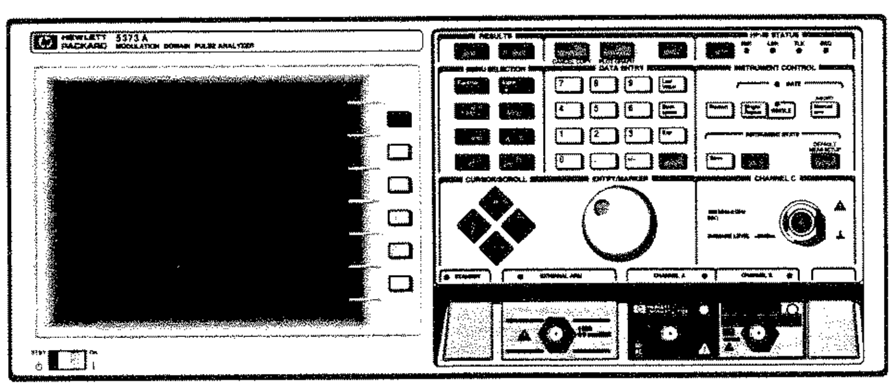
HP 5373A

Modulation Domain Pulse Analyzer

OPERATING MANUAL



HEWLETT PACKARD

Certification and Warranty

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by that organization's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

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.

OPERATING MANUAL

HP 5373A
Modulation Domain Pulse Analyzer

MANUAL APPLICABILITY

This manual applies directly to an HP 5373A having the serial number prefix listed below. If this number does not match your instrument, refer to the "Manual Updating Changes" included with this manual.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY THIS MANUAL in the Introduction.

SERIAL NUMBER
Serial Number Prefix: 3102

Edition 1
E0191

Printed: JANUARY 1991

HEWLETT PACKARD

MANUAL PART NUMBER 05373-90001
Microfiche Part Number 05373-90002

Safety Considerations

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed. Refer to instructions in Appendix B of the Operating Manual.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.

Safety Symbols

⚠	Instruction manual symbol; the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual.
ϟ	Indicates hazardous voltages.
⏚	Indicates earth (ground) terminal.
⊥ OR ⊥	Indicates terminal is connected to chassis when such connection is not apparent.
∿	Alternating current.
⎓	Direct current.

WARNING

THIS DENOTES A HAZARD. IT CALLS ATTENTION TO A PROCEDURE, PRACTICE, OR THE LIKE, WHICH, IF NOT CORRECTLY PERFORMED OR ADHERED TO, COULD RESULT IN PERSONAL INJURY. DO NOT PROCEED BEYOND A *WARNING* SIGN UNTIL THE INDICATED CONDITIONS ARE FULLY UNDERSTOOD AND MET.

CAUTION

This denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a *CAUTION* sign until the indicated conditions are fully understood and met.

Safety Information

WARNING

Any interruption of the protective grounding conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.)

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earthed pole terminal (neutral) of the power source.

Instructions for adjustments while covers are removed and for servicing are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform such adjustments or servicing unless qualified to do so.

For continued protection against fire, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay). Do not use repaired fuses or short circuited fuseholders.

When measuring power line signals, be extremely careful and always use a step-down isolation transformer whose output voltage is compatible with the input measurement capabilities of this product. This product's front and rear panels are typically at earth ground, so NEVER TRY TO MEASURE AC POWER LINE SIGNALS WITHOUT AN ISOLATION TRANSFORMER.

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HOW TO USE THIS MANUAL

This manual is written and organized as a reference manual. It is the most complete source of information on the front-panel operation of the HP 5373A.

To learn the basic operation of the HP 5373A, read the *Application Guide* and then use this manual when you have questions regarding details of the instrument's operation.

To help you find information quickly, this manual is divided into 17 chapters plus five appendices, and the index. In addition to a comprehensive table of contents at the beginning of this book, each chapter is preceded by its own table of contents for easy reference.

The HP 5373A Operating Manual is organized as follows:

- Chapters 1 through 4 describe the measurement functions.
  - Time Interval Measurements
  - PRF, Frequency, PRI, and Period Measurements
  - Special-Purpose Measurements
  - Histogram Measurements
- Chapter 5 discusses arming and provides an example of how each arming mode operates.
  - Arming
- Chapter 6 describes the front and rear panel features.
  - Front Panel/Rear Panel
- Chapters 7 through 14 provide information on each of the menus.
  - Function Menu
  - Input Menu
  - Math Menu
  - Pre-trigger Menu
  - Instrument State Menu
  - System Menu
  - Test Menu
  - Help Menu

- Chapters 15 and 16 describe the numeric and graphic analysis capabilities.
    - Numeric Results
    - Graphic Results
- Chapter 17 provides procedures for operation verification and the testing of the HP 5373A against its specifications.
    - Performance Tests
- Appendices A through E provide additional useful information.
    - A Guide to the Function Menu
    - Unpacking and Installing
    - Status and Error Messages
    - 10:1 Probe Calibration Procedure
    - Specifications

HP 5373A OVERVIEW

The Hewlett-Packard 5373A Modulation Domain Pulse Analyzer makes PRF, Frequency, PRI, Period, and Time Interval Measurements at rates of up to 13.3 million measurements-per-second. The 5373A analyzes this data, turning it into useful information by producing statistics, histograms, time variation graphs, and performing limit tests. The 5373A has the unique ability to analyze the dynamics of frequency, time interval, and phase as a function of time. This new representation is called the "modulation domain." The HP 5373A provides full HP-IB programmability, and a powerful set of arming and triggering features which allow you to precisely select signal features to be measured.

The HP 5373A Key Features

The key features include:

- Continuous measurements at up to a 13.3 MHz rate
- DC to 500 MHz frequency range (100 MHz to 2 GHz with optional input channel)
- Histogram measurements using hardware processing for acquiring and analyzing very large sample sizes quickly
- Pre-trigger for frequency and time interval measurements
- Averaging for measurements to increase resolution
- Single-channel phase measurement (Phase Deviation function)

- Cumulative time jitter measurement (Time Deviation function)
- Measurement arming by signal edge, time, events
- – 4.0 to +4.0 second time interval range
- Selection of input pods: 50Ω Envelope Detector, 50Ω, 1 MΩ, or 10 kΩ active probe
- Selectable hysteresis for measurements on noisy signals

MANUALS SUPPLIED

The following manuals are supplied with the HP 5373A:

- Application Guide
- Operating Manual
- Programming Manual

ACCESSORIES SUPPLIED

The HP 5373A Frequency and Time Interval Analyzer is supplied with the following:

- Detachable Power Cable
- 1 - HP 53702A Envelope Detector Pod
- 1 - HP 54002A BNC Input Pod

The type of power cable supplied depends on the country of destination. Refer to *Table B-1, AC Power Cables Available,* for the part number of the appropriate cable.

ACCESSORIES AVAILABLE

The following accessories are available for the HP 5373A:

- HP 53702A 50Ω Envelope Detector Pod
- HP 54001A 10 kΩ/2pF, 10:1, 1 GHz Miniature Active Probe/Pod
- HP 54002A 50Ω BNC Pod
- HP 54003A 1 MΩ/8pF, 300 MHz Pod with 10:1 Probe
- HP 54300A Pod Multiplexer
- HP J06-59992A Time Interval Calibrator
- HP P/N 1494-0059 Rack Slide-Mount Kit
- HP P/N 05373-67001 Service Support Kit

OPTIONS AVAILABLE

The following options are available for the HP 5373A:

- 020 FastPort
- 030 Channel C
- 908 Rack mount kit for mounting without front handles
- 910 Additional Application Guide, Operating Manual, and Programming Manual
- 913 Rack mount kit for mounting with front handles
- 916 Additional Operating Manual and Programming Manual

HP 5373A SPECIFICATIONS

Instrument specifications are listed in Appendix E, SPECIFICATIONS. These specifications are the performance standards or limits against which the instrument can be tested.

INSTRUMENTS COVERED BY THIS MANUAL

This instrument has a two-part serial number in the form 0000A00000 which is stamped on the serial number plate attached to the rear of the instrument. The first four digits and the letter constitute the serial number prefix and the last five digits form the suffix. The prefix is the same for all identical instruments. It changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. This manual applies directly to instruments having the same serial number prefix as listed under SERIAL NUMBER on the title page.

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. These unlisted numbers indicate that the instrument is different from that documented in this manual. The manual for this newer instrument is accompanied by a "Manual Updating Changes" supplement. This supplement contains information that explains how to adapt the manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Updating Changes. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page.

Complimentary copies of the supplement are available from Hewlett-Packard. For information concerning a serial number prefix that is not listed on the title page or the Manual Changes supplement, contact your nearest Hewlett-Packard Sales and Support Office.

Listed on the title page is the part number for a microfiche version of the Operating Manual. This number can be used to order 100 ×150 mm (4 ×6 inch) microfilm transparencies of the manual. Each microfiche contains up to 96 photo-duplicates of the manual pages.

1

Contents of Chapter

1

TIME INTERVAL MEASUREMENTS

CHAPTER OVERVIEW

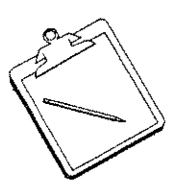
This chapter describes the time interval measurements of the HP 5373A and how to use them.

The HP 5373A makes three types of time interval measurements:

- Time Interval (TI)
- Continuous Time Interval (CTI)
- ±Time Interval (±TI)

The topics discussed in this chapter are:

- A comparison of Time Interval, Continuous Time Interval, and ±Time Interval measurements
- Examples of how to interpret time interval results
- An illustration of each time interval measurement and arming mode



TECHNICAL COMMENT

Several basic concepts of the HP 5373A are described at the beginning of Chapter 2.

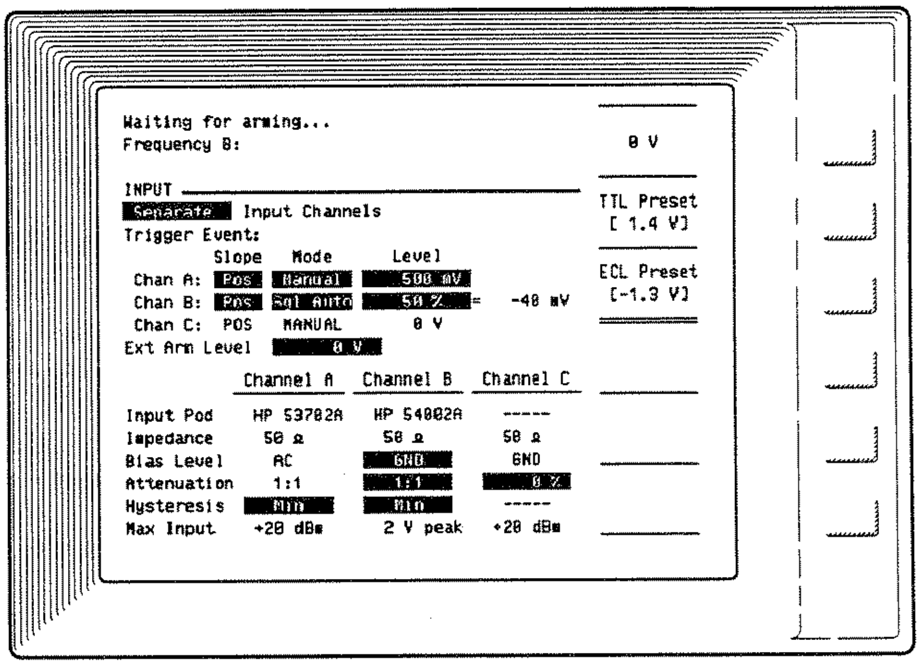
Please review the following topics in Chapter 2 for the fundamentals of how the HP 5373A makes measurements:

- *Time and Events*
- *A sample*
- *Sampling*

TIME INTERVAL MEASUREMENTS COMPARED

A time interval is a measurement of elapsed time between two electrical pulses. Electrical pulses are defined by changes in voltage. Rising voltage is associated with a positive-going edge or slope and falling voltage with a negative-going edge. These changes in voltage can trigger the start and stop of a measurement. A "trigger event" is a specific voltage on a rising or falling slope of an input signal that will trigger the HP 5373A. For example, the trigger event can be specified on the Input menu of the HP 5373A as a 500 mV level on the positive slope of a signal. *Figure 1-1* shows such a setting on the Input menu.

Figure 1-1. Trigger Event Settings



Normal/Fast Measurement Mode

The rate at which the HP 5373A is able to store measurement data can be set to one of two settings. The feature is called "Measurement Mode," and is set on the System Menu. The choices are Normal and Fast. Be aware that the range of measurement is limited with some arming modes when using the Fast Measurement Mode. The exact range of operation is included with the arming mode descriptions that follow.

- Normal Measurement Mode:

  TI and ±TI — 200 ns between measurements is required to store data

CTI — 100 ns between measurement samples is required to store data

- Fast Measurement Mode:

  TI and ±TI — 135 ns between measurements is required to store data

  CTI — 75 ns between measurement samples is required to store data

Time Interval

The Time Interval function measures time intervals on one input channel, or positive time intervals from one channel to another. The measurements are "individual." That is, there is a start and stop for each measurement. After each measurement, the data for that measurement is stored away. Only then can another measurement start.

The Time Interval function measures time intervals from 10 ns to 8.0 seconds (10 ns to 131 μs in Fast Mode). Data storage between measurements takes 200 ns in the Normal measurement mode and less than 135 ns in the Fast measurement mode. (For more on Normal and Fast measurement modes, refer to "System Menu," chapter 12.) If you need to measure time intervals less than 10 ns, use ±TI. The two examples below show how TI measurements are made.

Figure 1-2 shows an example of a one-channel Time Interval measurement—

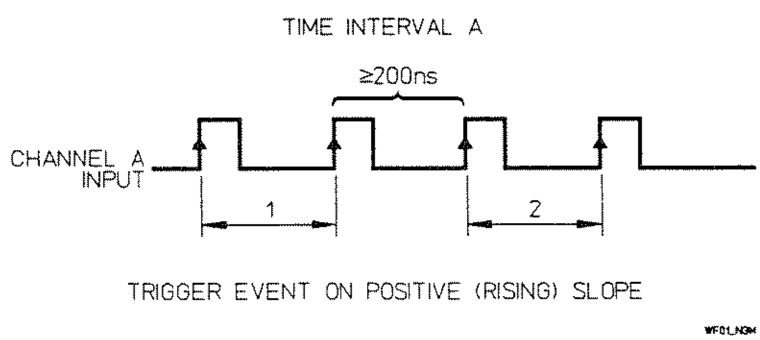


Figure 1-2. Time Interval on One Channel

Note that the HP 5373A can display when each measurement occurs, by the number of trigger events or time, with the Time Variation graph on the Graphic screen. For more information on Time Variation graph, refer to "Graphic Results," chapter 16.

Figure 1-3 shows an example of a two-channel Time Interval measurement—

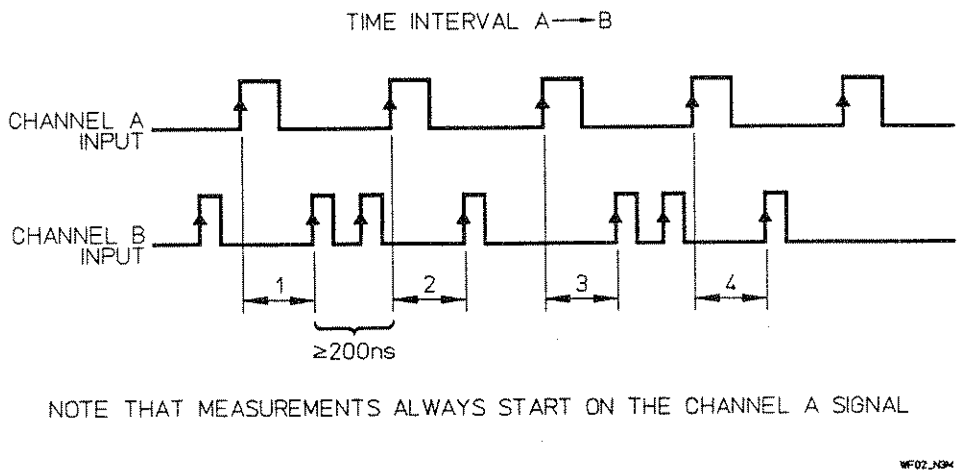


Figure 1-3. Time Interval on Two Channels

A pulse-width measurement is also a "two-channel" measurement, although it is made on a single input signal. Pulse-width measurements are described in "Special-Purpose Measurements," chapter 3.

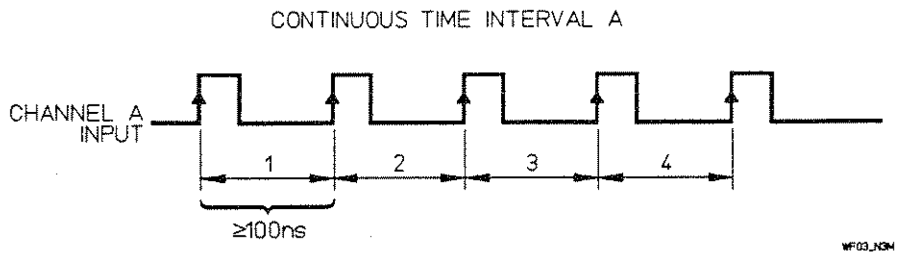
Continuous Time Interval

The Continuous Time Interval function measures single-channel time intervals only. This time interval type is called continuous because, unlike the other time interval types, CTI provides time interval results between every pair of samples, rather than only between start and stop pairs. Compare the CTI measurement in *Figure 1-4* with the TI measurement in *Figure 1-2.*

The Continuous Time Interval function measures time intervals from 100 ns to 8.0 seconds in the Normal measurement mode and 75 ns to 131 μs in the Fast measurement mode. (For more on Normal and Fast measurement modes, refer to "System menu," chapter 12.)

Figure 1-4 shows an example of a Continuous Time Interval measurement—

Figure 1-4. Continuous Time Interval



Continuous Time Interval is similar to a Period measurement, but CTI never provides the average time interval when a measurement occurs over more than one period of the signal. A CTI result is the time over which the measurement was made. A Period result is the average of the signal periods that occur during the time of the measurement. *Figure 1-5* compares CTI and Period measurements.

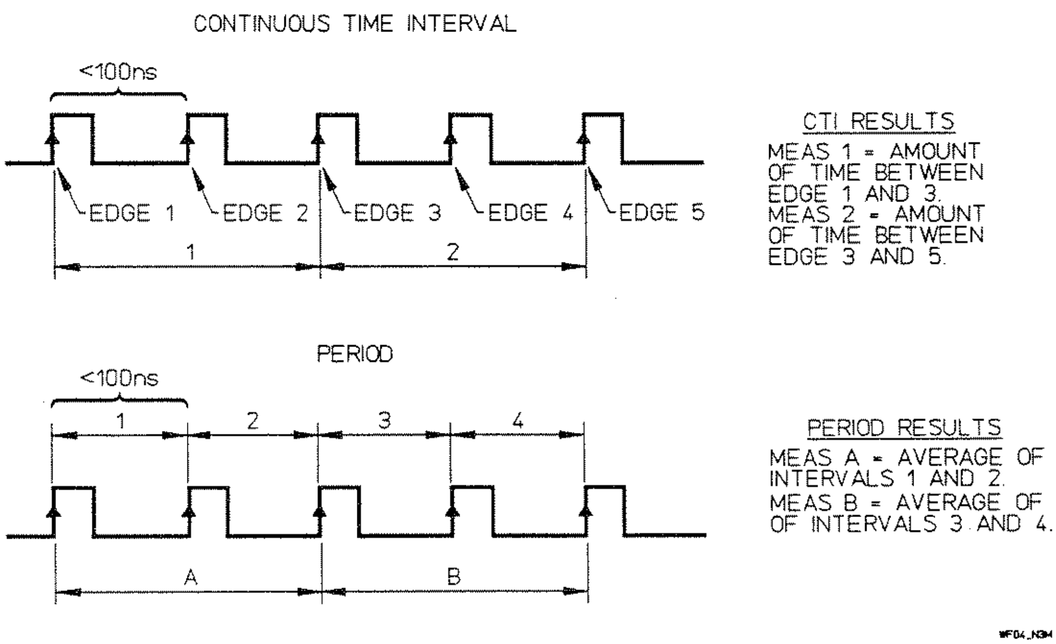


Figure 1-5. Continuous TI vs. Period

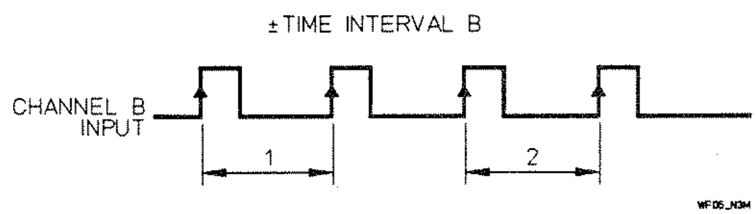
±Time Interval

The ±Time Interval function measures positive or negative time intervals on one channel, or from one channel to another channel. The measurements are "individual." As with TI measurements, there is a start and stop for each measurement. After each measurement, the data for that measurement is stored away. Only then can another measurement start.

The ±TI function measures intervals from –4.0 seconds to +4.0 seconds, including 0 seconds (–65 μs to +65 μs in Fast Mode). Data storage between measurements takes 200 ns in the Normal measurement mode and 135 ns in the Fast measurement mode. (For more on Normal and Fast measurement modes, refer to "System Menu," chapter 12.) You can measure intervals less than 10 ns with ±TI (0 seconds with two-channel ±TI). The two examples below show how ±TI measurements are made.

Figure 1-6 shows an example of a one-channel ±Time Interval measurement—

Figure 1-6. ±Time Interval on One Channel



The only difference between a TI measurement on one channel and a ±TI on one channel is that the ±TI can measure shorter time intervals.

Figure 1-7 shows an example of a two-channel ±Time Interval measurement—

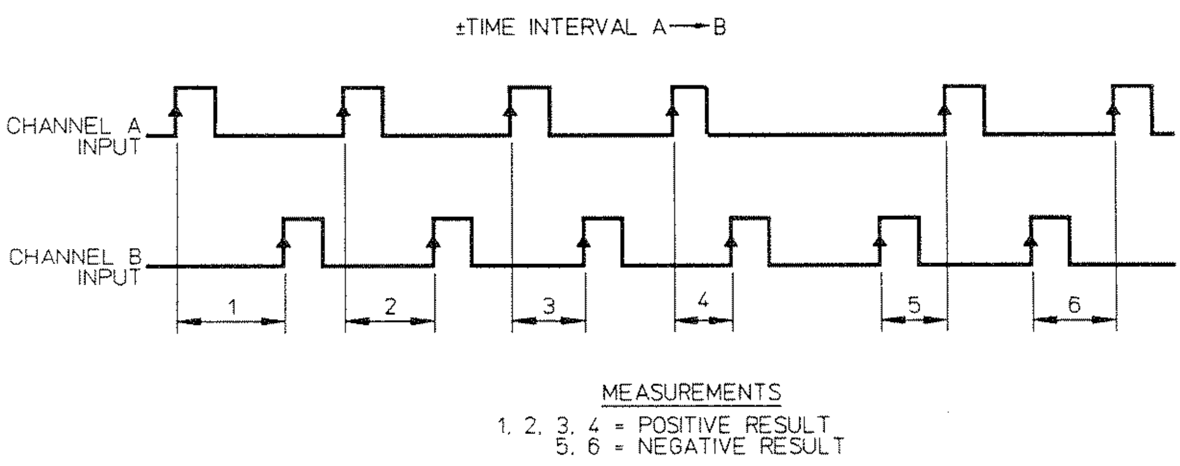


Figure 1-7. ±Time Interval on Two Channels

HOW TO INTERPRET TIME INTERVAL RESULTS

This section describes two time interval measurements and how to interpret the measurement results. For each example, the signal to be measured is described, and the arming mode used for the measurement is explained.

TECHNICAL COMMENT

Arming is an important element of every HP 5373A measurement setup. It allows you to specify when to begin a group of measurements and how often measurement samples within the group will be acquired.

Refer to "Arming," chapter 5, for more on what arming is and how it works. In the following examples of time interval measurements, different arming modes are demonstrated to show their effect on the measurements.

Time Interval with Missed Events Example

This example describes a Time Interval measurement where not all intervals are measured because of the rate at which events are occurring. The description here also applies to ±TI measurements. The signal to be measured is shown in *Figure 1-8*.

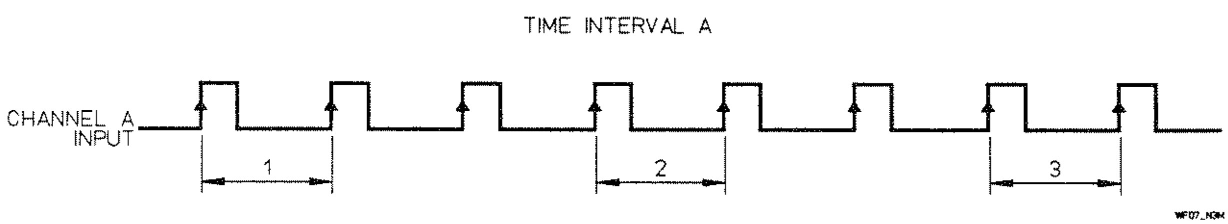
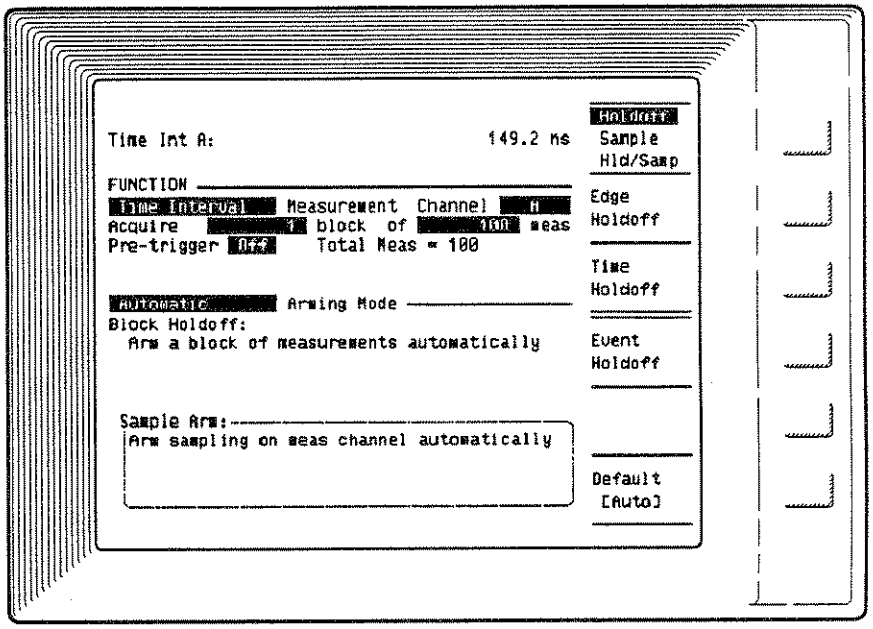


Figure 1-8. Time Interval on Channel A

Because the time intervals are occurring at a rate at which the HP 5373A is not able to capture every interval, there are time intervals that are not measured. Even though the intervals are not measured, the number of edges of the input signal between each measurement is known, as well as the time between each measurement. The results from this example will show how this works.

1. The Function menu is the default setup selected with the **Preset** key. The menu is shown in *Figure 1-9*.

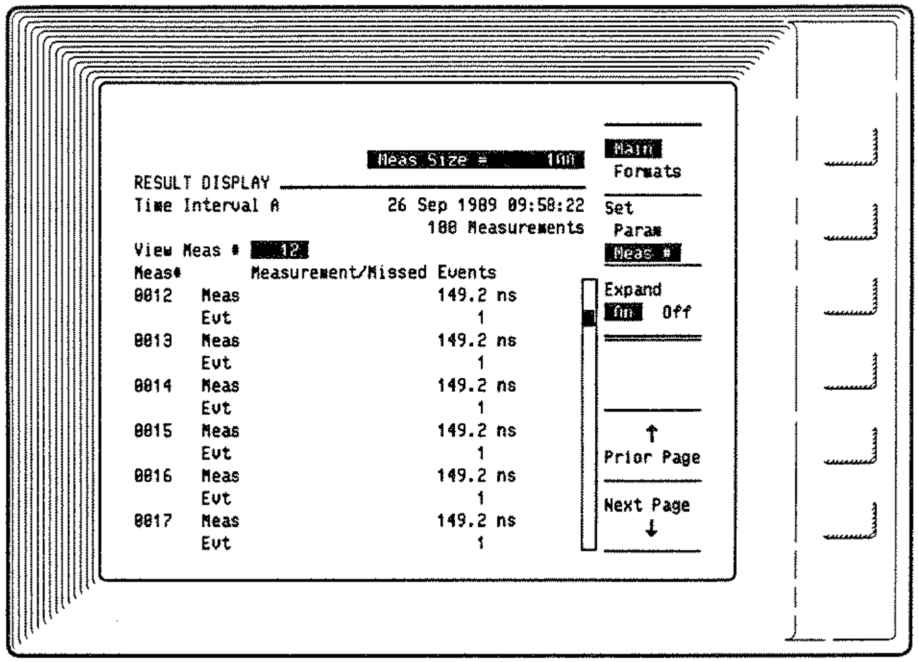
Figure 1-9. Function Menu



The arming mode is Automatic. Automatic arming begins the group of measurements as soon as possible and provides for acquisition of measurement samples as quickly as possible.

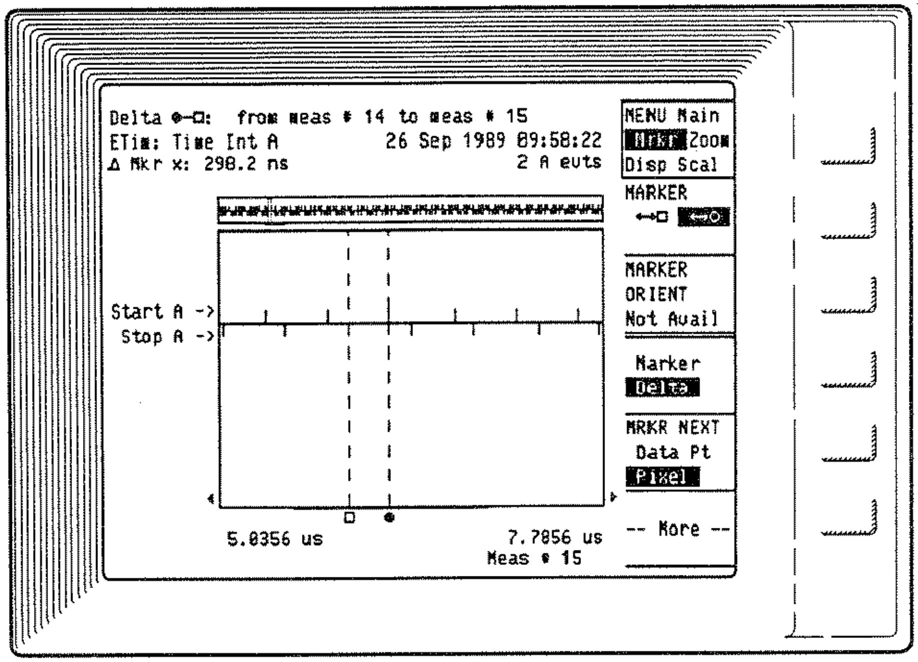
2. The Numeric screen in *Figure 1-10* shows a portion of the results. The Expanded Data feature is set to On.

Figure 1-10.
Time Interval results



The Expanded Data feature displays the number of events that are "missed" during time interval measurements. According to the results, one event is missed between each measurement. A missed event is an edge of the input signal that is counted, but not timed. Since when the event occurred is not known, no measurement can be computed. Because the HP 5373A continues to count time and events during a group of measurements, it can provide the time between measurements, as well as the time of measurements. This can be seen on the Event Timing graph in *Figure 1-11*. The time from the end of one measurement to the beginning of the next is displayed with the Delta feature.

Figure 1-11. Time Between Measurements



This information is presented with the waveform of the signal in *Figure 1-12.*

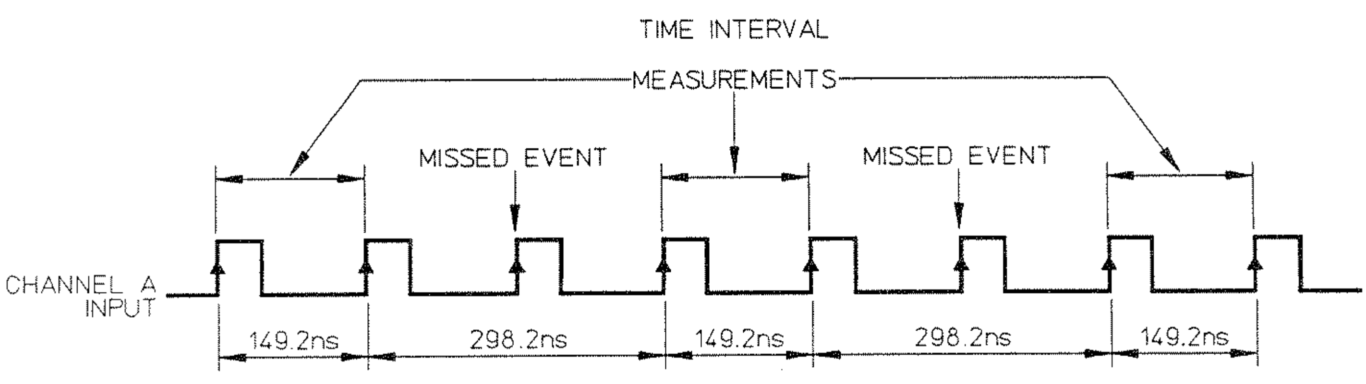
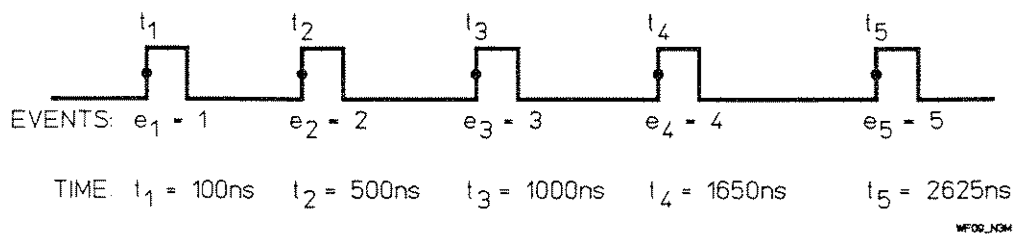


Figure 1-12. Time Interval With Missed Events

TECHNICAL COMMENT

When the HP 5373A collects measurement data, it is in the form of a count of events and time. The event count is the number of trigger events (an event as specified on the Input menu) that have occurred since the start of the measurement sequence. The time is the elapsed time from the beginning of the measurement sequence to when the event occurs. You can see in the drawing below a graphic representation of this idea of keeping a running total of the number of events and the time they occurred.



From this event and time data, the results for the measurement functions can be computed. When events are occurring faster than the HP 5373A can store the time of the events, the number of events without the time of occurrence information is known and can be displayed as missed events on the Numeric screen using the Expanded Data feature.

Continuous Time Interval with Missed Events Example

This example will show what missed events means for CTI as opposed to missed events for TI and ±TI. Again, this situation occurs when events are occurring at rate faster than the HP 5373A is able to store away the time at which the event occurred. You should compare this example with the previous TI measurement example. The comparison highlights the differences between the individual measurement technique of TI and ±TI and the continuous nature of CTI measurements.

This CTI measurement is made with Event Holdoff arming. Holdoff arming lets you control when the block of measurements can begin. In this example, the first measurement will not begin until after the specified number of events have occurred following a signal on the External Arm input. The samples of measurement data will then be collected as quickly as possible. If another block of measurements was collected, the Holdoff condition would need to be satisfied once again before the measurements could begin.

1. The Function menu setup for this measurement is shown in *Figure 1-13.*

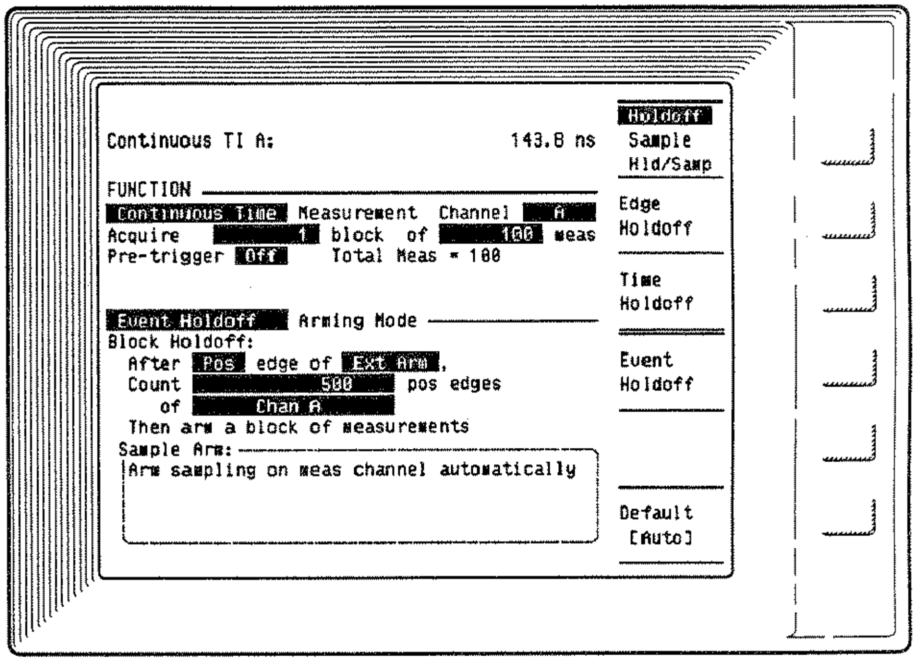
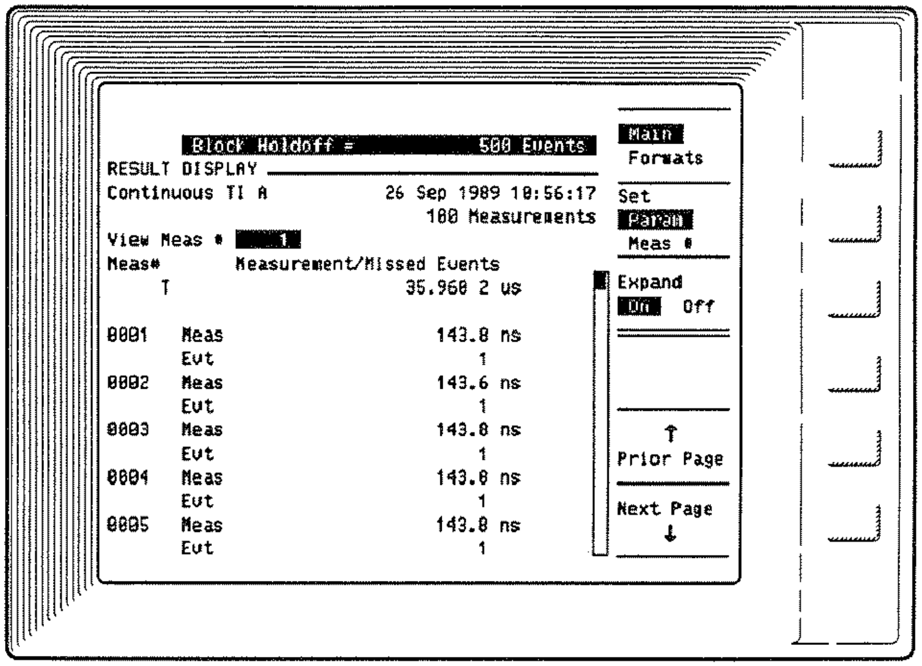


Figure 1-13.
Function Menu

As described on the menu, after a positive event on External Arm, 500 events will be counted on Channel A before the first measurement sequence begins.

2. The Numeric screen in *Figure 1-14* shows a portion of the results. The Expanded Data feature is set to On.

Figure 1-14. Continuous Time Interval Results



The Numeric screen shows that one event was missed for each measurement. For CTI measurements, this means that one event was not timed during each measurement, but was included in the measurement. Notice the time listed before the first measurement. It is preceded by a "T". This is the time from the occurrence of the event on External Arm to when the first measurement sample is acquired. For this example, "T" is the time for 500 events.

TECHNICAL COMMENT

The "T" time displayed on the Numeric screen in this example is called, the Time Stamp of the block arming edge. It is provided for this measurement setup of CTI with Event Holdoff. This feature of referencing the arming edge provides the ability to reference a group of measurements (a block) to the arming edge of the block. Multiple blocks of measurements can then be averaged by the HP 5373A. There is a Function menu field that will appear when the number of blocks is set to more than 1 for configurations that allow averaging. Averaged results will be displayed on the Numeric screen and the Time Variation graph on the Graphic screen. The arming modes for CTI that provide for averaging are noted in this chapter. This feature is also described in "Arming," chapter 5 and in "Function Menu," chapter 7.

The one event that is missed during each measurement is included in the measurement result. This is shown in the waveform in *Figure 1-15* that represents a portion of the measured signal.

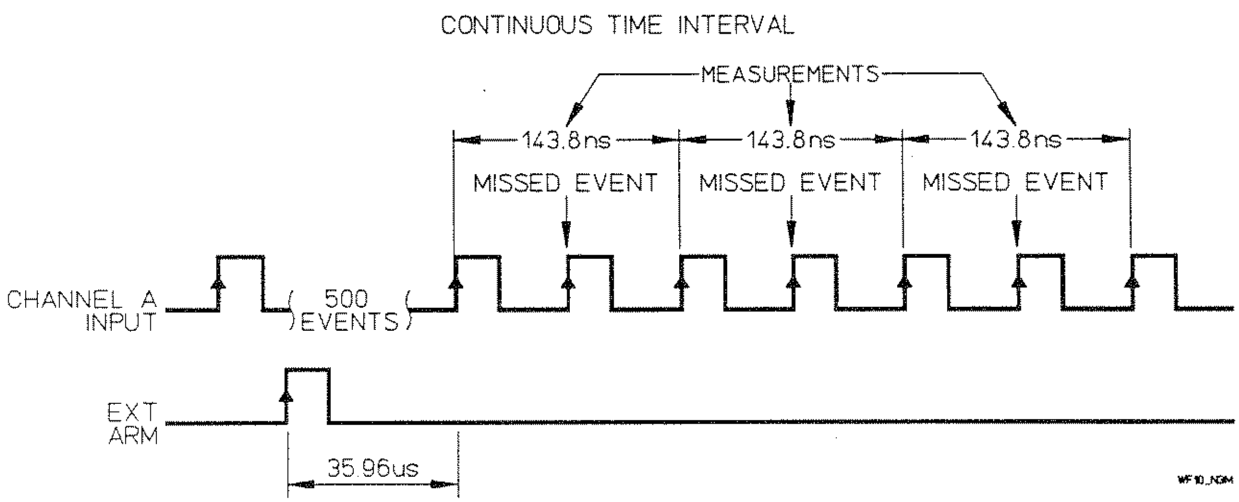
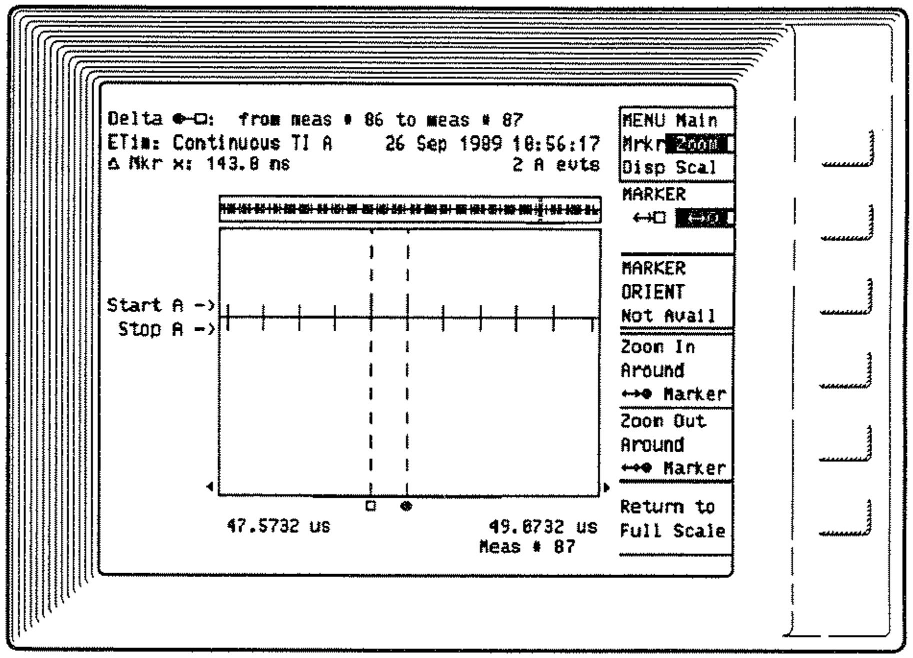


Figure 1-15. CTI With Missed Events

Two periods of the input signal are collected for each measurement. This information is also represented by the Event Timing graph on the Graphic screen. Notice that the start and stop ticks on the graph line up. This shows that the end of one measurement is also the start of the next. See *Figure 1-16* below.

Figure 1-16. Event Timing Graph of CTI



TIME INTERVAL ARMING MODES

Shown below are the measurement channels and arming modes available for each of the time interval types.

HP 5373A Function and Arming Summary

ARMING MODE	MEASUREMENT FUNCTION												
	TIME INTERVAL OR HISTOGRAM TI		CONTINUOUS TIME INTERVAL OR HISTOGRAM CTI	±TIME INTERVAL OR HISTOGRAM ±TI		PRF, FREQUENCY, PRI, PERIOD		TOTALIZE		PULSE WIDTH, OFFTIME, RISE TIME, FALL TIME, DUTY CYCLE	PHASE	ENVELOPE POWER, AMPLITUDE MODULATION	PHASE DEVIATION, TIME DEVIATION, FREQUENCY DEVIATION
	A	A → B	A	A	A → B	A	DUAL[1]	A	DUAL[1]	A	A rel B	A	A
	B	B → A	B	B	B → A	B	RATIO[2]	B	RATIO[3]		B rel A	B	B
						C	SUM[3]		SUM[4]				
							DIFF[4]		DIFF[4]				
AUTOMATIC													
AUTOMATIC	C*	C*	C*		C*	C*	C*			C*	C*	N*	C*
HOLDOFF													
EDGE HOLDOFF	C	C	C		C	C					C		C
TIME HOLDOFF	C	C	C			C							
EVENT HOLDOFF	C	C	C			C							
SAMPLING													
INTERVAL SAMPLING	C	C	C		C	C	C	C*	C*		C		C
TIME SAMPLING						N							
CYCLE SAMPLING						C							
EDGE SAMPLING						C	C	C	C				
PARITY SAMPLING					C								
REPET EDGE SAMPLING	C	C	C		C								
REPET EDGE-PARITY SAMPLING					C								
RANDOM SAMPLING	C	C			C								
HOLDOFF/SAMPLING													
EDGE/INTERVAL	C	C	C		C	C	C	C	C		C		C
EDGE/TIME						N							
EDGE/EDGE						C		C	C				
EDGE/CYCLE						C							
EDGE/EVENT				N	N	N							
EDGE/PARITY					C								
EDGE/RANDOM	C	C			C								
TIME/INTERVAL						C		C					
TIME/TIME				N	N	N							
EVENT/INTERVAL						C							
EVENT/EVENT				N*	N	N							
EXTERNALLY GATED						C		C	C				
MANUAL								N	N				

Symbol C or N indicates that a measurement can be made using the corresponding combination of Function, Channel, and Arming selections.

C = Continuous Arming, (Block/Sample Arming)

N = Non-Continuous arming, (Start/Stop Arming), setups are limited to M blocks of 1 measurement.

1. DUAL. Simultaneous Dual-channel, (2 results). Frequency and PRI options are: A&B, A&C, B&C. Totalize option is: A&B.
2. RATIO. Frequency and Period ratio options are: A/B, A/C, B/A, B/C, C/A, C/B. Totalize ratio options are: A/B, B/A.
3. SUM. Frequency and Period sum options are: A+B, A+C, B+C. Totalize sum option is: A+B.
4. DIFFERENCE. Frequency and Period difference options are: A–B, A–C, B–A, B–C, C–A, C–B. Totalize difference options are: A–B, B–A.

* = Default Arming

Measurements Referenced To The Block Arming Edge

There are four arming modes for Continuous Time Interval measurements that reference all measurements of a block to the block holdoff arming edge. They are:

- Edge Holdoff
- Time Holdoff
- Event Holdoff
- Edge / Interval

For these arming modes, the edge which arms each block is "time-stamped," and the elapsed time between the block arming edge and the first measurement sample is measured.

While all the arming modes provide the time from the beginning of the first measurement of a block, these time-stamp arming modes also provide the time between the block arming edge and the first measurement sample that is collected. The time value is displayed on the Numeric screen. It is listed before the first measurement result of the block and has a "T" in front of it. The diagrams in the next part of this chapter show the time-stamp arming modes with a portion of the example signal labeled with a "T".

NOTE

To receive valid data, the interval between the block arming edge and the first measurement sample must be within the measurable range of the selected measurement mode:

Normal Measurement Mode = 10 ns to 8.0 s

Fast Measurement Mode = 10 ns to 131 μs

TECHNICAL COMMENT

The HP 5373A has been optimized to always capture both the block arming edge and the first measurement sample, even if they occur only 10 ns apart.

If the first measurement sample is received by the HP 5373A less than 100 ns (75 ns for Fast mode) after the block arming edge, the measurement sample will be captured, but the instrument will be storing data during the 180 ns which follow the arming edge. During that 180 ns, trigger events of the measurement signal will be counted but will have no time data associated with them.

Averaged Results for Continuous Time Interval

The feature of time-stamping the arming edge makes it possible for the HP 5373A to average multiple blocks of measurements. When you select one of the four arming modes from the previous page for a multiple-block Continuous Time Interval measurement, a field on the Function menu will allow selection of "Averaged Results" (the other option is "All Results"). The averaged results are shown on the Numeric screen, the Time Variation and Event Timing graphs. If the total number of measurements selected exceeds the size of internal memory, "Averaged Results" is the only option available.

TIME INTERVAL ARMING MODE EXAMPLES

This section shows the different types of time interval measurements along with a timing diagram to illustrate each available arming mode. In all the examples, the rate of events to be measured is assumed to be within the HP 5373A's capability to collect event and time data for all measurement trigger events. The trigger event is the positive slope of the measurement signal for these examples.

Time Interval Measurements

TIME INTERVAL MEASUREMENT WITH AUTOMATIC ARMING

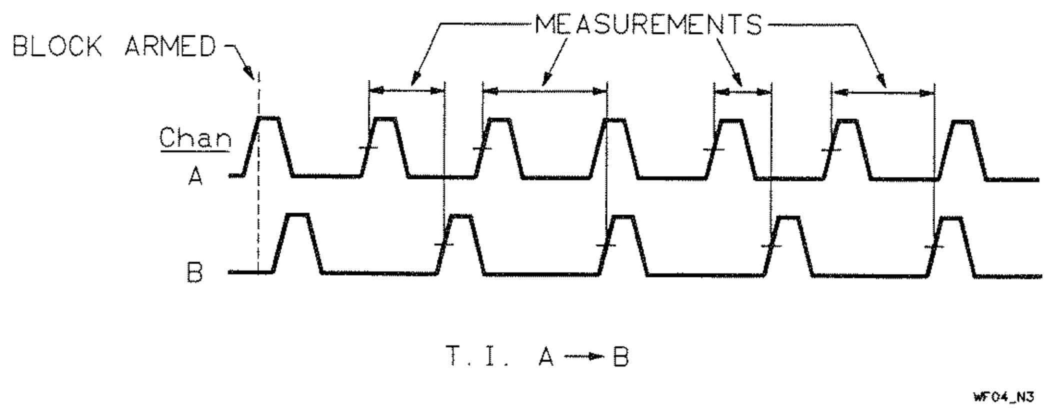


Figure 1-17. Time Interval | Automatic

DESCRIPTION:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data is collected as quickly as possible at the trigger events of the signals being measured. Four measurements are shown.

TIME INTERVAL MEASUREMENT WITH EDGE HOLDOFF ARMING

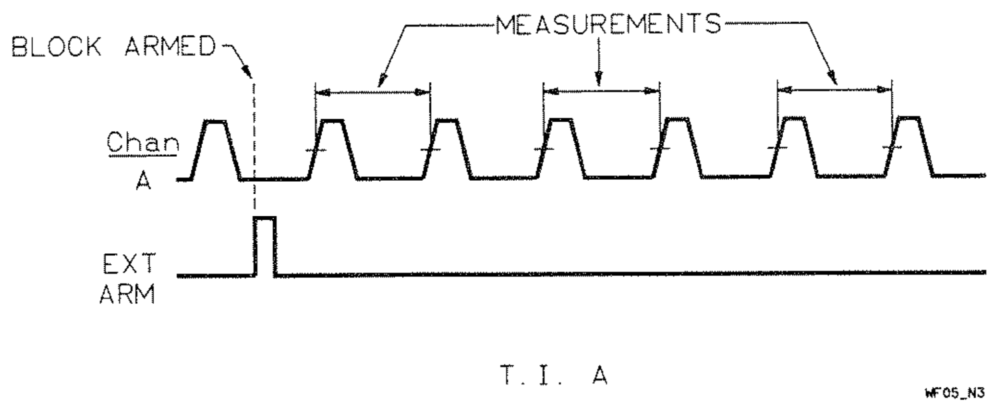


Figure 1-18. Time Interval | Edge Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on External Arm. The measurement start is delayed until the arming edge occurs.
- Measurement data is then collected as quickly as possible at the trigger events of Channel A. Three measurements are shown.
- The diagram shows an edge holdoff of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.

TIME INTERVAL MEASUREMENT WITH TIME HOLDOFF ARMING

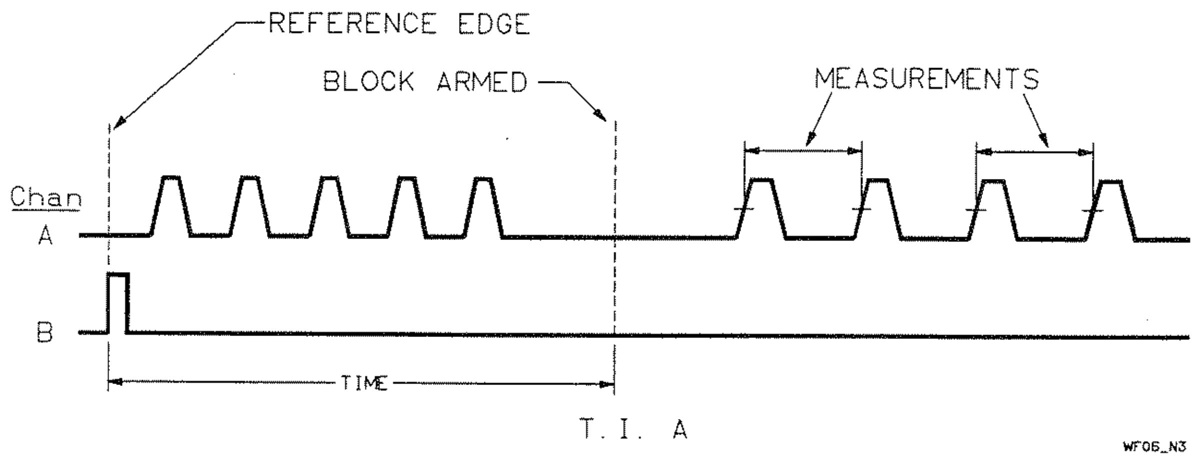


Figure 1-19. Time Interval | Time Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable time delay. The start of the delay is referenced to a positive edge on Channel B.
- Measurement data is then collected as quickly as possible at the trigger events of Channel A. Two measurements are shown.
- The diagram shows the time delay referenced to a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- For Normal Measurement Mode —

  Range of Time = 2 ns to 8.0 s. Can be set with a 2 ns resolution.

- For Fast Measurement Mode —

  Range of Time = 2 ns to 131 μs. Can be set with a 2 ns resolution.

TIME INTERVAL MEASUREMENT WITH EVENT HOLDOFF ARMING

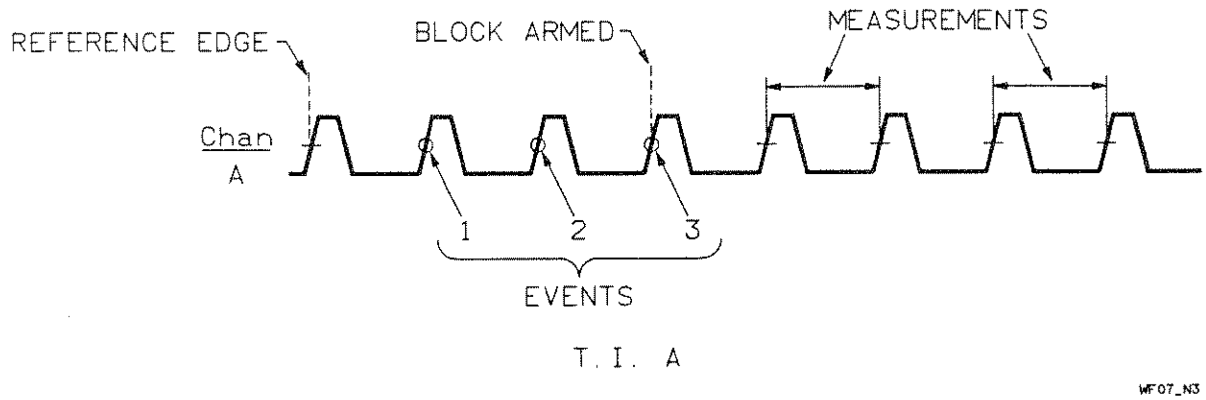


Figure 1-20. Time Interval | Event Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable event delay. The start of the three-event delay here is referenced to a positive edge on Channel A.
- Measurement data is then collected as quickly as possible at the trigger events of Channel A. Two measurements are shown.
- The diagram shows an event delay referenced to a positive edge on Channel A. Other options are a positive or negative edge on Channel B or External Arm.
- The delay events can be on Channel A or B.
- For Normal Measurement Mode:

  Range of Events = 0 to 4,000,000,000
- For Fast Measurement Mode:

  Range of Events = 0 to 65,000

TIME INTERVAL MEASUREMENT WITH INTERVAL SAMPLING ARMING

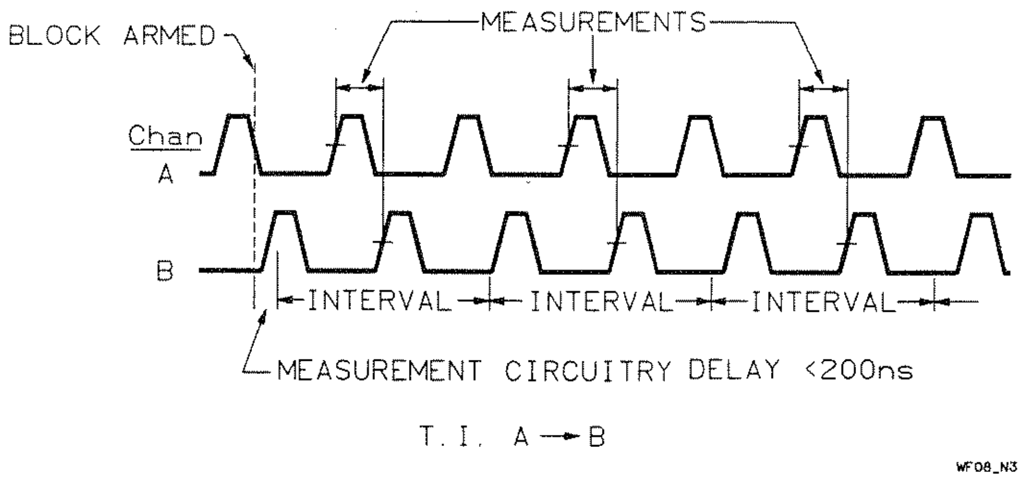


Figure 1-21. Time Interval | Interval Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- For Time Interval measurements, one measurement is taken per interval when the specified sample interval is longer than the time interval measured. If the sample interval is shorter than the time interval measured, the measurement data will be collected just as it is for Time Interval measurements using the Automatic arming mode. In the example shown above, the sample interval sets the time between measurements. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.
- For Normal Measurement Mode:

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.
- For Fast Measurement Mode:

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

TIME INTERVAL MEASUREMENT WITH REPETITIVE EDGE ARMING

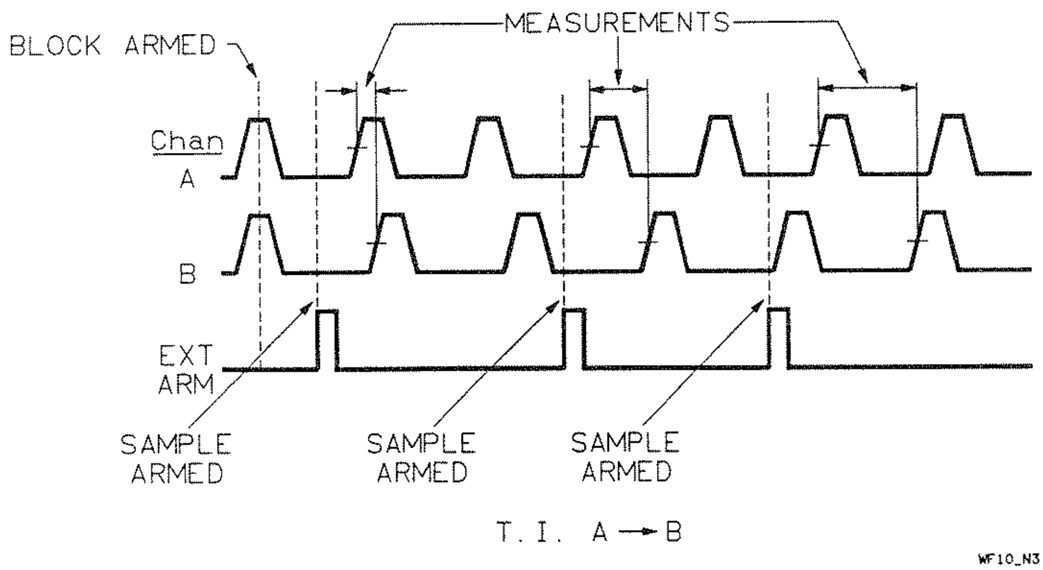


Figure 1-22. Time Interval | Repetitive Edge

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data for one measurement is then collected after each positive edge on External Arm. There is one measurement per arming edge. Three measurements are shown.
- The diagram shows a sample arm of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.

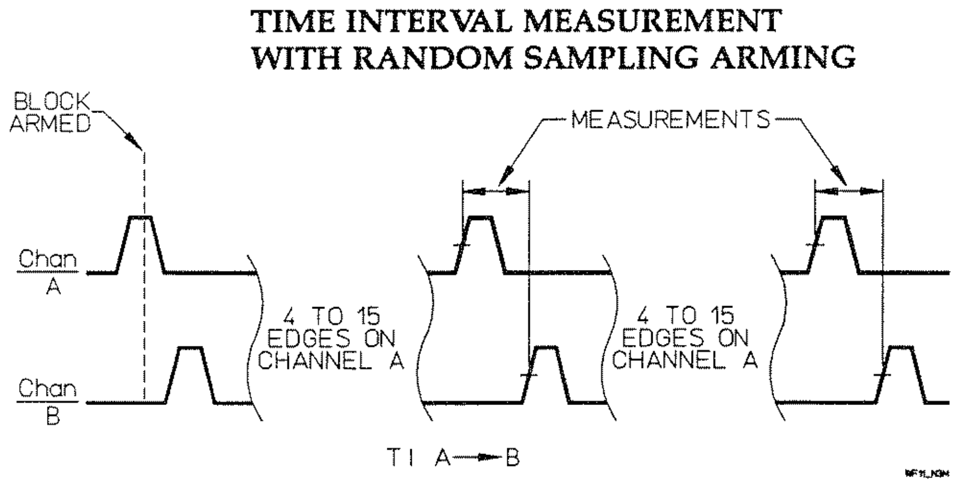


Figure 1-23. Time Interval | Random Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data for each measurement is then collected after a random number of edges on Channel A. The random number of edges on Channel A varies from 4 to 15 between each measurement.
- HP 5373A always randomizes on Channel A.
- Random sampling is only valid up to a 100 MHz rate. For more information, refer to "Arming," chapter 5.

NOTE

The pseudo-random sequence generator operates in a "free-run" mode. Because of this, the first measurement in a sequence can occur after fewer than four edges on Channel A. For the measurements that follow, the pseudo-random sequence generator arms a measurement every six to seventeen edges on Channel A.

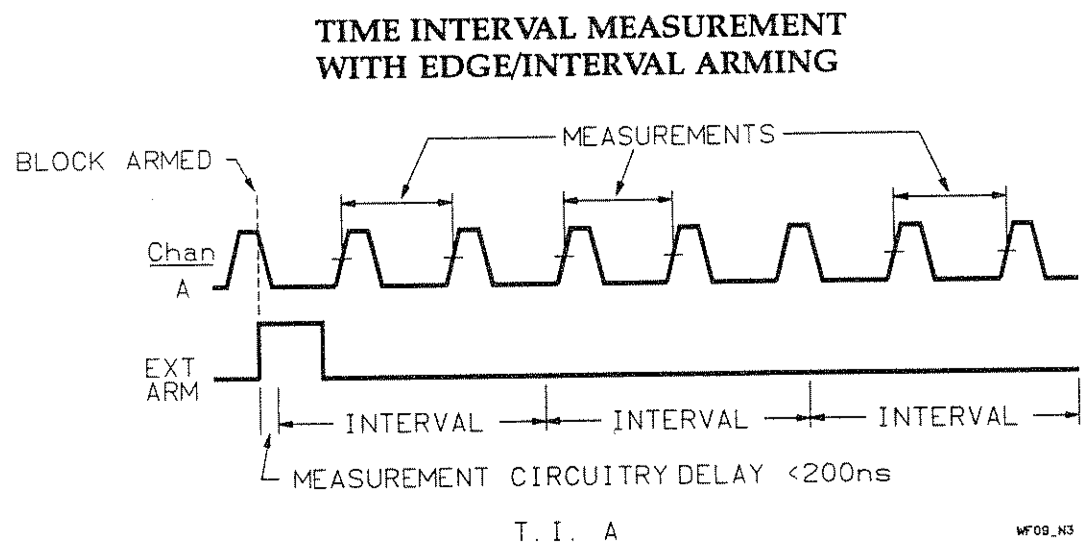


Figure 1-24. Time Interval | Edge/Interval

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on External Arm. The start is delayed until the arming edge occurs.
- For Time Interval measurements, one measurement is taken per interval when the specified sample interval is longer than the time interval measured. If the sample interval is shorter than the time interval measured, the measurement data will be collected just as it is for Time Interval measurements using the Automatic arming mode. In the example shown above, the sample interval sets the time between measurements. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.
- The diagram shows an edge holdoff of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- For Normal Measurement Mode:

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.
- For Fast Measurement Mode:

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

TIME INTERVAL MEASUREMENT WITH EDGE/RANDOM ARMING

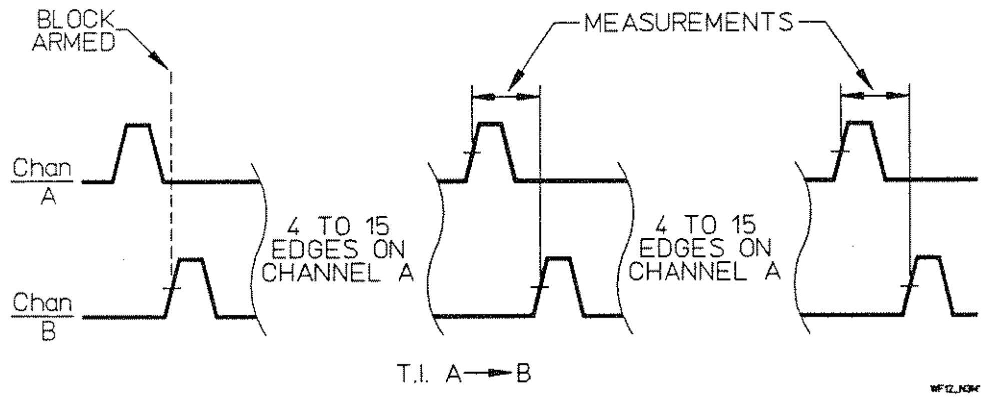


Figure 1-25. Time Interval | Edge/Random

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on Channel B. The measurement start is delayed until the arming edge occurs.
- Measurement data is then collected for each measurement after a random number of edges on Channel A. The random number of edges on Channel A varies from 4 to 15 between each measurement.
- The diagram shows an edge holdoff of a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- HP 5373A always randomizes on Channel A.
- Random sampling is only valid up to a 100 MHz rate. For more information, refer to "Arming," chapter 5.

NOTE

The pseudo-random sequence generator operates in a "free-run" mode. Because of this, the first measurement in a sequence can occur after fewer than four edges on Channel A. For the measurements that follow, the pseudo-random sequence generator arms a measurement every six to seventeen edges on Channel A.

Continuous Time Interval Measurements

CONTINUOUS TIME INTERVAL MEASUREMENT WITH AUTOMATIC ARMING

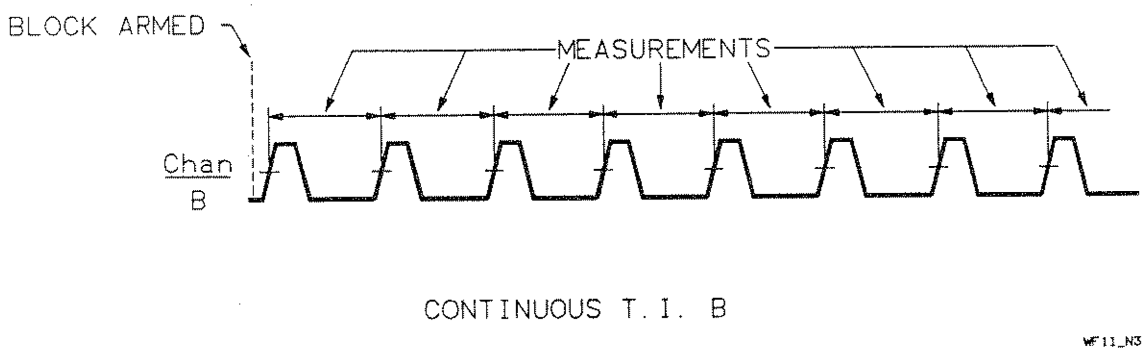


Figure 1-26. Continuous Time Interval | Automatic

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data is then collected as quickly as possible at the trigger events of Channel B. Seven measurements are shown.

CONTINUOUS TIME INTERVAL MEASUREMENT WITH EDGE HOLDOFF ARMING

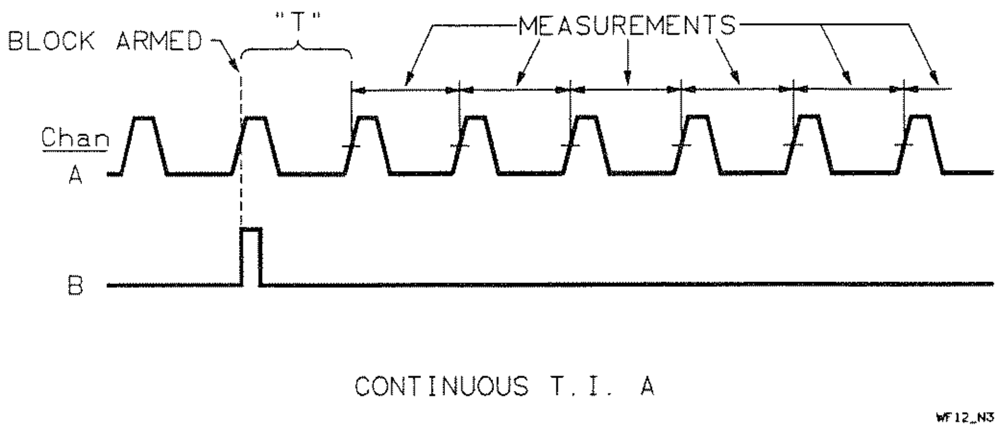


Figure 1-27. Continuous Time Interval | Edge Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on Channel B.
- Measurement data is then collected as quickly as possible at the trigger events of Channel A. Five measurements are shown.
- The diagram shows an edge holdoff of a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported.

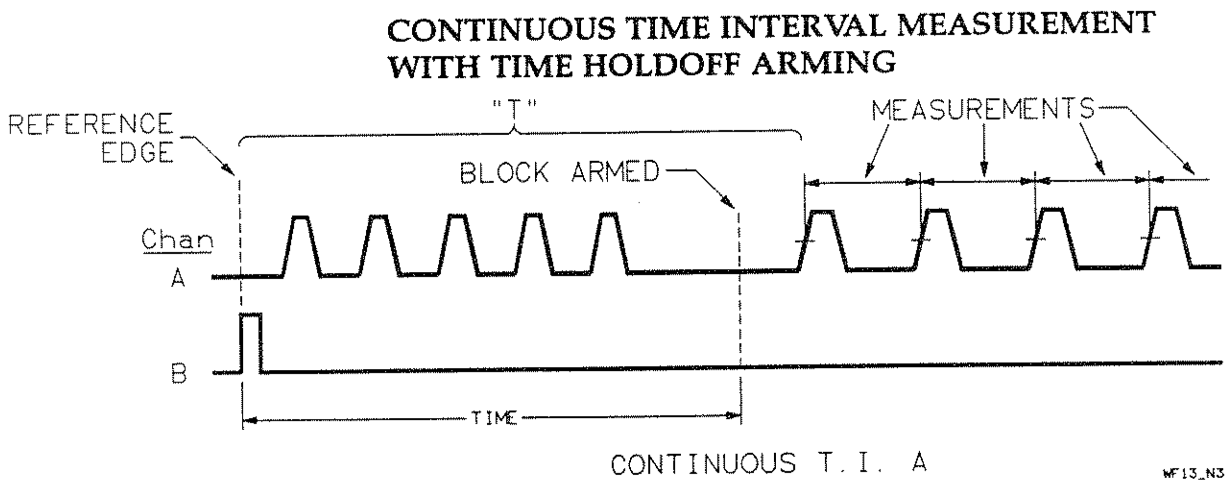


Figure 1-28. Continuous Time Interval | Time Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable time delay. The start of the delay is referenced to a positive edge on Channel B.
- Measurement data is then collected as quickly as possible at the trigger events of Channel A. Three measurements are shown.
- The diagram shows the time delay referenced to a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported.
- For Normal Measurement Mode:

  Range of Time = 2 ns to 8.0 s. Can be set with a resolution of 2 ns.
- For Fast Measurement Mode:

  Range of Time = 2 ns to 131 μs. Can be set with a resolution of 2 ns.

CONTINUOUS TIME INTERVAL MEASUREMENT WITH EVENT HOLDOFF ARMING

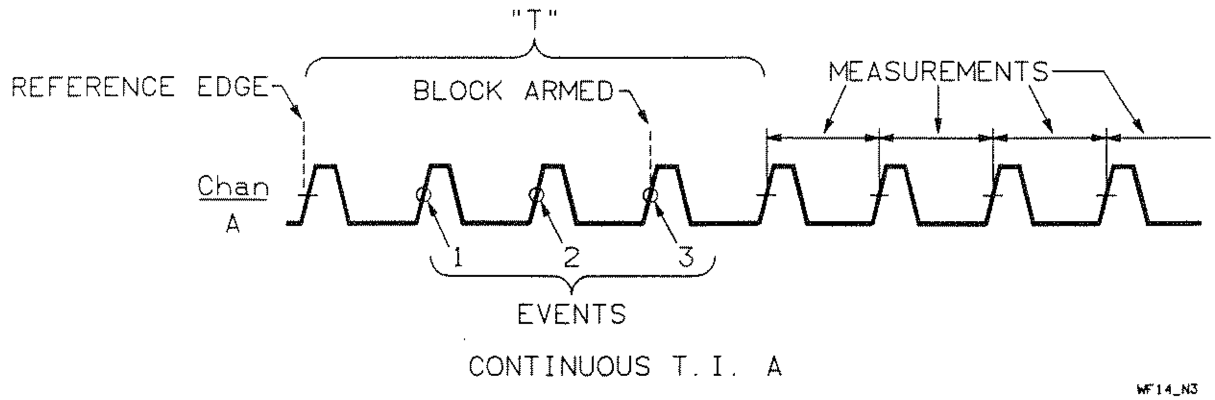


Figure 1-29. Continuous Time Interval | Event Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable event delay. The start of the three-event delay is referenced to a positive edge on Channel A.
- Measurement data is then collected as quickly as possible at the trigger events of Channel A. Three measurements are shown.
- The diagram shows an event delay referenced to a positive edge on Channel A. Other options are a positive or negative edge on Channel B or External Arm.
- The delay events can be on Channel A or B.
- The reference edge is time stamped, so all measurements in the block are referenced to the holdoff edge. Averaging of multiple blocks is supported.
- For Normal Measurement Mode:

  Range of Events = 0 to 4,000,000,000
- For Fast Measurement Mode:

  Range of Events = 0 to 65,000

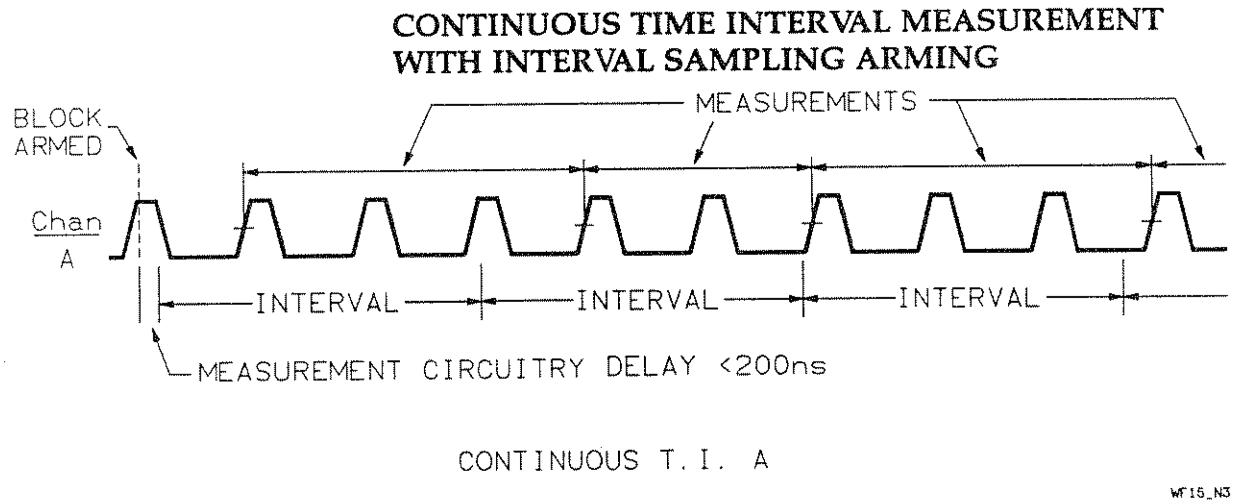


Figure 1-30. Continuous Time Interval | Interval Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data is then collected on the trigger event of Channel A after each specified sample interval.

The first measurement begins on the trigger event after the start of the first interval. Thereafter, measurements end on the trigger event following each interval. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.

- For Normal Measurement Mode:

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- For Fast Measurement Mode:

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

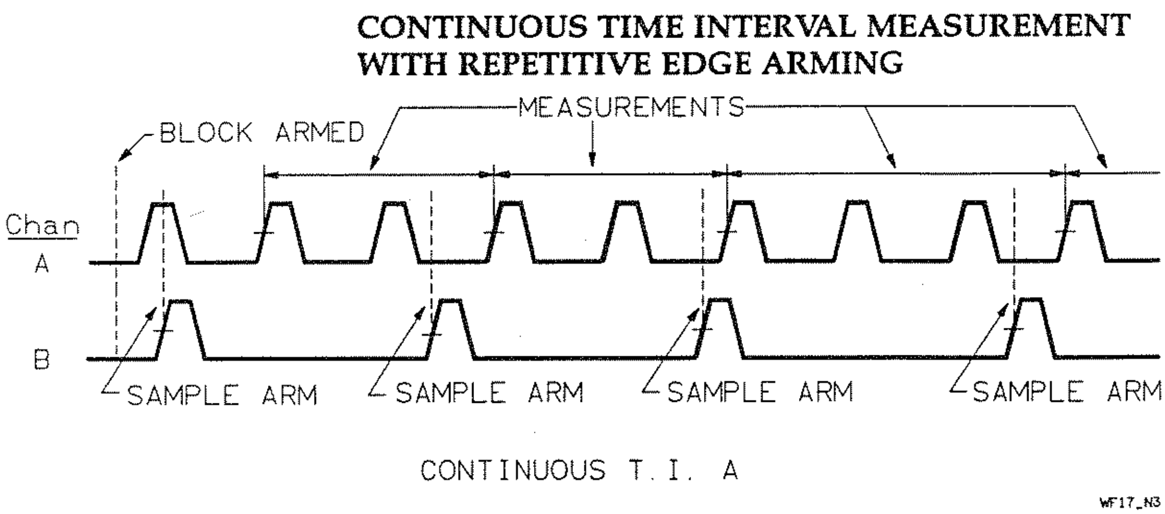


Figure 1-31. Continuous Time Interval | Repetitive Edge

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data is then collected after each positive edge on Channel B. One sample is collected per arming edge. Three measurements are shown.
- The diagram shows a sample arm of a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.

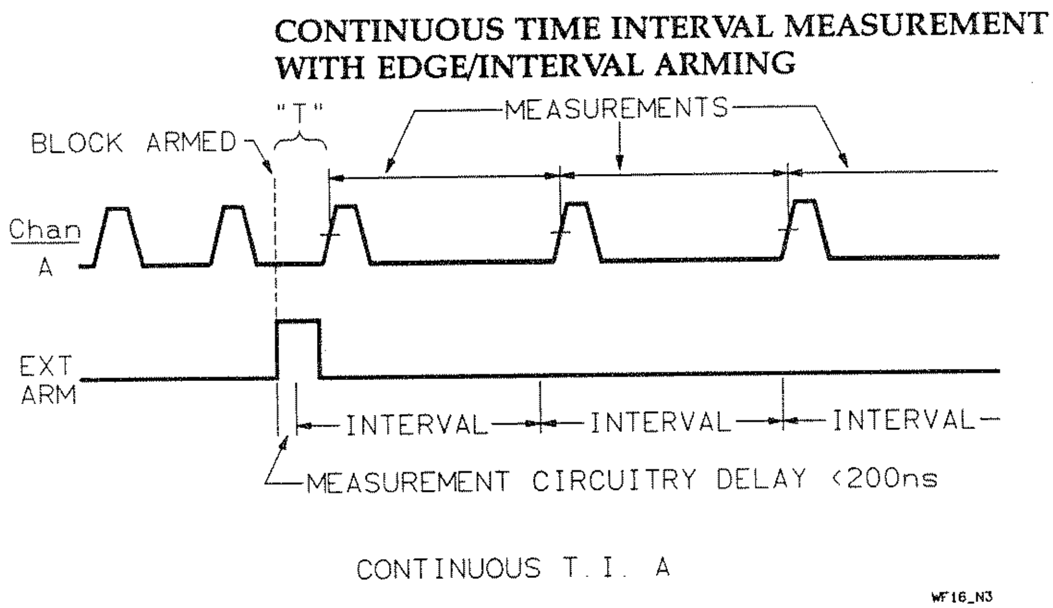


Figure 1-32. Continuous Time Interval | Edge/Interval

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on External Arm.
- Measurement data is then collected on the trigger event of Channel A after each specified sample interval.

The first sample is collected on the trigger event after the start of the first interval. Thereafter, measurements end on the trigger event following each interval. The sample interval is repetitive and asynchronous with the signal being measured. Two measurements are shown.

- The diagram shows an edge holdoff of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported.

- For Normal Measurement Mode:

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- For Fast Measurement Mode:

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

±Time Interval Measurements

±TIME INTERVAL MEASUREMENT WITH AUTOMATIC ARMING

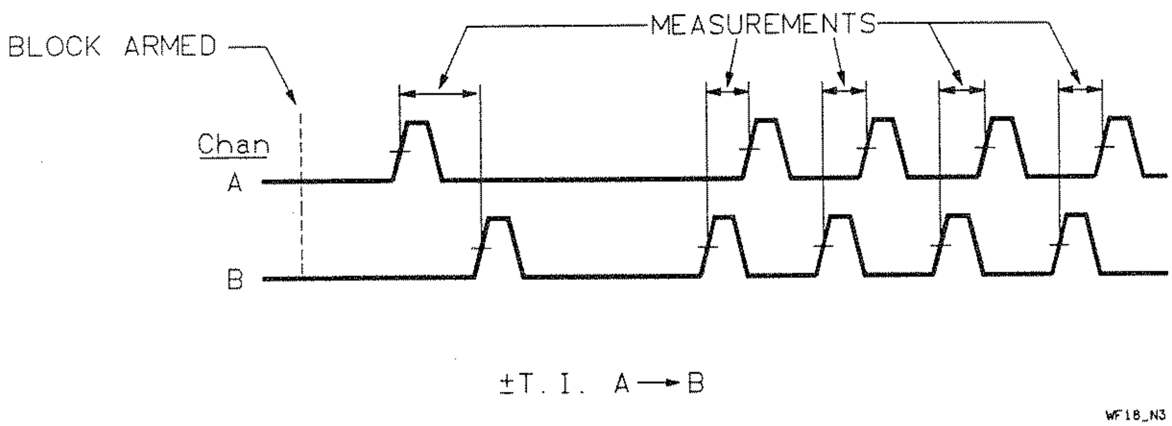


Figure 1-33. ±Time Interval | Automatic

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data is collected as quickly as possible at the trigger events of the signals being measured. Five measurements are shown.

