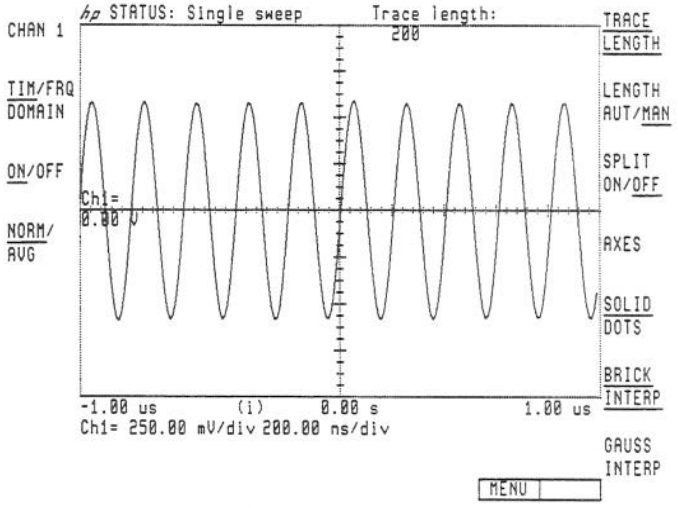

Figure 2-47. Sine Wave with Brick Interpolation

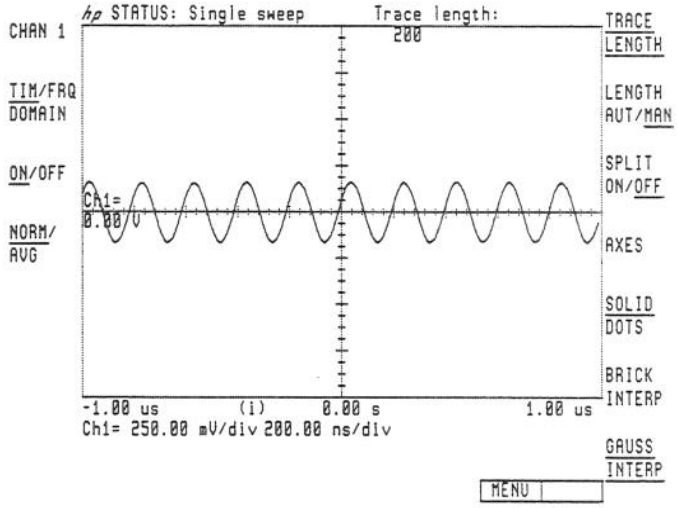

Figure 2-48. Sine Wave with Gaussian Interpolation

CHANNEL X / FUNCTION X / MEMORY X

The *CHAN X/FUNC X/MEM X* softkey function allows selection of available channels, functions, or memory registers with previously-stored trace data to be viewed. Pressing this softkey repeatedly displays the available channels, functions, and memory registers.

This softkey function also serves as the selection key for the softkeys located directly below it: *TIM/FRQ DOMAIN*, *ON/OFF* or *TOP/BOT/OFF*, or *NORM/AVG* softkeys for the channel, function, and memory displays. For each channel, function, or memory display selected, all of the above softkey functions are available.

When the display of the selected channel, function, or memory is ON, the following annotation located below the bottom graticule line pertains only to the selected display: the left, center, and right graticule timebase reference, the SECONDS/DIVISION setting, the VOLTS/DIVISION setting, and the interpolation indicator ("i"). See Figure 2-49 for an example of a waveform saved in MEMORY 2 and its related annotation.

When a memory register is displayed, it is designated by "Me" followed by the memory number (e.g., Me3) which indicates the voltage OFFSET and the VOLTS/DIVISION setting that are located at the center-right and lower-right graticule edges. For a function, the annotation is designated by "Fn" followed by the function number. When Channel 1 is displayed, it will always be designated by "Ch1" at the center-left and lower-left graticule edges.

When one digitizer is configured in a system, one channel, one function, and one memory register may all be displayed simultaneously or sequentially. However, only one set of annotation (located below the graticule) may be displayed at one time, with the exception of the VOLTS/DIVISION setting of one other channel, function, or memory.

This function operates in conjunction with the ON/OFF, TOP/BOTTOM/OFF function described below for selecting the indicated channel, function, or memory register to be turned on and off.

When one digitizer is configured in a system, a maximum of one channel, one function, and one memory register may be displayed at one time. When two to four digitizers are configured in a system, a maximum of two to four channels (respectively), one function, and one memory register may be displayed at one time.

Hints:

- Channel 1 is always available with at least one digitizer configured in the system.
- Trace data must be previously stored in a memory register before the memory register is available for viewing.
- The maximum number of channels, functions, and memory registers may be displayed at one time, but the annotation only pertains to the currently-indicated display.

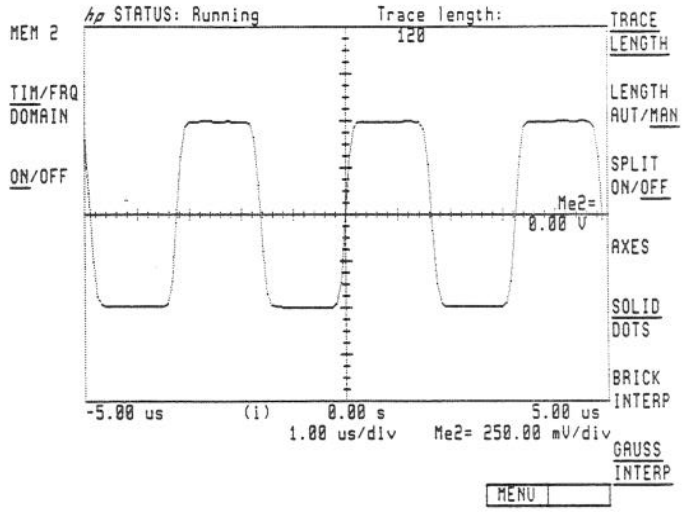

Figure 2-49. MEMORY 2 and Related Annotation

TIME / FREQUENCY DOMAIN

The *TIM/FRQ DOMAIN* softkey allows selection of either the time or frequency domain for displaying sampled data measurements. The time domain displays data as amplitude versus time and the frequency domain displays data as a logarithmic amplitude versus frequency.

When the instrument is preset, the time domain mode is active and all references to the horizontal axis are related to time (e.g., timebase is measured in SECONDS/DIVISION).

When the FREQUENCY domain is enabled, an FFT is performed periodically to translate the data from the time domain to the frequency domain. Also, all references to the horizontal axis are related to frequency. The range of frequencies displayed is the stop frequency (or frequency span) and is indicated at the lower-right graticule edge.

When in the FREQUENCY domain, the GRID display graticule has a vertical range of 100 dB; the sensitivity per division is annotated in the lower-left portion of the display screen.

Refer to Figures 2-50 and 2-51 for examples of a waveform displayed in the TIME domain and then in the FREQUENCY domain.

UNIFORM, HANNING, and FLATTOP Windows

The UNIFORM, HANNING, and FLATTOP windows are used by the FFT algorithm when translating data from the time domain to the frequency domain.

NOTE

The UNIFORM, HANNING, and FLATTOP windows are only available when operating the instrument in the frequency domain.

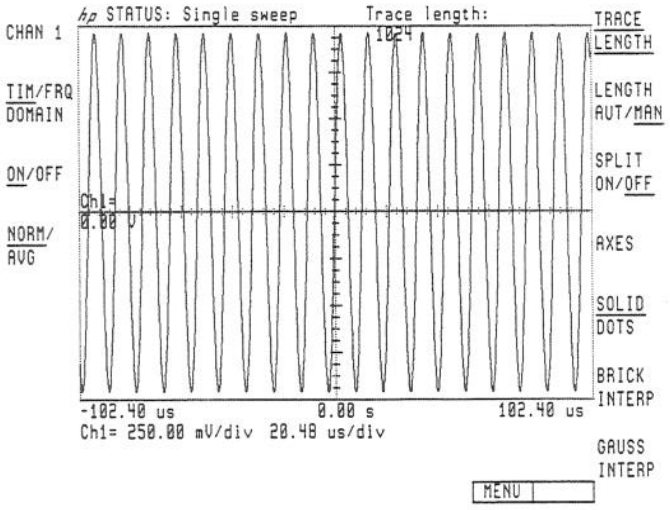

Figure 2-50. TIME Domain

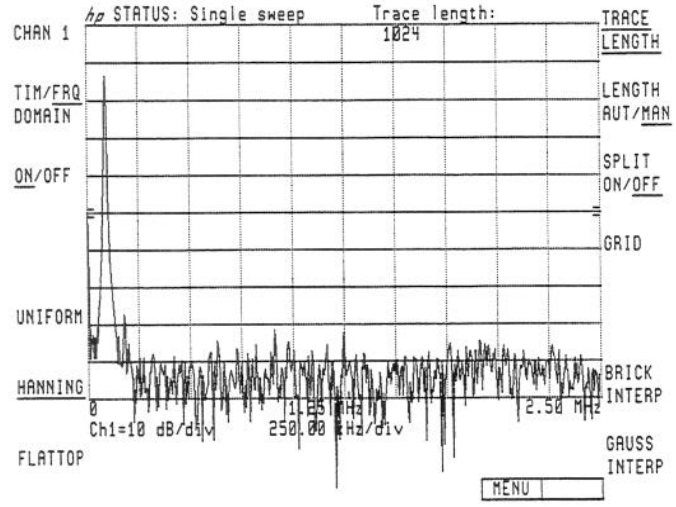

Figure 2-51. FREQUENCY Domain

When the FREQUENCY domain is enabled for the first time, the HANNING window is the default window used by the FFT.

The effect of the window on the frequency domain representation is most easily demonstrated for sinusoidal signals. Suppose the input to the digitizer is a pure sine wave. Then the window controls the shape and size of the main lobe and side lobes of the display in the FREQUENCY domain. This is accomplished when an FFT is performed to translate data from the time domain to the frequency domain. When the sampled time domain waveform is truncated to a finite number of data points, it is the same as multiplying the waveform by a rectangular window. Each window achieves a different compromise between the narrowness of the main lobe (frequency resolution) and attenuation of the side lobes.

The *UNIFORM* softkey selects the rectangular window for use by the FFT algorithm.

With a sine wave input of 85.0 kHz, Figure 2-52 shows the frequency domain trace obtained using a UNIFORM window. Note the narrow main lobe at 85.0 kHz, and the relatively high side lobes that are characteristic of a UNIFORM window.

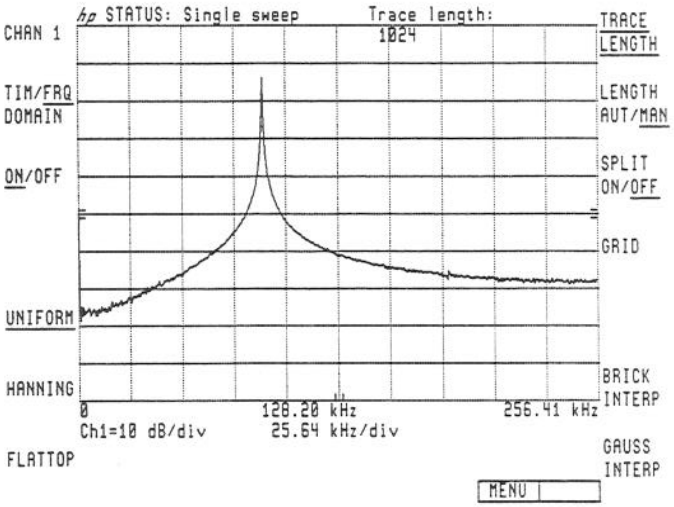

Figure 2-52. UNIFORM Window

The *HANNING* softkey selects a HANNING window for use by the FFT algorithm.

Using the same sinusoidal input of Figure 2-52, the HANNING window produces a trace with lower side lobes, but with a wider main lobe. See Figure 2-53.

The *FLATTOP* softkey selects a FLATTOP window for use by the FFT algorithm. Relative to the HANNING window, this produces a trace with a wider main lobe and lower side lobes. See Figure 2-54.