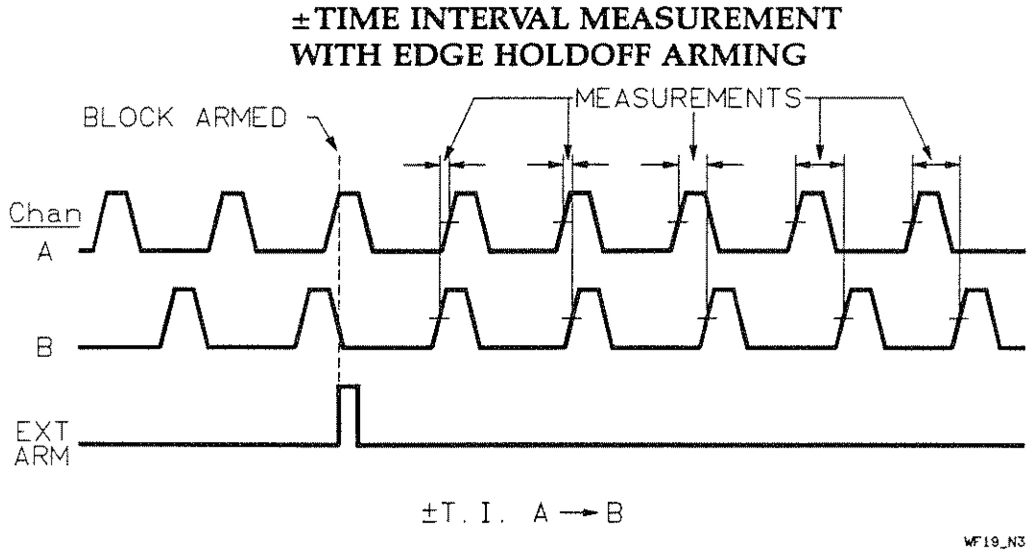


Figure 1-34. ±Time Interval | Edge Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on External Arm.
- Measurement data is then collected as quickly as possible at the trigger events of the signals being measured. Five measurements are shown.
- The diagram shows an edge holdoff of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.

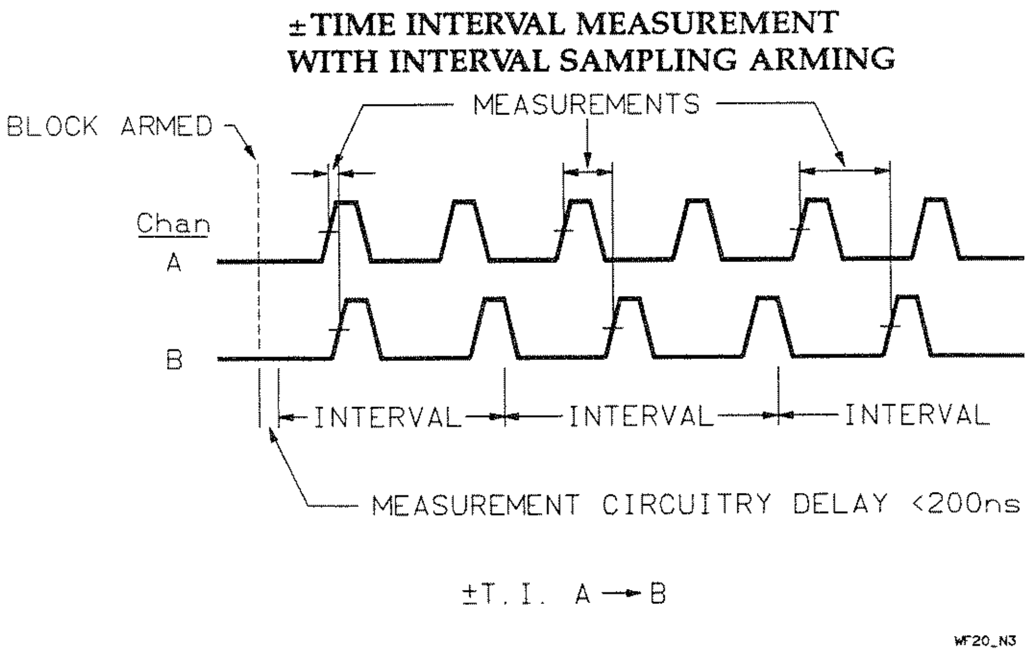


Figure 1-35. ±Time Interval | Interval Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- For ±Time Interval measurements, one measurement is taken per interval when the specified sample interval is longer than the time interval measured. If the sample interval is shorter than the time interval measured, the measurement data will be collected just as it is for ±Time Interval measurements using the Automatic arming mode. In the example shown above, the sample interval sets the time between measurements. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.
- For Normal Measurement Mode:

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.
- For Fast Measurement Mode:

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

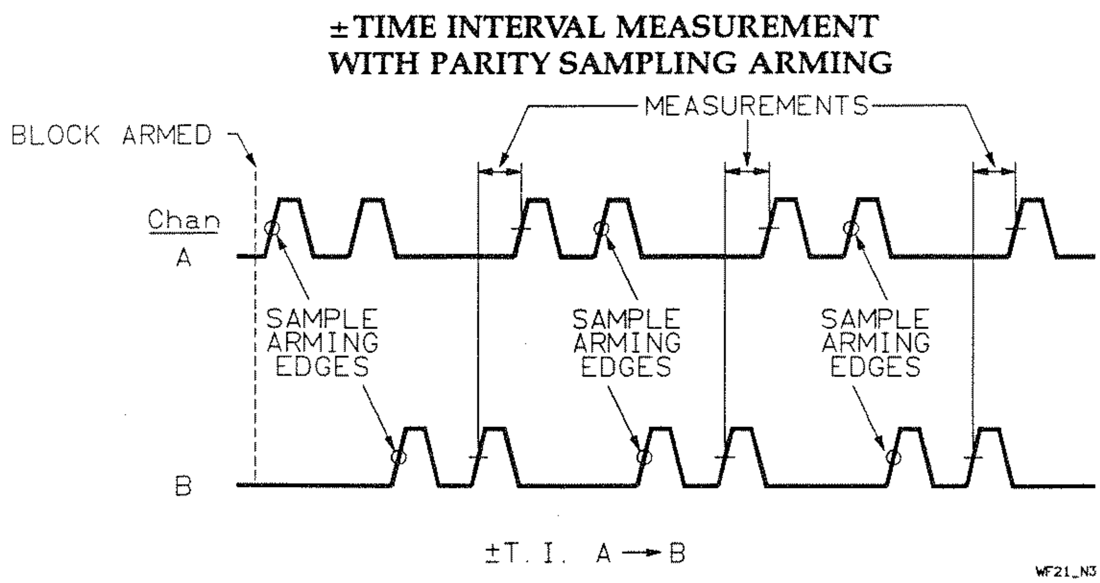


Figure 1-36. ±Time Interval | Parity Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- For ±Time Interval measurements, one measurement is collected following a trigger event on each of the two measurement channels. Three measurements are shown.

NOTE

This diagram shows the operation of this arming mode and is not an example of an application. This arming mode is intended for a set of signals that do not go out of phase more than 360 degrees (that is, on average, there should be the same number of edges on Channel A as on Channel B).

NOTE

For Parity Sampling (Parity = two sample arming edges)—

During an approximately 200 ns interval after every measurement (this is when the HP 5373A is storing the measurement data to memory), detection of the sample arming edges operates according to the following rules:

1. *If an unequal number of edges occur on the two input channels (for example, 2 on A and 0 on B, 1 on A and 0 on B, or 2 on A and 1 on B), only one more edge on the input channel with fewer edges (Channel B in this example) is needed after the 200 ns interval, to satisfy the parity condition required for the next measurement.*

2. *If an equal number of edges occur on the two measurement channels (for example, 1 on A and 1 on B, or 2 on A and 2 on B), one more edge on each of the two measurement channels is required after the 200 ns interval to satisfy the parity condition required for the next measurement.*

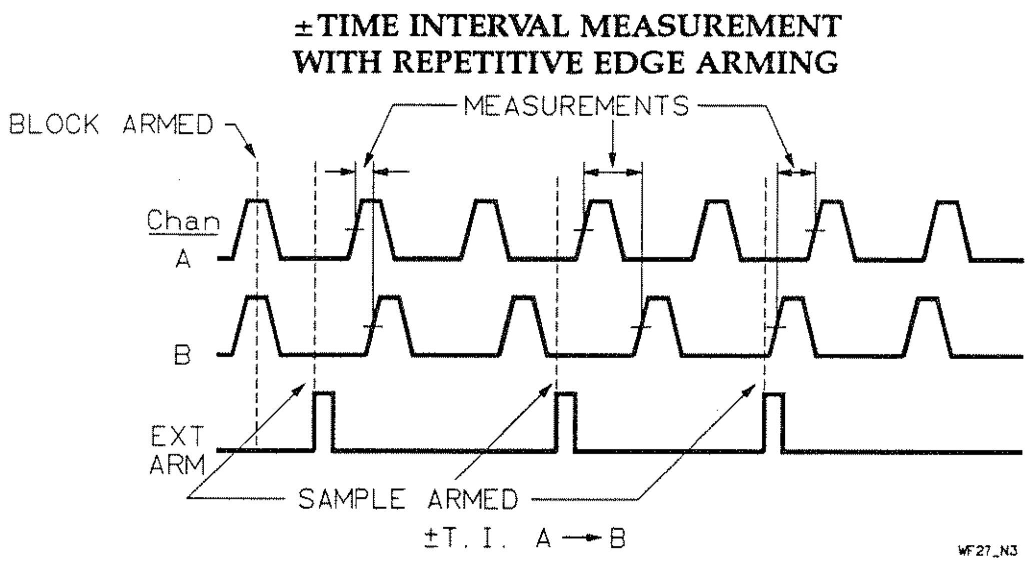


Figure 1-37. ±Time Interval | Repetitive Edge

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data for one measurement is then collected after each positive edge on External Arm. There is one measurement per arming edge. Three measurements are shown.
- The diagram shows a sample arm of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.

±TIME INTERVAL MEASUREMENT WITH REPETITIVE EDGE-PARITY ARMING

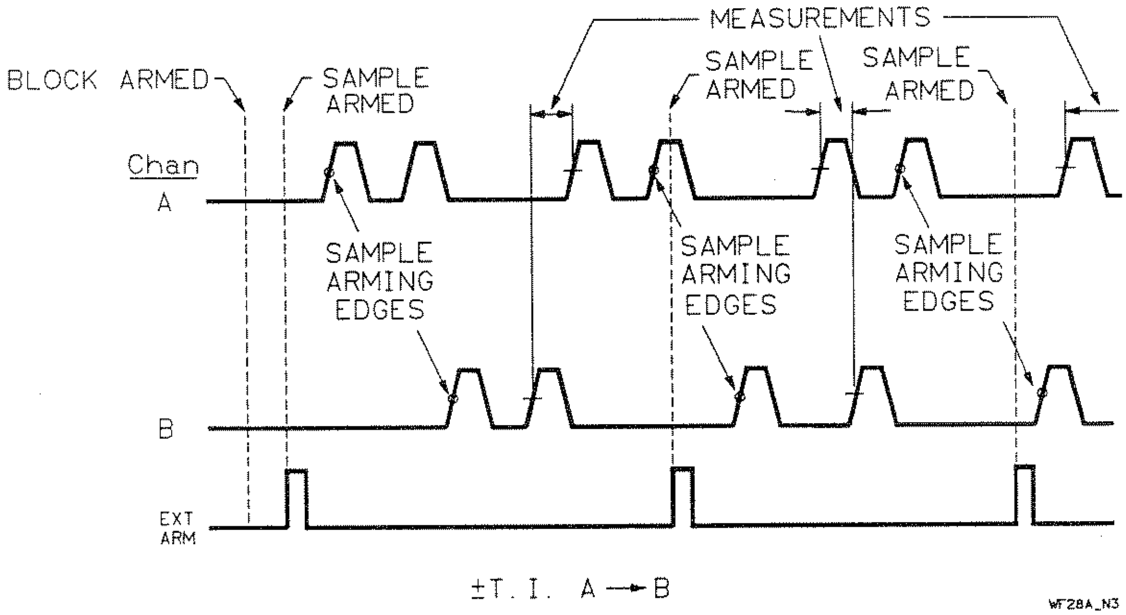


Figure 1-38. ±Time Interval | Repetitive Edge-Parity

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data for one measurement is then collected after a positive edge on External Arm and a trigger event on each of the two measurement channels. Two measurements are shown.
- The diagram shows a sample arm of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.

NOTE

This diagram shows the operation of this arming mode and is not an example of an application. This arming mode is intended for a set of signals that do not go out of phase more than 360 degrees (that is, on average, there should be the same number of edges on Channel A, as on Channel B).

NOTE

For Parity Sampling (Parity = two sample arming edges)—

During an approximately 200 ns interval after every measurement, detection of the sample arming edges operates according to the following rules:

1. *If an unequal number of edges occur on the two input channels (for example, 2 on A and 0 on B, or 1 on A and 0 on B, or 2 on A and 1 on B), only one more edge on the input channel with fewer edges (Channel B in this example) is needed after the 200 ns interval, to satisfy the parity condition required for the next measurement.*
2. *If an equal number of edges occur on the two measurement channels (for example, 1 on A and 1 on B, or 2 on A and 2 on B), one more edge on each of the two measurement channels is required after the 200 ns interval to satisfy the parity condition required for the next measurement.*

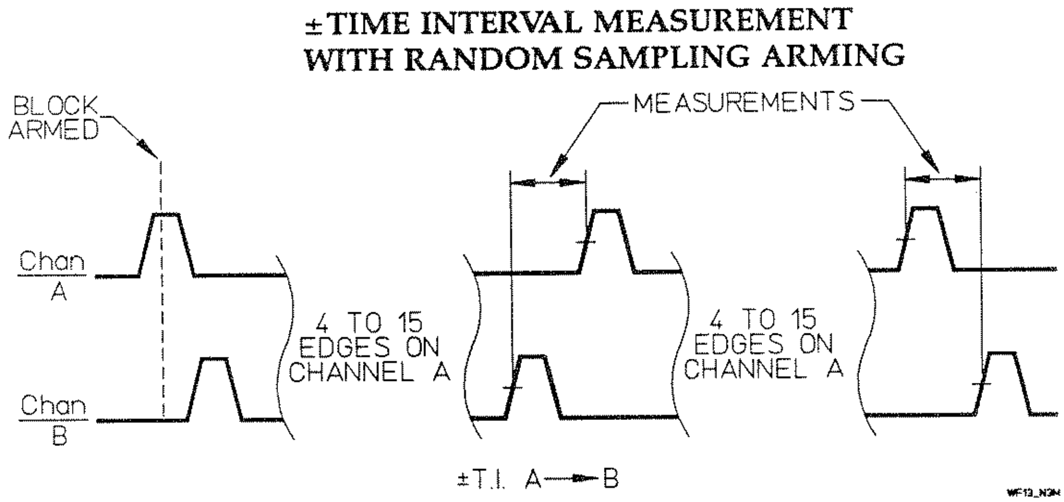


Figure 1-39. ±Time Interval | Random Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready.
- Measurement data for each measurement is then collected after a random number of edges on Channel A. The random number of edges on Channel A varies from 4 to 15 between each measurement.
- HP 5373A always randomizes on Channel A.
- Random sampling is only valid up to a 100 MHz rate. For more information, refer to "Arming," chapter 5.

NOTE

The pseudo-random sequence generator operates in a "free-run" mode. Because of this, the first measurement in a sequence can occur after fewer than four edges on Channel A. For the measurements that follow, the pseudo-random sequence generator arms a measurement every six to seventeen edges on Channel A.

±TIME INTERVAL MEASUREMENT WITH EDGE/INTERVAL ARMING

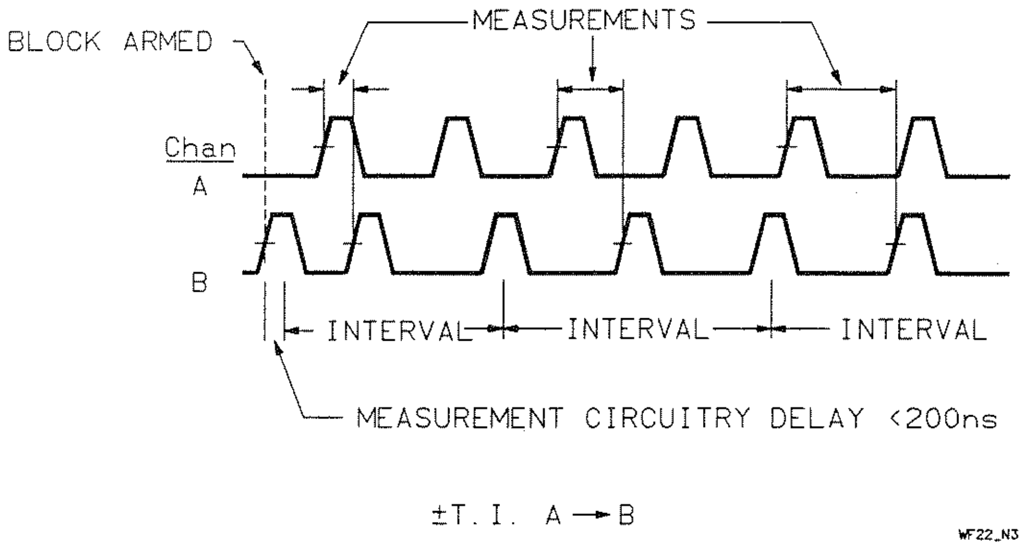


Figure 1-40. ±Time Interval | Edge/Interval

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on Channel B. The start is delayed until the arming edge occurs.
- For ±Time Interval measurements, one measurement is taken per interval when the specified sample interval is longer than the time interval measured. If the sample interval is shorter than the time interval measured, the measurement data will be collected just as it is for ±Time Interval measurements using the Automatic arming mode. In the example shown above, the sample interval sets the time between measurements. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.
- The diagram shows an edge holdoff of a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.

- For Normal Measurement Mode:

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- For Fast Measurement Mode:

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

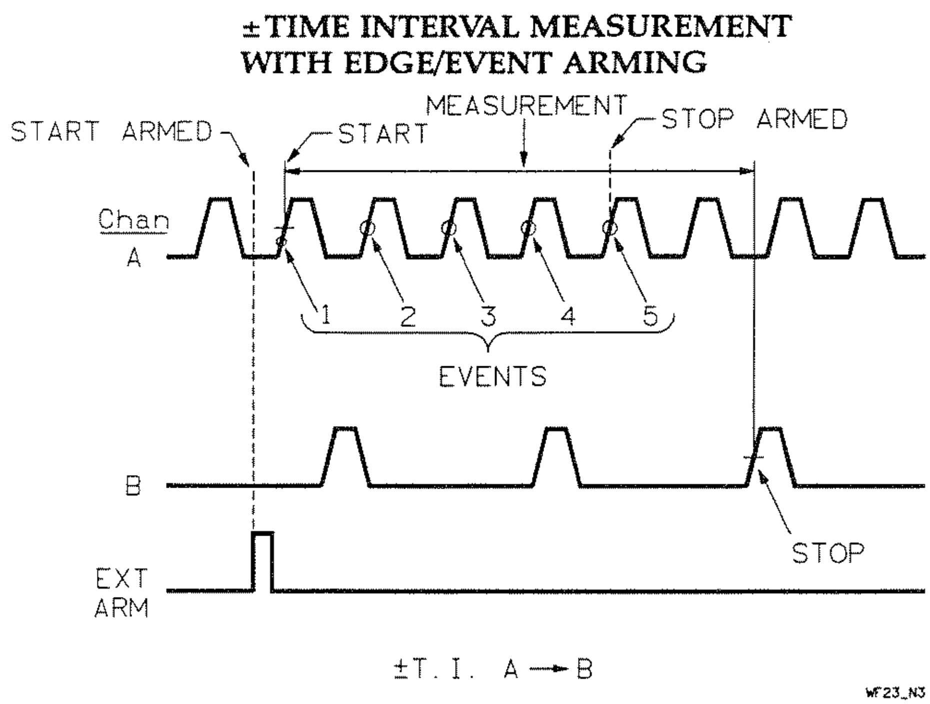


Figure 1-41. ±Time Interval | Edge/Event

DESCRIPTION OF DIAGRAM:

- Measurement can begin after a positive edge on External Arm.
- Measurement starts on the next trigger event on either of the two measurement channels after the arming edge.
- Measurement ends on the trigger event of the other measurement channel following the specified number of events on Channel A.
- The diagram shows an edge holdoff of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- The delay events can be on Channel A or B.
- The maximum number of measurements per block is 1. Configurations such as 100 blocks of 1 measurement are allowed.
- For Normal Measurement Mode:

  Range of Events = 0 to 2,000,000,000

NOTE

Total period of Stop Arm events should not exceed 4.0 s.

- For Fast Measurement Mode:

  Range of Events = 0 to 32,500

NOTE

Total period of Stop Arm events should not exceed 65 μs.

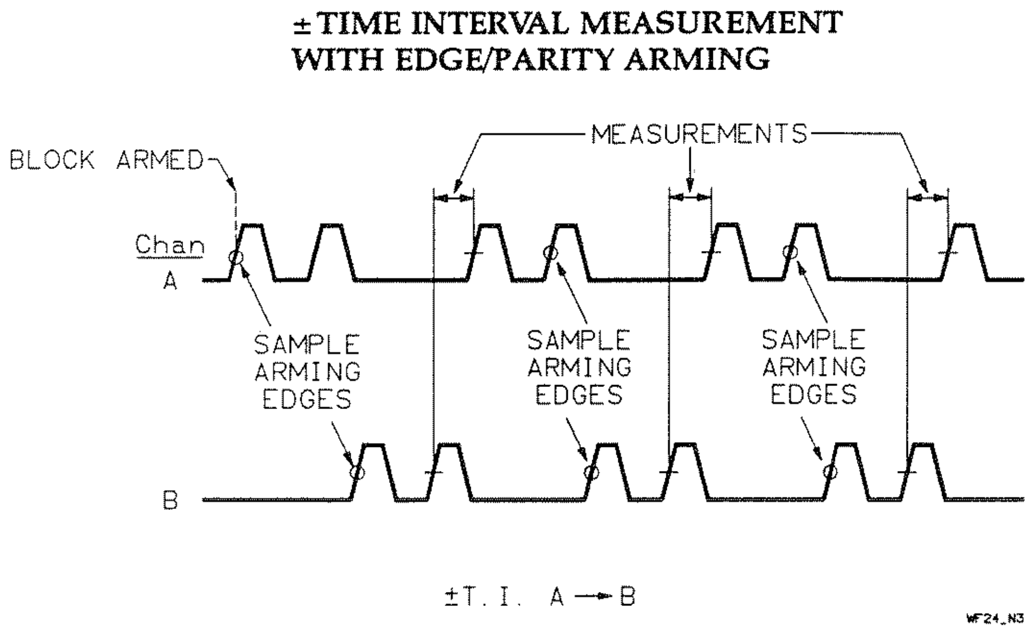


Figure 1-42. ±Time Interval | Edge/Parity

DESCRIPTION OF DIAGRAM:

- A block can begin after a positive edge on Channel A.
- For ±Time Interval measurements, one measurement is collected following a trigger event on each of the two measurement channels. Three measurements are shown.
- The diagram shows an edge holdoff of a positive edge on Channel A. Other options are a positive or negative edge on Channel B or External Arm.

NOTE

This diagram shows the operation of this arming mode and is not an example of an application. This arming mode is intended for a set of signals that do not go out of phase more than 360 degrees (that is, on average, there should be the same number of edges on Channel A, as on Channel B).

NOTE

For Parity Sampling (Parity = two sample arming edges)—

During an approximately 200 ns interval after every measurement, detection of the sample arming edges operates according to the following rules:

1. *If an unequal number of edges occur on the two input channels (for example, 2 on A and 0 on B, or 1 on A and 0 on B, or 2 on A and 1 on B), only one more edge on the input channel with fewer edges (Channel B in this example) is needed after the 200 ns interval, to satisfy the parity condition required for the next measurement.*
2. *If an equal number of edges occur on the two measurement channels (for example, 1 on A and 1 on B, or 2 on A and 2 on B), one more edge on each of the two measurement channels is required after the 200 ns interval to satisfy the parity condition required for the next measurement.*

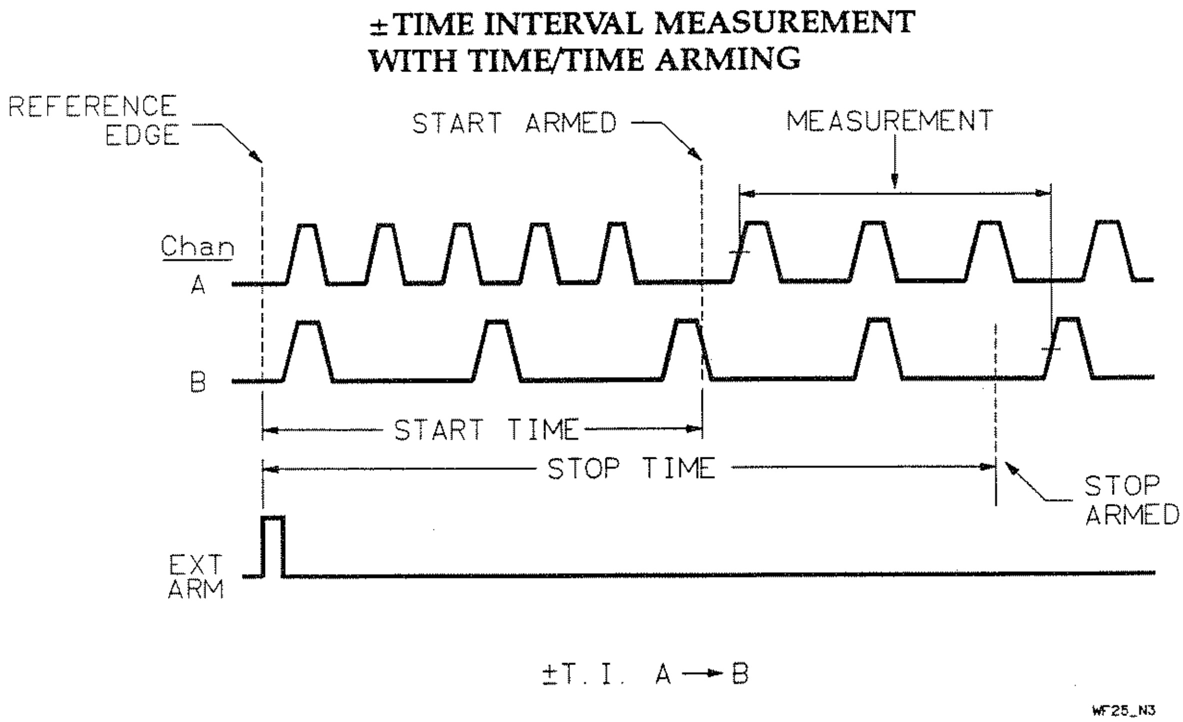


Figure 1-43. ±Time Interval | Time/Time

DESCRIPTION OF DIAGRAM:

- Measurement can begin after a positive time delay. The start of the time delay is referenced to a positive edge on External Arm.
- Measurement starts on the next trigger event following the end of the start-time delay.
- Measurement ends on the trigger event following the end of the stop-time delay. The start- and stop-time delays are referenced to the same arming edge (the External Arm edge in this example).
- The diagram shows the time delay referenced to a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- The maximum number of measurements per block is 1. Configurations such as 100 blocks of 1 measurement are allowed.
- For Normal Measurement Mode:

  Range of Time = 2 ns to 8.0 s. Can be set with a resolution of 2 ns.

NOTE

The time of the interval measured must not exceed ±4.0 s.

- For Fast Measurement Mode:

  Range of Time = 2 ns to 131 μs. Can be set with a resolution of 2 ns.

NOTE

The time of the interval measured must not exceed ±65 μs.

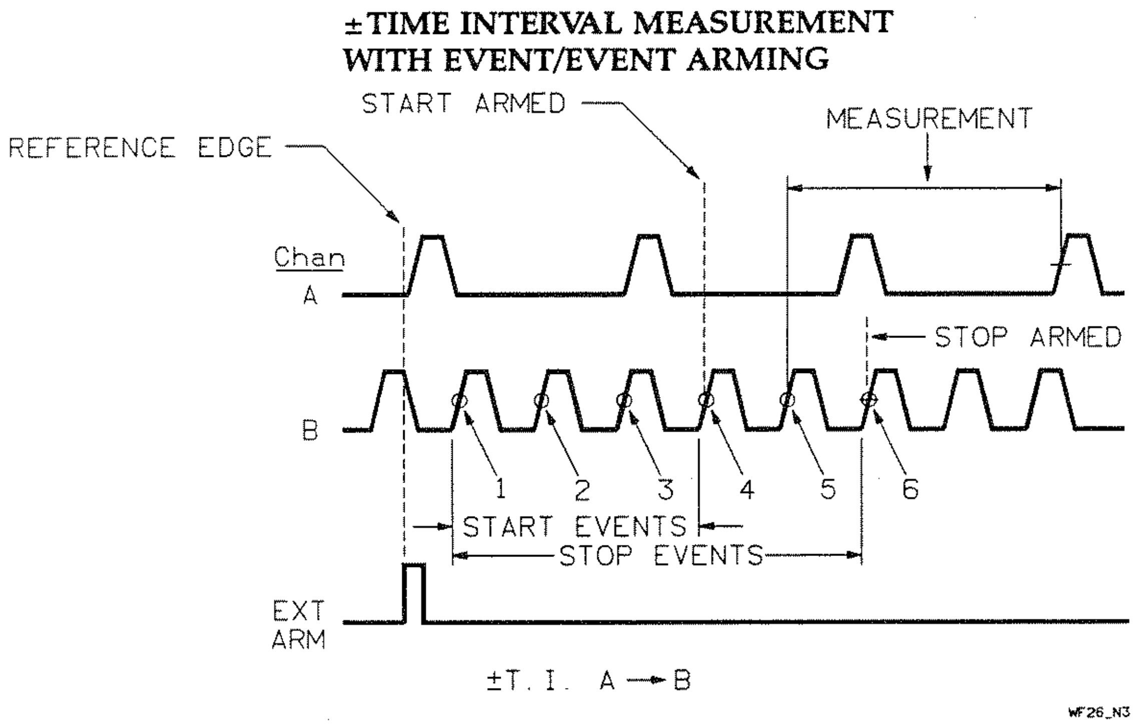


Figure 1-44. ±Time Interval | Event/Event

DESCRIPTION OF DIAGRAM:

- A measurement can begin after an event delay. The start of the delay is referenced to a positive edge on External Arm.
- A measurement starts on the trigger event following the end of the start-event delay. In this example, the start delay is four events.
- The measurement ends on the trigger event following the end of the stop-event delay. In this example, the stop-delay is six events. The start- and stop-event delays are referenced to the same arming edge.
- The diagram shows the event delays referenced to a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- The delay events can be on Channel A or B.
- The maximum number of measurements per block is 1. Configurations such as 100 blocks of 1 measurement are allowed.

- For Normal Measurement Mode:

  Range of Events = 0 to 4,000,000,000

NOTE

The time of the interval measured must not exceed ±4.0 s.

- For Fast Measurement Mode:

  Range of Events = 0 to 65,000

NOTE

The time of the interval measured must not exceed ±65 μs.

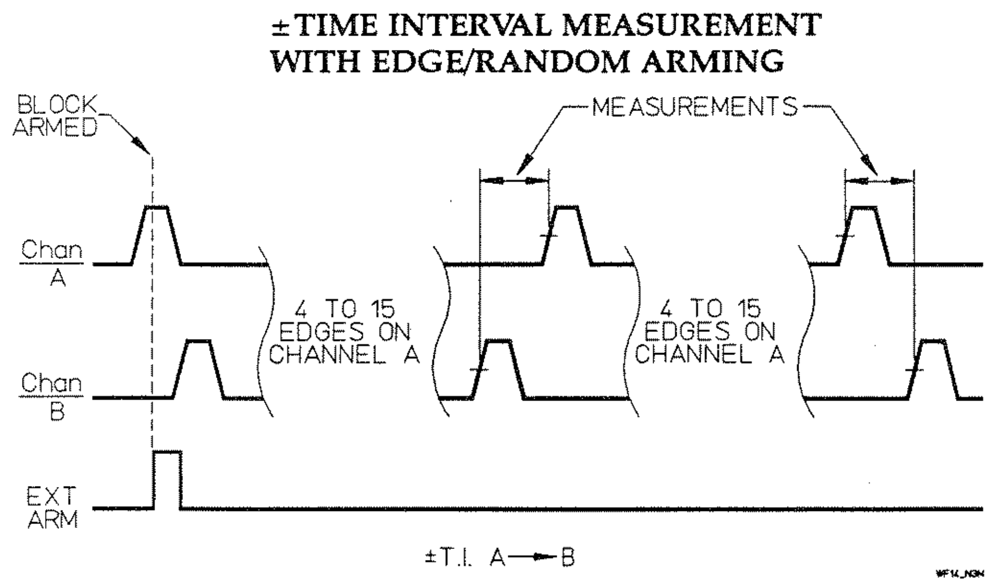


Figure 1-45. ±Time Interval | Edge/Random

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on External Arm. The measurement start is delayed until the arming edge occurs.
- Measurement data is then collected for each measurement after a random number of edges on Channel A. The random number of edges on Channel A varies from 4 to 15 between each measurement.
- The diagram shows an edge holdoff of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- HP 5373A always randomizes on Channel A.
- Random sampling is only valid up to a 100 MHz rate. For more information, refer to "Arming," chapter 5.

NOTE

The pseudo-random sequence generator operates in a "free-run" mode. Because of this, the first measurement in a sequence can occur after fewer than four edges on Channel A. For the measurements that follow, the pseudo-random sequence generator arms a measurement every six to seventeen edges on Channel A.

2

Contents of Chapter

2

PRF, FREQUENCY, PRI, and PERIOD MEASUREMENTS

CHAPTER OVERVIEW

This chapter describes the following:

- How the HP 5373A makes measurements
- Data collection for PRF, Frequency, PRI, and Period measurements
- Preview of arming
- Input channel options
- An illustration of each of the PRF, Frequency, PRI, or Period arming modes

HOW THE HP 5373A MEASURES PRF, FREQUENCY, PRI, AND PERIOD

It is helpful when learning to use the HP 5373A to understand how it makes measurements. This information will make your specific measurement setup much easier to accomplish. Before covering the specifics of PRF, Frequency, and PRI, and Period measurements, you need to start with the basics of what kind of data the HP 5373A collects and when it is collected.

Time and Events

Only two kinds of data are collected by the HP 5373A no matter what type of measurement is being made (Time Interval, Pulse Width, Pulse Offtime, PRF, Frequency, etc.).

The two kinds of data collected are:

- time
- events

The HP 5373A has a 500 MHz internal clock for measuring the time over which measurements occur. The clock is used as a stopwatch to measure the time of each measurement.

The events (trigger events) are counted for each measurement as well.

From this time and event data, measurement results can be calculated.

TECHNICAL COMMENT

A trigger event is a specific voltage on a rising or falling slope of an input signal that will trigger the HP 5373A to initiate some action. This action can be to arm a measurement, begin a measurement, or end a measurement. Refer to "Input Menu," chapter 8 for more information on how a trigger event is specified.

A Sample

Time and event data for a measurement is periodically captured by the HP 5373A. This capture of data consists of reading the accumulated time of the measurement from a time counter and the number of events that have occurred from an event counter. The two values are stored to internal memory. These two values constitute a SAMPLE.

The HP 5373A can continue to accumulate time and events while a sample is saved in memory. It is only at the end of the measurement sequence, that is, after the samples have been collected for a number of measurements, that the data capture ends and the measurement results are calculated. This provides for continuous PRF, Frequency, PRI, and Period measurements. The word "continuous" conveys the fact that there is no pause between measurements. The end of one measurement is the beginning of the next. Two consecutive samples define one measurement. This is seen in *Figure 2-1.*

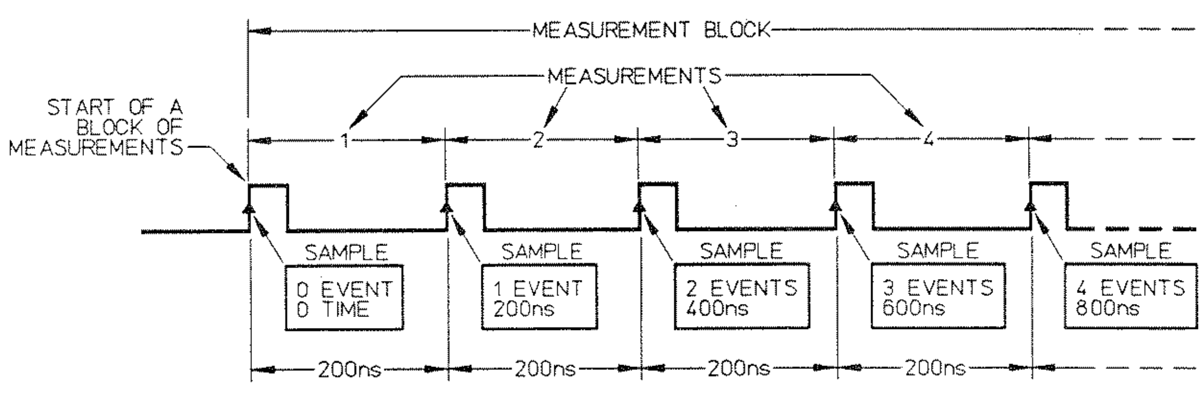


Figure 2-1. Measurements are Made from Samples

To review:

- Time data is the elapsed time from the beginning of the first measurement to when a sample is collected.
- Event data is the number of trigger events that have occurred from the beginning of the first measurement to when a sample is collected.

Sampling

The term, "SAMPLING," describes the process of collecting a sample.

There are two important elements of sampling to keep in mind when making PRF, Frequency, PRI, and Period measurements:

1. The sampling is synchronized to the signal being measured. That is, a sample can only be taken at a trigger event of the measurement signal.

   AND

2. The sampling rate has an upper limit. Sampling can happen on every trigger event of the measurement signal, depending on the rate at which events are occurring and the arming mode you specify. More about this later.

When are Samples Taken?

The point at which samples of your signal will be taken is a function of the following:

- The rate at which events are occurring helps determine when samples are taken. When events occur at a rate less than 10 MHz (13.3 MHz in Fast Mode), you can collect a sample (time and event data) at every trigger event. (*Figure 2-1* shows this situation where there is time data and event data for every trigger event.)

TECHNICAL COMMENT

If events are occurring at a rate faster than the measurement hardware of the HP 5373A is able to capture and store the information to memory, not every trigger event will have associated time and event data. This is because new samples cannot be captured while a previous sample is being stored. That is, when the event rate exceeds 10 MHz, a new sample will be collected only at the trigger event following the storing of a previous sample to memory. Events occurring while a sample is being stored will be counted but will have no time data associated with them. An example of this is shown in Figure 2-2.

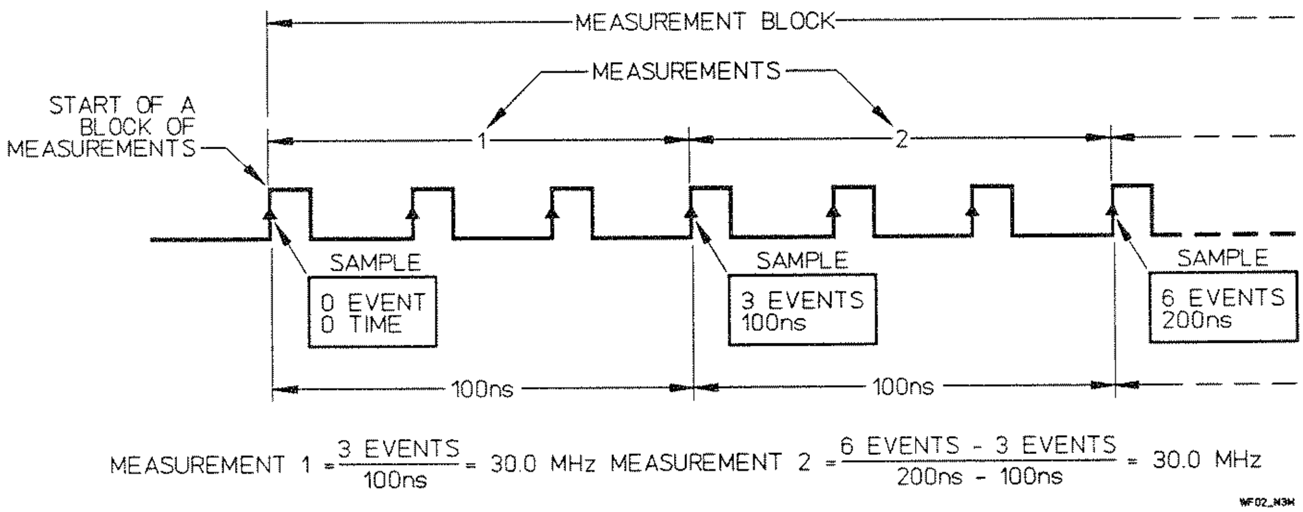


Figure 2-2. Trigger Events Occurring Faster than They can be Stored

For PRF, Frequency, PRI, and Period measurements when the event rate exceeds 10 MHz, individual measurements will have a duration greater than one pulse repetition interval of the measurement signal. For example, a PRF or Frequency measurement may be made over 5, 10, 20, 1000, or more, pulses of the signal.

This is a simplified description of what composes a PRF or Frequency measurement:

The raw data for a PRF or Frequency measurement consists of a time and event count for the start of a measurement and a time and event count for the end of a measurement. From this is calculated the time over which the measurement was made and the number of trigger events that occurred during that time. Then dividing the delta events by the delta time provides the final PRF or Frequency result. See the example in *Figure* 2-2.

- The selected arming mode helps determine when samples are taken. An arming mode can specify when the HP 5373A will collect the time and event samples. In *Figure* 2-3, an arming mode is introduced to show how it can control when samples are taken. In this case, a sample is captured only after a specified time interval elapses. The full range of control possible with the arming modes is illustrated later in this chapter. There is an example for each arming mode available for PRF, Frequency, PRI, and Period measurements. (Refer to *Figure* 2-4 to see the Function menu setup for the arming mode example in *Figure* 2-3.)

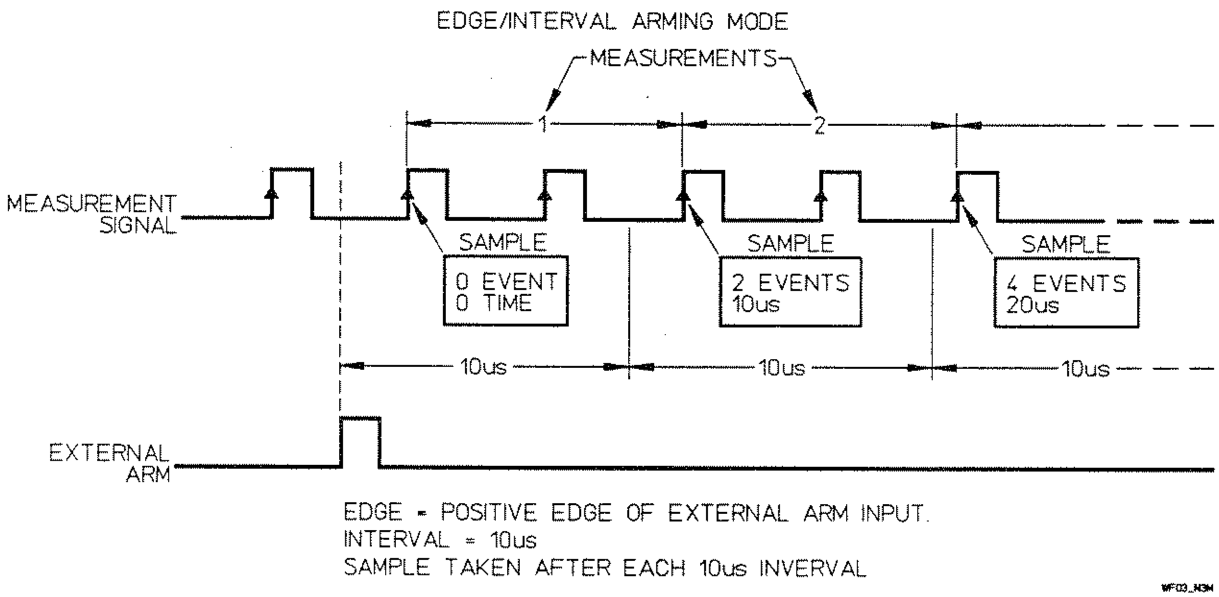


Figure 2-3. Arming Mode can Specify When Data is Collected

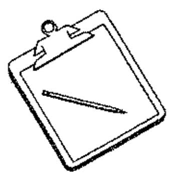
Sampling Interval

As noted above, the rate at which events are occurring on the input signal is one factor in determining when samples are taken. Another is the selected arming mode that can set the time between samples. But, it is the time required by the HP 5373A to store a sample to memory that sets the minimum time between samples. This is also called, "the minimum sampling interval."

The HP 5373A provides a choice of two minimum sampling intervals. The selection is made on the System menu at the field labeled, "Measurement Mode."

The sampling interval can be set to "Normal" or "Fast." The default measurement mode is Normal. Normal mode provides a minimum sampling interval of 100 ns. The Fast mode provides a minimum sampling interval of 75 ns. You should be aware that when using the Fast mode, the range of measurement is limited from what it is for Normal. The limits are included with the arming mode descriptions in this chapter.

TECHNICAL COMMENT



When you select the Normal or Fast measurement mode, you are choosing between two different data sizes for the time and event samples. Normal mode uses the full 32 bits of counting register data to provide the maximum measurement range of time and frequency. In contrast, Fast mode uses only 16 bits of register data to allow a faster sample rate, but a decreased range of time and frequency measurements.

Fast mode limits the minimum frequency measurement to 8 kHz and limits the maximum period measurement to 131 μs. In Normal mode the minimum frequency is 0.125 Hz and the maximum period measurement is 8.0 s. Unless a faster sampling rate is critical to your measurement, use Normal mode. The measurement limits for Normal and Fast modes are described in this chapter and throughout this manual.

Deciding How Often To Take Samples

When making PRF, Frequency, PRI, and Period measurements with trigger events occurring at a rate slower than the sampling rate, every trigger event could have a time and event count stored away for it. This may be desirable, depending on your signal to be measured and what you want to learn from your measurements.

For example, if you were to make 8,191 measurements on a 10 MHz signal using Automatic arming (which provides a sample every 100 ns), you will capture 819 μs of signal data (8,191 ×100 ns). Depending on what you want to learn from the signal, this amount of data could be sufficient, or it might represent only a very small portion of what you want to capture.

Other arming modes let you specify when samples are taken. For example, one arming mode gives you the ability to capture a sample from once every 100 ns to once every 8.0 s. The following paragraphs go into more detail about this and other arming modes.

A Block

A "block" of measurements is one or more measurements collected in a group. The importance of a block is that you can specify a block holdoff condition which must be satisfied prior to the capture of each block of measurement data. After the holdoff condition is met, the instrument cycles repeatedly through a two part sampling process: arming a sample and capturing a sample, until all measurements in the block are acquired. The next section describes how arming lets you first set conditions for a block of measurements, and then for each measurement within the block.

Arming

Arming gives you control over when the HP 5373A starts a measurement, or block of measurements, and when it ends a measurement. The size of the block and the number of measurements in a block are specified on the Function menu.

Arming specifies the conditions which must be satisfied before a block of measurements can begin, and then before each sample within that block can be collected.

1. A block of measurements can be delayed, or held off, until:
   - a specified edge of an input signal
   - a reference edge occurs, followed by a specified elapsed time
   - a reference edge occurs, followed by a specified number of events

   AND THEN

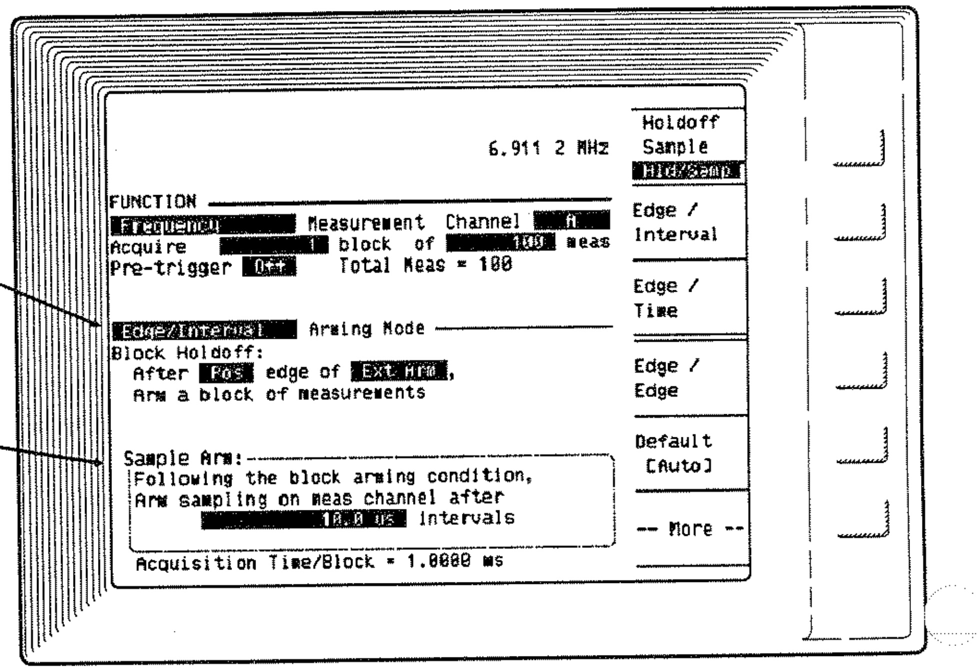
2. A sample can be delayed until:
   - a specified edge of an input signal
   - a specified time elapses
   - a specified number of events occur

The text on the Function menu screen that describes the arming mode setup is partitioned so it highlights the separate specification of when to start the block of measurements (Block Holdoff) and when to collect the measurement samples (Sample Arm). This is shown in *Figure 2-4*. For more on all aspects of arming, refer to "Arming," chapter 5.

Figure 2-4.
Arming Mode Text and Explanation

Before a block of measurements can begin, a rising edge on Ext. Arm must occur.

After the Block Holdoff, a sample (time and events) will be taken every 10 μs.



HP 53702A Envelope Detector Pod

The standard HP 5373A configuration includes an HP 53702A Envelope Detector Pod in the CHANNEL A input, and an HP 54002A 50Ω Input Pod in the CHANNEL B input. The HP 53702A output into the HP 5373A is the detected envelope of the carrier at its input. As shown in *Figure 2-4A*, the HP 53702A Envelope Detector Pod uses a full-wave detector to sample both the positive and the negative sides of the modulated carrier. The HP 53702A output is a negative-going version of the envelope. The HP 5373A reports measurement setups based on this arrangement. However, pulse measurements are reported as if a positive-going version of the envelope was used.

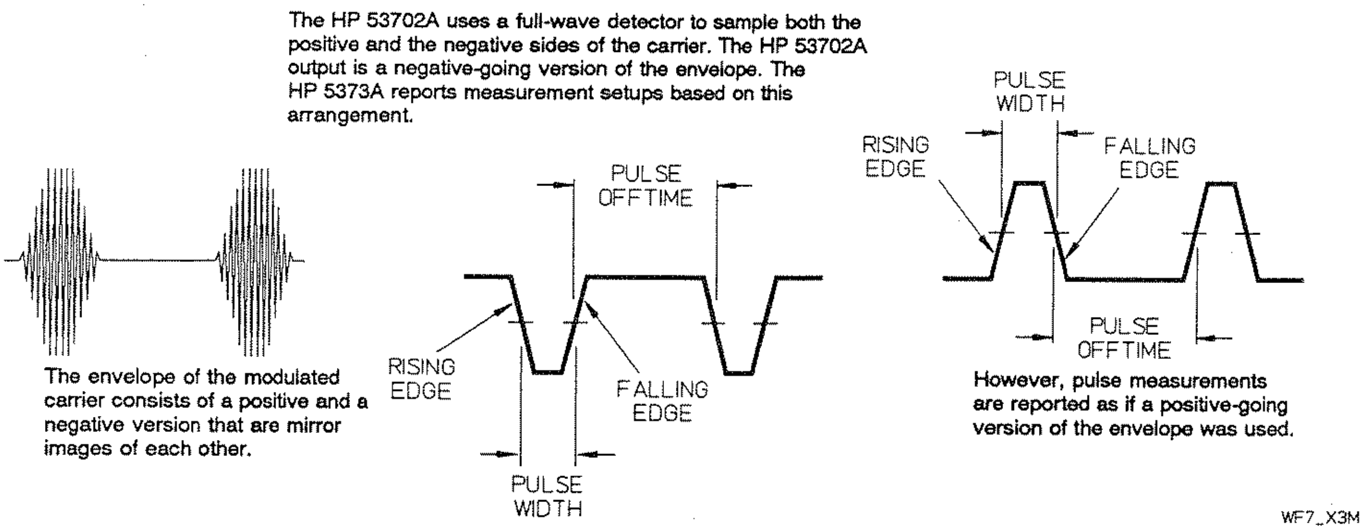


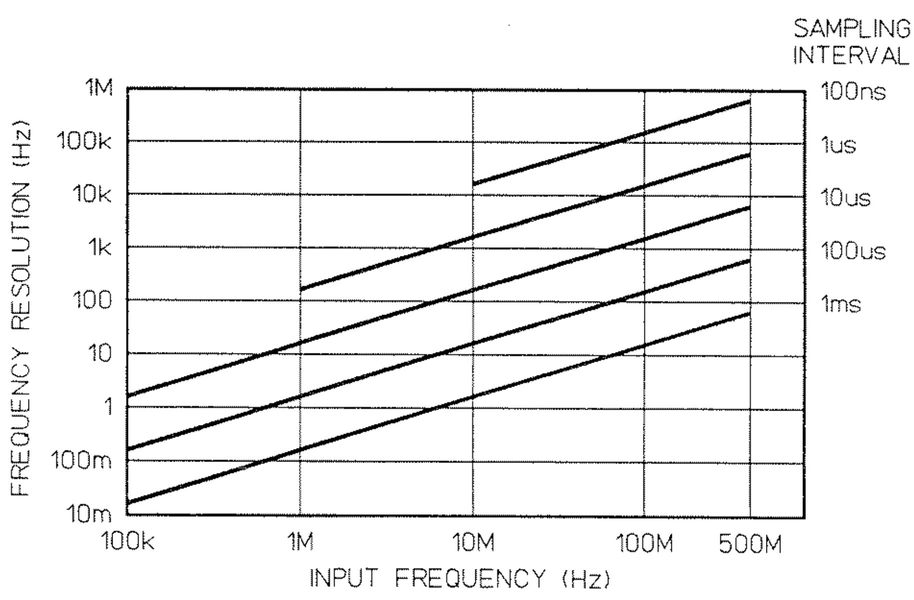
Figure 2-4A. HP 53702A Envelope Detector Pod

PRF or Frequency Resolution

The resolution of your PRF or Frequency results is determined by the input PRF or Frequency and the interval between samples. The longer the sampling interval, the higher the resolution of the results. *Figure 2-5* shows the single-shot resolution of the HP 5373A as a function of sampling interval and input PRF or Frequency.

For example, taking samples at 100 μs intervals on a 10 MHz input signal will yield a result resolved to 10 Hz (10. 000 00 MHz).

Figure 2-5. Frequency Resolution



PRF OR FREQUENCY RANGE

The PRF or Frequency range of the HP 5373A is:

Normal Measurement Mode
(See description under Sampling Interval)

- 30 MHz to 500 MHz on Channel A (with HP 53702A pod)
- 0.125 Hz to 500 MHz on Channel B (with HP 54002A pod)
- 0.250 Hz to 500 MHz on Channel A and B simultaneously (if both channels have HP 54002A pod)
- 100 MHz to 2 GHz on Channel C (optional)

Fast Measurement Mode

- 8 kHz to 500 MHz on Channel B
- 16 kHz to 500 MHz on Channel A and B simultaneously (if both channels have HP 54002A pod)
- 100 MHz to 2 GHz on Channel C (optional)

PRI OR PERIOD RANGE

The range of PRI or Period for the HP 5373A is:

Normal Measurement Mode
(See description under Sampling Interval)

- 2 ns to 8.0 s on Channel A (with HP 53702A pod)
- 2 ns to 8.0 s on Channel B
- 2 ns to 4.0 s on Channel A and Channel B simultaneously (if both channels have HP 54002A pod)
- 500 ps to 10 ns on Channel C (optional)

Fast Measurement Mode

- 2 ns to 131 μs on Channel B
- 2 ns to 65 μs on Channel A and B simultaneously (if both channels have HP 54002A pod)
- 500 ps to 10 ns on Channel C (optional)

NOTE

When using the Fast Mode, the minimum PRF or Frequency that can be measured is 8 kHz. The maximum time that can be measured, and therefore the maximum time that may elapse between samples is 131 μs. The restriction on elapsed time is applicable regardless of the reason the sampling interval approaches the specified limits. It is therefore important to consider this restriction when setting up arming and when planning to Inhibit a measurement sequence for intervals approaching 131 μs. For more on the Inhibit feature, refer to "Pre-trigger Menu," chapter 10.

PRF OR FREQUENCY AND PRI OR PERIOD MEASUREMENTS DESCRIBED

There is no difference in how the time and event data is collected for PRF, Frequency, PRI, Period measurements. The difference is in how the measurement results are computed for the two measurement types.

PRF or Frequency results are calculated by dividing the number of trigger events by the time over which those trigger events were counted. PRI or Period is just the reverse with the results calculated by dividing the time of the measurement by the number of trigger events.

An example of a PRF, Frequency, PRI, or Period calculation:

PRF or Frequency =	Δ Event Count/Δ Time Count 100 Events / 10 μs = 10 MHz
PRI or Period =	Δ Time Count/Δ Event Count 50 μs / 100 Events = 500 ns

PRF, FREQUENCY, PRI, AND PERIOD CHANNEL CHOICES

The HP 5373A offers the same channel choices for PRF, Frequency PRI, and Period measurements.

The maximum number of measurements per block is 8,191 for all single-channel choices.

Two-channel configurations (A & B, A – C, B / A, etc.) are limited to a measurement size of 4,095.

NOTE

For meaningful two-channel measurement data, the same pod type (HP 54002A, for example) should be installed in both channels.

Single-Channel

A carrier frequency or period measurement can be made on any of the input channels. (The channel to be used must not have an HP 53702A Envelope Detector Pod as its input.) The menu choices are:

- A
- B
- C (optional)

A PRF or PRI measurement requires an HP 53702A Envelope Detector Pod or a user-supplied envelope in the channel to be used. The menu choices are:

- A
- B

Two-Channel

A carrier frequency or period measurement can be made on two input channels simultaneously. (Any channel to be used must not have an HP 53702A Envelope Detector Pod as its input.)

TWO-RESULT MEASUREMENT

- A & B
- A & C (optional)
- B & C (optional)

A PRF or PRI measurement can be made using the A and B channels simultaneously. (Each channel must have an HP 53702A Envelope Detector Pod as its input.)

- A & B

Two-Result Measurement Features:

- Full accuracy is provided for each of the measurement channels.
- Measurement and time of measurement data can be displayed for both channels on the Numeric screen. (Use Numeric screen, Main menu, Expanded Data On)

- Histogram and Time Variation graphs can be viewed individually for each of the two measurement channels. (Use Graphic screen, Display menu, View Channel)
- Statistics can be calculated on both measurement channels. (Use Math menu, Stats On)

RATIO MEASUREMENT

The ratio of two input signals can be displayed. The menu choices are:

- A / B
- A / C (optional)
- B / A
- B / C (optional)
- C / A (optional)
- C / B (optional)

The ratio is calculated by taking the result of the "first" channel and dividing it by the result of the "second" channel. For example, the result of "B / A" will be the Channel B result divided by the Channel A result. The Analyzer can display ratios of less than 1.

SUM MEASUREMENT

The sum of two PRF or frequency, or two PRI or period, measurements can be displayed. The menu choices are:

- A + B
- A + C (optional)
- B + C (optional)

The two results are added together.

DIFFERENCE MEASUREMENT

The Analyzer can display the difference of two PRF, Frequency, PRI, or Period measurements. The menu choices are:

- A – B
- A – C (optional)
- B – A
- B – C (optional)
- C – A (optional)
- C – B (optional)

The result at the "second" channel is subtracted from the "first" channel.

NOTE

For Two-Channel Measurements:

- *For a measurement involving Channel A and Channel B, both channels must have the same type of input pod.*
- *For a measurement involving Channel C, the other channel being used (Channel A or Channel B) should not have an HP 53702A Envelope Detector Pod at its input.*
- *Both signals must be present at the input channels before the Analyzer will begin a measurement.*
- *The number of measurements per block cannot exceed 4,095.*
- *The measurement rate is set by the signal with the longer PRI or Period . For example, imagine you are measuring the PRF or Frequency of two signals. The PRF or Frequency of one is 10 MHz and the other is 1 Hz. With the arming set to Automatic, which will have the Analyzer sample as fast as possible, it is the 1 Hz signal that sets the sample rate. There will be a measurement on each of the measurement channels approximately once every second.*
- *All two-channel measurements will sample the first channel before sampling the second channel. For example, when making a B/A measurement, sampling of Channel A is first, even if Channel B events come before events on Channel A.*

HP 5373A Function and Arming Summary

ARMING MODE	MEASUREMENT FUNCTION												
	TIME INTERVAL OR HISTOGRAM TI		CONTINUOUS TIME INTERVAL OR HISTOGRAM CTI	±TIME INTERVAL OR HISTOGRAM ± TI		PRF, FREQUENCY, PRI, PERIOD		TOTALIZE		PULSE WIDTH, OFFTIME, RISE TIME, FALL TIME, DUTY CYCLE	PHASE	ENVELOP POWER, AMPLITUDE, MODULATION	PHASE DEVIATION, TIME DEVIATION, FREQUENCY DEVIATION
	A	A → B	A	A	A → B	A	DUAL[1]	A	DUAL[1]	A	A ref B	A	A
	B	B → A	B	B	B → A	B	RATIO[2]	B	RATIO[2]		B ref A	B	B
						C	SUM[3]		SUM[3]				
							DIFF[4]		DIFF[4]				
AUTOMATIC													
AUTOMATIC	C*	C*	C*		C*	C*	C*			C*	C*	N*	C*
HOLDOFF													
EDGE HOLDOFF	C	C	C		C	C					C		C
TIME HOLDOFF	C	C	C			C							
EVENT HOLDOFF	C	C	C			C							
SAMPLING													
INTERVAL SAMPLING	C	C	C		C	C	C	C*	C*		C		C
TIME SAMPLING						N							
CYCLE SAMPLING						C							
EDGE SAMPLING						C	C	C	C				
PARITY SAMPLING					C								
REPET EDGE SAMPLING	C	C	C		C								
REPET EDGE-PARITY SAMPLING					C								
RANDOM SAMPLING	C	C			C								
HOLDOFF/SAMPLING													
EDGE/INTERVAL	C	C	C		C	C	C	C	C		C		C
EDGE/TIME						N							
EDGE/EDGE						C		C	C				
EDGE/CYCLE						C							
EDGE/EVENT				N	N	N							
EDGE/PARITY					C								
EDGE/RANDOM	C	C			C								
TIME/INTERVAL						C		C					
TIME/TIME				N	N	N							
EVENT/INTERVAL						C							
EVENT/EVENT				N*	N	N							
EXTERNALLY GATED						C		C	C				
MANUAL								N	N				

Symbol C or N indicates that a measurement can be made using the corresponding combination of Function, Channel, and Arming selections.

C = Continuous Arming, (Block/Sample Arming)

N = Non-Continuous arming, (Start/Stop Arming), setups are limited to M blocks of 1 measurement.

1. DUAL. Simultaneous Dual-channel, (2 results). Frequency and PRI options are: A&B, A&C, B&C. Totalize option is: A&B.
2. RATIO. Frequency and Period ratio options are: A/B, A/C, B/A, B/C, C/A, C/B. Totalize ratio options are: A/B, B/A.
3. SUM. Frequency and Period sum options are: A+B, A+C, B+C. Totalize sum option is: A+B.
4. DIFFERENCE. Frequency and Period difference options are: A–B, A–C, B–A, B–C, C–A, C–B. Totalize difference options are: A–B, B–A.

* = Default Arming

PRF, FREQUENCY, PRI, AND PERIOD ARMING MODES

Shown below are the measurement channels and arming modes available for PRF, Frequency, PRI, and Period measurements.

Measurements Referenced To The Block Arming Edge

There are eight arming modes for PRF, Frequency, PRI, and Period measurements that reference all measurements of a block to the block holdoff arming edge. They are:

- Edge Holdoff
- Time Holdoff
- Event Holdoff
- Edge / Interval
- Edge / Edge
- Edge / Cycle
- Time / Interval
- Event / Interval

For these arming modes, the edge which arms each block is "time-stamped," and the elapsed time between the block arming edge and the first measurement sample is measured.

While all the arming modes provide the time from the beginning of the first measurement of a block, these time-stamp arming modes also provide the time between the block arming edge and the first measurement sample that is collected. The time value is displayed on the Numeric screen. It is listed before the first measurement result of the block and has a "T" in front of it. The diagrams in the next part of this chapter show the time-stamp arming modes with a portion of the example signal labeled with a "T".

NOTE

To receive valid data, the interval between the block arming edge and the first measurement sample must be within the measurable range of the selected measurement mode:

Normal Measurement Mode = 10 ns to 8.0 s

Fast Measurement Mode = 10 ns to 131 μs

TECHNICAL COMMENT

The HP 5373A has been optimized to always capture both the block arming edge and the first measurement sample, even if they occur only 10 ns apart.

If the first measurement sample is received by the HP 5373A less than 100 ns (75 ns for Fast mode) after the block arming edge, the measurement sample will be captured, but the instrument will be storing data during the 180 ns which follow the arming edge. During that 180 ns, trigger events of the measurement signal will be counted but will have no time data associated with them.

Averaged Results for PRF, Frequency, PRI, and Period Measurements

The feature of time-stamping the arming edge makes it possible for the HP 5373A to average multiple blocks of measurements. When you select one of the eight arming modes from the previous page for a multiple-block, single-channel PRF, frequency, PRI, or period measurement, a field on the Function menu will allow selection of "Averaged Results" (the other option is "All Results"). The averaged results are shown on the Numeric screen and the Time Variation graph. If the total number of measurements selected exceeds the size of internal memory, "Averaged Results" is the only option available.

PRF, FREQUENCY, PRI, AND PERIOD ARMING MODE EXAMPLES

Shown on the following pages are the arming modes available for PRF, Frequency, PRI, and Period measurements along with a timing diagram to illustrate each arming mode. PRF and frequency measurements are used for all the examples, but PRI or period measurements operate identically. The difference between the two measurement types is in how the data is processed after the measurement. For these examples, the trigger event is always on the positive slope.

PRF OR FREQUENCY MEASUREMENT WITH AUTOMATIC ARMING

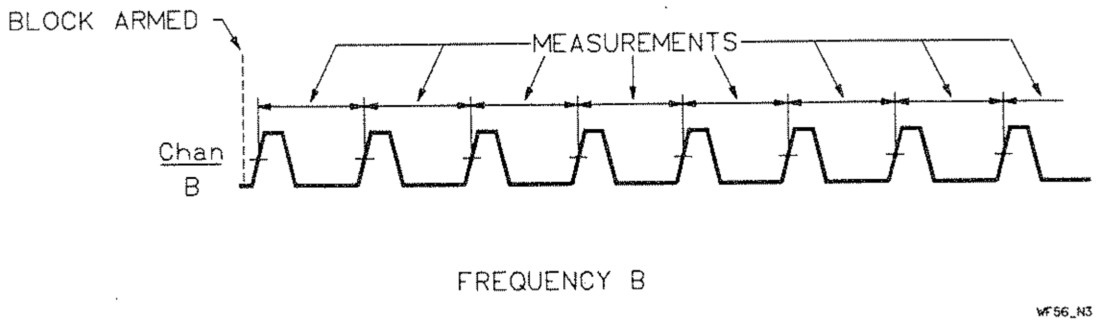


Figure 2-6. Frequency | Automatic

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready. The block is armed when the Analyzer is ready to begin measuring.
- Samples are then collected as quickly as possible at the trigger events of Channel B. Seven measurements are shown.

PRF OR FREQUENCY MEASUREMENT WITH EDGE HOLDOFF ARMING

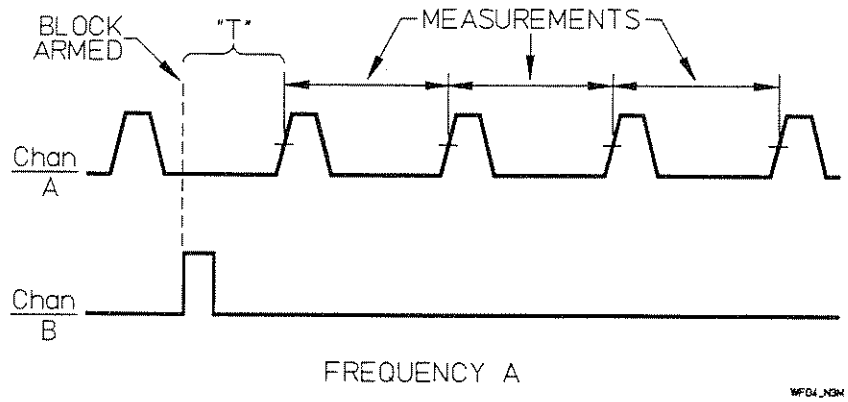


Figure 2-7. Frequency | Edge Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on Channel B. The block is armed when the block holdoff edge occurs.
- Samples are then collected as quickly as possible at the trigger events of Channel A. Three measurements are shown.
- The diagram shows an edge holdoff of a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported. ("T" on the waveform shows the time measured.)

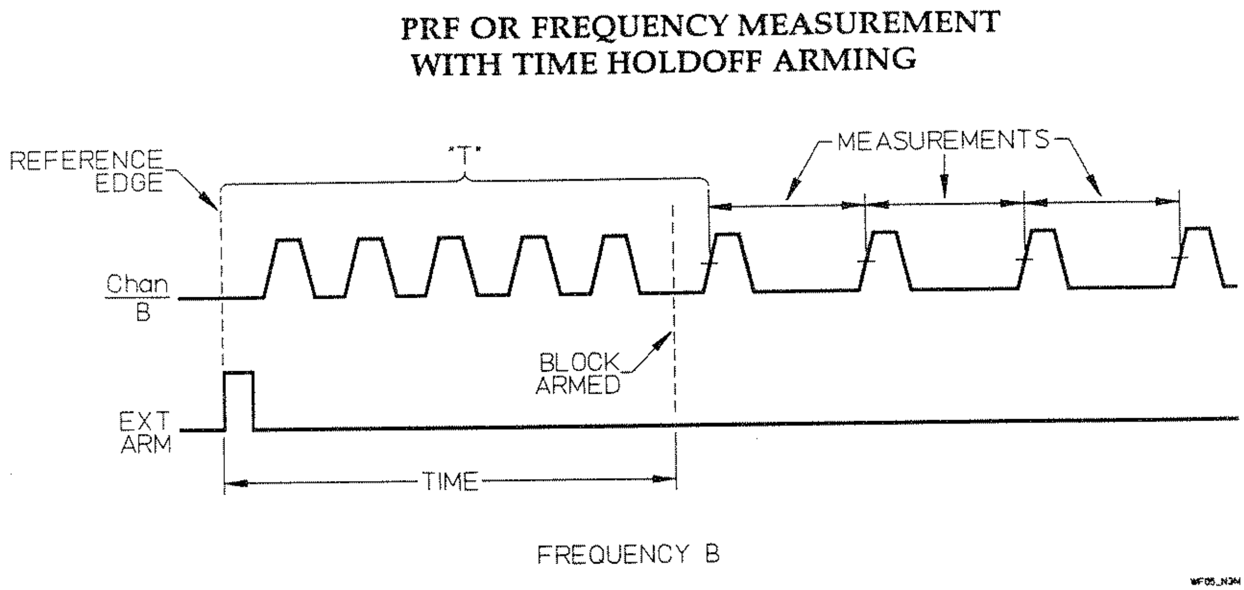


Figure 2-8. Frequency | Time Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable time delay. The start of the time delay is referenced to a positive edge on External Arm. The block is armed when the specified time elapses.
- Samples are then collected as quickly as possible at the trigger events of Channel B. Three measurements are shown.
- The diagram shows the time delay referenced to a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported. ("T" on the waveform shows the time measured.)
- For Normal Measurement Mode:

  Range of Time = 2 ns to 8.0 s. Can be set with a resolution of 2 ns.
- For Fast Measurement Mode:

  Range of Time = 2 ns to 131 μs. Can be set with a resolution of 2 ns.

PRF OR FREQUENCY MEASUREMENT WITH EVENT HOLDOFF ARMING

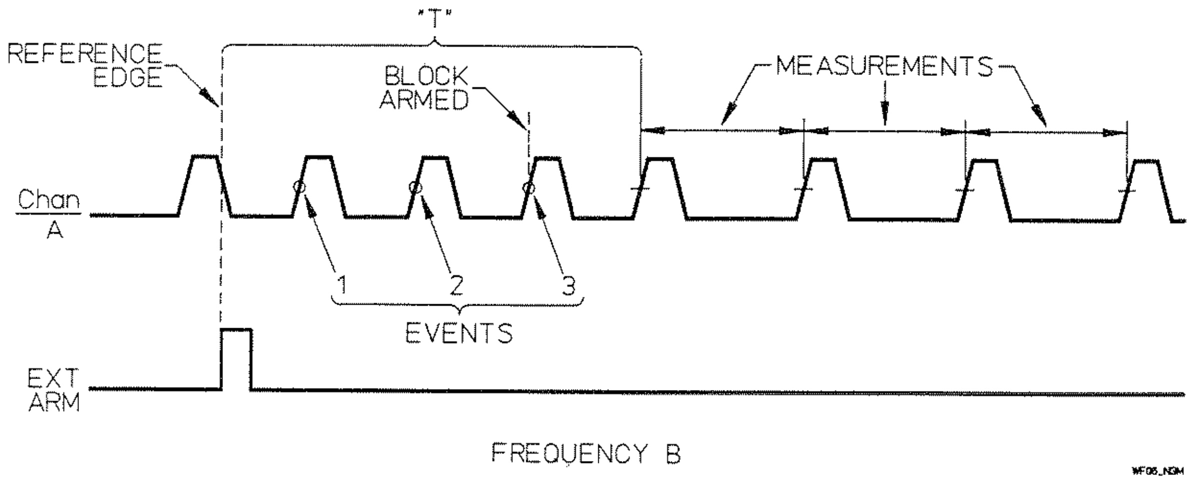


Figure 2-9. Frequency | Event Holdoff

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable event delay. The start of the event delay is referenced to a positive edge on External Arm. The block is armed after the specified number of events (edges) occur on Channel A.
- Samples are then collected as quickly as possible at the trigger events of Channel A. Three measurements are shown.
- The diagram shows an event delay referenced to a positive edge on External Arm. Other options for the reference edge include a positive or negative edge on Channel A or B.
- The delay events can be counted on Channel A or B.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported. ("T" on the waveform shows the time measured.)
- For Normal Measurement Mode:

  Range of Events = 0 to 4,000,000,000
- For Fast Measurement Mode:

  Range of Events = 0 to 65,000

PRF OR FREQUENCY MEASUREMENT WITH INTERVAL SAMPLING ARMING

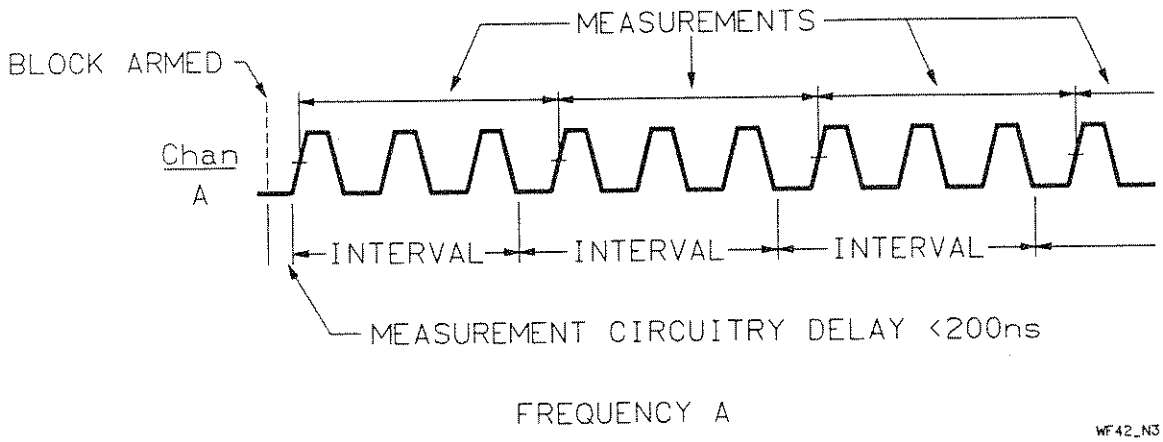


Figure 2-10. Frequency | Interval Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready. The block is armed when the Analyzer is ready to begin measuring.
- A sample is then collected at the trigger event of Channel A after each specified sample interval. The first sample is taken at the trigger event after the start of the first interval. Measurements end at the trigger event following each interval. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.
- For Normal Measurement Mode:

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.
- For Fast Measurement Mode:

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

PRF OR FREQUENCY MEASUREMENT WITH TIME SAMPLING ARMING

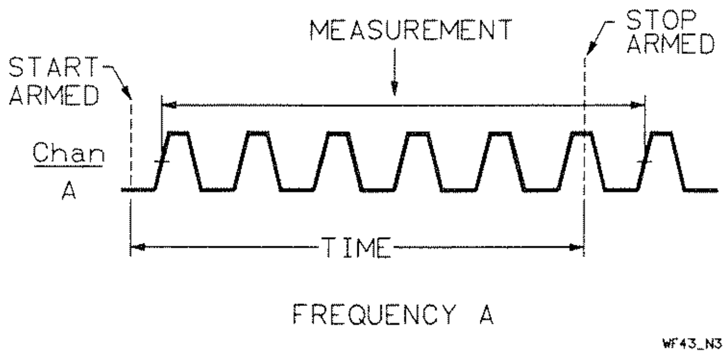


Figure 2-11. Frequency | Time Sampling

DESCRIPTION OF DIAGRAM:

- Measurement can begin as soon as the Analyzer is ready. The measurement start is armed when the Analyzer is ready to begin measuring.
- Measurement starts at the trigger event of Channel A following the Start Arm.
- Measurement ends at the trigger event following the end of the Stop Arm time delay. The time delay is referenced to the Start Arm.
- The maximum number of measurements per block is 1. Configurations such as 100 blocks of 1 measurement are allowed.
- For Normal Measurement Mode:

  Range of Time = 2 ns to 8.0 s. Can be set with a resolution of 2 ns.
- For Fast Measurement Mode:

  Range of Time = 2 ns to 131 μs. Can be set with a resolution of 2 ns.

PRF OR FREQUENCY MEASUREMENT WITH CYCLE SAMPLING ARMING

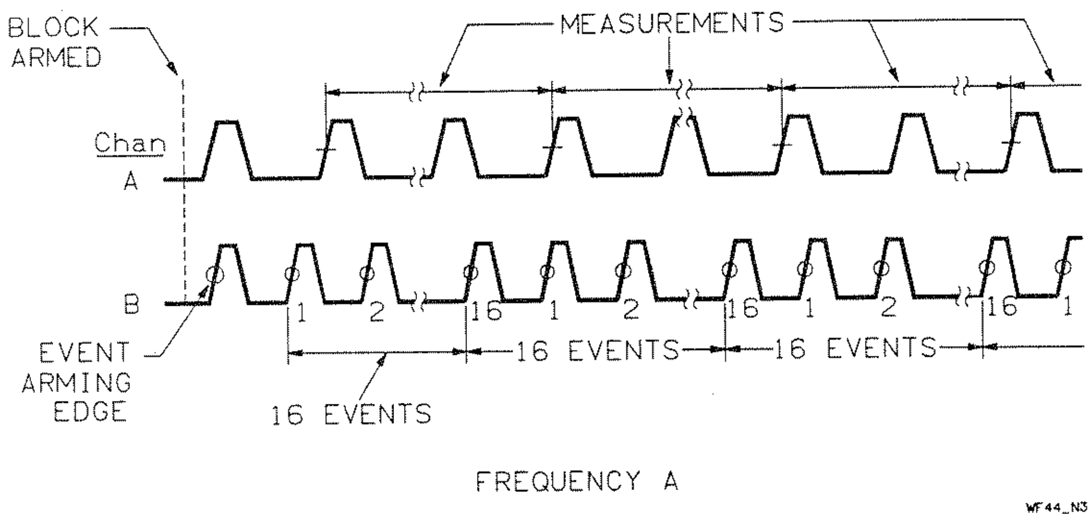


Figure 2-12. Frequency | Cycle Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready. The block is armed when the Analyzer is ready to begin measuring.
- A trigger event on Channel B arms the start of the counting of cycles on Channel B.
- Samples are collected at the trigger event of Channel A after each specified cycle interval. The first sample is taken on the trigger event on Channel A following the event arming edge. Measurements end at the trigger event after each cycle interval. Three measurements are shown.
- The diagram shows cycles being counted on positive edges of Channel B. Other options are negative or positive edges of Channel A, or the 2 ns internal timebase. The slope for Channel A and B edges is set on the Input menu Slope field.

- For Normal Measurement Mode:

Cycles	Minimum Frequency on Arming Channel
2^4	2 Hz
2^8	32 Hz
2^{12}	512 Hz
2^{16}	8.192 kHz
2^{20}	131.072 kHz
2^{24}	2.097152 MHz
2^{28}	33.554432 MHz

- For Fast Measurement Mode:

Cycles	Minimum Frequency on Arming Channel
2^4	122.137 kHz
2^8	1.954198 MHz
2^{12}	31.267175 MHz

NOTE

If you set up cycle arming such that the channel arming the samples is the same as the channel being measured, you must be careful not to violate the conditions below.

Elapsed events between samples must not exceed:

($2^{32} - 2$) in Normal Measurement Mode

($2^{16} - 2$) in Fast Measurement Mode

PRF OR FREQUENCY MEASUREMENT WITH EDGE SAMPLING ARMING

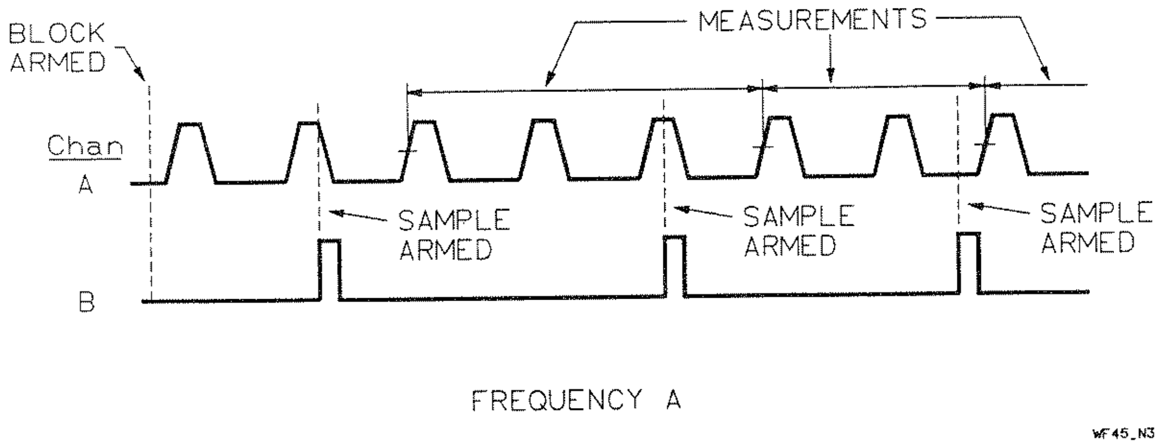


Figure 2-13. Frequency | Edge Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready. The block is armed when the Analyzer is ready to begin measuring.
- Samples are armed after a positive edge on Channel B. One sample is collected per arming edge. An edge is required before each sample. Two measurements are shown.
- The diagram shows a positive edge on Channel B arming each sample. Other options for the arming edge are a positive or negative edge on Channel A or External Arm.
- For Normal Measurement Mode:

NOTE

The PRI or Period of the sample arm signal should not exceed 8.0 s.

- For Fast Measurement Mode:

NOTE

The PRI or Period of the sample arm signal should not exceed 131 μs.

PRF OR FREQUENCY MEASUREMENT WITH EDGE/INTERVAL ARMING

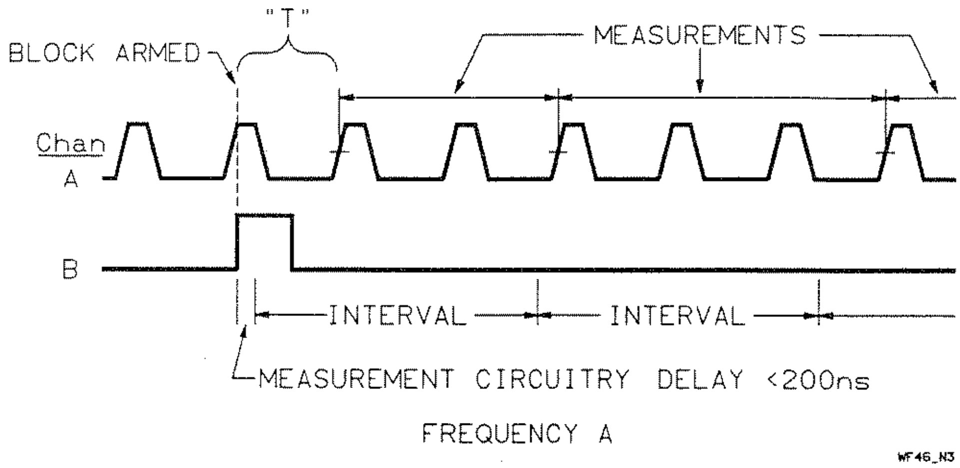


Figure 2-14. Frequency | Edge/Interval

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on Channel B. The block is armed when the edge occurs on Channel B.
- Samples are then collected at the trigger event of Channel A after each interval. The first sample is taken at the trigger event after the start of the first interval. Measurements end at the trigger event following each interval. The sample interval is repetitive and asynchronous with the signal being measured. Two measurements are shown.
- The diagram shows an edge holdoff of a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported. ("T" on the waveform shows the time measured.)
- For Normal Measurement Mode:

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.
- For Fast Measurement Mode:

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

PRF OR FREQUENCY MEASUREMENT WITH EDGE/TIME ARMING

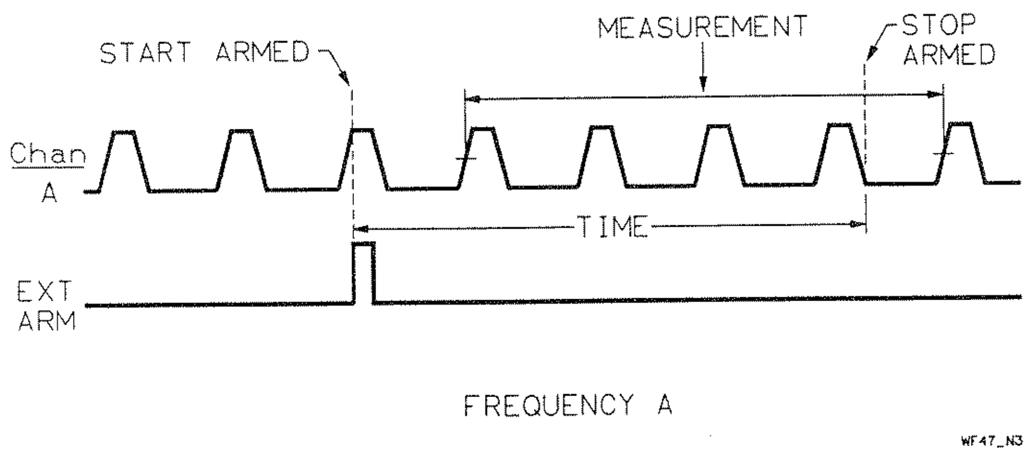


Figure 2-15. Frequency | Edge/Time

DESCRIPTION OF DIAGRAM:

- Measurement can begin after a positive edge on External Arm. The measurement start is armed when the Start Arm edge occurs on External Arm.
- Measurement starts at the trigger event of Channel A following the Start Arm edge.
- Measurement ends at the trigger event following the end of the Stop Arm time delay. The Stop Arm time delay is referenced to the Start Arm edge.
- The diagram shows an edge holdoff of a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- The maximum number of measurements per block is 1. Configurations such as 100 blocks of 1 are allowed.
- For Normal Measurement Mode:

  Range of Time = 2 ns to 8.0 s. Can be set with a resolution of 2 ns.

- For Fast Measurement Mode:

  Range of Time = 2 ns to 131 μs. Can be set with a resolution of 2 ns.

PRF OR FREQUENCY MEASUREMENT WITH EDGE/EDGE ARMING

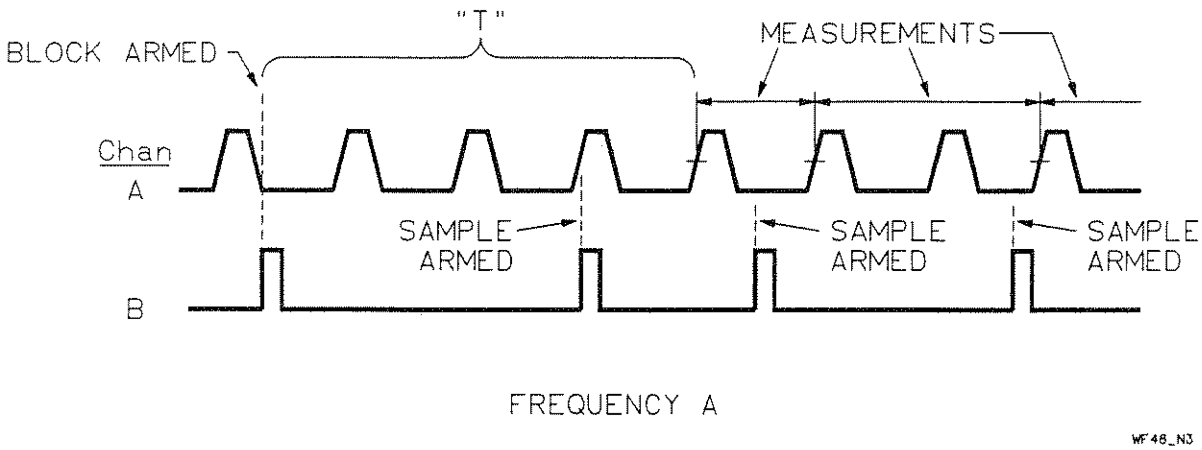


Figure 2-16. Frequency | Edge/Edge

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on Channel B. The block is armed when the block holdoff edge occurs.
- A sample is then collected after a positive edge on Channel B. One sample is collected per arming edge. An edge is required before each sample. Two measurements are shown.
- The diagram shows an edge holdoff and a sample edge of a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- The block holdoff reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported. ("T" on the waveform shows the time measured.)

PRF OR FREQUENCY MEASUREMENT WITH EDGE/CYCLE ARMING

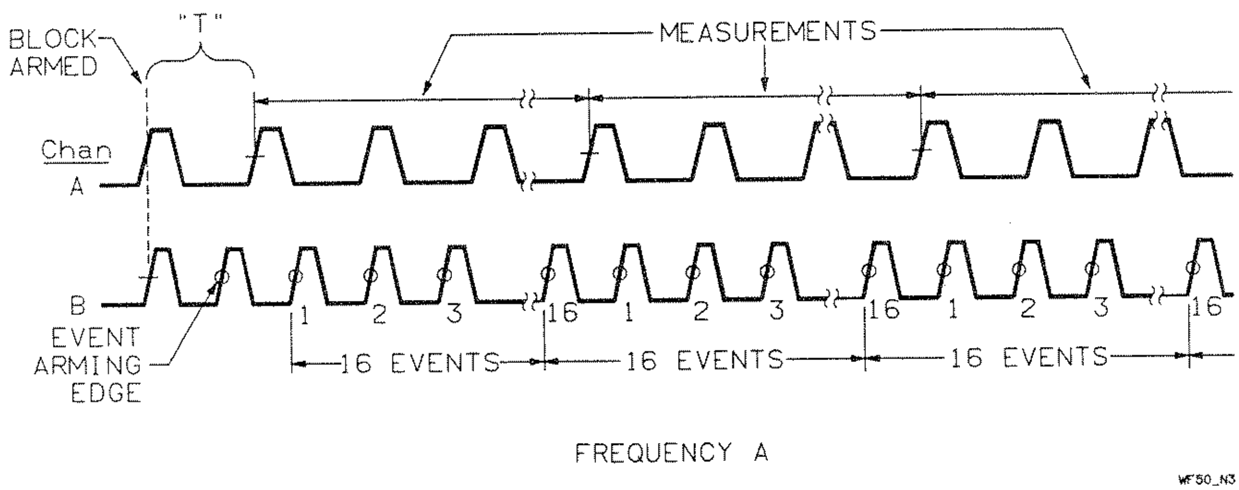


Figure 2-17. Frequency | Edge/Cycle

DESCRIPTION OF DIAGRAM:

- A block of measurements is armed after a positive edge on Channel B.
- A trigger event on Channel B arms the start of the counting of cycles on Channel B.
- Samples are then taken on the trigger event of Channel A after each specified cycle interval. The first sample is taken on the trigger event of Channel A after the arming edge. The measurements end on the trigger event following each cycle interval. Two measurements are shown.
- The diagram shows an edge holdoff of a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- The diagram shows cycles being counted on positive edges of Channel B. Other options are negative or positive edges of Channel A, or the 2 ns internal timebase. The slope for Channel A and B is set on the Input menu Slope field.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported. ("T" on the waveform shows the time measured.)

- For Normal Measurement Mode:

Cycles	Minimum Frequency on Arming Channel
2^4	2 Hz
2^8	32 Hz
2^{12}	512 Hz
2^{16}	8.192 kHz
2^{20}	131.072 kHz
2^{24}	2.097152 MHz
2^{28}	33.554432 MHz

- For Fast Measurement Mode:

Cycles	Minimum Frequency on Arming Channel
2^4	122.137 kHz
2^8	1.954198 MHz
2^{12}	31.267175 MHz

NOTE

If you set up cycle arming such that the channel arming the samples is the same as the channel being measured, you must be careful not to violate the conditions below:

Elapsed events between samples must not exceed:

(2^{32}–2) in Normal Measurement Mode

(2^{16}–2) in Fast Measurement Mode

PRF OR FREQUENCY MEASUREMENT WITH EDGE/EVENT ARMING

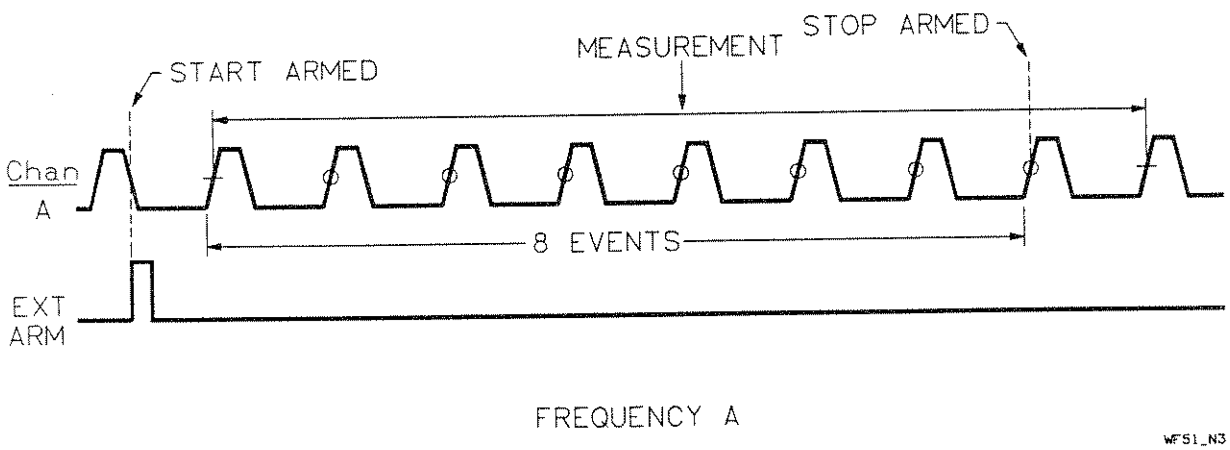


Figure 2-18. Frequency | Edge/Event

DESCRIPTION OF DIAGRAM:

- Measurement can begin after a positive edge on External Arm. The measurement start is armed when the Start Arm edge occurs on External Arm.
- Measurement starts at the trigger event of Channel A following the Start Arm edge.
- The start of the selectable event delay is at the next trigger event on Channel A. (If you are counting and measuring on the same signal, as shown in the diagram, the first counted event is also the start of the measurement.)
- Measurement ends at the trigger event following the last of the Stop Arm events. The Stop Arm delay is eight events on Channel A.
- The diagram shows the Start Arm edge as a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- The delay events can be counted on Channel A or B.

- For Normal Measurement Mode:

  Range of Events = 0 to 4,000,000,000

NOTE

The total PRI or Period of the Stop Arm events must not exceed 8.0 s.

- For Fast Measurement Mode:

  Range of Events = 0 to 65,000

NOTE

The total PRI or Period of the Stop Arm events must not exceed 131 μs.

PRF OR FREQUENCY MEASUREMENT WITH TIME/INTERVAL ARMING

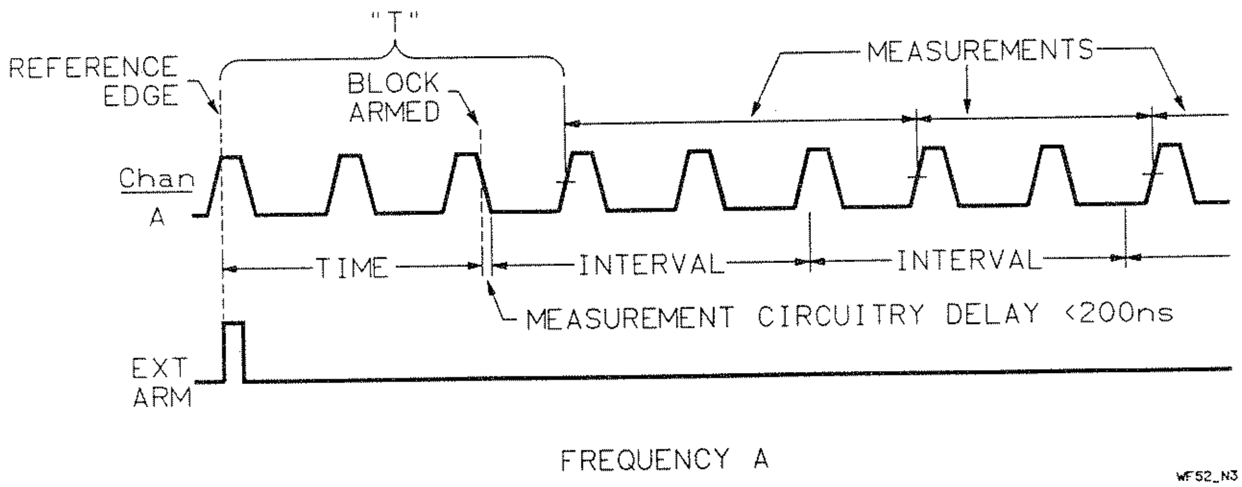


Figure 2-19. Frequency | Time/Interval

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable time delay. The start of the time delay is referenced to a positive edge on External Arm.
- Samples are collected at the trigger event of Channel A after each interval. The first sample is taken at the trigger event after the start of the first interval. Measurements end at the trigger event following each interval. The sample interval is repetitive and asynchronous with the signal being measured. Two measurements are shown.
- The diagram shows a time delay referenced to a positive edge on External Arm. Other options are a positive or negative edge on Channel A or B.
- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported. ("T" on the waveform shows the time measured.)

- For Normal Measurement Mode:

  Range of Time = 2 ns to 8.0 s. Can be set with a resolution of 2 ns.

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- For Fast Measurement Mode:

  Range of Time = 2 ns to 131 μs. Can be set with a resolution of 2 ns.

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns

PRF OR FREQUENCY MEASUREMENT WITH TIME/TIME ARMING

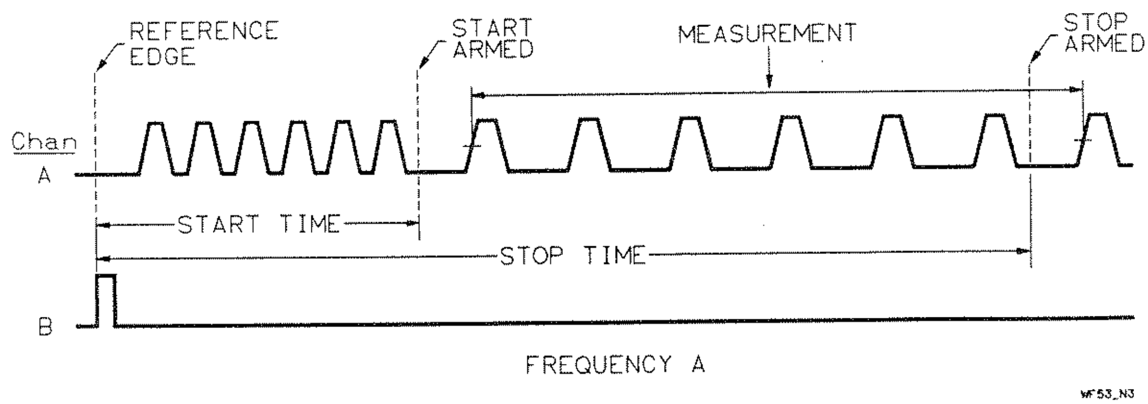


Figure 2-20. Frequency | Time/Time

DESCRIPTION OF DIAGRAM:

- Measurement can begin after a selectable time delay. The start of the time delay is referenced to a positive edge on Channel B. The measurement start is armed when the specified time elapses.
- Measurement starts at the trigger event of Channel A, following the end of the Start Arm time delay.
- Measurement ends at the trigger event following the end of the Stop Arm time delay. The Start and Stop Arm time delays are both referenced to the Start Arm reference edge.
- The diagram shows a time delay referenced to a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.
- The maximum number of measurements per block is 1. Configurations such as 100 blocks of 1 measurement are allowed.

- For Normal Measurement Mode:

  Range of Time = 2 ns to 8.0 s. Can be set with a resolution of 2 ns.

- For Fast Measurement Mode:

  Range of Time = 2 ns to 131 μs. Can be set with a resolution of 2 ns.

NOTE

The elapsed time between measurement samples should not exceed 4.0 s for Normal measurement mode or 65 μs for Fast measurement mode.

PRF OR FREQUENCY MEASUREMENT WITH EVENT/INTERVAL ARMING

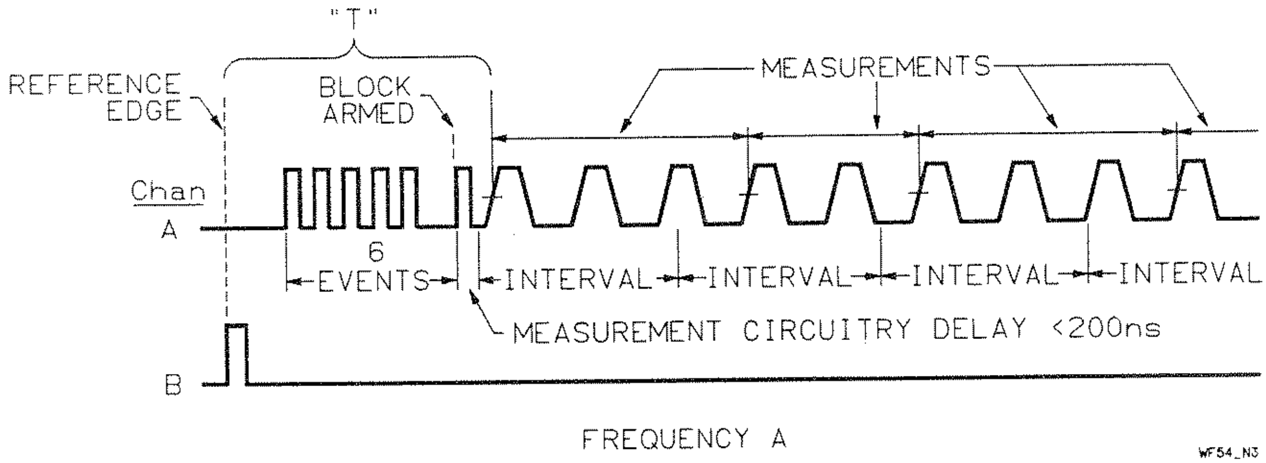


Figure 2-21. Frequency | Event Interval

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable event delay. The start of the event delay is referenced to a positive edge on Channel B. The block is armed after the specified number of events (edges) occur on the specified input.

- A sample is collected at the trigger event of Channel A after each interval. The first sample is taken at the trigger event after the start of the first interval. Measurements end on the trigger event following each interval. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.

- The diagram shows an event delay referenced to a positive edge on Channel B. Other options are a positive or negative edge on Channel A or External Arm.

- The reference edge is time stamped, so all measurements in the block are referenced in time to the holdoff edge. Averaging of multiple blocks is supported. ("T" on the waveform shows the time measured.)

- For Normal Measurement Mode:

  Range of Events = 0 to 4,000,000,000

  Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- For Fast Measurement Mode:

  Range of Events = 0 to 65,000

  Range of Interval = 100 ns to 131 μs. Can be set with a resolution of 100 ns.

PRF OR FREQUENCY MEASUREMENT WITH EVENT/EVENT ARMING

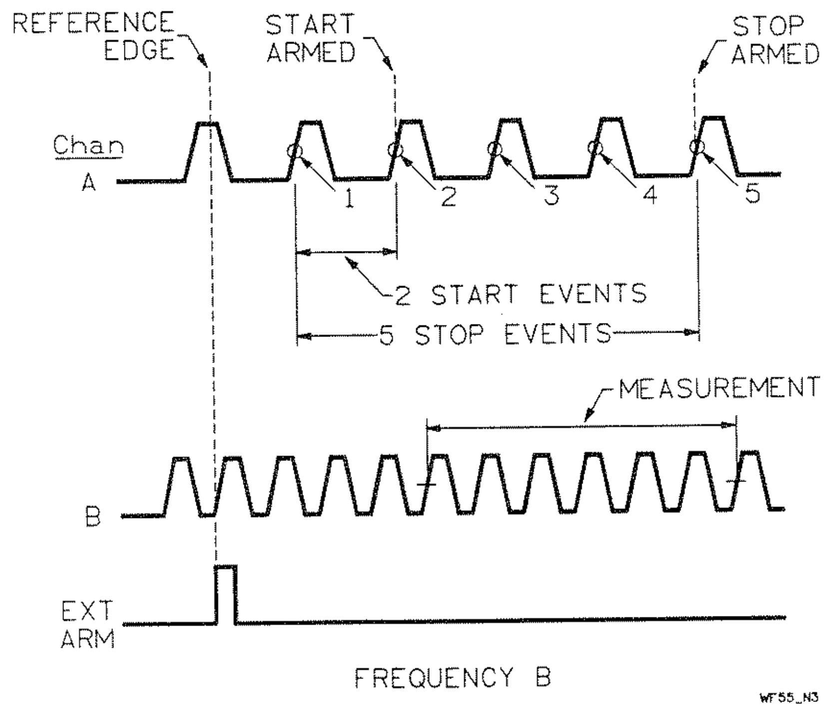


Figure 2-22. Frequency | Event/Event

DESCRIPTION OF DIAGRAM:

- Measurement can begin after a selectable event delay. The start of the event delay is referenced to a positive edge on External Arm. The measurement start is armed after the specified number of events (edges) occur on Channel A.
- Measurement starts at the trigger event of Channel B, following the Start Arm event count. The start delay is two events.
- Measurement ends at the trigger event following the end of the Stop Arm event count. The stop delay is five events. The start and stop event delays are both referenced to the Start Arm edge.
- The diagram shows an event delay referenced to a positive edge on External Arm. Other options for the reference edge are a positive or negative edge on Channel A or B.
- The delay events can be counted on Channel A or B.

- The maximum number of measurements per block is 1. Configurations such as 100 blocks of 1 measurement are allowed.
- For Normal Measurement Mode:

  Range of Events = 0 to 4,000,000,000
- For Fast Measurement Mode:

  Range of Events = 0 to 65,000

NOTE

The elapsed time between samples must fall within the measurable range. It is 10 ns to 4.0 s for Normal measurement mode or 10 ns to 65 μs for Fast measurement mode.

If the Stop Arm condition is satisfied before the Start Arm condition, the gate time will be positive. The gate time is the absolute value of the stop time - start time.

PRF OR FREQUENCY MEASUREMENT WITH EXTERNALLY GATED ARMING

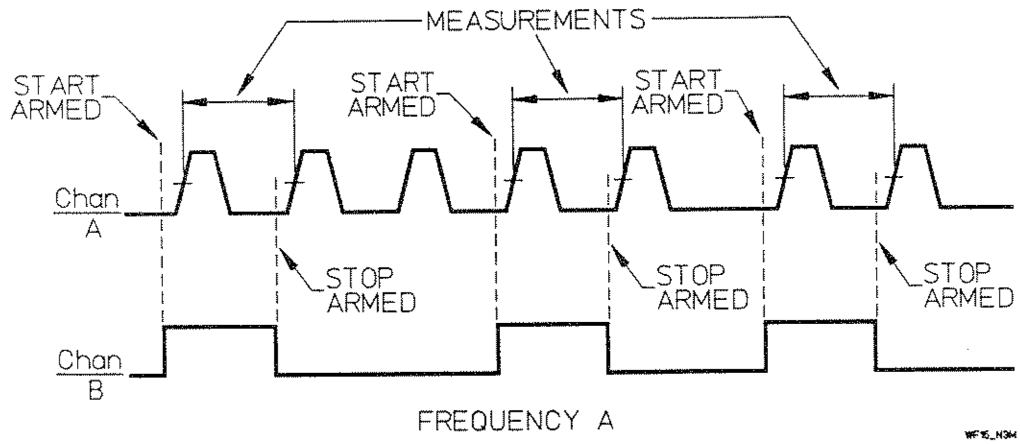


Figure 2-23. Frequency | Externally Gated

DESCRIPTION OF DIAGRAM:

- Start of measurement can begin after a positive edge on Channel B.
- Measurement starts at the next trigger event of Channel A.
- Stop of measurement is armed after the opposite edge of the Start Arm signal.
- Measurement stops at the next trigger event of Channel A.
- The diagram shows the Start Arm/Stop Arm signal occurring on Channel B. Other options include a signal on Channel A or External Arm.
- For Normal Measurement Mode:

  Pulse width of gating channel should be less than 8.0 s. Samples must be separated by an elapsed time less than 8.0 s.
- For Fast Measurement Mode:

  Pulse width of gating channel should be less than 131 μs. Samples must be separated by an elapsed time less than 131 μs.

3

Contents of Chapter

3

SPECIAL-PURPOSE MEASUREMENTS

CHAPTER OVERVIEW

Special-Purpose Measurements is a category of HP 5373A functions that includes:

- Totalize
- Rise Time
- Fall Time
- Pulse Width
- Pulse Offtime
- Duty Cycle
- Phase
- Envelope Power
- Amplitude Modulation
- Phase Deviation
- Time Deviation
- Frequency Deviation

These measurement functions are called "Special-Purpose Measurements" because they are more specific in what they can accomplish than are time interval or frequency and PRI measurements. Details are included in the individual measurement descriptions that follow.

This chapter contains the following:

- A description of each of the measurements.
- The channel options available for each measurement.
- The available arming modes for each measurement.

TOTALIZE

The Totalize function counts the number of trigger events on the input signal received during a specified period of time, between a pair of designated signal edges, or between presses of the Manual Arm key. The totalize function allows counting of 0 to 4,000,000,000 events on Channel A and B.

TECHNICAL COMMENT

A trigger event is a specific voltage on a rising or falling slope of an input signal that will trigger the HP 5373A to initiate some action. This action can be to arm a measurement, begin a measurement, or end a measurement. Refer to "Input Menu," chapter 8 for more information on how a trigger event is specified.

Totalize Measurements Described

In contrast to the other measurement functions of the HP 5373A, a totalize measurement sample is not necessarily taken at the trigger event of the input signal. (Refer to chapter 2 for a description of a "sample.")

Instead of measurement samples only being taken at the trigger event following an arming event, for totalize measurements, the sampling is synchronous with the arming event.

The arming event can be the end of a specified time interval, a specified edge, or a press of the Manual Arm key (for the Manual arming mode).

A totalize measurement is defined by two consecutive samples. The totalize result is the number of events counted between the two sample points.

NOTE

Fast Measurement Mode is not supported for Totalize Measurements.

TOTALIZE CHANNEL CHOICES

The HP 5373A offers the same input channel combinations for totalize as for frequency and PRI measurements.

The maximum number of measurements per block is 4,095 for all channel choices. The maximum number of measurements allowed (number of blocks ×number of measurements per block) can equal 99,999,999 ×4,095.

Single-Channel

A totalize measurement can be made on the Channel A or B input. The menu choices are:

- A
- B

Two-Channel

NOTE

For meaningful two-channel measurement data, the same pod type (HP 54002A, for example) should be installed in both channels.

A totalize measurement can be made on two input channels simultaneously.

TWO-RESULT MEASUREMENT

- A & B

Two-Result Measurement Features:

- Full accuracy is provided for each of the measurement channels.
- Measurement and time of measurement data can be displayed for both channels on the Numeric screen. (Use Numeric screen, Main menu, Expanded Data On)
- Histogram and Time Variation graphs can be viewed individually for each of the two measurement channels. (Use Graphic screen, Display menu, View Channel)
- Statistics can be calculated on both measurement channels. (Use Math menu, Statistics On)

RATIO MEASUREMENT

The ratio of two input signals can be displayed. The menu choices are:

- A / B
- B / A

The ratio is calculated by taking the result of the "first" channel and dividing it by the result of the "second" channel. For example, the result of "B / A" will be the Channel B result divided by the Channel A result. The HP 5373A can display ratios of less than 1.

SUM MEASUREMENT

The sum of two totalize measurements can be displayed. The menu choice is:

- A + B

The two results are added together.

DIFFERENCE MEASUREMENT

The HP 5373A can display the difference of two totalize measurements. The menu choices are:

- A – B
- B – A

The result of the "second" channel is subtracted from the result of the "first" channel.

TOTALIZE ARMING MODES

Shown below are the arming modes for totalize measurements.

HP 5373A Function and Arming Summary

ARMING MODE	MEASUREMENT FUNCTION												
	TIME INTERVAL OR HISTOGRAM TI		CONTINUOUS TIME INTERVAL OR HISTOGRAM CTI	± TIME INTERVAL OR HISTOGRAM ± TI		PRF, FREQUENCY, PRI, PERIOD		TOTALIZE		PULSE WIDTH, OFFTIME, RISE TIME, FALL TIME, DUTY CYCLE	PHASE	ENVELOPE POWER, AMPLITUDE MODULATION	PHASE DEVIATION, TIME DEVIATION, FREQUENCY DEVIATION
	A	A → B	A	A	A → B	A	DUAL[1]	A	DUAL[1]	A	A rel B	A	A
	B	B → A	B	B	B → A	B	RATIO[2]	B	RATIO[2]		B rel A	B	B
						C	SUM[3]		SUM[3]				
							DIFF[4]		DIFF[4]				
AUTOMATIC													
AUTOMATIC	C*	C*	C*		C*	C*	C*			C*	C*	N*	C*
HOLDOFF													
EDGE HOLDOFF	C	C	C		C	C					C		C
TIME HOLDOFF	C	C	C			C							
EVENT HOLDOFF	C	C	C			C							
SAMPLING													
INTERVAL SAMPLING	C	C	C		C	C	C	C*	C*		C		C
TIME SAMPLING						N							
CYCLE SAMPLING						C							
EDGE SAMPLING						C	C	C	C				
PARITY SAMPLING					C								
REPET EDGE SAMPLING	C	C	C		C								
REPET EDGE-PARITY SAMPLING					C								
RANDOM SAMPLING	C	C			C								
HOLDOFF/SAMPLING													
EDGE/INTERVAL	C	C	C		C	C	C	C	C		C		C
EDGE/TIME						N							
EDGE/EDGE						C		C	C				
EDGE/CYCLE						C							
EDGE/EVENT				N	N	N							
EDGE/PARITY					C								
EDGE/RANDOM	C	C			C								
TIME/INTERVAL						C		C					
TIME/TIME				N	N	N							
EVENT/INTERVAL						C							
EVENT/EVENT				N*	N	N							
EXTERNALLY GATED						C		C	C				
MANUAL								N	N				

Symbol C or N indicates that a measurement can be made using the corresponding combination of Function, Channel, and Arming selections.

C = Continuous Arming, (Block/Sample Arming)

N = Non-Continuous arming, (Start/Stop Arming), setups are limited to M blocks of 1 measurement.

1. DUAL. Simultaneous Dual-channel, (2 results). Frequency and PRI options are: A&B, A&C, B&C. Totalize option is: A&B.
2. RATIO. Frequency and Period ratio options are: A/B, A/C, B/A, B/C, C/A, C/B. Totalize ratio options are: A/B, B/A.
3. SUM. Frequency and Period sum options are: A+B, A+C, B+C. Totalize sum option is: A+B.
4. DIFFERENCE. Frequency and Period difference options are: A–B, A–C, B–A, B–C, C–A, C–B. Totalize difference options are: A–B, B–A.

* = Default Arming

TOTALIZE ARMING MODE EXAMPLES

Shown below are the arming modes available for totalize measurements along with a timing diagram to illustrate each arming mode. For these examples, the trigger event is always on the positive slope of the input signals.

TOTALIZE MEASUREMENT WITH INTERVAL SAMPLING ARMING

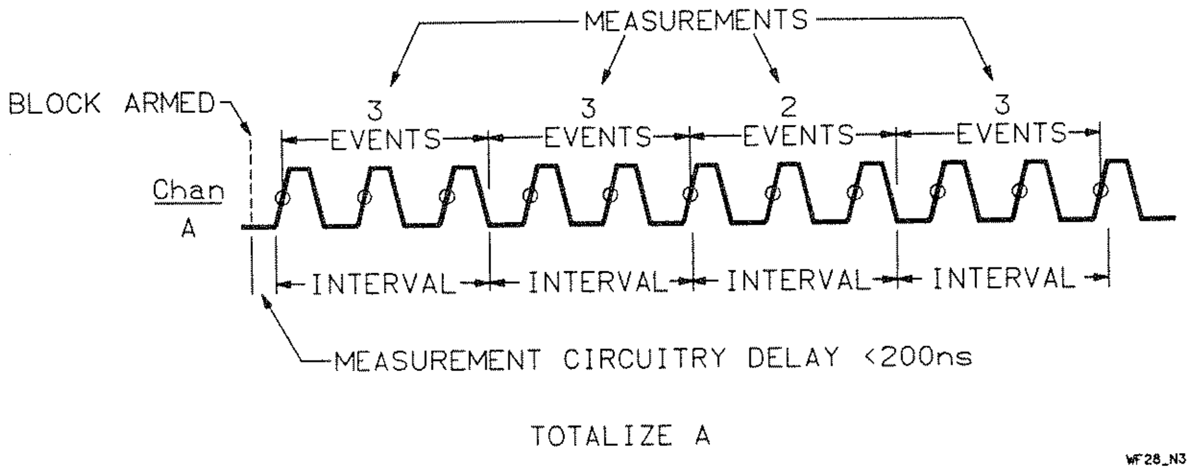


Figure 3-1. Totalize | Interval Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready. The block is armed when the Analyzer is ready to begin measuring.
- Samples are then taken at each interval. The measurements end at the conclusion of each interval. The sample interval is repetitive and asynchronous with the signal being measured. Four measurements are shown.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

TOTALIZE MEASUREMENT WITH EDGE SAMPLING ARMING

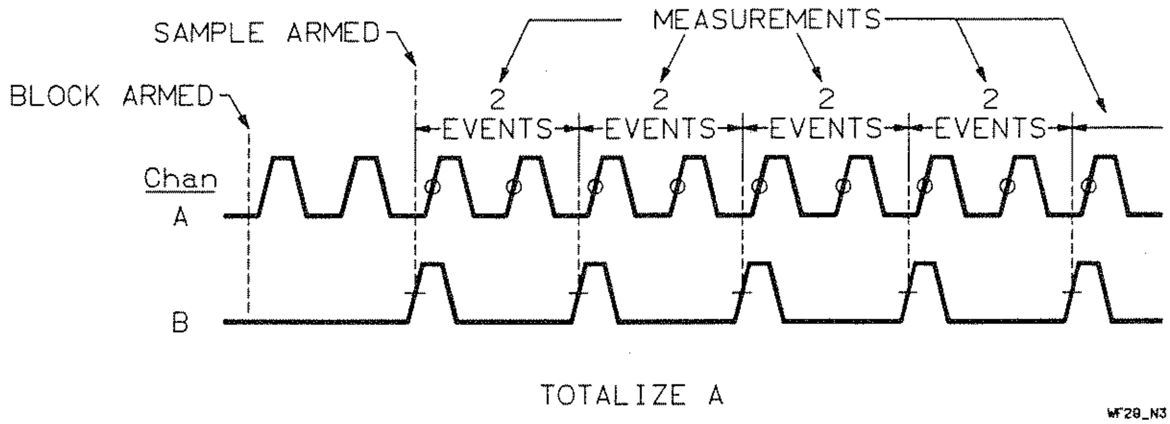


Figure 3-2. Totalize | Edge Sampling

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin as soon as the Analyzer is ready. The block is armed when the Analyzer is ready to begin measuring.
- Samples are armed at a positive edge on Channel B. One sample is collected per arming edge. An edge is required before each sample. Four measurements are shown.

NOTE

The PRI of the sample arm signal should not exceed 8.0 s.

TOTALIZE MEASUREMENT WITH EDGE/INTERVAL ARMING

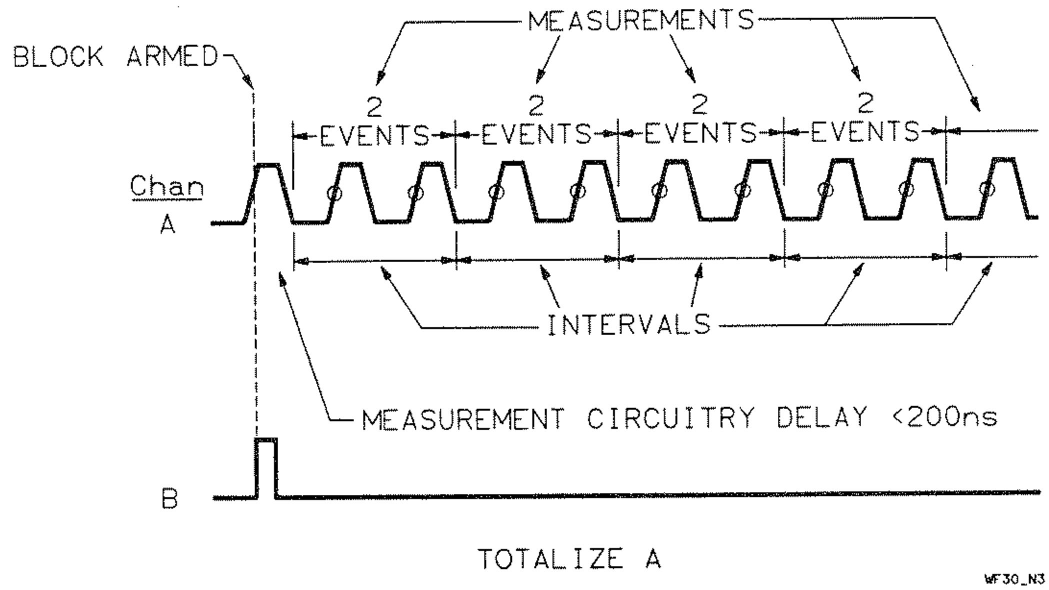


Figure 3-3. Totalize | Edge/Interval

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a positive edge on Channel B. The block is armed when the edge occurs on Channel B.
- Samples are collected at each interval. The measurements end at the conclusion of each interval. The sample interval is repetitive and asynchronous with the signal being measured. Four measurements are shown.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

TOTALIZE MEASUREMENT WITH EDGE/EDGE ARMING

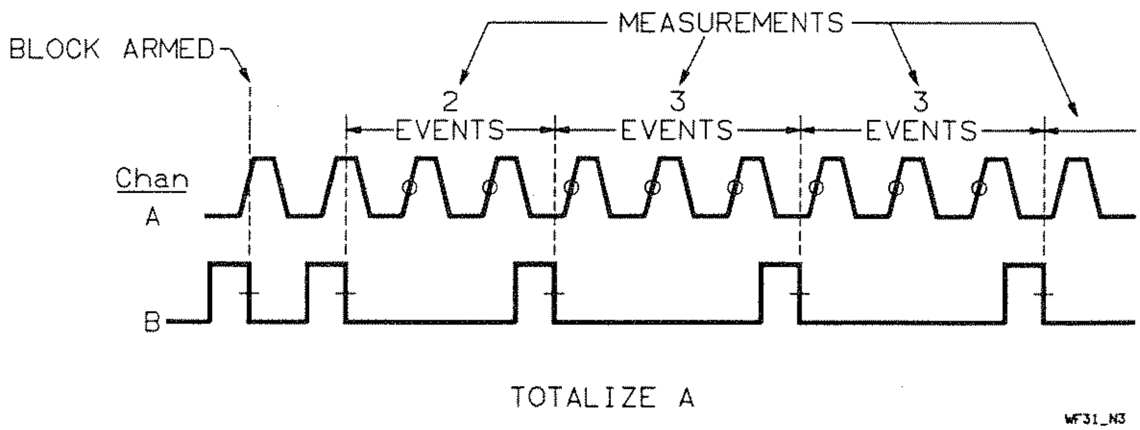


Figure 3-4. Totalize | Edge/Edge

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a negative edge on Channel B. The block is armed when the edge occurs on Channel B.
- Samples are collected at a negative edge on Channel B. One sample is taken per edge. An edge is required for each sample. Three measurements are shown.

NOTE

The PRI of the sample arm signal should not exceed 8.0 s.

TOTALIZE MEASUREMENT WITH EXTERNALLY GATED ARMING

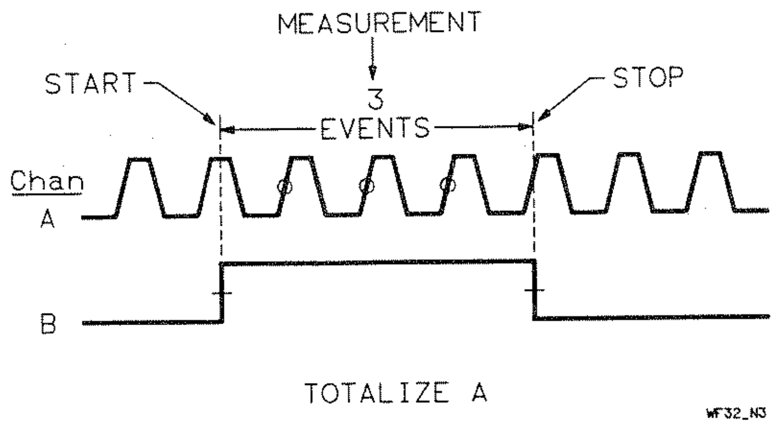


Figure 3-5. Totalize | Externally Gated

DESCRIPTION OF DIAGRAM:

- Measurement starts at a rising edge on Channel B.
- Measurement ends at a falling edge on Channel B.

NOTE

Pulse width of external gate signal should not exceed 8.0 s.

TOTALIZE MEASUREMENT WITH TIME/INTERVAL ARMING

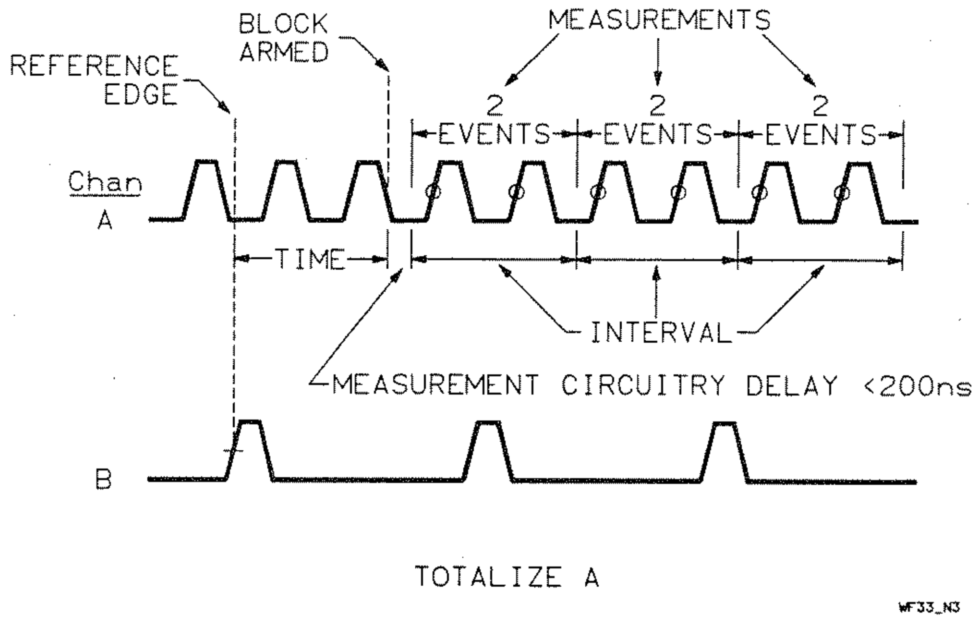


Figure 3-6. Totalize | Time/Interval

DESCRIPTION OF DIAGRAM:

- A block of measurements can begin after a selectable time delay. The start of the time delay is referenced to a positive edge on Channel B.
- Samples are collected at each interval. The measurements end at the conclusion of each interval. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.

Range of Time = 2 ns to 8.0 s. Can be set with a resolution of 2 ns.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

TOTALIZE MEASUREMENT WITH MANUAL ARMING

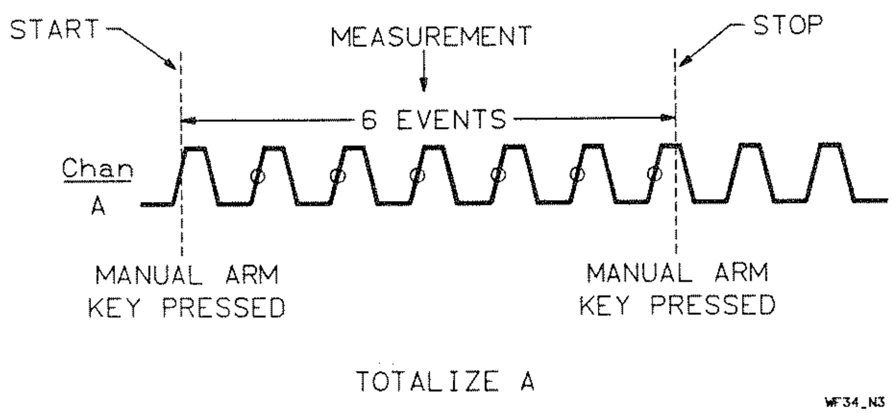


Figure 3-7. Totalize | Manual

DESCRIPTION OF DIAGRAM:

- Measurement starts when the Manual Arm key is pressed. The GATE LED comes on, and the CRT status line displays, "Gate open."
- Measurement ends when the Manual Arm key is pressed. The GATE LED goes off, the CRT status message "Gate open" is turned off, and the measurement result is displayed.
- When the Single/Repetitive feature is set to "Single," the Restart key must be pressed between each measurement.
- When the Single/Repetitive feature is set to "Repetitive," multiple totalize measurements can be made. The totalize result will be the accumulated count from multiple measurements. Use the Restart key to clear the totalize count.
- See the description of the Manual Arm key operation in "Front Panel/Rear Panel," chapter 6.

AUTOMATIC MEASUREMENTS

For the following measurements, no parameters need to be specified on the Function and Input menu screens. There is a set of default values for each of the measurements. Some of these default values can be modified. This information is listed for each measurement under "Parameters that can be modified."

The automatic measurements are:

Rise Time
Fall Time
Pulse Width
Pulse Offtime
Duty Cycle
Envelope Power
Amplitude Modulation

NOTE

It is recommended that you press the **Preset** *key to return instrument settings to default values after making any of these automatic measurements. There are instances where the settings selected for the automatic measurements could cause confusion with the setup of a new measurement.*

Rise Time

Description:

The Rise Time function automatically configures the HP 5373A to perform a rise time measurement on the signal at Channel A. The default trigger level points are at 20% and 80% of the input signal. These levels can be changed on the Input menu screen.

Range: 1 ns to 100 μs transitions on rising edge of input signal.

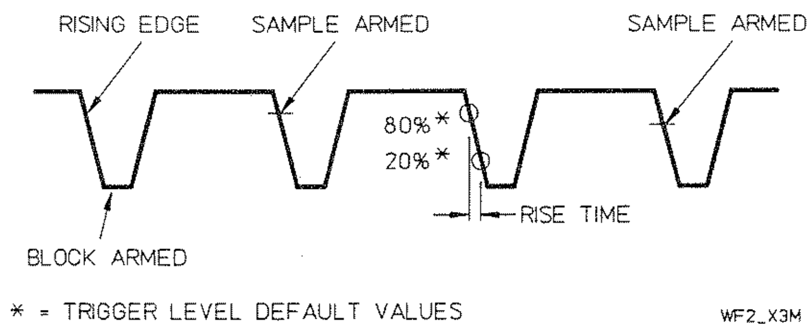


Figure 3-8. Rise Time A

Defaults:

- Measurement Channel – A
- Arming Mode – Automatic
- Input Channels – Common
- Channel A Trigger Event:

NOTE

When the Input Channels field is set to Common, the limits and defaults for the Channel B Trigger Event parameters (slope, mode, and level settings) are determined by the input pod installed at Channel A and the attenuation setting for Channel A.

Channel A Pod:	HP 53702A Envelope Detector Pod	HP 54002A 50Ω Input Pod
Channel A Trigger Event:		
Slope	Negative	Positive
Mode	Repetitive Auto	Repetitive Auto
Level	80%	20%
Channel B Trigger Event:		
Slope	Negative	Positive
Mode	Repetitive Auto	Repetitive Auto
Level	20%	80%

Parameters that can be modified:

- Input screen:

  Trigger Event Mode
  Trigger Event Level

NOTE

At least 8 ns must elapse between arming edge and the first sample of each measurement.

Fall Time

Description:

The Fall Time function automatically configures the HP 5373A to perform a fall time measurement on the signal at Channel A. The default trigger level points are at 80% and 20% of the input signal. These levels can be changed on the Input menu screen.

Range: 1 ns to 100 μs transitions on the falling edge of the input signal.

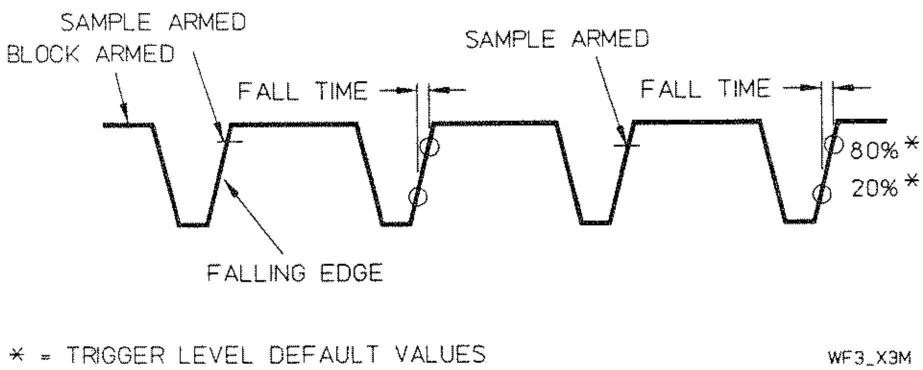


Figure 3-9. Fall Time A

Defaults:

- Measurement Channel – A
- Arming Mode – Automatic
- Input Channels – Common
- Channel A Trigger Event:

NOTE

When the Input Channels field is set to Common, the limits and defaults for the Channel B Trigger Event parameters (slope, mode, and level settings) are determined by the input pod installed at Channel A and the attenuation setting for Channel A.

Channel A Pod:	HP 53702A Envelope Detector Pod	HP 54002A 50Ω Input Pod
Channel A Trigger Event: Slope Mode Level	 Positive Repetitive Auto 20%	 Negative Repetitive Auto 80%
Channel B Trigger Event: Slope Mode Level	 Positive Repetitive Auto 80%	 Negative Repetitive Auto 20%

Parameters that can be modified:

- Input screen:

  Trigger Event Mode
  Trigger Event Level

NOTE

At least 8 ns must elapse between the arming edge and the first sample of each measurement.

Pulse Width

Description:

The Pulse Width function automatically configures the HP 5373A to perform a pulse width measurement on the signal at Channel A. The default trigger level points are 50% for the rising and falling edge of the positive pulse of the input signal. These levels can be changed on the Input menu screen.

Range: 8 ns to 8 ms pulse widths (auto trigger)

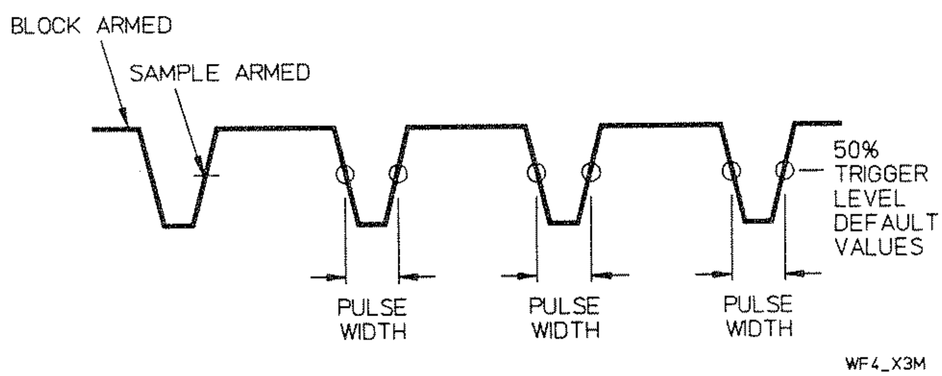


Figure 3-10. Pulse Width A

Defaults:

- Measurement Channel – A
- Arming Mode – Automatic
- Input Channels – Common
- Trigger Events

NOTE

When the Input Channels field is set to Common, the limits and defaults for the Channel B Trigger Event parameters (slope, mode, and level settings) are determined by the input pod installed at Channel A and the attenuation setting for Channel A.

Channel A Pod:	HP 53702A Envelope Detector Pod	HP 54002A 50Ω Input Pod
Channel A Trigger Event:		
Slope	Negative	Positive
Mode	Repetitive Auto	Repetitive Auto
Level	50%	50%
Channel B Trigger Event:		
Slope	Positive	Negative
Mode	Repetitive Auto	Repetitive Auto
Level	50%	50%

Parameters that can be modified:

- Input screen:

  Trigger Event Mode
  Trigger Event Level

TECHNICAL COMMENT

Time Interval or ±Time Interval measurement functions could be used to make pulse width or pulse offtime measurements. The advantage of using Time Interval or ±Time Interval is the ability to use different arming modes.

When using a time interval function to measure pulse width, set the measurement channel to A→B on the Function menu. On the Input menu, set the Input Channels to Common, and the Channel A and Channel B trigger slopes to the default values listed above.

NOTE

At least 8 ns must elapse between the arming edge and the first sample of each measurement.

Pulse Offtime

Description:

The Pulse Offtime function automatically configures the HP 5373A to perform a pulse offtime measurement on the signal at Channel A. The default trigger level points are 50% for the falling and rising edge of the negative pulse of the input signal. These levels can be changed on the Input menu screen.

Range: 8 ns to 8 ms pulse widths (auto trigger)

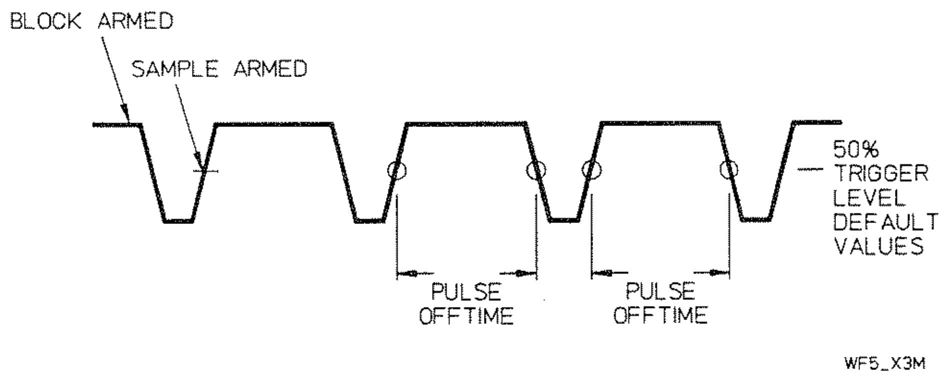


Figure 3-11. Pulse Offtime A

Defaults:

- Measurement Channel – A
- Arming Mode – Automatic
- Input Channels – Common
- Trigger Events

NOTE

When the Input Channels field is set to Common, the limits and defaults for the Channel B Trigger Event parameters (slope, mode, and level settings) are determined by the input pod installed at Channel A and the attenuation setting for Channel A.

Channel A Pod:	HP 53702A Envelope Detector Pod	HP 54002A 50Ω Input Pod
Channel A Trigger Event:		
Slope	Positive	Negative
Mode	Repetitive Auto	Repetitive Auto
Level	50%	50%
Channel B Trigger Event:		
Slope	Negative	Positive
Mode	Repetitive Auto	Repetitive Auto
Level	50%	50%

Parameters that can be modified:

- Input screen:

  Trigger Event Mode
  Trigger Event Level

TECHNICAL COMMENT

Time Interval or ±Time Interval measurement functions could be used to make pulse width or pulse offtime measurements. The advantage of using Time Interval or ±Time Interval is the ability to use different arming modes.

When using a time interval function to measure pulse width, set the measurement channel to A→ B on the Function menu. On the Input menu, set the Input Channels to Common, and the Channel A and Channel B trigger slopes to the default values listed above.

NOTE

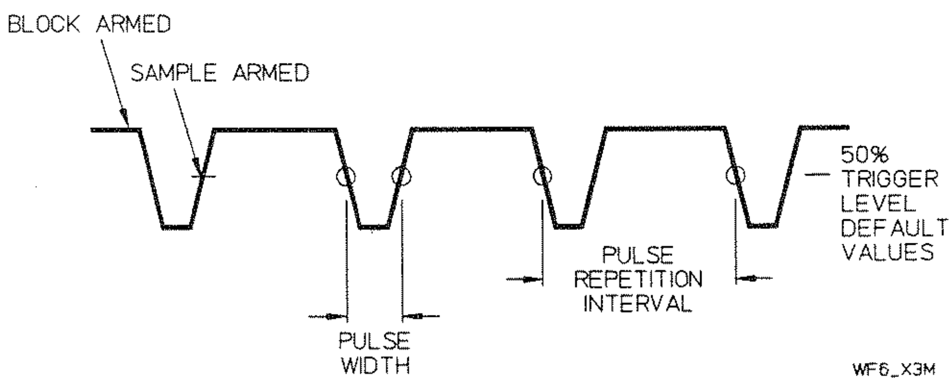
At least 8 ns must elapse between the arming edge and the first sample of each measurement.

Duty Cycle

Description:

The Duty Cycle function automatically configures the HP 5373A to perform a duty cycle measurement on the signal at Channel A. The default trigger level points are 50% for the rising and falling edge of the positive pulse of the input signal. These levels can be changed on the Input menu screen. The Duty Cycle result is a pulse width measurement expressed as a percentage of the PRI of the input signal.

Range: 0% to 100% for a pulse width greater than 1 ns and a signal PRI less than 1 ms (auto trigger) or 4 s (manual trigger).



$$\text{Duty Cycle (in percent)} = \frac{\text{Pulse Width}}{\text{Pulse Repetition Interval}} \times 100$$

NOTE: Pulse Width and Pulse Repetition Interval are not measured on the same pulse.

Figure 3-12. Duty Cycle A

Defaults:

- Measurement Channel – A
- Arming Mode – Automatic
- Input Channels – Common
- Trigger Events

NOTE

When the Input Channels field is set to Common, the limits and defaults for the Channel B Trigger Event parameters (slope, mode, and level settings) are determined by the input pod installed at Channel A and the attenuation setting for Channel A.

Channel A Pod:	HP 53702A Envelope Detector Pod	HP 54002A 50Ω Input Pod
Channel A Trigger Event:		
Slope	Negative	Positive
Mode	Repetitive Auto	Repetitive Auto
Level	50%	50%
Channel B Trigger Event:		
Slope	Positive	Negative
Mode	Repetitive Auto	Repetitive Auto
Level	50%	50%

Parameters that can be modified:

- Input screen:

  Trigger Event Mode
  Trigger Event Level

NOTE

At least 8 ns must elapse between the arming edge and the first sample of each measurement.

Phase

Description:

The Phase function automatically configures the HP 5373A to perform a phase measurement between the signals on Channel A and B. Channel options are: Channel A relative to B, or Channel B relative to A. The phase difference of the two signals is determined by measuring the period of the reference signal (the "relative to" signal) and the time interval between the positive edges (at the 50% points) of the two signals. So an "A rel B" measurement makes a period measurement on the B signal. If the reference signal's edge occurs before the other signal's edge, the phase is negative.

NOTE

> *For meaningful Phase measurement results, both HP 5373A input channels should have the same type of pod (HP 53702A, HP 54002A, etc.).*

Phase measurement results can be displayed in two different formats, depending on the setting of the Math menu **Phase Result** field. The choices are:

- Modulo 360°
- Cumulative

Modulo 360 displays results in the range of –180° to +180°. When set to Cumulative, if the number of measurements per block is set greater than 1, the phase results are referenced to the first measurement of the block. The results will show the cumulative phase shift between the two signals.

Range: – 180° to +180° (Modulo 360)
> ±360° (Cumulative)

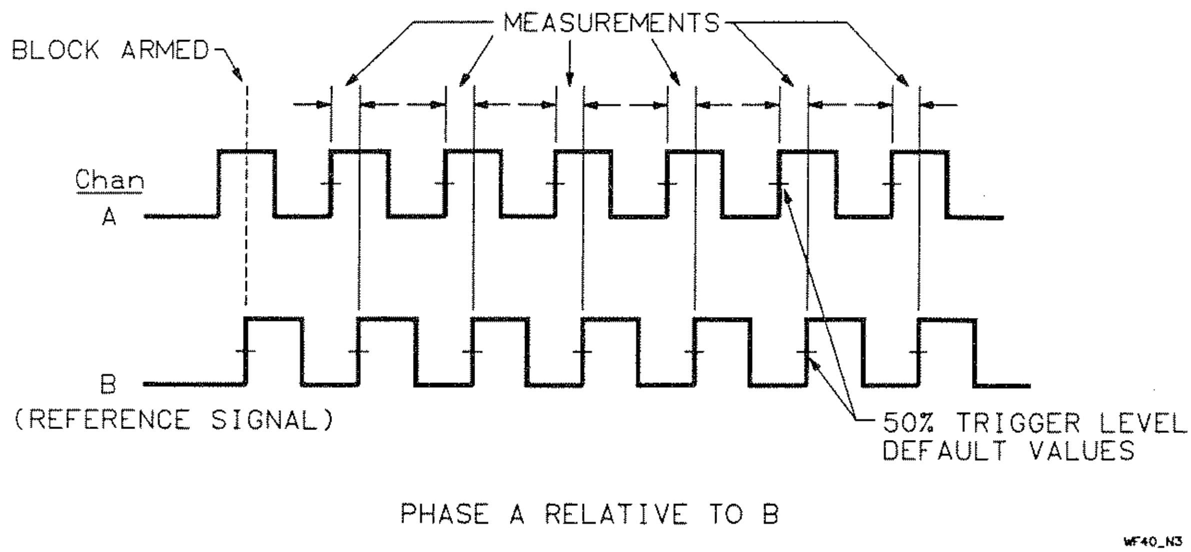


Figure 3-13. Phase A Relative to B

TECHNICAL COMMENT

The Modulo 360 option for both Phase and Phase Deviation measurements can be used to keep the range of phase results limited to a total span of 360°. Modulo 360 is useful for comparing phases on multi-burst signals.

The HP 5373A implementation of Modulo 360 does not compute cumulative phase MOD 360, which would provide results in the range 0° to 360°. Instead the upper 180° of the MOD 360 function (180° to 360°) are translated to the range –180° to 0°. This is done to avoid the display scatter that would take place on the Time Variation graph when the displayed phase results crossed the 0° boundary.

For the case where your phase results are crossing the 180° boundary, you can introduce an offset to move the boundary away from your data. By adding an offset value before the modulus operation, then subtracting the offset after the modulus operation, the boundary is moved to 180°+ (offset)°.

This is accomplished as follows:

1. *Select the Math menu and set Math "On" for:*
   - *Channel A for a Phase A rel B measurement*
   - *Channel A for a Phase B rel A measurement*
   - *Channel A for a Phase Deviation A measurement*
   - *Channel B for a Phase Deviation B measurement*
2. *Move the menu cursor down to the Offset field and enter the number of degrees by which you want to move the boundary. The formula for the displayed result is shown at the bottom of the screen. It reads:*

"Display = (Result+Offset) MOD 360 - Offset"

The new range for Modulo 360 is (–180° - Offset) to (180° - Offset).

Defaults:

- Measurement Channel – A relative to B
- Arming Mode – Automatic
- Input Channels – Separate
- Channel A Trigger Event:

  Slope – Pos
  Mode – Single Auto
  Level – 50%

- Channel B Trigger Event:

  Slope – Pos
  Mode – Single Auto
  Level – 50%

Parameters that can be modified:

- Function screen:

  Channel option

- Input screen:

  Input Channels
  Trigger Event Slope
  Trigger Event Mode
  Trigger Event Level

Arming Modes:

- Automatic — Measurements are taken as quickly as possible.

- Edge Holdoff — A block of measurements will be delayed, or held off, until an edge occurs on Channel A, B, or External Arm.

- Interval Sampling — The time between phase measurements can be set.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- Edge/Interval — A block of measurements will be delayed, of held off, until an edge occurs on Channel A, B, or External Arm. Also, the time between phase measurements can be set.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

Envelope Power

Description:

Refer to *Figure 3-14*

Envelope Power is the maximum (peak) detected pulse envelope power derived from the formula below. This corresponds to the maximum envelope power for the HP 53702A Envelope Detector Pod. For the HP 53702A, minimum envelope power corresponds to the pulse offtime power. For the HP 54002A 50Ω Input Pod, maximum envelope power corresponds to the maximum positive input signal power, and minimum envelope power corresponds to the maximum negative signal power.

$$P_{in}\ \mathrm{dBm} = 10 \log \left[\frac{\left(Ve / \sqrt{2}\right)^2}{50\Omega} \Big/ 1\mathrm{mW} \right]$$

The Envelope Power function automatically configures the HP 5373A to measure the maximum and minimum envelope power of the signal at Channel A or B.

NOTE

The Envelope Power function requires an envelope signal for its input. We suggest using the output of the HP 53702A Envelope Detector Pod as the easiest way to obtain this signal.

The maximum number of blocks is 1; the maximum number of measurements per block is 1.

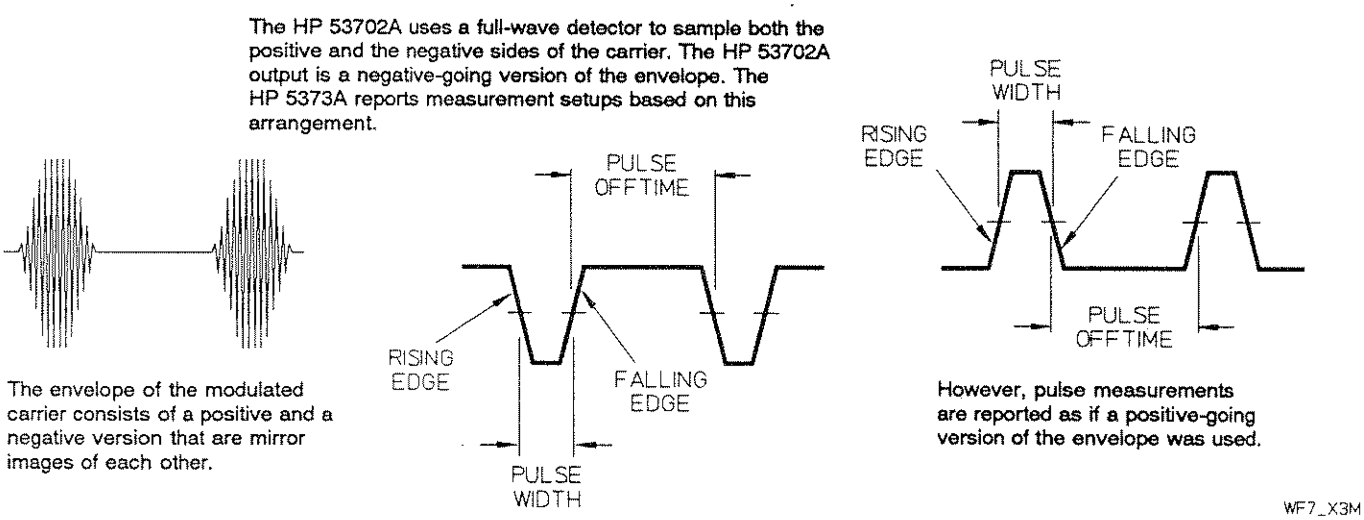


Figure 3-14. Pulse Burst Measurement Parameters

Pulse Repetition Frequency Range: 1 kHz to 2 MHz

Amplitude Range: –20 dBm to +6 dBm

Defaults:

- Measurement Channel – A
- Arming Mode – Automatic
- Input Channels – Separate
- Channel A Trigger Event:

  Slope – Pos
  Mode – Single Auto
  Level – 50%

- Channel B Trigger Event:

  Slope – Pos
  Mode – Single Auto
  Level – 50%

Parameters that can be modified:

- Function screen:

  Channel option

- Input screen:

  Input Channels

Figure 3-14 also shows other pulse burst measurements that the HP 5373A can make. These are described below.

- Pulse Repetition Frequency (PRF) is the number of pulses per second.

- Carrier Frequency (for Pulse or CW) is measured in Hertz. The Carrier period is measured in units of time. Carrier Frequency and Carrier Period have the relationship shown below.

$$\frac{1}{\text{Carrier Frequency}} = \text{Carrier Period}$$

$$\frac{1}{\text{Carrier Period}} = \text{Carrier Frequency}$$

- Pulse Repetition Interval (PRI) is the time between the leading edges of two consecutive pulses and is the reciprocal value of PRF (PRI = 1/PRF).

- Pulse Width (PW) is the time from the leading edge of a pulse to the trailing edge of the same pulse.

- Pulse Offtime is the time between two adjacent pulses, measured from the trailing edge of the first pulse to the leading edge of the second pulse.

- Duty Cycle is the Pulse Width (PW) divided by the Pulse Repetition Interval (PRI), then multiplied by 100, to give a percentage value.

$$\text{Duty Cycle} = \frac{\text{Pulse Width}}{\text{Pulse Repitition Interval}} \times 100$$

Table 3-1 shows the single-channel pulse or CW measurement performed by the HP 5373A as a result of various measurement softkey and channel selections. Information in this table assumes an HP 53702A Envelope Detector Pod in CHANNEL A, and an HP 54002A 50Ω Input Pod in CHANNEL B. Other measurement functions and softkeys are listed in the "Measurement Function Menus" section of Chapter 2. Details of the standard Time Interval/Frequency/Period/Histogram measurements, along with Arming, are in Chapters 1 through 5 of the HP 5373A Operating Manual.

Table 3-1. Pulse/CW Measurement Functions

SOFTKEY	CHANNEL	MEASUREMENT FUNCTION
PRF / Frequency	A	Pulse Repetition Frequency (PRF)
	B	Pulse/CW Carrier Frequency
	C	Pulse/CW Carrier Frequency
PRI / Period	A	Pulse Repetition Interval (PRI)
	B	Pulse/CW Carrier Period
	C	Pulse/CW Carrier Period
Pulse Width	A	Pulse Width (PW)(time)
Pulse Offtime	A	Pulse Offtime (time)
Duty Cycle	A	Duty Cycle (PW/PRI x 100)
Envelope	A	Detected Envelope (Vpeak) Power
	B	ac signal maximum positive power

Amplitude Modulation

Description:

The Amplitude Modulation function automatically configures the HP 5373A to measure the percentage AM of the signal at Channel A or B. Percentage AM is defined as:

$$\% \text{ AM} = 100 \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

NOTE

The Amplitude Modulation function requires an envelope signal for its input. We suggest using the HP 53702A Pod as the easiest way to obtain this signal.

The maximum number of blocks is 1; the maximum number of measurements per block is 1.

Modulation Frequency Range: 1 kHz to 9 MHz
Percentage AM Range: 20% to 85% at 0 dBm

Defaults:

- Measurement Channel – A
- Arming Mode – Automatic
- Input Channels – Separate
- Channel A Trigger Event:

  Slope – Pos
  Mode – Single Auto
  Level – 50%

- Channel B Trigger Event:

  Slope – Pos
  Mode – Single Auto
  Level – 50%

Parameters that can be modified:

- Function screen:

  Channel option

- Input screen:

  Input Channels

PHASE, TIME, AND FREQUENCY DEVIATION MEASUREMENTS

The HP 5373A has several measurement functions for the task of measuring the deviation of an input signal from a reference. The measurements are:

- Phase Deviation for single-channel phase measurement
- Time Deviation for cumulative time jitter measurement
- Frequency Deviation for single-channel frequency measurement

Each function shows the deviation of the measurements of the signal from a reference value. The choice is made in the **Carrier Freq** field on the Math menu. The choices are:

- Compute Carrier Pulse. In this case, the reference value is calculated automatically from a pulse input. When this method is chosen, any measurement that includes off-time data is not used in the calculation.
- Compute Carrier CW. In this case, the reference value is calculated automatically from a CW input.
- Compute Carrier Manual. In this case, the reference value is specified as a constant frequency, entered manually.

  Manual Carrier Range is 1E–12 to 10E+9 (Hz). The HP-IB command is CFR.
- Compute Carrier Linear. In this case, the reference value is specified as a frequency that changes at a constant rate, determined by manually-entered slope and start values.

  Slope Range is –10E+9 to 10E+9 (Hz/μsec).

  Starting Point Range is 1E–12 to 10E+9 (Hz).

The HP-IB commands for Slope and Starting Point are CSL and CST.

TECHNICAL COMMENT

In the Compute Carrier Pulse mode, the on-time and off-time data points are determined as follows:

- *for Frequency, all points whose frequency is less than 1/5 of the maximum frequency are considered to be off-time data points and are rejected.*
- *for PRI, all points whose average period is greater than 5 times the minimum average period are considered to be off-time data points and are rejected.*

Measurements Referenced To The Block Arming Edge

There are two arming modes for phase deviation, time deviation, and frequency deviation measurements that reference all measurements of a block to the block holdoff arming edge. They are:

- Edge Holdoff
- Edge / Interval

For these arming modes, the edge which arms each block is "time-stamped," and the elapsed time between the block arming edge and the first measurement sample is measured.

While all the arming modes provide the time from the beginning of the first measurement of a block, these time-stamp arming modes also provide the time between the block arming edge and the first measurement sample that is collected. The time value is displayed on the Numeric screen. It is listed before the first measurement result of the block and has a "T" in front of it.

NOTE

To receive valid data, the interval between the block arming edge and the first measurement sample must be within the range of 100 ns to 8.0 s.

Averaged Results for Deviation Measurements

The feature of time-stamping the arming edge makes it possible for the HP 5373A to average multiple blocks of measurements. When you select one of the two arming modes from the previous page for a multiple-block Phase Deviation, Time Deviation, or Frequency Deviation measurement, a field on the Function menu will allow selection of "Averaged Results" (the other option is "All Results"). The averaged results are shown on the Numeric screen, the Time Variation and Event Timing graphs. If the total number of measurements selected exceeds the size of internal memory, "Averaged Results" is the only option available. See the Note below.

NOTE

Block averaging is available for Phase Deviation, Time Deviation, and Frequency Deviation, under the following conditions:

- *The arming mode is Edge Holdoff or Edge/Interval.*
- *The number of blocks is set greater than 1.*
- *The* **Carrier Frequency** *field is set to Manual on the Math menu. The appropriate carrier frequency value should be entered.*

Phase Deviation

Description:

The Phase Deviation function displays the amount of phase difference between an input signal and a carrier signal over some period of time. It is a way to analyze the jitter of a signal.

The reference can be: 1) a frequency computed as the mean value of a block of data from a pulsed or CW carrier, 2) a constant frequency, entered manually, or, 3) a linearly changing frequency whose slope and starting values are entered manually.

When the computed mean frequency for a pulsed or CW carrier is used, the measurements in each block are referenced to the mean of that block.

When the manually entered constant carrier frequency is used, all measurements are referenced to it.

When the manually entered linearly changing carrier is used, the reference carrier frequency is computed as follows:

reference carrier = starting point frequency + (time) * (slope)

where the time is referenced to the beginning of the measurement. Each measurement is referenced to the carrier frequency corresponding to the time at which the measurement was made.

The selection is made in the **Carrier Frequency** field on the Math menu.

The Phase Deviation function establishes the time of occurrence for each trigger event on the input signal. It also establishes the time of occurrence for each corresponding event on the reference signal. The "Deviation" is the difference between the two times as a measure of the extent to which the input signal deviates from its reference. Expressed in degrees, this is "Phase Deviation." One PRI of the reference corresponds to 360°.

TECHNICAL COMMENT

When Carrier Frequency determination method is "Compute Carrier CW", the "mean" used as the reference is the Bicentroid Mean. This is an algorithm which calculates mean frequency by estimating the Least Squares Fit of a line to the events vs time data. The slope of this line is a constant frequency. The frequency thus calculated is used as the Carrier.

When Carrier Frequency determination method is "Compute Carrier Pulse", "mean" used as the reference is the Bicentroid Mean of the pulse on-time frequency values. Pulse off-time frequency values are not used in the calculation. The pulse on-time and off-time data points are determined as follows:

- *for Frequency, all points whose frequency is less than 1/5 of the maximum frequency are considered to be off-time data points and are rejected.*
- *for PRI, all points whose average period is greater than 5 times the minimum average period are considered to be off-time data points and are rejected.*

Phase Deviation results can be displayed in two different formats, depending on the setting of the Math menu **Phase Result** field. The choices are:

- Modulo 360°
- Cumulative

Modulo 360 displays results in the range of –180° to +180°. When set to Cumulative, the phase deviation results are referenced to the first sample of the block. The results will show the cumulative phase deviation of the input signal from the reference.

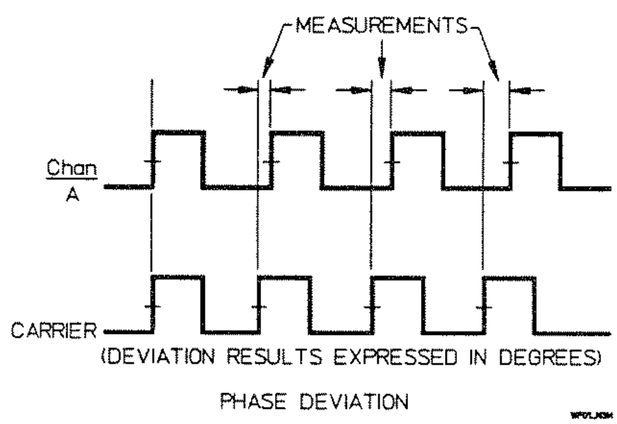


Figure 3-15. Phase Deviation

When the input signal leads the reference, the results are positive. Conversely, negative results indicate that the input signal lags behind the reference.

Range: –180° to +180° (Modulo 360)
> ±360° (Cumulative)

TECHNICAL COMMENT

The Modulo 360 option for both Phase and Phase Deviation measurements can be used to keep the range of phase results limited to a total span of 360°. Modulo 360 is useful for comparing phases on multi-burst signals.

The HP 5373A implementation of Modulo 360 does not compute cumulative phase MOD 360, which would provide results in the range 0° to 360°. Instead the upper 180° of the MOD 360 function (180° to 360°) are translated to the range –180° to 0°. This is done to avoid the display scatter that would take place on the Time Variation graph when the displayed phase results crossed the 0° boundary.

For the case where your phase results are crossing the 180° boundary, you can introduce an offset to move the boundary away from your data. By adding an offset value before the modulus operation, then subtracting the offset after the modulus operation, the boundary is moved to 180° + (offset)°.

This is accomplished as follows:

1. *Select the Math menu and set Math "On" for:*
   - *Channel A for a Phase A rel B measurement*
   - *Channel A for a Phase B rel A measurement*
   - *Channel A for a Phase Deviation A measurement*
   - *Channel B for a Phase Deviation B measurement*
2. *Move the menu cursor down to the Offset field and enter the number of degrees by which you want to move the boundary. The formula for the displayed result is shown at the bottom of the screen. It reads:*

"Display = (Result+Offset) MOD 360 - Offset"

The new range for Modulo 360 is (–180° - Offset) to (180° - Offset).

Defaults:

- Measurement Channel – A

Arming Modes:

- Automatic — Measurements are taken as quickly as possible.
- Edge Holdoff — A block of measurements can be delayed, or held off, until an edge occurs on Channel A, B, or External Arm. The reference edge is time stamped, so all measurements in the block are referenced to the holdoff edge. Averaging of multiple blocks is supported. See the introduction to phase and time deviation measurements for the conditions that allow block averaging.
- Interval Sampling — The time between phase deviation measurements can be set.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- Edge/Interval — A block of measurements will be delayed, or held off, until an edge occurs on Channel A, B, or External Arm. Also, the time between phase deviation measurements can be set. The reference edge is time stamped, so all measurements in the block are referenced to the holdoff edge. Averaging of multiple blocks is supported. See the introduction to phase and time deviation measurements for the conditions that allow block averaging.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

NOTE

When using the Edge Holdoff or Edge/Interval arming modes, in order to display the carrier on the Numeric screen, you must set the Numeric screen softkey, **Expand**, *to On.*

Time Deviation

Description:

The Time Deviation function displays the amount of time by which an input signal deviates from a carrier value over some period of time. It is a way to analyze the jitter of an input signal.

The reference can be: 1) a frequency computed as the mean value of a block of data from a pulsed or CW carrier, 2) a constant frequency, entered manually, or, 3) a linearly changing frequency whose slope and starting values are entered manually.

When the computed mean frequency for a pulsed or CW carrier is used, the measurements in each block are referenced to the mean of that block.

When the manually entered constant carrier frequency is used, all measurements are referenced to it.

When the manually entered linearly changing carrier is used, the reference carrier frequency is computed as follows:

reference carrier = starting point frequency + (time) * (slope)

where the time is referenced to the beginning of the measurement. Each measurement is referenced to the carrier frequency corresponding to the time at which the measurement was made.

The selection is made in the **Carrier Frequency** field on the Math menu.

The Time Deviation function establishes the time of occurrence for each trigger event on the input signal. It also establishes the time of occurrence for each corresponding event on the reference signal. The "Deviation" is the difference between the two times as a measure of the extent to which the input signal deviates from its reference.

TECHNICAL COMMENT

When Carrier Frequency determination method is "Compute Carrier CW", the "mean" used as the reference is the Bicentroid Mean. This is an algorithm which calculates mean frequency by estimating the Least Squares Fit of a line to the events vs time data. The slope of this line is a constant frequency. The frequency thus calculated is used as the Carrier.

When Carrier Frequency determination method is "Compute Carrier Pulse", "mean" used as the reference is the Bicentroid Mean of the pulse on-time frequency values. Pulse off-time frequency values are not used in the calculation. The pulse on-time and off-time data points are determined as follows:

- *for Frequency, all points whose frequency is less than 1/5 of the maximum frequency are considered to be off-time data points and are rejected.*
- *for PRI, all points whose average period is greater than 5 times the minimum average period are considered to be off-time data points and are rejected.*

For each block of measurements, the time deviation starts at zero and accumulates.

When the input signal leads the reference, the results are positive. Conversely, negative results indicate that the input signal lags behind the reference.

Range: > ±1 reference PRI

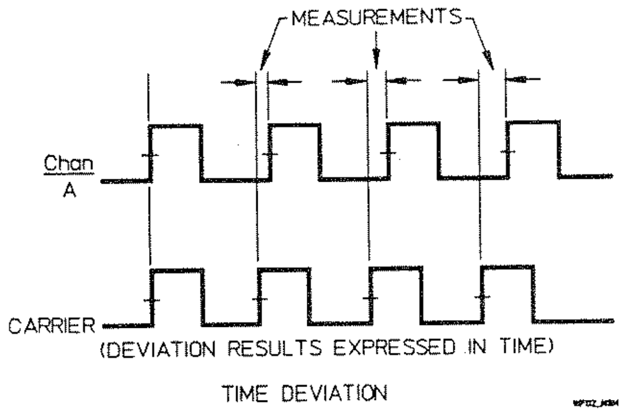


Figure 3-16. Time Deviation

Defaults:

- Measurement Channel – A

Arming Modes:

- Automatic — Measurements are made as quickly as possible.
- Edge Holdoff — A block of measurements will be delayed, or held off, until an edge occurs on Channel A, B, or External Arm. The edge is time stamped, so all measurements in the block are referenced to the holdoff edge. Averaging of multiple blocks is supported. See the introduction to phase and time deviation measurements for more about the conditions that allow block averaging.
- Interval Sampling — The time between Time Deviation measurements can be set.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- Edge/Interval — A block of measurements will be delayed, or held off, until an edge occurs on Channel A, B, or External Arm. Also, the time between time deviation measurements can be set. The edge is time stamped, so all measurements in the block are referenced to the holdoff edge. Averaging of multiple blocks is supported. See the introduction to phase and time deviation measurements for the conditions that allow block averaging.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

NOTE

When using the Edge Holdoff or Edge/Interval arming modes, in order to display the carrier on the Numeric screen, you must set the Numeric screen softkey, **Expand**, *to On.*

Frequency Deviation

Description:

The Frequency Deviation function displays the frequency by which an input signal differs from a carrier value over some period of time. It is a way to analyze the frequency modulation on an input signal.

The reference can be: 1) a frequency computed as the mean value of a block of data from a pulsed or CW carrier, 2) a constant frequency, entered manually, or, 3) a linearly changing frequency whose slope and starting values are entered manually.

When the computed mean frequency for a pulsed or CW carrier is used, the measurements in each block are referenced to the mean of that block.

When the manually entered constant carrier frequency is used, all measurements are referenced to it.

When the manually entered linearly changing carrier is used, the reference carrier frequency is computed as follows:

reference carrier = starting point frequency + (time) * (slope)

where the time is referenced to the beginning of the measurement. Each measurement is referenced to the carrier frequency corresponding to the time at which the measurement was made.

The selection is made in the **Carrier Frequency** field on the Math menu.

The Frequency Deviation function establishes the frequency for each trigger event on the input signal. It also establishes the frequency at each corresponding time on the reference signal. The "Frequency Deviation" is the difference between the two frequencies as a measure of the extent to which the input signal deviates from its reference.

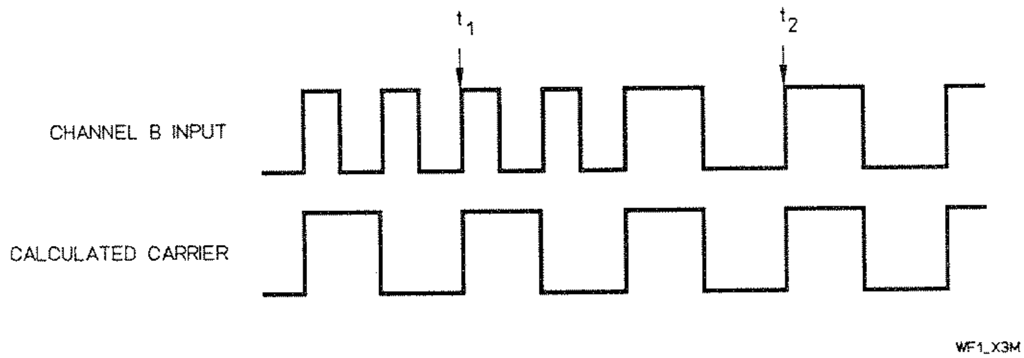
TECHNICAL COMMENT

When Carrier Frequency determination method is "Compute Carrier CW", the "mean" used as the reference is the Bicentroid Mean. This is an algorithm which calculates mean frequency by estimating the Least Squares Fit of a line to the events vs time data. The slope of this line is a constant frequency. The frequency thus calculated is used as the Carrier.

When Carrier Frequency determination method is "Compute Carrier Pulse", "mean" used as the reference is the Bicentroid Mean of the pulse on-time frequency values. Pulse off-time frequency values are not used in the calculation. The pulse on-time and off-time data points are determined as follows:

- *for Frequency, all points whose frequency is less than 1/5 of the maximum frequency are considered to be off-time data points and are rejected.*
- *for PRI, all points whose average period is greater than 5 times the minimum average period are considered to be off-time data points and are rejected.*

When the input signal frequency exceeds that of the reference, the results are positive. Conversely, negative results indicate that the input signal frequency was less than that of the reference.



At t_1, the Channel B input frequency (F_b) is twice that of the calculated carrier (F_c), so the frequency deviation ($F_b - F_c$) is the same as the carrier frequency. ($2F_c - F_c = F_c$).

At t_2, the Channel B input frequency (F_b) is the same as that of the calculated carrier (F_c), so the frequency deviation ($F_b - F_c$) is zero. ($F_c - F_c = 0$).