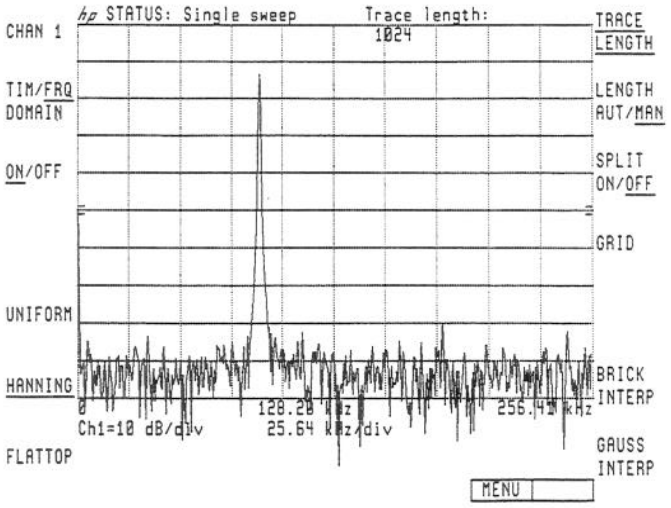

Figure 2-53. HANNING Window

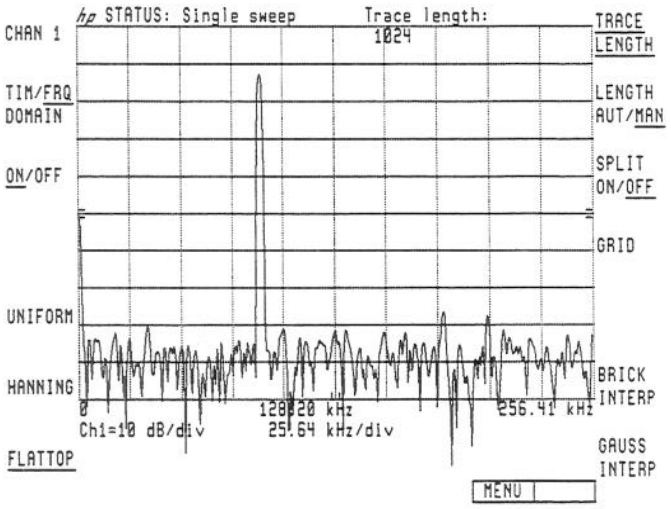

Figure 2-54. FLATTOP Window

ON / OFF or TOP / BOTTOM / OFF

The *ON/OFF* softkey turns on and off the indicated channel, function, or memory register on a full-screen display. Figure 2-55 displays CHANNEL 1 and MEMORY 3 on a full-screen display.

The *ON/OFF* softkey automatically becomes the *TOP/BOTTOM/OFF* softkey when the split-screen display is selected. The TOP/BOTTOM/OFF softkey function positions the indicated channel, function, or memory register in either the top or bottom portion of a split-screen display, or alternatively blanks it. Figure 2-56 displays CHANNEL 1 in the top portion of a split-screen display and MEMORY 3 in the bottom portion.

This function operates in conjunction with the CHANNEL X/FUNCTION X/MEMORY X function described above for turning on and off the indicated channel, function, or memory register.

When one digitizer is configured in a system, a maximum of one channel, one function, and one memory register may be displayed at one time. When two to four digitizers are configured in a system, a maximum of two to four channels (respectively), one function, and one memory register may be displayed at any one time.

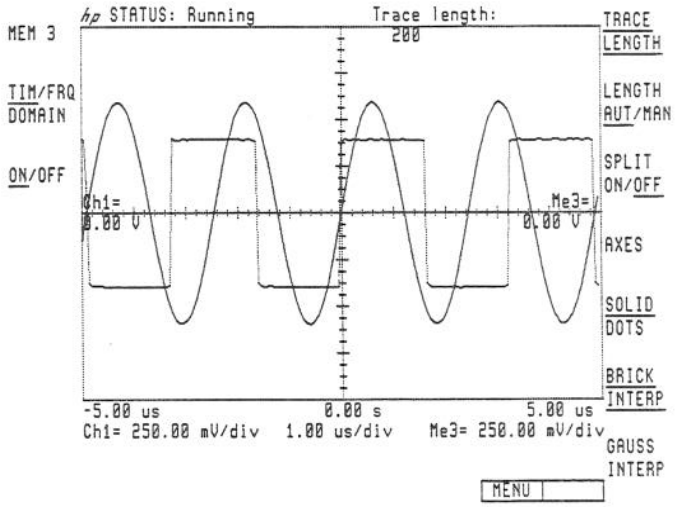

Figure 2-55. CHANNEL 1 and MEMORY 3 on a Full-Screen Display

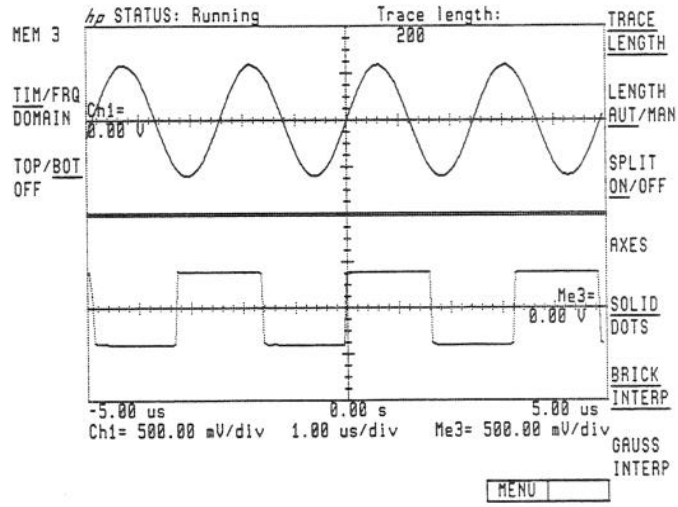

Figure 2-56. CHANNEL 1 and MEMORY 3 on a Split-Screen Display

NORMAL / AVERAGE

The *NORM/AVG* softkey enables and disables the trace-averaging function and is only available in the time domain.

When the AVERAGE mode is enabled, the number of averaged traces may be selected. The traces averaged are always the most recent traces (or sweeps) taken. This method of averaging traces is also known as a "moving average filter".

To disable the AVERAGE mode, the NORMAL mode must be selected.

Data Input

The numeric key pad directly enters any number which must be terminated with the *ENTER* softkey.

The step up/down keys change the number of averaged traces by 10.

The RPG knob changes the number of averaged traces by one.

Example:

Figure 2-57 displays a waveform with noise. To help decrease the noise level, Figure 2-58 displays the same waveform with 20 traces averaged.

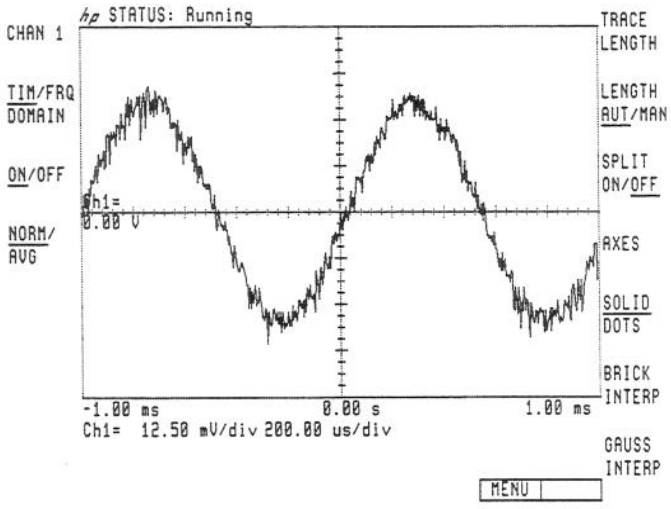

Figure 2-57. Waveform to be AVERAGED

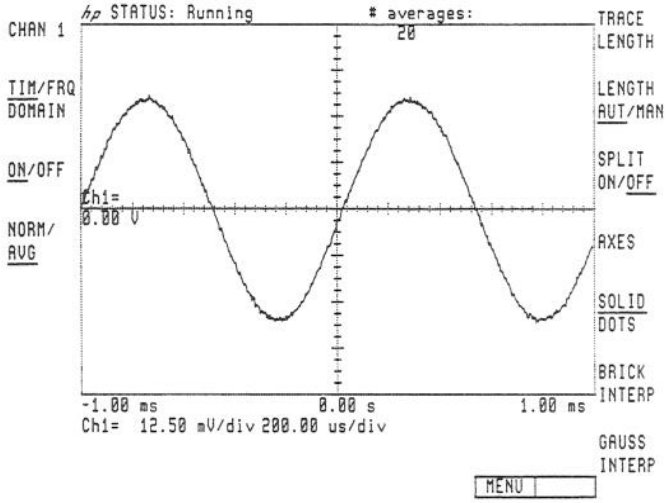

Figure 2-58. AVERAGED Waveform

MARKER FUNCTIONS

Marker Functions allow the user to use time and voltage markers for making measurements. The *markers* softkey on the Main Menu accesses the Marker Functions menu. See Figure 2-59.

The MARKER softkey functions are briefly described below, and in more detail following the Overview section.

NOTE

The MARKER functions are only available when operating the instrument in the time domain.

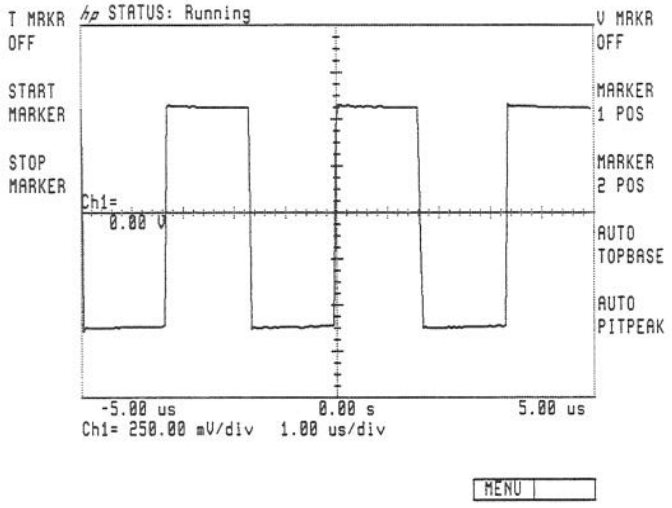

Figure 2-59. MARKERS Softkey Menu

OVERVIEW

V MRKR OFF/CHAN X/FUNC X/MEM X turns on or off the display of voltage MARKERs 1 and 2 on the selected channel, function, or memory display.

MARKER 1 POS selects and activates voltage MARKER 1 for repositioning.

MARKER 2 POS selects and activates voltage MARKER 2 for repositioning.

AUTO TOPBASE automatically sets the voltage markers to the waveform top and base that correspond to the histogram peaks of the waveform.

AUTO PITPEAK automatically sets the voltage markers to the maximum and minimum amplitudes of the waveform.

0-100 enables any one of four percentages (0—100, 10—90, 20—80, and 50—50) to use the voltage markers for performing simple math functions.

T MRKR OFF/ON/FUNC X/MEM X turns on or off the display of the START and STOP time markers on the selected channel, function, or memory display.

START MARKER activates the START MARKER (time MARKER 1) for repositioning.

STOP MARKER activates the STOP MARKER (time MARKER 2) for repositioning.

START POS/NEG positions the START marker at a specified intersection of voltage MARKER 1 and the waveform.

STOP POS/NEG positions the STOP marker at a specified intersection of voltage MARKER 2 and the waveform.

MAGNIFY ON/OFF enables and disables the function that expands the area set by the START and STOP markers to full-screen.

MAGNIFY DELAY allows repositioning of the MAGNIFY function anywhere on the displayed waveform.

VOLTAGE MARKERS OFF / CHANNEL X / FUNCTION X / MEMORY X

The *V MRKR OFF/CHAN X/FUNC X/MEM X* turns on or off the display of voltage MARKERS 1 and 2 on the selected channel, function, or memory display. The annotation related to the voltage markers is also turned off and on by this softkey. See Figure 2-60.

This softkey function also serves as the selection key for both the voltage and time markers for the channel, function, and memory displays. That is, if the voltage markers are positioned on the channels, the time markers can only be positioned on the channels.

For example, when the voltage markers are displayed on Channel 1 and then the time markers are turned on, the time markers are automatically positioned on the Channel 1 display. If the voltage markers are then moved to a memory display, the time markers also move to the selected memory display.

The difference between the two voltage marker settings is indicated by the "dV" (delta voltage) annotation at the bottom of the display screen.

When the instrument is preset, the voltage markers are preset to ±500 mV.

To reposition the voltage markers, the *MARKER 1 POS* or *MARKER 2 POS* softkey must be selected to activate the desired marker. Refer to the individual softkey descriptions below for more information on how to reposition the voltage markers.

After the voltage markers have been activated, setting the VOLTAGE MARKERS function to OFF will disable their function and display.

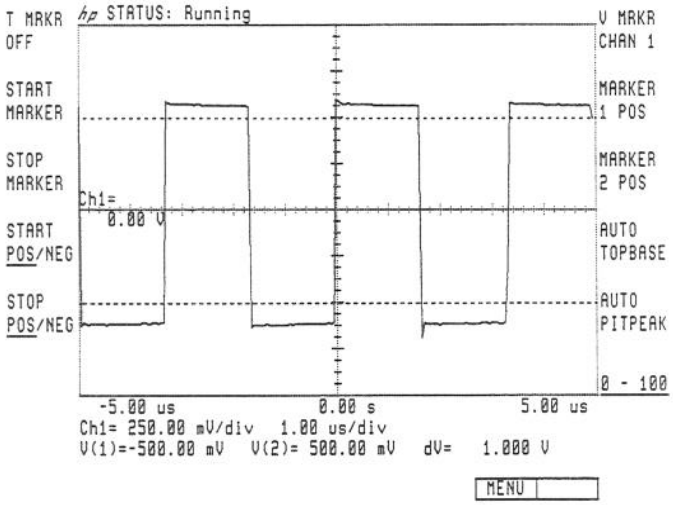

Figure 2-60. Voltage MARKERS ON

MARKER 1 or MARKER 2 POSITION

The *MARKER 1 POS* or *MARKER 2 POS* softkey activates the selected voltage marker for repositioning.