Figure 3-17. Frequency Deviation

Range (Hz): > 0 to 10E+9

Defaults:

- Measurement Channel – A

Arming Modes:

- Automatic — Measurements are made as quickly as possible.
- Edge Holdoff — A block of measurements will be delayed, or held off, until an edge occurs on Channel A, B, or External Arm. The edge is time stamped, so all measurements in the block are referenced to the holdoff edge. Averaging of multiple blocks is supported. See the introduction to phase, time, and frequency deviation measurements for more about the conditions that allow block averaging.
- Interval Sampling — The time between Frequency Deviation measurements can be set.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

- Edge/Interval — A block of measurements will be delayed, or held off, until an edge occurs on Channel A, B, or External Arm. Also, the time between frequency deviation measurements can be set. The edge is time stamped, so all measurements in the block are referenced to the holdoff edge. Averaging of multiple blocks is supported. See the introduction to phase, time, and frequency deviation measurements for the conditions that allow block averaging.

Range of Interval = 100 ns to 8.0 s. Can be set with a resolution of 100 ns.

NOTE

When using the Edge Holdoff or Edge/Interval arming modes, in order to display the carrier on the Numeric screen, you must set the Numeric screen softkey, **Expand**, *to On.*

4

Contents of Chapter

4

HISTOGRAM MEASUREMENTS

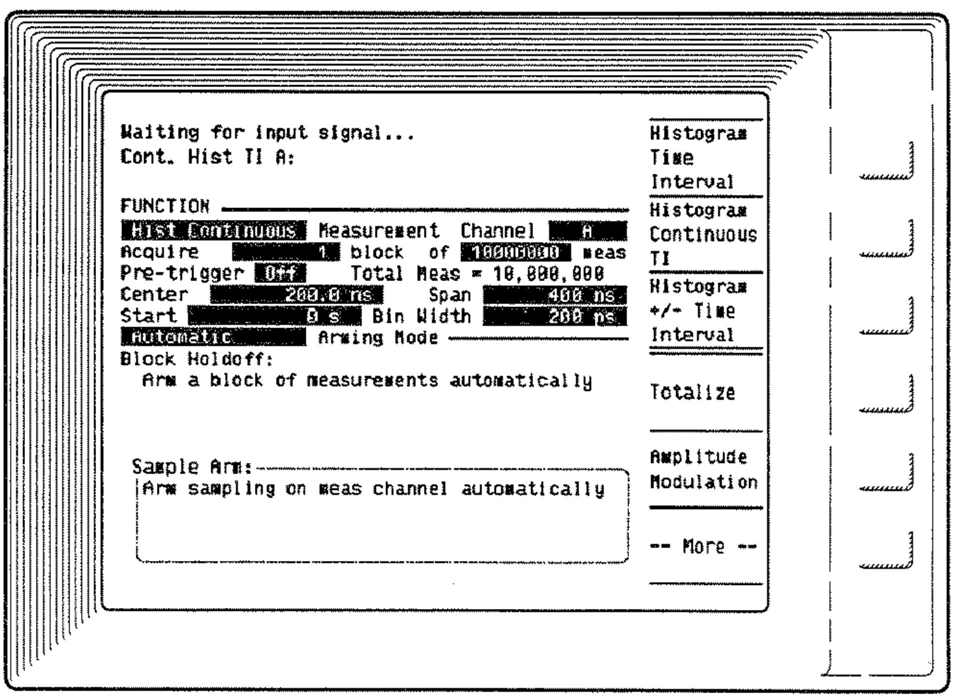
CHAPTER OVERVIEW

This chapter describes Histogram measurements and how to use them. Any features that are unique to these measurements are explained in this chapter. Otherwise, references to other parts of this manual appear throughout this chapter to indicate where common feature explanations are located.

The three Histogram measurement functions are:

- Histogram Time Interval
- Histogram Continuous Time Interval
- Histogram ±Time Interval

Figure 4-1. Histogram Measurement Setup



The Histogram measurements are similar to time interval measurements in the way data is collected. The differences are the rate at which data is collected and in how the data is processed and displayed.

INFORMATION POINTERS

The purpose of the following list is to help you find the information you need to make Histogram measurements. Since many features operate no differently for Histogram measurements, their descriptions are referenced here.

- For information about how Histogram measurements are made, that is, how samples are collected for the three types of Histogram measurements, review chapter 1, "Time Interval Measurements." For example, read about ±Time Interval measurements when you want to know how Histogram ±Time Interval measurements operate.
- For information about how the arming modes for Histogram measurements operate, review chapter 1, "Time Interval Measurements," and chapter 5, "Arming."
- For information about the Graphic features for Histogram measurements, review chapter 16, "Graphic Results," and this chapter.
- For information about what numeric results are available for Histogram measurements, read this chapter.
- If you want to know how to use the Pre-trigger feature with Histogram measurements, read this chapter and chapter 10, "Pre-trigger Menu."

WHAT ARE HISTOGRAM MEASUREMENTS?

Histogram measurements can acquire and analyze a large amount of data very quickly. They provide a display of a histogram distribution of time interval measurement results. Histogram measurements sort data into histogram bins at the measurement rate of the HP 5373A (up to 13.3 million measurements per second). The numeric data available consists of the histogram bin range values and the number of measurements that were sorted into each bin.

TECHNICAL COMMENT

Histogram measurements should not be confused with the Histogram graphs available for most measurements. There is a fundamental difference.

The Histogram graphs available for measurements other than Histogram measurements, are the result of software processing. No calculations or sorting of data takes place until the acquisition of each block of data is completed. This can take a sizable amount of time, even for a relatively small sample size (8,000 measurements).

For Histogram measurements, the HP 5373A uses hardware processing to dramatically increase the size of measurement acquisitions and decrease processing time. Sample sizes of 1,000,000 measurements, or more, can be acquired in a fraction of the time required for software-processed measurements. In order to achieve this speed of measurement and analysis, the Histogram graph is the only way the data can be viewed graphically. The numeric results are presented as the number of measurements that were sorted into each histogram bin. For a description of a Histogram graph, refer to "Graphic Results," chapter 16.

ADVANTAGES AND LIMITATIONS OF HISTOGRAM MEASUREMENTS

There are tradeoffs to consider when deciding whether to use Histogram measurements or time interval measurements to collect your data.

Advantages of Histogram Measurements

This is a list of the benefits of Histogram measurements:

- A maximum acquisition size of 2,000,000,000,000,000 (2E15) measurements.
- Measurements are acquired at the measurement rate of the HP 5373A (up to 13.3 million measurements per second).
- A Pause/Continue feature that allows you to suspend acquisition, view the results accumulated to that point, and then resume acquisition.

Limitations of Histogram Measurements

Here is a list of the limitations of Histogram measurements:

- Missed event information is not available for Histogram measurements. The time interval measurements do provide this information. Missed events are explained in chapter 1, "Time Interval Measurements."

- The time-sequence order in which the data was collected is not available. There is no Time Variation graph or Event Timing graph for Histogram measurements.
- You must set the boundaries of the Histogram graph prior to data acquisition. Only intervals occurring in this range will be displayed in the Histogram graph.
- When only hardware processing is used for multiple blocks of Histogram measurements (indicated by **Fast Arm** displayed on the Function menu) bins overflow at 16,777,215 counts. If there is a possibility of reaching that limit, be aware that any measurements landing in a bin after overflow will be lost and not counted in the bin but will be counted in the total. The alternative is to use the increased bin height feature called, "Big Bin." This increases bin capacity to 2,000,000,000,000,000 (2E15), but the bin limit for each block is still 16,777,215 counts. The drawback is that the increased bin height is made possible by the introduction of software processing of results between each block. The data acquisition rate is slowed as a result of the software processing.
- Binary results are not available.
- No Math menu features are available.
- Manual scaling for x-axis is not available on the Graphic screen.

FUNCTION MENU

The Function menu setup is a bit more involved for Histogram measurements. The sections below explain the additional fields and the limits and options for each of them.

Measurement Field

The **Measurement** field choices for Histogram measurements are:

- Histogram Time Interval
- Histogram Continuous TI
- Histogram ±Time Interval

Channel Field

The **Channel** field options are:

For Histogram Time Interval and Histogram ±Time Interval:

- A
- B
- A→ B
- B→ A

For Histogram Continuous Time Interval:

- A
- B

Issues to Consider

There are issues to consider when setting the HP 5373A to make a Histogram measurement. The size of the measurement acquisition is set by specifying a number of blocks and a number of measurements per block. The limits vary depending on the use of features such as Pre-trigger or increased Histogram bin capacity. These issues, and more, are explained below.

HOW TO AVOID BIN OVERFLOW

The Histogram is made up of 2,000 bins of sorted measurement data. These 2,000 bins are used for every measurement sequence. It depends on the spread of the data and the boundaries set for the Histogram with the values of Start, Center, Span, and Bin Width as to whether or not data is sorted into these bins and appear in the Histogram result. The boundaries of the Histogram will be discussed later, but an important issue when considering making large measurements (greater than 16 million measurements) is the possibility of exceeding the capacity of a Histogram bin.

Each Histogram bin can hold up to 16,777,215 measurements. Any measurements that land in an overflowed bin will not be included in the Histogram graph or in the Numeric results. This situation is not necessarily to be avoided. If you are interested in the information at the distribution tails of the Histogram, it does not matter that other portions of the Histogram distribution overflow the bins. The next three figures show what to expect when bin overflow occurs.

Figure 4-2 shows a measurement setup that could easily cause a bin overflow. The total number of measurements is over 327 million.

Figure 4-2. Measurement Setup Where Bin Overflow Could Occur

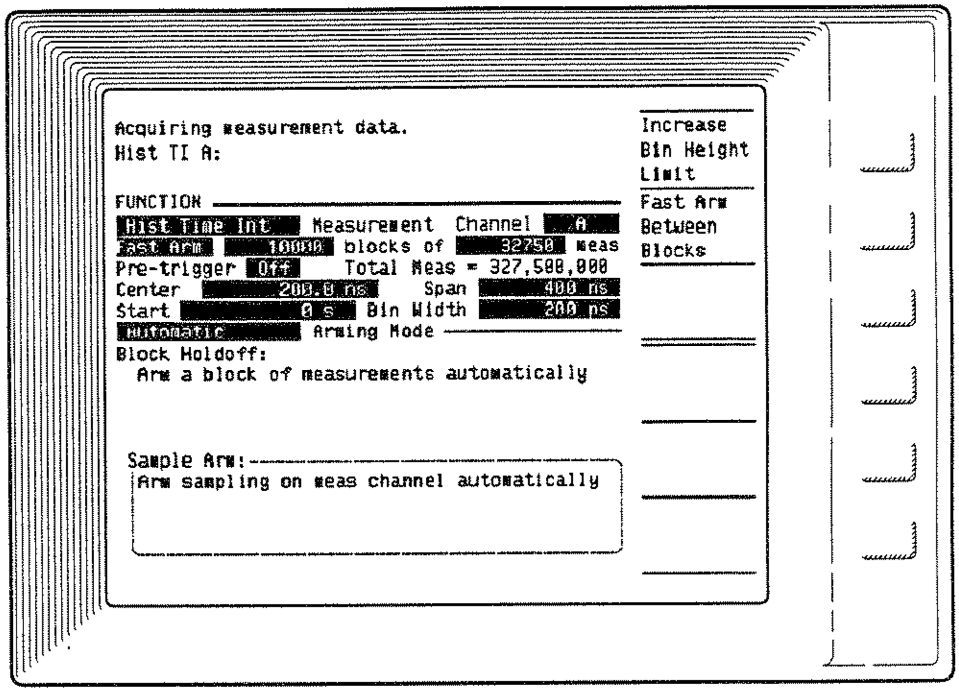


Figure 4-3 shows the Histogram graph with a marker on an overflowed bin. There is also a message at the top of the graph display to indicate a bin overflow. The Delta and Stats features operate as follows when one or more bins have overflowed:

- In Delta mode, if one or both markers are on an overflowed bin, the message, "bin overflowed" appears where the y-axis value would be displayed. If both markers are on valid measurements, the delta values for the x-axis and y-axis are displayed.
- In Stats mode, if the portion of the graph enclosed within the markers includes an overflowed bin, only the minimum and maximum values are displayed. The mean and standard deviation are not computed.

Figure 4-3.
An Overflowed Bin

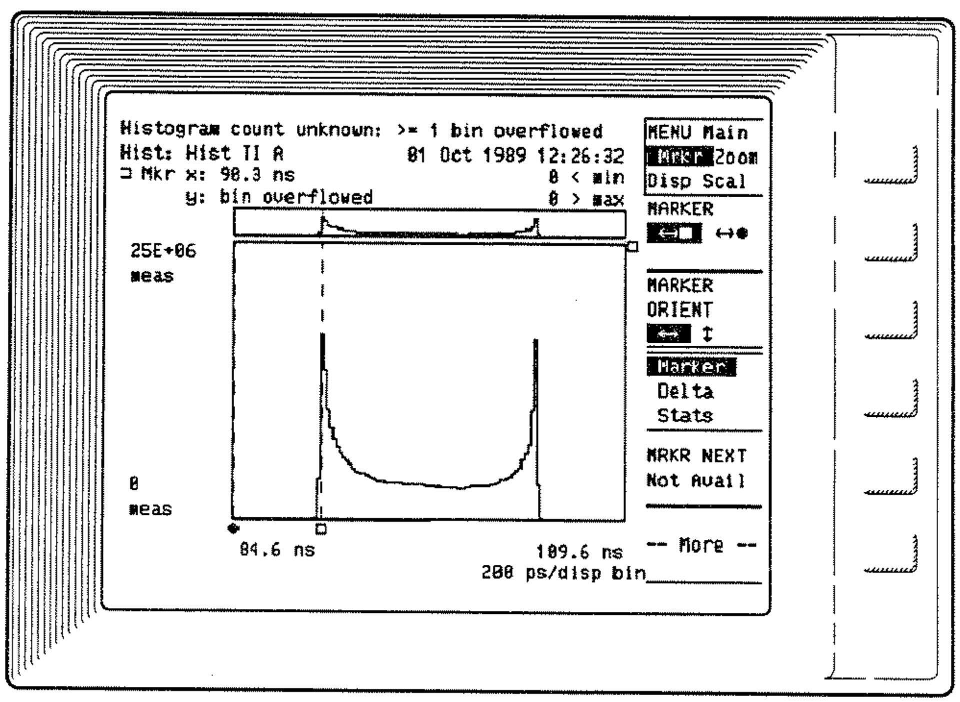


Figure 4-4 shows the Numeric results summary for the Histogram measurement. The bin that overflowed shows a count of 16,777,215 measurements.

NOTE

It cannot be determined how many additional measurements landed in an overflowed bin. The Numeric screen does show the total number of measurements that have been made. This is not necessarily the number of measurements that has been graphed. Measurements that land in overflowed bins, or occur outside the boundaries of the measurement, will not be graphed.

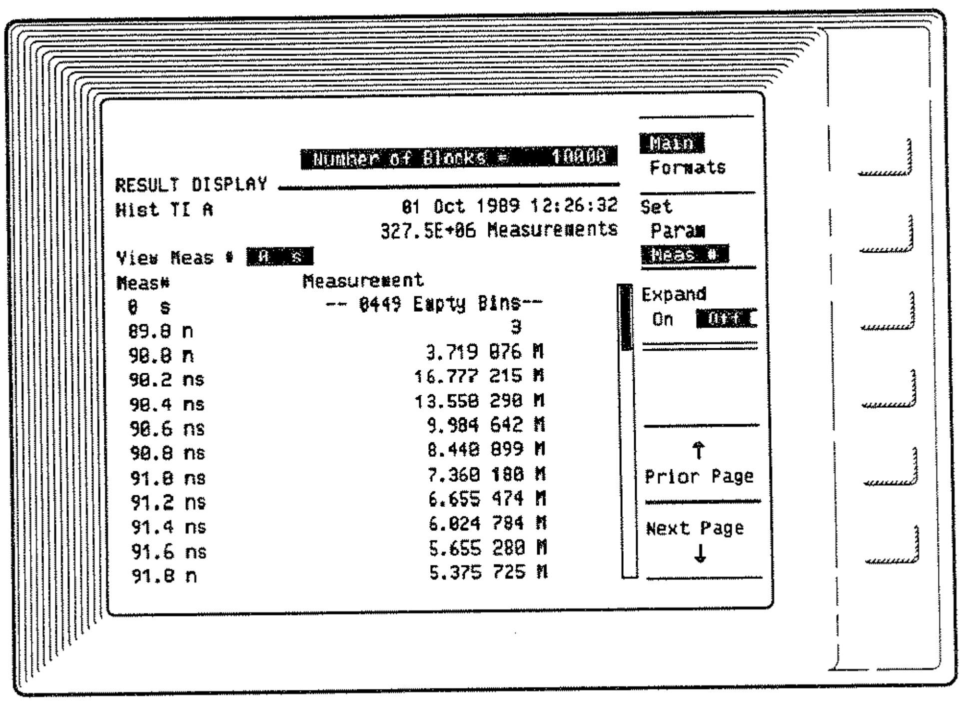


Figure 4-4.
Histogram Measurement Numeric Results Showing Bin Overflow

In situations where there is a possibility of over 16 million measurements landing in one bin, use the increased bin height selection AND set the number of measurements per block to less than 16,777,215. *Figure 4-5* shows an example of a setup where bins would not overflow. There will be no overflow because at the end of each block of measurements, the bins are cleared and the accumulated counts are stored in software. This processing does slow the rate of data acquisition.

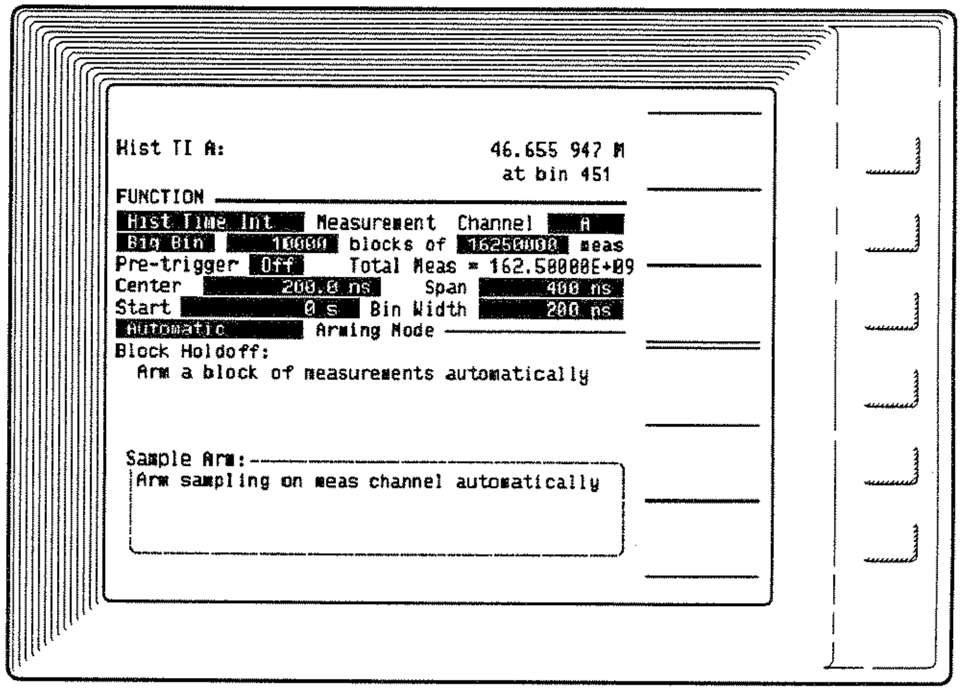


Figure 4-5. Function Menu Configuration To Avoid Bin Overflow

PRE-TRIGGER/TI DETECT

The Pre-trigger feature makes it possible to capture measurement data that occurs before some specified event. It is an alternative method for ending data acquisition (the other being an end of data acquisition once the specified number of measurements have been collected).

Pre-trigger operates somewhat differently for Histogram measurements versus all other measurement functions. When making Histogram measurements with pre-trigger, there is no selectable amount of pre-trigger as with the other functions. Only 100% pre-trigger is allowed. This means that all data from the first measurement to the pre-trigger event is captured. No data is discarded. Acquisition stops at 1,099,511,627,775 (2^{40}–1) measurements if a pre-trigger event is not detected.

The pre-trigger event is specified on the Pre-trigger menu. As with the other measurement functions, the pre-trigger event can be designated as a signal at the External Arm input or a measured time interval using the TI Detect feature. There is an explanation of this feature in chapter 10, "Pre-trigger Menu." There is also a difference (compared with non-Histogram measurements) with setting the TI Detect condition. The TI Detect boundary values are limited to the start and stop boundaries of the Histogram measurement (specified on the Function menu). The pre-trigger event can be specified as a measured time interval value that meets one of the following conditions:

- **Above** the lower or upper boundary of the Histogram graph. (Exclusive of boundary values)
- **Below** the lower or upper boundary of the Histogram graph. (Exclusive of boundary values)
- **Inside** the lower and upper boundaries of the Histogram graph. (Inclusive of boundary values)
- **Outside** the lower and upper boundaries of the Histogram graph. (Exclusive of boundary values)

Measurement Acquisition Types

There are seven configurations for specifying the method for acquiring Histogram measurements. They are each described in the following paragraphs. There is an example setup for each type and information on any limitations that may exist.

1 BLOCK OF N MEASUREMENTS

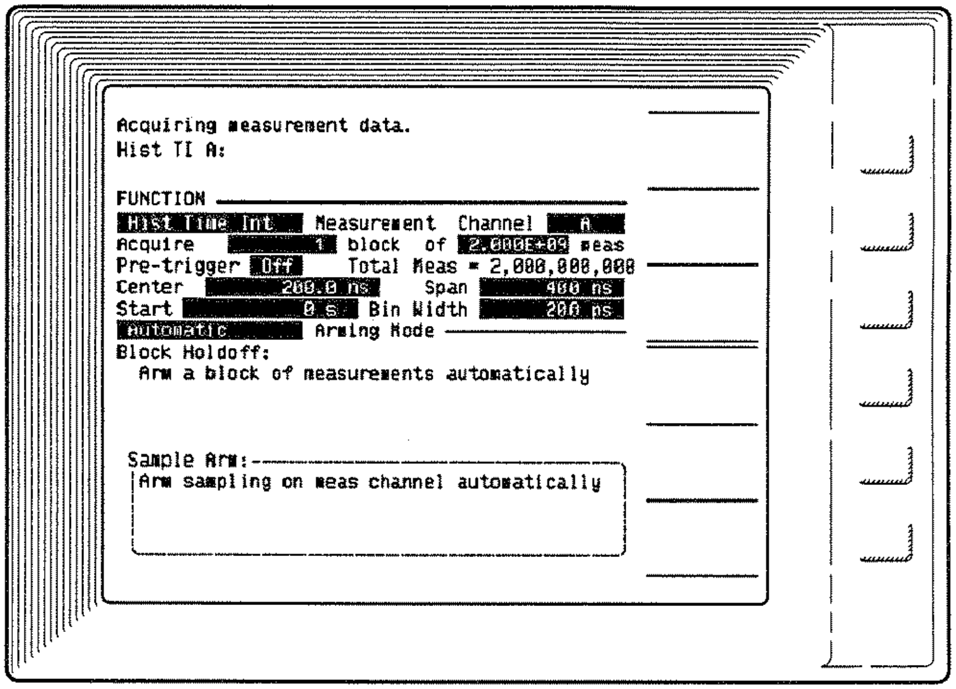


Figure 4-6. Setup 1: One Block

Measurement Acquisition Size:

N (number of measurements) = 1 to 2,000,000,000 (2E9)

The exponent key (**Exp**) can be used for exponential entry when specifying the number of measurements.

Bin Capacity:

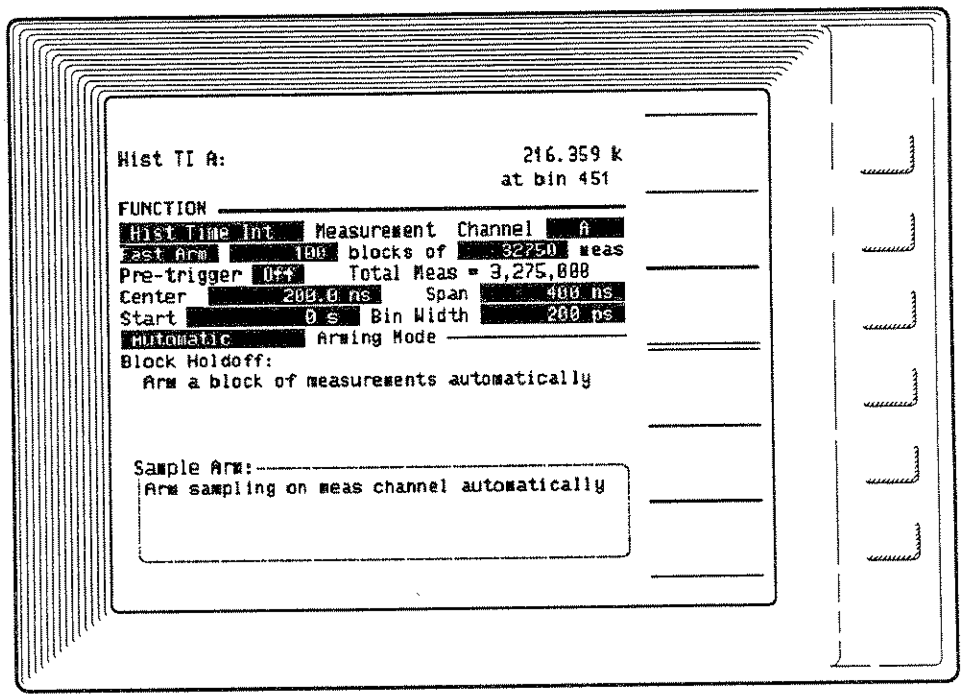
Each Histogram bin can hold 16,777,215 measurements before overflowing. Any additional measurements landing in an overflowed bin are not included in the Histogram graph or the Numeric screen results. Use the "Big Bin" feature described below if a bin overflow would be inappropriate for your measurement application. (See "Issues to Consider" above for an explanation of bin overflow.)

Pause/Continue:

Pressing the **Pause** softkey on the Graphics screen Disp (Display) menu suspends the measurement sequence and displays the accumulated results. Pressing the **Continue** softkey will resume the measurement acquisition as soon as the sample arming conditions are satisfied.

M BLOCKS OF N MEASUREMENTS / FAST ARM

Figure 4-7. Setup 2: M Blocks — Fast Arm Between Blocks



Measurement Acquisition Size:

M (number of blocks) = 2 to 99,999,999

N (number of measurements per block) =

1 to 65,500 (Hist. CTI)

1 to 32,750 (Hist. TI, Hist. ±TI)

Total size of measurement (blocks x measurements) can equal 1,000,000,000,000 (1E12).

NOTE

If a value is entered for the number of blocks or the number of measurements that would cause this limit (1E12) to be exceeded, the last value entered takes priority and forces a reduction in the other value.

Bin Capacity:

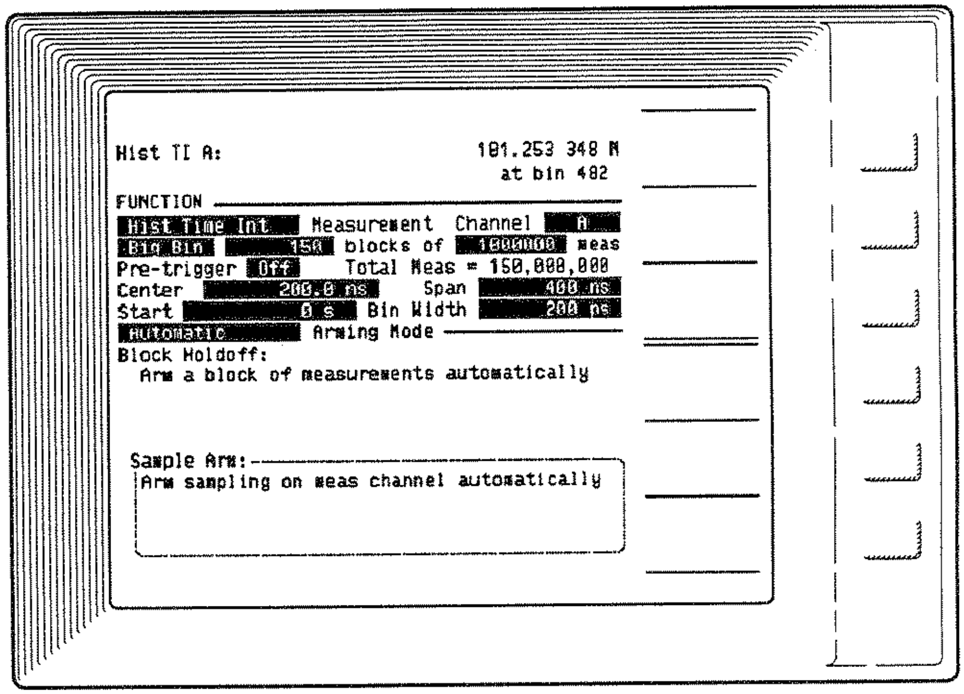
Each Histogram bin can hold up to 16,777,215 measurements before overflowing. Any additional measurements landing in an overflowed bin are not included in the Histogram graph or the Numeric screen results. Use the "Big Bin" feature described below when you need greater bin capacity for larger measurements. (See "Issues to Consider" above for an explanation of bin overflow.)

Pause/Continue:

Pressing the **Pause** softkey on the Graphics screen Disp (Display) menu suspends the measurement sequence and displays the accumulated results. Pressing the **Continue** softkey will resume the measurement acquisition as soon as the the block holdoff and sample arming conditions are satisfied.

M BLOCKS OF N MEASUREMENTS / BIG BIN

Figure 4-8. Setup 3: M Blocks — Increased Bin Height Limit



Measurement Acquisition Size:

M (number of blocks) = 2 to 99,999,999

N (number of measurements per block) = 1 to 2,000,000,000 (2E9)

The exponent key (**Exp**) can be used for exponential entry when specifying the number of measurements.

Total size of measurement (blocks × measurements) can equal 2,000,000,000,000,000 (2E15).

NOTE

If a value is entered for the number of blocks or the number of measurements that would cause this limit (2E15) to be exceeded, the last value entered takes priority and forces a reduction in the other value.

Bin Capacity:

For the "Big Bin" setting, the effective capacity of each Histogram bin is 2,000,000,000,000,000 (2E15) total measurements. The increased capacity is achieved by clearing the accumulated counts from the Histogram bins and storing the results in software after each block of measurements is acquired. There is still a bin capacity of 16,777,215 measurements before overflow FOR EACH BLOCK. The processing necessary to clear all the bins and store accumulated counts slows the rate of data acquisition. If it is important in your application to avoid the possibility of overflowing a bin, set the number of measurements per block to no greater than 16,777,215. (See "Issues to Consider" above for an explanation of bin overflow.)

Pause/Continue:

Pressing the **Pause** softkey on the Graphics screen Disp (Display) menu suspends the measurement sequence and displays the accumulated results. Pressing the **Continue** softkey will resume the measurement acquisition as soon as the block holdoff and sample arming conditions are satisfied.

Update While/After:

Selecting the **While** softkey on the Graphics screen Disp (Display) menu will cause the accumulated Histogram graph results to be updated after each block is acquired. Selecting the **After** softkey causes the Histogram graph results to be displayed only at the completion of the entire measurement acquisition. **While** is the default setting.

SINGLE BLOCK / PRE-TRIGGER

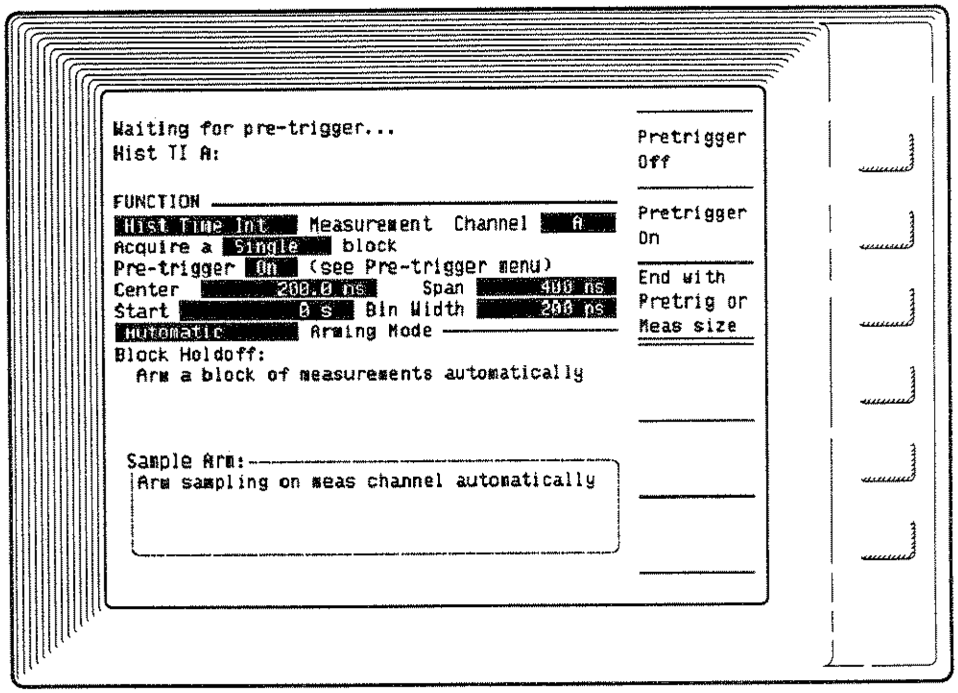


Figure 4-9. Setup 4: Single Block — Measurements End on Pre-trigger

Measurement Acquisition Size:

The HP 5373A will accumulate measurements until the pre-trigger event occurs. The pre-trigger event ends the measurement sequence. The acquisition stops after 1,099,511,627,775 (2^{40}–1) measurements if no pre-trigger event is detected.

Bin Capacity:

Each Histogram bin can hold up to 16,777,215 measurements. With the allowed total number of measurements, bins could overflow. If that happens, measurements landing in the overflowed bins will not be included in the Histogram graph or the Numeric results screen. (See "Issues to Consider" above for an explanation of bin overflow.) The increased bin capacity feature ("Big Bin") is not available for this measurement setup.

Pre-trigger Setting:

The pre-trigger event is specified on the Pre-trigger menu. It can be a signal at the External Arm input or a measured time interval using the TI Detect feature. See chapter 10, "Pre-trigger Menu," for more on TI Detect. The pre-trigger amount is fixed at 100%. (See "Issues to Consider" above for an explanation of pre-trigger with Histogram measurements).

Pause/Continue:

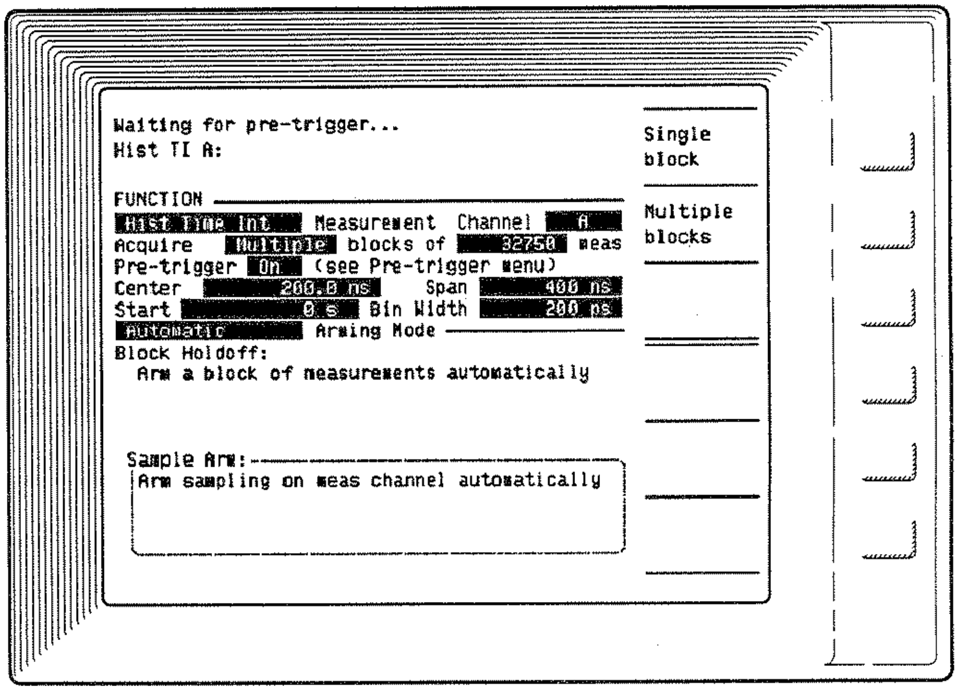
Pressing the **Pause** softkey on the Graphics screen Disp (Display) menu suspends the measurement sequence and displays the accumulated results. Pressing the **Continue** softkey will resume the measurement acquisition as soon as the sample arming conditions are satisfied.

NOTE

If the pre-trigger event is a signal on the External Arm input, it will also be detected if it occurs during a Pause. Of course, a pre-trigger event of a time interval value cannot be satisfied during a Pause because no measurements are taking place.

MULTIPLE BLOCKS OF N MEASUREMENTS / PRE-TRIGGER

Figure 4-10. Setup 5: Multiple Blocks — Measurements End on Pre-trigger



Measurement Acquisition Size:

N (number of measurements per block) =

1 to 65,500 (Hist. CTI)

1 to 32,750 (Hist. TI, Hist. ±TI)

The HP 5373A will accumulate measurements until the pre-trigger event occurs. The pre-trigger event ends the measurement sequence. The acquisition will stop at 1,099,511,627,775 (2^{40}–1) measurements if no pre-trigger event is detected.

For a comparison of Single block vs. Multiple blocks with Pre-trigger, refer to chapter 10, “Pre-trigger Menu”.

Bin Capacity:

Each Histogram bin can hold up to 16,277,215 measurements before overflowing. With the total number of measurements allowed, bins could overflow. If that happens, measurements landing in the overflowed bins will not be included in the Histogram graph or the Numeric results screen. (See "Issues to Consider" above for an explanation of bin overflow.) The increased bin capacity feature ("Big Bin") is not available for this measurement setup.

Pre-trigger Setting:

The pre-trigger event is specified on the Pre-trigger menu. It can be a signal at the External Arm input or a measured time interval using the TI Detect feature. See chapter 10, "Pre-trigger Menu," for more on TI Detect. The pre-trigger amount is fixed at 100%. (See "Issues to Consider" above for an explanation of pre-trigger with Histogram measurements).

Pause/Continue:

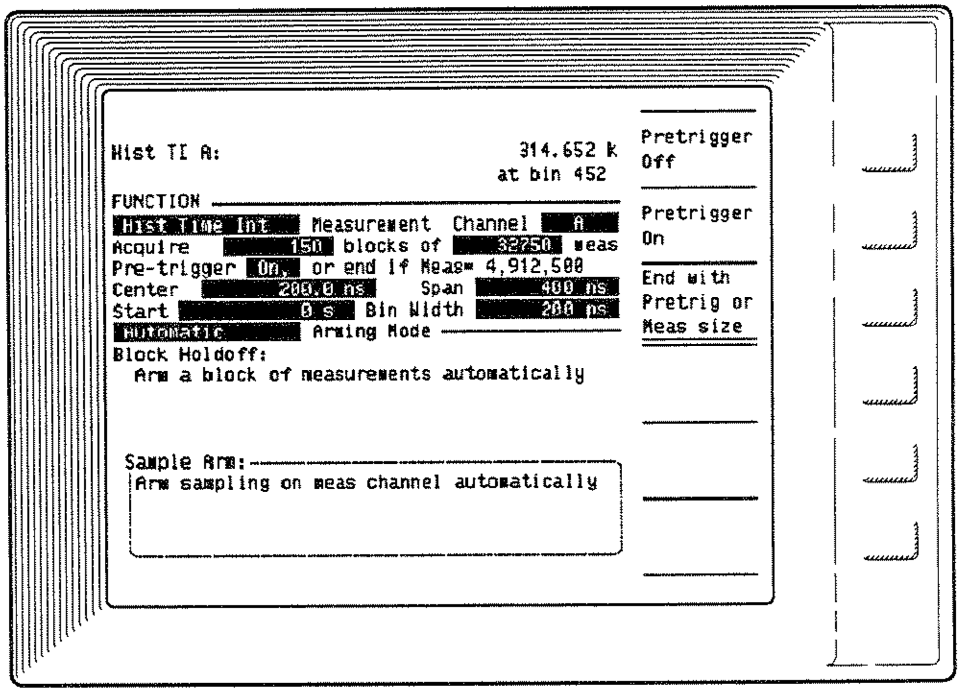
Pressing the **Pause** softkey on the Graphics screen Disp (Display) menu suspends the measurement sequence and displays the accumulated results. Pressing the **Continue** softkey will resume the measurement acquisition as soon as the next sample arming conditions are satisfied.

NOTE

If the pre-trigger event is a signal on the External Arm input, it will also be detected if it occurs during a Pause. The measurement sequence will end as soon as it is continued. If an External Arm pre-trigger event occurs between blocks, it will not be detected. Of course, a pre-trigger event of a time interval value cannot be satisfied during a Pause, or between blocks, because no measurements are taking place.

M BLOCKS OF N MEASUREMENTS / PRE-TRIGGER OR # OF MEAS

Figure 4-11. Setup 6: M Blocks — Measurements End on Pre-trigger or M



Measurement Acquisition Size:

M (number of blocks) = 2 to 99,999,999

N (number of measurements per block) =

1 to 65,500 (Hist. CTI)

1 to 32,750 (Hist. TI, Hist. ±TI)

The HP 5373A will accumulate measurements until the pre-trigger event occurs, or the specified number of measurements have been collected, **whichever comes first.** Total size of measurement (blocks ×measurements) can equal 1,000,000,000,000 (1E12).

NOTE

If a value is entered for the number of blocks or the number of measurements that would cause this limit (1E12) to be exceeded, the last value entered takes priority and forces a reduction in the other value.

Bin Capacity:

Each Histogram bin can hold up to 16,777,215 measurements. With the allowed total number of measurements, bins could overflow. If that happens, measurements landing in the overflowed bins will not be included in the Histogram graph or the Numeric results screen. (See "Issues to Consider" above for an explanation of bin overflow.) The increased bin capacity feature ("Big Bin") is not available for this measurement setup.

Pause/Continue:

Pressing the **Pause** softkey on the Graphics screen Disp (Display) menu suspends the measurement sequence and displays the accumulated results. Pressing the **Continue** softkey will resume the measurement acquisition as soon as the next block holdoff and sample arming conditions are satisfied.

NOTE

If the pre-trigger event is a signal on the External Arm input, it will also be detected if it occurs during a Pause. The measurement sequence will end as soon as it is continued. If an External Arm pre-trigger event occurs between blocks, it will not be detected. Of course, a pre-trigger event of a time interval value cannot be satisfied during a Pause, or between blocks, because no measurements are taking place.

1 BLOCK OF N MEASUREMENTS / PRE-TRIGGER OR # OF MEAS

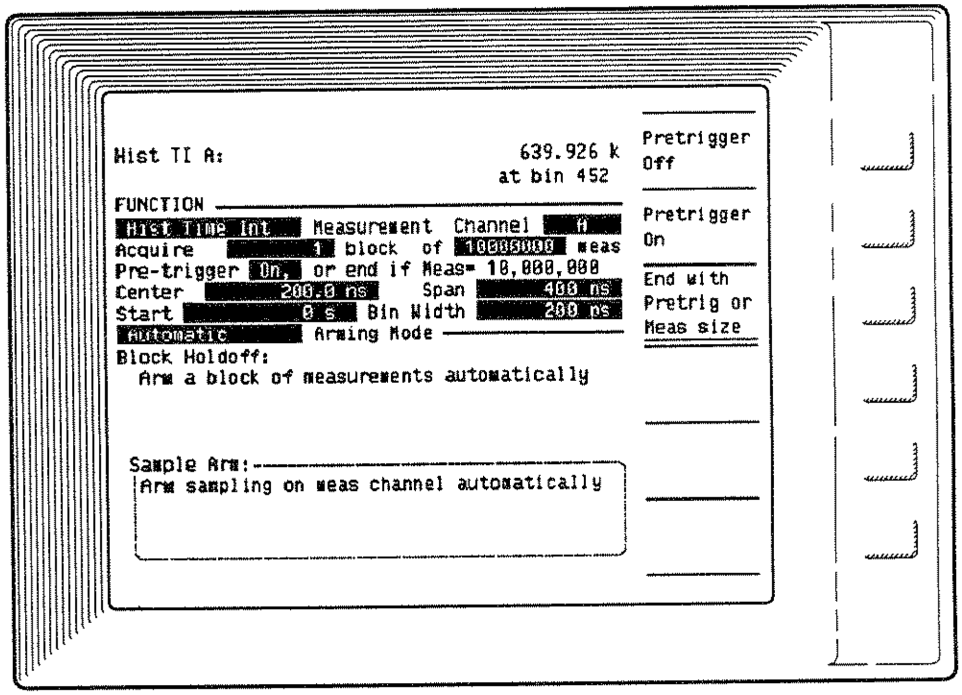


Figure 4-12. Setup 7: One Block — Measurements End on Pre-trigger or Measurements.

Measurement Acquisition Size:

M (number of blocks) = 1

N (number of measurements) = 1 to 2,000,000,000 (2E9)

The exponent key (**Exp**) can be used for exponential entry when specifying the number of measurements.

The HP 5373A will accumulate measurements until the pre-trigger event occurs, or the specified number of measurements have been collected, **whichever comes first.**

Bin Capacity:

Each Histogram bin can hold up to 16,777,215 measurements. With the allowed total number of measurements, bins could overflow. If that happens, measurements landing in the overflowed bins will not be included in the Histogram graph or the Numeric results screen. (See "Issues to Consider" above for an explanation of bin overflow.) The increased bin capacity feature ("Big Bin") is not available for this measurement setup.

Pause/Continue:

Pressing the **Pause** softkey on the Graphics screen Disp (Display) menu suspends the measurement sequence and displays the accumulated results. Pressing the **Continue** softkey will resume the measurement acquisition as soon as the next sample arming condition is satisfied.

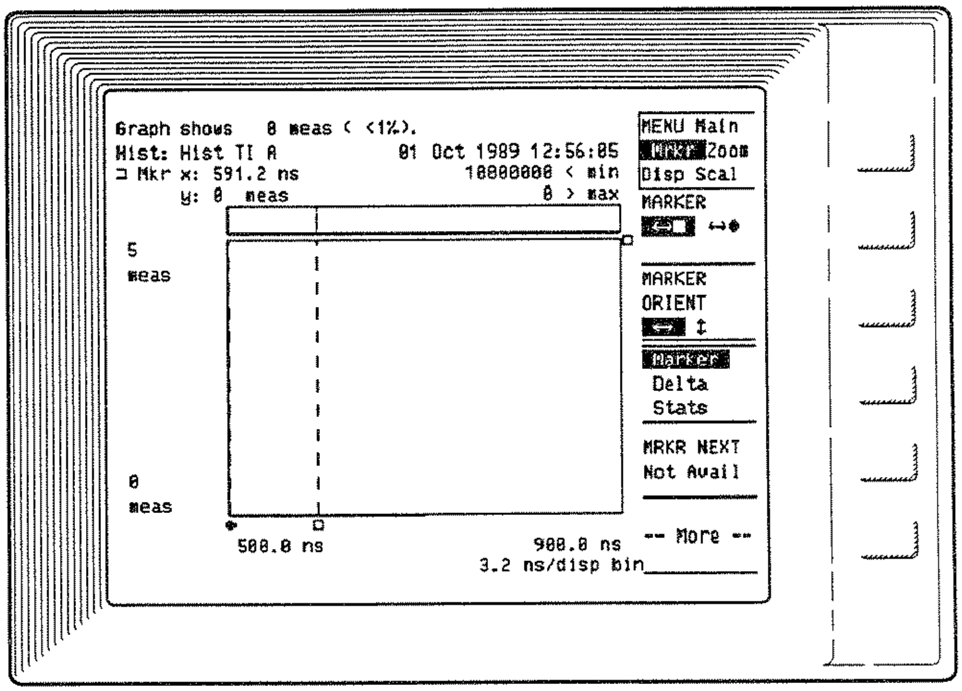
NOTE

If the pre-trigger event is a signal on the External Arm input, it will also be detected if it occurs during a Pause. The measurement sequence will then end as soon as it is continued. Of course, a pre-trigger event of a time interval value cannot be satisfied during a Pause because no measurements are taking place.

Graph Limits

Prior to making a Histogram measurement, the Histogram graph boundaries must be set according to the range of measurements to be collected. Only measurement results occurring in this range will be displayed by the graph. *Figure 4-13* shows the results of setting the Histogram graph limits incorrectly for the range of measurements collected. Notice the "min" and "max" indicators showing the number and location of measurements that occured outside the graph limits. All the measurements fell outside the range of the Histogram boundaries.

Figure 4-13. Incorrectly Set Graph Limits



Boundary Fields

There are four fields for setting the Histogram graph boundaries as shown in *Figure 4-14.*

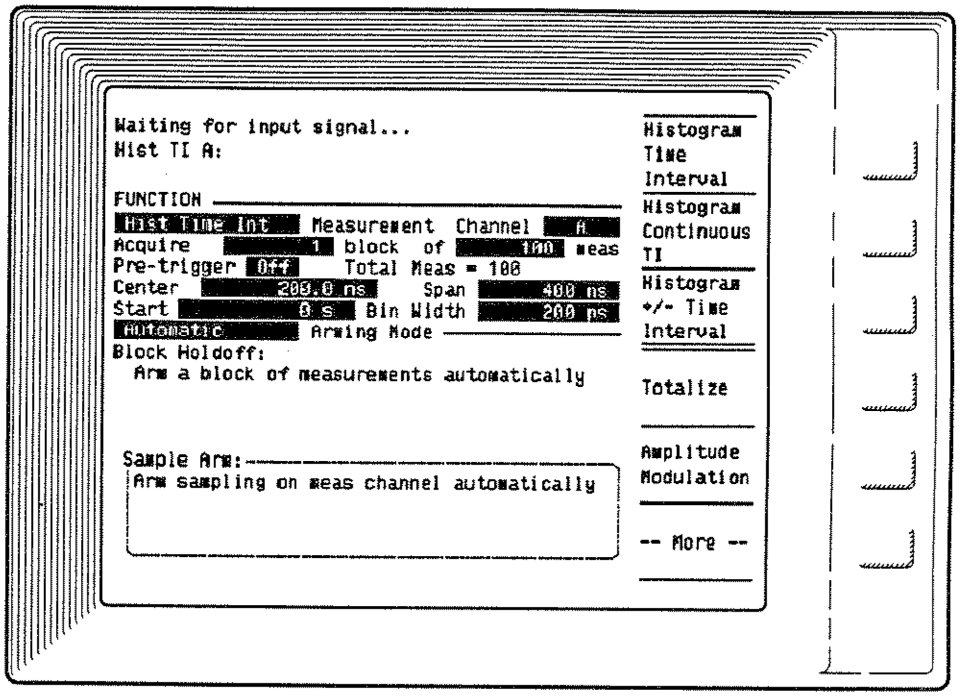


Figure 4-14. Histogram Graph Boundary Fields

CENTER

Center sets the time center of the histogram. Changing this value causes a corresponding change in the start value. The span and bin width values are not affected.

SPAN

Span sets the width of the histogram.

Span = 2,000 × Bin Width

400 ns to 3.3554432 s (Normal Mode)

400 ns to 128 μs (Fast Mode)

START

Start sets the left boundary of the histogram, that is, the minimum time limit. Changing this value causes a corresponding change in the center value. The span and bin width remain unchanged.

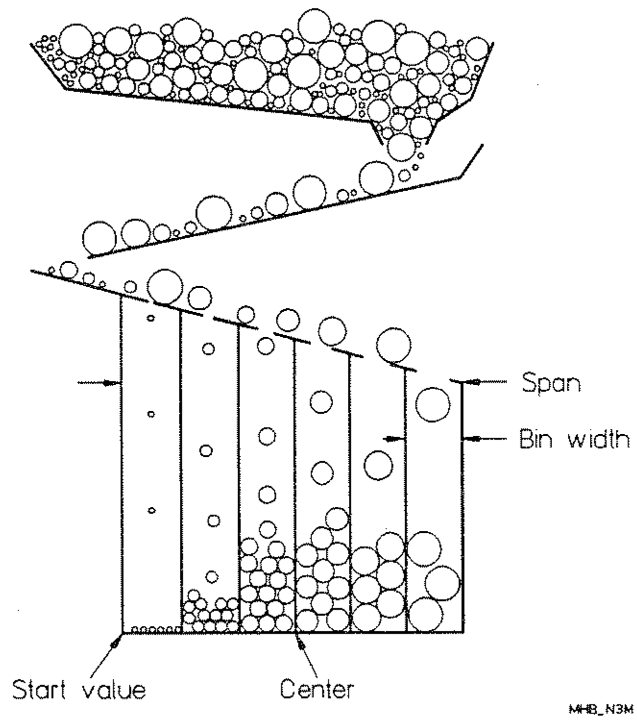
BIN WIDTH

Bin Width sets the width of the bins in the histogram. Changing this value changes the center and span values, but not the start. The number of bins is fixed at 2,000. The span of the histogram is always 2,000 times the width of one bin.

Note that the Histogram's lower and upper limits are determined by setting a combination of parameters — Start and Bin Width, or Center and Span. These parameters are interrelated.

See *Figure 4-15* for an illustration of the Histogram graph boundaries. It also shows a representation of how measurements are sorted into Histogram bins.

Figure 4-15. Histogram Graph Boundaries Illustrated

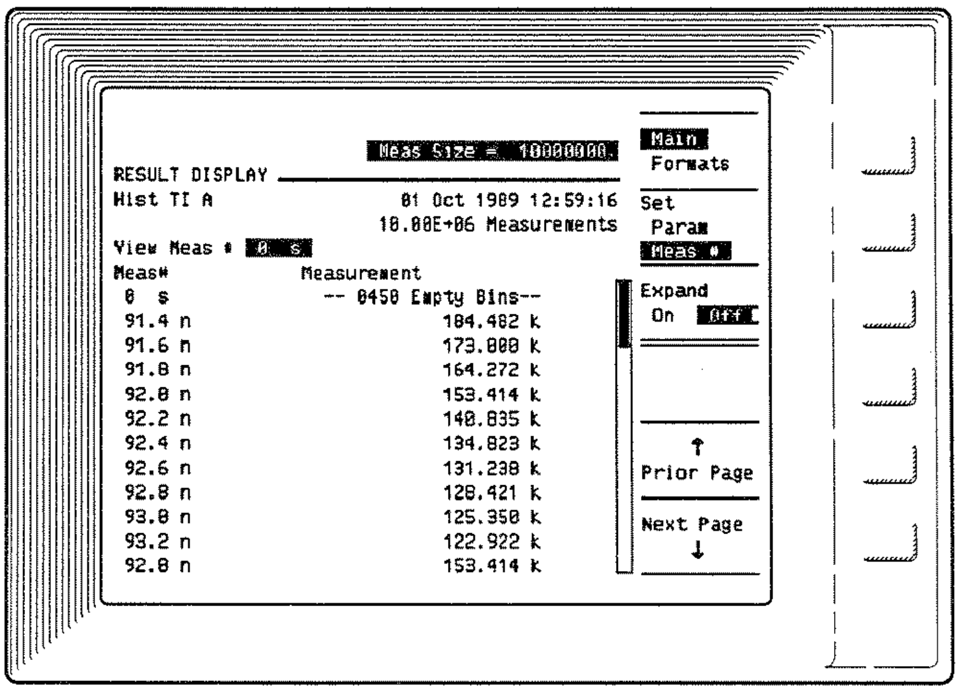


NUMERIC RESULTS

The Numeric screen displays a listing of the Histogram bin values and the number of measurements that landed in each bin.

Figures 4-16 and *4-17* show typical result displays. They are the first "page" of results and the last "page" of results. Note the indicator bar alongside the softkeys. It shows the portion of results currently displayed. The column on the left of the screen is the starting value of each bin. On the right is the column listing the number of measurements that landed in each bin. The bin width is 200 ps for this measurement sequence. This is the smallest bin width available. Although 2,000 bins are used for every measurement sequence, not every bin received data. This is evident from the number of empty bins displayed.

Figure 4-16. Numeric Results of Histogram Measurement, First Page



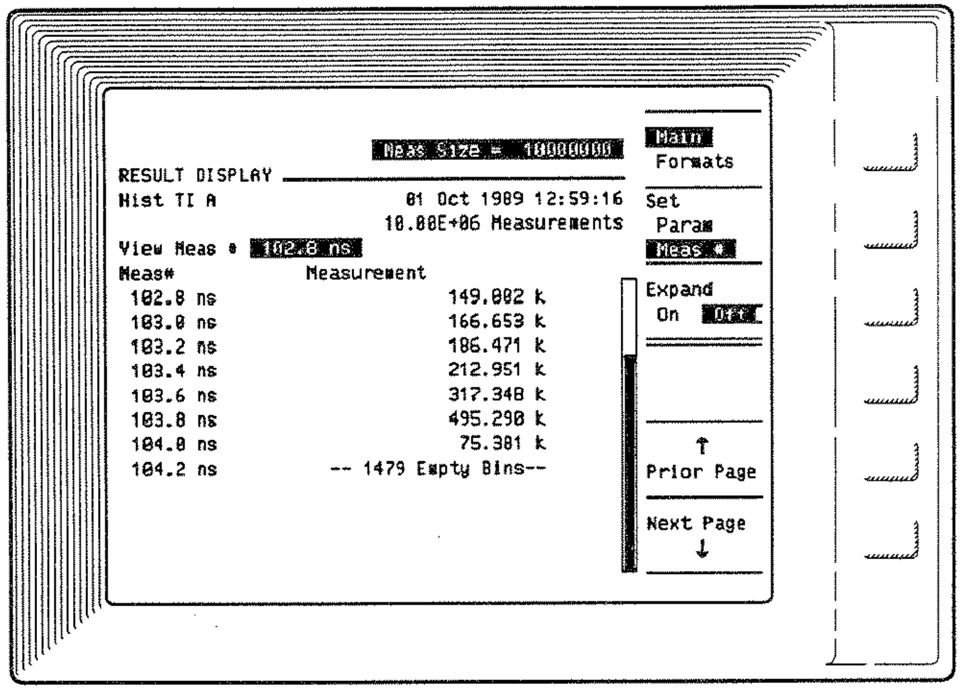


Figure 4-17. Numeric Results of Histogram Measurement, Last Page

There are two menus for reviewing the numeric results.

Main Menu

The **Main** softkeys provide for the modification of a parameter or the selection of Histogram bin value to display.

SET PARAM / MEAS

The **Set Param / Meas #** softkey has two functions:

- Param (Parameter) — The numeric entry field at the top of the screen is available for modification. The field is always the last numeric entry field to be selected on the Function, Input, or Pre-trigger menu. Use it when you want to see the effect on measurement results of changing one numeric parameter.

- Meas # — The "View Meas #" field is active. The Entry/Marker knob can be used to scroll the results or a bin value can be entered to display the number of measurements in that bin.

PRIOR PAGE / NEXT PAGE

This softkey option allows the scrolling of results one page at a time.

Formats Menu

There is only one results format available for Histogram measurements. It shows bin values and the number of measurements in each bin.

5

Contents of Chapter

5

ARMING

ARMING PREVIEW

Arming is one of the most important features of the HP 5373A. With it, you tell the Analyzer when to measure. This can be of great value when trying to measure particular portions of the signal, while avoiding others.

No matter what type of measurement is being made, the HP 5373A performs these basic functions:

- Collects time and event data
- Processes data into measurements
- Displays results

Your selection of an arming mode helps determine when the data is collected. After some basic introductory material, this chapter will concentrate on how the data is captured with the use of arming modes.

TIME AND EVENTS

Two kinds of data are collected by the HP 5373A. They are:

- time
- events

A sample is a time count and an event count. Each sample reflects the time that has elapsed and the number of trigger events that have occurred as referenced to the first sample of the measurement block. There are internal counters to keep track of the accumulated time and events. From this time and event data, measurement results are calculated. (Refer to chapters 1, 2, and 3, for details on how samples are processed into measurement results.)

WHAT IS ARMING?

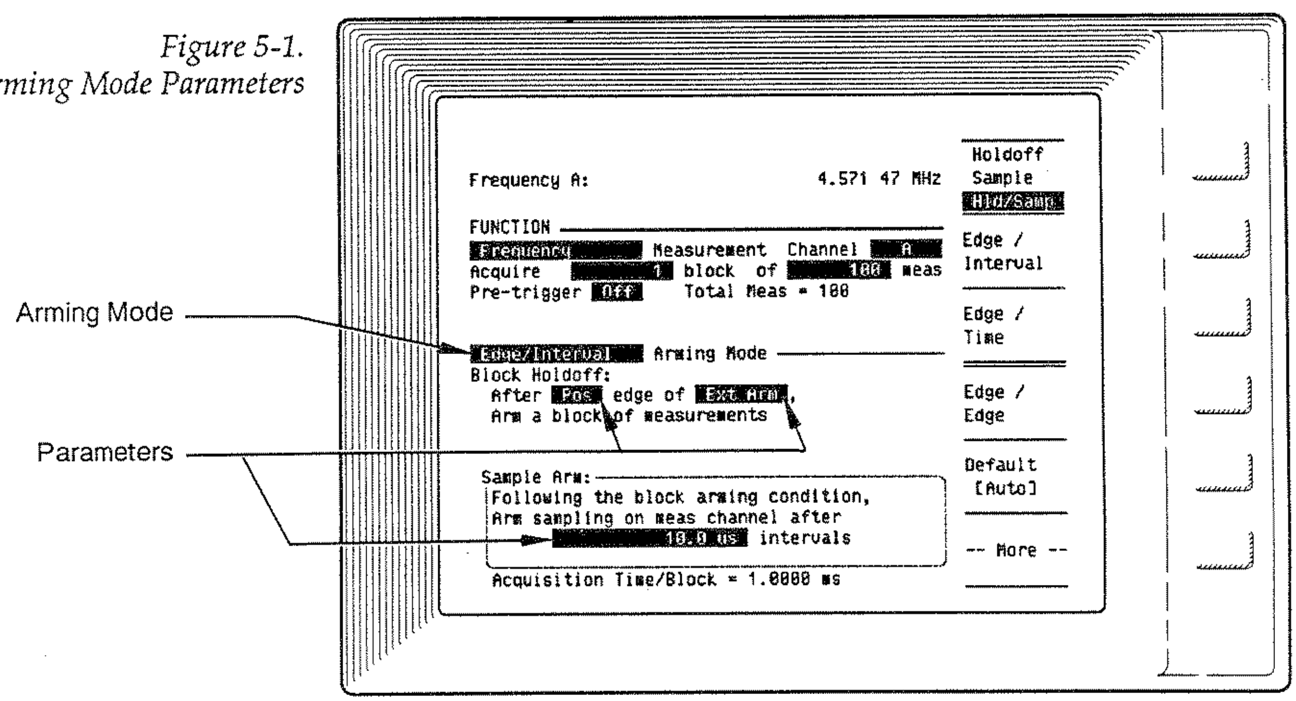
Arming lets you specify **WHEN** the HP 5373A will begin measuring and **HOW OFTEN** it will make measurements thereafter.

The HP 5373A arming modes are structured as a two-step process. The following description of the process is applied to the Edge/Interval arming mode:

In general, the first term of the arming mode name (Edge/) specifies WHEN the HP 5373A can begin to acquire a group, or block, of measurements. The second term of the arming mode name (/Interval) specifies HOW OFTEN measurement samples within the block of measurements can be acquired. When the data for the requested number of measurements have been collected, the HP 5373A will then perform calculations on the data to compute the results.

The specifying of the arming conditions is accomplished by selecting an arming mode on the Function menu and then selecting the parameters presented for the arming mode. *Figure 5-1* shows the parameters that specify the conditions for the Edge/Interval arming mode.

Figure 5-1.
Arming Mode Parameters



Group vs. Individual Arming

The arming mode selected determines how measurements are acquired. The HP 5373A has two ways of acquiring measurements:

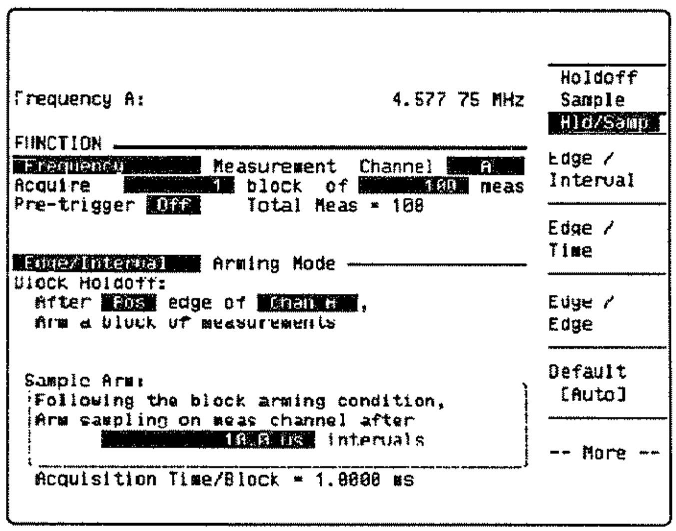
1. Measurements can be acquired in a group of contiguous measurements. This is called, "continuous arming."

   OR

2. Measurements can be acquired separately. This is called, "non-continuous arming."

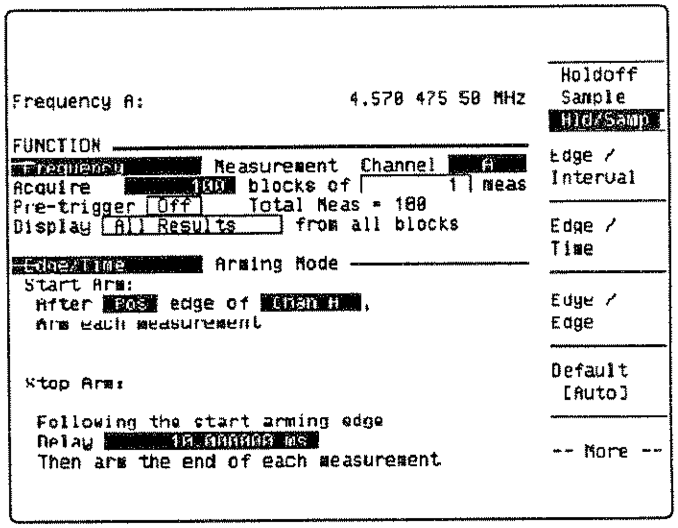
TECHNICAL COMMENT

There are several ways to know from the text on the menu screen whether the selected arming mode provides continuous or non-continuous arming. What follows shows two examples of how you can tell if your measurements will be acquired in a group, or individually.

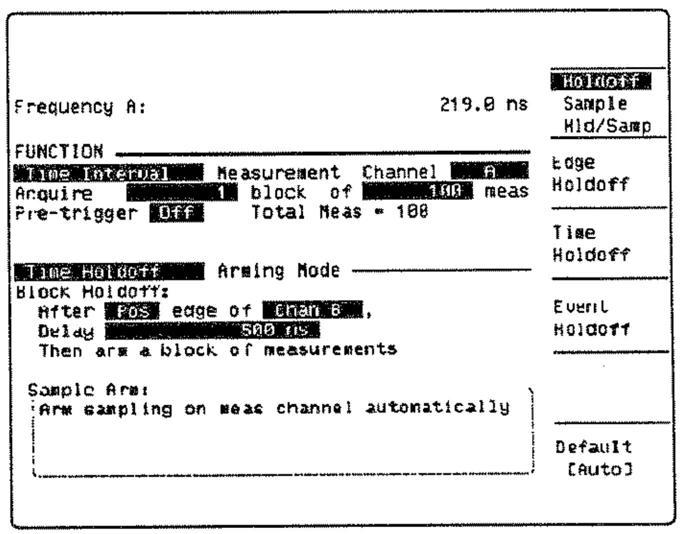


Measurements are acquired in a group. The group of measurements is called a "block." For example, 1 block of 100 measurements. The HP 5373A will make 100 measurements without stopping. This is an example of a continuous arming process.

OR

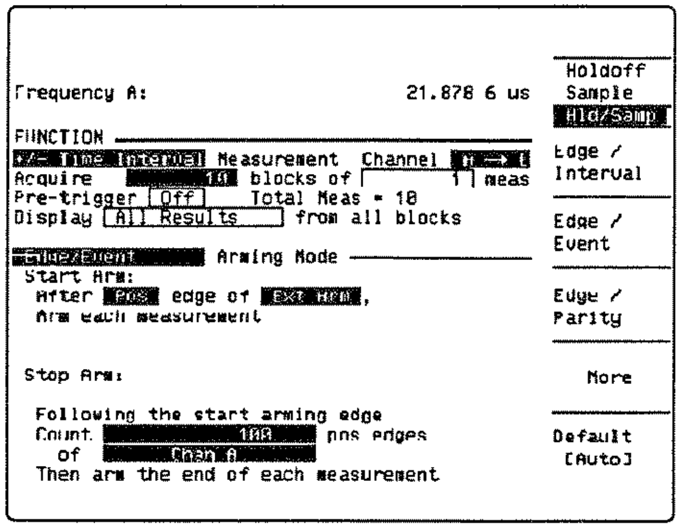


Measurements will be collected one at a time. For example, 100 blocks of 1 measurement. Each measurement will have a discrete start and stop. This is an example of a non-continuous arming process.



The term, "Block Holdoff," implies that there is some condition which must be satisfied before the Analyzer can begin to collect measurement samples. This is continuous arming.

OR



The use of the two terms, "Start Arm and Stop Arm," is intended to communicate that the measurements are collected individually. Each measurement has a start condition and a stop condition. This is non-continuous arming.

Continuous and Non-continuous Arming

Figures 5-2 and 5-3 show a comparison of the the continuous and non-continuous arming process.

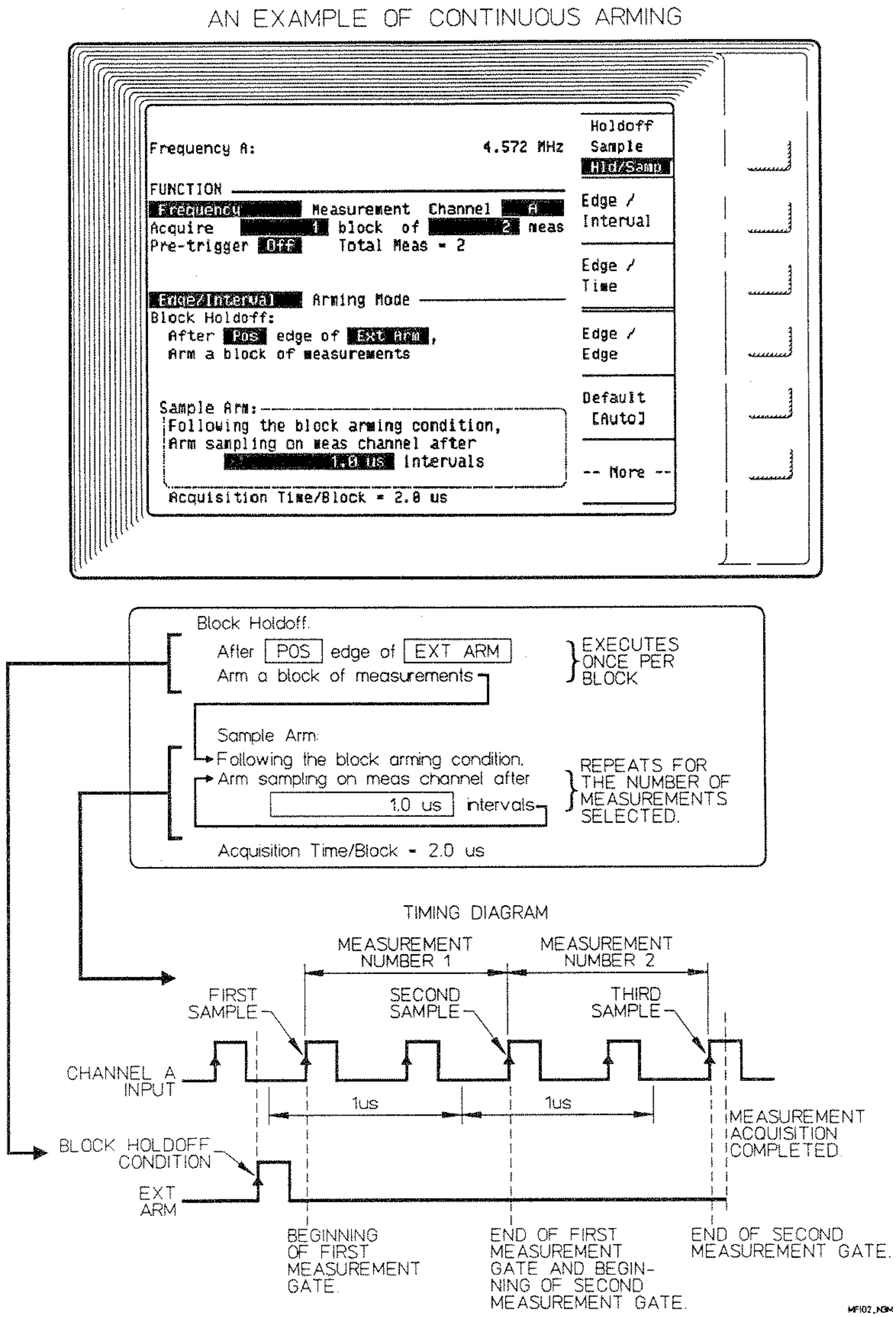
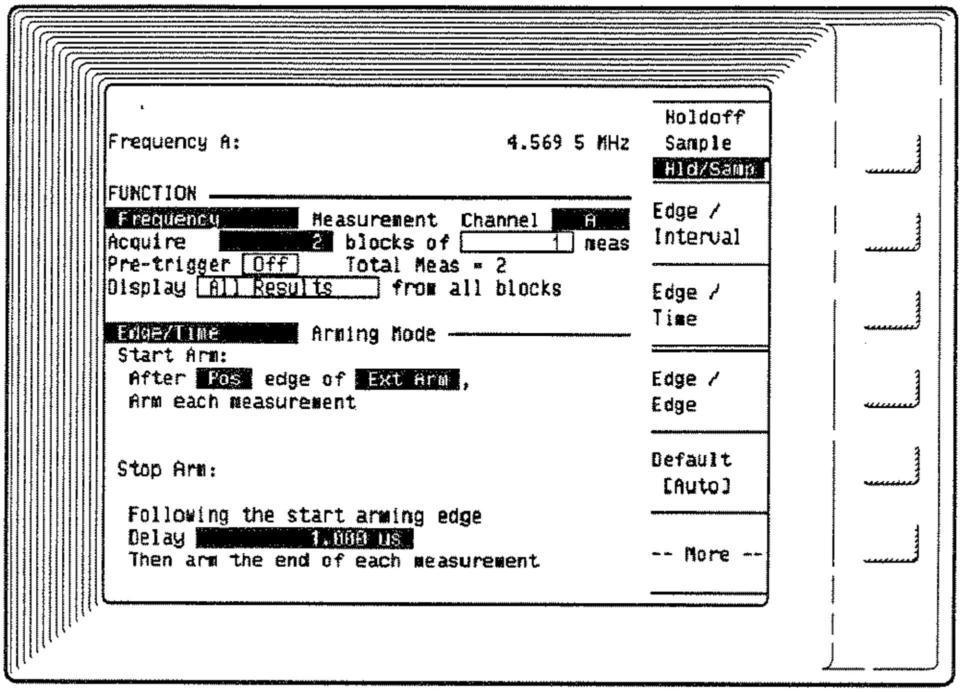


Figure 5-2. Group of Measurements

AN EXAMPLE OF NON-CONTINUOUS ARMING



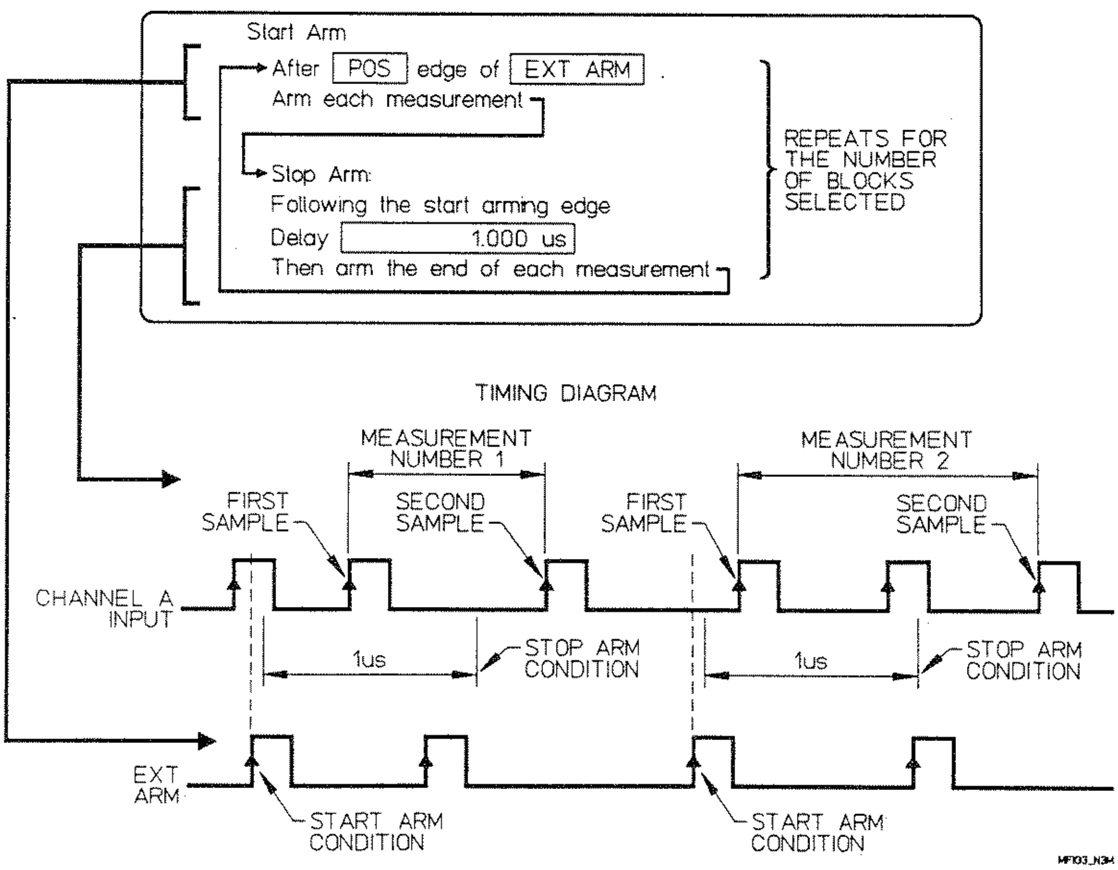


Figure 5-3. Separate Measurements

Continuous or Non-Continuous?

The advantages of continuous arming are:

- A continuous "profile" of a signal's variations and characteristics over time can be studied directly.
- The measurements are related to one another. That is, the time of each of the measurements, and the number of events that occurred during each measurement are known for the entire block of measurements.
- Typically, the measurement sequence executes faster than a non-continuous arming measurement.

NOTE

A measurement using a continuous arming mode can be made to acquire measurements non-continuously by specifying the measurement sequence as N blocks of 1 measurement.

In most cases, you will probably want to use the continuous arming modes. However, non-continuous modes may be useful if:

1. The measurement application requires a single measurement made in a particular portion of a complex signal.
2. The required measurement rate exceeds the maximum measurement rate of the HP 5373A. If the signal is repetitive, multiple "passes" can be made over the signal. Arming modes can be used to "step" the measurement through the portion of interest.

Arming Mode Categories

Arming modes specify collection of a sample in one of four ways:

1. Automatically
2. After an edge
3. After some time or "interval"
4. After a number of edges or "events"

Each of the arming modes uses one of these methods or a combination of two or more to allow the collection of samples at very specific points.

The 25 arming modes are grouped into four categories:

- Automatic (implies no holdoff and the fastest possible measurement pacing)
- Holdoff (implies fastest possible measurement pacing)
- Sampling (implies no holdoff)
- Holdoff/Sampling (you have control over both the block holdoff and the measurement pacing within the block of measurements)

Each category gives you a different level of control over the start of a measurement sequence and over how often measurement samples are collected. Your selection depends on your measurement application. Here is an overview of the four arming categories and the arming modes in each.

AUTOMATIC MODE

Choose the **AUTOMATIC** mode if you want the block of measurements to start as soon as possible, and you want the measurement samples collected as quickly as possible. The mode is:

- AUTOMATIC — A block of measurements starts as soon as the Analyzer is ready, and samples are collected as quickly as possible. (Continuous arming)

HOLDOFF MODES

Choose a **HOLDOFF** mode if you want to delay starting a block of measurements until a condition which you specify is met. Measurement samples are then collected as quickly as possible. The Holdoff modes are:

- EDGE HOLDOFF — A block of measurements is delayed until a specified edge is received. (Continuous arming)
- TIME HOLDOFF — A block is delayed until a specified edge followed by a specified time. (Continuous arming)
- EVENT HOLDOFF — A block is delayed until a specified edge followed by a specified number of events. (Continuous arming)

SAMPLING MODES

With a **SAMPLING** mode, a block of measurements begins as soon as possible, but you specify how often a sample will be collected within a block of measurements. The Sampling modes are:

- INTERVAL SAMPLING — Specifies a time between samples. (Continuous arming)
- TIME SAMPLING — Similar to Interval Sampling, but the arming is non-continuous. The time between samples can be set with greater resolution. (Non-continuous arming)
- CYCLE SAMPLING — Specifies a constant number of events between samples. (Continuous arming)
- EDGE SAMPLING — Each sample taken after a specified edge. (Continuous arming)
- PARITY SAMPLING — Each measurement taken after an edge on both Channel A and B. (Continuous arming)
- REPETITIVE EDGE — Each sample taken after a specified edge. (Continuous arming)
- REPETITIVE EDGE – PARITY — Each measurement taken after a specified edge followed by an edge on both Channel A and B. (Continuous arming)
- RANDOM SAMPLING — Samples taken after a randomly selected number of events. (Continuous arming)

HOLDOFF / SAMPLING MODES

The **HOLDOFF/SAMPLING** mode combines both a delay of the measurement block start AND a specification of when each sample within the block will be collected. The Holdoff/Sampling modes are:

- EDGE / INTERVAL — The start of the block is delayed until a specified edge. Samples within the block are taken after a specified time. (Continuous arming)
- EDGE / TIME — The start of the measurement is delayed until a specified edge. The end of the measurement comes after a specified time. (Non-continuous arming)
- EDGE / EDGE — The start of the block is delayed until a specified edge. Each sample taken after a specified edge. (Continuous arming)

- EDGE / CYCLE — The start of the block is delayed until a specified edge. Samples taken after a specified number of events. (Continuous arming)

- EDGE / EVENT — The start of the measurement is delayed until a specified edge. The end of the measurement comes after a specified number of events. (Non-continuous arming)

- EDGE / PARITY — The start of the block is delayed until a specified edge. Each measurement taken after a specified edge on both Channel A and B. (Continuous arming)

- EDGE / RANDOM — The start of the block is delayed until a specified edge. Samples taken after a randomly selected number of events. (Continuous arming)

- TIME / INTERVAL — The start of the block is delayed until after a specified edge followed by a specified time. Samples taken after a specified time. (Continuous arming)

- TIME / TIME — The start of the measurement is delayed until after a specified edge followed by a specified time. The end of the measurement comes after a specified time. (Non-continuous arming)

- EVENT / INTERVAL — The start of the block is delayed until after a specified edge followed by a number of events. Samples taken after a specified time. (Continuous arming)

- EVENT / EVENT — The start of the measurement is delayed until after a specified edge followed by a number of events. The end of the the measurement comes after a specified number of events. (Non-continuous arming)

- EXTERNALLY GATED — The start of the measurement is taken after a leading edge of a positive or negative pulse. The measurement ends after the trailing edge of the pulse. (Continuous arming)

- MANUAL — Measurement starts when the Manual Arm key is pressed. Measurement ends when the Manual Arm key is pressed again. (Non-continuous arming)

FUNCTION AND ARMING MODE SUMMARY

The following table summarizes the four groups of arming modes and the available arming modes for each function.

HP 5373A Function and Arming Summary

ARMING MODE	MEASUREMENT FUNCTION												
	TIME INTERVAL OR HISTOGRAM TI		CONTINUOUS TIME INTERVAL OR HISTOGRAM CTI	±TIME INTERVAL OR HISTOGRAM ±TI		PRF, FREQUENCY, PRI, PERIOD		TOTALIZE		PULSE WIDTH, OFFTIME, RISE TIME, FALL TIME, DUTY CYCLE	PHASE	ENVELOPE POWER, AMPLITUDE MODULATION	PHASE DEVIATION, TIME DEVIATION, FREQUENCY DEVIATION
	A	A→B	A	A	A→B	A	DUAL[1]	A	DUAL[1]	A	A rel B	A	A
	B	B→A	B	B	B→A	B	RATIO[2]	B	RATIO[2]		B rel A	B	B
						C	SUM[3]		SUM[3]				
							DIFF[4]		DIFF[4]				
AUTOMATIC													
AUTOMATIC	C*	C*	C*		C*	C*	C*			C*	C*	N*	C*
HOLDOFF													
EDGE HOLDOFF	C	C	C		C	C					C		C
TIME HOLDOFF	C	C	C			C							
EVENT HOLDOFF	C	C	C			C							
SAMPLING													
INTERVAL SAMPLING	C	C	C		C	C	C	C*	C*		C		C
TIME SAMPLING						N							
CYCLE SAMPLING						C							
EDGE SAMPLING						C	C	C	C				
PARITY SAMPLING					C								
REPET EDGE SAMPLING	C	C	C		C								
REPET EDGE-PARITY SAMPLING					C								
RANDOM SAMPLING	C	C			C								
HOLDOFF/SAMPLING													
EDGE/INTERVAL	C	C	C		C	C	C	C	C		C		C
EDGE/TIME						N							
EDGE/EDGE						C		C	C				
EDGE/CYCLE						C							
EDGE/EVENT				N	N	N							
EDGE/PARITY					C								
EDGE/RANDOM	C	C			C								
TIME/INTERVAL						C		C					
TIME/TIME				N	N	N							
EVENT/INTERVAL						C							
EVENT/EVENT				N*	N	N							
EXTERNALLY GATED						C		C	C				
MANUAL								N	N				

Symbol C or N indicates that a measurement can be made using the corresponding combination of Function, Channel, and Arming selections.

C = Continuous Arming, (Block/Sample Arming)

N = Non-Continuous arming, (Start/Stop Arming), setups are limited to M blocks of 1 measurement.

1. DUAL. Simultaneous Dual-channel, (2 results). Frequency and PRI options are: A&B, A&C, B&C. Totalize option is: A&B.
2. RATIO. Frequency and Period ratio options are: A/B, A/C, B/A, B/C, C/A, C/B. Totalize ratio options are: A/B, B/A.
3. SUM. Frequency and Period sum options are: A+B, A+C, B+C. Totalize sum option is: A+B.
4. DIFFERENCE. Frequency and Period difference options are: A–B, A–C, B–A, B–C, C–A, C–B. Totalize difference options are: A–B, B–A.

* = Default Arming

HP 5373A Function and Arming Summary (Continued)

ARMING CATEGORIES

Category	Continuous Arming Modes	Non-Continuous Arming Modes
Automatic	Block Holdoff is Automatic Sample Arm is Automatic	none
Holdoff Modes	Block Holdoff is User-defined Sample Arm is Automatic	none
Sampling Modes	Block Holdoff is Automatic Sample Arm is User-defined	Start Arm is Automatic Stop Arm is User-defined
Holdoff/Sampling Modes	Block Holdoff is User-defined Sample Arm is User-defined	Start Arm is User-defined Stop Arm is User-defined

Where Arming Fits In

Selection of the appropriate arming mode is an important element in preparing the HP 5373A to make a measurement. This short review of a measurement setup shows where arming fits in. A chirped radar pulse in *Figure 5-4* is used to illustrate how the measurement would be made.

A measurement setup includes the following:

1. Select the measurement function on the Function menu.

   An example is: PRF or Frequency measurement on Channel A.

2. Specify the number of measurements in the measurement sequence on the Function menu.

   An example is: 1 block of 100 measurements.

3. Select an arming mode on the Function menu.

   An example is: Edge/Interval.

   The edge is specified as a positive slope on Ext Arm. The interval is specified as 100 ns.

This arming mode delays the start of a block of measurements until a positive edge occurs at the External Arm input, and then samples are collected after a specified time interval.

4. Specify the trigger event on the Input menu.

   An example is: Positive slope of the signal at Channel A at 0 volts.

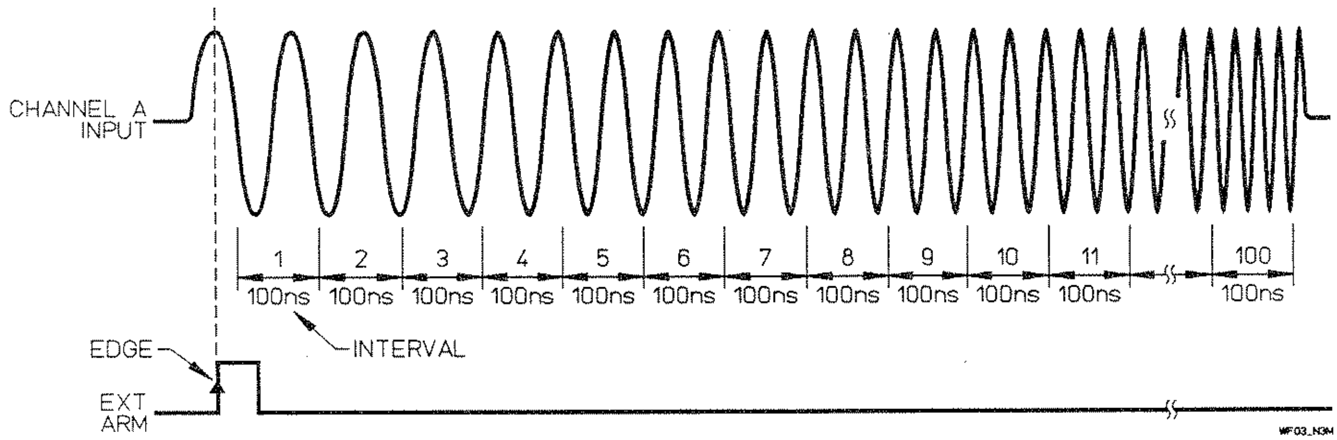


Figure 5-4. Edge/Interval Arming Example

ARMING SCREEN TERMS

You select the arming mode and specify its parameters on the Function menu. Text is used on the arming portion of the screen in a sentence-like structure to assist you in specifying how and when you want your measurement samples to be collected. There is a lot of flexibility in how an arming setup can be configured.

Some examples are included here to introduce the context in which the terms are used. Once you understand the terms, you will realize the power of the HP 5373A to make your measurement.

Following this section is a detailed description of each of the arming modes. It includes all the arming mode parameters. Use it as a reference to obtain detailed information about how a particular arming mode operates. Refer to the measurement chapters (1,2,3,4) for the exact ranges of arming mode parameters for every measurement and arming mode combination.

NOTE

Consult the appropriate chapter describing your measurement to see how the measurement data is collected. The arming examples in this chapter are intended to demonstrate the arming mode, not how a particular type of measurement is made. Some subtleties of specific measurement types may not be seen here.

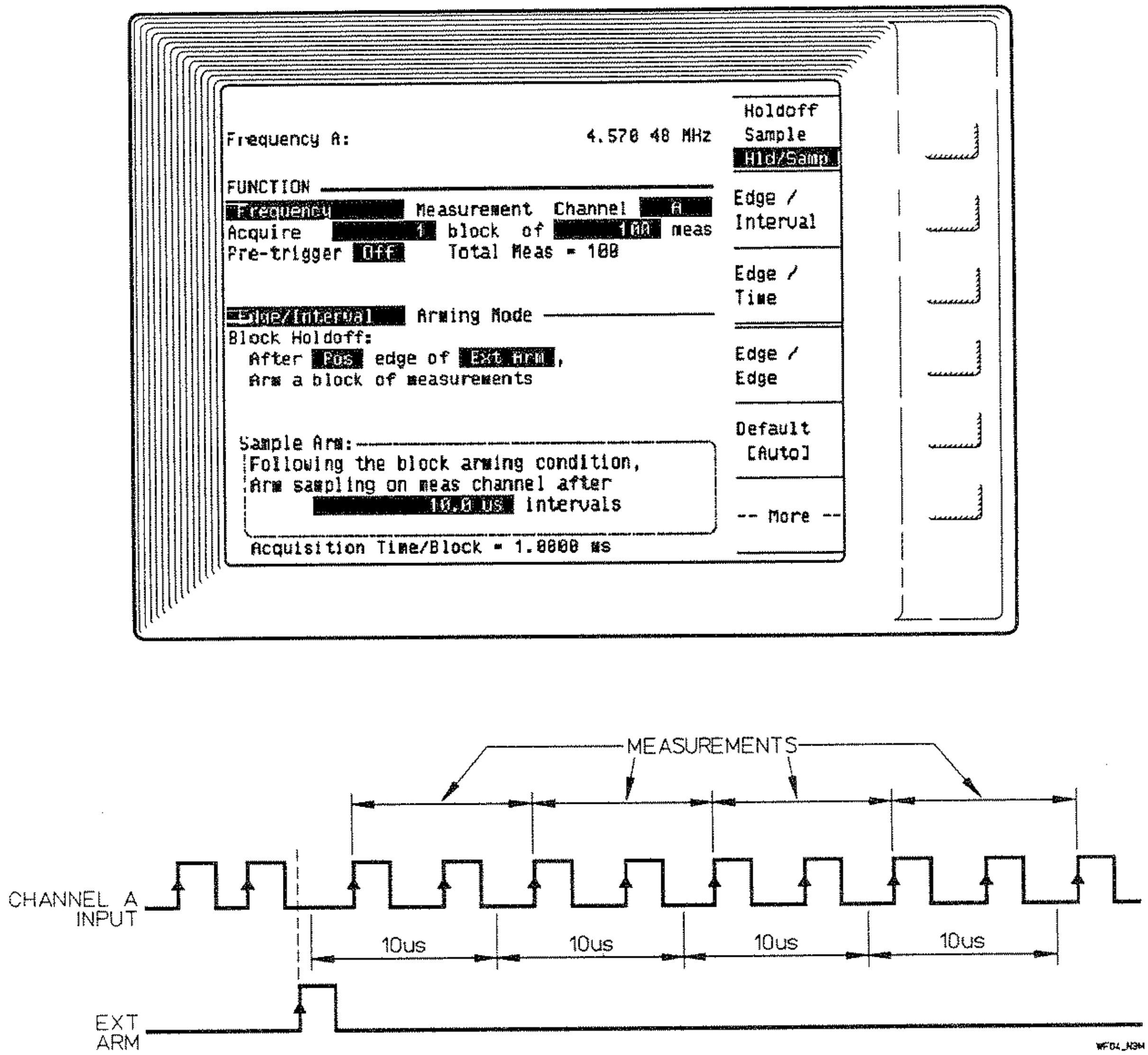


Figure 5-5. Continuous Arming Phrases

Arming Menu Phrases from *Figure 5-5*:

- **Block Holdoff** — The specified condition, or conditions, which must occur before a block of measurements can begin

- **Arm a block of measurements** — The HP 5373A is ready to begin the first measurement of a block after the block holdoff occurs. The first measurement begins (that is, the first sample is captured) at the next trigger event on the measurement channel.

- **Sample Arm** — The specified condition that must occur before each measurement sample can be captured within the block of measurements.
- **Following the block arming condition** — Once the block arm condition occurs, the sample arm condition can then execute. The sample arm condition cannot occur until after the block arm condition is satisfied.
- **Arm sampling on meas channel** — The HP 5373A is ready to capture a measurement sample after the sample arm occurs. A sample is captured at the next trigger event on the measurement channel.
- **intervals** — A repetitive time period that sets the time between measurement samples.

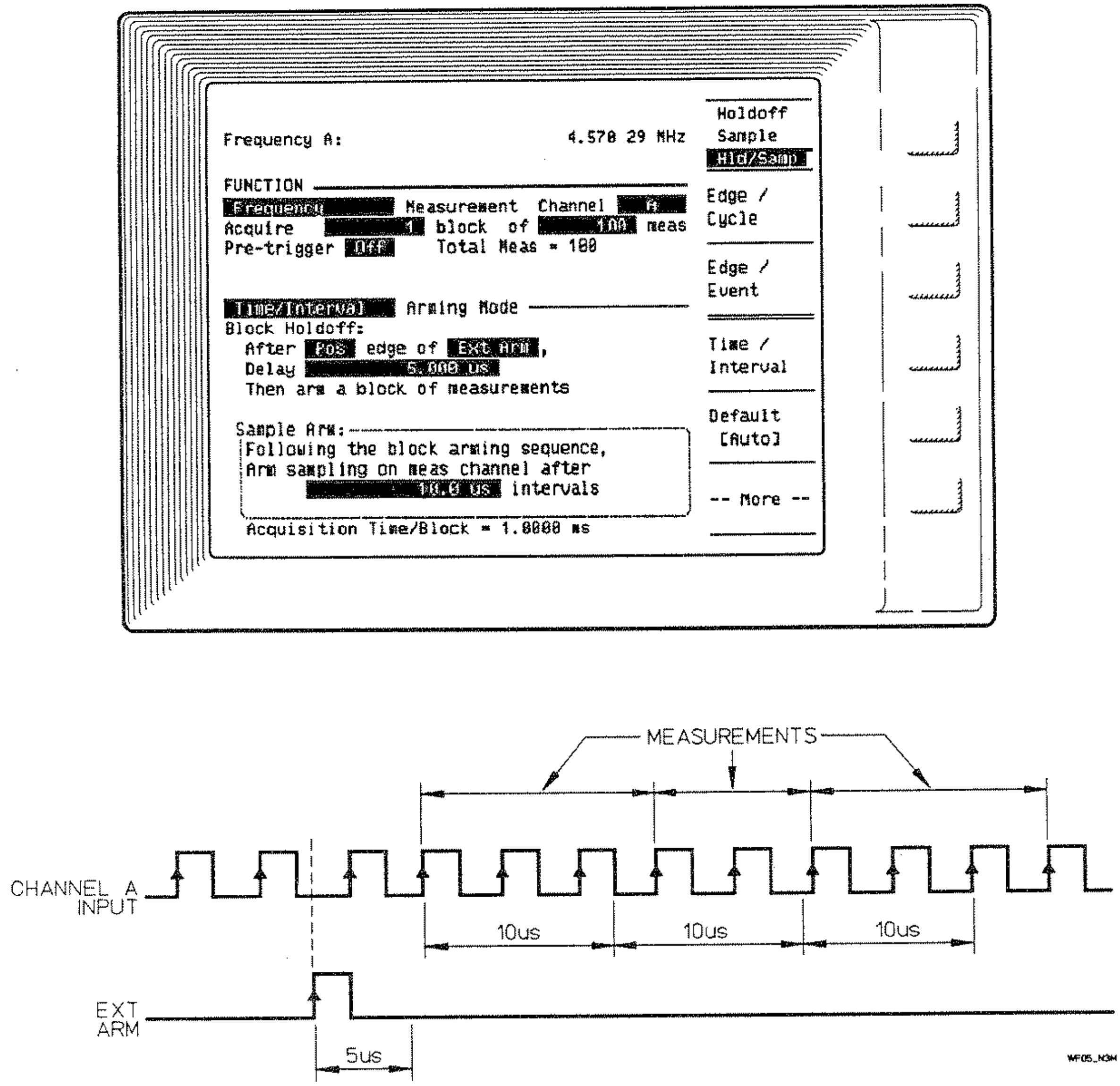


Figure 5-6. More Continuous Arming Phrases

Arming Menu Phrase from *Figure 5-6*:

- **Following the block arming sequence** — "Block arming sequence" refers to a two-stage block holdoff. The conditions are: an edge plus some time or an edge plus a number of events. Once the block arm conditions occur, the sample arm condition can then execute. The sample arm condition cannot occur until after the block arm conditions are satisfied.

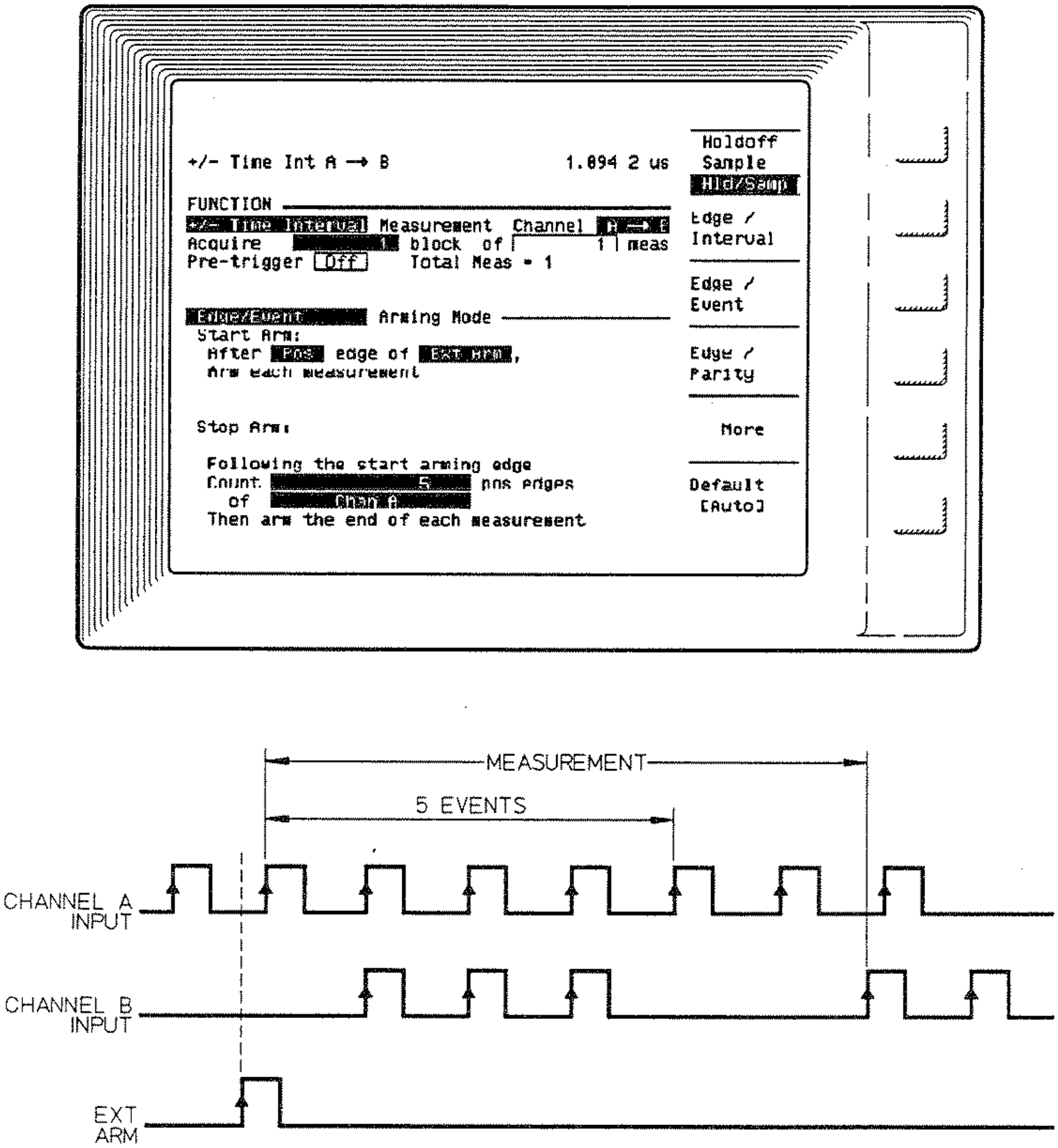
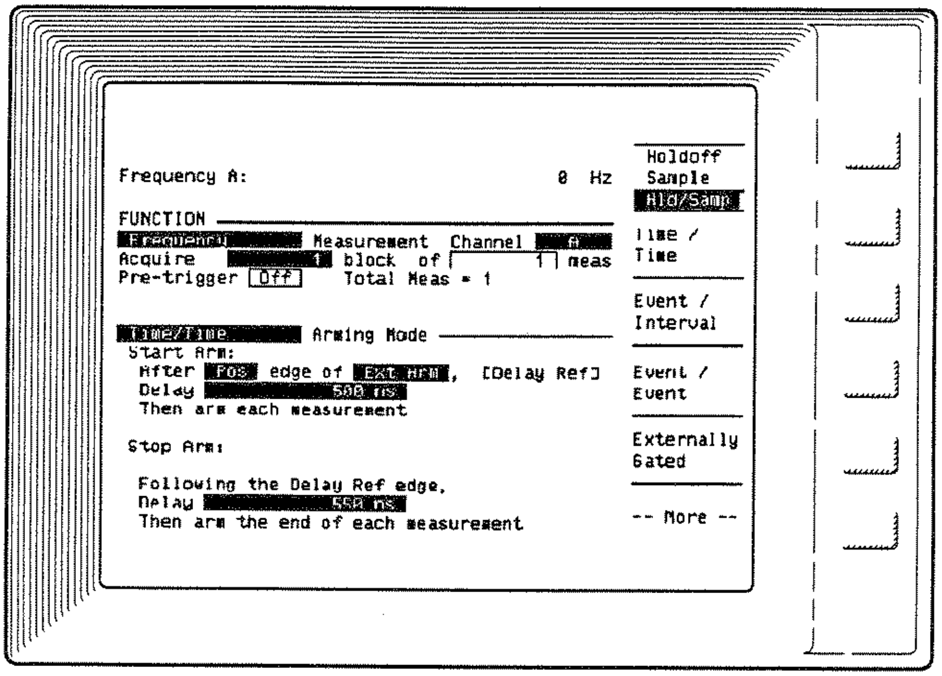


Figure 5-7. Non-continuous Arming Phrases

Arming Menu Phrases from *Figure 5-7*:

- **Start Arm** — The specified condition which must occur before a sample can be captured to begin a measurement.
- **Arm each measurement** — The HP 5373A is ready to capture a sample after the start arm occurs. A sample is captured at the next trigger event on the measurement channel.

- **Stop Arm** — The specified condition which must occur before a sample can be captured to end a measurement.
- **Following the start arming edge** — Once the start arm edge occurs, the stop arm condition can then execute. The stop arm condition cannot occur until after the start arm edge condition is satisfied.
- **Count** (events) — Specifies how many events (edges on the input A, B, or External Arm) should be counted before the HP 5373A is ready to capture a sample on the measurement channel.
- **arm the end of each measurement** — The HP 5373A is ready to capture a sample after the stop arm occurs. The sample is captured at the next trigger event on the measurement channel to end the measurement.



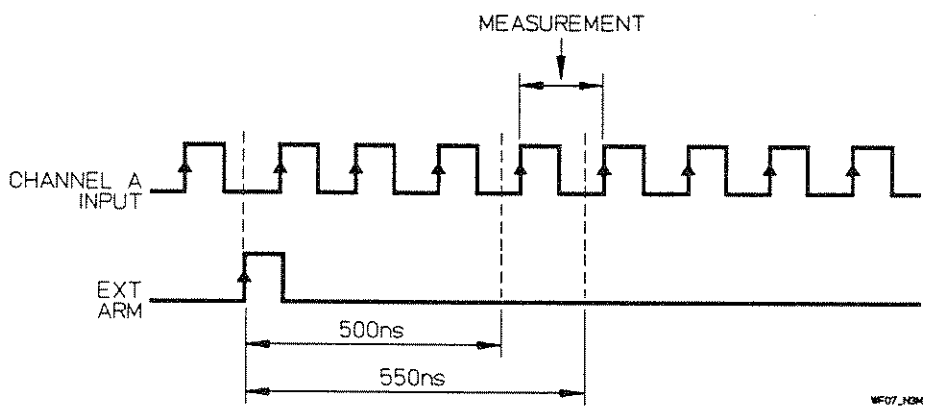


Figure 5-8. More Non-continuous Arming Phrases

Arming Menu Phrases from *Figure 5-8*:

- **[Delay Ref]** — A label for the delay reference edge. The delay being a delay of a specified time or number of events. In this example, the delay reference edge is a positive edge on External Arm.
- **Delay** (time or events) — Specifies how long the HP 5373A will wait before it is ready to capture a sample on the measurement channel.

- **Following the Delay Ref edge** — Once the delay reference edge occurs, the stop arm condition can execute. The stop arm condition cannot occur until after the delay reference edge

DETAILED ARMING MODE DESCRIPTIONS

The following pages contain a detailed description of each arming mode. Included for each mode is information on:

- Measurement functions which can be used in each arming mode
- How the measurement is armed
- Block Holdoff / Sample Arm
- Start Arm / Stop Arm
- Function menu setup screens
- Timing diagrams

Refer to the measurement chapters (1,2,3,4) for the specific limits on measurement functions and arming modes.

Measurements Referenced To The Block Arming Edge

There are eight arming modes that can reference all measurements of a block to the block holdoff arming edge. They are:

- Edge Holdoff
- Time Holdoff
- Event Holdoff
- Edge / Interval
- Edge / Edge
- Edge / Cycle
- Time / Interval
- Event / Interval

For these arming modes, the edge which arms each block is "time-stamped," and the elapsed time between the block arming edge and the first measurement sample is measured.

This feature is not available for all measurement functions using these arming modes. Consult the arming mode descriptions that follow to find if the time value for the block arming edge is supported for your particular measurement.

While all the arming modes provide the time from the beginning of the first measurement of a block, these time-stamp arming modes also provide the time between the block arming edge and the first measurement sample that is collected. The time value is displayed on the Numeric screen. It is listed before the first measurement result of the block and has a "T" in front of it. The diagrams in the next part of this chapter show the time-stamp arming modes with a portion of the example signal labeled with a "T", where the example includes a measurement function for which this feature is available.

Averaged Results

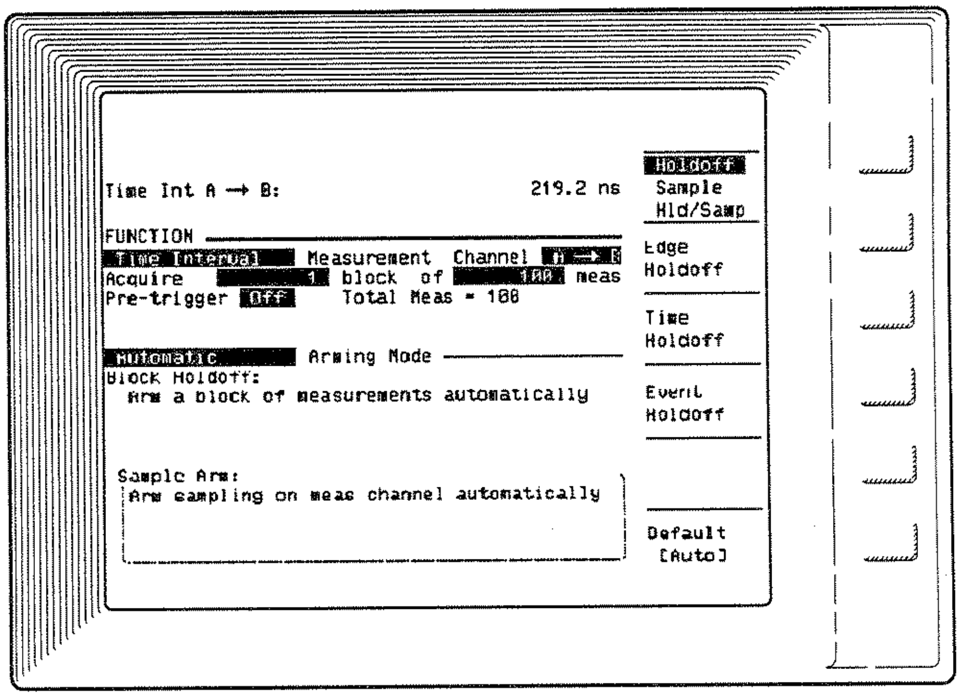
The feature of time-stamping the block arming edge makes it possible for the HP 5373A to average multiple blocks of measurements. When you select a measurement function and arming mode that support averaging, a field on the Function menu will allow selection of "Averaged Results" (the other option is "All Results"). The averaged results are shown on the Numeric screen, the Time Variation and Event Timing graphs. If the total number of measurements selected exceeds the size of internal memory, "Averaged Results" is the only option available.

AUTOMATIC MODE

DESCRIPTION:

This arming mode allows measurements to start as soon as the HP 5373A is ready. There is no external delay before measurements begin, and the sampling is determined by the input signal and the particular measurement being made. (Rise Time/Fall Time, Pulse Width, Pulse Offtime, and Duty Cycle measurements require some time to do the peak-to-peak amplitude measurements necessary before each measurement.)

Figure 5-9. AUTOMATIC Menu Screen



MEASUREMENTS: Time Interval, Continuous Time Interval, ±Time Interval, PRF or Frequency, PRI or Period, Phase, Frequency Deviation, Phase Deviation, Time Deviation, Envelope Power, and Amplitude Modulation

ARMING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: Automatic

COMMENTS: Automatic arming takes samples as quickly as possible. For signals > 10 MHz, PRF, Frequency, PRI, Period, and Continuous Time Interval measurements will occur every 100 ns (75 ns for Fast measurement mode, see "System Menu," chapter 12). For signals < 10 MHz, the measurement intervals are determined by the PRI or period of the signal being measured. For example, a 1 kHz signal measured with Automatic will cause the HP 5373A to sample every 1 ms. That is as fast as possible for the situation.

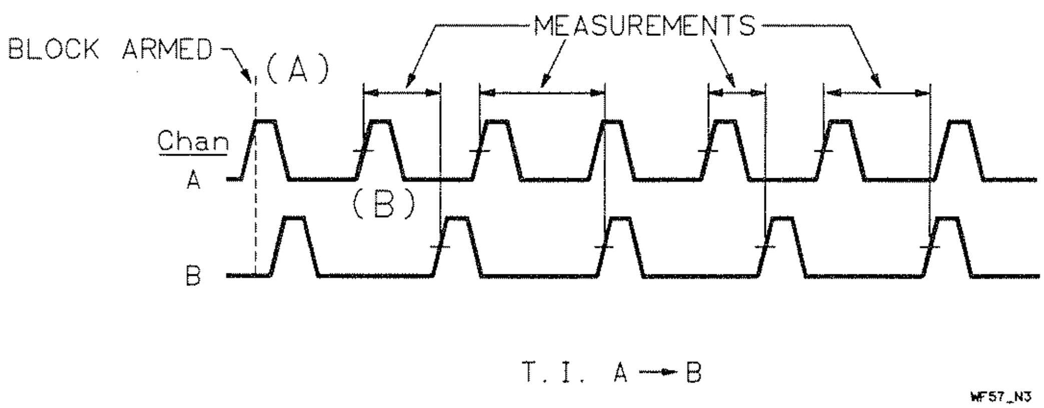


Figure 5-10. AUTOMATIC Timing Diagram

```
(A) Block of measurements is automatically
    armed as soon as the Analyzer is ready.

(B) Measurements begin on the next trigger
    event of Channel A.
```

HOLDOFF MODES

DESCRIPTION:

This arming group allows measurements to be held off, or delayed, until:

- EDGE: A signal edge on a selected input channel.
- TIME: A time period elapses after an edge.
- EVENT: A number of events are counted after an edge.

Edge Holdoff

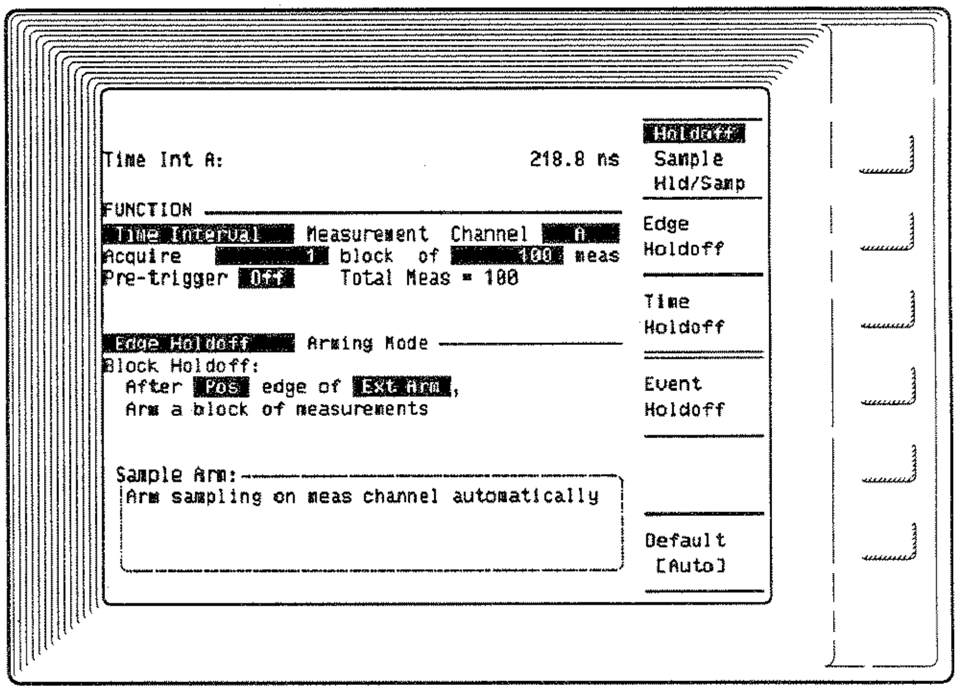


Figure 5-11. EDGE HOLDOFF Menu Screen

MEASUREMENTS: Time Interval, Continuous Time Interval, ±Time Interval, PRF or Frequency, PRI or Period, Phase, Frequency Deviation, Phase Deviation, and Time Deviation

ARMING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or Ext Arm

SAMPLE ARM: Automatic

COMMENTS: The reference edge is time stamped for PRF, Frequency, PRI, Period, Continuous Time Interval, Frequency

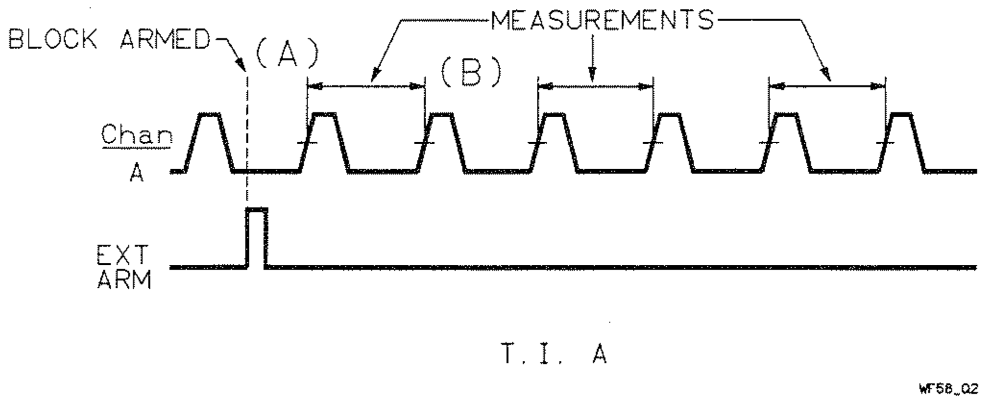


Figure 5-12. EDGE HOLDOFF Timing Diagram

Deviation, Phase Deviation, and Time Deviation measurements.

(A) Block of measurements is armed by a positive edge on Ext Arm.

(B) Measurements are taken on the trigger event of Channel A.

Time Holdoff

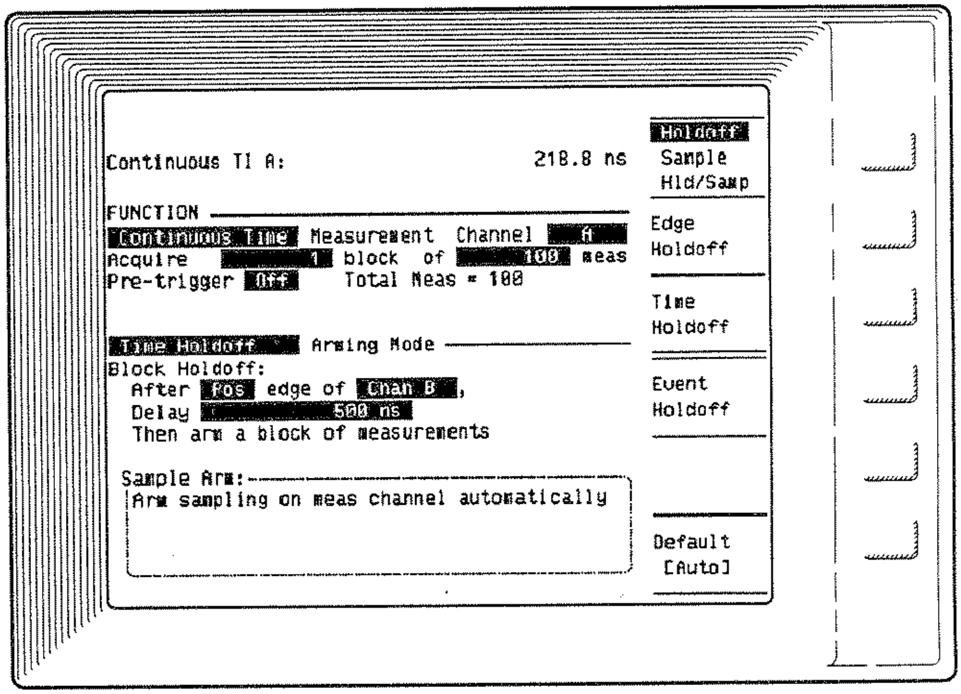


Figure 5-13.
TIME HOLDOFF
Menu Screen

MEASUREMENTS: Time Interval, Continuous Time Interval, PRF, Frequency, PRI, or Period

ARMING: Continuous

BLOCK HOLDOFF: Time referenced to an edge on Channel A, B, or Ext Arm

SAMPLE ARM: Automatic

COMMENTS: The reference edge is time stamped for PRF, Frequency, PRI, Period, and Continuous Time Interval measurements.

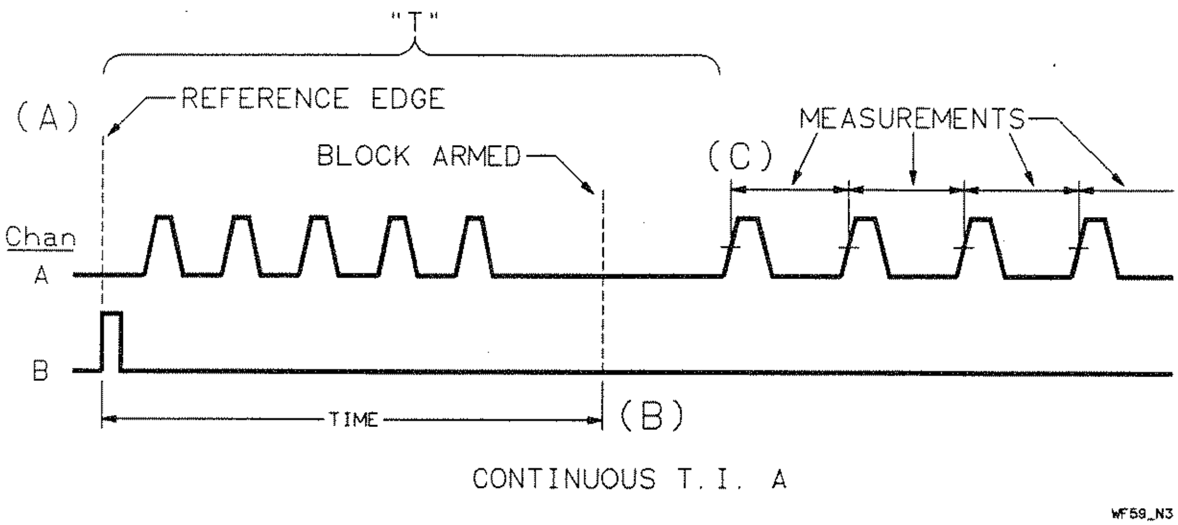


Figure 5-14. TIME HOLDOFF Timing Diagram

(A) A positive edge of Channel B provides the reference edge for the time delay.

(B) Block of measurements is armed at the end of the time delay.

(C) Measurements are taken on the trigger event of Channel A.

Event Holdoff

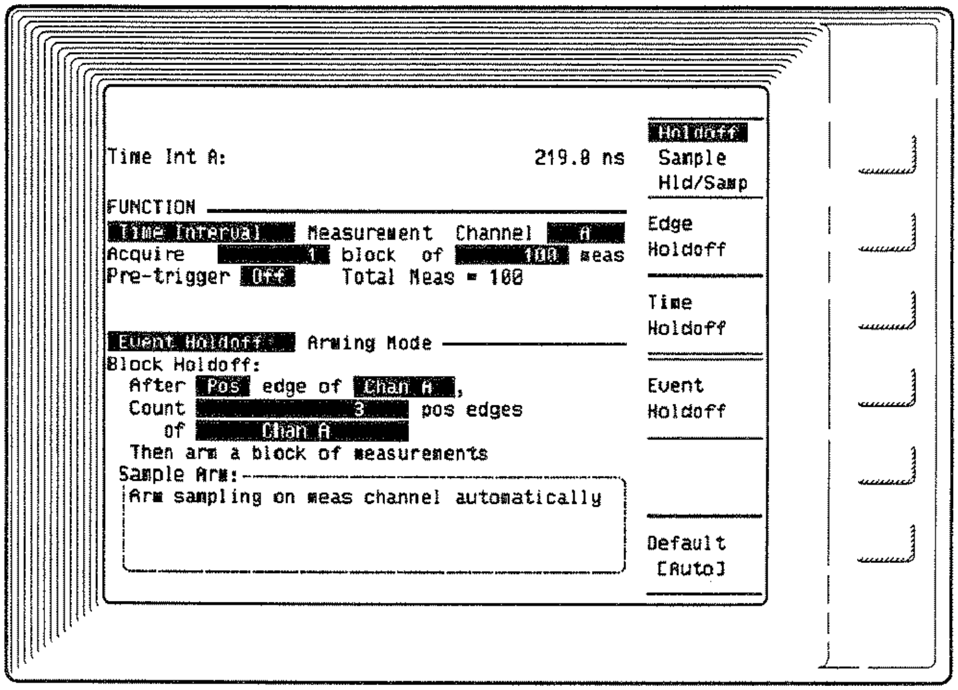


Figure 5-15. EVENT HOLDOFF Menu Screen

MEASUREMENTS: Time Interval, Continuous Time Interval, PRF, Frequency, PRI, or Period

ARMING: Continuous

BLOCK HOLDOFF: Events on Channel A or B referenced to an edge on Channel A, B, or Ext Arm

SAMPLE ARM: Automatic

COMMENTS: The reference edge is time stamped for PRF, Frequency, PRI, Period, and Continuous Time Interval measurements.

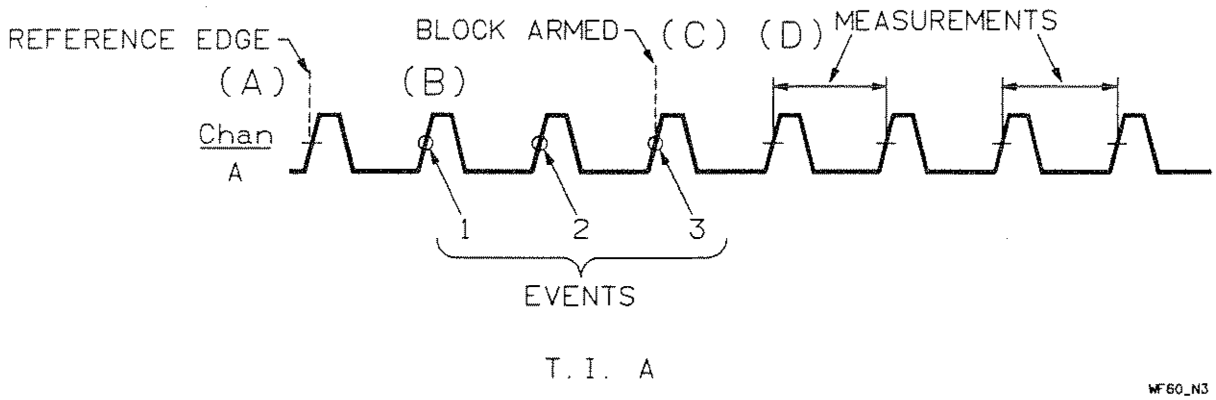


Figure 5-16. EVENT HOLDOFF Timing Diagram

(A) A positive edge of Channel A provides the reference edge for the event delay.

(B) The holdoff events begin on the trigger event of Channel A after the reference edge.

(C) Block of measurements is armed after three events are counted.

(D) Measurements are taken on the trigger event of Channel A.

SAMPLING MODE

Description:

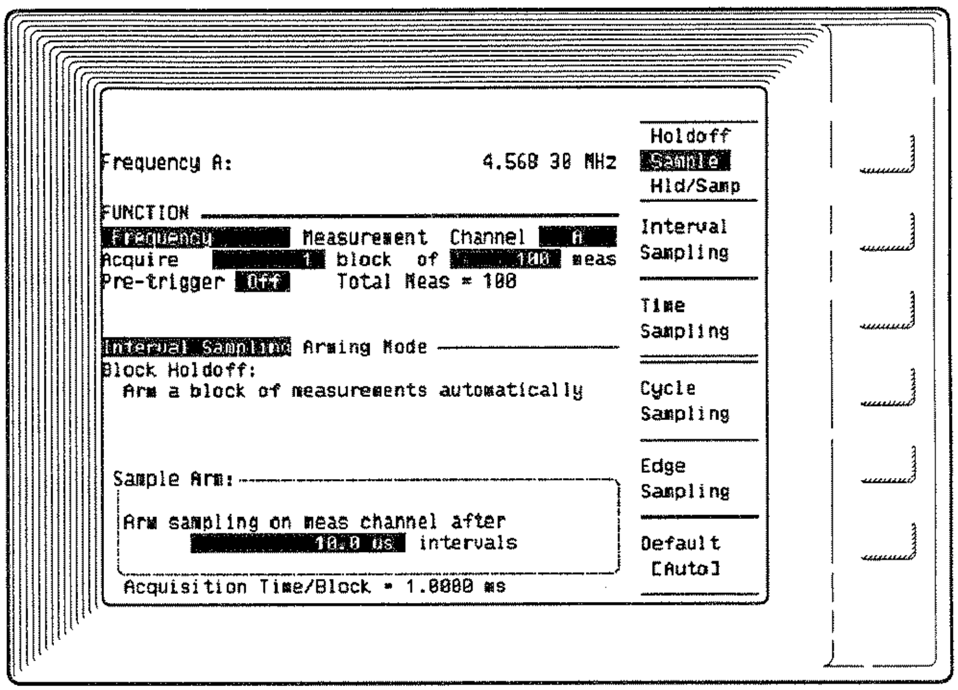
This arming group allows blocks of measurements to start as soon as the HP 5373A is ready. There is no external delay before measurements begin. The sampling can then take place after:

- Interval: A repetitive time period
- Time: A higher resolution, non-continuous time period (2 ns resolution)
- Cycle: A predetermined number of events (cycles).
- Edge: A designated edge for PRF, Frequency, PRI, Period, and Totalize measurements.
- Parity: A trigger event on each of the two measurement channels. (±Time Interval only)
- Repetitive Edge: A designated edge for Time Interval measurements.

- Repetitive Edge-Parity: A designated edge and a trigger event on each of the two measurement channels. (±Time Interval only)
- Random: A random number of edges on Channel A between measurements.

Interval Sampling

Figure 5-17. INTERVAL SAMPLING Menu Screen



MEASUREMENTS: Time Interval, Continuous Time Interval, ±Time Interval, PRF, Frequency, PRI, Period, Totalize, Phase, Frequency Deviation, Phase Deviation, and Time Deviation

ARMING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: Interval referenced to the automatic block holdoff signal

COMMENTS: Sampling takes place on the trigger event following the set time interval.

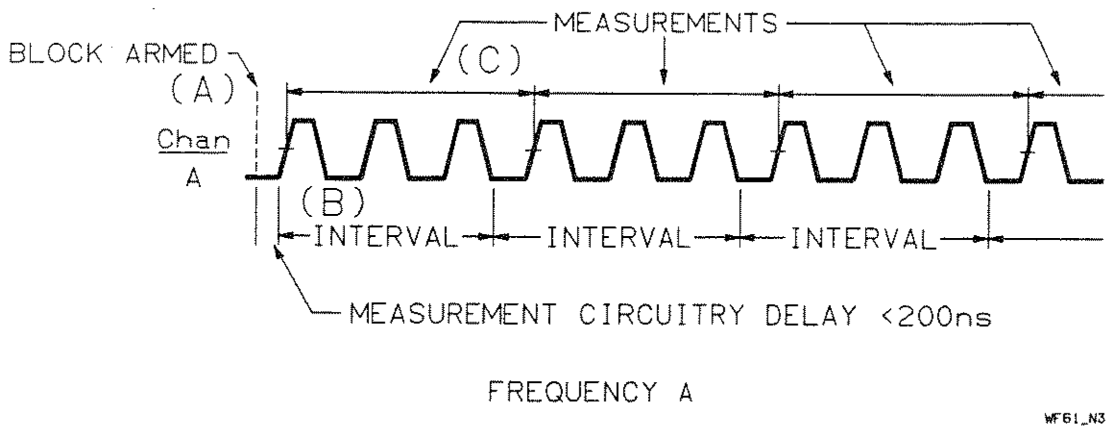


Figure 5-18. INTERVAL SAMPLING Timing Diagram

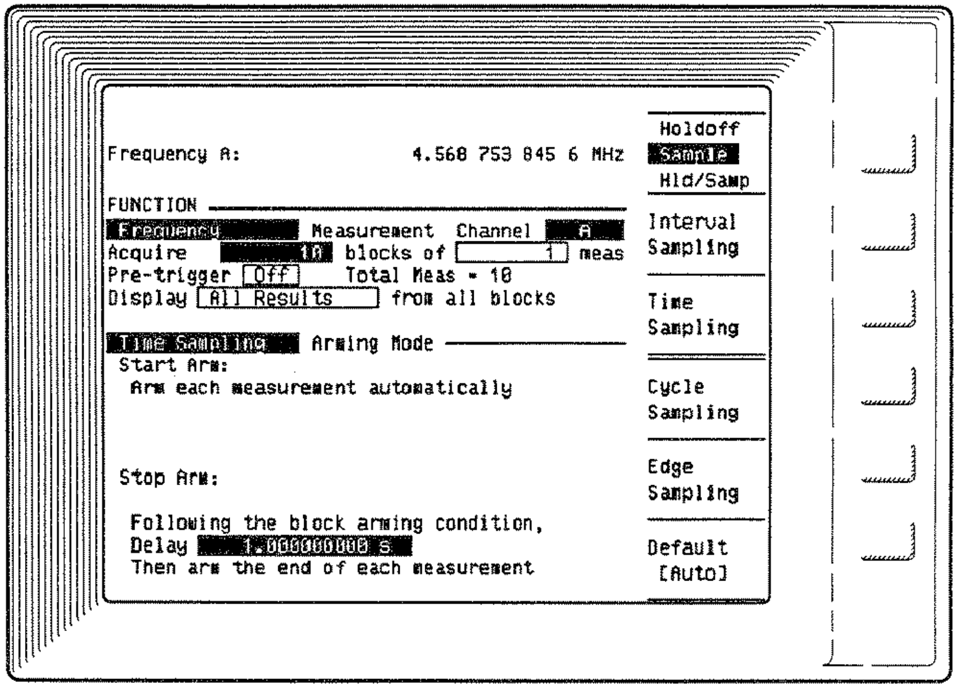
(A) Block of measurements is armed as soon as the Analyzer is ready.

(B) The first specified interval then begins after the internal circuitry delay.

(C) The first measurement ends on the trigger event following the end of the first interval.

Time Sampling

Figure 5-19.
TIME SAMPLING
Menu Screen



MEASUREMENTS: PRF, Frequency, PRI, and Period

ARMING: Non-continuous

START ARM: Automatic

STOP ARM: Time referenced to the automatic start arm signal.

COMMENTS: Each measurement ends on the trigger event following the set time. Use this mode if you want to make "individual" PRF, Frequency, PRI, or Period measurements. The arming is non-continuous, but the time can be specified with a 2 ns resolution. Use Interval Sampling for continuous measurements (multiple measurements in a block). Interval Sampling offers an interval resolution of 100 ns.

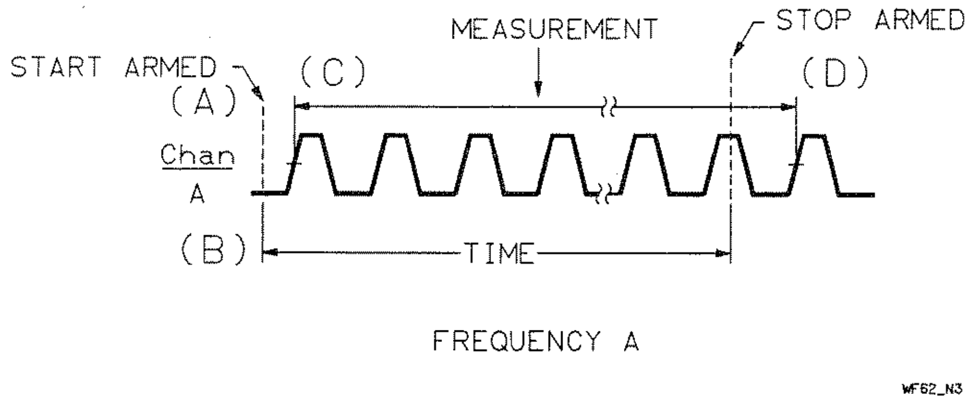


Figure 5-20. TIME SAMPLING Timing Diagram

(A) Measurement start is armed as soon as the Analyzer is ready.

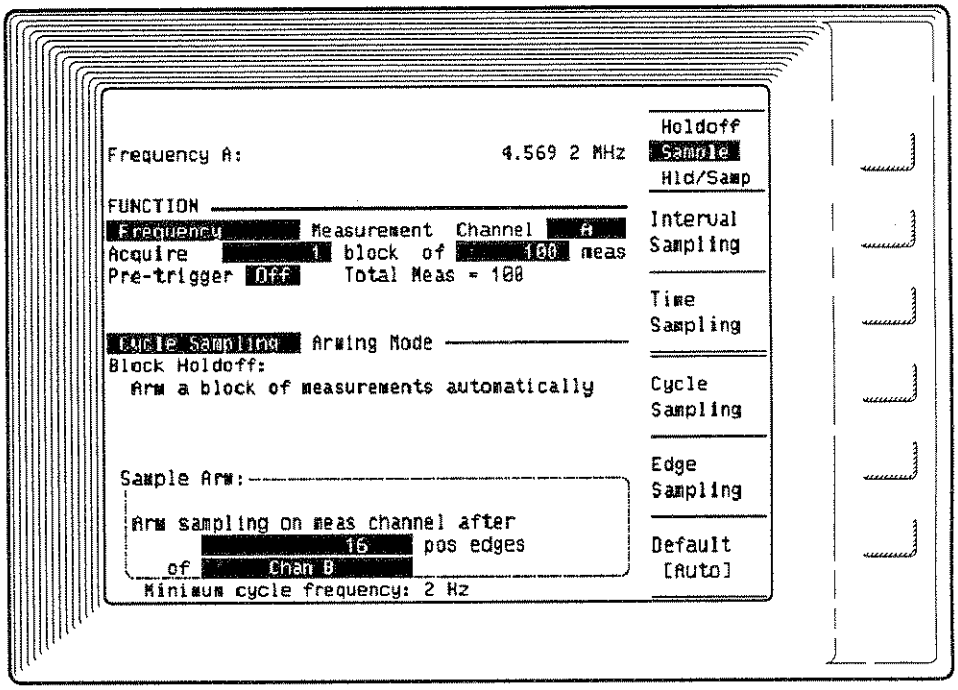
(B) The time period is referenced to the arming signal.

(C) The measurement starts on the trigger event of Channel A following the arming signal.

(D) The measurement ends on the trigger event of Channel A after the time period ends.

Cycle Sampling

Figure 5-21.
CYCLE SAMPLING
Menu Screen



MEASUREMENTS: PRF, Frequency, PRI, and Period

ARMING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: Cycles (events) of Channel A, B, or internal time base referenced to the automatic block holdoff signal.

COMMENTS: Sampling takes place on the trigger event following the counting of the selected number of cycle events. If the input PRF or Frequency is below the minimum cycle PRF or Frequency, as shown on the Cycle arming mode screen, measurement results will be incorrect.

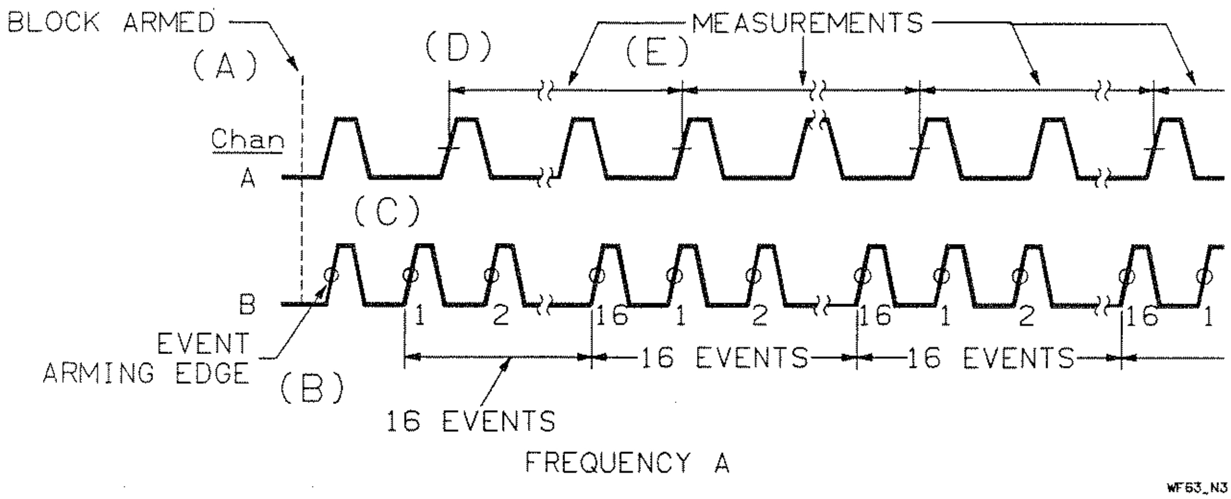


Figure 5-22. CYCLE SAMPLING Timing Diagram

(A) Block of measurements is armed as soon as the Analyzer is ready.

(B) The event arming edge on the cycle channel arms the start of the first measurement and the counting of cycles on the cycle channel. If Channel A was the measurement channel and the cycle channel, the first measurement and the cycle count would both begin on the first trigger event of Channel A, after the event arming edge.

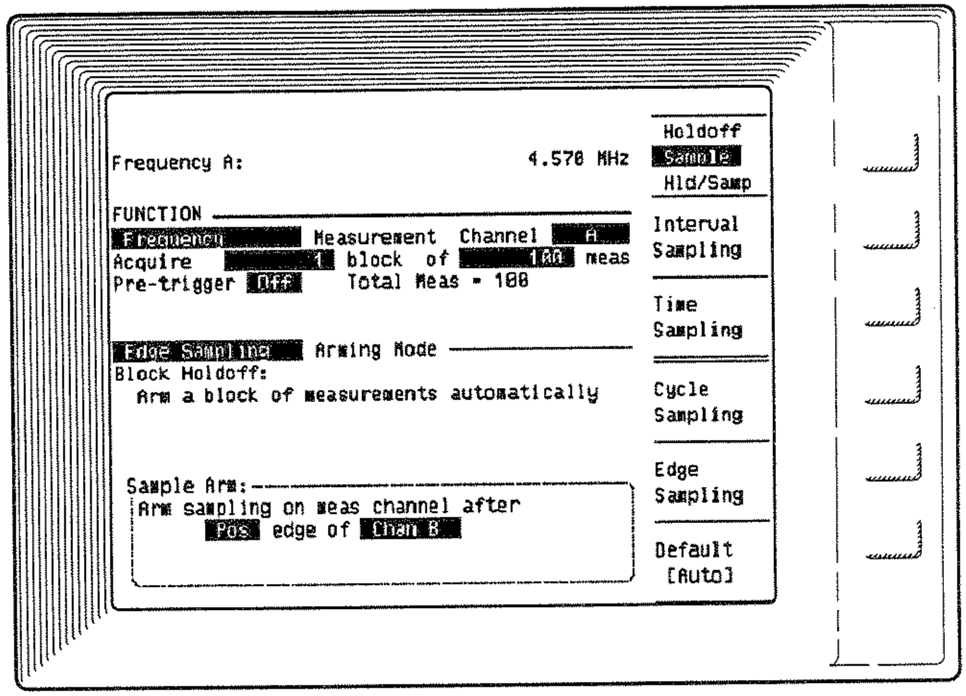
(C) The counting of cycles begins on the next trigger event of the cycle channel, after the event arming edge.

(D) The first measurement starts on the next trigger event on Channel A, after the event arming edge.

(E) The measurement ends on the Channel A trigger event after 16 events are counted on the cycle channel. Following measurement samples are taken on the trigger events after each 16 events on the cycle channel.

Edge Sampling

Figure 5-23.
EDGE SAMPLING
Menu Screen



MEASUREMENTS: PRF, Frequency, PRI, Period, and Totalize

ARMING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: Edge on Channel A, B, or Ext Arm

COMMENTS: Sampling takes place on the trigger event following the designated edge.

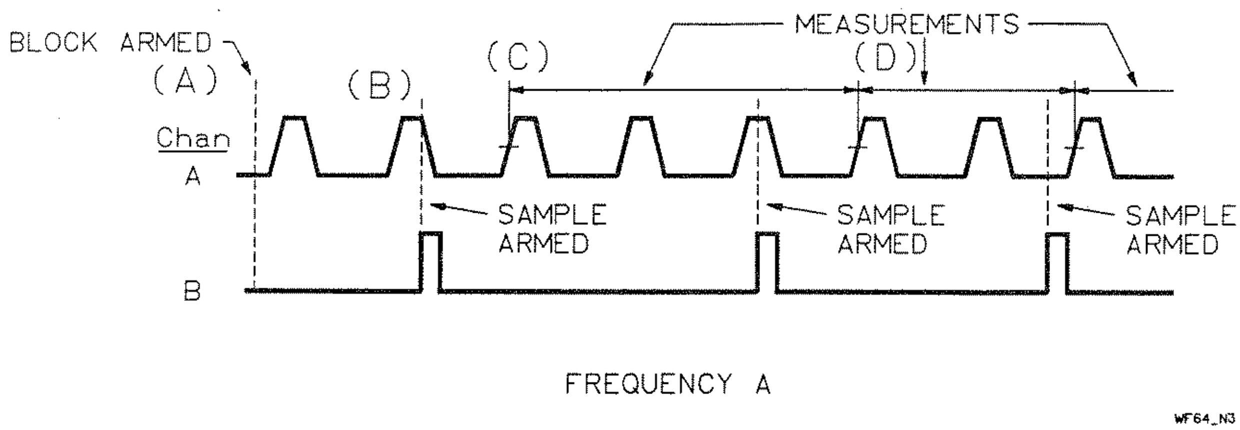


Figure 5-24. EDGE SAMPLING Timing Diagram

(A) Block of measurements is armed as soon as the Analyzer is ready.

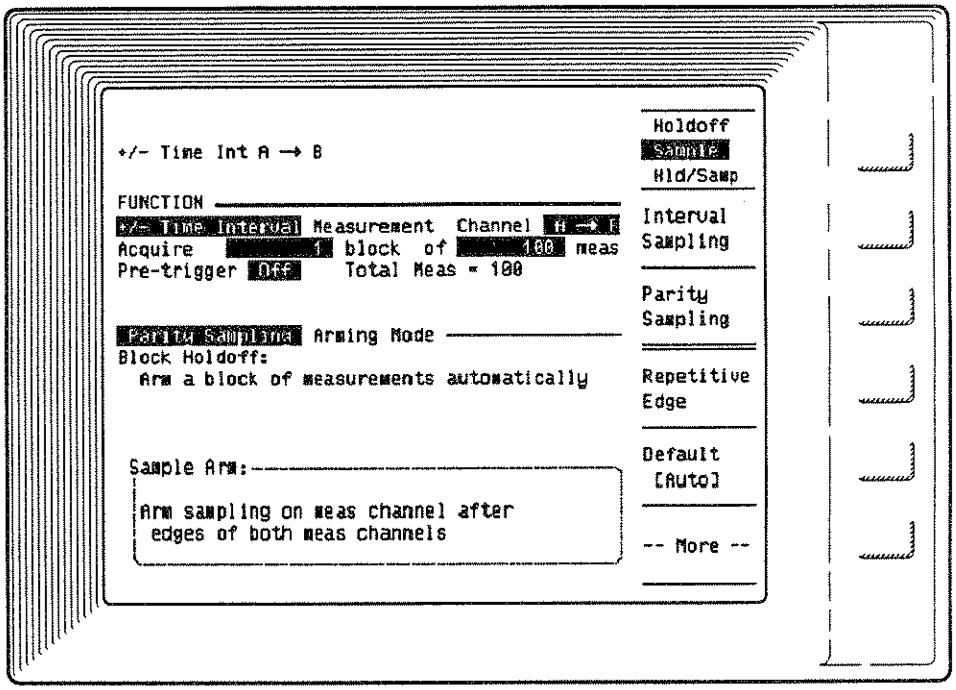
(B) A positive edge on Channel B arms the start of the first measurement.

(C) First measurement starts on the trigger event on Channel A following the arming edge.

(D) First measurement ends on the Channel A trigger event following another positive edge on Channel B. Each of the following Channel B sample arming edges prepares the Analyzer to end a measurement on the next Channel A trigger event.

Parity Sampling

Figure 5-25.
PARITY SAMPLING
Menu Screen



MEASUREMENT: ±Time Interval (two-channel)

ARMING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: Parity (An arming edge on Channel A and B)

COMMENTS: After an edge on each of two channels, a measurement is made. This arming mode is useful for applications where it is important to maintain a certain sequence for the two edges you are measuring. For example, you want to measure time intervals between two edges that lead and follow one another randomly.

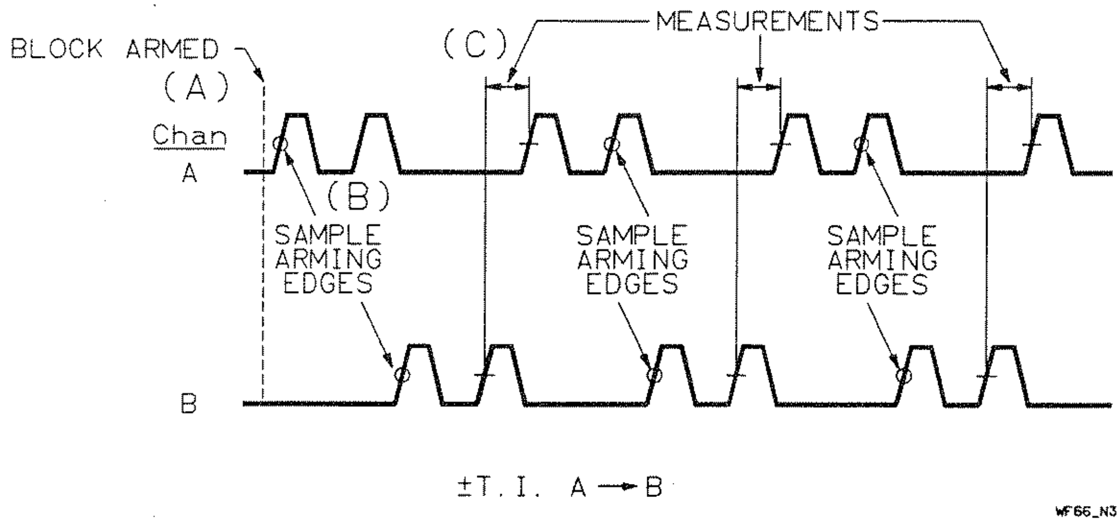


Figure 5-26. PARITY SAMPLING Timing Diagram

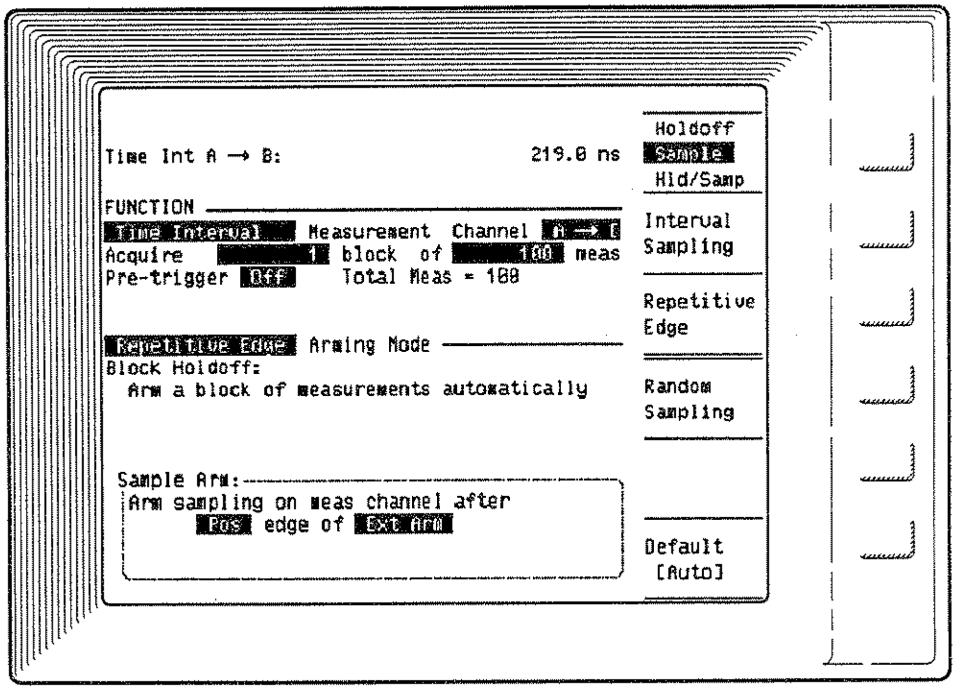
(A) Block of measurements is armed as soon as the Analyzer is ready.

(B) A trigger event on both Channel A and B is required before a measurement can be acquired.

(C) After the sample arm requirement of a trigger event on each of the measurement channels, a measurement is taken on the next pair of Channel A and B trigger events. The sequence of (B) and (C) is repeated for each measurement.

Repetitive Edge

Figure 5-27. REPETITIVE EDGE Menu Screen



MEASUREMENTS: Time Interval, Continuous Time Interval, and ±Time Interval

ARMING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: An edge on Channel A, B, or Ext Arm before every sample

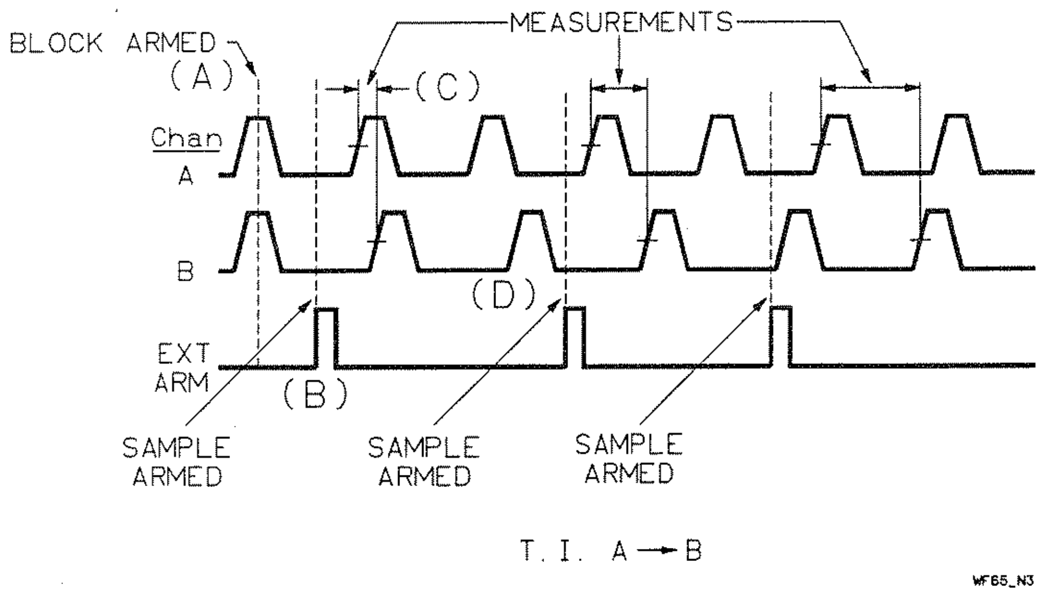


Figure 5-28. REPETITIVE EDGE Timing Diagram

(A) Block of measurements is armed as soon as the Analyzer is ready.

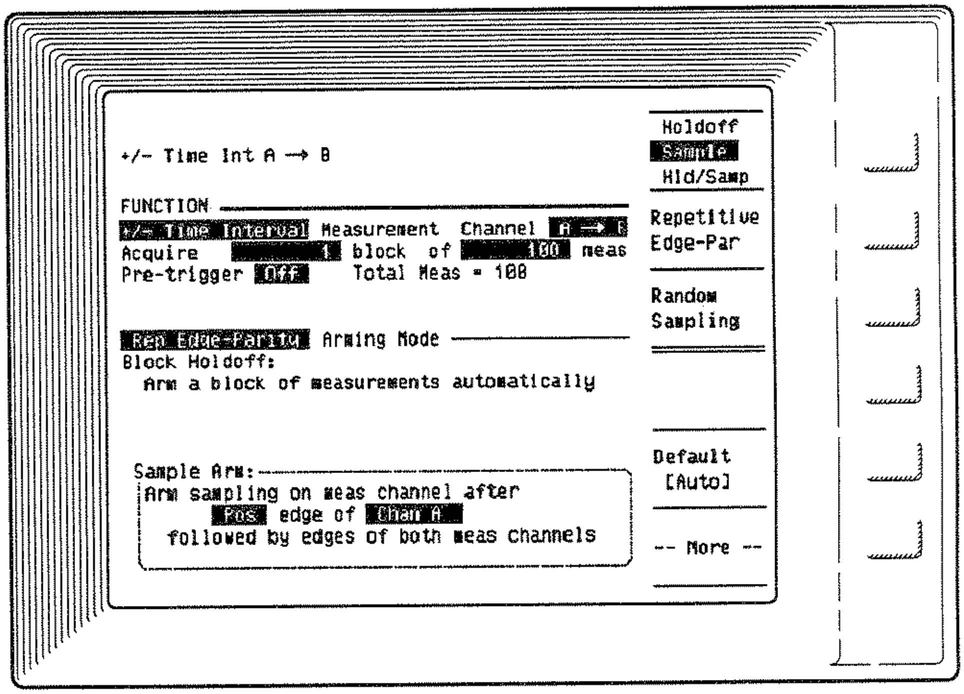
(B) A positive edge of Ext Arm arms the start of the first measurement.

(C) The first measurement starts on the next trigger event of Channel A and ends on the following trigger event of Channel B.

(D) Another positive edge of Ext Arm is required before the start of each measurement.

Repetitive Edge-Parity

Figure 5-29. REPETITIVE EDGE-PARITY Menu Screen



MEASUREMENTS: ±Time Interval (two-channel)

ARMING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: Edge on Channel A, B, or Ext Arm followed by parity

COMMENTS: After an edge on Channel A, B, or Ext Arm followed by an edge on each of two input channels, A and B, a measurement is made. This arming mode is useful for applications where it is important to maintain a certain sequence for two edges you are measuring. For example, you want to measure time intervals between two edges that lead and follow one another randomly.

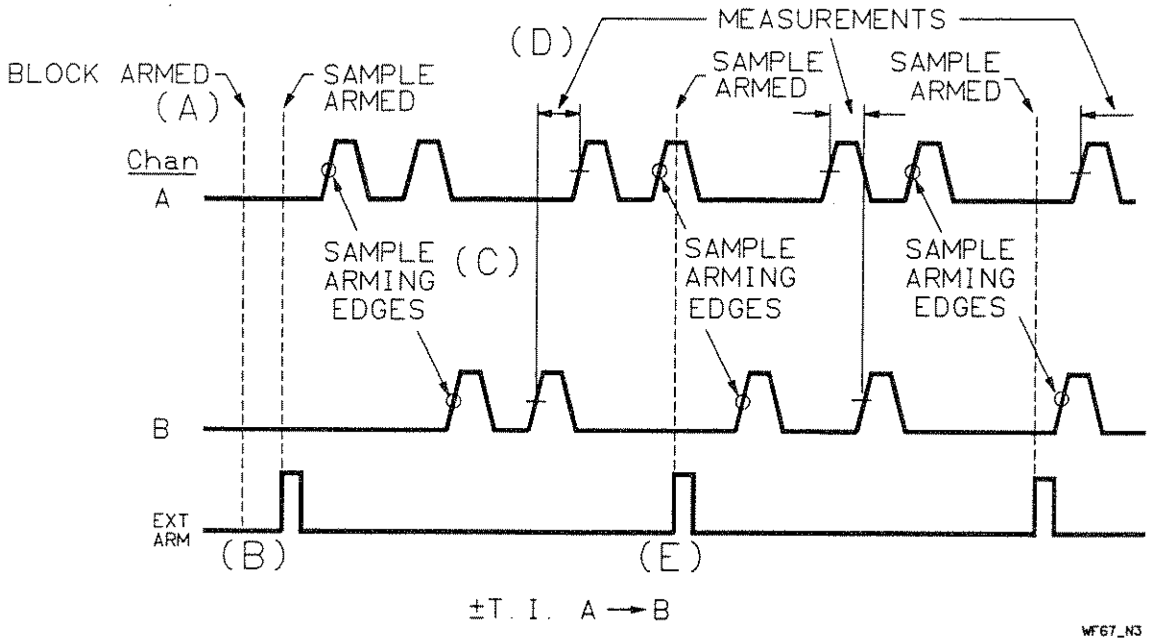


Figure 5-30. REPETITIVE EDGE-PARITY Timing Diagram

(A) Block of measurements is armed as soon as the Analyzer is ready.

(B) A positive edge of Ext Arm followed by (C) arms the start of a measurement.

(C) A trigger event on both Channel A and B is required before a measurement can be acquired.

(D) After a sample arm requirement of an edge and a trigger event on each of the measurement channels, a measurement is taken on the next pair of Channel A and B trigger events. The sequence of (B) and (C) is repeated for each measurement.

(E) The next positive edge of Ext Arm begins the sample arming sequence again.

Random Sampling

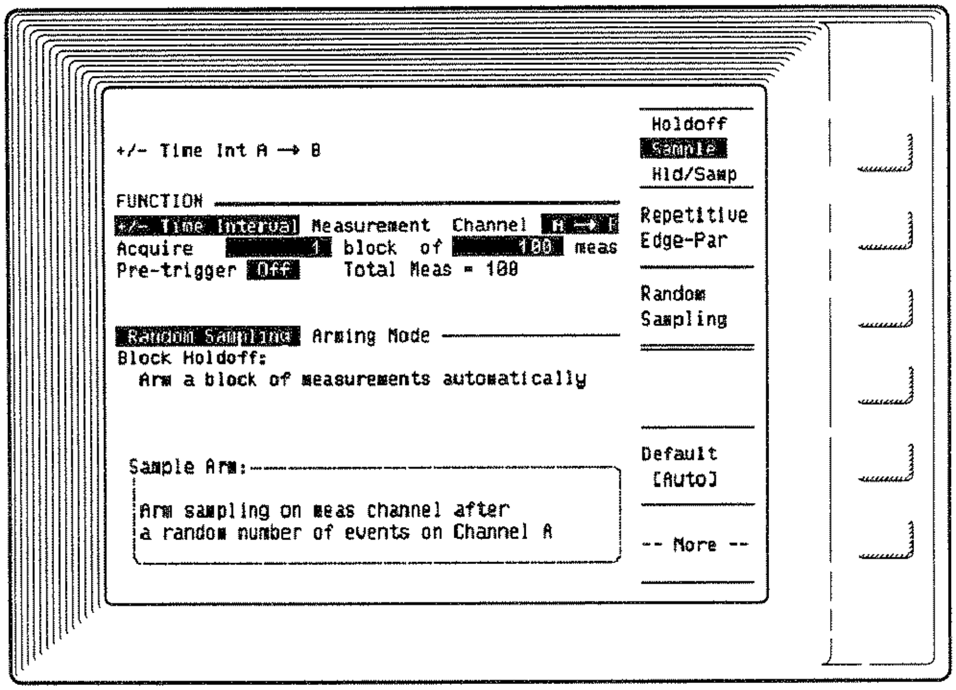


Figure 5-31.
RAMDOM SAMPLING
Menu Screen

MEASUREMENTS: Time Interval, ±Time Interval

ARMING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: 4 to 15 edges on Channel A (maximum Channel A PRF or Frequency for randomizer is 100 MHz)

COMMENTS: Measurements take place following a random number of edges on Channel A. This sampling mode is useful for measuring time intervals that could occur during the period when data samples are stored by the HP 5373A to memory. This could happen with intervals less than 200 ns. If one or more of the time intervals are synchronized to the data collection rate, so they always occur during memory access, they will never be measured. Random sampling ensures that all time intervals have an equal chance of being measured. Because of the delays introduced into the measurement sequence by the random sampling technique, a time interval measurement is being acquired, on average, at a rate of one every six edges on Channel A. To guarantee that a reasonable distribution is acquired for your signal data, use a minimum number of measurements per block of 500.

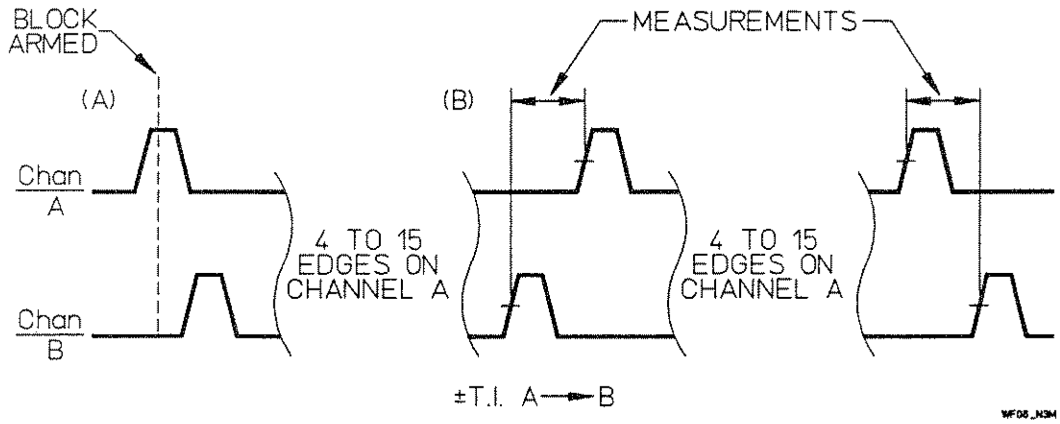


Figure 5-32. RANDOM SAMPLING Timing Diagram

(A) Block of measurements is armed as soon as the Analyzer is ready.

(B) Each measurement begins after a random number of edges on Channel A. The number of edges will vary from 4 to 15 between measurements.

NOTE

The pseudo-random sequence generator operates in a "free-run" mode. Because of this, the first measurement in a sequence can occur after fewer than four edges on Channel A. For the measurements that follow, the pseudo-random sequence generator arms a measurement every six to seventeen edges on Channel A.

HOLDOFF/SAMPLING MODE

DESCRIPTION:

The Holdoff/Sampling modes allow the most flexibility in determining how measurements are armed. It is possible to specify when blocks of measurements begin and when samples are collected, or when measurements start and stop.

Edge/Interval

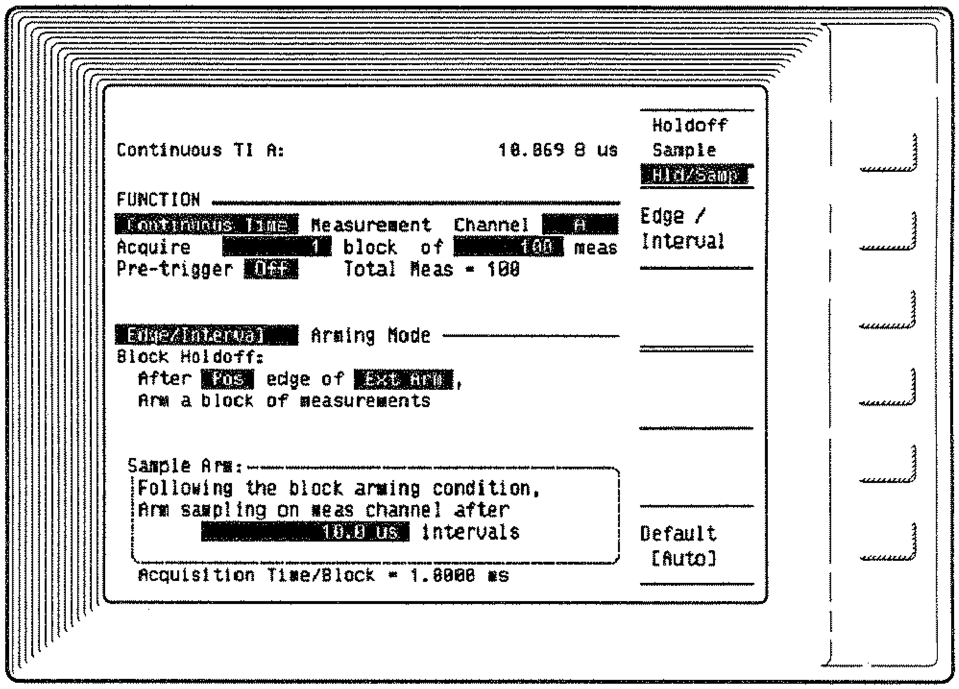


Figure 5-33. EDGE/INTERVAL Menu Screen

MEASUREMENTS: Time Interval, Continuous Time Interval, ±Time Interval, PRF, Frequency, PRI, Period, Totalize, Phase, Frequency Deviation, Phase Deviation, and Time Deviation

ARMING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or Ext Arm

SAMPLE ARM: Interval referenced to block holdoff edge

COMMENTS: The reference edge is time stamped for PRF, Frequency, PRI, Period, Continuous Time Interval, Frequency Deviation, Phase Deviation, and Time Deviation measurements.

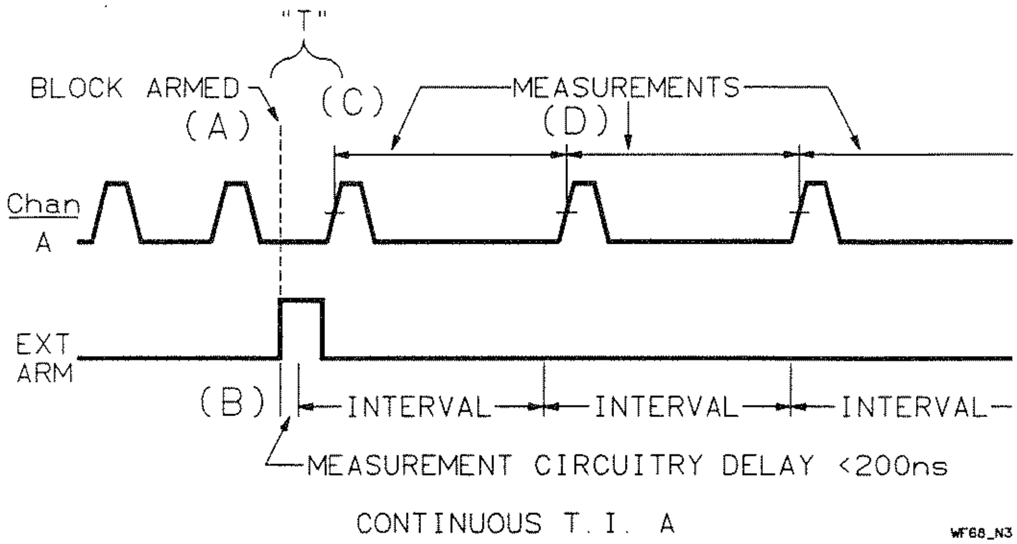


Figure 5-34. EDGE/INTERVAL Timing Diagram

(A) Block of measurements is armed after a positive edge on Ext Arm.