When selected, either of these softkeys supersedes the VOLTAGE MARKERS function by automatically displaying both voltage markers and their annotation.

When the instrument is preset, voltage MARKER 1 is positioned at −500 mV and voltage MARKER 2 is positioned at +500 mV. Refer to the annotation below the graticule for the current position settings of the voltage markers.

Setting the VOLTAGE MARKERS function to OFF turns off the display and annotation of the voltage markers.

Data Input

The numeric key pad directly enters any number which must be terminated with the *V* or *mV* softkey.

The step up/down keys reposition the voltage markers in 1 division increments.

The RPG knob repositions the voltage markers in 1% increments of full-range (i.e., number of divisions multiplied by the VOLTS/DIVISION setting).

AUTO TOPBASE

AUTO TOPBASE automatically sets voltage MARKERS 1 and 2 to the top and base of the waveform.

A histogram of specific amplitude values of the waveform is used to determine the top and base of the waveform. The top and base values correspond to peaks in the histogram, which are a measure of the greatest number of occurrences at specific amplitude values. Thus, the voltage markers are placed at these top and base values when *AUTO TOPBASE* is pressed. See Figure 2-61.

When selected, *AUTO TOPBASE* supersedes the VOLTAGE MARKERS function by automatically displaying both voltage markers and their annotation.

Setting the VOLTAGE MARKERS function to OFF turns off the display and annotation of the voltage markers.

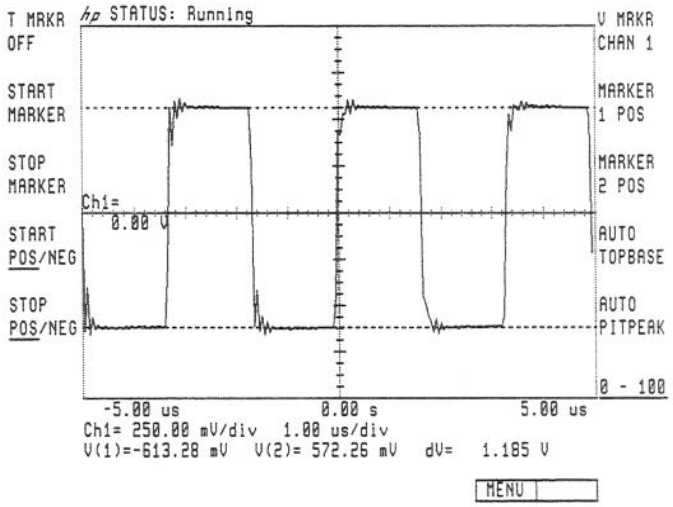

Figure 2-61. AUTO TOPBASE Enabled

AUTO PITPEAK

The *AUTO PITPEAK* softkey function automatically sets voltage MARKERS 1 and 2 to the absolute maximum and minimum amplitude values of the waveform. The maximum and minimum amplitude values include any noise that may be displayed as "spikes".

When selected, *AUTO PITPEAK* supersedes the VOLTAGE MARKERS function by automatically displaying both voltage markers and their annotation.

Setting the VOLTAGE MARKERS function to OFF turns off the display and annotation of the voltage markers.

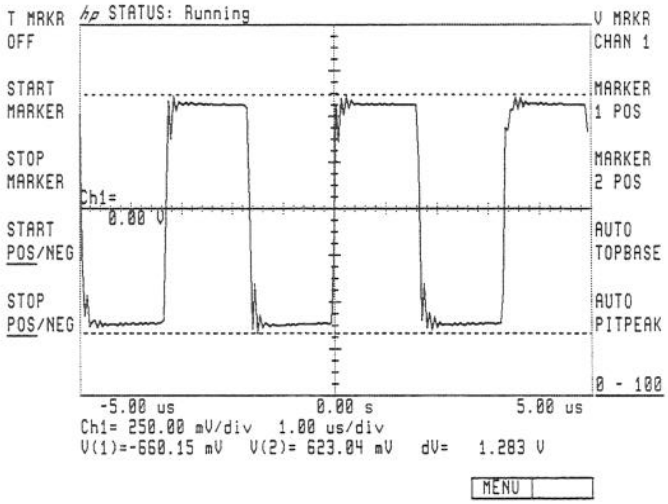

Figure 2-62. AUTO PITPEAK Enabled

0—100, 10—90, 20—80, 50—50 PERCENTAGES

The *0-100* softkey enables access of four preset percentages used by the voltage markers to perform simple math functions on the displayed waveform.

The reference for all the percentages is based on the voltage marker positions with the *0-100* softkey active. While in the 0—100 percent range, the voltage markers may be positioned at any two points as references. The other three percentage ranges are then based on these positions.

The difference between the two voltage marker settings is indicated by the "dV" annotation near the lower right of the display screen. The voltage marker positions are indicated by the V(1) and V(2) annotation located at the bottom of the display screen.

NOTE

The 0—100 PERCENTAGE softkey function is only available when the voltage markers are enabled.

Example:

When the *0-100* softkey function is enabled and the voltage markers are placed at the minimum and maximum amplitude points of a waveform (by using *AUTO TOPBASE*), this is referred to as the reference. Selecting the *10-90* softkey function at this time automatically moves the voltage markers to the 10% and 90% levels of the waveform. The 10% and 90% levels are positioned with respect to the 0% and 100% reference levels. Refer to Figures 2-63 and 2-64 for displayed examples.

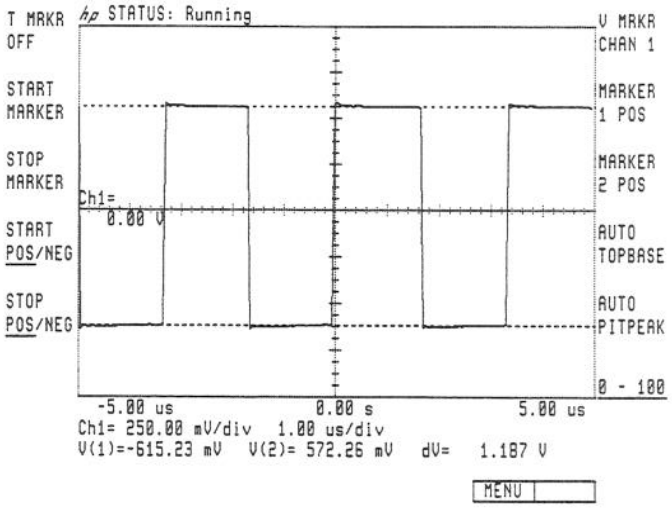

Figure 2-63. Voltage Markers at 0—100%

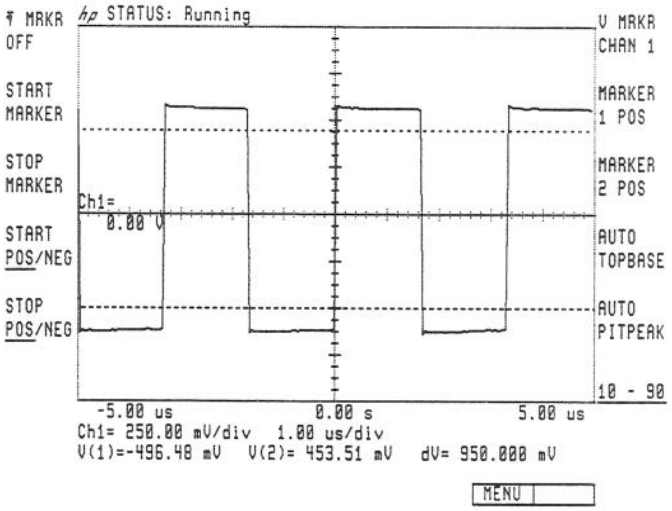

Figure 2-64. Voltage Markers at 10—90%

TIME MARKERS OFF / ON / FUNCTION X / MEMORY X

The *T MRKR OFF/ON* turns on or off the display of the START and STOP time markers on the selected channel, function, or memory display. The annotation related to the time markers is indicated by T(1) and T(2) and is also turned off and on by this softkey. See Figure 2-65.

The time markers are turned on independently of the voltage markers, but their display on a channel, memory, or function is dependent on the VOLTAGE MARKERS function.

When the voltage markers are either off or displayed on a channel, the time markers can be displayed on a channel. However, when the voltage markers are displayed on a memory or function, the time markers can only be displayed on the same memory or function. For example, if the voltage markers are displayed on

MEMORY 2 and the time markers are turned on, the time markers (and their annotation) will also be displayed on MEMORY 2.

The difference between the two time marker settings is indicated by the "dT" annotation at the bottom of the display screen.

At instrument preset, the time markers are preset to ±2.50 µs.

To reposition the time markers, the *START MARKER* or *STOP MARKER* softkey must be selected to activate the desired marker. Refer to the individual softkey descriptions below for more information on how to reposition each time marker.

After the time markers have been activated, setting the *T MRKR OFF/ON* softkey to OFF will disable their function and display.

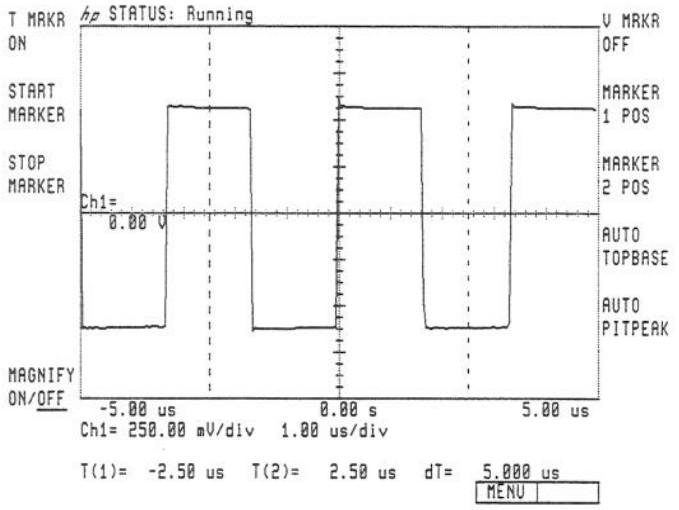

Figure 2-65. Time Markers ON

START MARKER or STOP MARKER

The *START MARKER* or *STOP MARKER* softkey activates the selected time marker for repositioning.

When selected, either of these softkeys supersedes the TIME MARKERS function by automatically displaying both time markers and their annotation.

At instrument preset, the START marker is positioned at −2.50 µs and the STOP marker is positioned at +2.50 µs. Refer to the annotation below the graticule for the current position settings of the time markers.

Setting the TIME MARKERS function to OFF turns off the display and annotation of the time markers.

Data Input

The numeric key pad directly enters any number which must be terminated with the s, ms, us, or ns softkey.

The step up/down keys reposition the time markers in one-division increments.

The RPG knob repositions the time markers in increments of one sample period.

START MARKER POSITIVE/NEGATIVE

START POS/NEG positions the START marker at a specified intersection of voltage MARKER 1 and the waveform.

Each intersection is determined by where voltage MARKER 1 and the waveform intersect. The intersection that occurs farthest to the left is indicated as "start edge: 1". The active parameter for this function indicates at which intersection the START marker is positioned. The POSITIVE or NEGATIVE status selects the slope of the waveform at which the intersection occurs.

Refer to Figure 2-66 for an example of the START marker with a POSITIVE-going edge at "start edge: 2".

When this softkey is activated for the first time, the START marker is preset to be positioned at the intersection of the first POSITIVE-going edge of the waveform and voltage MARKER 1.

The START marker setting is indicated by the "T(1)" annotation at the bottom of the display screen. The difference between the START and STOP marker settings is indicated by the "dT" (delta time) annotation near the lower right of the display screen.

The intersection number of the waveform and voltage MARKER 1 is indicated by "start edge:" in the active function block and should be restricted to the portion of the measurement that is displayed onscreen. If the intersection number indicated is greater than the actual number of intersections displayed, the START marker is automatically positioned at the right graticule edge. The START marker setting and the "dT" value will automatically default to the value of the right graticule edge.

Data Input

The numeric key pad directly enters any specific intersection number and must be terminated by the ENTER softkey.

The step up/down keys change the intersection number in increments of one.

The RPG knob also changes the intersection number in increments of one.

NOTE

The START and STOP MARKER POSITIVE/NEGATIVE functions are only available when the voltage markers are displayed.