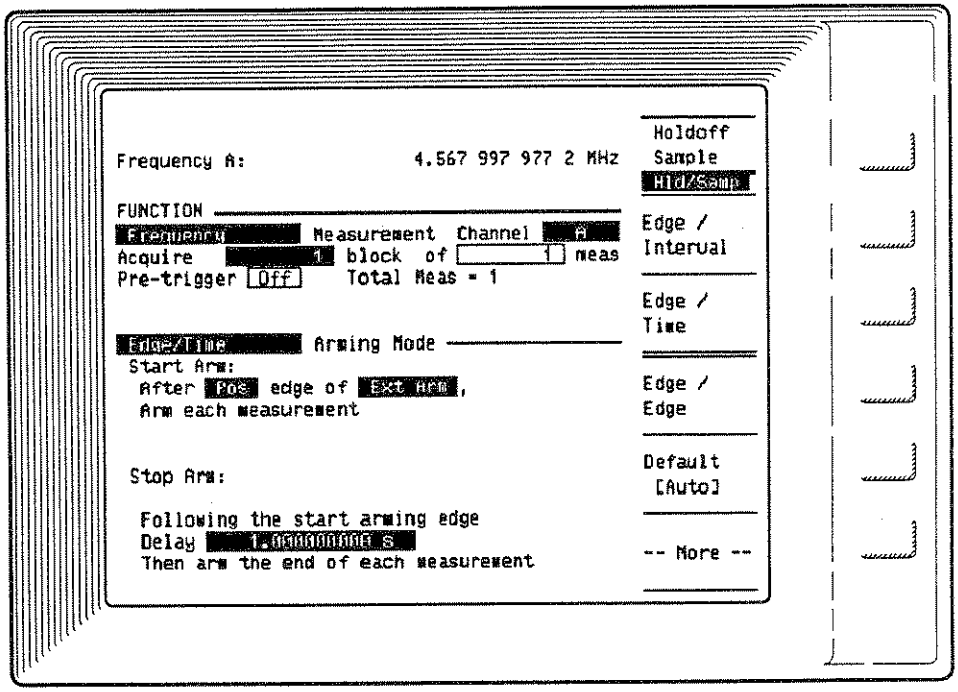
(B) The first specified interval then begins after the internal circuitry delay.

(C) The first measurement begins on the trigger event of Channel A after the start of the first interval.

(D) The first measurement ends, and the second measurement begins, on the trigger event following the end of the first interval. Each of the measurements end on the trigger event following the specified interval.

Edge/Time

Figure 5-35. EDGE/TIME Menu Screen



MEASUREMENTS: PRF, Frequency, PRI, and Period

ARMING: Non-continuous

START ARM: Edge on Channel A, B, or Ext Arm

STOP ARM: Time referenced to the start arm edge.

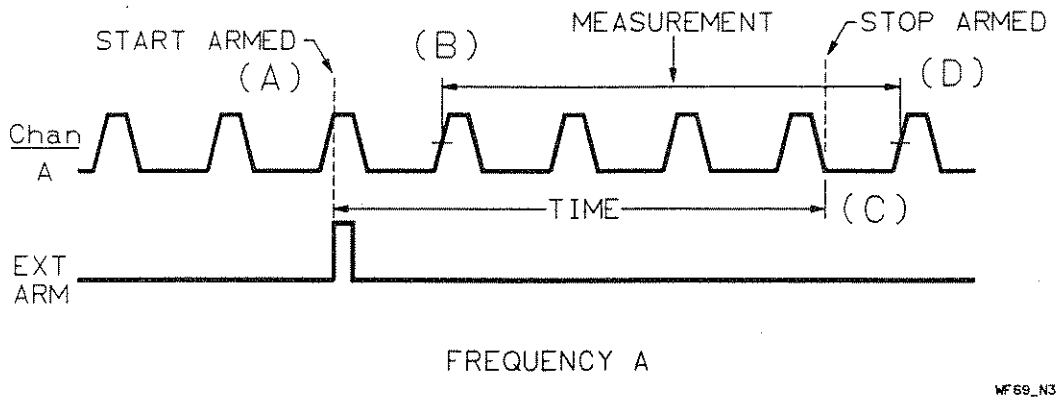


Figure 5-36. EDGE/TIME Timing Diagram

(A) Measurement start is armed after a positive edge on Ext Arm. The time period is also referenced to this edge.

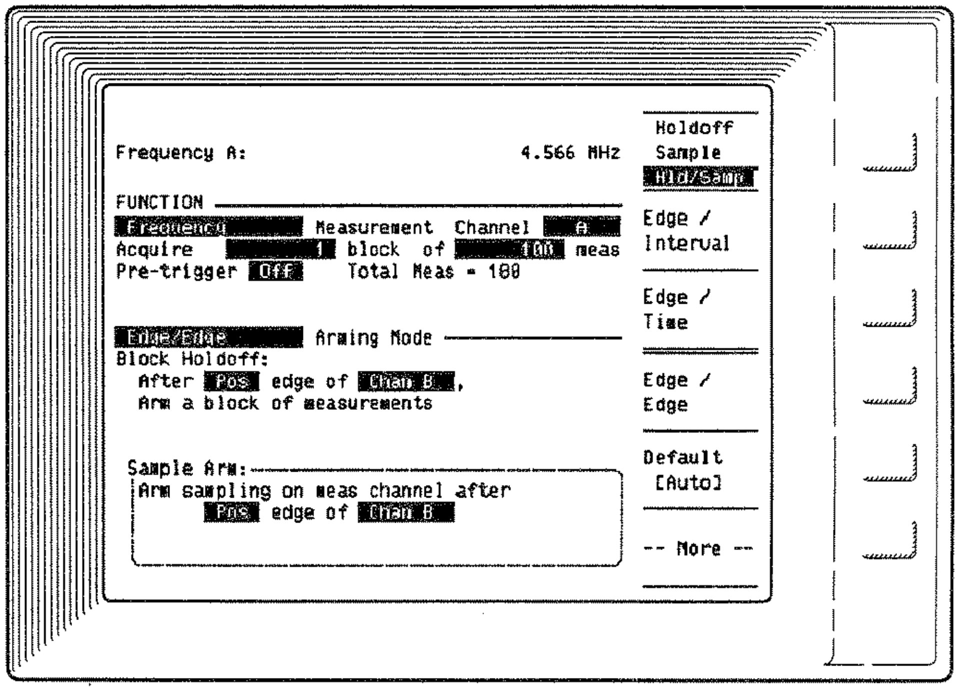
(B) The measurement starts on the trigger event of Channel A following the arming signal.

(C) The end of the time period arms the end of the measurement.

(D) The measurement ends on the trigger event of Channel A following the end of the time period.

Edge/Edge

Figure 5-37. EDGE/EDGE Menu Screen



MEASUREMENTS: PRF, Frequency, PRI, Period, and Totalize

ARMING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or Ext Arm

SAMPLE ARM: Edge on Channel A, B, or Ext Arm before every sample

COMMENTS: Measurements and arming can be set to occur on the same channel. The effect would be to sample on every other edge of the input signal.

The block holdoff edge is time stamped for PRF, Frequency, PRI, and Period measurements.

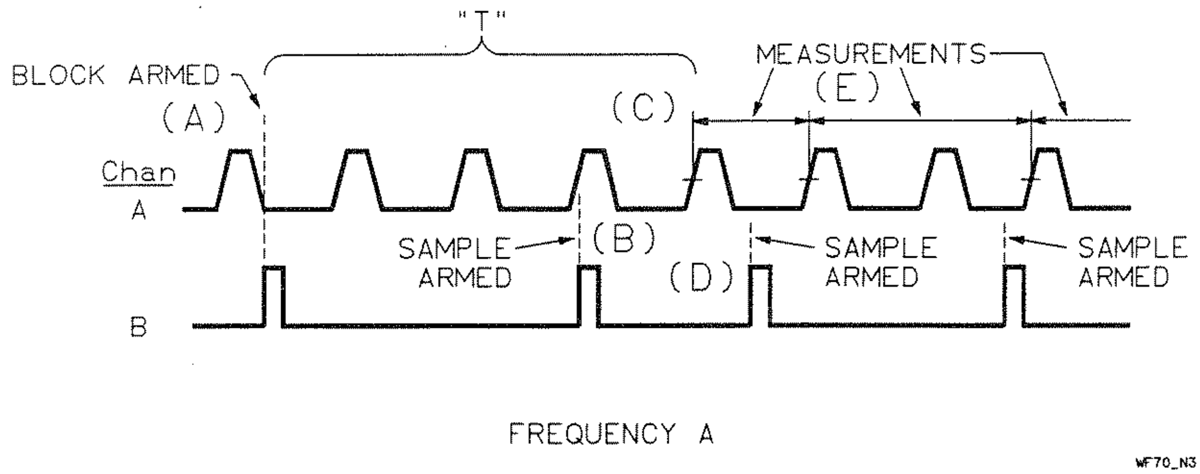


Figure 5-38. EDGE/EDGE Timing Diagram

(A) Block of measurements is armed after a positive edge of Channel B.

(B) Another positive edge of Channel B arms the start of the first measurement.

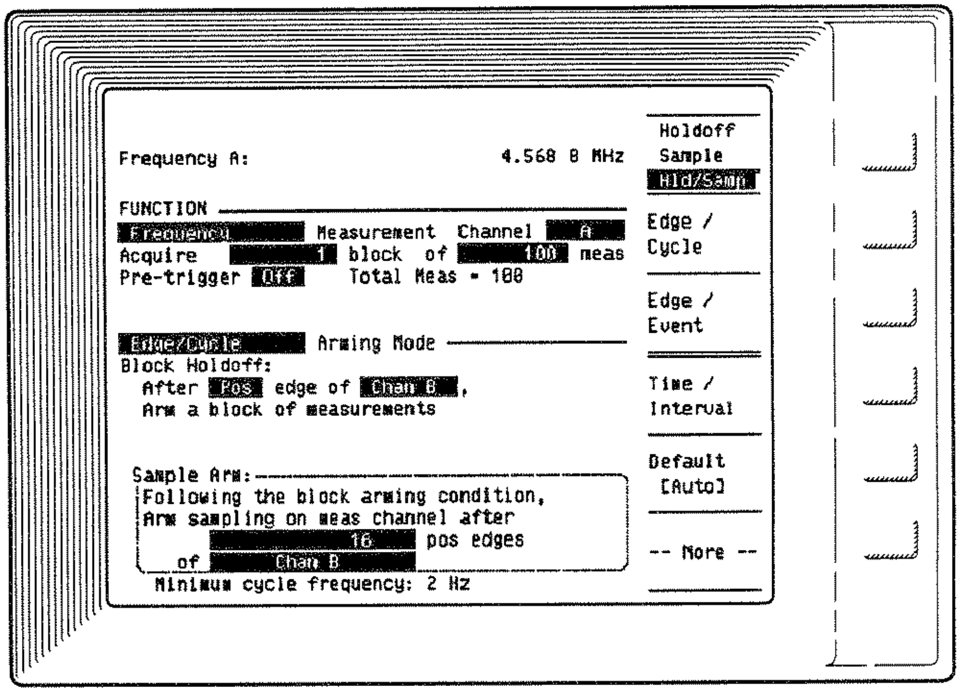
(C) The first measurement starts on the trigger event of Channel A following the arming edge.

(D) The next positive edge of Channel B arms end of the first measurement.

(E) The first measurement ends on the trigger event of Channel A following the arming edge. Subsequent measurement samples are taken after each arming edge.

Edge/Cycle

Figure 5-39. EDGE/CYCLE Menu Screen



MEASUREMENTS: PRF, Frequency, PRI, and Period

ARMING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or Ext Arm

SAMPLE ARM: Cycles (events) of Channel A, B, or internal timebase

COMMENTS: Sampling takes place on the trigger event following the counting of the selected number of cycle events. If the input PRF or Frequency is below the minimum cycle PRF or Frequency, as shown on the Cycle arming mode screen, measurement results will be incorrect.

The block holdoff edge is time stamped for PRF, Frequency, PRI, and Period measurements.

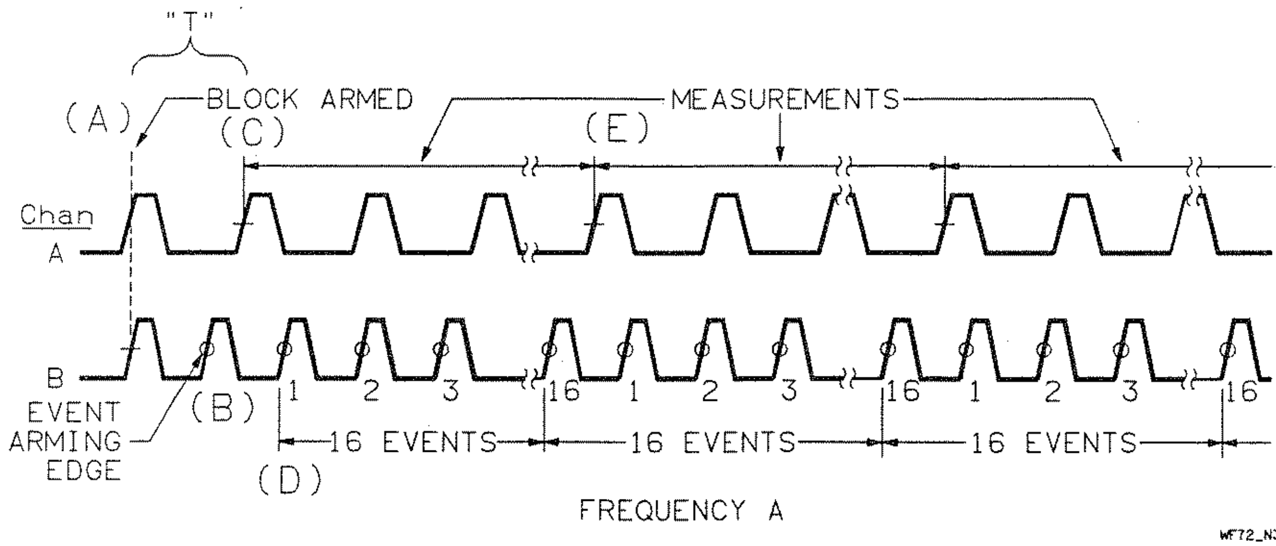


Figure 5-40. EDGE/CYCLE Timing Diagram

(A) Block of measurements is armed after a positive edge of Channel B.

(B) The event arming edge on the cycle channel arms the start of the first measurement and the counting of the cycles on the cycle channel. If Channel A was the measurement channel and the cycle channel, the first measurement and the cycle count would both begin on the first trigger event of Channel A, after the event arming edge.

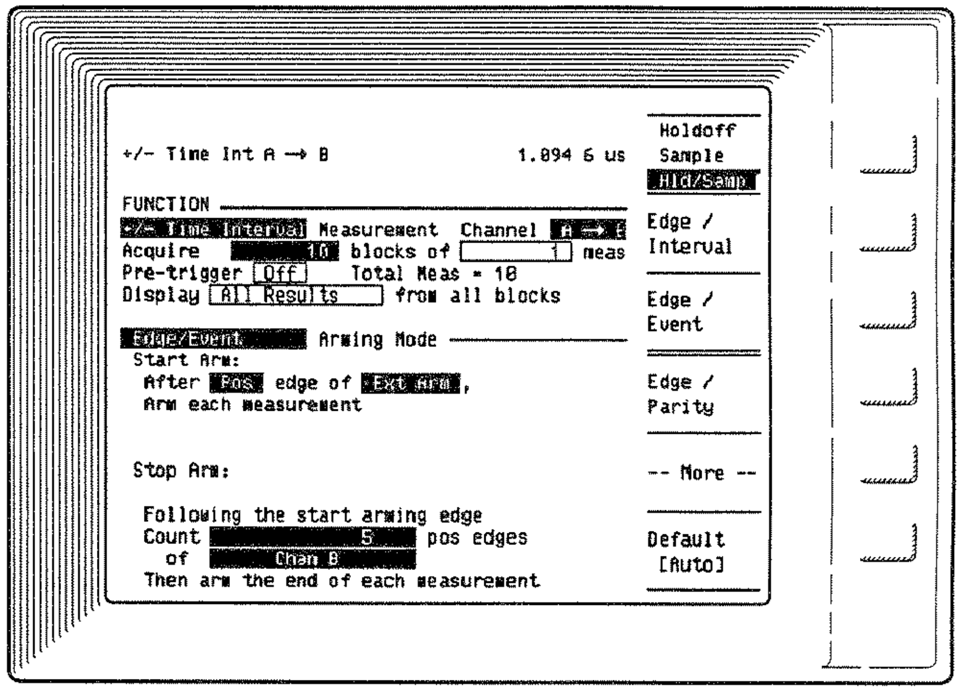
(C) The first measurement starts on the next trigger event on Channel A, after the event arming edge.

(D) The counting of cycles begins on the next trigger event of the cycle channel, after the event arming edge.

(E) The first measurement ends on the Channel A trigger event after 16 events are counted on the cycle channel. Subsequent measurement samples are taken on the trigger events after each 16 events on the cycle channel.

Edge/Event

Figure 5-41. EDGE/EVENT Menu Screen



MEASUREMENTS: ±Time Interval, PRF, Frequency, PRI, and Period

ARMING: Non-continuous

START ARM: Edge on Channel A, B, or Ext Arm

STOP ARM: Events on Channel A or B referenced to the start arm edge

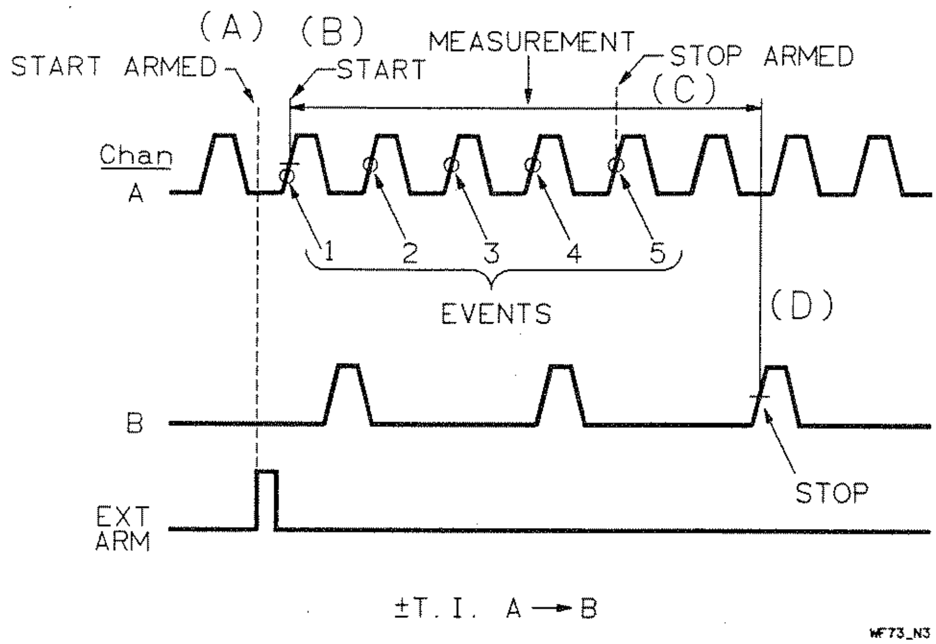


Figure 5-42. EDGE/EVENT Timing Diagram

(A) Measurement start is armed by a positive edge on Ext Arm.

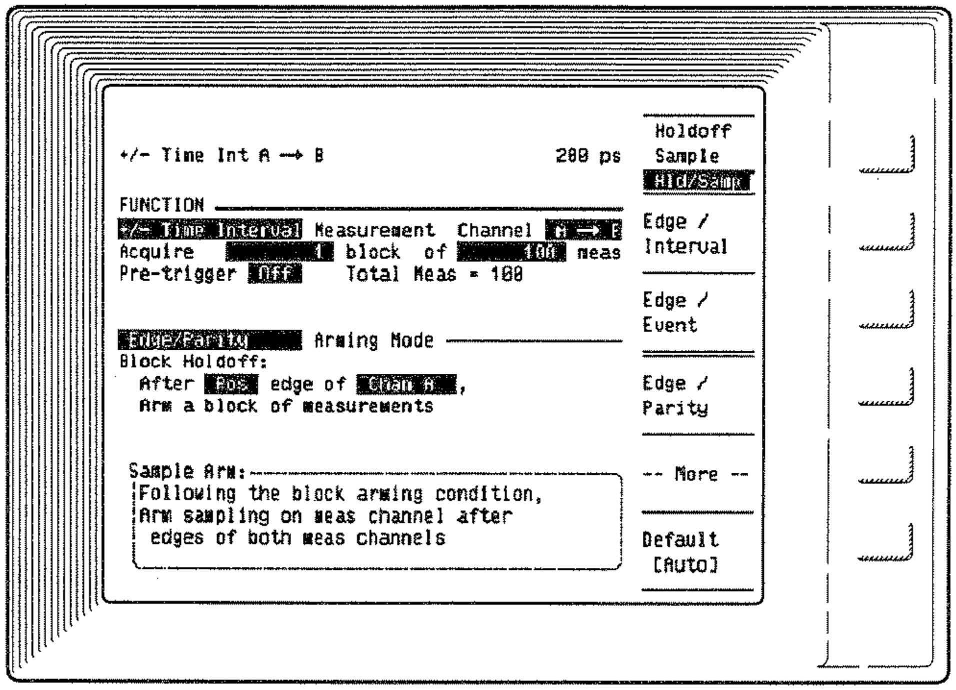
(B) Measurement starts on the next trigger event of Channel A. The event count on Channel A starts on the same trigger event edge.

(C) Measurement end is armed after the fifth event of Channel A.

(D) Measurement ends on the next trigger event of Channel B.

Edge/Parity

Figure 5-43. EDGE/PARITY Menu Screen



MEASUREMENT: ±Time Interval (two-channel)

ARMING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or Ext Arm

SAMPLE ARM: Parity (An arming edge on Channel A and B)

COMMENTS: Following the block holdoff reference edge, each measurement is made after an edge on each of two channels, A and B. This arming mode is useful for applications where it is important to maintain a certain sequence for the two edges you are measuring. For example, you want to measure time intervals between two edges that lead and follow each other randomly.

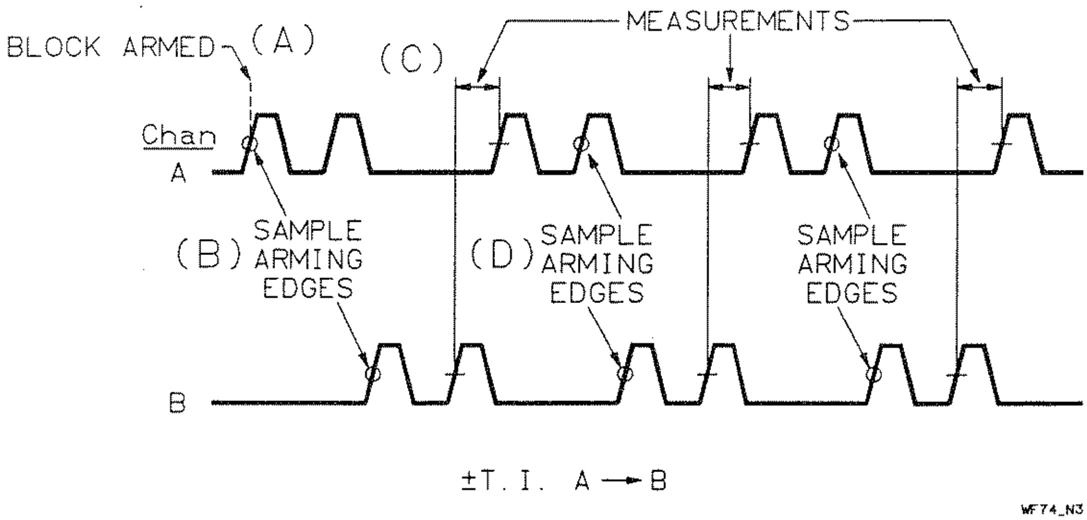


Figure 5-44. EDGE/PARITY Timing Diagram

(A) Block of measurements is armed after a positive edge of Channel A.

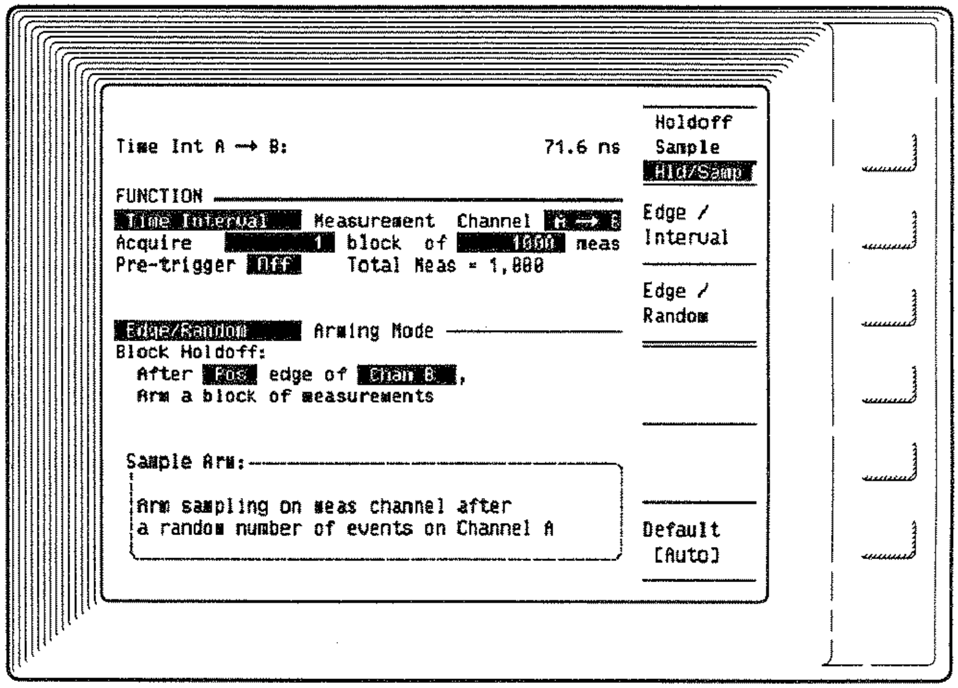
(B) A trigger event on both Channel A and B is required before a measurement can be acquired.

(C) After the sample arm requirement of a trigger event on each of the measurement channels, a measurement is taken on the next pair of Channel A and B trigger events. The sequence of (B) and (C) is repeated for each measurement.

(D) A trigger event on both Channel A and B arms the next measurement.

Edge/Random

Figure 5-45. EDGE/RANDOM Menu Screen



MEASUREMENT: Time Interval, ±Time Interval (two-channel)

ARMING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or Ext Arm

SAMPLE ARM: 4 to 15 edges on Channel A (maximum Channel A PRF or Frequency for randomizer is 100 MHz)

COMMENTS: Measurements take place following a random number of edges on Channel A. This sampling mode is useful for measuring time intervals that could occur during the period when data samples are stored by the HP 5373A to memory. This could happen with intervals less than 200 ns. If one or more of the time intervals are synchronized to the data collection rate so they always occur during memory access, they will never be measured. Random sampling ensures that all time intervals have an equal chance of being measured. Because of the delays introduced into the measurement sequence by the random sampling technique, a time interval measurement is acquired, on average, at a rate of one every six edges on Channel A. To guarantee that a reasonable distribution is acquired for your signal data, use a minimum number of measurements per block of 500.

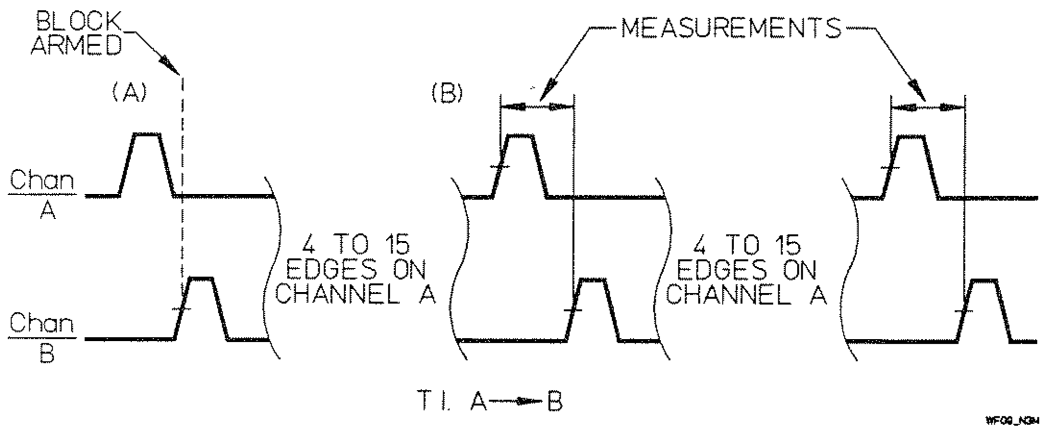


Figure 5-46. EDGE/RANDOM Timing Diagram

(A) Block of measurements is armed after a positive edge of Channel B.

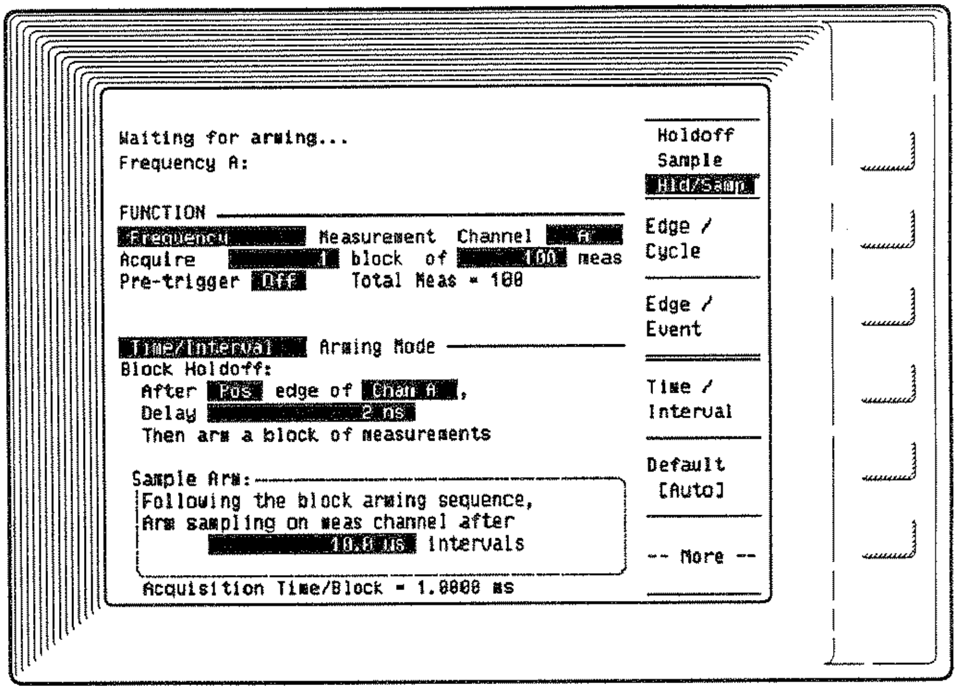
(B) Each measurement begins after a random number of edges on Channel A. The number of edges will vary from 4 to 15 between measurements.

NOTE

The pseudo-random sequence generator operates in a "free-run" mode. Because of this, the first measurement in a sequence can occur after fewer than four edges on Channel A. For the measurements that follow, the pseudo-random sequence generator arms a measurement every six to seventeen edges on Channel A.

Time/Interval

Figure 5-47. TIME/INTERVAL Menu Screen



MEASUREMENTS: PRF, Frequency, PRI, Period, and Totalize

ARMING: Continuous

BLOCK HOLDOFF: Time referenced to an edge on Channel A, B, or Ext Arm

SAMPLE ARM: Interval referenced to the block holdoff conditions

COMMENTS: The block holdoff edge is time stamped for PRF, Frequency, PRI, and Period measurements.

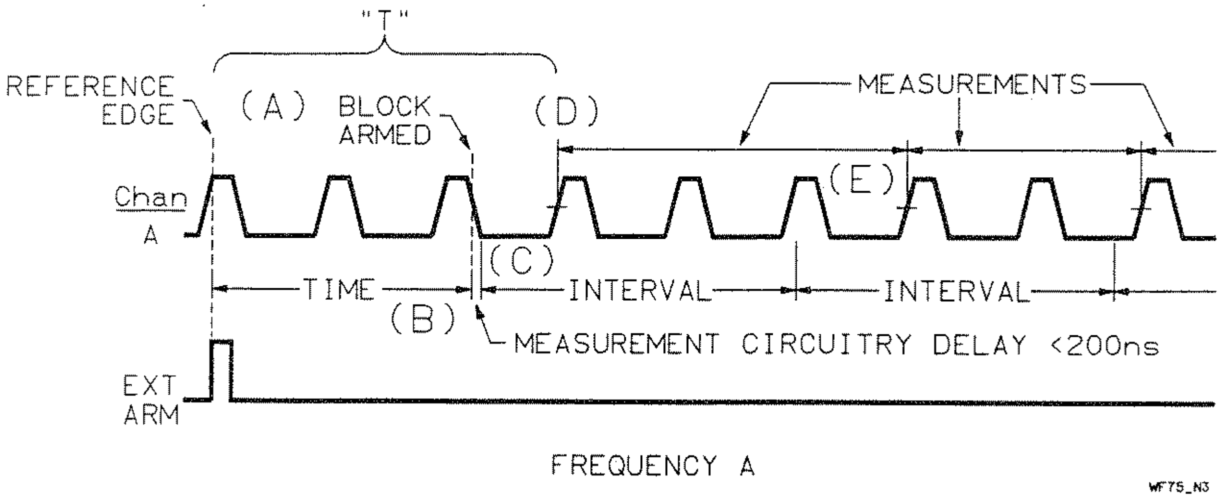


Figure 5-48. TIME/INTERVAL Timing Diagram

(A) A positive edge of Ext Arm provides the reference edge for the time delay.

(B) Block of measurements is armed at the end of the time delay.

(C) The first specified interval then begins after the internal circuitry delay.

(D) The first measurement begins on the trigger event of Channel A following the start of the interval.

(E) The first measurement ends on the Channel A trigger event following the end of the first interval. Subsequent measurements end on the trigger event after each interval.

Time/Time

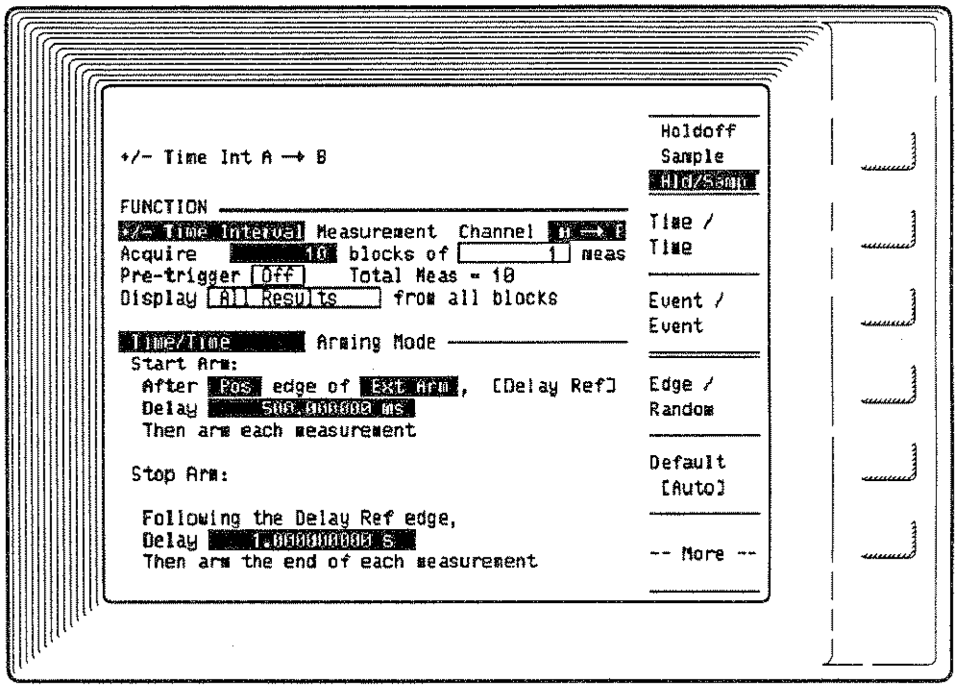


Figure 5-49. TIME/TIME Menu Screen

MEASUREMENTS: ±Time Interval, PRF, Frequency, PRI, and Period

ARMING: Non-continuous

START ARM: Time referenced to an edge on Channel A, B, or Ext Arm

STOP ARM: Time referenced to the start arm edge.

COMMENTS: For a ±Time Interval measurement, if the stop arm comes before the start arm, the result will always be negative. For a PRF or Frequency measurement, the result will always be positive. This arming mode is valuable to specifically "window" a period of time with a resolution of 2 ns.

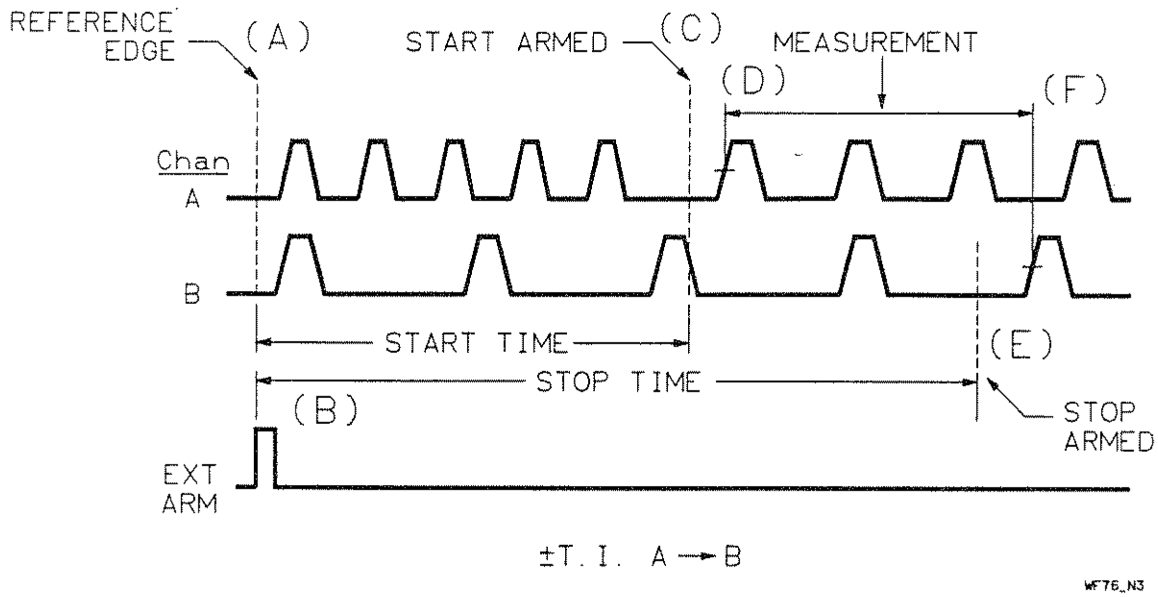


Figure 5-50. TIME/TIME Timing Diagram

(A) A positive edge of Ext Arm provides a reference edge for the time delays.

(B) Both the start and stop time delays are referenced to the same reference edge.

(C) The measurement start is armed after the start time ends.

(D) The measurement starts on the trigger event of Channel A after the start time.

(E) The measurement stop is armed after the stop time ends.

(F) The measurement ends on the trigger event of Channel B after the stop time.

Event/Interval

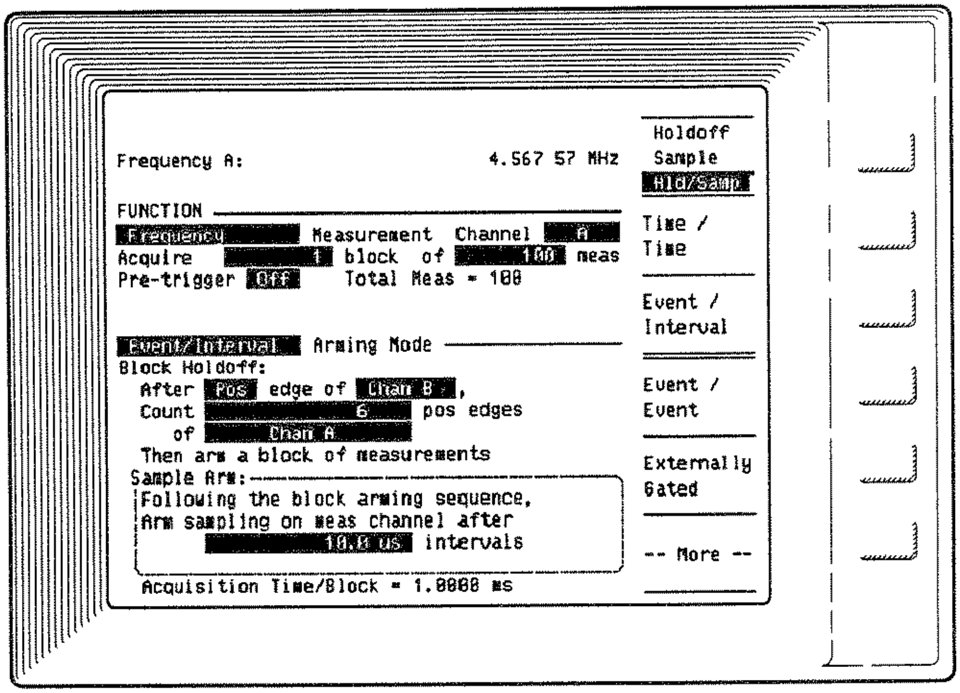


Figure 5-51.
EVENT/INTERVAL
Menu Screen

MEASUREMENTS: PRF, Frequency, PRI, and Period

ARMING: Continuous

BLOCK HOLDOFF: Events on Channel A or B referenced to an edge on Channel A, B, or Ext Arm

SAMPLE ARM: Interval referenced to the block holdoff conditions

COMMENTS: The block holdoff edge is time stamped for PRF, Frequency, PRI, and Period measurements.

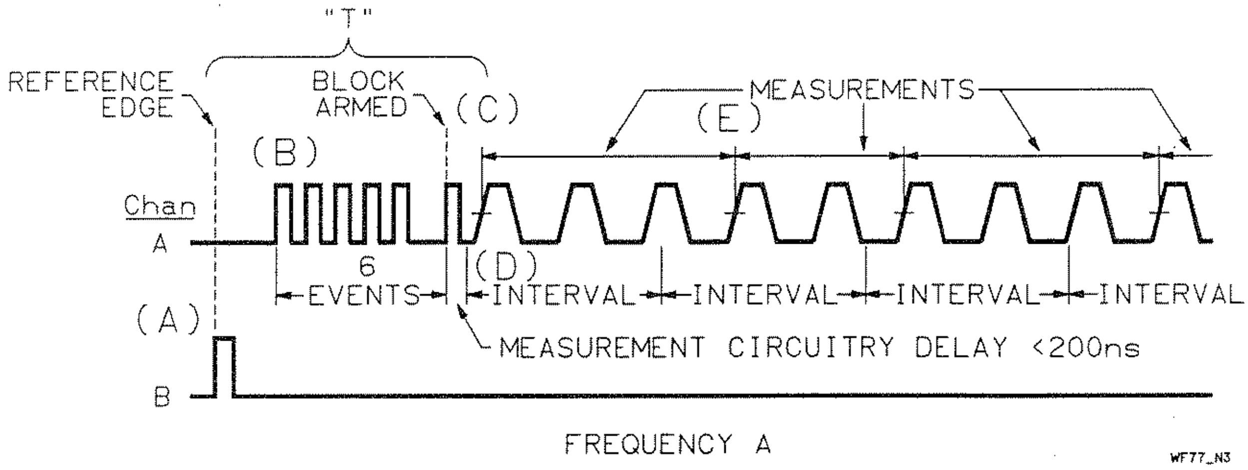


Figure 5-52. EVENT/INTERVAL Timing Diagram

(A) A positive edge of Channel B provides the reference edge for the event delay.

(B) The event count starts on the next positive edge of Channel A.

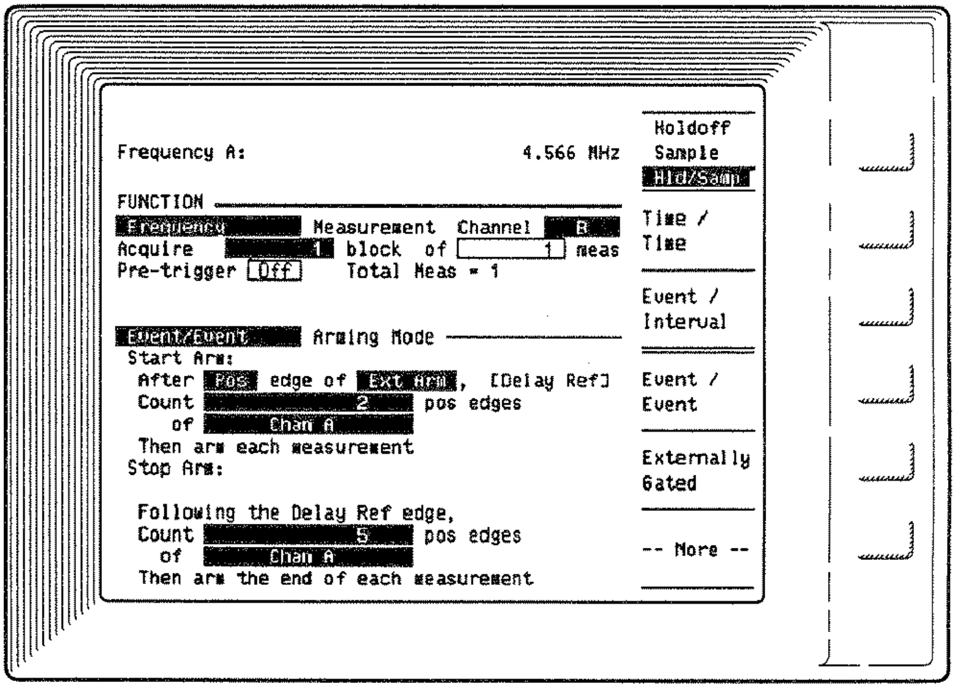
(C) Block of measurements is armed after six events are counted.

(D) The first specified interval then begins after the internal circuitry delay. The first measurement begins on the trigger event of Channel A following the start of the interval.

(E) The measurement ends on the Channel A trigger event following the end of the first interval. Subsequent measurements end after each of the specified intervals.

Event/Event

Figure 5-53. EVENT/EVENT Menu Screen



MEASUREMENTS: ±Time Interval, PRF, Frequency, PRI, and Period

ARMING: Non-continuous

START ARM: Events on Channel A or B referenced to an edge on Channel A, B, or Ext Arm

STOP ARM: Events on Channel A or B referenced to the start arm edge

COMMENTS: For PRF, Frequency, PRI, and Period measurements, if the start arm occurs before the stop arm, results will be positive. For ±Time Interval measurements, a stop arm coming before a start arm will give a negative result.

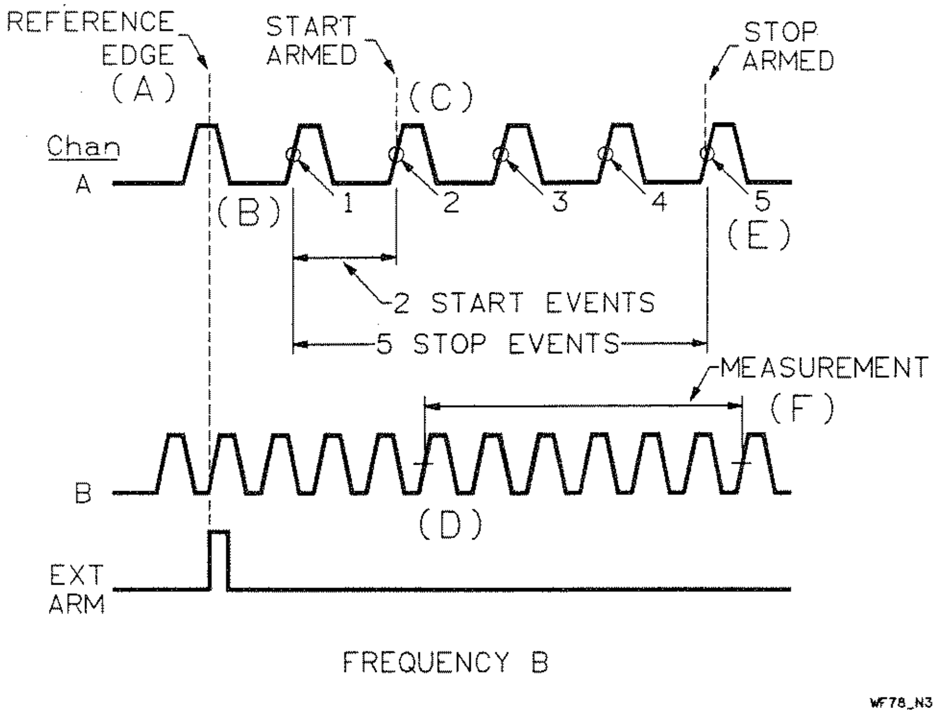


Figure 5-54. EVENT/EVENT Timing Diagram

(A) A positive edge of Ext Arm provides the reference edge for the event delays.

(B) The start and stop event counts begin on the trigger event of Channel A after the reference edge. In this example, the start and stop events are counted on the same channel. They can occur on different channels.

(C) The measurement start is armed after the second positive event of Channel A, following the reference edge.

(D) The measurement begins on the next trigger event of Channel B, after the start arm signal.

(E) The measurement end is armed after the fifth positive event of Channel A, following the reference edge.

(F) The measurement ends on the next trigger event of Channel B, after the stop arm signal.

Externally Gated

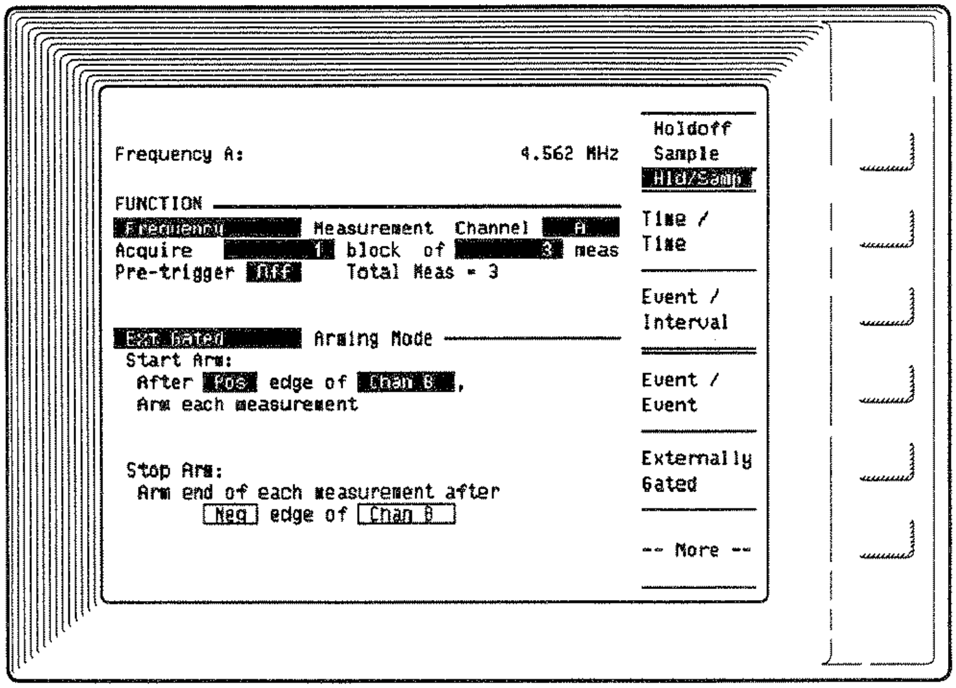


Figure 5-55. EXTERNALLY GATED Menu Screen

MEASUREMENTS: PRF, Frequency, PRI, Period, and Totalize

ARMING: Continuous

START ARM: Edge on Channel A, B, or Ext Arm

STOP ARM: Opposite edge of start arm pulse

COMMENTS: The start and stop of the measurement is armed by the leading and trailing edge of a positive or negative pulse on Channel A, B, or External Arm.

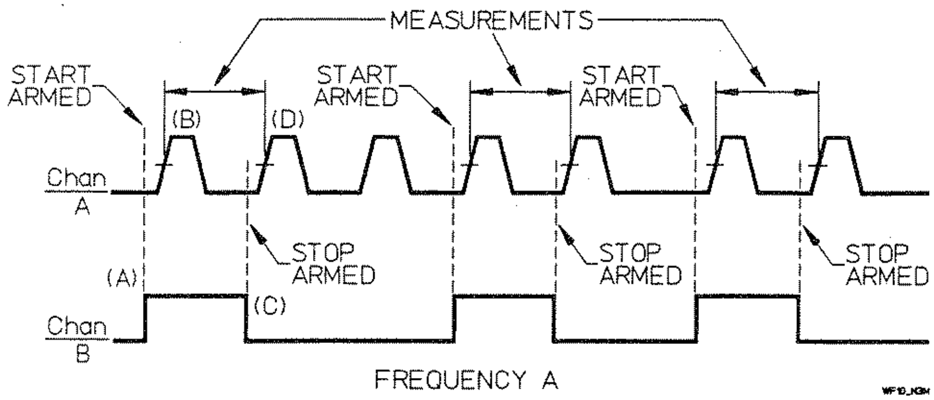


Figure 5-56. EXTERNALLY GATED Timing Diagram

(A) Start of measurement is armed by the positive edge of Channel B.

(B) Measurement starts on the trigger event of Channel A following start arming signal.

(C) End of measurement is armed by the next negative edge of Channel B.

(D) Measurement ends on the trigger event of Channel A following stop arming signal.

Manual

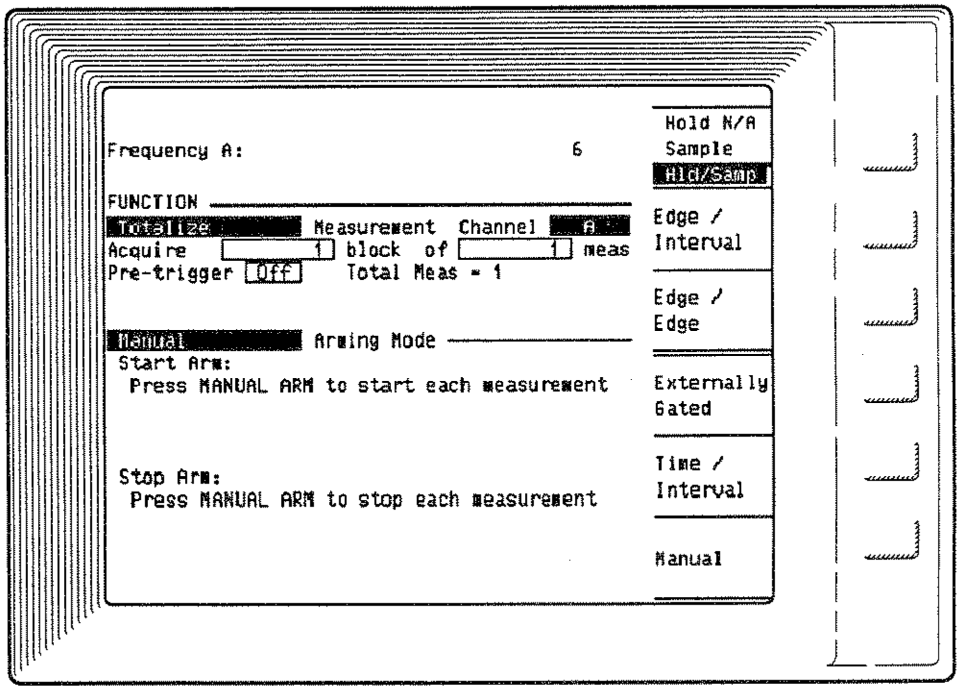


Figure 5-57. MANUAL Menu Screen

MEASUREMENT: Totalize

ARMING: Non-continuous

START MEASUREMENT: Press **Manual Arm** key once.

STOP MEASUREMENT: Press **Manual Arm** key again.

COMMENTS: This arming mode is only available for Totalize measurements. When the front-panel **Single/Repet** key is set to Repetitive, successive measurements will accumulate. When in Single mode, the **Restart** key must be pressed between measurements, and successive measurements do not accumulate.

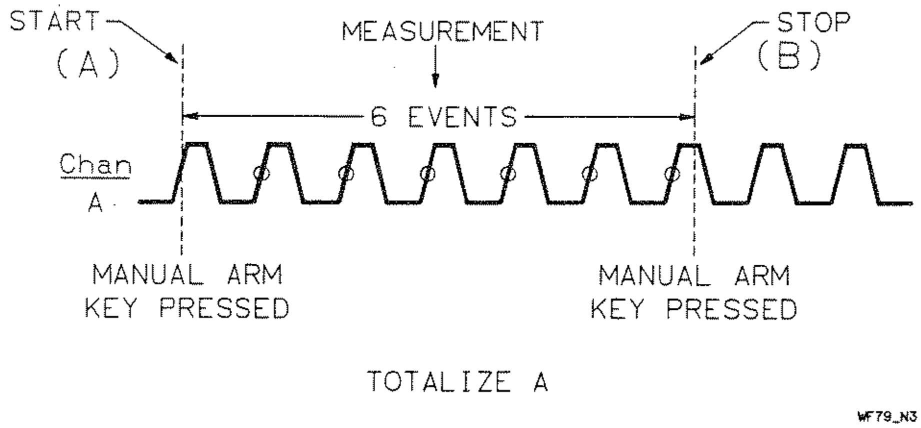


Figure 5-58. MANUAL Timing Diagram

(A) Measurement starts when the **Manual Arm** key is pressed.

(B) Measurement stops when the **Manual Arm** key is pressed a second time. The measurement result is the total number of trigger events that occurred on Channel A between the key presses.

6

Contents of Chapter

6

FRONT PANEL / REAR PANEL

CHAPTER OVERVIEW

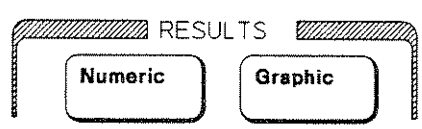
This chapter describes the front panel's functional layout and the front-panel keys. The rear panel's input and output features are described, as well.

FRONT PANEL ORGANIZATION

The HP 5373A has been designed so that related controls and features are grouped together. As a result, its front panel is divided into eight functional areas. These are:

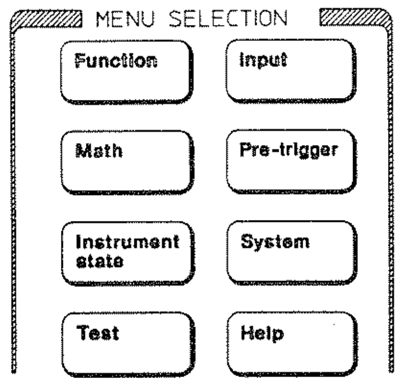
- Results
- Menu Selection
- Data Entry
- HP-IB Status
- Instrument Control
- Cursor/Scroll — Entry/Marker
- Display Screen and Softkeys
- Additional Keys

RESULTS AREA



The RESULTS keys are located at the top of the front panel adjacent to the instrument display screen. These keys control the display of numeric and graphic data. The function of each key is discussed in detail in its own chapter of this manual.

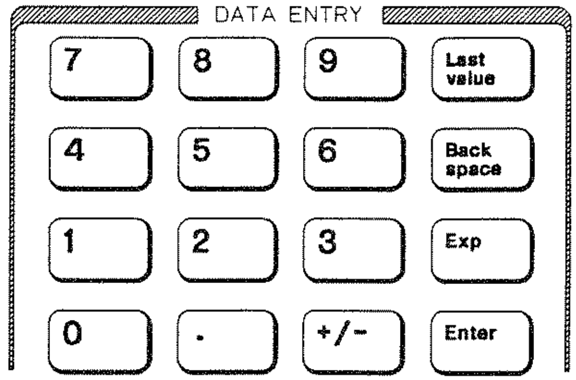
MENU SELECTION AREA



The MENU SELECTION keys are located below the RESULTS keys. The function of each key is discussed in detail in its own chapter of this manual. Here is a short description of the features behind each of the menu selection keys:

- **Function** — Use to select the measurement function, the number of measurements, and the arming of the measurement.
- **Input** — Use to define the trigger event and select input signal conditioning.
- **Math** — Use to select post-processing math, statistics, and limit testing. For phase deviation, time deviation, or frequency deviation, this is where you specify the carrier estimation value(s) to be used.
- **Pre-trigger** — Use to specify the conditions for pre-trigger, TI Detect, and Measurement Inhibit.
- **Instrument State** — Use to display the contents of each Save/Recall register and to set overwrite protection.
- **System** — Use to set the HP-IB configuration, display installed options, select data width (Measurement Mode), set the system clock, and blank the display.
- **Test** — Provides diagnostic tests for a service technician when a failure of the instrument is suspected.
- **Help** — Use to display summarized instrument operating information.

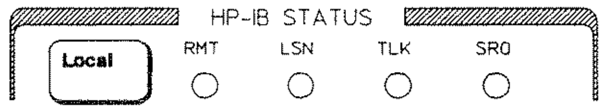
DATA ENTRY AREA



Data Entry keys are used to enter numbers into the numeric fields of the menu screens.

- Use digits, 0 to 9, and "." (decimal point) to enter numbers.
- Use the ±key to change the sign of the number being entered. The change-sign key will apply to the exponent when the exponent is displayed.
- Pressing the **Exp** (exponent) key adds "E+00" to the number already displayed. While in this mode, the digit and change-sign keys apply to the value of the exponent.
- The **Last value** key terminates the data entry mode without saving the entered value. The previous value is restored.
- The **Back space** key erases the last digit entered in the numeric field during a data entry sequence.
- The **Enter** key completes a data entry sequence by accepting and saving the entered value.

HP-IB STATUS AREA



The Local key and four LEDs make up the HP-IB status area.

Local key

Pressing this key returns the HP 5373A to front panel control when in remote operation. This key is ignored when the Local Lockout mode is enabled.

RMT LED

The **RMT** LED indicates that the HP 5373A is in the remote operating state.

LSN LED

The **LSN** LED indicates that the HP 5373A is addressed to listen or is an active listener.

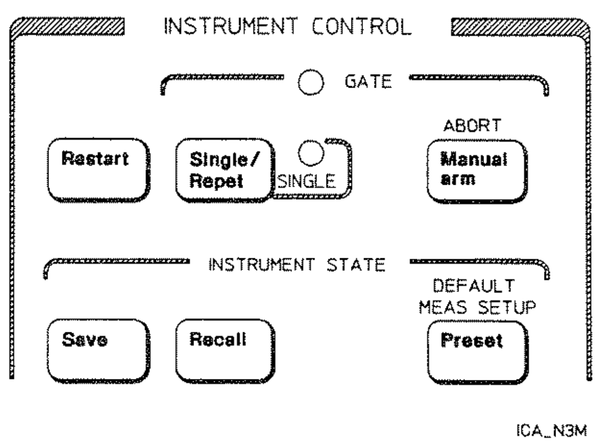
TLK LED

The **TLK** LED indicates that the HP 5373A is addressed to talk or is an active talker.

SRQ LED

The **SRQ** LED indicates that the HP 5373A is requesting service from the interface controller.

INSTRUMENT CONTROL AREA



The Instrument Control keys provide control of data acquisition, the Save/Recall registers, and the default setup of the HP 5373A.

GATE LED

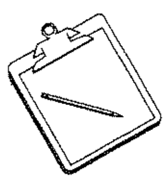
The GATE LED comes on when the HP 5373A is acquiring data. The LED also comes on when the HP 5373A is attempting to make a measurement with no input signal connected.

Restart key

Pressing this key restarts a measurement process and clears cumulative results and error messages. It also terminates a data entry sequence without saving the entered value. The previous value is left unchanged.

Single/Repet key

Pressing this key toggles between the single and repetitive acquisition mode. When the single mode is selected, the SINGLE LED is on. The HP 5373A will execute one measurement sequence as specified on the Function menu and then stop. Each time the **Restart** key is pressed, another measurement sequence will execute. When in the repetitive mode, the measurement sequence will repeatedly execute, with a new one starting as soon as possible after the previous one ends.



TECHNICAL COMMENT

The single mode is useful when first configuring the HP 5373A to make a measurement or using the Numeric or Graphic screens to view and analyze collected data. Otherwise, in repetitive mode, the instrument will begin another measurement sequence as soon as the processing for the previous one is completed. Current measurement results will be overwritten by the next sequence.

Manual arm key

The **Manual arm** key provides manual control of the measurement gate for Totalize measurements made with Manual arming. Refer to chapter 3, "Special-Purpose Measurements," for a description of this arming mode.

The **Manual arm** key operates as follows when making a Totalize measurement with Manual arming:

With the **Single/Repet** key set to the single acquisition mode,

1. Pressing the **Manual arm** key opens the gate and starts the measurement.

2. Pressing it a second time closes the gate and ends the measurement.

3. The **Restart** key must be pressed before another measurement can be started.

With the **Single/Repet** key set to the repetitive acquisition mode,

1. Pressing the **Manual arm** key opens the gate and starts the measurement.

2. Pressing it a second time closes the gate and ends the measurement.

3. Pressing the **Manual arm** key a third time starts another measurement.

4. Pressing it a fourth time ends the measurement. The result is the accumulated results of both the first and the second measurements.

5. Any additional measurements will add to the total count. Pressing the **Restart** key will clear the totalize count. The next measurement will begin at zero.

ABORT function

This is a shifted function. It involves a two-key sequence. First press the **Shift** key and then the **Manual arm** key.

The Abort feature can be used to retrieve partial measurement data when a measurement sequence, for some reason, does not run to completion. For example, a measurement sequence would not finish if the input signal was removed prematurely, or if there were not enough input events to satisfy the requirements of the measurement sequence.

Abort can also be used to interrupt a measurement sequence that would require too much time if it were allowed to run to completion. Measurement data acquired up to point at which the sequence was aborted can be displayed on the Numeric and Graphic result screens. A measurement acquisition must be in progress at the time of the abort.

The type of measurement setup on the Function menu determines the amount of measurement data available at the time of an abort. Below the Pre-trigger On/Off selection field on the Function menu, the following messages can appear. If none of these appear for your measurement setup, then behavior will be as for "All Results":

- "Display All Results from all blocks" — All measurements acquired up to the time of the abort will be displayed on the Numeric screen, Histogram graph, Time Variation graph, and the Event Timing graph.
- "Display Averaged Results from all blocks" — All measurements acquired up to the time of the abort will be included in the Histogram graph. The Numeric screen, the Time Variation and Event Timing graphs show the averaged data results from the blocks of measurements collected to that point.
- "Results will be most recently acquired block" — All measurements acquired up to the time of the abort will be included in the Histogram graph. Only the last block of data to be acquired before the abort will be available on the Numeric screen, the Time Variation, and the Event Timing graphs.

IMMEDIATE ABORT

Abort will execute an immediate halt in data collection under these conditions:

1. Single acquistion mode is selected with the **Single/Repet** key, and
2. Measurement is not Totalize with Manual arming, and
3. Measurement setup does not produce averaged results.

ABORT AT END OF BLOCK

Abort will execute a halt in data collection at the completion of the next block of measurements under these conditions:

1. Single acquisition mode is selected with the **Single/Repet** key, and
2. Measurement is not Totalize with Manual arming, and
3. Measurement setup produces averaged results, and

4. The number of measurements exceeds the size of measurement memory. (A way to tell if measurements do not all fit in memory is to view the Function menu screen. If the "Averaged Results" field is locked out, that is, it cannot be selected with the menu cursor, the size of the measurement exceeds internal memory.)

NO ABORT EXECUTED

Abort will not execute if any of the following conditions is true:

- Repetitive acquisition mode is selected with the **Single/Repet** key.

  OR

- Measurement is Totalize with Manual arming.

  OR

- Measurement setup produces averaged results from multiple blocks.

  AND

- The number of measurements fits within measurement memory. (This is the case when the "Averaged Results" field on the Function menu can be selected with the menu cursor, "All Results" is the other softkey option offered for this field.)

A new measurement sequence will begin when the **Restart** key is pressed or the instrument is put into repetitive acquisition mode.

Save key

Pressing this key and then a number, 1 to 9, saves the current front panel setup in one of nine non-volatile Save/Recall registers. All instrument settings, except the HP-IB configuration, are saved in the registers.

Register "0" is a recall-only storage register. It is reserved for storage of the current front-panel setup when either the Preset or Default Meas Setup function is selected.

Recall key

Pressing this key followed by a number, 0 to 9, recalls a previously stored front panel setup.

Preset key

Pressing this key initializes instrument settings to a default operating state. This key provides a quick way of recovering from a complex operating state. Whenever the **Preset** key is pressed, the current instrument setup is stored in Register "0" of the Save/Recall registers.

The following table shows the Preset conditions:

Table 6-1. HP 5373A Preset State

Function, Mode, or Value	Preset State
FUNCTION MENU SETTINGS	
Measurement Function	Frequency (PRF)
Measurement Channel	A
Block Size	1
Measurement Size	100
Pre-trigger	Off
Histogram Measurement Center	200.0 ns
Histogram Measurement Start	0 s
Histogram Measurement Span	400 ns
Histogram Measurement Bin Width	200 ps
Arming Mode	Automatic
Start channel	A
Start channel slope	Positive
Stop channel	A
Stop channel slope	Positive
Start delay events	1
Start delay time	200 ns
Start delay channel	A
Stop delay events	1
Stop delay interval	10 us
Stop delay time	1 s
Stop delay cycles	16
Stop delay channel	A
PRE-TRIGGER MENU SETTINGS	
Pre-trigger acquisition percentage	50%
Pre-trigger condition	Time Interval
TI Detect region	Above
Measurement Inhibit	Off

Table 6-1. HP 5373A Preset State (Continued)

Function, Mode, or Value	Preset State
INPUT MENU SETTINGS	
Input Channels	Separate
Channel A trigger slope	Positive
Channel B trigger slope	Positive
Channel A trigger mode	Single Auto
Channel B trigger mode	Single Auto
Channel A auto trigger level	50%
Channel B auto trigger level	50%
Channel A manual trigger level	0 V
Channel B manual trigger level	0 V
External Arm trigger level	0 V
Channel A Bias level	AC
Channel B Bias level	GND
Channel A Attenuation	1:1
Channel B Attenuation	1:1
Channel C Attenuation	0%
Channel A Hysteresis	Min
Channel B Hysteresis	Min
MATH MENU SETTINGS	
Channel A Statistics	Off
Channel B Statistics	Off
Channel C Statistics	Off
Channel A Math	Off
Channel B Math	Off
Channel C Math	Off
Channel A Offset	0
Channel B Offset	0
Channel C Offset	0
Channel A Normalize	1
Channel B Normalize	1
Channel C Normalize	1
Channel A Scale	1
Channel B Scale	1
Channel C Scale	1
Channel A Reference	0
Channel B Reference	0
Channel C Reference	0
Channel A Low limit	0
Channel B Low limit	0
Channel C Low limit	0
Channel A High limit	0
Channel B High limit	0
Channel C High limit	0
Carrier mode	Pulse
Carrier Manual Frequency	10 MHz
Carrier Linear Slope	0 Hz/μs
Carrier Linear Start Frequency	10 MHz
Phase Result	Modulo 360

Table 6-1. HP 5373A Preset State (Continued)

Function, Mode, or Value	Preset State
SYSTEM MENU SETTINGS	
Result format	ASCII
Response timeout value	5 s
Response timeout	Off
Measurement mode	Normal
NUMERIC SCREEN SETTINGS	
Numeric format	Result
Expanded data display	Off
GENERAL SETTINGS	
Displayed menu	Function
Acquistion mode	Repetitive
Measurement memory	Cleared
Wait-to-send mode	Off

Default Meas Setup function

This is a shifted function. It involves a two-key sequence. First press the **Shift** key and then the **Preset** key.

When selected, a default instrument setup will be invoked for the current measurement function. This feature is designed to provide the setup most likely to produce valid measurement results for the selected measurement function.

The following instrument conditions are invoked by Default Measurement Setup:

- The previous instrument setup is saved in storage register "0".
- Displayed menu is Numeric screen.
- Numeric results display is Results/Statistics.
- Block Size is set to 1.
- Measurement Size is set to 100, except for: 1) Envelope Power or Amplitude Modulation (where the default measurement size is 1), and; 2) Histogram measurements (where the default measurement size is 1,000,000).
- Channel A Trigger Mode is set to Repetitive Auto Trigger.

- Channel B Trigger Mode is set to Repetitive Auto Trigger.
- Channel A Bias Level is set to GND
- Channel B Bias Level is set to GND
- Channel A Attenuation is set to 1:1.
- Channel B Attenuation is set to 1:1.
- Channel C Attenuation is set to 0%.
- Reference values are set to 0.
- Statistics are enabled.
- Math functions are disabled.
- Limit testing is disabled.
- Acquisition mode set to Repetitive

The default setup values for each measurement type are listed below:

Time Interval:
Arming set to Automatic.
Source Channel set to A
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

±Time Interval:
Arming set to Automatic.
Source Channel set to A→ B.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Continuous Time Interval:
Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

PRF (Pulse Repetition Frequency) or Frequency:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

PRI (Pulse Repetition Interval) or Period:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Totalize:

Arming set to Interval Sampling.
Interval Time set to 10.0 μs.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Pulse Width:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (negative slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Common.

Pulse Offtime:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (negative slope).
Input Mode set to Common.

Risetime:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 80% (negative slope).
Channel B Trigger Level set to 20% (negative slope).
Input Mode set to Common.

Falltime:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 20% (positive slope).
Channel B Trigger Level set to 80% (positive slope).
Input Mode set to Common.

Duty Cycle:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (negative slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Common.

Phase:

Arming set to Automatic.
Start on Positive edge of Channel A.
Source Channel set to A relative to B (A rel B).
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Phase Deviation:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Time Deviation:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Frequency Deviation:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

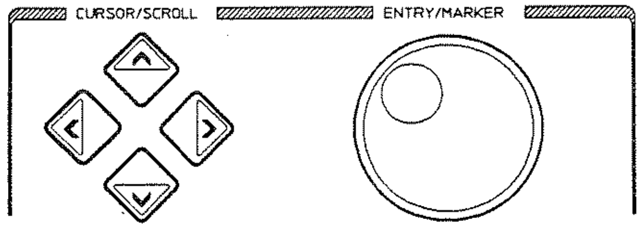
Envelope Power:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Amplitude Modulation:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

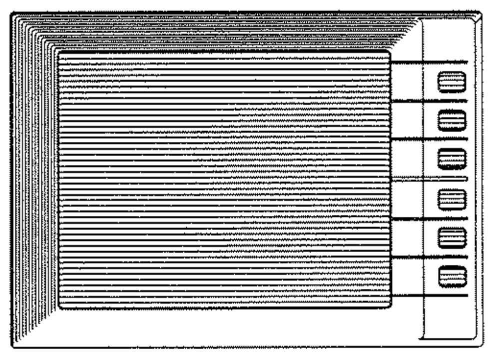
CURSOR/SCROLL — ENTRY/MARKER SECTION



Cursor/Scroll keys are used to move the menu cursor (the highlighting that moves on the display screen from menu field to menu field) in the direction indicated on each key. These keys are also used to scroll measurement results on the Numeric screen and graph data on the Graphic screen.

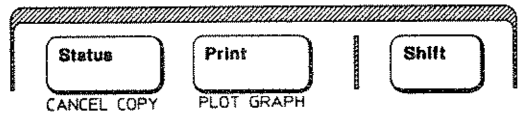
Entry/Marker knob is used to modify numeric field entries by the smallest increment available. This knob is also used to control markers on the Graphic screen and to scroll displayed graphs. It can also scroll measurement results on the Numeric screen when the **Set Param/Meas #** softkey is set to **Meas #**.

DISPLAY SCREEN AND SOFTKEY AREA



The display and softkey section contains the CRT (cathode ray tube) and the six softkeys. The CRT is a raster-scan, green phosphor display. The screen display resolution is 408 pixels horizontally by 304 pixels vertically. Graph display resolution is 250 pixels horizontally by 180 pixels vertically. The softkeys select the options that appear along the right edge of the display.

ADDITIONAL KEYS AREA



The additional keys are located above the DATA ENTRY keys.

Status key

Pressing the **Status** key displays a summary of the current instrument settings. Along with the date and time, the current conditions for the Function, Input, Math, and Pre-trigger menus are summarized on this screen.

Print key

Pressing this key causes the currently displayed screen on the CRT to be sent to an attached HP-IB graphics printer, such as the HP 2225A ThinkJet Printer. The following conditions must first be set on the HP 5373A System menu:

- Addressing Mode: Talk Only
- Print option: Display

The printer must be set to "LISTEN ONLY". For more information, refer to chapter 12, "System Menu."

Shift key

The blue Shift key is used along with four other front panel keys to perform additional functions. The four keys are:

- Manual arm (ABORT function)
- Status (CANCEL COPY function)
- Print (PLOT GRAPH function)
- Preset (DEFAULT MEAS SETUP function)

The shifted functions are labeled with blue letters to show the association with the **Shift** key. To select a shifted function, press the **Shift** key and then press the function key.

CANCEL COPY function

This feature will cause a print or plot operation in progress to be halted. To cancel a print or plot operation, press the **Shift** key and then press the **Status** key.

PLOT GRAPH function

This feature causes the currently displayed Graphic screen on the CRT to be sent to an attached HP-IB HP-GL plotter, such as the HP 7440A ColorPro Plotter with Option 002. Only graphs can be plotted. These graphs are the Histogram, Time Variation, and Event Timing graphs. The following conditions must first be set on the HP 5373A System menu:

- Addressing Mode: Talk Only
- Print option: Display

To plot a graph, press the **Shift** key and then press the **Print** key.

POWER SWITCH

Located at the lower-left corner of the front panel, the power switch has two settings: STBY and ON.

1. When in STBY (Standby), power is provided to the oven that keeps the timebase reference crystal at a controlled temperature. The front panel Standby LED will be on.

2. The ON setting causes power to be applied to all areas of the HP 5373A.

Power-Up Condition

The instrument configuration when the HP 5373A was powered-down will be restored. The following three statements describe the condition of the HP 5373A at power-up:

1. The previous measurement is restarted.

2. Measurement and graphics display memories are cleared.

3. If the power-up memory verification test fails, default settings defined under Preset are selected, and a warning message appears on the display.

FRONT PANEL INPUTS

The standard front panel inputs are Channel A, B, and External Arm. Channel C input (100 MHz to 2 GHz) is available as an option (Option 030).

Channel A and Channel B

The HP 5373A accepts several types of interchangeable input pods as the point of entry for signals into the A and B channels. The pod used determines the termination impedance for the channel. All settings related to the Channel A and B inputs are on the Function and Input menus.

NOTE

Standard HP 5373A configuration requires an HP 53702A Envelope Pod as the CHANNEL A input and an HP 54002A 50 Ω BNC input pod as the CHANNEL B input. Some HP 5373A measurements cannot be made with any other pod configuration.

Both Channel A and Channel B have a trigger light on the front panel. The LEDs operate at two levels:

1. The LED is off when the input signal is above or below the trigger level for the input channel.
2. The LED is flashing when the input signal is triggering properly. That is, the input signal is crossing the upper and lower hysteresis levels. The trigger level is at the center of the hysteresis window.

Range (all pods except HP 53702A):	dc to 500 MHz
Range (HP 53702A pod only):	30 MHz to 500 MHz
Damage Level (all pods except HP 53702A):	X1 ±2.5 V (dc ±ac pk) X2.5 ±5.5 V (dc ±ac pk)
Damage Level (HP 53702A pod only):	20 dBm

A full description of the A and B input characteristics can be found in appendix E, "Specifications."

CAUTION

Do not remove an input pod while the HP 5373A is powered on. Always set to Standby before removing or inserting an input pod. Damage to the pod can result from not following this caution.

External Arm

All settings related to the External Arm input are included on the Function and Input menu screens. The External Arm input is used for arming and/or Pre-trigger only.

The External Arm input has a trigger light on the front panel. The LED operates at two levels:

1. The LED is off when the input signal is above or below the trigger level for the input channel.
2. The LED is flashing when the input signal is triggering properly. That is, the input signal is crossing the upper and lower hysteresis levels. The trigger level is at the center of the hysteresis window.

Range: 0 to 100 MHz

Input Impedance: 1 MΩ, shunted by <50 pF

Damage Level: 5 V rms (±15 V pk-pk, dc ±peak ac)

A full description of the External Arm input characteristics can be found in appendix E, "Specifications."

Channel C (Option 030)

The Channel C option extends the ability of the HP 5373A to measure frequency to 2 GHz. This is accomplished with a divide-by-4 prescaler which divides down the input frequency to the range of the 5373A. One input pulse is sent on to the measurement circuitry for every four pulses received at the Channel C input.

The Channel C can measure pulse bursts as well as CW signals. The attenuation setting for Channel C on the Input menu is useful when measuring pulsed RF signals with noise in the region between the pulse bursts.

Range: 100 MHz to 2 GHz

Trigger Level: 0 V on a Positive Slope

Input Impedance: AC coupled, 50Ω, VSWR ≤2.5

Damage Level: AC > +20 dBm
DC ±5 V

A full description of the Channel C input characteristics can be found in appendix E, "Specifications."

REAR PANEL FEATURES

The features on the rear panel are:

- Power Module
- HP-IB Cable Connector
- Frequency Standard Input/Output
- Gate Outputs
- Arm Delay Outputs
- Measurement Inhibit
- Time Interval Detect
- Option 020, FastPort

Line Power Module

Line power for the HP 5373A is provided through a three-wire power cable, which connects to a power module on the rear panel of the instrument. The power module includes provisions for selecting one of several line voltages. It also includes a protection fuse for the HP 5373A. Refer to appendix B, "Unpacking and Installing," for more information.

HP-IB Connector

The HP-IB connector can be used for connecting the HP 5373A to a controller, or optionally, a listen-only printer or plotter. Refer to appendix B, "Unpacking and Installing," for more information on the HP-IB connector.

Frequency Standard

The HP 5373A can operate with an internal or external frequency standard. The internal time base is a 10 MHz high-performance, ovenized crystal oscillator.

EXTERNAL INPUT

This is a BNC connector that provides for the connection of a house standard frequency source to the HP 5373A. This input frequency is used in place of the internal 10 MHz ovenized time base. The acceptable input frequencies are: 1 MHz, 2 MHz, 5 MHz, and 10 MHz. Refer to appendix E for the acceptable signal levels.

Whenever a frequency standard change is made, that is, connecting an external frequency standard to take the place of the internal time base or switching back to the internal time base by removing the external signal, the HP 5373A stops making measurements. Measurements will only resume after the user acknowledges the time base change by pressing the Restart key. A status message will appear at the top of the display with this message, "Alternate Time Base selected. Press Restart."

OUTPUT

This BNC connector provides a buffered 10 MHz output whether the HP 5373A is using an internal or external frequency source. This signal allows synchronizing another instrument to the time base used by the HP 5373A. When a signal is connected to the External Input, the 10 MHz output is derived from the external signal.

GATE OUTPUTS

Two BNC connectors provide signals that indicate when measurement samples occur. These falling-edge signals are designated as Gate 1 and Gate 2 outputs. The outputs can be used to trigger other instruments. These outputs are active during Inhibited measurements. Listed below are the available Gate 1 and Gate 2 signals for the listed measurement/arming modes.

NOTE

Gate Output signals will not equal the resolution of the measurement results. Refer to appendix E, "Specifications," for the performance characteristics of these output signals.

Time Interval

Refer to chapter 1, "Time Interval Measurements", for a detailed timing diagram for each of the arming modes available for Time Interval measurements.

For the following arming modes, the falling edges at Gate 1 and Gate 2 correspond to the point at which time interval samples are acquired. An edge at the start of a time interval occurs at Gate 1. An edge at the end of a time interval occurs at Gate 2.

- Automatic
- Edge Holdoff
- Time Holdoff
- Event Holdoff
- Interval Sampling
- Repetitive Edge
- Random Sampling
- Edge/Interval
- Edge/Random

Continuous Time Interval

Refer to chapter 1, "Time Interval Measurements," for a detailed timing diagram for each of the arming modes available for Continuous Time Interval measurements.

For the following arming modes, the falling edges at Gate 2 correspond to when the Continuous Time Interval samples are acquired. Each time a measurement sample is taken, Gate 2 will output a falling edge.

- Automatic
- Edge Holdoff
- Time Holdoff
- Event Holdoff
- Interval Sampling
- Repetitive Edge
- Edge/Interval

±Time Interval

Refer to chapter 1, "Time Interval Measurements," for a detailed timing diagram for each of the ±Time Interval arming modes.

For the following arming modes, the falling edges at Gate 1 and Gate 2 correspond to when the ±Time Interval samples are acquired. An edge at the start of a time interval occurs at Gate 1. An edge at the end of a time interval occurs at Gate 2.

- Automatic
- Edge Holdoff
- Interval Sampling

- Parity Sampling
- Repetitive Edge
- Repetitive Edge/Parity
- Random Sampling
- Edge/Interval
- Edge/Event
- Edge/Parity
- Time/Time
- Event/Event
- Edge/Random

PRF, Frequency, PRI, Period

The gate outputs are the same for PRF, Frequency, PRI, and Period measurements. Refer to chapter 2, "PRF, Frequency, PRI, and Period Measurements," for a detailed timing diagram for each of the PRF, Frequency, PRI, and Period arming modes.

For the following arming modes, Gate 1 (Channel A) and Gate 2 (Channel B) are active for two-channel measurements; only Gate 2 is active for one-channel measurements. In either case, falling edges at the gate output correspond to when samples are acquired.

- Automatic
- Interval Sampling
- Edge Sampling
- Edge/Interval

For the following arming modes, only Gate 2 is active. Falling edges at Gate 2 correspond to when measurement samples are acquired.

- Edge Holdoff
- Time Holdoff
- Event Holdoff
- Cycle Sampling
- Edge/Cycle
- Edge/Edge
- Time/Interval
- Event/Interval

For the following arming modes, Gate 1 and 2 are active. Falling edges at Gate 1 and 2 correspond to when measurement samples are acquired. An edge at the start of a measurement occurs on Gate 1. An edge at the end of a measurement occurs on Gate 2.

- Time Sampling
- Edge/Time
- Edge/Event
- Time/Time
- Event/Event

Totalize

Refer to chapter 3, "Special-Purpose Measurements," for a detailed timing diagram for each of the Totalize arming modes.

For the following arming modes, Gate 2 is active. The falling edges at the Gate 2 output correspond to when the measurement samples are acquired.

- Interval Sampling
- Edge Sampling
- Edge/Interval
- Edge/Edge
- Time/Interval

For the following arming mode, Gate 1 and 2 are active. The falling edges at Gate 1 and 2 correspond to when measurement samples are acquired. An edge at the start of a measurement occurs at Gate 1. An edge at the end of a measurement occurs at Gate 2.

- Externally Gated
- Manual

Rise/Fall Time, Pulse Width, Pulse Offtime, Duty Cycle, Phase

Refer to chapter 3, "Special-Purpose Measurements," for a detailed timing diagram for each of the arming modes.

For the following arming mode, the falling edges at Gate 1 and Gate 2 correspond to the time interval of the measurement being acquired. An edge at the start of the interval occurs at Gate 1. An edge at the end of the interval occurs at Gate 2.

- Automatic

ARM DELAY OUTPUTS

Two BNC connectors provide signals that indicate when arming conditions have been satisfied. For example, a time holdoff arming condition is satisfied when the specified time has elapsed. A falling edge occurs at one of these outputs at the completion of an arming condition. The outputs can be used to trigger other instruments. These outputs are active during Inhibited measurements. Refer to appendix E, "Specifications," for the performance characteristics of these output signals.

Listed below are the available Arm Delay 1 and Arm Delay 2 signals for the arming modes. This description assumes you are familiar with the first five chapters of this manual. It is there that the principles of arming and its application to the different measurement functions are explained.

Automatic

There is a falling edge at Arm 1 when the block holdoff condition is satisfied. For Automatic arming, this is generated by the HP 5373A.

There is a falling edge at Arm 2 every time the sample arm condition is satisfied before each sample is acquired.

Edge Holdoff

There is a falling edge at Arm 1 when the block holdoff condition is satisfied.

Time Interval

Refer to chapter 1, "Time Interval Measurements," for a detailed timing diagram for each of the Time Interval arming modes.

For the following arming mode, there will be a falling edge at Arm Delay 2 at the completion of the specified block holdoff time.

- Time Holdoff

For the following arming mode, there will be a falling edge at Arm Delay 2 at the completion of the specified number of block holdoff events.

- Event Holdoff

Continuous Time Interval

Refer to chapter 1, "Time Interval Measurements," for a detailed timing diagram for each of the Continuous Time Interval arming modes.

For the following arming mode, there will be a falling edge at Arm Delay 2 at the completion of the specified block holdoff time.

- Time Holdoff

For the following arming mode, there will be a falling edge at Arm Delay 2 at the completion of the specified number of block holdoff events.

- Event Holdoff

±Time Interval

Refer to chapter 1, "Time Interval Measurements," for a detailed timing diagram for each of the ±Time Interval arming modes.

For the following arming mode, there will be a falling edge at Arm Delay 1 at the completion of the specified number of stop arm events.

- Edge/Event

For the following arming mode, there will be a falling edge at Arm Delay 1 at the completion of the start arm time; there will be a falling edge at Arm Delay 2 at the completion of the stop arm time.

- Time/Time

For the following arming mode, there will be a falling edge at Arm Delay 1 at the completion of the start arm events; there will be a falling edge at Arm Delay 2 at the completion of the stop arm events.

- Event/Event

PRF, Frequency, PRI, Period

Refer to chapter 3, "PRF, Frequency, PRI, and Period Measurements," for a detailed timing diagram for each of the PRF, Frequency, PRI, and Period arming modes.

For the following arming modes, there will be a falling edge at Arm Delay 1 at the completion of the specified stop arm time.

- Time Sampling
- Edge/Time

For the following arming mode, there will be a falling edge at Arm Delay 1 at the completion of the specified number of stop arm events.

- Edge/Event (PRF or Frequency only)

For the following arming mode, there will be a falling edge at Arm Delay 2 at the completion of the specified block holdoff time.

- Time/Interval

For the following arming mode, there will be a falling edge at Arm Delay 1 at the completion of the start arm time; there will be a falling edge at Arm Delay 2 at the completion of the stop arm time.

- Time/Time

For the following arming mode, there will be a falling edge at Arm Delay 2 at the completion of the specified number of block holdoff events.

- Event/Interval

For the following arming mode, there will be a falling edge at Arm Delay 1 at the completion of the start arm events; there will be a falling edge at Arm Delay 2 at the completion of the stop arm events.

- Event/Event

INHIBIT INPUT

This high-impedance input can be used to control when the HP 5373A acquires measurements. By enabling Inhibit on the Pre-trigger menu, it is possible to prevent the HP 5373A from storing measurement data.

TECHNICAL COMMENT

One possible application of Inhibit is in measuring data from a disk drive sector. The Inhibit input can be used to prevent measuring the header information in the sector. Another application is to use the Inhibit input to avoid making measurements between bursts of pulsed frequency signals.

The Inhibit feature is enabled, and the parameters of the inhibit signal are set, on the Pre-trigger menu. The conditions for the controlling signal can be set to above or below, 0.0 V (GND), 1.4 V (TTL), or –1.3 V (ECL). More information on the Inhibit feature can be found in chapter 10, "Pre-trigger Menu."

NOTE

There is up to a 50 ns delay between the point when Inhibit is enabled at the rear-panel input and when the storage of measurement data is suppressed.

TIME INTERVAL DETECT

This output provides a TTL low when a measured time interval falls above or below a specified time interval value; inside or outside of a range of specified time interval values. The detect feature is enabled, and the conditions are set, on the Pre-trigger menu. A TTL high is output otherwise.

The TI Detect feature is only available when making time interval measurements:

- Time Interval — a TTL low is output for every time interval that satisfies the TI Detect conditions.
- ±Time Interval — a TTL low is output for every time interval that satisfies the TI Detect conditions.
- Continuous Time Interval — the output will stay low for the entire period of time the measurements are outside the specified range, if the rate of time intervals is above 10 MHz. For this reason, do not use the output to count the number of time intervals that satisfy the TI Detect

conditions when making Continuous Time Interval measurements at these rates. At lower rates, a TTL low is output for every time interval satisfying the TI Detect conditions.

- Histogram Measurements — The TI Detect range values are determined by the Histogram boundaries.

NOTE

The TI Detect output signal will go low no more than 600 ns after a time interval occurs that satisfies the TI Detect conditions. The signal will go high when a measured time interval does not satisfy the TI Detect conditions or the measurement sequence is completed.

FastPort (Option 020)

This option consists of three rear-panel 40-pin connectors that provide access to raw, unprocessed time and event data. The data is output at high speed to an external memory system. All measurement result calculations and analysis are done in a host computer. There is a separate document that describes the FastPort feature.

HP 5373A Front Panel Features

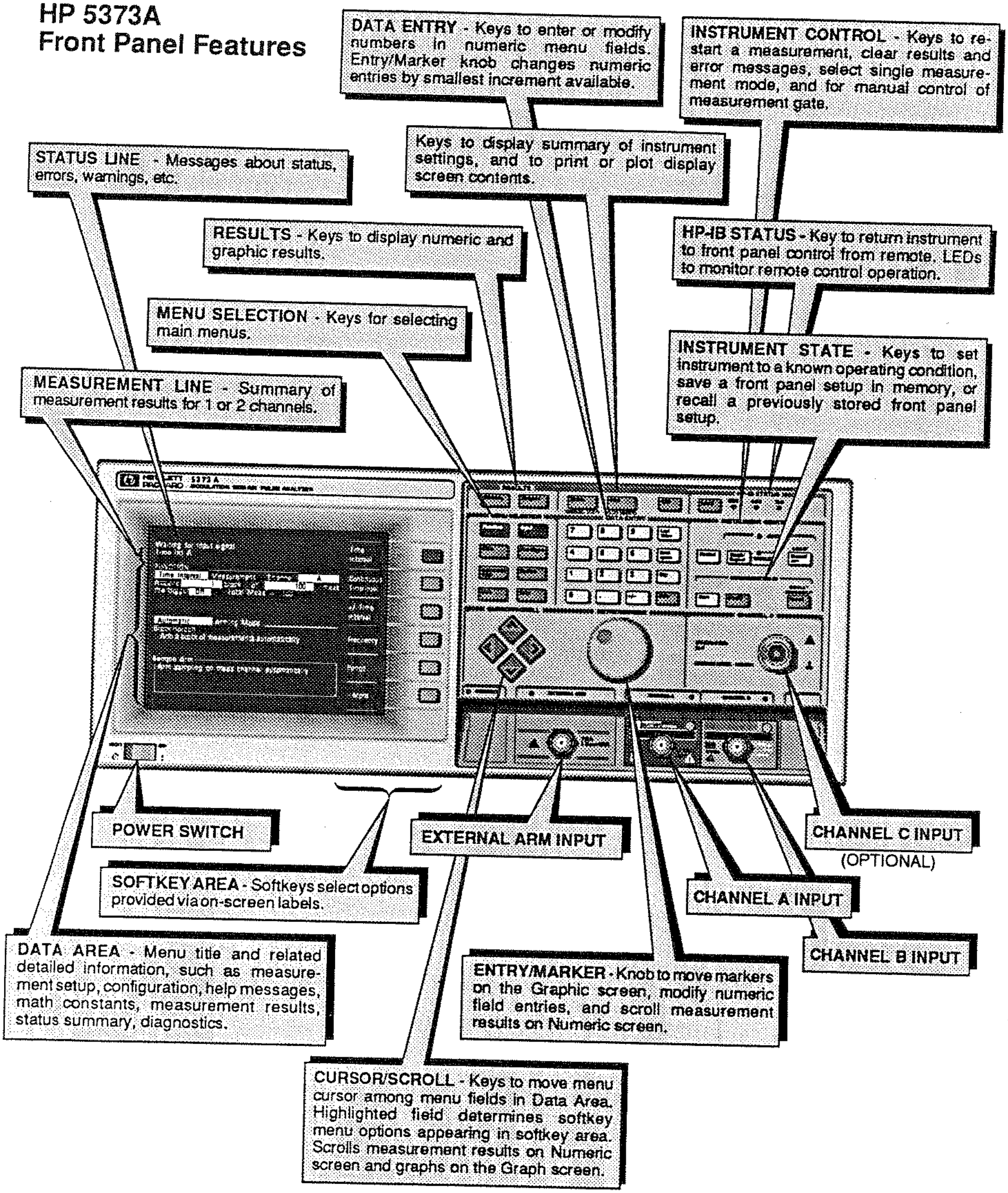


Figure 6-1. Front Panel Features

HP 5373A
Rear Panel Features

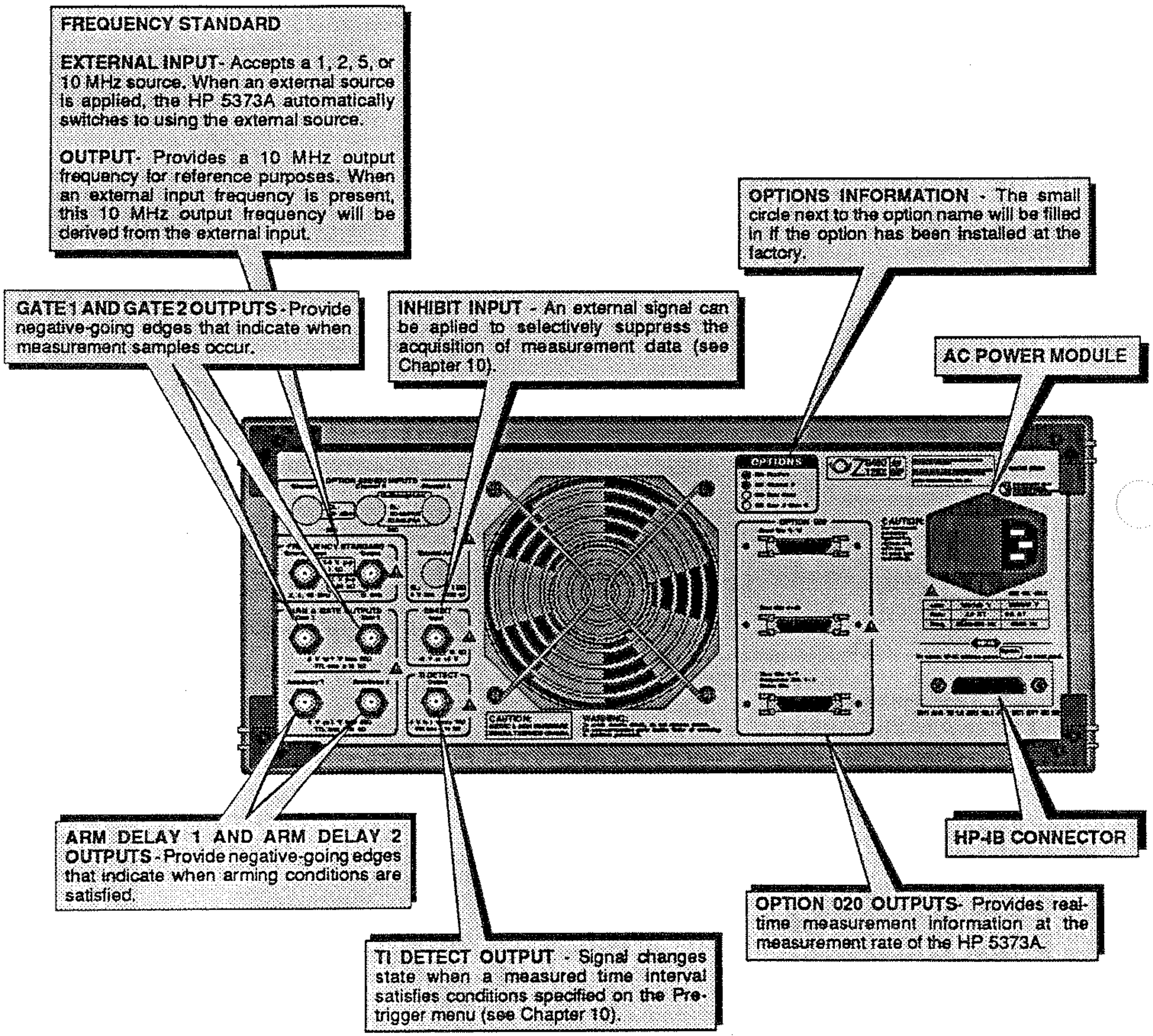


Figure 6-2. Rear Panel Features

7

Contents of Chapter

7

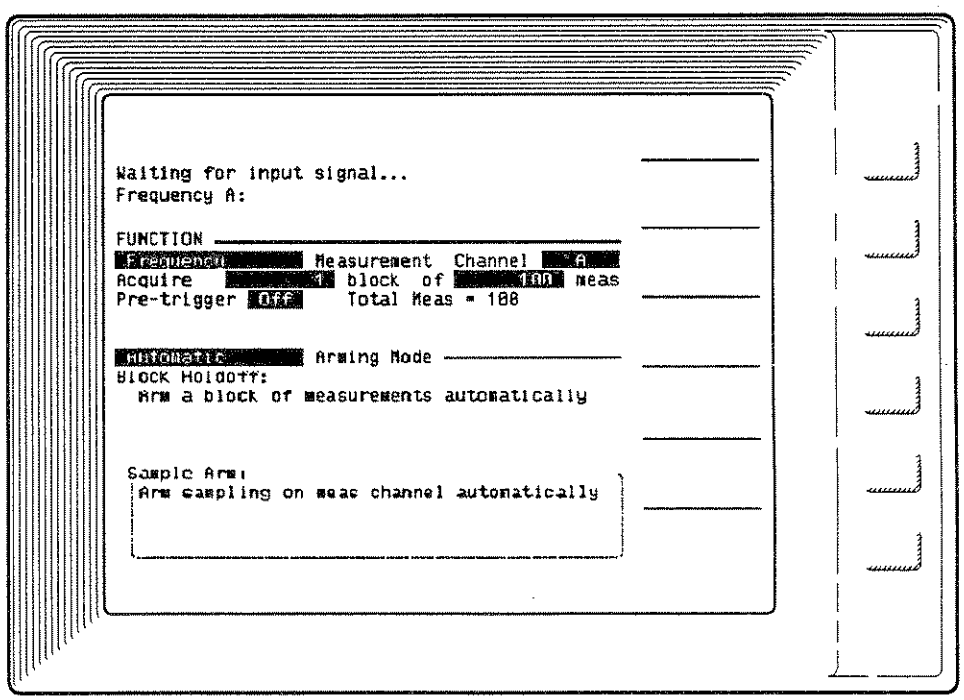
FUNCTION MENU

CHAPTER OVERVIEW

While the Function menu is displayed, the following parameters can be set:

- Measurement function (Time Interval, PRF/Frequency, etc.)
- Measurement channel(s)
- Number of blocks
- Number of measurements per block
- Pre-trigger
- Arming mode

Figure 7-1. Function Menu Screen



MEASUREMENT FIELD

The measurement field allows selection of the measurement function.

The measurement functions for the HP 5373A are:

- PRF/Frequency
- PRI/Period
- Pulse Width
- Pulse Offtime
- Duty Cycle
- Envelope Power
- Rise Time
- Fall Time
- Time Interval
- Continuous Time Interval
- ±Time Interval
- Phase
- Phase Deviation
- Frequency Deviation
- Time Deviation
- Histogram Time Interval
- Histogram Continuous Time Interval
- Histogram ±Time Interval
- Totalize
- Amplitude Modulation

NOTE

Since the measurement configuration and features available with the Histogram measurements are somewhat unique, these measurement functions are described in chapter 4, "Histogram Measurements." There will be only minor references to Histogram measurements in this chapter. The three Histogram measurements use special hardware in the HP 5373A that allows measurements to be histogrammed very quickly.

Softkey Options:

PRF/Frequency | PRI/Period | Pulse Width | Pulse Offtime | Duty Cycle

Envelope Power | Rise Time | Fall Time | Time Interval | Continuous Time Intvl

±Time Interval | Phase | Phase Deviation | Frequency Deviation | Time Deviation

Histogram Time Interval | Histogram Continuous TI | Histogram ±Time Interval | Totalize | Amplitude Modulation

HP-IB Parameters:

PRF or FREQ | PRI or PER | PWID | OFFT | DUTY

POW | RTIM | FTIM | TINT | CTIN

PMT | PHAS | PDEV | FDEV | TDEV

HTIM | HCT | HPMT | TOT | AMPM

Comments:

Not all measurement channel and arming mode combinations are available for all measurements. Consult chapter 1, 2, or 3 for a listing of the channel/arming combinations available for the measurement you want to make.

There is interaction between the different fields on this menu. The measurement selection determines the available channel options. The measurement and channel selection determines the available arming modes.

CHANNEL FIELD

The **Channel** field allows selection of the input channel, or channels, upon which to make the measurement.

Softkey Options for Channels A and B:

A, B, A & B, A / B, B / A, A + B, A – B, B – A, A→ B, B→ A, A rel B, B rel A

HP-IB Parameters for Channels A and B:

A, B, (A^B), (A/B), (B/A), (A+B), (A-B), (B-A), (A>B), (B>A), (A<B), (B<A)

Softkey Options for Channel C (Option 030):

C, A & C, B & C, C / A, C / B, A / C, B / C, A + C, B + C, C – A, C – B, A – C, B – C

HP-IB Parameters for Channel C (Option 030):

C, (A^C), (B^C), (C/A), (C/B), (A/C), (B/C), (A+C), (B+C), (C-A), (C-B), (A-C), (B-C)

Comments:

The channel options available are dependent on the selected measurement function and arming mode. Not all channel options are available for all measurements. Only the available channel options for the selected measurement and arming mode will appear in the softkey area.

The Channel C input can only be used for Frequency and Period measurements.

BLOCK FIELD AND MEAS FIELD

These two fields are used to specify the total number of measurements to collect in a measurement sequence.

In the **block** field, specify the number of blocks you want to acquire. In the **meas** field, specify the number of measurements per block. The total number of measurements = (the number of blocks) x (the number of measurements per block).

Options:

Use the DATA ENTRY keypad to enter the number of blocks and the number of measurements in each block. Conclude the entry by pressing the **Enter** key. Current values can be modified using the ENTRY/MARKER knob. If you are in the single acquisition mode (the SINGLE LED is on), the **Enter** key or the **Restart** key must be pressed to initiate a new measurement sequence after using the knob to change a value. In the repetitive acquisition mode, setting a new value with the knob causes an update of the parameter value the next time a measurement acquisition restarts.

Block range = 1 to 99,999,999
Meas range = 1 to 8,191 (maximum)

The total number of measurements can equal 99,999,999×8191.

NOTE

These limits do not apply to the three Histogram measurements. Histogram Time Interval, Histogram Continuous Time Interval, and Histogram ±Time Interval functions allow a total number of measurements up to 2,000,000,000,000,000 (2E15). Refer to chapter 4, "Histogram Measurements" for details.

TECHNICAL COMMENT

With the exception of Histogram measurements (see chapter 4), there are 8,192 memory locations that can be used to store data collected in a single block, or multiple blocks. The number of measurements that fit in these 8K locations varies with measurement function, channel choices, and arming mode. For every configuration, the meas *field value will automatically default to the maximum number of measurements that will fit in the 8K memory locations when you attempt to enter a value that exceeds the maximum. Use appendix A as a guide to selecting the maximum number of measurements that will fit in memory for some common measurement functions. The guide provides information for single or multiple block configurations. When all measurements fit in memory, you have access to all the results for numeric or graphic review. The rest of this chapter explains the measurement setup options for size of measurement and what results and analysis features are available.*

Two examples of how the choice of function and arming sets the maximum number of measurements in a block —

The maximum number of measurements in one block of a Frequency, single channel, Automatic arming measurement = 8,191. (After the first measurement, each measurement requires only one sample.)

The maximum number of measurements in one block of a Time Interval, A channel, Automatic arming measurement = 4,096. (Each measurement requires a start sample and a stop sample.)

HP-IB Commands:

For the **block** field — BLOC <n>, where <n> = 1 to 99,999,999
For the **meas** field — MSIZ <n> or SSIZ <n> where <n> = 1 to 8,191 Max. (Value will default to the maximum for the selected function, channel, and arming mode when a value above the maximum is entered.)

MEASUREMENTS AND PRE-TRIGGER

The HP 5373A provides two methods for specifying how to complete your measurement sequence:

- **Measurements with Pre-trigger Off** — Data collection begins when the initial arming conditions are satisfied, and terminates when the specified number of measurements have been collected.

- **Measurements with Pre-trigger On** — Data collection begins when the initial arming conditions are satisfied. A stream of data is collected continually into a "circular" buffer, that is, data is stored in measurement memory with the newest data overwriting the oldest data. When the pre-trigger event occurs, the measurement sequence completes according to the pre-trigger control settings on the Pre-trigger menu. The amount of pre-trigger data can be specified by a number of measurements or a percentage of measurements within a block. For example, a pre-trigger amount of 20% would specify that 80% of the measurements in the block will be acquired after the pre-trigger event. The pre-trigger event can be a signal applied to the External Arm input or a measured time interval using the TI Detect feature (also set on the Pre-trigger menu).

When data collection is completed, one block of data is processed into measurement results. The block of data is the one most recently acquired. If the pre-trigger event occurs before one complete block of data is collected, the instrument processes and displays less than a full block of results. For details about the Pre-trigger and TI Detect features beyond what is described in this chapter, review chapter 10, "Pre-trigger Menu."

NOTE

The above discussion of measurements using Pre-trigger does not apply to Histogram measurements. For Histogram measurements using Pre-trigger, the pre-trigger amount is restricted to 100%. See chapter 4, "Histogram Measurements," for more information.

Measurements with Pre-trigger Off

Measurement sequences with pre-trigger off will acquire the total number of measurements you have specified in the **block** and **meas** fields.

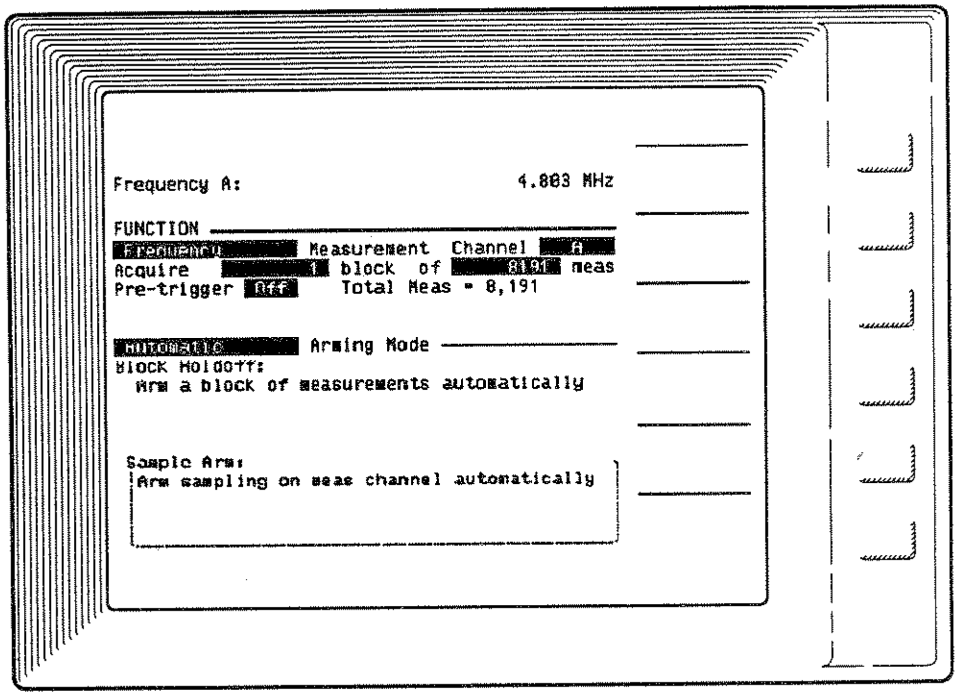
There are four configurations for measurements not using pre-trigger. Each is explained and includes what you can expect for results and analysis capabilities.

TECHNICAL COMMENT

As you will see in this section, not all of the measurement results may be saved in measurement memory, depending on the type of measurement you want to make and the number of measurements you specify. Even though individual measurement results may not be available, all results will be included in the Histogram graph. The Statistics feature when enabled will provide statistical values that include all the results, whether or not they fit into measurement memory. Additionally, for the measurement configurations that offer block averaging, all results will be included in the final averaged results.

1 BLOCK OF N MEASUREMENTS

Figure 7-2. One Block — All Measurements Fit In Memory



When the number of blocks is set to one, every measurement result will be stored in measurement memory and available for review. For the menu shown in *Figure* 7-2, the following results features are available:

- **On the Numeric Screens** — 8,191 measurement results can be displayed and included in statistics and limit testing.
- **On the Graphic Screens** — All graphic features supported for the measurement function selected (PRF/Frequency here) include the 8,191 measurement results.

- **Measurement Abort** — If the measurement sequence is aborted, data acquisition is immediately halted and the data that was collected before the abort is displayed. For information on the instrument conditions that allow the Abort feature to interrupt measurement sequences, refer to chapter 6, "Front Panel/Rear Panel."
- **Appendix A** — Use appendix A as a guide for determining the maximum number of measurements per block for your single-block acquisition.

M BLOCKS OF N MEASUREMENTS / ALL RESULTS

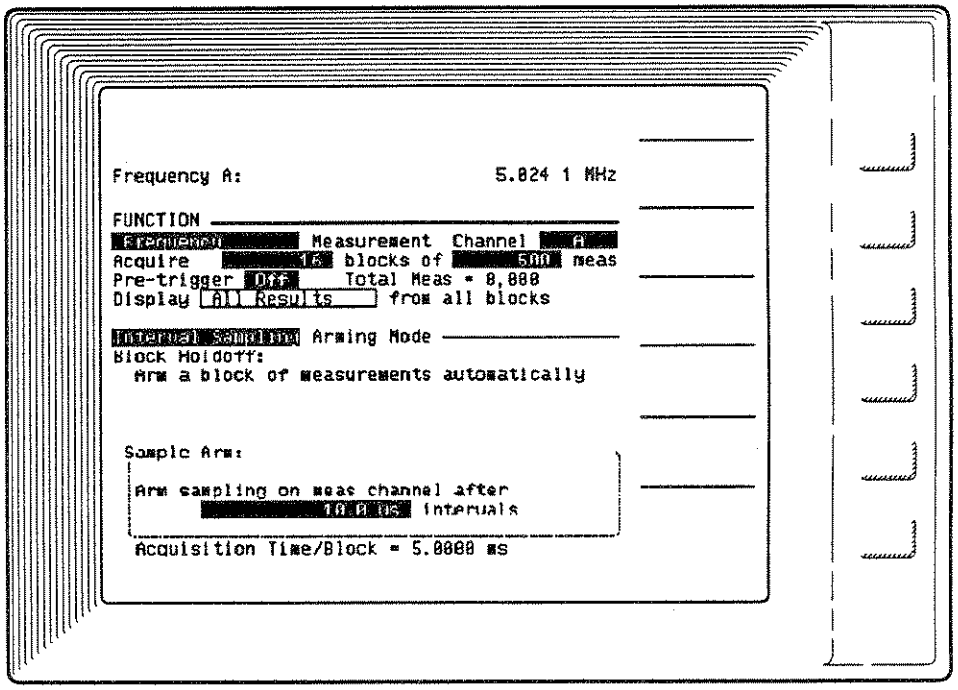
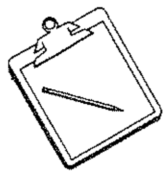


Figure 7-3. M Blocks — All Measurements Fit In Memory

When the number of blocks is set greater than one, it is possible that not all measurements will fit into measurement memory. *Figure* 7-3 shows an example where a multiple block measurement does fit in memory. The following results features are available for the menu shown in *Figure* 7-3:

- **On the Numeric Screens** — 8,000 measurement results can be displayed and included in statistics and limit testing.
- **On the Graphic Screens** — All graphic features supported for the measurement function selected (PRF/Frequency here) include the 8,000 measurement results.
- **Measurement Abort** — If the measurement sequence is aborted, data acquisition is immediately halted and the data that was collected before the abort is displayed. For information on the instrument conditions that allow the Abort feature to interrupt measurement sequences, refer to chapter 6, "Front Panel/Rear Panel."

- **Appendix A** — Use appendix A as a guide for determining the maximum number of measurements that will fit into memory for your multiple-block acquisition.



TECHNICAL COMMENT

Generally, the HP 5373A will clear the measurement memory before acquiring a new block of measurements. Consequently, only the last block of data can be reviewed and analyzed. However, if the total number of measurements from a multiple-block acquisition can fit in memory, the HP 5373A will automatically segment its measurement memory to store all the measurements. All measurements are available for review and analysis. When memory segmentation is used, the time between blocks of measurements is minimized (<2 μs).

Note that over HP-IB, using the WTS command (Wait To Send), it is possible to retrieve each block of data before the measurement sequence continues. Refer to the Programming Manual for details.

M BLOCKS OF N MEASUREMENTS / NOT ALL RESULTS

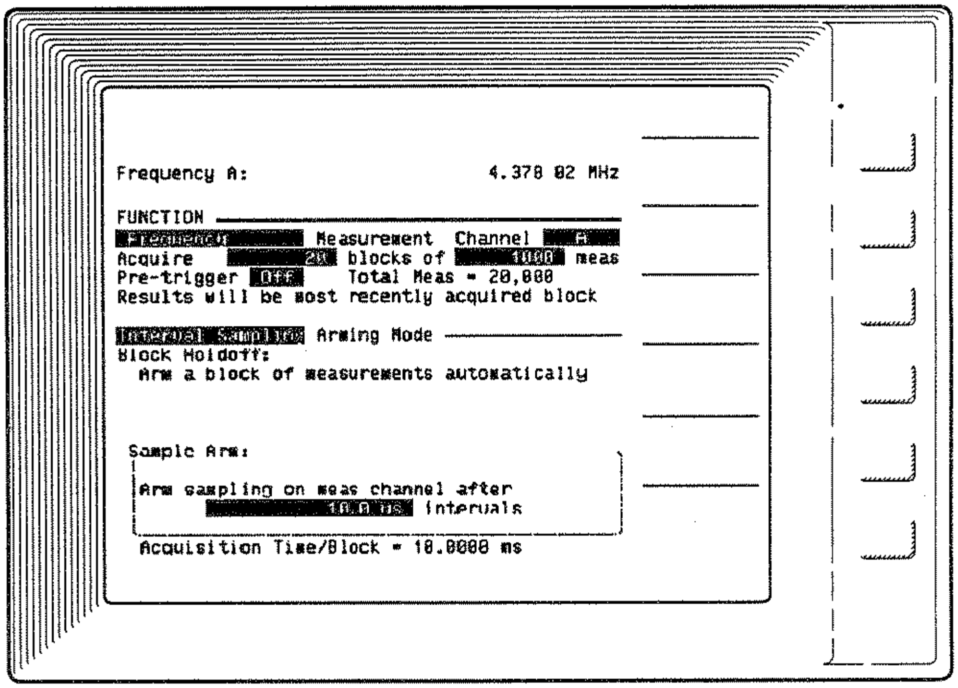


Figure 7-4. M Blocks — Measurements Do Not All Fit In Memory

With the number of blocks set greater than one, and the number of measurements per block set so the total number of measurements exceeds the size of measurement memory, the following line of text will appear on the Function menu, **"Results will be most recently acquired block."** *Figure 7-4* shows an example of this situation. The following results are available for the menu shown in *Figure 7-4*:

- **On the Numeric Screens** — 1,000 measurement results (the last block acquired) can be displayed. If the Statistics feature was enabled on the Math menu prior to the measurement sequence, all 20,000 measurements would be included in the statistics. If Statistics is enabled after a measurement sequence has completed, a new measurement will be initiated.

- **On the Graphic Screens** — The Histogram graph includes the entire measurement acquisition, 20,000 measurements. The Time Variation graph, and the Event Timing graph (if available), will display only the last block of data (1,000 measurements here).

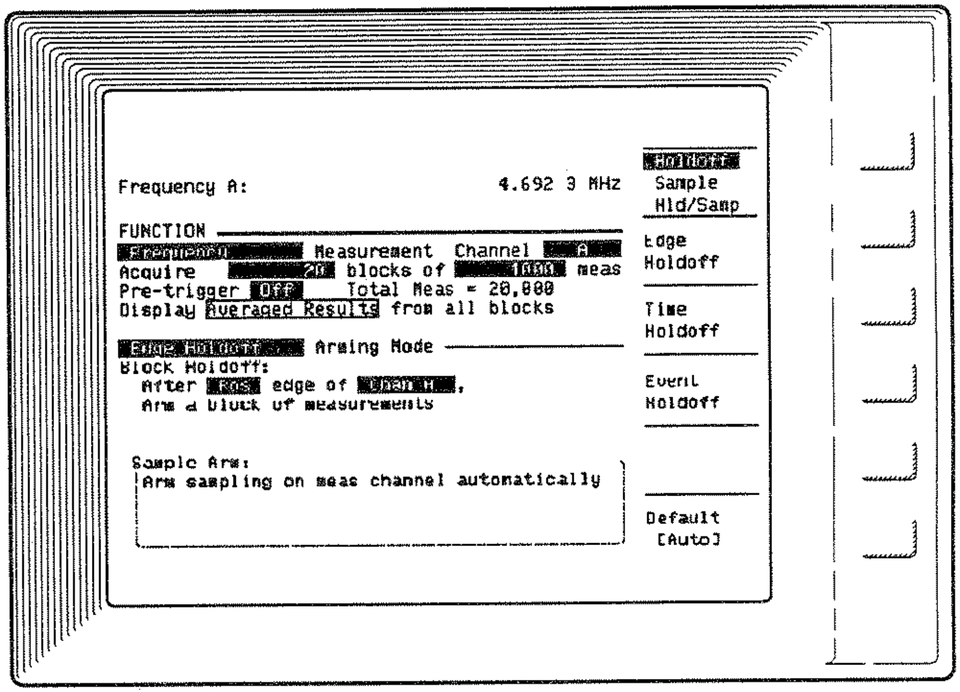
- **Measurement Abort** — If the measurement sequence is aborted, data acquisition is immediately halted and data that was collected before the abort is displayed according to these rules:

1. If the acquisition was interrupted between blocks:
   - Numeric results show only the last acquired block of data.
   - Histogram graph shows all measurements collected up to the abort.
   - Time Variation and Event Timing graphs show only the last acquired block of data.
2. If the acquisition was interrupted during a block:
   - Numeric results show only the portion of the last block up to the abort.
   - Histogram graph shows all measurements collected up to the abort.
   - Time Variation and Event Timing graphs show only the portion of the last block up to the abort.

- **Appendix A** — Use appendix A as a guide for determining the maximum number of measurements that will fit into memory for your multiple-block acquisition.

M BLOCKS OF N MEASUREMENTS / AVERAGED RESULTS

Figure 7-5. M Blocks — Blocks Are Averaged



- Averaged results are provided from multiple blocks when you are making a PRF/Frequency or PRI/Period measurement with one of the following arming modes:

  - Edge Holdoff
  - Time Holdoff
  - Event Holdoff
  - Edge / Interval
  - Edge / Cycle
  - Time / Interval
  - Event / Interval

OR you are making a Continuous Time Interval measurement with one of the following arming modes:

- Edge Holdoff
- Time Holdoff
- Event Holdoff
- Edge / Interval

OR you are making a Phase Deviation, Time Deviation, or Frequency Deviation measurement with one of the following arming modes:

- Edge Holdoff
- Edge/Interval (see chapter 3)

For the menu shown in *Figure 7-5*, the following results features are available:

- "Averaged Results from all blocks" indicates that the measurement function and arming mode combination will provide averaging. The way this works is that the first measurement of each of the blocks is averaged, the second measurement of each of the blocks is averaged, and so on to 1,000 for the measurement shown.

- **On the Numeric Screens** — 1,000 results can be displayed. Each one is the average of 20 measurements. If the Statistics feature was enabled on the Math menu prior to the measurement sequence, all 20,000 measurements would be included in the statistics. If Statistics is enabled after a measurement sequence has completed, a new measurement will be initiated. The limit testing feature operates similarly to Statistics in this configuration. The statistics are calculated on the individual results, while limit testing is on the averaged values.

- **On the Graphic Screens** — The Histogram graph includes the entire measurement acquisition, 20,000 measurements. The Time Variation graph will display one block of averaged results. The Event Timing graph (if available for the measurement function) will show one block of 1,000 averaged results.

- **Measurement Abort** — If the measurement sequence is aborted, data acquisition is halted at the end of the block being acquired at the time the abort is executed. The data that was collected before the abort is displayed. For information on the instrument conditions that allow the Abort feature to interrupt measurement sequences, refer to chapter 6, "Front Panel/Rear Panel."

Measurements With Pre-trigger On

Measurement sequences with Pre-trigger on can be executed on single or multiple blocks of measurements. Measurement data will be collected as determined by the pre-trigger control settings on the Pre-trigger menu. The HP 5373A can monitor measurement data and then capture data that occurs prior to, and following, the pre-trigger event.

TECHNICAL COMMENT

It is possible that less than the number of measurements you specify in the **meas** *field will be collected when the pre-trigger event causes the measurement sequence to end before all measurements have been collected. This happens when the pre-trigger event occurs before the specified amount of pre-trigger data has been collected. For example, if the pre-trigger amount is set to 60% and the pre-trigger event occurs at the start of a measurement sequence, only the post-trigger amount of the measurement total (40%) will be acquired before the measurement sequence ends. So, with the pre-trigger amount set to 60% and a measurement size of 1,000, the HP 5373A acquires the 400 measurements that occur after the pre-trigger event.*

SINGLE BLOCK OF N MEASUREMENTS / PRE-TRIGGER

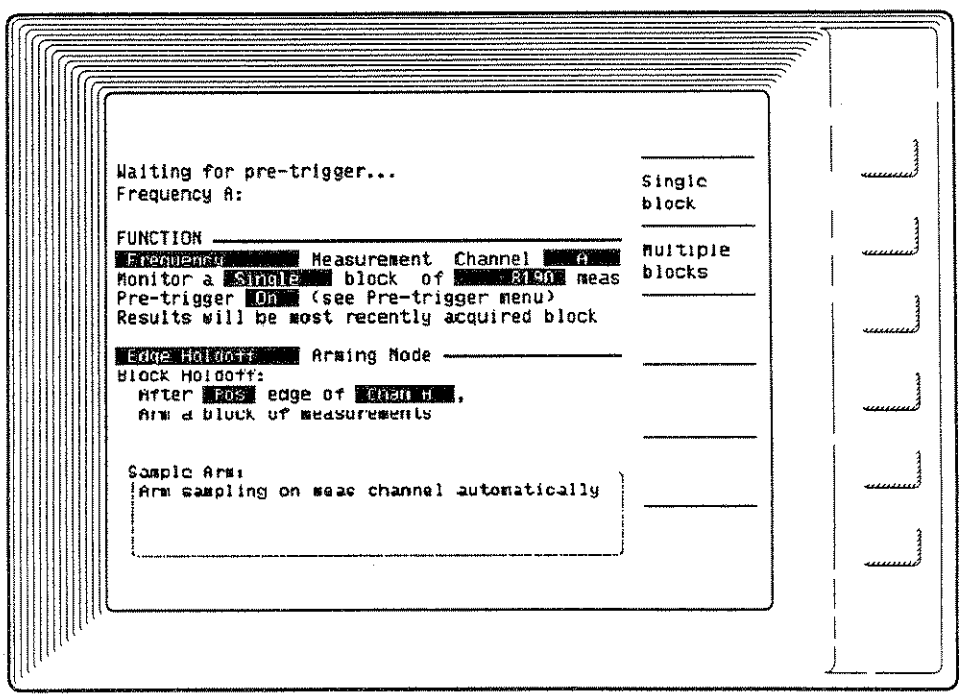


Figure 7-6. Single Block — Measurements Specified By Pre-trigger

- Pre-trigger is only available for continuous arming modes (Block Holdoff / Sample Arm). Refer to chapter 5, "Arming," for more information on continuous arming modes.

- The block holdoff condition is satisfied only once and then samples are collected and may overwrite the block start data. This occurs when the amount of data monitored (and collected) exceeds the size of measurement memory. Consequently, the results display may show the block start followed by measurements, or may show only measurements. If the pre-trigger event terminates acquisition before the pre-trigger amount (specified as a number of samples or a percentage of the total acquisition) is collected, then less than the specified pre-trigger amount is collected and displayed.

- The number of measurements that will be collected prior to the pre-trigger event is set by the user on the Pre-trigger menu (see chapter 10, "Pre-trigger Menu"). The number may not exceed the number of measurements in the block, and will be reduced automatically if it is too large.

For the menu shown in *Figure 7-6*, the following results features are available:

- **On the Numeric screens** — Up to 8,190 measurements (one block of data) that were collected around the pre-trigger event can be displayed. Statistics and limit testing are available.

- **On the Graphic Screens** — The graphs will include the one block of data that was collected around the pre-trigger event. That is, the data that was monitored prior to, and collected after, the pre-trigger event.

- **Measurement Abort** — If the measurement sequence is aborted, data acquisition is immediately halted and the data that was collected before the abort is displayed. For information on the instrument conditions that allow the Abort feature to interrupt measurement sequences, refer to chapter 6, "Front Panel/ Rear Panel."

MULTIPLE BLOCKS OF N MEASUREMENTS / PRE-TRIGGER

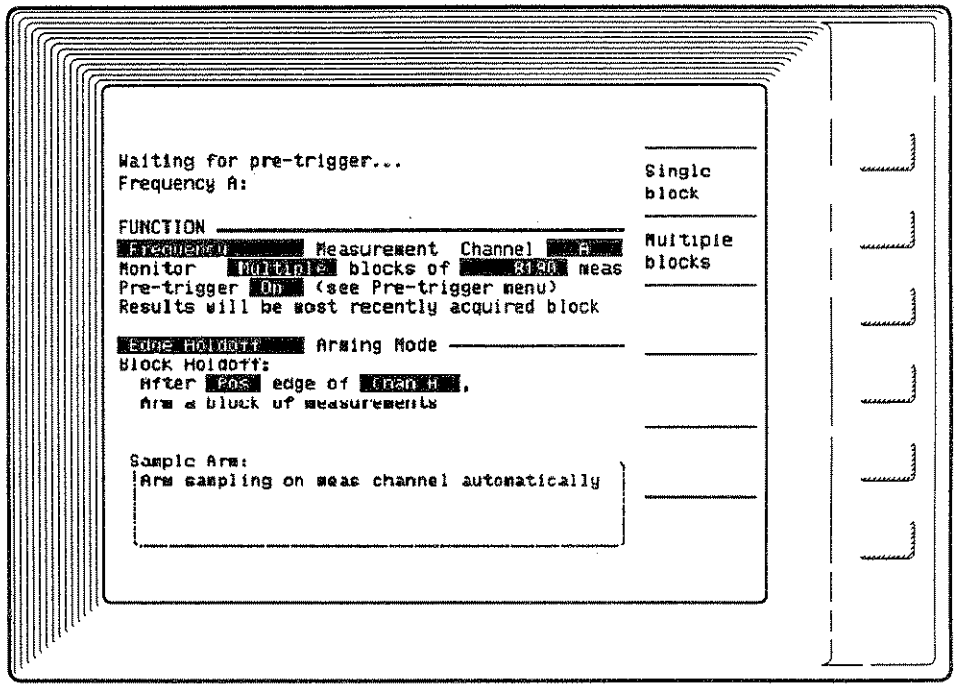


Figure 7-7. Multiple Blocks — Measurements Specified By Pre-trigger

- Pre-trigger is only available for continuous arming modes (Block Holdoff / Sample Arm). Refer to chapter 5, "Arming," for more information on continuous arming modes.

- The block holdoff condition must be repeated after the collection of each block of measurements. As samples are collected, a new block starts and new data progressively overwrite old block starts and data. Consequently, the results display may show a block start followed by measurements, or it may show measurements from one block followed by a block start and measurements from the next block. If the pre-trigger condition terminates acquisition before the pre-trigger amount (specified as a number of samples or a percentage of the total acquisition) is collected, then less than the specified pre-trigger amount is collected and displayed.

- The number of measurements that can be collected prior to the pre-trigger event is set by the user on the Pre-trigger menu (see chapter 10, "Pre-trigger Menu"). The number may not exceed the number of measurements in the block, and will be reduced automatically if it is too large.

For the menu shown in *Figure* 7-7, the following results features are available:

- **On the Numeric screens** — Up to 8,190 measurements (one block of data) that were collected around the pre-trigger event can be displayed. Statistics and limit testing are available.
- **On the Graphic Screens** — The graphs will include the one block of data that was collected around the pre-trigger event. That is, the data that was monitored prior to, and collected after, the pre-trigger event.
- **Measurement Abort** — If the measurement sequence is aborted, data acquisition is immediately halted and the data that was collected before the abort is displayed. For information on the instrument conditions that allow the Abort feature to interrupt measurement sequences, refer to chapter 6, "Front Panel/ Rear Panel."

ARMING MODE FIELD

The method used for arming the measurement, sampling data, and ending the measurement is set in the arming mode field and the data area below this field. The arming modes are listed below with the HP-IB command for each. For detailed information on each arming condition, refer to chapter 5, "Arming."

Softkey Options:

Automatic

Holdoff modes—

Edge Holdoff | Time Holdoff | Event Holdoff

Sampling Modes—

Interval Sampling | Time Sampling | Cycle Sampling
Edge Sampling | Parity Sampling | Repetitive Edge
Repetitive Edge-Parity | Random Sampling

Holdoff/Sampling modes—

Edge/Interval | Edge/Time | Edge/Edge | Externally Gated
Edge/Cycle | Edge/Event | Edge/Parity | Edge/Random
Time/Interval | Time/Time | Event/Interval
Event/Event | Manual

HP-IB Parameters:

AUT

Holdoff modes—

EDH | THOL | EVH

Sampling Modes—

ISAM | TSAM | CSAM
ESAM | PSAM | REDG
RPAR | RSAM

Holdoff/Sampling modes—

EDIN | EDT | EDED | EGAT
EDCY | EDEV | EDP | ERAM | TINT
TTIM | EVIN | EVEV | MAN

8

Contents of Chapter

INPUT MENU

CHAPTER OVERVIEW

While the INPUT screen is selected, the following parameters can be set:

- Separate or Common mode for Channel A and B
- Trigger event slope, mode, and level for Channel A and B
- Trigger level for External Arm signal
- Bias level and attenuation for Channel A and B
- Attenuation for the optional C Channel
- Hysteresis for Channel A and B

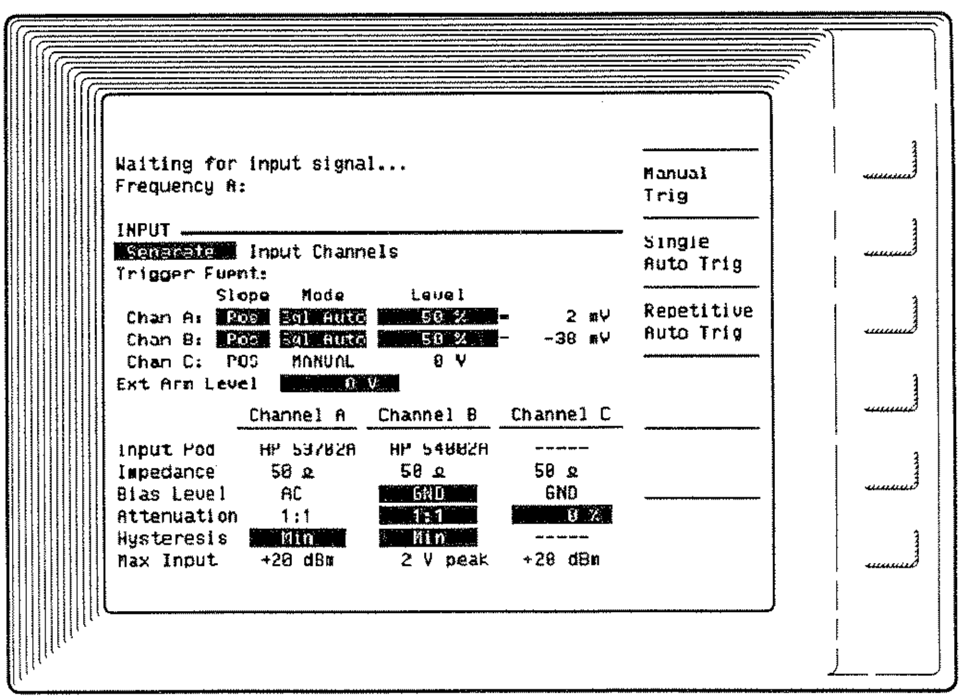


Figure 8-1. Input Menu Screen

INPUT CHANNELS FIELD

The standard input channels are Channel A and Channel B. The Input Channels field can be set to Separate or Common.

Separate: The Channel A and B input signals are connected to their respective input circuitry as shown in in *Figure 8-2* .

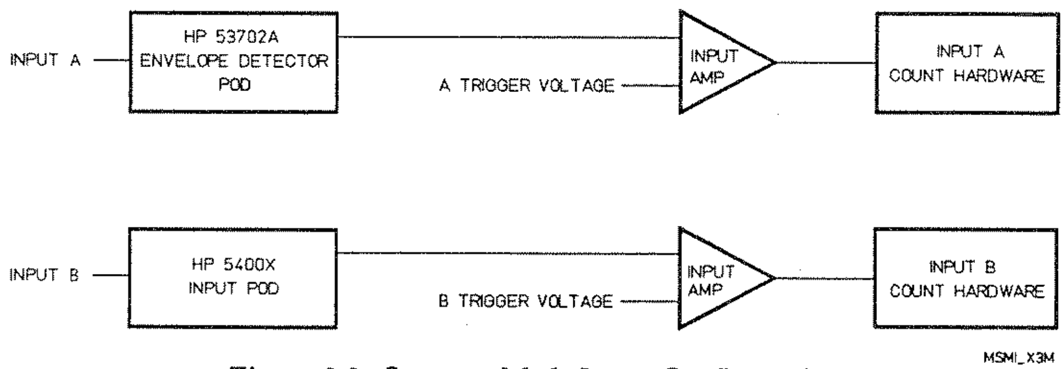


Figure 8-2. Separate Mode Input Configuration

Common: The Channel A input signal is also routed to the Channel B input circuitry, bypassing the Channel B input pod and attenuator. Any signal connected to Channel B will be terminated and attenuated as specified on the Input menu for Channel B. *Figure 8-3* shows the Common Mode configuration.

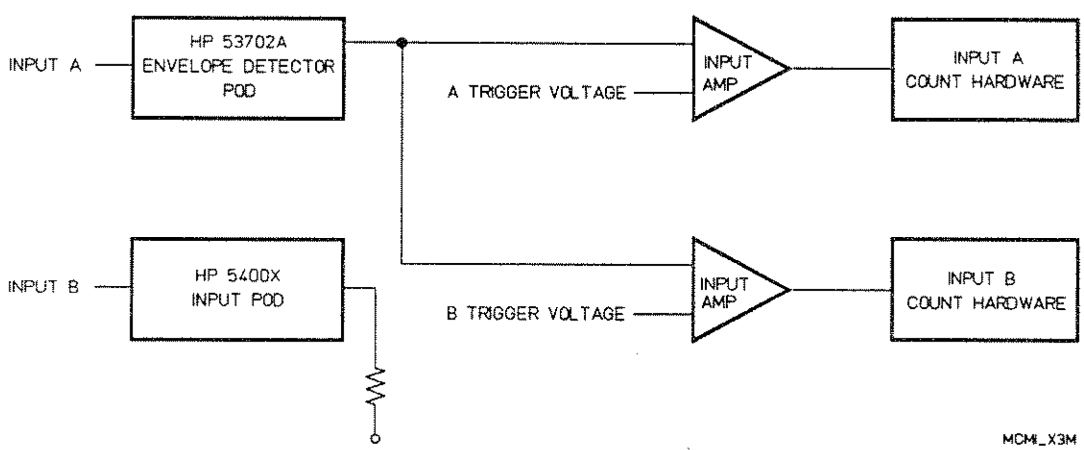


Figure 8-3. Common Mode Input Configuration

NOTE

When the Input Channels field is set to Common, the limits for the Channel B Trigger Event parameters (slope, mode, and level settings) are determined by the input pod installed at Channel A and the attenuation setting for Channel A. Set these Channel B parameters as required for the signal connected at Channel A.

Softkey Options:

Separate, Common

HP-IB Command:

MOD {SEP | COM}

Comments:

The Separate/Common circuitry is buffered so that neither input impedance nor input sensitivity is affected by the Input Channels setting.

The Common input mode is automatically invoked for Rise Time, Fall Time, Pulse Width, Pulse Offtime, and Duty Cycle measurements.

TRIGGER EVENT FIELDS

The trigger event is defined in three menu fields:

- Slope field
- Mode field
- Level field

The trigger event is the Channel A or Channel B event upon which measurements start, sample, and stop. It is defined for the A and B channels by setting a trigger slope, a trigger mode, and a trigger level for each channel.

Trigger Slope

The slope setting determines whether the trigger point will be on a rising or falling input voltage. Triggering occurs when the input signal reaches the selected voltage on the selected slope. The "Positive" setting specifies that the trigger point will be on a rising voltage. Likewise, the "Negative" setting specifies that the trigger point will be on a falling voltage.

Softkey Options:

Pos, Neg

HP-IB Command:

SLOP {POS | NEG}

Trigger Mode

Trigger mode is the method the HP 5373A uses to set the trigger level. There are three options:

- Manual Trigger
- Single Auto Trigger
- Repetitive Auto Trigger

NOTE

The operating range of the auto trigger modes (Single Auto and Repetitive Auto) is 1 kHz to 200 MHz.

MANUAL TRIGGER

When the Manual trigger mode is selected, the trigger level voltage is specified by entering a numeric value in the "Level" field. The default value is 0 V dc. Values can be entered using the softkeys, the DATA ENTRY keypad, or the ENTRY/MARKER knob.

1:1 Attenuation Range = –2.0 V dc to +2.0 V dc in 2 mV steps

2.5:1 Attenuation Range = –5.0 V dc to +5.0 V dc in 5 mV steps

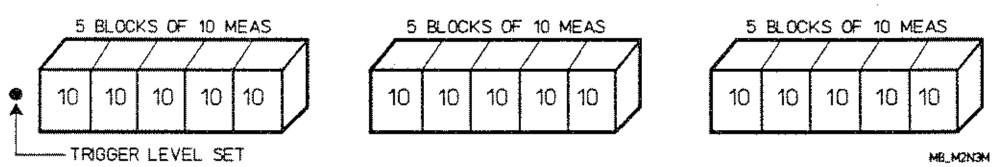
SINGLE AUTO TRIGGER

When you select Single Auto Trigger to set the trigger level, the input signal will have its peak amplitudes measured, and the trigger level will be set to a percentage of the peak-to-peak voltage value according to the following formula:

Trigger point = minimum peak + (maximum peak – minimum peak) ×percentage

The percentage is specified in the "Level" field. The Single Auto Trigger function sets the trigger level:

- whenever the Single Auto Trigger function is selected
- any time a measurement sequence restarts as a result of changing any parameter on the Function or Input menus
- whenever the **Restart** key is pressed
- prior to the start of every measurement sequence, when the Single/Repetitive acquisition mode is set to Single
- only prior to the first time a measurement sequence executes, when the Single/Repetitive acquisition mode is set to Repetitive (see illustration below.)

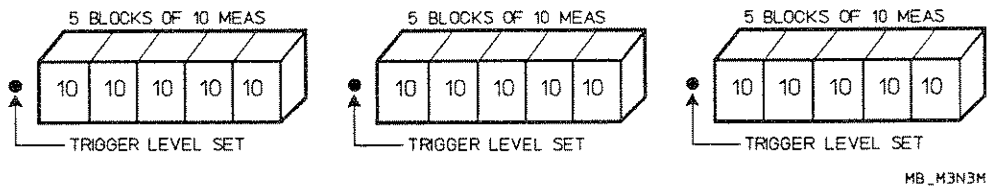


REPETITIVE AUTO TRIGGER

If you select Repetitive Auto Trigger to set the trigger level, the input signal will have its peak amplitudes measured and the trigger level will be set to a percentage of the peak-to-peak voltage value just as for the Single Auto Trigger mode. The Repetitive Auto Trigger function sets the trigger level:

- whenever the Repetitive Auto Trigger function is selected
- any time a measurement restarts as a result of changing any parameter on the Function or Input menus
- whenever the **Restart** key is pressed
- prior to the start of every measurement sequence, when the Single/Repetitive acquisition mode is set to Single

- prior to the start of every measurement sequence, when the Single/Repetitive acquisition mode is set to Repetitive (see illustration below).



NOTE

The Repetitive Auto Trigger function slows down the overall measurement rate because measurements cannot occur prior to setting the trigger level.

Softkey Options:

Manual Trig | Single Auto Trig | Repetitive Auto Trig

HP-IB Command:

TRIG {MAN | SAUT | RAUT}

Trigger Level

The trigger level is the voltage at which the input signal will trigger the HP 5373A.

If either Single Auto or Repetitive Auto trigger modes are selected, a percentage (0 to 100%) can be entered to specify triggering at a particular point on the peak-to-peak slope of the input signal. The Analyzer sets the trigger level and displays the trigger voltage on the Input menu. The default percentage is 50%.

Select the Manual trigger mode, and a specific voltage value can be entered into the Level field using the softkeys, the numeric keypad, or the ENTRY/MARKER knob. Use the **Enter** key to complete the entry sequence from the keypad.

Softkey Options:

Manual: 0 V | TTL Preset [1.4 V] | ECL Preset [-1.3 V]

Single Auto: 50% | 20% | 80%

Repetitive Auto: 50% | 20% | 80%

TRIGGER LEVEL NUMERIC SUMMARY

For Auto Trigger modes, Enter —

0 to 100% in 1% steps. Default is 50%.

For Manual Trigger mode, Enter —

–2.0 V dc to +2.0 V dc (in 2 mV steps) for 1:1 Attenuation

–5.0 V dc to +5.0 V dc (in 5 mV steps) for 2.5:1 Attenuation

Default is 0 V dc.

HP-IB Command:

RLEV <number> (specify an auto trigger level percentage)
LEV <number> (specify a manual trigger level voltage)

EXTERNAL ARM LEVEL FIELD

The External Arm trigger level can be set from –5.0 Vdc to +5.0 Vdc in 20 mV steps. The default value for the External Arm trigger level is 0 V dc.

Range = dc coupled to 100 MHz

Softkey Options:

0 V | TTL Preset [1.4 V] | ECL Preset [-1.3 V]

HP-IB Command:

LEV <number>

INPUT PODS

The HP 5373A uses removable input pods that can be chosen according to the measurement application. This instrument recognizes which model pod is installed and displays the pod's model number and impedance. The termination impedance for the Channel A and B inputs is dictated by the specific input pod used.

CAUTION

Do not remove an input pod while the HP 5373A is powered on. Always set Analyzer to Standby before removing or inserting an input pod. Damage to the pod can result from not following this caution.

Input Pod Characteristics

The following descriptions summarize the characteristics and operating environments for each of the available input pods.

- HP 53702A 50Ω Envelope Pod

This pod will terminate a 50Ω coaxial cable. One of these pods comes standard with the HP 5373A. For the class of signals that exist in a 50Ω environment, this pod provides low insertion loss and a good termination. This pod detects the envelope of a pulsed signal.

- HP 54002A 50Ω BNC Input Pod

This pod will terminate a 50Ω coaxial cable. One of these pods comes standard with the HP 5373A. For the class of signals that exist in a 50Ω environment, this pod provides low insertion loss and a good termination.

- HP 54001A 10-kΩ/2pF, 1 GHz Miniature Active Probe/Pod

This probe pod is very useful for high-speed logic measurements where wide bandwidth is essential and capacitive loading dominates the probe's effect on the signal.

- HP 54003A 1-MΩ/8pF, 300 MHz, 10:1 Probe/Pod

This probe pod is used to measure circuits that are sensitive to resistive loading (i.e., having resistances above a kilohm). These circuits are usually slow and not so sensitive to capacitive loading. The probe can be removed from the pod to provide a 1-MΩ, ~10 pF BNC input. This setup allows a coaxial connection in applications where bandwidth and capacitive load are not as critical as resistive loading.

BIAS LEVEL FIELD

For the HP 53702A pod, the bias is defaulted to ac.

For the 50Ω standard input pod, either a 0 volt (GND) or a –2 V (ECL) termination voltage may be specified. The BNC input connector remains connected to ground. The –2 V termination preserves the characteristics of high-speed ECL circuits. When any other type of pod is installed, the GND termination is automatically selected, and the –2 V bias level is not available.

Softkey Options (for 50Ω standard input pod only):

GND [0 V] | ECL [–2 V]

HP-IB Command (for 50Ω standard input pod only):

BIAS {GND | ECL}

ATTENUATION FIELD

CAUTION

Be careful when connecting signals to the HP 5373A. Attenuation is a manual setting. Check the amplitude of the signal before you apply it to the instrument. Damage to the instrument is possible if you connect a signal that exceeds ± 2.5 V with attenuation set to 1:1, or ±5.5V with attenuation set to 2.5:1. The Preset function resets the attenuation to the 1:1 setting.

NOTE

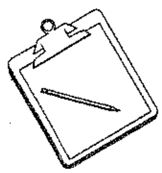
The HP 53702A Envelope Pod provides a 1:1 representation of the negative portion of the envelope of the signal at its input. The attenuation information that follows is not applicable to this pod. The attenuation or gain of the pod cannot be changed by the HP 5373A operator.

The HP 54002A 50Ω BNC Input Pod has two available attenuation values:

- 1:1 (0 dB), which is no attenuation;
- 2.5:1 (8 dB), which allows a signal having an amplitude 2.5 times the normal operating range to be applied to the selected input channel.

Increased attenuation allows the HP 5373A to measure a signal that would otherwise exceed the signal operating range of the instrument. It may also be used in some circumstances to improve the noise immunity of the measurement.

TECHNICAL COMMENT



Low Frequency Measurements —

The HP 5373A provides high bandwidth, high gain, and high sensitivity at its inputs. Care should be exercised when measuring noisy, low amplitude signals with slow slew rates. Because of its high input sensitivity, noisy or low frequency signals can cause the HP 5373A to count noisy events, resulting in a miscount and erroneous measurement results. Many signal sources do not provide good frequency response at low frequencies (in general, 10 MHz and below, although response varies from source to source). If the HP 5373A is miscounting a low frequency signal, it could be the result of a noisy source. Here are four ways to solve the problem:

1. *Use a filter to filter out the noise on the input signal. Use a spectrum analyzer to see where your noise is, then choose the appropriate filter.*
2. *If the noise on the input signal is low enough, and the amplitude is high enough, then using the 2.5:1 attenuation setting may attenuate the noise enough to avoid miscounts.*
3. *Use a signal source that can provide a low frequency signal with a high signal-to-noise ratio.*
4. *Select maximum hysteresis to provide additional noise immunity.*

Softkey Options (HP 54002A 50Ω BNC Input Pod only):

1:1 | 2.5:1

HP-IB Command (HP 54002A 50Ω BNC Input Pod only):

ATT {X1 | X2}

Channel C (Option 030) Attenuation Field

When the Channel C input option is installed, a field for setting attenuation appears on the Input menu. The field can be set from 0% to 100%, in 5% steps. The attenuation range is from 0 dB to 26 dB of attenuation.

The Channel C attenuator can be used when measuring noisy signals.

Softkey Options:

0% | 25% | 50% | 75% | 100%

HP-IB Command:

CATT <number> (0 to 100)

Comments:

The Channel C input has the following characteristics:

Trigger Level is 0 V on a positive slope.

Input Impedance is 50Ω, AC coupled.

HYSTERESIS FIELD

The Hysteresis feature can be used to increase the noise immunity of the Channel A and/or B inputs. If the HP 5373A is miscounting an input signal, it could be the result of noise on the signal. This feature allows you to select a level of hysteresis that will make the input circuitry less susceptible to counting on the noise of a signal.

Hysteresis can be set to minimum or maximum. Minimum hysteresis is the default value and represents the maximum sensitivity setting. Maximum hysteresis decreases the sensitivity so that a signal of greater amplitude is required to trigger the HP 5373A.

Softkey Options:

Min | Max

HP-IB Command:

HYST {MIN | MAX}

Comments:

The Hysteresis feature may be used in combination with the Attenuation feature to make measurements in low frequency applications.

It is assumed that your signal satisfies the sensitivity requirements of the HP 5373A. Refer to appendix E, "Specifications," for the sensitivity limits.

9

Contents of Chapter

9

MATH MENU

CHAPTER OVERVIEW

While the MATH screen is selected, the following features can be set:

- Source Channel
- Statistics
- Math processing
- Limit testing
- Reference setting
- Carrier frequency for Phase Deviation, Time Deviation, or Frequency Deviation measurements
- Phase result format for Phase and Phase Deviation measurements

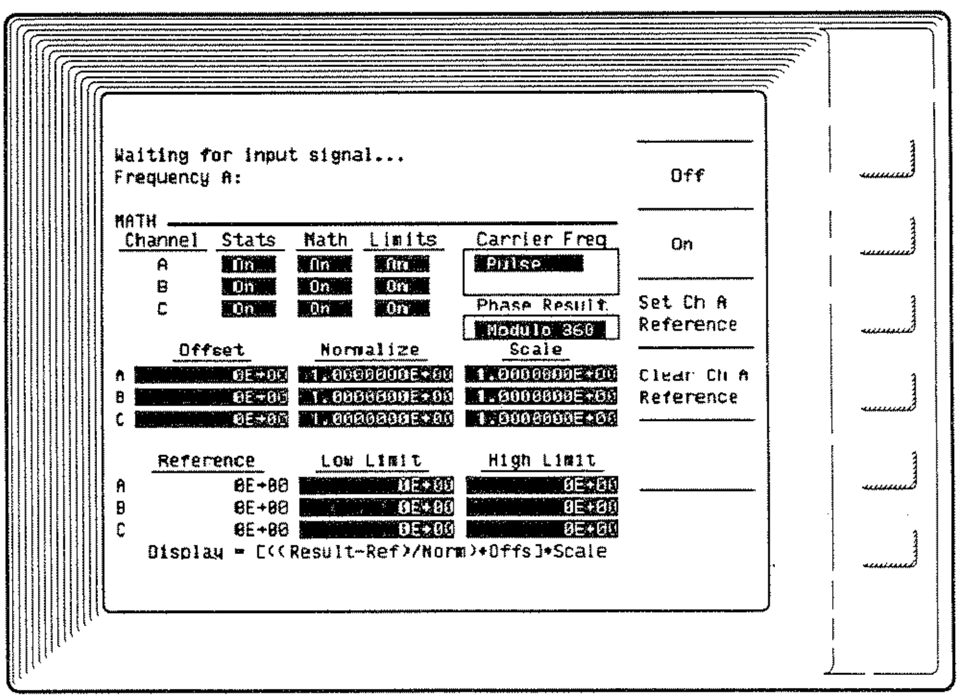


Figure 9-1. Math Menu Screen

SOURCE CHANNEL

The HP 5373A MATH menu presents choice and selection information for only one channel at a time. The channel for which information is presented is indicated and selected via the Channel field at the upper-left-hand corner of the screen.

The channel specification is made independently of the channel specification that is made in the Function menu.

STATISTICS FIELD

The HP 5373A can compute statistics for all measurement functions, except Histogram measurements (described in chapter 4). The parameters computed include:

- Minimum value of acquired measurements
- Maximum value of acquired measurements
- Mean estimate of acquired measurements
- Variance of acquired measurements
- Standard Deviation of acquired measurements
- Allan Variance of acquired measurements
- Root Allan Variance of acquired measurements
- Root Mean Square of acquired measurements

These functions are enabled as a group when Statistics is set to On. When using HP-IB remote control, any of the above values can be retrieved (individually or as a group). If Statistics is running in the Pulse AUTO mode and the measurement function is Frequency or PRI, the statistics apply only to data points measured during pulse on-times (i.e., those times when the pulse is on).

Statistical Functions

MEAN —

$$\text{Mean} = \frac{\sum_{i=1}^{n} X_i}{N}$$

NOTE

For arithmetic mean, the first measurement of the group is subtracted from each measurement for the calculation and then added back at the end of the calculation.

TECHNICAL COMMENT

In the Compute Carrier Pulse mode, the on-time and off-time data points are determined as follows:

- *for Frequency, all points whose frequency is less than 1/5 of the maximum frequency are considered to be off-time data points and are rejected.*
- *for Period, all points whose period is greater than 5 times the minimum period are considered to be off-time data points and are rejected.*

In the Pulse AUTO mode, the on-time and off-time data points are determined as follows:

- *for Frequency, all points whose frequency is less than 1/5 of the maximum frequency are considered to be off-time data points and are rejected.*
- *for Period, all points whose average period is greater than 5 times the minimum average period are considered to be off-time data points and are rejected.*

A different method for calculating the mean is used in the following situations:

- *The measurement function is Frequency or Period*
- *A continuous arming mode is selected*
- *Not in Pulse AUTO Mode*

Continuous arming is explained in chapter 5. An easy method for identifying continuous arming is to look for the terms "Block Holdoff" and "Sample Arm" on the Function menu below the **Arming Mode** *field. If these terms appear, the arming mode is continuous.*

- *The number of measurements per block is 3 or more*
- *Pre-trigger*
- *is off (see Function menu)*
- *Inhibit is off (see Pre-trigger menu)*

When the above conditions are met, the Bicentroid Mean method is used. This is an algorithm which calculates mean frequency by estimating the Least Squares Fit of a line to the events vs. time data (refer to chapter 2, "Frequency/Period Measurements," for more about time and events). The slope of this line is a constant frequency. This mean estimate more accurately represents the characteristics of the collected data as compared to the simple arithmetic mean.

VARIANCE —

$$\text{Variance} = \frac{\sum_{i=1}^{N} X_i^2 - \frac{\left(\sum_{i=1}^{N} X_i\right)^2}{N}}{N-1}$$

NOTE

For variance, the first measurement of the group is subtracted from each measurement for the calculation and is NOT added back at the end of the calculation.

STANDARD DEVIATION —

$$\text{Standard Deviation} = \sqrt{\text{Variance}}$$

ALLAN VARIANCE —

$$\text{Allan Variance} = \frac{\sum_{i=2}^{N} \left(X_i - X_{i-1}\right)^2}{2\,(N-1)}$$

ROOT ALLAN VARIANCE —

$$\text{Root Allan Variance} = \sqrt{\text{Allan Variance}}$$

NOTE

The Allan Variance and Root Allan Variance are not calculated if the Inhibit feature is available and enabled.

RMS —

$$\text{RMS} = \frac{\sum_{i=1}^{N} X_i^2}{N}$$

NOTE

For RMS, the first measurement of the group is subtracted from each measurement for the calculation and then added back at the end of the calculation.

For the above calculations:

- X_i = an individual measurement
- N = the number of measurements
- All summations except Allan Variance are for i = 1 to N
- For Allan Variance i = 2 to N

Softkey Options:

On | Off

HP-IB Command:

STAT {ON | OFF}

MIN? | MAX? | MEAN? | VAR? | SDEV? | AVAR? | RAV?
RMS?

Comments:

If math processing is enabled, (i.e., offset, normalize, scale), statistical calculations are performed on the measurement data after the math processing has completed.

If results are averaged (as described in chapter 7), the statistics are calculated using the measurement results before averaging.

MATH FIELD

The HP 5373A normally displays the result of time interval, frequency, and PRI measurements in units of seconds or Hertz. In some situations, it may be desirable to have calculations performed on the measured results before they are displayed. This is where the math operators are useful. They can subject the measured result to division, addition, subtraction, and multiplication before display. Industrial parameters such as flow, speed (RPM), pressure, and temperature can be expressed directly.

Math processing can be used for all measurement functions, except Histogram measurements. The math operators act on the measured results after any Reference value is subtracted, but before other post-processing operations such as statistics, limit testing, and the graphic display of the data.

Math processing is enabled or disabled separately for Channels A and B (and Channel C, Option 030). Specific math operations are also set separately for the input channels. When Math is on, the time and frequency units are blanked from the displayed results.

There are three math operators:

- Offset
- Normalize
- Scale

These functions are applied as follows:*

$$\text{Displayed result} = \left[\frac{\text{Result} - \text{Reference}}{\text{Normalize}} + \text{Offset}\right] \times \text{Scale}$$

* Except for Phase or Phase Deviation with Modulo 360 Phase Result (see chapter 3).

Offset Field

The Offset function is used to add (or subtract) a specified constant to the measurement.

Default Value = 0

Range: –1E+12 to +1E+12

Resolution = 1E–12

Normalize Field

The Normalize function divides the measured value by a specified constant.

Default Value = 1

Negative Range: –1E+12 to –1E–12

Positive Range: +1E-12 to +1E+12

Resolution = 1E–12

Scale Field

The Scale function multiplies a measurement by a specified scaling factor.

Default Value = 1

Range: –1E+12 to +1E+12

Resolution = 1 E–12

HP-IB Command:

NORM <number>
OFF <number>
SCAL <number>

Comments:

The advantage of having both a normalizing factor and a scale factor as part of the math processing is that a multiplying operation can come before or after the offset factor.

- Multiplication by 1.5 after the offset:

$$\text{Value} = \left[\frac{\text{Result}}{\text{Normalize}} + \text{Offset}\right] \times \text{Scale}$$

$$\text{Value} = \left[\frac{4.0}{1} + 5.0\right] \times 1.5 = 13.5$$

The result is multiplied by the scale factor after the offset is added.

- Multiplication by 1.5 before the offset:

$$\text{Value} = \left[\frac{\text{Result}}{\text{Normalize}} + \text{Offset}\right] \times \text{Scale}$$

$$\text{Value} = \left[\frac{4.0}{.6666667} + 5.0\right] \times 1 = 11$$

The reciprocal of 1.5 $\left(\frac{1}{1.5}\right)$ used as the normalization constant will effectively multiply the result by 1.5 before the offset is added.

The default values for offset, normalize, and scale (0, 1, 1 respectively) have no effect on the measurement value. Use these default values to "turn off" the functions not needed when using math processing.

Limits Field

The Limits feature allows upper and lower limits to be set for the processed results. That is, after any math and reference processing, the measured result is compared to the entered high and low limits. When a result falls outside the limits, it will be indicated on the Numeric results screens with a "High" or "Low" label, and over HP-IB (an SRQ will be generated if at least one value is out of range).

Limit Testing works in a second mode if the lower limit is greater than the upper limit. If a result falls inside these reversed limits, it will be indicated with an "Ins" label. This is considered out of range. The result will be labeled "Pass" if it falls outside the limit values.

The following results are not limit tested: time stamps, data extended by Inhibit, and invalid data.

The Limit Status format option (Numeric screen) displays the number of measurements that were high, that passed, and that were low. This screen also shows the percentage of measurements in each of those categories. This screen will show the number of measurements that passed and the number of measurements that were "inside" when the lower limit is set to a larger number than the upper limit.The entered limits (a maximum and minimum value) are displayed on the Histogram graph as vertical lines and the Time Variation graph as horizontal lines.

Range: –1E+34 to +1E+34

Resolution: 1E–34

Softkey Options:

On | Off

G | M | k | m | u | n

HP-IB Command:

LIM {ON | OFF}
HLIM <number>
LLIM <number>

REFERENCE VALUE

A reference value is subtracted from measurements before any math processing or display of results. Once a reference value is set, it remains in effect until it is cleared by the Clear Channel Reference softkey.

The reference value can be the statistical mean of a group of measurements or the first measured value in that group. For example, if statistics is enabled on Channel A, pressing the Set Ch A Reference softkey will enter the statistical mean of the most recently acquired Channel A measurements as the reference value.

If statistics are off, pressing Set Ch A Reference after a measurement acquisition will enter the first valid measurement result of the measurement acquisition on Channel A as the reference value. Until the reference value is cleared, it will be subtracted from every Channel A measurement result before it is displayed.

If a particular value needs to be subtracted from the measured value, use a negative value as the offset in math processing. One use for Reference is to cancel measurement offsets due to differing signal path lengths in a measurement setup.

Softkey Options:

Set Ch A Reference | Clear Ch A Reference
Set Ch B Reference | Clear Ch B Reference
Set Ch C Reference | Clear Ch C Reference (Option 030)

HP-IB Command:

SREF
CREF

Comments:

When Set Reference is selected, with Math and Statistics already enabled, the statistical mean used as the reference value is the mean of the measurement results before any math processing.

NOTE

If you want to enable Statistics, Math, Limits, or the Reference Value for any two-channel, single-result measurement, be aware of the following:

The feature(s) must be enabled for the input channel that comes first alphabetically.

The following examples of two-channel, single-result measurements will help illustrate this concept:

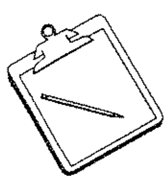
Two-Channel, Single-Result Measurement Configurations	*Enable Feature(s) on Channel*
Time Interval B→ A	*A*
Frequency B+C	*B*
Period C/A	*A*
Phase B rel A	*A*

CARRIER FREQUENCY FIELDS

The top field in the Carrier Freq box indicates the current carrier specification method. When this box is highlighted, the top four softkeys are given labels that allow you to chose some other method of determining the carrier frequency to be used for deviation measurements. The choices are:

- Compute Carrier Pulse. In this case, the reference value is calculated automatically from a pulse input. When this method is chosen, any measurement that includes off-time data is not used in the calculation.

TECHNICAL COMMENT



In the Compute Carrier Pulse mode, the on-time and off-time data points are determined as follows:

- *for Frequency, all points whose frequency is less than 1/5 of the maximum frequency are considered to be off-time data points and are rejected.*
- *for PRI, all points whose average period is greater than 5 times the minimum average period are considered to be off-time data points and are rejected.*

- Compute Carrier CW. In this case, the reference value is calculated automatically from a CW input.
- Compute Carrier Manual. In this case, the reference value is specified as a constant frequency, entered manually.

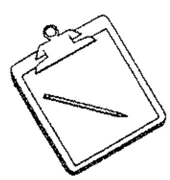
  Manual Carrier Range is 1E–12 to 10E+9 (Hz). The HP-IB command is CFR.

- Compute Carrier Linear. In this case, the reference value is specified as a frequency that changes at a constant rate, determined by manually-entered slope and start values.

  Slope Range is –10E+9 to 10E+9 (Hz/μsec).

  Starting Point Range is 1E–12 to 10E+9 (Hz).

The HP-IB commands for Slope and Starting Point are CSL and CST.



TECHNICAL COMMENT

When Carrier Frequency is set to Automatic, the "mean" used as the reference is the Bicentroid Mean. This is an algorithm which calculates mean frequency by estimating the Least Squares Fit of a line to the events vs. time data. The slope of this line is a constant frequency. The frequency thus calculated is

Softkey Options:

Compute Carrier Pulse | Compute Carrier CW | Compute Carrier Manual | Compute Carrier Linear

HP-IB Commands:

CARR {PULS | CW | MAN | LIN} ; CARR? queries for current choice.

CFR <number> specifies the frequency value for "Manual" mode. CFR? queries for this value.

CSL <number> specifies the frequency slope value for "Linear" mode. CSL? queries for this value.

CST <number> specifies the starting frequency value for "Linear" mode. CST? queries for this value.

Comments:

Refer to chapter 3, "Special Purpose Measurements," for a description of the Phase Deviation, Time Deviation, and Frequency Deviation measurement functions.

PHASE RESULT FIELD

The HP 5373A can display the results of Phase and Phase Deviation measurements in two different result formats. The options are:

- **Modulo 360** — All results will be in the range of –180 degrees to +180 degrees
- **Cumulative** — If the number of measurements per block is greater than 1, the phase results are referenced to the first sample of the block. The results will reflect the cumulative phase deviation of the input signal from the reference.

Softkey Options:

Phase Result MOD 360 | Phase Result Cumulative

HP-IB Command:

PHAS {MOD | CUM}

Comments:

Refer to chapter 3, "Special-Purpose Measurements," for a description of the Phase and Phase Deviation measurement functions.

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PRE-TRIGGER MENU

CHAPTER OVERVIEW

The Pre-trigger Menu provides access to three features. They are:

- Pre-trigger Control
- TI Detect
- Measurement Inhibit

This chapter describes the three features and includes details on the use of each.

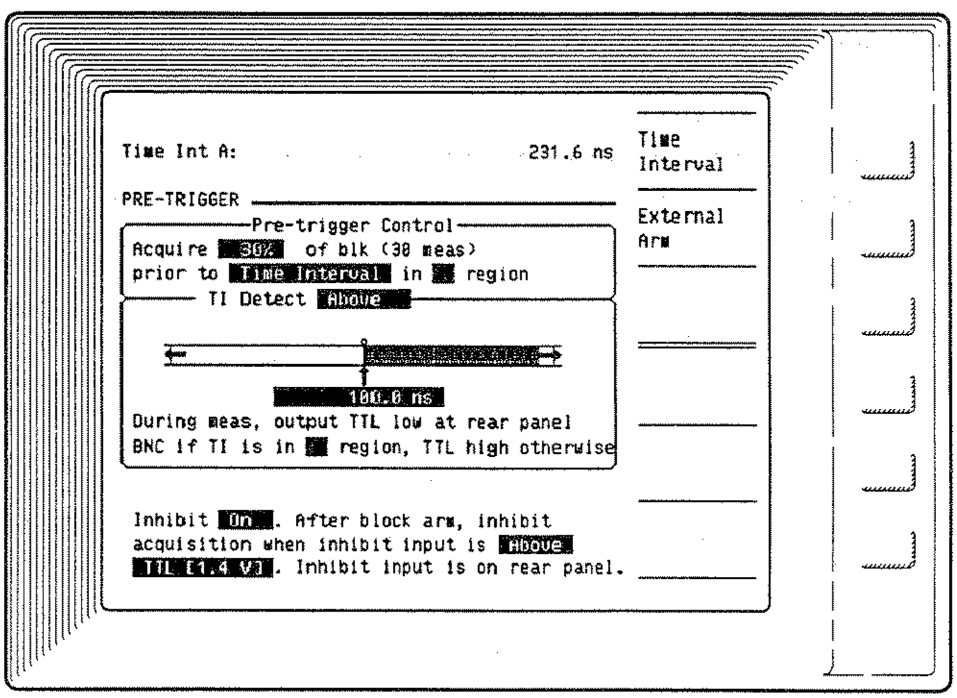


Figure 10-1.
Pre-trigger Menu Screen

PRE-TRIGGER

Pre-trigger provides an alternative method for ending a measurement sequence. In addition to being able to specify the end of a data acquisition by a number of measurements, Pre-trigger allows the end of a measurement sequence to be determined by events occurring in the data stream (see TI Detect), or an external input.

Using the Pre-trigger Control parameters it is possible to capture the data that occurs in a "window" positioned about the pre-trigger event. Measurements falling inside the window are acquired and displayed. Pre-trigger can operate in single and multiple block measurement sequences.

Figure 10-2 shows Pre-trigger operation for a "Single block" of measurements. Data is monitored up to the point where the pre-trigger event occurs; data is captured according to the Pre-trigger Control settings. The Block Holdoff conditions are satisfied once.

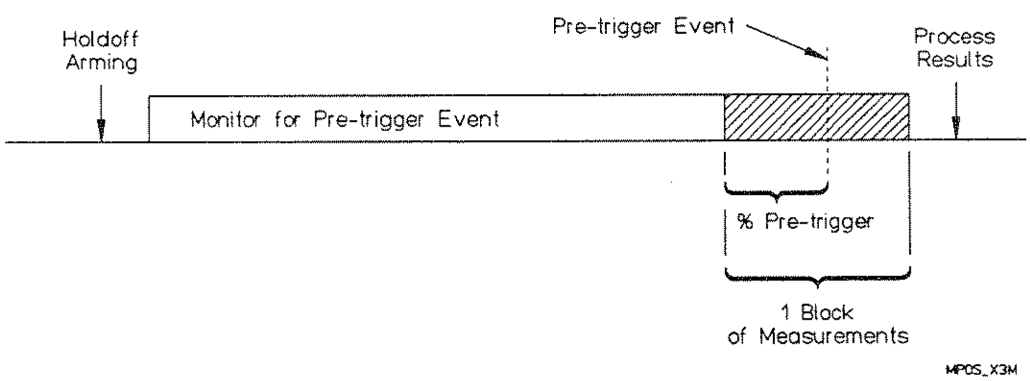


Figure 10-2. Pre-trigger Operation on a Single Block of Measurements

Figure 10-3 is an example of the "Multiple block" setting. Data is monitored for the pre-trigger event across block boundaries. Again, once the pre-trigger event occurs, data is captured as specified by the Pre-trigger Control settings. This can include data captured from portions of two different blocks. The Block Holdoff conditions must be satisfied prior to each block of measurements being monitored. If the pre-trigger event occurs between blocks, it will not be detected. The pre-trigger event is specified on the Pre-trigger menu. Pre-trigger is enabled on the Function menu.

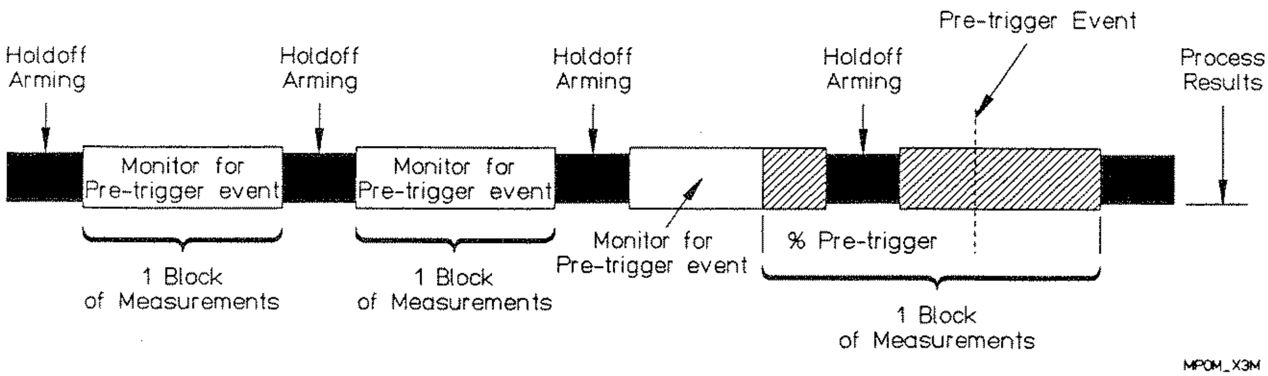


Figure 10-3. Pre-trigger Operation on Multiple Blocks of Measurements

NOTE

Pre-trigger is unavailable for the following measurement functions:

- *Rise Time*
- *Fall Time*
- *Pulse Width*
- *Pulse Offtime*
- *Duty Cycle*
- *Phase*
- *Phase Deviation*
- *Time Deviation*
- *Frequency Deviation*
- *Envelope Power*
- *Amplitude Modulation*

Pre-trigger is unavailable for non-continuous arming modes. Refer to chapter 5, "Arming," for a description of these modes.