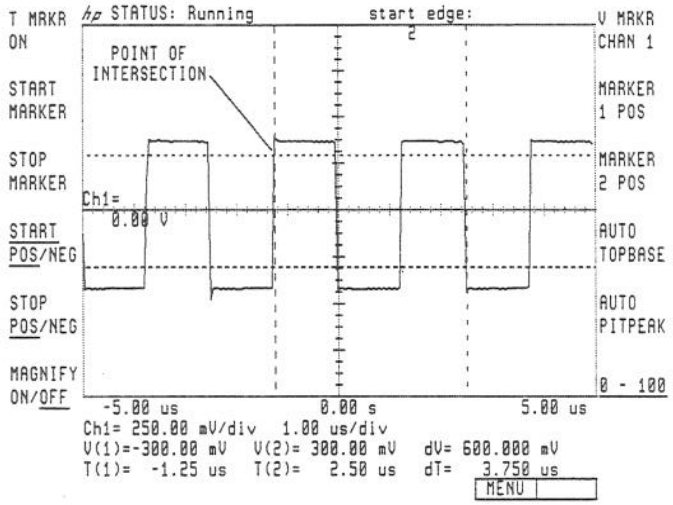

Figure 2-66. START Marker POSITIVE ON (Start Edge: 2)

STOP MARKER POSITIVE/NEGATIVE

STOP POS/NEG positions the STOP marker at a specified intersection of voltage MARKER 2 and the waveform.

Each intersection is determined by where voltage MARKER 2 and the waveform intersect. The intersection that occurs farthest to the left is indicated as "stop edge: 1". The active parameter for this function indicates at which intersection the STOP marker is positioned. The POSITIVE or NEGATIVE status selects the slope of the waveform at which the intersection occurs.

Refer to Figure 2-67 for an example of the STOP marker with a NEGATIVE-going edge at "stop edge: 3".

When this softkey is activated for the first time, the STOP marker is preset to be positioned at the intersection of the first POSITIVE-going edge of the waveform and voltage MARKER 2.

The STOP marker setting is indicated by the "T(2)" annotation at the bottom of the display screen. The difference between the START and STOP marker settings is indicated by the "dT" (delta time) annotation near the lower right-hand corner of the display screen.

The intersection number of the waveform and voltage MARKER 2 is indicated by "stop edge:" in the active function block and should be restricted to the portion of the measurement that is displayed onscreen. If the intersection number indicated is greater than the actual number of intersections displayed, the STOP marker is automatically positioned at the right graticule edge. The STOP marker setting and the "dT" value will automatically default to the value of the right graticule edge.

Data Input

The numeric key pad directly enters any specific intersection number and must be terminated by the *ENTER* softkey.

The step up/down keys change the intersection number in increments of one.

The RPG knob also changes the intersection number in increments of one.

NOTE

The START and STOP MARKER POSITIVE/NEGATIVE functions are only available when the voltage markers are displayed.

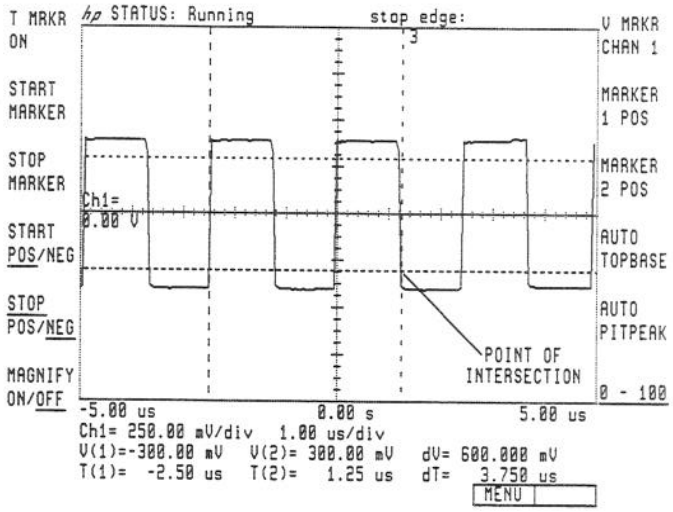

Figure 2-67. STOP Marker NEGATIVE ON (Stop Edge: 3)

MAGNIFY ON/OFF

The *MAGNIFY ON/OFF* softkey function expands the area between the START and STOP markers to full-screen.

A small portion of the waveform may be viewed by placing the START and STOP markers on either side of the desired area and then pressing *MAGNIFY*. The area between the markers expands to full-screen placing the markers at the outside graticule edges. The center between the START and STOP markers now becomes the center screen reference of the display screen. In doing this, the SECONDS/DIVISION function is automatically decreased to accommodate the MAGNIFY function.

When enabled, the START and STOP markers can still be used as time markers on the magnified area.

Multiple magnifications can also be performed to obtain more detailed resolution of a displayed area. This can be accomplished by repositioning the START and STOP markers on either side of the area to be

expanded, turning the MAGNIFY function off, and then turning the MAGNIFY function back on. By repeating this procedure, greater and greater resolution may be achieved.

Figures 2-68 and 2-69 demonstrate the use of the MAGNIFY softkey function.

Hints:

- The MAGNIFY function is intended for use on measurements performed in the SINGLE SWEEP mode. If an area is to be magnified on a waveform displayed in the CONTINUOUS SWEEP mode, it may be easier to use the DELAY and SECONDS/DIVISION functions located under the TIMEBASE softkey function.
- To provide sufficient resolution in the resulting magnified area, it is advantageous to use a large number of points for the TRACE LENGTH on the original waveform.

NOTE

The MAGNIFY function is only available when the time markers are displayed.

MAGNIFY DELAY

The *MAGNIFY DELAY* softkey function allows repositioning of the MAGNIFY function anywhere on the displayed waveform. Once the size of the area to be magnified has been established by the START and STOP markers, the MAGNIFY DELAY function can be used to view other portions of the displayed waveform of that particular size.

Refer to Figure 2-70 for an example of the MAGNIFY DELAY function used on the waveform shown in Figures 2-68 and 2-69.

NOTE

The MAGNIFY DELAY function is only available if the MAGNIFY function is enabled.

Data Input

The numeric key pad directly enters any value of time as the center display screen reference and must be terminated with the *s*, *ms*, *us*, or *ns* softkey.

The step up/down keys change the position of the magnified area by one division.

The RPG knob changes the position of the magnified area by one sample period.

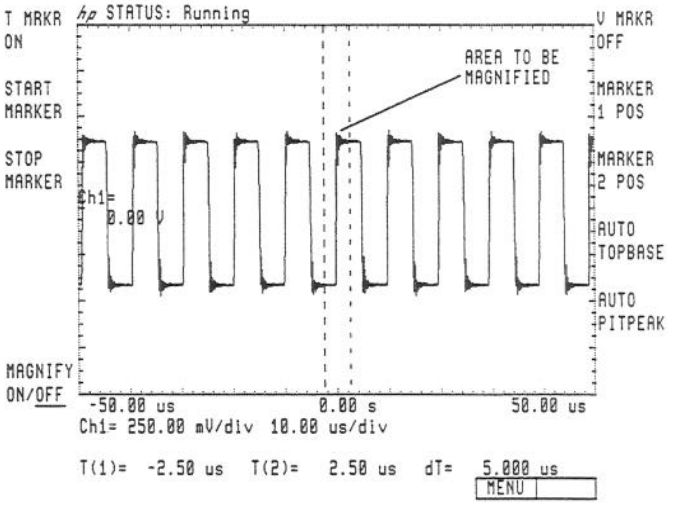

Figure 2-68. START and STOP Markers Positioned for Magnification

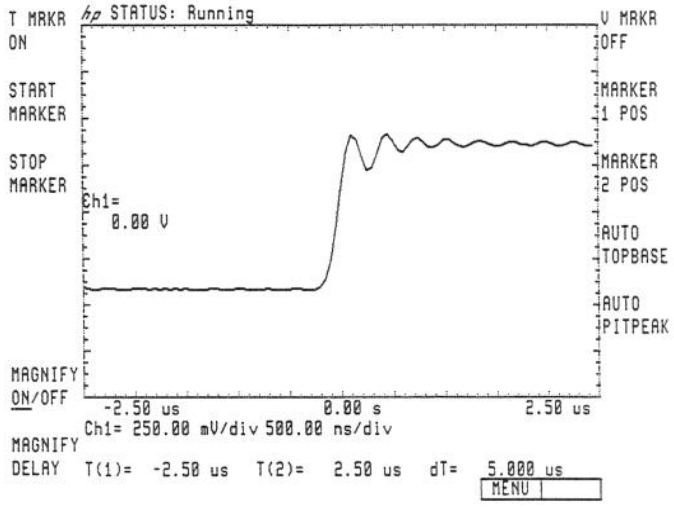

Figure 2-69. MAGNIFY Softkey Function ON

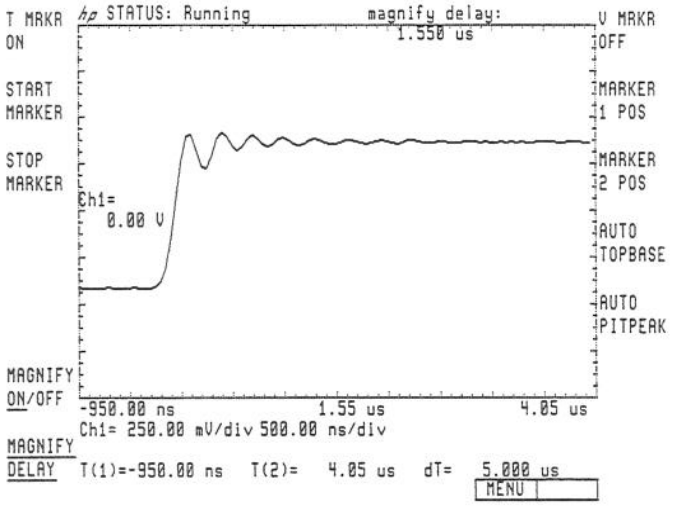

Figure 2-70. MAGNIFY DELAY ON

MEASURE FUNCTIONS

Measure Functions enable the user to make waveform parameter measurements automatically, including such measurements as frequency and duty cycle. Rise time, fall time, preshoot, and overshoot measurement parameters are only valid for pulses.

When a Measure Function softkey is enabled, a "snapshot" of the waveform is taken, and the measurement is taken at that time. Therefore, for repeatability purposes, SINGLE SWEEP should be used.

AUTO SCALE and trace manipulation functions, WAVEFORM SAVE and WAVEFORM MATH, are also included in this section.

The functions mentioned above may be accessed through the *measure*, *AUTO SCALE*, *waveform save*, and *waveform math* softkeys on the Main Menu of the digitizer display screen.

The Measure, Auto Scale, Waveform Save, and Waveform Math softkey functions are briefly described below, and in more detail following the Overview section.

OVERVIEW

AUTO SCALE automatically determines the range of the input signal and displays two to four cycles of the waveform on the display screen.

NOTE

The MEASURE functions are only available when operating the instrument in the time domain.

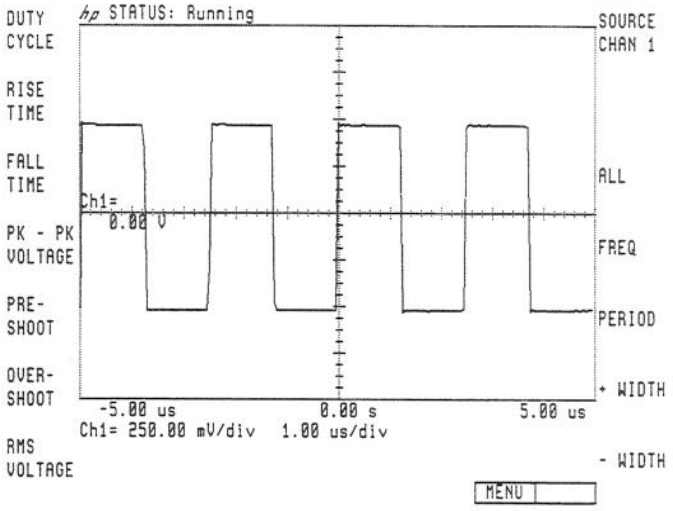

Figure 2-71. MEASURE Softkey Menu

measure accesses the softkey functions that make waveform parameter measurements automatically.

SOURCE CHAN X/FUNC X/MEM X selects the channel, function, or memory display on which the measurement is made.

ALL automatically measures all parameters listed below.

FREQ measures the fundamental frequency of a periodic waveform.

PERIOD measures the period of a periodic waveform.

+ WIDTH measures the time during which the signal is high (positive).

- WIDTH measures the time during which the signal is low (negative).

DUTY CYCLE measures the duty cycle of a periodic waveform.

RISE TIME measures the rise time of the waveform.

FALL TIME measures the fall time of the waveform.

PK-PK VOLTAGE measures the peak-to-peak voltage of the waveform.

PRE-SHOOT measures any preshoot on the waveform.

OVER-SHOOT measures any overshoot on the waveform.

RMS VOLTAGE measures the rms voltage of the waveform.

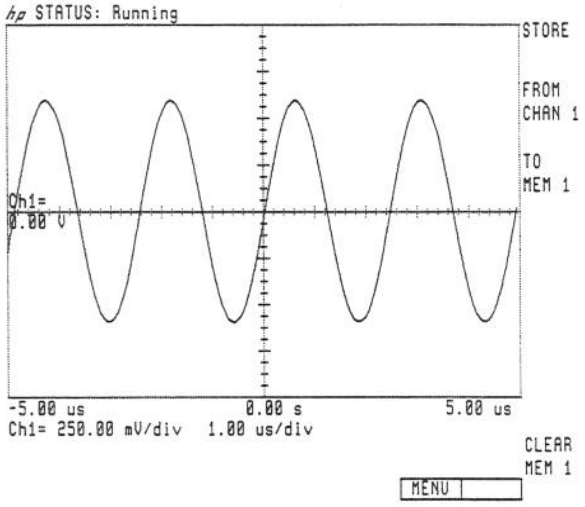

Figure 2-72. WAVEFORM SAVE Softkey Menu

waveform save accesses the softkey functions that enable the user to save trace data in one of four memory registers.

STORE saves the displayed waveform in the indicated memory register.

FROM CHAN X/FUNC X indicates the displayed channel or function that is to be saved.

TO MEM 1/2/3/4 selects the desired memory register in which to save a displayed waveform.

CLEAR MEM 1/2/3/4 clears the indicated memory register.

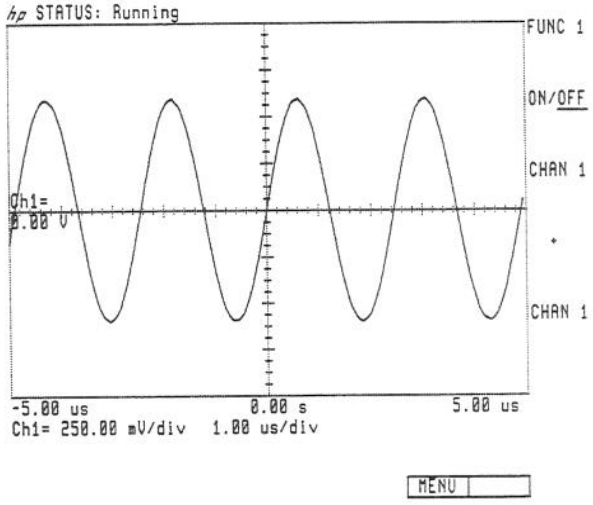

Figure 2-73. WAVEFORM MATH Softkey Menu

waveform math accesses the softkeys that allow the user to perform trace manipulations between available channels and memory registers.

FUNC 1 indicates the display of a trace function that has been performed.

ON/OFF, *TOP/BOT/OFF* turns on or off the displayed trace data for the indicated function display for either a full- or split-screen display.

CHAN X/MEM X selects and indicates the first operand of a trace function.

+/-/VERSUS/x/ONLY/INVERT indicates the trace function to be performed.

CHAN X/MEM X selects and indicates the second operand of a trace function.

VOLTS/DIV allows the vertical axis range (amplitude in volts) to be changed for the indicated function.

OFFSET allows the level (amplitude reference, in volts) of the display midscreen to be changed for the indicated function.

AUTO SCALE

The *AUTO SCALE* softkey function automatically determines the range of the input signal and displays two to four cycles of the waveform on the display screen. This is accomplished by automatically adjusting the SECONDS/DIVISION, VOLTS/DIVISION, OFFSET, and TRIGGER LEVEL parameters.

When enabled, The AUTO SCALE function attempts to fill more than half the display screen with the waveform, but is restricted by the parameters listed above.

Example:

The input signal may appear as a straight line if the timebase and voltage range settings are not correct. Pressing *AUTO SCALE* automatically locates and displays the input signal. The parameters SECONDS/ DIVISION, VOLTS/DIVISION, OFFSET, and TRIGGER LEVEL are adjusted to reflect the values of the displayed waveform. Refer to Figures 2-74 and 2-75 for examples of the AUTO SCALE function.

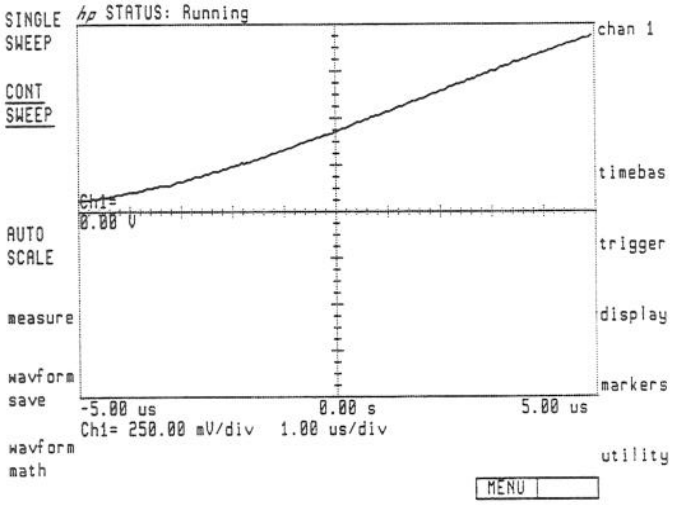

Figure 2-74. Displayed Waveform

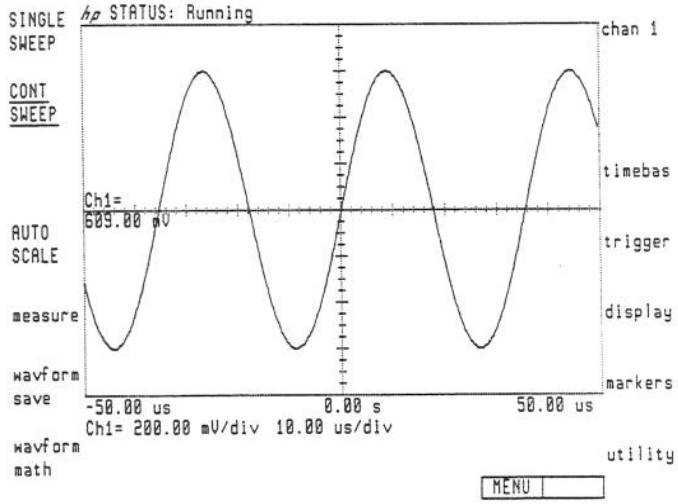

Figure 2-75. Displayed Waveform AUTO-SCALED

SOURCE CHANNEL X / FUNCTION X / MEMORY X

The *SOURCE CHAN X* softkey function selects the channel, function, or memory display on which a measurement is to be performed. Each time this softkey is pressed, the screen displays the next channel, function, or memory that has been previously set up to be displayed by the DISPLAY functions. At this time, any of the MEASURE functions may be performed on the displayed waveform.

When only one digitizer is configured in a system, this softkey is indicated as *SOURCE CHAN 1* until a memory or function display has been utilized.

When one digitizer is configured in a system, a maximum of one channel, one function, and one memory register may be displayed at any one time. When two to four digitizers are configured in a system, a maximum of two channels, one function, and one memory register may be displayed at any one time. Refer to the descriptions of the DISPLAY functions for additional information on displaying the available channels, functions, or memory registers.

Example:

A system configured with one digitizer has been set up by the DISPLAY functions to display CHANNEL 1, MEMORY 2 with previously stored trace data, and FUNCTION 1 which displays the trace math of MEMORY 2 subtracted from CHANNEL 1.

To measure the rise time of the resulting FUNCTION 1 waveform, the MEASURE functions must first be accessed by the *measure* softkey on the Main Menu. Then press the *SOURCE CHAN 1* softkey until the FUNCTION 1 display appears. Finally, press the *PERIOD* softkey to initiate a rise time measurement on the displayed FUNCTION 1 waveform. See Figure 2-76.

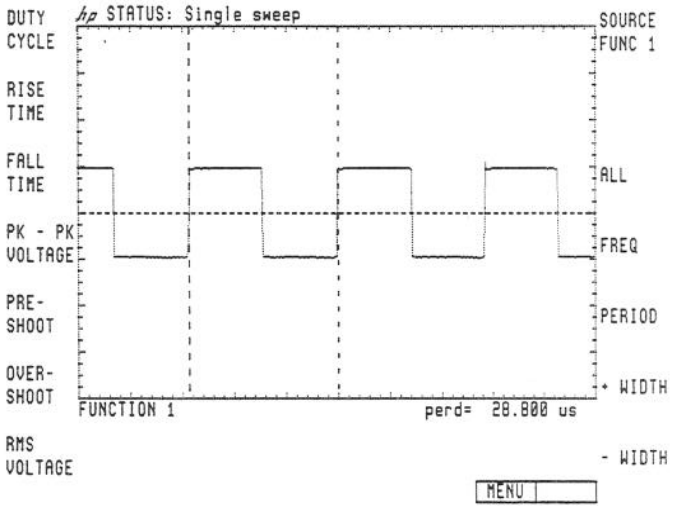

Figure 2-76. SOURCE FUNCTION 1 Period Measurement

ALL

ALL automatically measures and displays the following parameter measurement results simultaneously: frequency, period, + width, − width, duty cycle, rise time, fall time, peak-to-peak voltage, preshoot, overshoot, and rms voltage. See Figure 2-77.

All the measurement results are displayed in annotation located below the graticule.

Refer to the individual softkey descriptions below for more detailed information with respect to each softkey function.

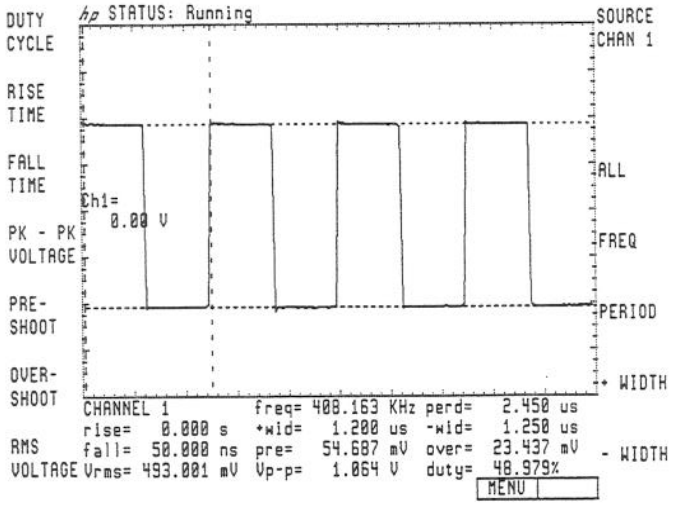

Figure 2-77. ALL Functions Enabled

FREQUENCY

The *FREQ* softkey function automatically measures the frequency of the waveform and displays the results in annotation located below the graticule.

The FREQUENCY measurement is based on:

$$\text{frequency} = 1 / \text{period}$$

The period is defined as the time between two successive rising edges (or falling edges) at the 50% level (TOPBASE value / 2).

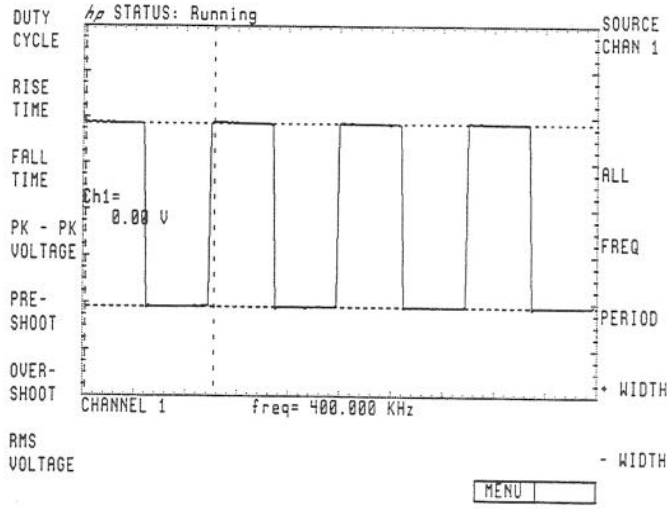

Figure 2-78. FREQUENCY Enabled

PERIOD

The *PERIOD* softkey function automatically measures the period of the waveform and displays the results in annotation located below the graticule. The period is defined as the time required for one complete cycle of a regular, repeating series of events. However, the period measurement is actually made by measuring the time between two successive rising edges (or falling edges) at the 50% level (TOPBASE value / 2).

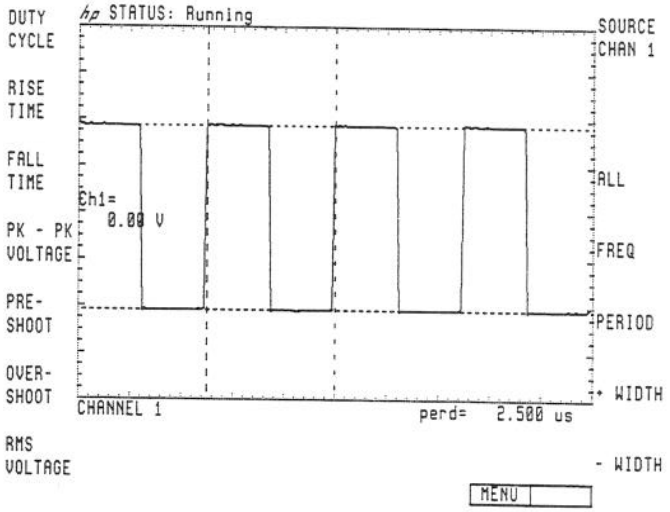

Figure 2-79. PERIOD Enabled

+ WIDTH

+ WIDTH automatically measures the time during which the signal is positive (above the 50% level) and displays the results in annotation located below the graticule.

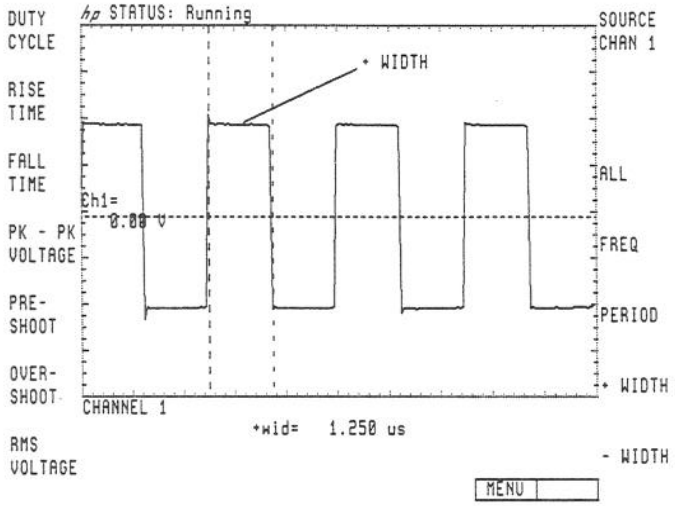

Figure 2-80. + WIDTH Enabled

– WIDTH

– WIDTH automatically measures the time during which the signal is negative (below the 50% level) and displays the results in annotation located below the graticule.

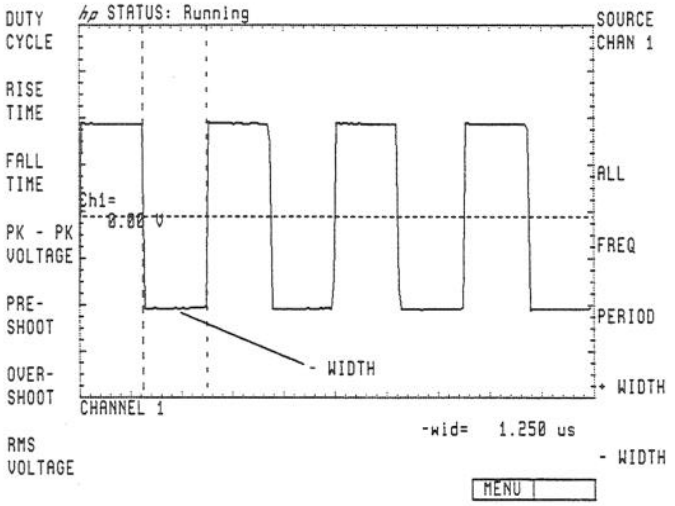

Figure 2-81. – WIDTH Enabled

DUTY CYCLE

The *DUTY CYCLE* softkey function automatically measures the duty cycle of the waveform and displays the results in annotation located below the graticule.

DUTY CYCLE is measured from 0 to 100% and is based on the following:

duty cycle (%) = positive pulse width / period

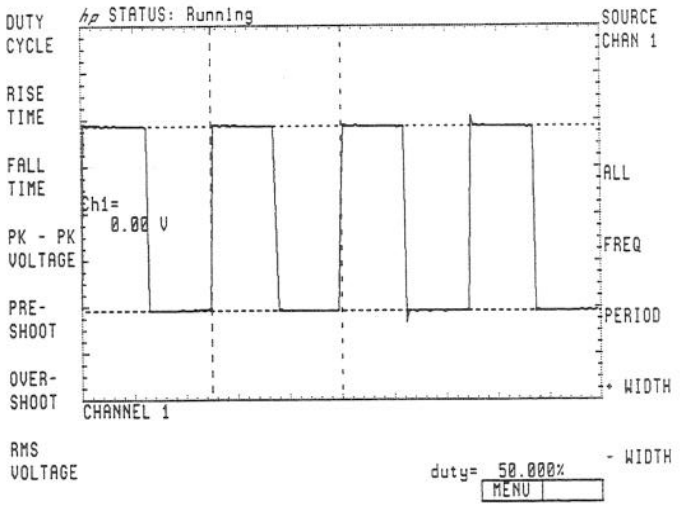

Figure 2-82. DUTY CYCLE Enabled

RISE TIME

RISE TIME automatically measures the rise time of the waveform and displays the results in annotation located below the graticule. The rise time is defined as the time during which the leading edge of a pulse rises from 10% to 90% of the waveform top and base values.

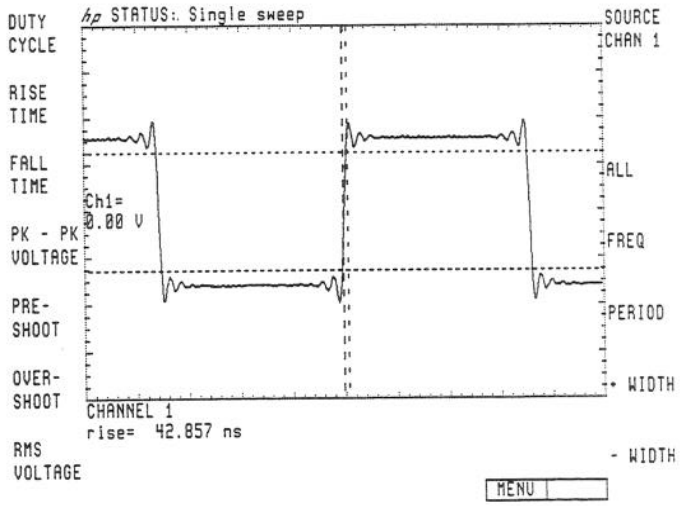

Figure 2-83. RISE TIME Enabled

FALL TIME

FALL TIME automatically measures the fall time of the waveform and displays the results in annotation located below the graticule. The fall time is defined as the time during which a pulse decreases from 90% to 10% of its maximum (TOPBASE) amplitude value.

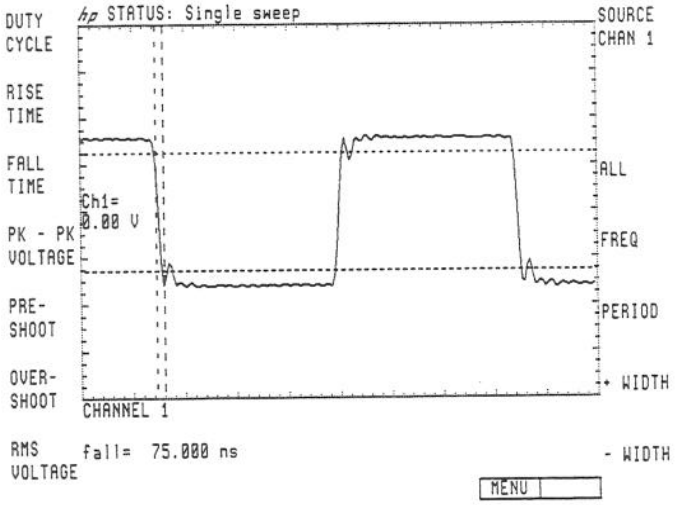

Figure 2-84. FALL TIME Enabled

PEAK-TO-PEAK VOLTAGE

The peak-to-peak voltage is the difference between the extreme positive and negative values. The *PK-PK VOLTAGE* softkey function automatically measures the peak-to-peak voltage of the waveform.

The results are displayed in annotation located below the graticule.

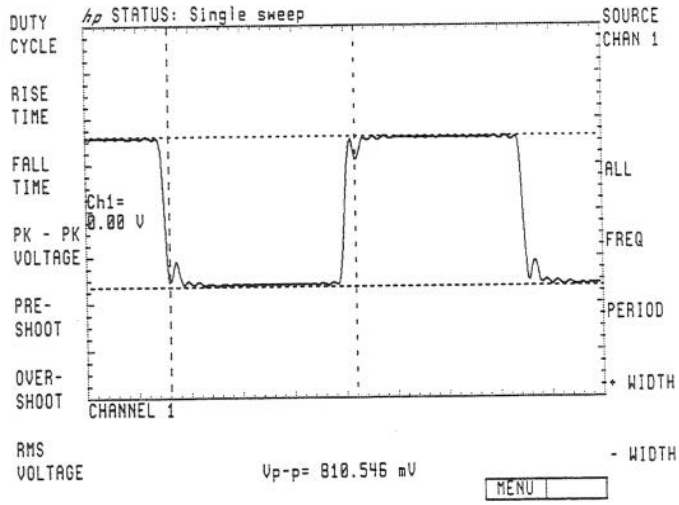

Figure 2-85. PEAK-TO-PEAK VOLTAGE Enabled

PRESHOOT

Preshoot is a quantitative measurement of the amount of ringing before the first edge of the waveform. The *PRESHOOT* softkey function automatically measures any preshoot on the waveform. The results are displayed in annotation located below the graticule.

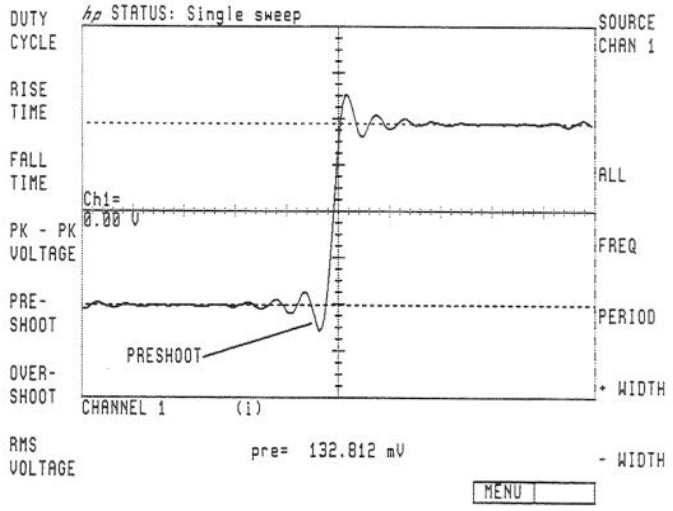

Figure 2-86. PRESHOOT Enabled

OVERSHOOT

Overshoot is a quantitative measurement of the amount of ringing after the first edge of the waveform. The *OVERSHOOT* softkey function automatically measures any overshoot on the waveform. The results are displayed in annotation located below the graticule.

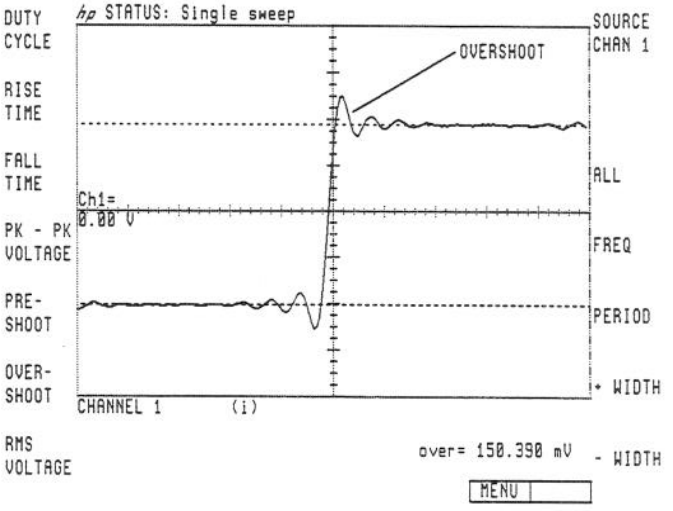

Figure 2-87. OVERSHOOT Enabled

RMS VOLTAGE

The *RMS VOLTAGE* softkey function automatically measures the rms voltage of the waveform, which uses one complete cycle of the waveform as the interval for this calculation. The results are displayed in annotation located below the graticule.

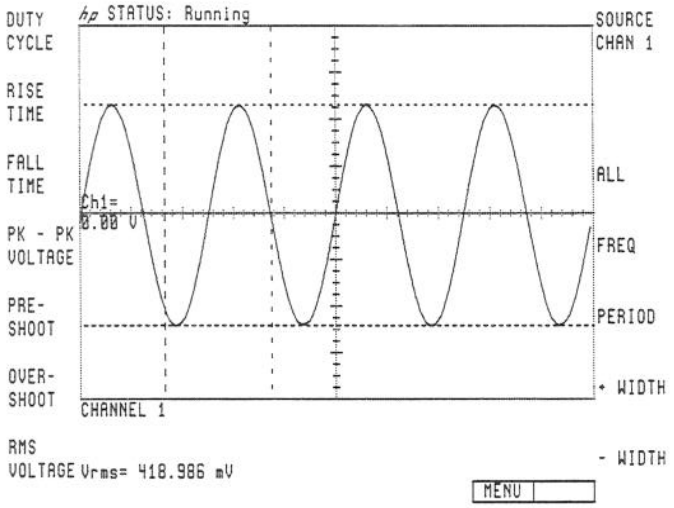

Figure 2-88. RMS VOLTAGE Enabled

WAVEFORM SAVE FUNCTIONS

The WAVEFORM SAVE functions enable the user to save data in one of four memory registers. The stored waveform and its corresponding SECONDS/DIVISION and VOLTS/DIVISION settings can then be redisplayed by using the Display Functions. Refer to Display Functions in this chapter for more information on displaying trace data that has been saved in a memory register.

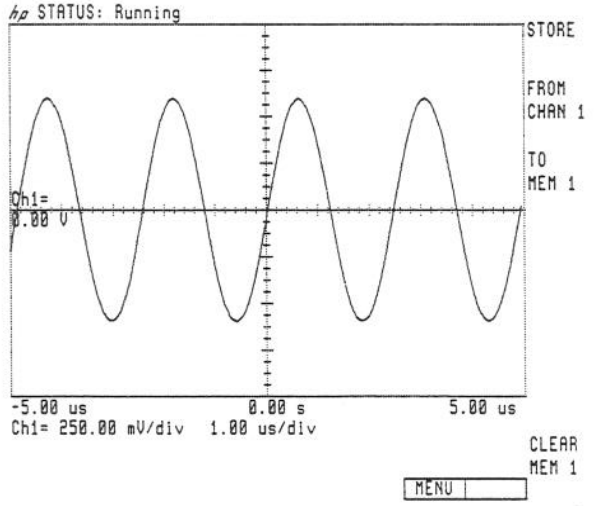

Figure 2-89. WAVEFORM SAVE Softkeys

NOTE

If the trace length is greater than 512, then it is compressed in order to be stored.

STORE

The *STORE* softkey function saves the displayed channel or function in the selected memory register.

This function operates in conjunction with the FROM CHANNEL X / FUNCTION X and TO MEMORY 1 / 2 / 3 / 4 functions, which must be set prior to pressing the *STORE* softkey.

FROM CHANNEL X / FUNCTION X

The *FROM CHAN X/FUNC X* softkey function indicates the displayed channel or function that is to be saved.

This function will only indicate the available channels and functions already being displayed via the Display functions. Therefore, if a waveform from a specific channel or function is to be saved, it must first be displayed using the DISPLAY softkey functions.

TO MEMORY 1 / 2 / 3 / 4

TO MEM 1/2/3/4 allows selection of one of the four memory registers in which to save a waveform. Pressing this softkey repeatedly automatically selects the next memory register, in sequential order.

CLEAR MEMORY 1 / 2 / 3 / 4

The *CLEAR MEM 1/2/3/4* softkey function clears the selected memory register of all data.

WAVEFORM MATH FUNCTIONS

The WAVEFORM MATH function enables the user to perform the indicated trace function between available channels and memory registers, the result of which may then be saved in a memory register via the Waveform Save Functions. After a trace function has been performed and is indicated as a function (e.g., FUNC1), it can then be used as a source for making waveform parameter measurements such as rise time or fall time.

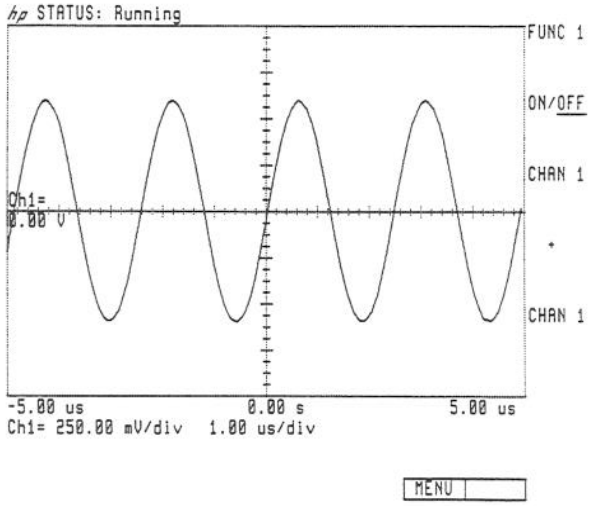

Figure 2-90. WAVEFORM MATH Softkeys

FUNCTION 1

The *FUNC1* softkey indicates the function display and can be used to save a trace function in a memory register.

ON / OFF or TOP / BOTTOM / OFF

The *ON/OFF* softkey turns on and off the indicated function on a full-screen display. The *ON/OFF* softkey automatically becomes the *TOP/BOTTOM/OFF* softkey when the split-screen display is selected. The *TOP/BOTTOM/OFF* softkey function positions the indicated function in either the top or bottom portion of a split-screen display, or alternatively blanks it.

This softkey function operates the same as the ON/OFF or TOP/BOTTOM/OFF function in the Display Functions and is only specific to the FUNCTION 1 display when it is used in the Waveform Math softkey menu. Refer to the Display Functions for more information on using a split-screen display with a channel, memory, or function display.

CHANNEL X / MEMORY X

The first *CHAN X/MEM X* softkey function selects and indicates the first operand of the trace function to be either an available channel or memory register.

ADDITION / SUBTRACTION / VERSUS / MULTIPLY / ONLY / INVERT

The *+/-/VERSUS/×/ONLY/INVERT* softkey indicates the trace function to be performed is addition, subtraction, the first operand versus the second operand, display of the first operand only, or the first operand inverted.

The ADDITION trace function requires two operands; the first operand added to the second operand. Figure 2-91 displays the trace addition of CHANNEL 1 and MEMORY 2 in the bottom portion of the split-screen display.

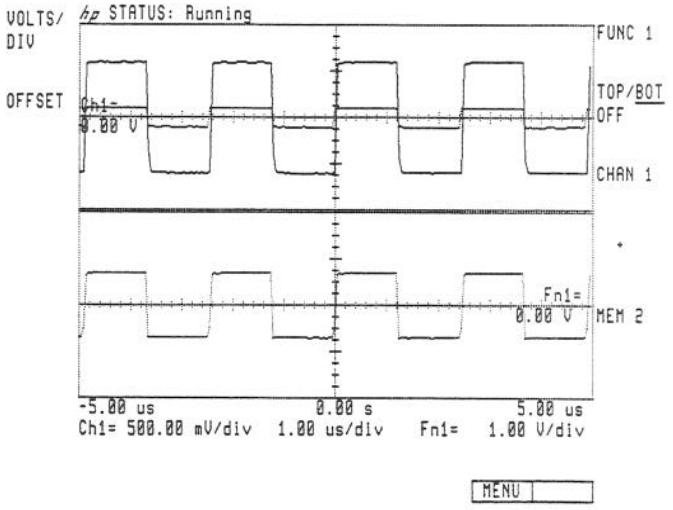

Figure 2-91. ADDITION of CHANNEL 1 and MEMORY 2

The SUBTRACTION trace function also requires two operands; the second operand is subtracted from the first operand. Figure 2-92 displays the subtraction of MEMORY 2 from CHANNEL 1 in the bottom portion of the split-screen display.

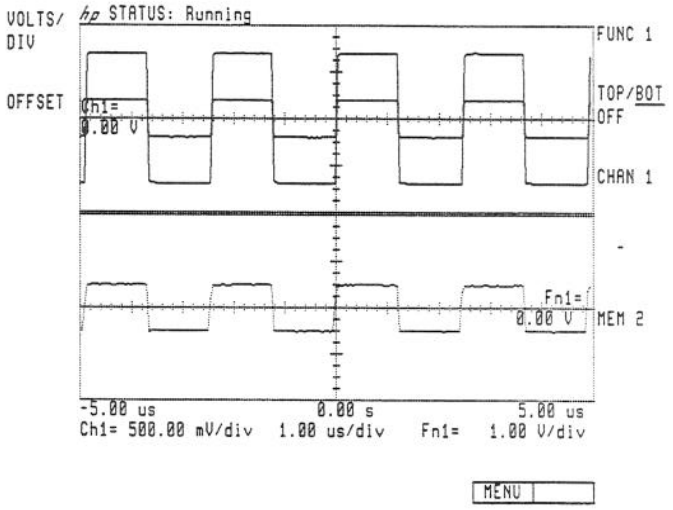

Figure 2-92. SUBTRACTION of MEMORY 2 from CHANNEL 1

The VERSUS trace function requires two operands; the first operand is plotted with respect to the other on the X and Y axes. Figure 2-93 displays CHANNEL 1 versus MEMORY 2 in the bottom portion of the split-screen display.

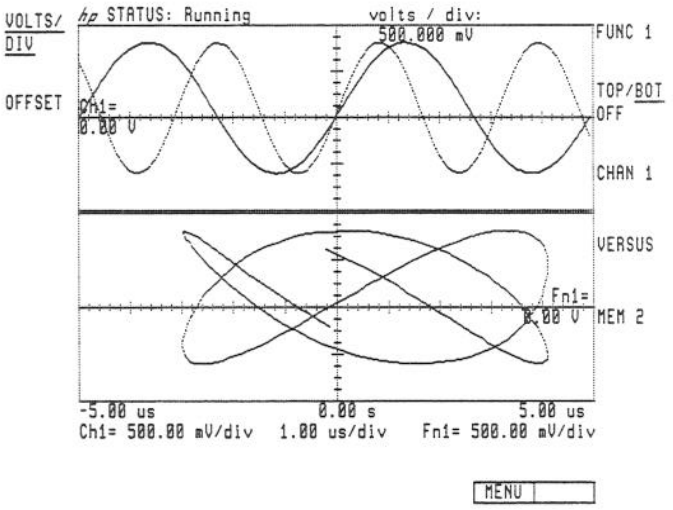

Figure 2-93. CHANNEL 1 VERSUS MEMORY 2

The MULTIPLY trace function requires two operands; the first operand is multiplied by the second operand. Figure 2-94 displays CHANNEL 1 multiplied by MEMORY 2 in the bottom portion of the split-screen display.

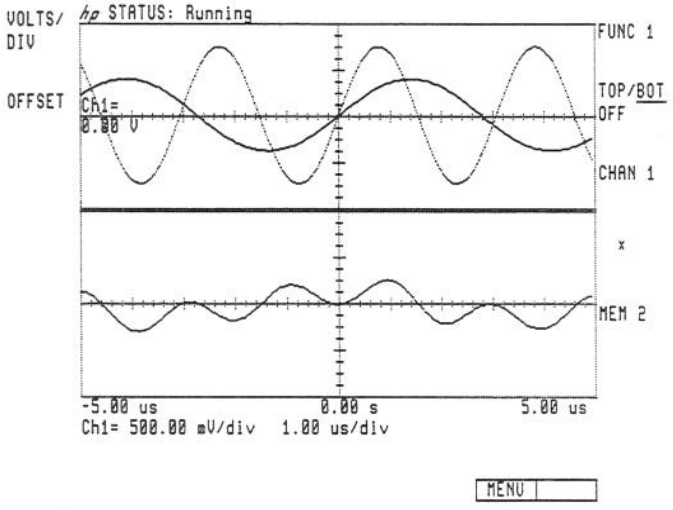

Figure 2-94. CHANNEL 1 MULTIPLIED by MEMORY 2

The ONLY trace function requires only the first operand and is the exact display of the selected channel or memory with no change. Figure 2-95 displays CHANNEL 1 in the top portion and the ONLY function of CHANNEL 1 in the bottom portion of the split-screen display.

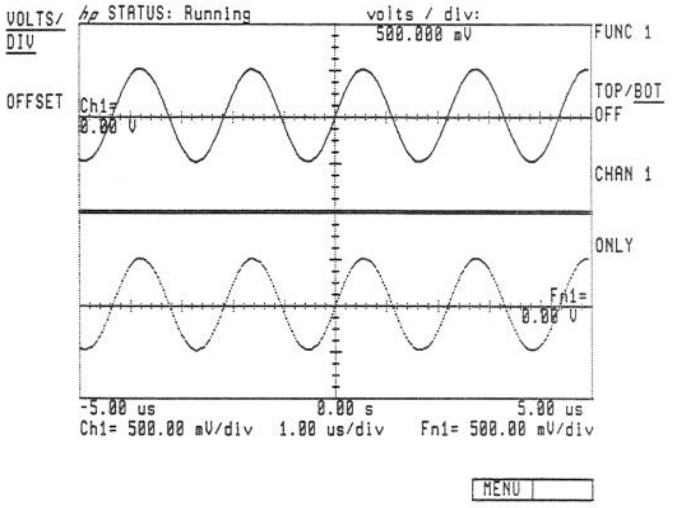

Figure 2-95. CHANNEL 1 ONLY

The INVERT trace function also requires only the first operand, in which it will be inverted. For example, if y = f(x), then INVERTed y = −f(x). Figure 2-96 displays CHANNEL 1 in the top portion and CHANNEL 1 inverted in the bottom portion of the split-screen display.

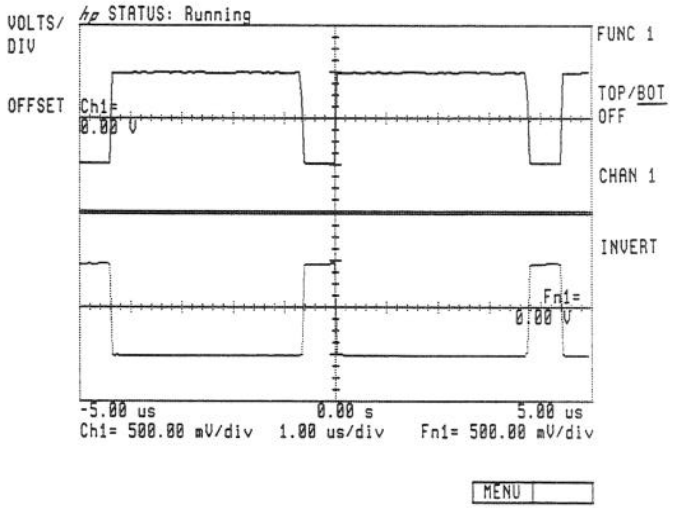

Figure 2-96. CHANNEL 1 INVERTED

CHANNEL X / MEMORY X

The second *CHAN X/MEM X* softkey function indicates the second operand of the trace function to be either an available channel or memory.

VOLTS/DIVISION

The *VOLTS/DIV* softkey allows the vertical axis range (amplitude in volts) to be changed for the indicated function and is only available when the indicated function is displayed.

This softkey function operates the same as the VOLTS/DIVISION function in the Channel Functions, but is only specific to the FUNCTION 1 display when it is used in the Waveform Math softkey menu.

OFFSET

The *OFFSET* softkey allows the level (amplitude reference, in volts) of the display midscreen to be changed for the indicated function. The offset value is indicated midscreen at the left-hand side of the graticule in either mV or V units.

This softkey function operates the same as the OFFSET function in the Channel Functions, but is only specific to the FUNCTION 1 display when it is used in the Waveform Math softkey menu.

UTILITY FUNCTIONS

Utility Functions allow the user to invoke calibration or self-testing of the digitizer module, save and recall measurement setup parameters for a waveform, and determine the current ROM/RAM firmware version. The *utility* softkey on the Main Menu is used to access the Utility Functions. See Figure 2-97.

The UTILITY softkey functions are briefly described below, and in more detail following the Overview section.

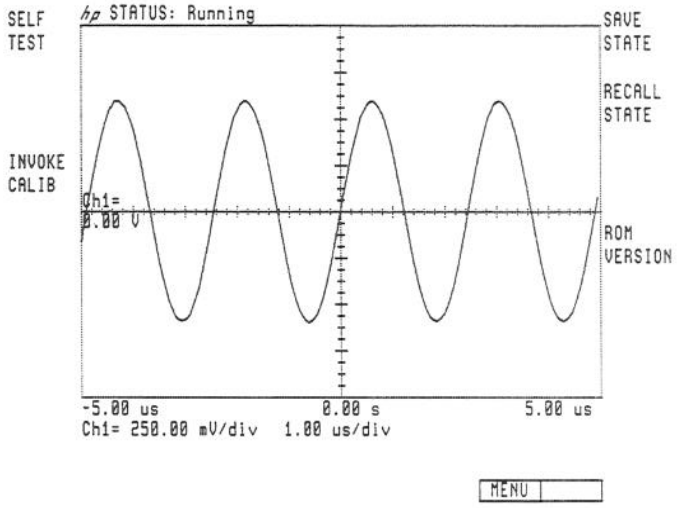

Figure 2-97. UTILITY Softkey Menu

OVERVIEW

SAVE STATE retains previously-established measurement parameters.

RECALL STATE restores previously-saved measurement parameters to the display screen.

ROM VERSION displays the current firmware version of ROM and RAM.

SELF-TEST invokes an automatic self-testing routine of the digitizer module.

INVOKE CALIB invokes an automatic calibration routine of the digitizer module.

SAVE STATE

NOTE

The SAVE STATE function only retains established measurement settings. It does not retain any trace data. Refer to the WAVEFORM SAVE Functions for storing trace data.

The *SAVE STATE* softkey allows the user to retain previously-established measurement settings, including any parameters set by the front-panel softkey functions. This function does not retain the trace data that is displayed at the time the setup parameters are saved.

For example, if specific measurement conditions are necessary to measure a waveform, then all of these measurement settings can be retained for future use on other waveforms by using the SAVE STATE function.

The SAVE STATE function has access to only two registers, 1 and 2, in which to save information.

Data Input

The numeric key pad must be used to select register 1 or 2 and must be terminated by the *ENTER* softkey.

RECALL STATE

NOTE

The RECALL STATE function only restores the previously-saved measurement settings. It does not restore any trace data. Refer to the DISPLAY Functions to display previously-stored trace data.

The *RECALL STATE* softkey function restores previously-saved measurement settings (via the SAVE STATE function) to the display screen. This function does not restore the trace data that was displayed at the time the measurement settings were saved.

To "recall" a previously-saved state, register 1 or 2 must be selected. If the selected register has not had any previously-saved information stored in it, then the display screen will indicate an "empty state register" message.

Data Input

The numeric key pad must be used to select register 1 or 2 and must be terminated by the *ENTER* softkey.

ROM VERSION

The *ROM VERSION* softkey function displays the current firmware version of ROM and RAM. See Figure 2-98.

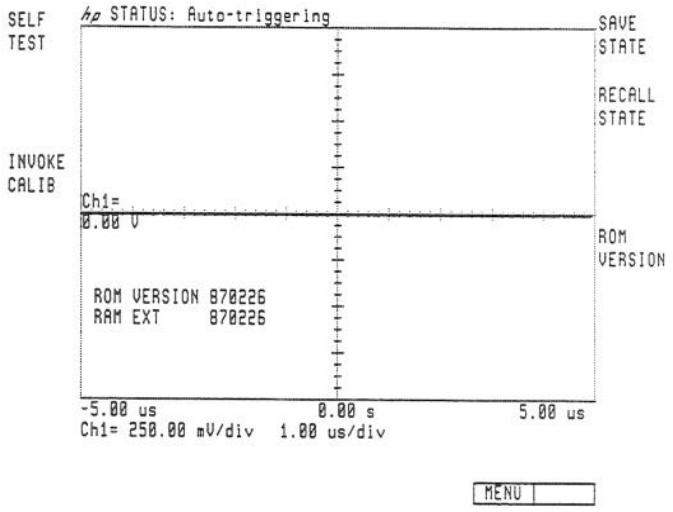

Figure 2-98. Displayed ROM/RAM Versions

SELF TEST

SELF-TEST invokes an automatic self-testing routine that tests the hardware of the digitizer module. SELF-TEST is the same test that runs when the instrument is first turned on. While the test is in progress, "SELF TEST" will be indicated in the status function block on the display screen.

If SELF-TEST is completed without any errors, the instrument will resume the state that existed prior to performing this routine. However, the trace data displayed prior to performing this function is destroyed.

For example, if a waveform is displayed in the SINGLE SWEEP mode at the time a SELF-TEST routine is performed and completed without any errors, the display resumes the SINGLE SWEEP state but blanks the previously-displayed trace data.

If SELF-TEST is complete but indicates "Stopped" in the status function block and displays an error message below in the display graticule, the instrument is now in a state in which the user may remotely review any error data. Otherwise, usage of the instrument may be continued by enabling either the SINGLE SWEEP or CONTINUOUS SWEEP mode via the Main Menu.

INVOKE CALIBRATION

The *INVOKE CALIB* softkey function automatically performs a calibration routine that makes gain and offset corrections to the digitizer module. While the test is in progress, "CALIBRATE" will be indicated in the status function block.

If the INVOKE CALIBRATION test is completed without any errors, the instrument will resume the state it was in prior to performing this function. However, the trace data displayed prior to performing this function is destroyed.

For example, if a waveform is displayed in the SINGLE SWEEP mode at the time the INVOKE CALIBRATION function is performed and completed without any errors, the display resumes the SINGLE SWEEP state but blanks the previously-displayed trace data.

If the INVOKE CALIBRATION test is complete but indicates "Stopped" in the status function block and displays an error message, the instrument is now in a state in which the user may review any error data by means of a controlling computer. Otherwise, usage of the instrument may be continued by enabling either the SINGLE SWEEP or CONTINUOUS SWEEP mode via the Main Menu.

MULTIPLE DIGITIZER FUNCTIONS

When more than one digitizer module is present in a digitizer system, it is important to understand the relationship between the master digitizer module and the slave modules.

NOTE

Refer to the HP 70700A Digitizer Installation and Verification Manual for more detailed and specific information on installation, configuration, and addressing of digitizer systems.

The HP-IB/HP-MSIB addressing is what determines whether a module is a master or a slave. The master digitizer module must be located in row 0 for HP-IB access and error-reporting capabilities. The slave digitizer modules must be positioned in either the same column above row 0 or in any other higher-address column above row 0 of the master module. Refer to Figure 2-99.

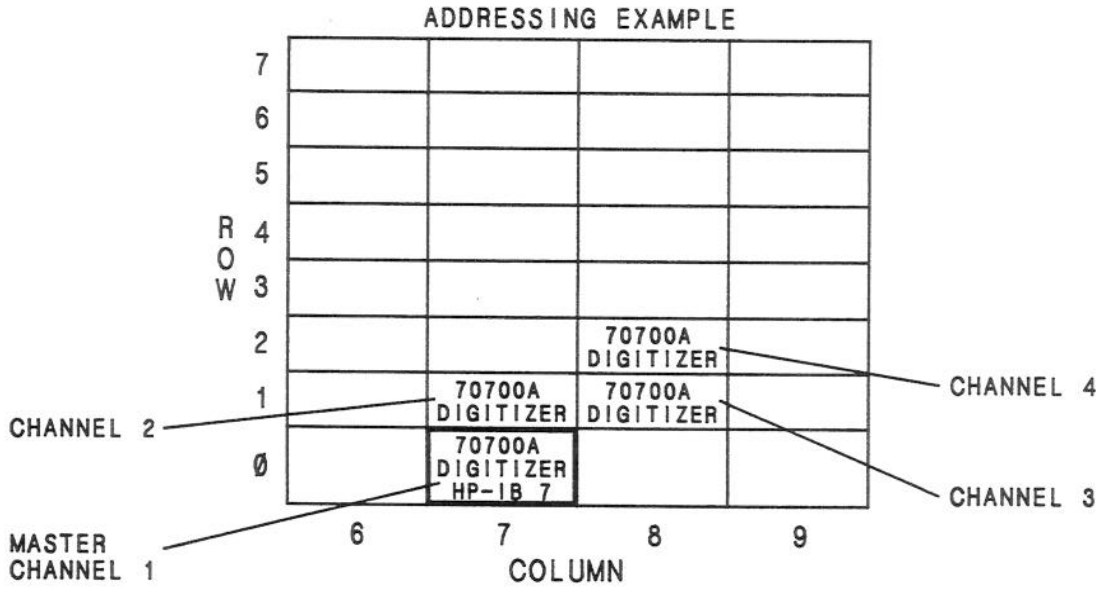

Figure 2-99. Multiple-Channel Digitizer System Addressing

The channel number assignment is also determined by the HP-IB/HP-MSIB addressing. The master digitizer module, located in row 0, will always be assigned as CHANNEL 1. The next HP 70700A Digitizer module encountered by the master module in its search will be assigned as CHANNEL 2. This process continues until all of the HP 70700A Digitizer modules have been assigned channels. The sequence in which the Address Map is searched is from bottom to top and left to right. A maximum of four channels are available in a digitizer system that is controlled from a display front panel.

CHANNEL DISPLAY

The number of digitizers configured in a system determines the number of channels that are available for display. In addition, one function and one memory may also be displayed at the same time as the maximum number of channels are displayed. For example, if three digitizer modules are configured in a system, three channels, one function, and one memory can all be displayed at the same time.

To display the available channels, function, or memory registers, the Display Functions must be accessed. By using the CHANNEL X/FUNCTION X/MEMORY X and ON/OFF (or TOP/BOTTOM/OFF) softkey functions in conjunction with each other, the selected channel, function, or memory may be turned on or off. This method is the only way in which an available channel, function, or memory register may be displayed for viewing.

NOTE

At instrument preset, only the master digitizer module CHANNEL 1 is displayed, regardless of the number of digitizer modules configured in a system.

It should be noted that the waveform of a specific channel does not have to be displayed in order to use it in making measurements; therefore, measurements made on a waveform may be displayed before, during, or after the measurement is complete.

CHANNEL FUNCTIONS

When three or four channels have been configured in a system, one more menu level is necessary to access the input parameters for a particular channel. The *channel* softkey in the Main Menu brings another menu to the screen, with the entries on this second menu accessing the individual channels. For example, to set the VOLTS/DIVISION on Channel 4 in a four-channel system, first *channel* would be selected from the Main Menu, then *chan 4* would be selected from the intermediate menu, and finally the VOLTS/DIVISION setting would be selected in the input parameter menu for Channel 4.

NOTE

The selection of two channels in the Main Menu does not affect which channels are actually displayed for viewing. Refer to the Display Functions for information on displaying available channels.

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