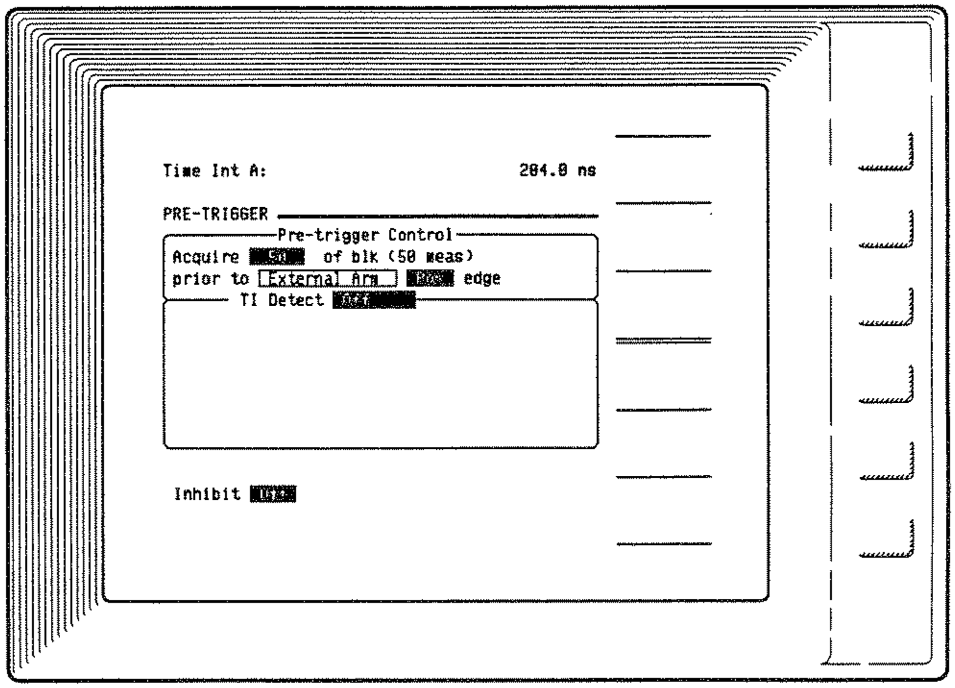


Figure 10-4. Pre-trigger on External Arm

PRE-TRIGGER CONTROL

The conditions for Pre-trigger are set under Pre-trigger Control. The HP 5373A can pre-trigger on a signal applied to the External Arm input or a measured time interval when using the TI Detect feature. Pre-trigger lets you capture a portion of the block of measurements prior to a pre-trigger event. The amount of data acquired before pre-trigger can be specified as a number of measurements, or a percentage of the number of measurements in a block. See *Figure 10-4* for an example of Pre-trigger Control set to capture 50% of the block that occurs before a positive edge at the External Arm input.

Pre-trigger Amount

The pre-trigger amount is the portion of the block of measurements specified on the Function menu that will be acquired prior to the pre-trigger event. The portion of the block can be specified as a percentage, 0% to 100%, or a number of measurements, 1 to the number of measurements in the block. Once a numeric entry is initiated for the pre-trigger amount, two softkey choices will appear. Use the **%** softkey to enter a percentage of the block; use the **Samples** softkey to enter a number of measurements. The **Enter** key defaults to the last mode used, either percentage or number of measurements.

NOTE

For Histogram measurements, the pre-trigger amount is not selectable; it is restricted to 100%. This means that all measurement data up to the pre-trigger event is captured. The pre-trigger event ends the measurement acquisition.

Softkey Options:

% | Samples

TECHNICAL COMMENT

Pre-trigger Amount Accuracy *— The Pre-trigger system has been designed for accurate, on-the-fly detection of characteristics in the data stream. When a pre-trigger event is detected, acquisition terminates with the data surrounding the pre-trigger event available for analysis.*

The collected data can be said to have occurred inside the "capture window". The width of the capture window, and its placement about the exact location of the pre-trigger event, are extremely sensitive to the input data, and to user-selected characteristics of the sampling. Consequently, it is inappropriate to expect exact numbers of measurements to precede, or follow, the pre-trigger event. (You should expect a variation of up to 6 measurements.) Similarly, it is inappropriate to expect an exact number of measurements to fall within the capture window. (You should expect the number of measurements to range from 0 to the measurement size +1, depending on the input data. Regardless of variations in the size or position of the capture window, the pre-trigger point is correctly located within the collected data.

Pre-trigger Event

The event upon which the HP 5373A will pre-trigger can be a signal applied to the External Arm input, or when making a time interval measurement, a measured time interval.

The pre-trigger event is specified as follows:

- A positive or negative slope of a signal at the External Arm input. The voltage value is set on the Input menu.

- A measured time interval value according to the settings of the TI Detect feature. It is possible to have the HP 5373A pre-trigger on the following conditions using the TI Detect feature:
  - A measured time interval greater than a specified value. Press the **Detect Region Above** softkey and enter the time interval value that if exceeded should cause pre-trigger. (Excludes set value)
  - A measured time interval less than a specified value. Press the **Detect Region Below** softkey and enter the time interval value below which the HP 5373A should pre-trigger. (Excludes set value)
  - A measured time interval between two specified values. Press the **Detect Region Inside** softkey and enter the value of the minimum time interval that should pre-trigger the Analyzer and the value of the maximum time interval that should cause pre-trigger. (Includes set values)
  - A measured time interval outside of a range specified by two values. Press the **Detect Region Outside** softkey and enter the time interval value below which the Analyzer should pre-trigger and the time interval value that if exceeded should cause pre-trigger. (Excludes set values)

Softkey Options:

External Arm | Time Interval

Pos | Neg

TI DETECT

The TI Detect feature can be used to output a signal at the rear panel when a measured time interval satisfies a specified condition. The time interval can also be used as a pre-trigger event for a time interval measurement. *Figure 10-5* shows an example of TI Detect set to output a TTL low signal when the measured time intervals are equal to, or above 99.0 ns and equal to, or below 101.0 ns.

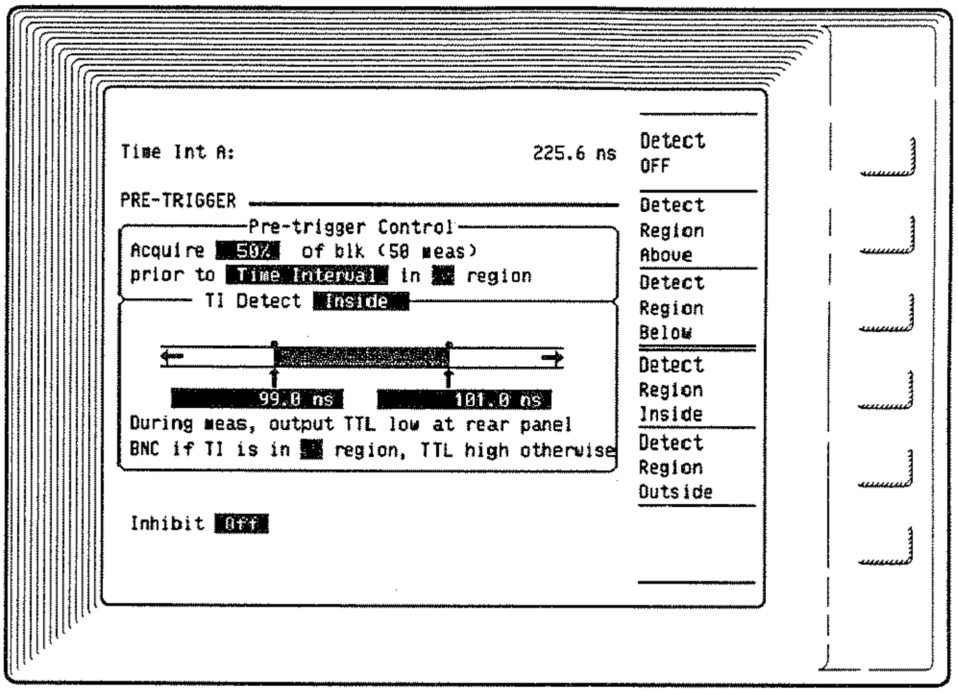


Figure 10-5. TI Detect Between Two Values

Time Interval Range

TI Detect allows you to set thresholds for time interval measurements so that when a measurement satisfies a specified condition:

- A pre-trigger event occurs for a time interval measurement sequence using Pre-trigger.
- A TTL low signal is supplied to the rear-panel TI Detect output.

To have TI Detect provide a pre-trigger event for a measurement sequence, Pre-trigger must be enabled on the Function menu and Pre-trigger Control must be set to **Time Interval** on the Pre-trigger menu.

The rear-panel output goes low at the first occurrence of a measured time interval that satisfies the conditions set for TI Detect. The signal stays low as long as measurements continue to satisfy the conditions, going high when a measurement value does not meet the conditions or whenever a new measurement sequence starts.

NOTE

TI Detect is only available for the following measurements:

- *Time Interval*
- *Continuous Time Interval*
- *±Time Interval*
- *Histogram Time Interval*
- *Histogram Continuous Time Interval*
- *Histogram ±Time Interval*

There is less than a 600 ns delay between the time a measurement value satisfies the TI Detect conditions and the time the signal level at the rear panel will change state. For this reason, the output may not be suitable for exact timing. This delay also applies when using TI Detect as the pre-trigger event. Up to 600 ns may elapse between a measured value that satisfies the TI Detect conditions and when the measurement hardware receives a pre-trigger signal.

TECHNICAL COMMENT

The TI Detect feature outputs a low signal at the rear panel when a measured time interval satisfies the set thresholds. The following list summarizes the TI Detect settings and what can be expected at the rear-panel output. Signal output levels are TTL (0 to 5 V) into ≥10 kΩ or 0 to 1 V (minimum) into 50 Ω.

- *TI Detect Region Above — Output is low when measured time interval is above the entered value, high when below.*
- *TI Detect Region Below — Output is low when measured time interval is below the entered value, high when above.*
- *TI Detect Region Inside — Output is low when measured time interval is equal to, or between the entered values, high when above or below.*
- *TI Detect Region Outside — Output is low when measured time interval is outside of the entered values, high when equal to, or between.*

TI Detect can only be enabled when time interval measurements are being made.

Softkey Options:

Detect OFF | Detect Region Above | Detect Region Below

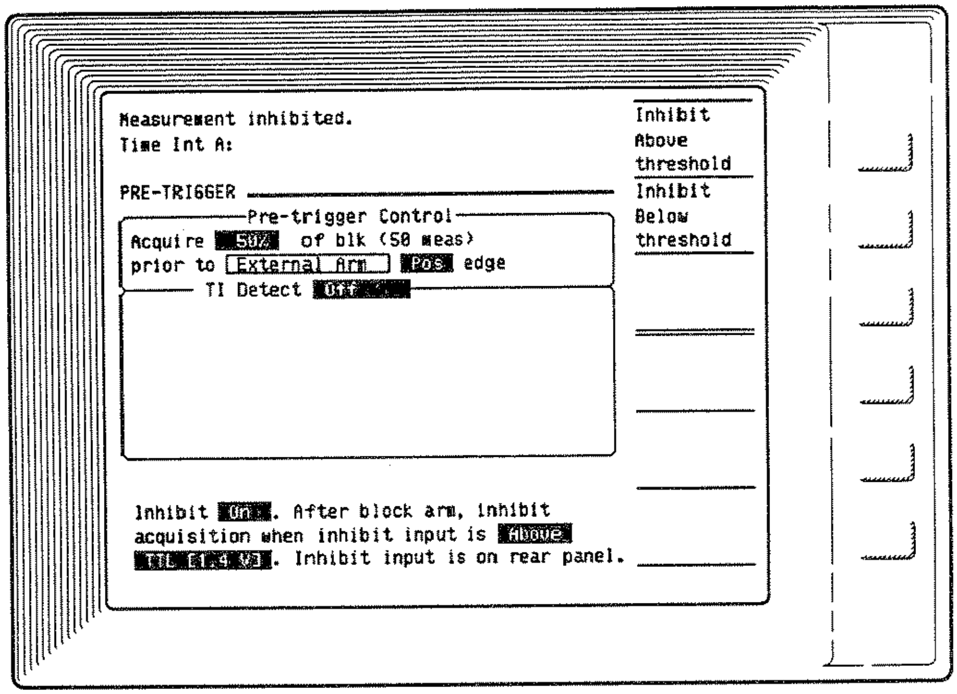
Detect Region Inside | Detect Region Outside

INHIBIT

The Inhibit feature makes it possible to selectively suppress data collection by the HP 5373A. An external signal is required at the Inhibit input on the rear panel. One of three voltage thresholds can be specified and the enabling condition can be set as above or below any of the three thresholds.

In general, when a measurement sequence is inhibited, the acquisition of measurement data is suspended. When no longer inhibited, the measurement sequence resumes and progresses to a normal termination once the specified number of measurements have been collected. *Figure 10-6* shows an example of a measurement inhibited by a signal that exceeds 1.4 V at the rear-panel Inhibit input.

Figure 10-6.
Measurement Inhibited
By Rear-Panel Signal



Softkey Options:

Off | On

Inhibit Above threshold | Inhibit Below threshold

Inhibit Level GND [0.0 V]

Inhibit Level TTL [1.4 V]

Inhibit Level ECL [-1.3 V]

Inhibit and Arming

Inhibit does not interfere with arming. Blocks and measurement samples within blocks are armed normally when Inhibit is asserted. No new measurements are collected until Inhibit is de-asserted.

NOTE

Inhibit is not available for the non-continuous arming modes. Refer to chapter 5, "Arming," for a description of these modes.

Inhibit and Pre-trigger

Inhibit does not stop detection of a pre-trigger event on the External Arm input. However, if the pre-trigger event is to be followed by measurements, no measurements will be made until Inhibit is de-asserted.

Inhibit will prevent detection of a time interval pre-trigger event. While Inhibit is asserted, the HP 5373A does not monitor the data for the pre-trigger criteria. Pre-trigger will operate normally once Inhibit is de-asserted.

Inhibit and Measurement Results

If a measurement is in progress when Inhibit is asserted, the action taken is determined by the type of measurement being made. During Time Interval, Histogram Time Interval, ±Time Interval, Histogram ±Time Interval, or Externally Gated measurements, the HP 5373A will discard the measurement in progress and wait until Inhibit is de-asserted to begin another measurement. If the measurement is Continuous Time Interval, Histogram Continuous Time Interval, PRF/Frequency, PRI/Period, or Totalize, the measurement will be extended, ending on the first input event after Inhibit is de-asserted. The measurements that are extended due to Inhibit are included in the list of results on the Numeric screen, but not in statistics or Histogram graph results.

Inhibit and Graph Data

On the Time Variation graph:

- When measurements are extended due to an Inhibit, an "I" will appear on the graph, but no data point will be plotted. An example with a frequency measurement is shown in *Figure 10-7*.
- When an Inhibit occurs between measurements, an "I" will appear on the graph with a measurement data point. This indicates that an Inhibit occurred between this measurement and the one preceding it. An example with a time interval measurement is shown in *Figure 10-8*. The display is similar for the Event Timing graph.

Figure 10-7. Frequency Measurement With Inhibit

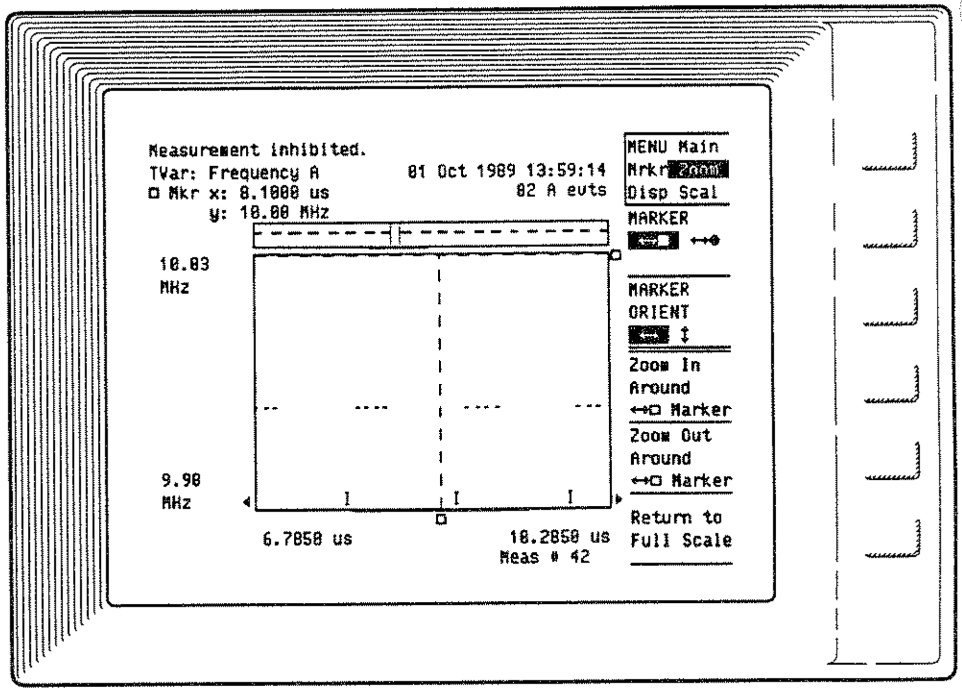
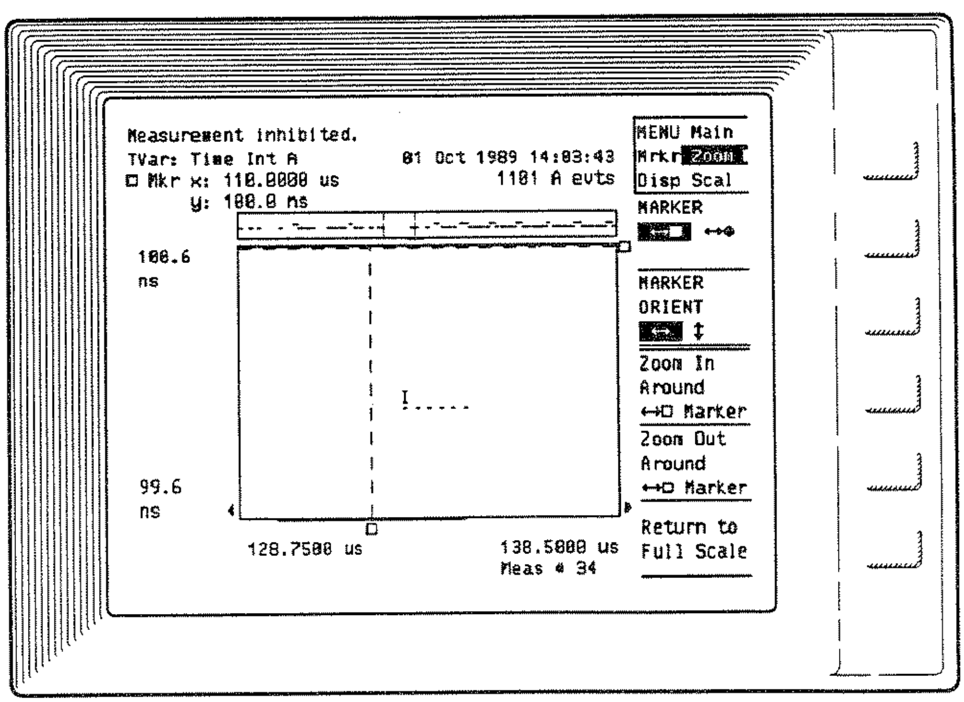


Figure 10-8. Time Interval Measurement With Inhibit



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INSTRUMENT STATE MENU

CHAPTER OVERVIEW

While the Instrument State menu is selected, the following features are available:

- Write protection for nine of the ten front panel storage registers can be switched on or off. (Register "0" is used to store the front panel setup when Preset or Default Meas Setup is selected. There is only a recall capability for Register "0".)
- Function and arming description for each of the stored front panel measurement setups.
- The date and time that each front panel setup was saved.

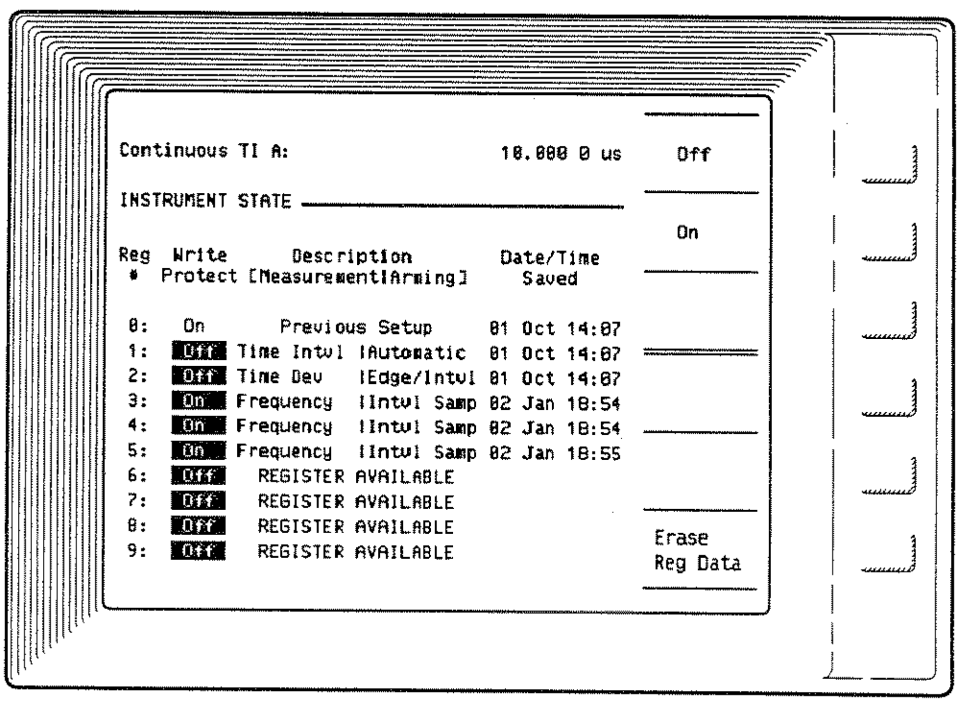

Figure 11-1. Instrument State Menu Screen.

INSTRUMENT STATE MENU

The Instrument State menu is a listing of all currently stored instruement setups. The stored setups can be protected from overwriting with the softkey choices. This is the only element that can be modified on the screen.

Up to ten front panel setups can be stored in registers "0" through "9". The Save key can only be used to store front panel setups in registers "1" through "9". Register "0" is reserved to automatically store the current front panel setup when the Preset or Default Meas Setup function is selected.

Save/Recall a Setup

A setup is stored in registers "1" through "9" by pressing the Save key on the front panel followed by the number of the register where the setup is to go. The recall feature works the same way. Press the Recall key followed by the number of the register ("0" to "9") where the setup is stored. This can be performed while using any menu.

Reg

The storage registers are numbered "0" to "9".

Write Protect

When set to "On" for a register, the contents of that register cannot be overwritten or erased. Register zero is always write-protected because it is used to store the setup prior to a Preset or Default Measurement Setup condition.

Description

The description of the contents of each register consists of the function and the arming mode of the stored instrument setup.

Date/Time Saved

The date and time a front panel setup was saved. (Note: Go to the System menu to set the correct date and time.)

Erase Register Data

Pressing this softkey will erase the data of the register highlighted by the menu cursor. The register becomes available. This function has no effect on write-protected registers. Register "0" is not erasable.

SAVED INSTRUMENT PARAMETERS

The following instrument parameters are stored for later recall when the Save key is used to store an instrument setup:

- Single or Repetitive acquisition mode
- All Function Menu settings
- All Input Menu settings
- All Math Menu settings
- All Pre-trigger Menu settings
- System Menu settings except for Talk/Listen or Talk Only mode selection, HP-IB address, or print source selection
- All Numeric screen settings
- The following Graphic screen settings:
    - Graph Type (Histogram, Time Variation, or Event Timing)
    - X- and Y-axis Manual Scaling status
    - All Manual Scaling values
    - Active marker ("square" or "circle" and orientation)
    - Marker display mode
    - Marker Next mode
    - Grid status
    - Outline mode
    - Yscale mode
    - Update mode
    - Connect data mode
    - View Channel mode for Histogram and Time Variation

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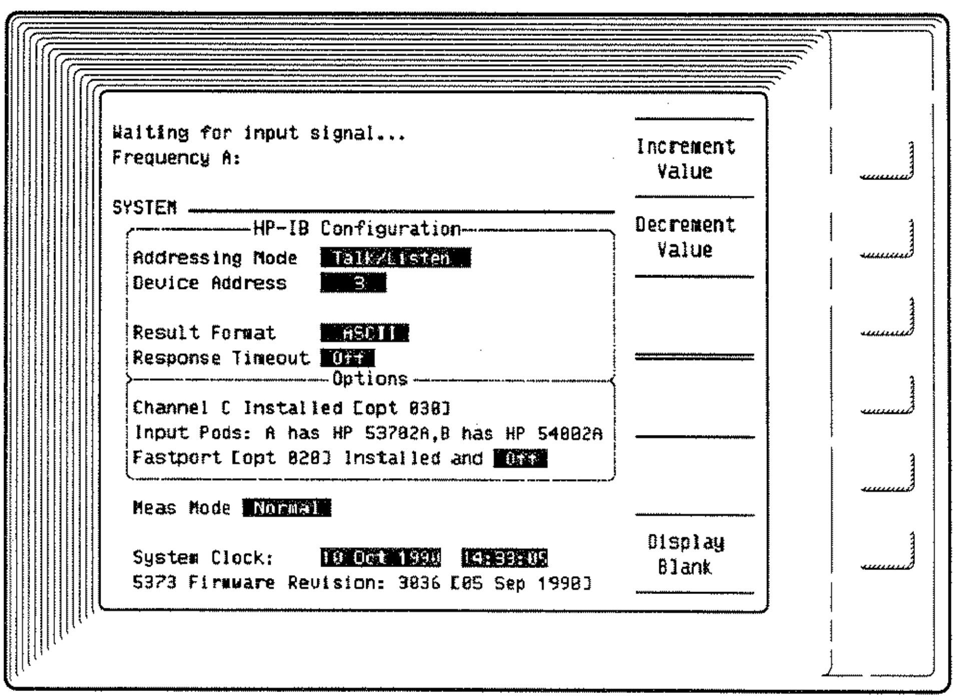
SYSTEM MENU

CHAPTER OVERVIEW

While the SYSTEM screen is selected, the following features can be set:

- HP-IB configuration for computer control of the HP 5373A
- HP-IB configuration for screen prints and plots without the need for an HP-IB controller
- Timeout limit
- FastPort (Option 020)
- Measurement Mode
- System clock
- Display blank

Figure 12-1. System Menu Screen



HP-IB CONFIGURATION

The HP-IB Configuration consists of setting the conditions that allow external control of the HP 5373A, or the copying of instrument display screens to a printer or plotter. Only Graphic screens can be plotted. The printer or plotter should be set to Listen Only.

Addressing Mode Field

The Talk/Listen mode sets the HP 5373A to respond to interface messages and programming commands. Interface messages consist of routine communications between the instrument and controller necessary for bus management.

The Talk Only mode allows the HP 5373A to only send data. This is useful to allow data to be sent to a plotter or printer without the need for an HP-IB controller. The communication path is one-way versus two-way for the Talk/Listen mode.

Softkey Options:

Talk / Listen | Talk Only

NOTE

Do not use the Print key while the HP 5373A is set to Talk Only and connected to an HP-IB controller. The HP 5373A will lock up (there is no response to any key press). The power switch needs to be set to STBY and then back to ON to continue operation.

Device Address/Print Field

A Device Address field appears when Talk/Listen mode is selected. The device address is the code used by the HP-IB controller to identify the HP 5373A. The range of permissible addresses is "0" to "30", inclusive. The address is saved in battery backed-up RAM when the instrument is switched off or unplugged. If the address cannot be recalled due to memory or battery failure, the device address defaults to "3".

When Talk Only addressing mode is selected, a Print field takes the place of the Device Address field on the menu screen. The options here are:

- Display
- Meas Result

Display sets the contents of the display screen as the source of information to be sent to the printer/plotter when the Print or Plot Graph function is enabled. Meas Result has the HP 5373A send measurement results to the attached printer whenever measurements are acquired, or when the Print function is enabled. The type of measurement result information that is sent to the printer is determined by the Numeric display screen selection at the time of the measurement. For example, if you want strictly measurement results, select the Result display format on the Numeric screen. All screens can be printed, but only Graphic screens can be plotted.

Softkey Options:

For Device Address field: Increment Value | Decrement Value

For Print Source field: Display | Meas Result

HP-IB Command:

Device address cannot be set over HP-IB.

For Print Source field: PSO {DISP | MEAS}

Result Format Field

There are three result formats for the output of measurement data from the HP 5373A. The formats are summarized here. For a full explanation of these output formats and how to use them, see the Programming Manual.

- ASCII

  The ASCII measurement format sends processed measurement data. This is the most complete and general format, but the slowest.

- Floating Point

  This format matches the numerical format of the HP 9000 Series 200/300 computers. It is faster than ASCII because no translation or reformatting is required between the HP 5373A and computer when the HP BASIC "Transfer" statement is used.

- Binary

  The Binary measurement format sends unprocessed measurement data to an HP-IB controller. This is the fastest output mode of the three. The data is made up of binary data from the counting hardware. Therefore, intermediate computations are required to convert binary data to floating point results.

NOTE

With Result Format set to "Binary," the HP 5373A does no processing of the measurement data being collected. As a result, no measurement results are available from the Analyzer, whether it is in Remote or Local.

Softkey Options:

ASCII | Floating Point | Binary

HP-IB Command:

OUTPUT {ASC | FPO | BIN}

Response Timeout Field

The Response Timeout field is used to set a time limit on how long the HP 5373A will wait to detect an input signal before "timing out." For front panel operation, timing out means that when the timeout value elapses before an input signal is detected, the message, "Waiting for signal...," appears at the top of the display for approximately three seconds. In remote operation, a bit in one of the status registers is set when a timeout occurs. The bit can be used to issue a message to the controller indicating that no measurement is taking place.

Softkey Options:

Numeric entry. Range = 0 to 36000 seconds, the default value is 5 seconds.

HP-IB Command:

MTST {ON | OFF}

MTV <number>

OPTIONS SUMMARY

A short summary is given of the status of the options installed in the HP 5373A. The On/Off selection for FastPort (Option 020) is included here as well.

MEASUREMENT MODE FIELD

The selection of the Fast or Normal measurement mode specifies one of two different data sizes for the time and event samples acquired by the HP 5373A. Normal mode uses the full 32 bits of counting register data to provide the maximum measurement range of time and frequency. In contrast, Fast mode uses only 16 bits of register data to allow a faster sample rate, but a decreased range of time and frequency measurements.

Fast mode limits the minimum frequency that can be measured to 8 kHz and limits the maximum time measurement to 131 μs. In Normal mode, the minimum frequency is 0.125 Hz and the maximum time measurement is 8.0s. The measurement limits for Normal and Fast modes are described throughout chapters 1, 2, and 3.

Softkey Options:

Fast | Normal

HP-IB Command:

MEAS;MMOD,{FAST | NORMAL}

Comments:

Unless a faster sampling rate is critical to your measurement, use Normal mode.

SYSTEM CLOCK FIELD

The system clock provides a real-time record for measurement screens and printer/plotter output.

Softkey Options:

Increment | Decrement

HP-IB Command:

TOD,<hr>,<min>,<sec>

DAT,<year>,<month>,<day>

Comments:

To Set the System Clock:

There are two clock fields, one for the date and one for the time. The date field displays the day, month, and year. The time field displays the hour, minute, and second. Each of these six indications is separately set. The hour display uses the 24-hour convention. The system clock setting is saved in battery backed-up RAM.

1. Move the menu cursor to the date or time field using the cursor keys.
2. Move the menu cursor to highlight the day or time indicator to be changed using the cursor keys.
3. Press the Increment or Decrement softkeys to set the desired entry.
4. Repeat steps 1, 2, and 3 until system clock is correctly set.

FIRMWARE REVISION

The display screen shows the firmware revision resident in your HP 5373A. This date code is important for reference purposes should firmware upgrade or service be necessary.

Softkey Options:

None.

HP-IB Command:

*IDN? (returns instrument I.D., i.e., HP 5373A, and the date code of the installed firmware revision)

DISPLAY BLANK SOFTKEY

The Display Blank softkey is used to disable the front panel and blank the display. Press Display Blank softkey, then press Lock Panel/Blank Dsp softkey. This key sequence enables the Display Blank Mode.

When in this mode, the display is blanked, except for the instructions for exiting Display Blank. Status messages will be displayed. All measurement data can be retrieved over HP-IB. The front panel keyboard is locked-out, except for the DATA ENTRY keypad and the Restart key. This mode is retained when the instrument is switched off, and can be exited only by entering a numeric value of "1000" or greater with the DATA ENTRY keypad.

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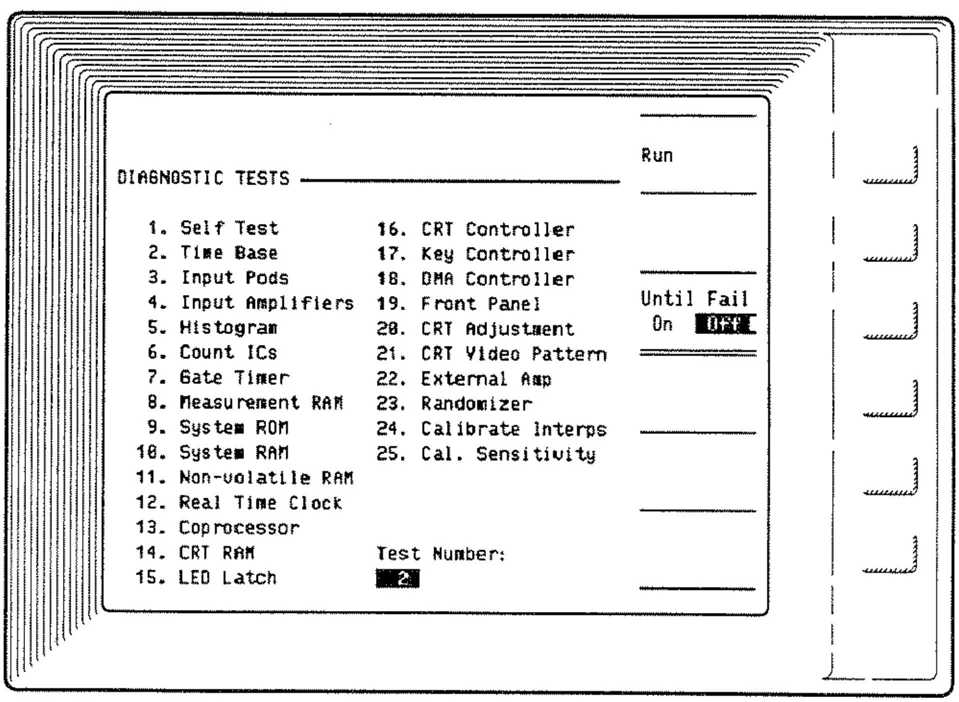
TEST MENU

CHAPTER OVERVIEW

While the Test menu is displayed, the following features are available:

- Instrument self-test
- Hardware diagnostic tests
- Memory diagnostic tests
- CRT diagnostic tests and adjustments
- Calibration routines

Figure 13-1.
Test Menu Screen



DIAGNOSTIC TESTS

The HP 5373A comes with a full complement of tests to check its operation and help troubleshoot suspected failures.

All of the test routines are intended to aid in repair and operation verification by qualified service personnel. Some tests, however, can be used to verify a limited number of instrument operations. These tests are summarized under *User Tests*. There is no detailed information presented here on how to interpret test results. Consult the HP 5373A Service Manual for complete information on these diagnostic tests.

Softkey Options:

Run | Pause | Until Fail | Stop

HP-IB Commands:

TEST <number> (1 to 25) — To run a test

PAUS — To pause a test

CONT — To resume a test

UFA {ON | OFF} — To run a test until a failure is detected

Comments:

Run starts the selected test, or resumes a test that has been paused.

Pause suspends a currently running test until the Run softkey is pressed.

Until Fail "On" causes a test to be cycled continuously until a failure is detected.

Stop halts a test and displays the main Diagnostic Test menu.

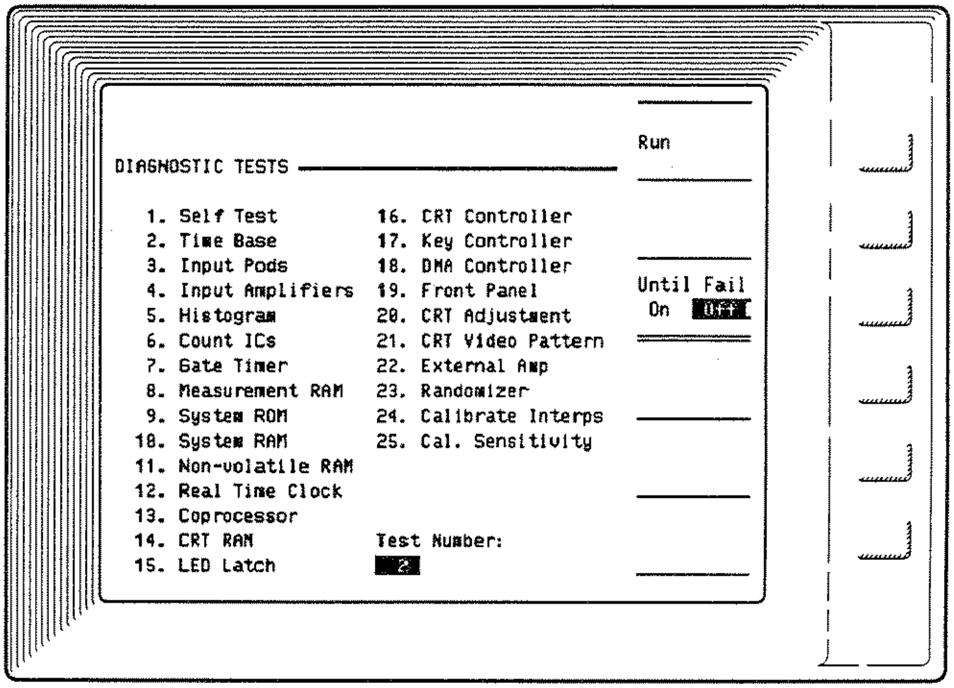


Figure 13-2. Diagnostic Test Screen

Test Screen

Once a test is started, the screen for the selected test will be displayed. The screen displays the title of the test currently running, the number of times the test has executed and the number of failures. The time of the current result, and the last failure result are also displayed, along with the detected failed component, if available.

To Run a Test

1. When the Test menu is called up, you will notice that one of the tests is highlighted. This test will execute if the Run softkey is pressed.

2. If you want to run a different test, highlight that test using the Cursor/Scroll keys, or enter the test number in the **Test Number** field using the numeric keys. Press the Enter key to complete a numeric entry.

3. Press the Run softkey to start the test. The test will execute continually until the Stop softkey is pressed, or until another menu key is selected via the keyboard or HP-IB.

4. The test can be temporarily halted by pressing the Pause softkey. This will suspend the test and freeze messages on the CRT display.

5. Press the Run softkey to resume the test.

6. The tests can also be executed in "Until Fail" mode. This mode causes tests to run continually until a failure occurs. At that time the test goes into the "pause" mode. Press the Until Fail softkey to turn on this function.

POWER-UP TESTS

A comprehensive series of tests are run at power-up. If any failures are detected, descriptive messages will be displayed on the CRT screen. The following tests are executed during power-up:

- Time Base
- Input Pods
- Input Amplifiers
- Histogram Hardware
- Count ICs
- Gate Timer
- Measurement RAM
- System ROM
- System RAM
- Non-volatile RAM
- Real-time Clock
- Co-processor
- CRT RAM
- LED Latch
- CRT Controller
- Key Controller
- DMA Controller

If any of these tests fail, have the instrument serviced.

USER TESTS

For the most part, the diagnostic tests are intended for the qualified service technician. There are some tests, however, that can help a user discover basic information about the current status of the instrument.

For example, is the reference oscillator locked? Are the input pods properly installed? Are all the front panel keys being detected by the internal processor? Use the following tests to check basic operation of the HP 5373A.

Self Test

Test #1: A group of fifteen diagnostic tests can be run. There will be a pass/fail indication displayed for each test. A message will be displayed for the last detected failure. This is a good test to run if you just want to quickly check overall instrument operation.

Time Base Test

Test #2: This test verifies that the 500 MHz reference oscillator is in a "locked" condition indicating that it is operating correctly. The frequency source for the reference oscillator is also specified. It can be either the internal source or an external frequency standard.

Input Pods Test

Test #3: This test verifies that the input pods are installed correctly and displays the model number of each pod.

Front Panel Test

Test #19: This test is used to verify the operation of each of the front panel keys and the knob. Follow the directions displayed on the test screen.

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14

HELP MENU

CHAPTER OVERVIEW

While the HELP screen is selected, the following features are available:

- User information organized by front panel feature
- Softkey selection of help information
- HP-IB output formats
- Arming mode summary
- Input signal specification summary

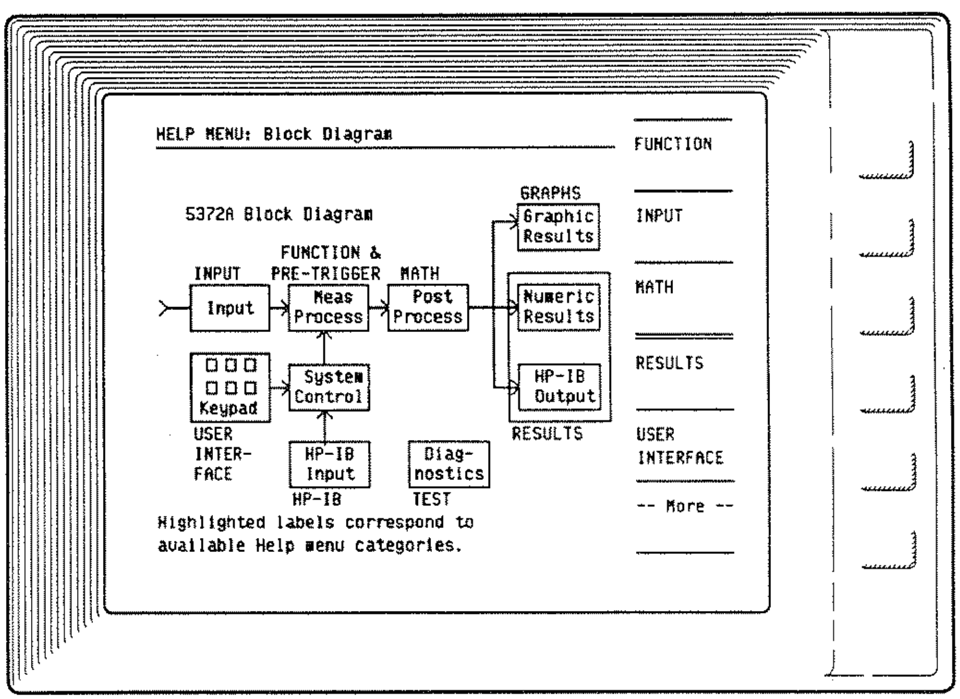

Figure 14-1. Help Menu Screen

HELP MENU

Description:

The HELP menu screen is softkey-driven and provides brief user information. Refer to the text below for references to the Operating and Programming manuals.

The HELP screen information is grouped as follows:

FUNCTION & PRE-TRIGGER

- Arming Overview
- Valid Arm Options
- Meas Size/Block Size
- Pre-trigger/TI Detect
- Inhibit

For more information: Chapter 5, 10

INPUT

- Input Channels
- Input Trigger
- Input Characterization
- Input Separate/Common
- Optional Channel C

For more information: Chapter 8

MATH

- Math Modifiers/Statistics
- Limits/Reference

For more information: Chapter 9

RESULTS

- Numeric Screens

For more information: Chapter 15

- ASCII Output
- Floating Point Output
- Binary Output

For more information: Programming Manual

USER INTERFACE

- User Interface

  For more information: Getting Started Guide

- Numeric Entry
- Other Keys

  For more information: Chapter 6

- Errors

  For more information: Appendix C

- Instrument State

  For more information: Chapter 11

GRAPHS

- Graphics Overview
- Marker Features
- Zoom Features
- Scaling Features

  For more information: Chapter 16

HP-IB

- Command Structure
- Status Byte
- Event Status Register
- Hardware Status Register

  For more information: Programming Manual

TEST

- Test

  For more information: Chapter 13

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15

NUMERIC RESULTS

CHAPTER OVERVIEW

While the Numeric screen is selected, the following formats for the measurement results are available:

- List of measurements
- Measurement statistics
- Pass/Fail data based upon user-set limits
- Expanded Data showing measurement interval or untimed events
- Enlarged numeric display of measurement results

MAIN/FORMATS SOFTKEY

This softkey is used to select the "Main" menu, or the "Format options" menu. The Format options menu is used to select between the five different numeric format displays. The Main menu options are described for each display in this chapter.

NUMERIC FORMAT DISPLAYS

The five Numeric format displays are:

- Result Display
- Statistics Display
- Result/Statistics Display
- Limit Status Display
- Bold Display

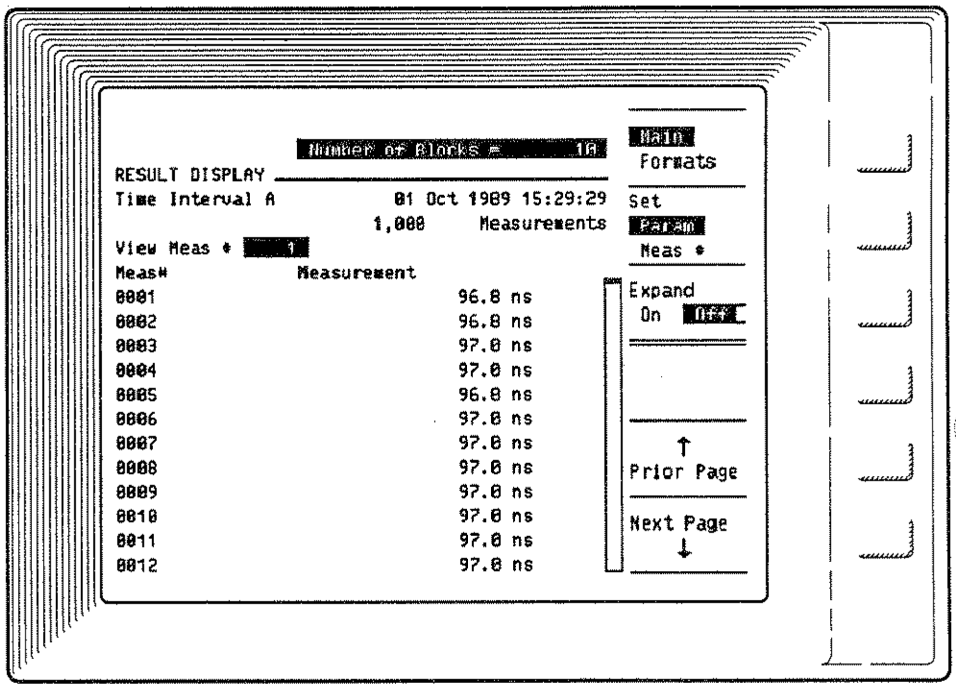
There is status information near the top of the Numeric screens to indicate the following conditions:

- Measurement function and channel(s)
- Date and time that each block of measurements is acquired
- Number of measurements
- Number of blocks for a multiple block acquisition that exceeds measurement memory
- Math On status

Additionally, there is a parameter field at the top of the Numeric screen. The parameter displayed depends on the numeric field last selected with the menu cursor prior to pressing the Numeric key. The numeric value can be modified here using the DATA ENTRY keypad or the ENTRY/MARKER knob. Only numeric fields are displayed, and it is the last selected numeric field from the Function, Input, Math, or Pre-trigger menu screen.

RESULT DISPLAY

Figure 15-1.
Result Display



The Result Display lists up to twelve measurement results.

Set Param/Meas # softkey

This softkey selects either the measurement number field or the numeric parameter field at the top of the display.

When "Meas #" is selected, enter the number of any measurement in the acquisition using the DATA ENTRY keypad, or the ENTRY/MARKER knob, and that measurement result will be displayed.

When "Param" is selected, the parameter field can be modified using the DATA ENTRY keypad or the ENTRY/MARKER knob. Only entries within the range of the selected parameter will be allowed.

Expanded Data softkey

This softkey sets Expanded Data On or Off. When set to "On":

- For Frequency, PRF, Period, PRI, or Totalize measurements, the time over which the measurement was acquired is displayed. Since the HP 5373A uses a reciprocal counting technique which synchronizes measurements to the input signal, actual measurement gates may vary by up to one period of the input signal from set intervals. (See chapter 2.)
- For Time Interval measurements, the number of missed events is shown. A missed event for a Time Interval measurement is an event that occurred between measurements. For Continuous Time Interval measurements, a missed event is an event that was included in the measurement but the time of occurrence of the event is not known. (See chapter 1.)

Prior Page/Next Page softkeys

Use these softkeys to view the results of the measurements acquired before (Prior Page) or after (Next Page) the currently displayed results in the acquisition.

Measurement Scrolling

The "up" and "down" CURSOR/SCROLL keys can be used to scroll through the measurement results one at a time.

Measurement Result Identifiers

There are a series of letters which appear on the Result Display to identify measurement results associated with certain features of the HP 5373A.

"E" — identifies the last result in a block of measurements and the last result in a measurement acquisition.

"I" — indicates measurement results affected by the Inhibit feature. If the measurement function is Continuous Time Interval, single-channel Frequency or PRF, single-channel Period or PRI, or Totalize, the "I" identifies measurements that had their gate time extended by an Inhibit that occurred during the measurement. These "extended" measurements are not included in statistics calculations or Histogram graph results. For Time Interval, ±Time Interval, Externally Gated measurements, and two-channel Frequency, PRF, Period, or

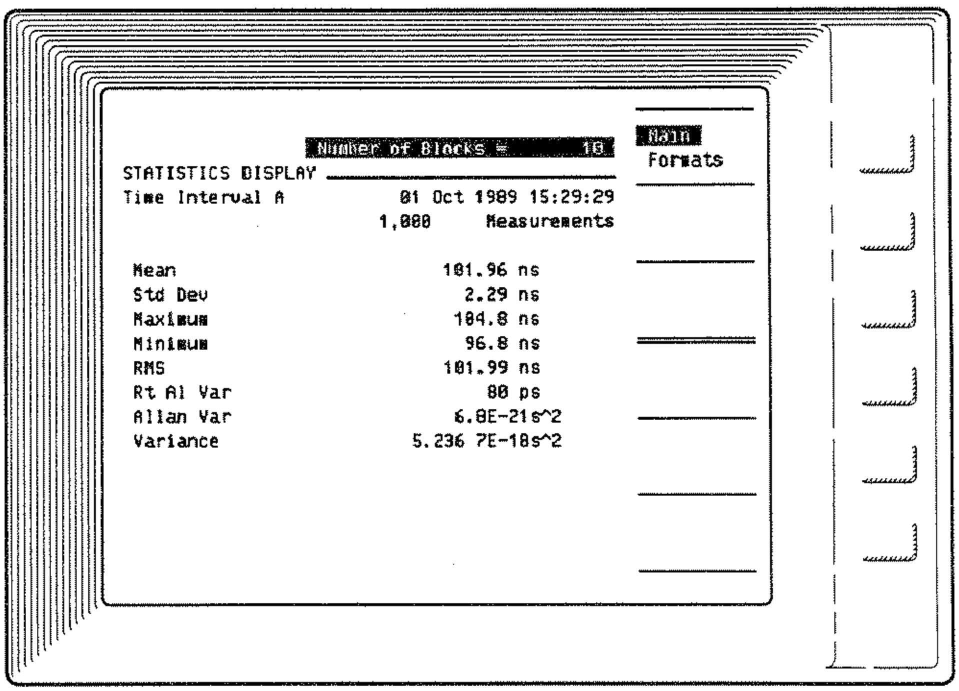
PRI measurements, the "I" indentifies measurements that occur immediately after an Inhibit condition is de-asserted. Any measurements interrupted by an Inhibit condition are discarded. (See chapter 10, "Pre-trigger Menu," for more on Inhibit.)

"P" — indicates the measurement result preceded by a pre-trigger event. (See chapter 10, "Pre-trigger Menu," for more on Pre-trigger.) If the source of the pre-trigger event is TI Detect, the "P" indicates the interval which met the conditions specified.

"T" — indentifies the time between the block arming edge and the first measurement sample that is collected. (See chapter 5, "Arming," Measurements Referenced To The Block Arming Edge, for a description of this feature.)

STATISTICS DISPLAY

Figure 15-2. Statistics Display



The Statistics Display shows eight statistical results. Statistics are enabled on the Math menu. The values are computed for each block of measurements. When the number of blocks is set greater than one, the statistics include the total number of measurements.

It should be noted that when statistical results are output to a printer using the PRINT function, or to a controller as part of an HP-IB program, the order of the statistical results output is different from the order on the display screen. The list below shows the sequence differences.

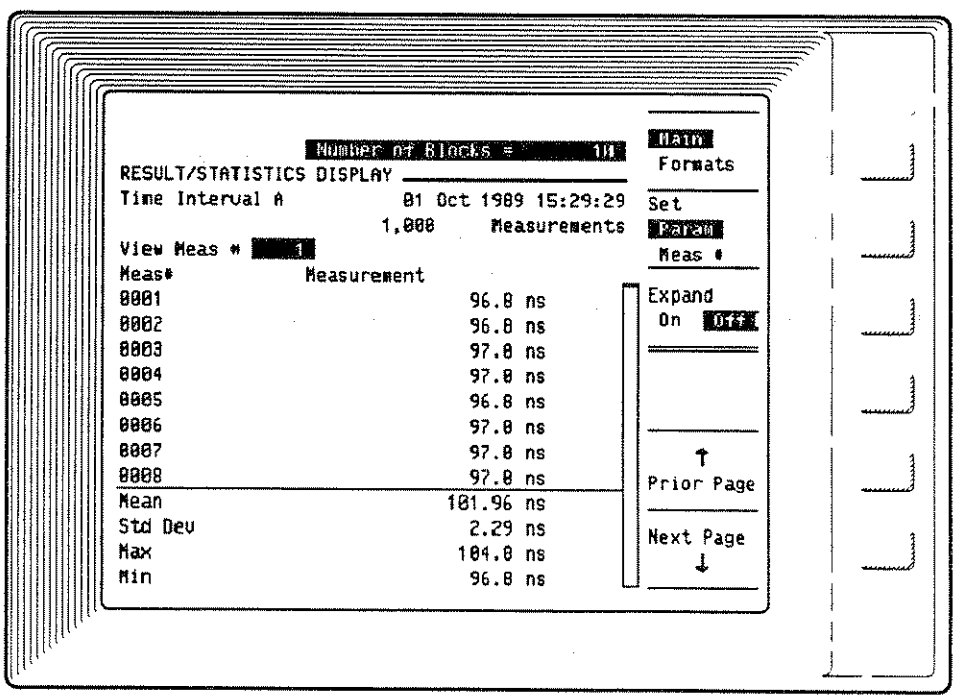
Display Screen Order	HP-IB Data Output Order
Mean	Mean
Standard Deviation	Standard Deviation
Maximum	Maximum
Minimum	Minimum
RMS	Variance
Root Allan Variance	Root Allan Variance
Allan Variance	RMS
Variance	Allan Variance

Numeric Parameter field

The numeric parameter at the top of the display can be modified on this screen.

RESULT/STATISTICS DISPLAY

Figure 15-3. Result/Statistics Display



This screen is a combination of the previous two displays. Fewer measurements and statistics values are listed here. The softkey options are the same as for the Result Display.

LIMIT STATUS DISPLAY

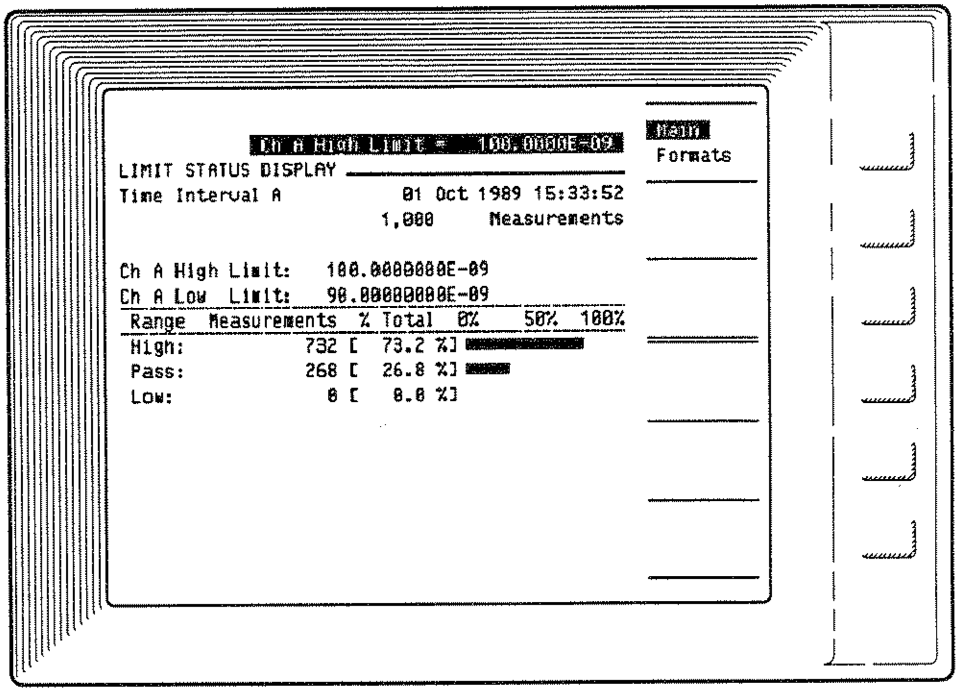


Figure 15-4. Limit Status Display

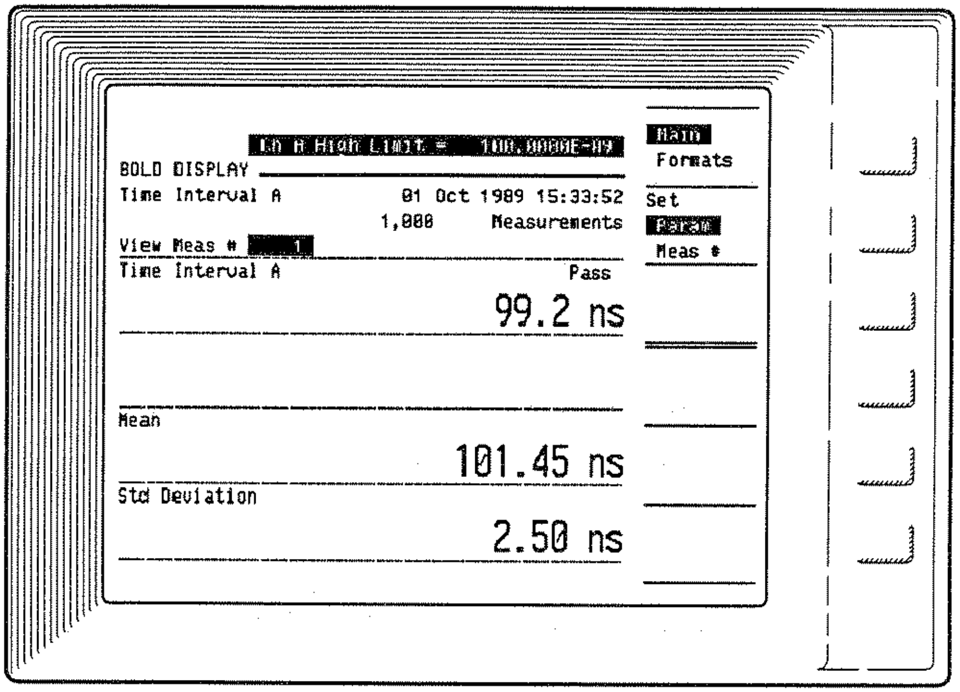
Limits are defined by the high and low values entered on the Math menu. The Limit Status display shows:

- the high and low limit values
- the number of measurements that exceeded the high value, were below the low value, and the number of measurements within the set limit range
- the number of measurements in each of the three categories (high, pass, low), expressed as a percentage of the total number of measurements
- If the lower limit is set above the upper limit on the Math menu, any result falling inside these reversed limits will be indicated with an "Ins" label. This is considered out of range. The result will be labeled "Pass" if it falls outside the limit values.

It is also possible to modify the numeric parameter displayed at the top of the screen.

BOLD DISPLAY

Figure 15-5.
Bold Display



The Bold Display is convenient for viewing measurement results from a short distance away. A result from each measurement acquisition is displayed. If Statistics is enabled, the mean and standard deviation for all measurement data are shown as well. If Limits are enabled, the limit status for the displayed measurement is also shown.

Set Param/Meas # Softkey

The softkey allows selection of the measurement number for display, or modification of the the numeric parameter at the top of the display.

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Contents of Chapter

16

GRAPHIC RESULTS

CHAPTER OVERVIEW

This chapter describes the graphics features for analyzing the data collected by the HP 5373A. These features operate on the three data graphs that display measurement data. The three graphs are:

- Histogram
- Time Variation
- Event Timing

The sequence for discussing the graphics features is as follows:

- A general description of the graphics features and how they apply to each of the graphs.

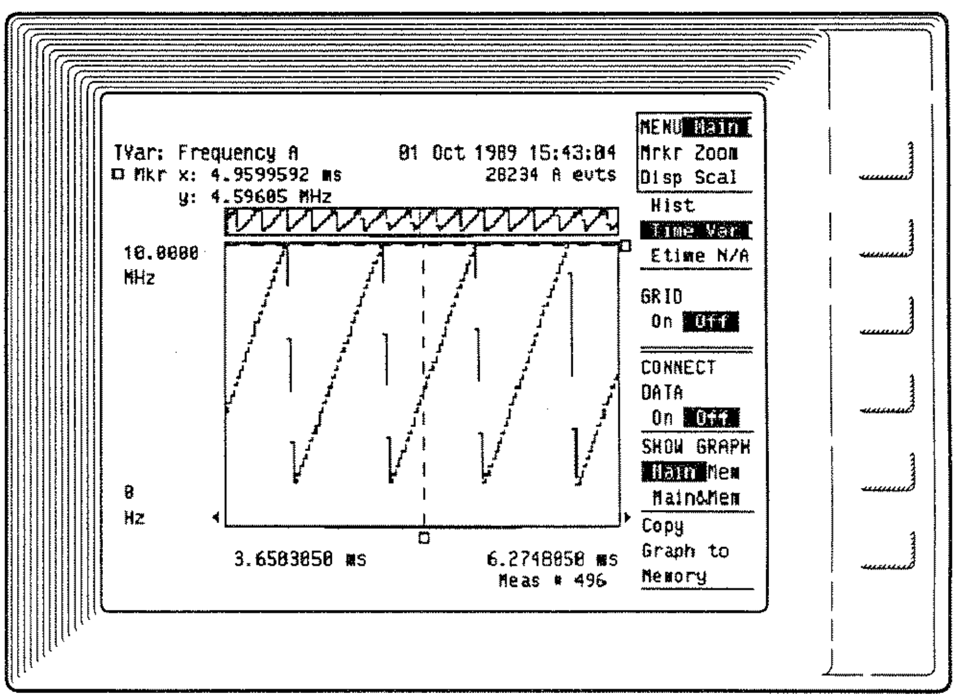


Figure 16-1. Main Menu for a Time Variation Graph

- A description of the graphs, including how to use the features available for each graph.
- The default settings for the graphics features.
- The graph parameters saved when an instrument setup is stored into memory, or when the instrument is switched off.

NOTE

Graphics are not allowed for the HP 5373A Envelope Power or Amplitude Modulation functions.

MENUS

The graphic features are organized into five menus accessed with the **Graphic** key. Each menu contains related features. Not all features are supported for all three graphs. Where a feature is not available, "N/A" or "Not Avail" is part of the softkey label. These exceptions are noted where appropriate.

The five menus are:

- Main Options
- Marker Options
- Zoom Options
- Display Options
- Scaling Options

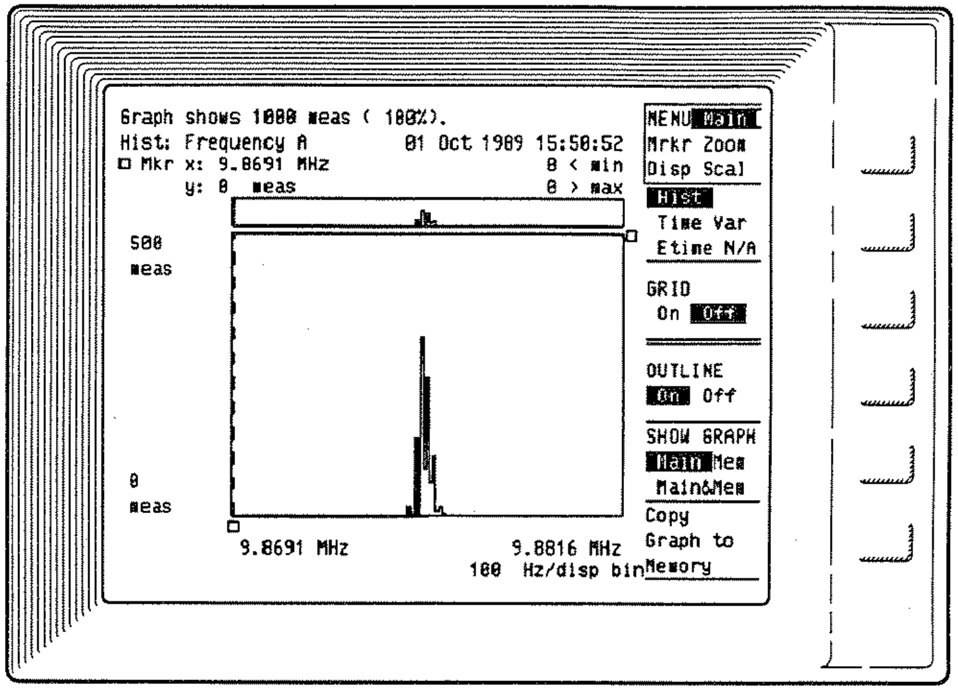
The individual graphics features are a combination of single and multiple softkey options. Where a softkey presents more than one option, the currently active choice is shown in inverse video. Pressing the softkey will cause the next option to become active. The inverse video will highlight the current selection.

When a softkey presents only one option (no inverse video), the feature has only one action, such as copying the graph to memory, or moving the marker to the minimum graph value. These softkeys may be pressed more than once in succession, but subsequent presses have no effect unless intermediate actions have caused the data or configuration to change.

MAIN OPTIONS

This menu contains softkeys for selecting the graph to display, enhancing the display of data, and saving a graph to allow later comparison with another.

Figure 16-2.
Main Menu Options



Active Graph

Hist
Time Var
Evt Time

This softkey selects the graph to display. The choices are the Histogram, Time Variation, or Event Timing graph.

Comments:

The Event Timing graph is not available for PRF, Frequency, PRI, Period, Totalize, and Phase measurement functions.

The Time Variation and Event Timing graphs are not available for the Histogram measurement functions (these are Histogram Time Interval, Histogram Continuous Time Interval, and Histogram ±Time Interval).

Grid Lines

GRID
On Off

Grid lines can be overlaid on the displayed graph to give you reference points for the measurement data. This feature can make interpreting data results easier.

- The Histogram graph is divided by four horizontal lines, and the display shows the number of measurements per division of the y-axis.

Comments:

The grid lines are different for Log scaling (selected on the Scaling Options menu). The number of horizontal lines depends on the decade values covered. For example, when the Histogram's y-axis covers 0 to 1,000 measurements in the Log scaling mode, horizontal lines appear at the 1, 10, and 100 measurement points on the y-axis.

- The Time Variation graph is divided by four horizontal lines and nine vertical lines. The display shows a range of PRF or Frequency, time, %, number of events, or degrees per division along the y-axis. The type of units depends on the measurement function.
- The Event Timing graph is divided by nine vertical lines. The spacing of the lines is not referenced to the displayed measurement results.

Outline/Connect Data

- When the Histogram graph is selected, the softkey is:

OUTLINE
On Off

The Outline feature's default value is On. It allows the graph to be drawn faster by eliminating the vertical lines of adjoining histogram bins. The first bin in a group will have a line drawn on its left side from the top of the bin to the x-axis. The last bin in a group will have a line drawn on its right side from the top of the bin to the x-axis. The bins in between are connected only by lines at the top. When Off, each bin is drawn individually.

- When the Time Variation graph is selected, the softkey is:

CONNECT
DATA
On Off

The Connect Data feature enables a "connect-the-dots" display of the measurement data. Lines are drawn on the display to connect each pair of consecutive data points. No interpolation is done. This is just a linear connection of data points.

Comments:

Measurements that have some discontinuity in the data acquisition are not connected. The special cases are:

1. There is no connecting line between blocks of a multiple block measurement sequence where all blocks are displayed.
2. There is no connecting line between measurements that are interrupted by an Inhibit condition.
3. There is no connecting line between measurements on either side of an invalid measurement result (1E+38).
4. There is no connecting line between a time stamp of the holdoff edge and the first measurement of the block.

- The Event Timing graph has no comparable feature.

Show Graph

SHOW GRAPH
Main Mem
Main&Mem

This softkey lets you select:

- Main — display the current graph
- Mem — display a stored graph
- Main&Mem — display current and stored graphs simultaneously

The Main graph is the graph containing the data of the most recently acquired measurement sequence. It can be a Histogram, Time Variation, or Event Timing graph.

The Memory graph is a graph that has been stored in memory. Only one graph can be stored at any time. The graph memory is cleared each time the Preset key is pressed, or the instrument is switched off. If you select the Mem feature when no graph has yet been stored, the current graph will automatically be copied into memory.

No actual data is stored for the graph, so no manipulation of the memory graph is possible. Just a copy of the current graph display is stored. The parameters saved with the graph are limited. The axes values, the header information describing the type of graph, and the date and time the data was captured are preserved.

The Main&Mem feature displays both the Main graph and the Memory graph. The graph in memory is displayed at a lower brightness level than the Main graph. None of the Memory graph parameters are displayed when the two graphs are shown simultaneously.

For all the graph types, the Main graph and the Memory graph are superimposed along the same axis.

Copy Graph

Copy Graph to Memory

This softkey will store the current graph in memory, overwriting whatever was previously saved. The current graph is stored without markers or limit lines. None of the graphics features can be used on the Memory graph.

MARKER OPTIONS

Four markers are available to identify specific graph data, to set boundaries on data of interest, or to scroll the graph data on the display. There are two markers that move from side to side (↔□ ↔●), and two that move from top to bottom (↕□ ↕●). The ↕□ ↕● markers are not available for Event Timing graphs.

The markers are presented as dashed lines in the graph display area. Use the front-panel Entry/Marker knob to move the markers.

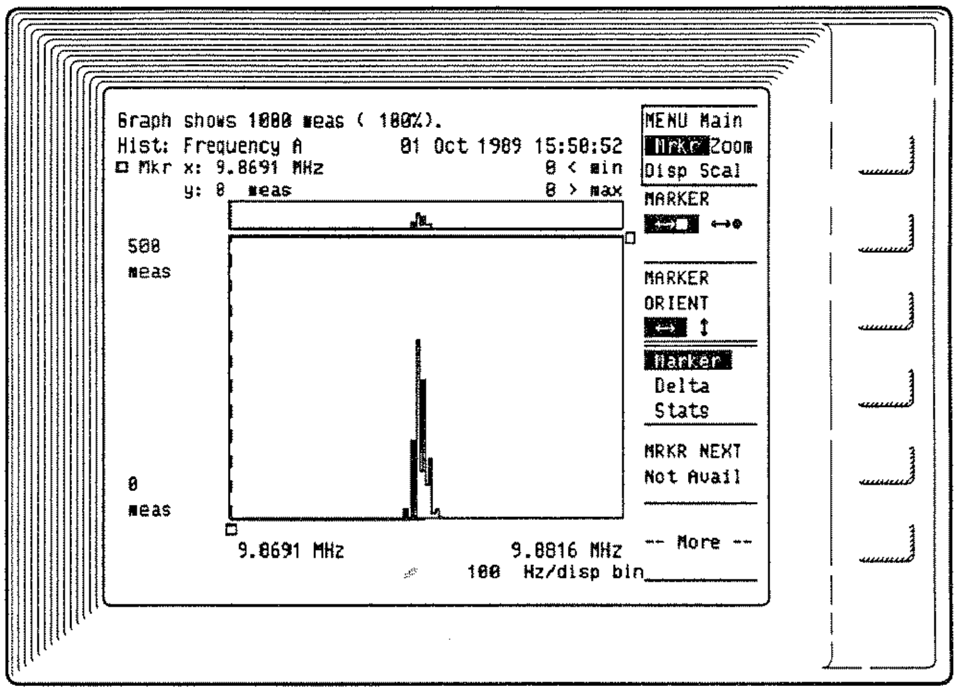


Figure 16-3. Marker Options Menu

Moving the Markers

Only one marker can be selected at any time. It is called the "active" marker. The active marker is moved by rotating the front-panel Entry/Marker knob. As the marker is moved, the coordinates of its current location are displayed above the graph. When the active marker reaches the right or left edge of the display, and there is no more data off the display, continuing to rotate the knob will have no effect. If there is data off the display, it will be scrolled into the display area as the marker is moved in that direction.

Scrolling the Graph

This refers to bringing a new portion of the graph into the display area. As long as there is data off the display, the right or left Cursor/Scroll keys can be used to "move" the display area by one display width in the direction selected. This method can be faster than using the markers to go to a particular portion of a graph, especially if the data is fairly evenly distributed. If the entire graph is already displayed, pressing these keys will have no effect.

If there is no data in the display width span immediately to the left or right of the current display, the display will eventually skip to the next display width span that does contain data. For sparse distributions, the search process can be slow. The "Re-calculating graph..." message indicates the search is underway.

Marker Selection

MARKER

↔□ ↔●

or

MARKER

↕□ ↕●

This softkey selects the active marker. The softkey choices depend on the setting of the Marker Orientation softkey below this one. Only one marker is active at any time. The markers are referred to as the "square" marker (black in the center) or the "circle" marker (white in the center). Each can have a vertical or horizontal orientation. The arrows beside the marker symbols indicate the direction the markers can be moved.

↔□ ↔● — markers can be moved left or right on the display and have x- and y-axis coordinate values associated with them.

↕□ ↕● — markers can be moved up or down on the display and have only y-axis coordinate values associated with them.

Comments:

All marker movements, commands, and displays are based on the location of the active marker.

If a marker is not in the graph display area when it is selected, the portion of the graph containing that marker will be displayed.

Marker Orientation

MARKER
ORIENT

↔ ↕

This softkey selects the orientation of the markers. The arrows indicate the direction that the marker travels.

- ↔□ ↔● markers define the bounds for statistics calculations on Histograms and Modulation Analysis on Time Variation graphs.
- ↕□ ↕● markers can be moved up or down and have only y-axis values associated with them. No x-axis values will be displayed. These markers are not associated with specific measurements, but with the relative location along the y-axis.

Comments:

The default marker orientation is ↔.

The statistics calculations on Histograms and modulation analysis on Time Variation graphs are not available when the marker orientation is set to ↕.

If the Marker Display mode is either **Stats** (statistics) or **Mod Vals** (modulation analysis values), and ↕□ ↕● markers are then selected, the Marker Display mode changes to **Marker.**

↕□ ↕● markers are not available for Event Timing graphs.

The Marker Selection and Marker Orientation softkeys are also on the Zoom Options and Scaling Options menus for your convenience.

Marker Display

- When the Histogram graph is selected, the following softkey choices are available:

Marker
Delta
Stats

- When the Time Variation graph is selected, the following softkey choices are available:

Marker
Delta
Mod Vals

- When the Event Timing graph is selected, the following softkey choices are available:

Marker
Delta

Marker mode:

- ↔□ ↔● markers — the x- and y-axis values at the position of the active marker are displayed.
- ↕□ ↕● markers — only the y-axis value at the position of the active marker is displayed.
- Histogram graphs — the x-axis value is the center value of the histogram bin at the active marker; the y-axis value is the number of measurements in the bin at the active marker.
- Time Variation graphs — the x-axis value is the time of the measurement at the active marker; the y-axis value is the measurement result at the active marker.
- Event Timing graphs — the x-axis value is the start or stop time of the measurement, depending on the marker's location along the time line.

Delta mode:

- ↔□ ↔● markers — the Delta feature displays the difference in position of the two markers. Delta is always calculated as 'the position of the active marker' minus 'the position of the inactive marker'.

- ↕□ ↕● markers — the Delta feature displays the difference in y-axis position of the two markers. There is no x-axis value available for horizontal markers.

NOTE

Delta results are always calculated as the value of the active marker minus the value of the inactive marker. For example, if the x-axis position of the active marker is to the left of the inactive marker, the 'Delta x' value will always be negative.

- Histogram graphs — 'Delta x' is the difference in the center value of the two bins at the markers; 'Delta y' is the difference in the number of measurements in the two bins at the markers.
- Time Variation graphs — 'Delta x' is the difference between the time of the measurements at the two markers; 'Delta y' is the difference in the measurement results at the two markers.
- Event Timing graphs — 'Delta x' is the difference between the time of the measurements at the two markers.
- The measurement numbers associated with the delta calculations between the two markers are displayed in a message on the status line above the graph.

Stats mode: (only available for Histogram graphs)

- Four statistics values are displayed. They are: minimum, maximum, mean, and standard deviation. The values are based upon Histogram bin values between the ↔□ ↔● markers (including the bins at the markers). See the Note on the next page.

NOTE

Histogram statistics (as opposed to the statistics available on the Numeric screen) are bin-value derived, not measurement-value derived. The reason is that for measurement sequences of more than one block, not all of the data is available to calculate statistics using every measurement value. The statistics displayed here (on the Graphic screen) will not precisely match those displayed on the Numeric screen for the same measurement sequence. This is because the histogram statistics are limited by the bin resolution. All measurements are assumed to lie at the center of the histogram bin.

- Minimum: the center value of the left-most bin enclosed by the markers.
- Maximum: the center value of the right-most bin enclosed by the markers.
- Mean (calculated as shown in the two steps below):
  1. The center value of each bin is multiplied by the number of measurements in that bin.
  2. The results of (1) are added together and then divided by the total number of measurements bounded by the markers.
- Standard Deviation: the standard formula is used, but the center value of each bin is used as the value of every measurement in that bin for the purposes of this calculation.
- The number of measurements used to calculate the statistics is displayed at the top of the display screen. It shows the number of measurements between the markers.

Mod Vals mode: (Only available for Time Variation graphs)

- Displays the following modulation parameters for the measurement data between the ↔□ ↔● markers: the peak-to-peak deviation, the modulation center value (½ pk-pk), and the average modulation rate.
- Modulation values are re-computed whenever the markers are moved or another measurement acquisition takes place.

Comments:

- The words, "not computable," will be displayed where the modulation rate normally appears when:

  1. The ↔□ ↔● markers do not have at least one cycle of the modulating signal between them.

  2. The modulation on the portion of the signal bounded by the ↔□ ↔● markers does not exhibit periodic behavior.

Marker Next

MRKR NEXT
Data Pt
Pixel

The HP 5373A CRT (cathode ray tube) can be divided into 125 columns in the horizontal direction for the display of graph data. The Marker Next feature provides two methods for scrolling the markers across the Time Variation or Event Timing graph data:

- Data Pt — the active marker moves from measurement to measurement. When many measurements are combined into the 125 data columns, such as for a measurement size of 1,000 results or more, marker movement may appear sluggish because it is moving among multiple measurements within each column. As you zoom in on a graph, the display columns have fewer and fewer data points within them, until only one data point is shown per column, or no data points are contained in a column.

- Pixel — the active marker moves from display column to display column. This can be a faster way of scrolling through the data when the data is concentrated on the display. If multiple measurements are included in a column, the marker will only indicate the first measurement to occur in time in each column. This is evident from watching the 'Meas #' readout just below the graph x-axis values as the marker is scrolled across the display.

Comments:

This function is not available for Histogram graphs. Marker movement on Histogram graphs is from the center value of one bin to another.

Move Marker to Maximum

**Move
(active) Marker
to Maximum**

When this softkey is pressed:

- The active marker moves to the largest y-axis data point on the portion of the graph currently displayed. If there is more than one point with that value, the marker will move to the closest one.
- For Histogram graphs, the maximum value is the bin with the most measurements.
- For Time Variation graphs, the maximum value is the largest measurement value.
- For Event Timing graphs, this feature is not available.

Comments:

This feature will stay active for consecutive blocks of data if no other commands or key presses occur before new data is graphed. For example, if the marker is moved, it will not automatically go to the maximum value of the data displayed for the next acquired block of data.

Use ↔□ or ↔● marker for precise readout of maximum value.

Move Marker to Minimum

**Move
(active) Marker
to Minimum**

When this softkey is pressed:

- The active marker moves to the smallest y-axis data point on the portion of the graph currently displayed. If there is more than one point with that value, the marker will move to the closest one.
- For Histogram graphs, the minimum value is the bin with the fewest measurements (zero is the smallest value).
- For Time Variation graphs, the minimum value is the smallest measurement value.
- For Event Timing graphs, this feature is not available.

Comments:

This feature will stay active for consecutive blocks of data if no other commands or key presses occur before new data is graphed. For example, if the marker is moved, it will not automatically go to the minimum value of the data displayed for the next acquired block of data.

Use ↔□ or ↔● marker for precise readout of minimum value.

Move Inactive Marker to Active Marker

Move (inactive marker) to (active marker) location

When this softkey is pressed:

- The inactive marker is moved to the same display location as the active marker. The inactive marker is visible only after the active marker is moved, as the active marker is shown "on top of" the inactive marker.

Comments:

This is a valuable feature when you have zoomed around the active marker, leaving the inactive marker at a location outside the zoom window. Now if you want to perform a Delta or Statistics function on this portion of the graph, this feature is a convenient way to bring the inactive marker into the display.

ZOOM OPTIONS

Zoom features for the HP 5373A make it possible to magnify a certain portion of the graph that may be of interest.

The list of Zoom Option softkeys include two that affect the markers: marker selection and marker orientation. Refer to Marker Options for a description of their operation.

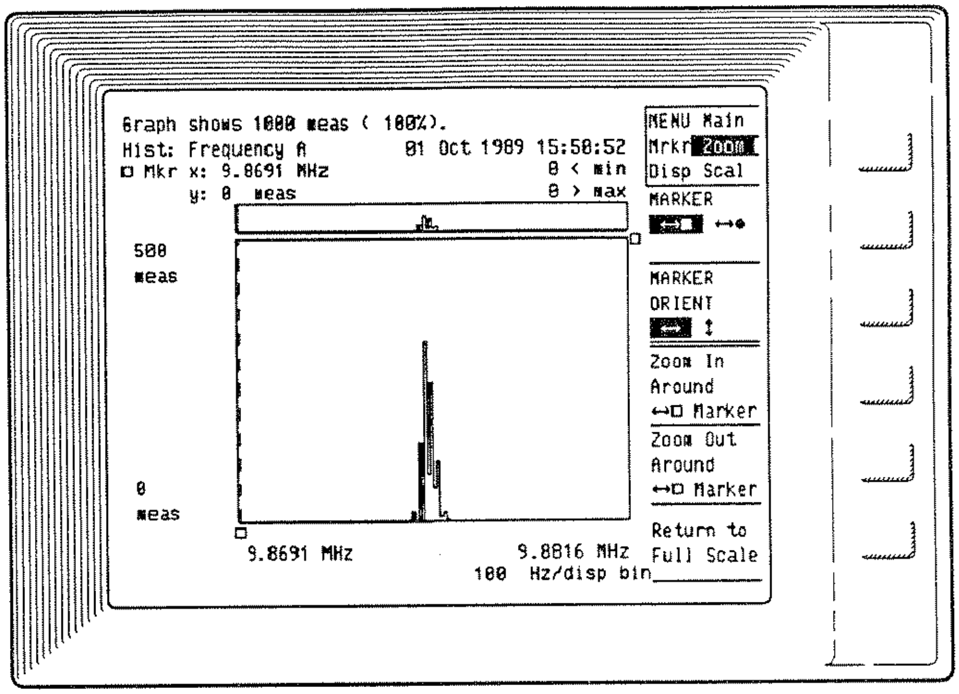


Figure 16-4. Zoom Options Menu

Zoom In

Zoom In
Around
(active) Marker

- Pressing this softkey magnifies a portion of the graph, giving a close-up view of the data. The zoom action takes place around the active marker.

- Below the active marker there is a 'preview bar' that tracks the active marker and indicates the portion of the graph that will fill the graph area when the Zoom In softkey is pressed. This bar appears as a highlighted portion of the x-axis when using ↔□ ↔● markers.

  There is also a preview bar for ↕□ ↕● markers on the Time Variation graph.

- Above the main display graph is the panorama display. It always shows all data available for viewing. When the main graph is zoomed in, the panorama display will continue to show all the data that has been graphed. A line segment under the panorama graph will be highlighted to indicate the portion of the whole graph that is currently shown in the main display area.

Comments:

The panorama display does not provide a detailed view, however, it will give you an idea of what portion of the data is currently displayed. In addition, displays with very concentrated data will be easier to see in this wide view. Examples are bi-modal histograms or burst data on Time Variation graphs.

↔□ ↔● markers appear on the panorama graph, while ↕□ ↕● markers do not.

The Zoom feature is not available for ↕□ ↕● markers on Histogram graphs.

Zoom Out

Zoom Out
Around
(active) Marker

- Pressing this softkey performs the reverse of the **Zoom In** softkey. Approximately twice as much of the graph will be displayed each time the **Zoom Out** softkey is pressed.

Full Scale

Return to
Full Scale

- Pressing this softkey re-scales the graph to full scale, showing all data.

DISPLAY OPTIONS

Display features are available for only the Histogram graphs and Time Variation graphs. These features affect how data will be displayed on the graphs.

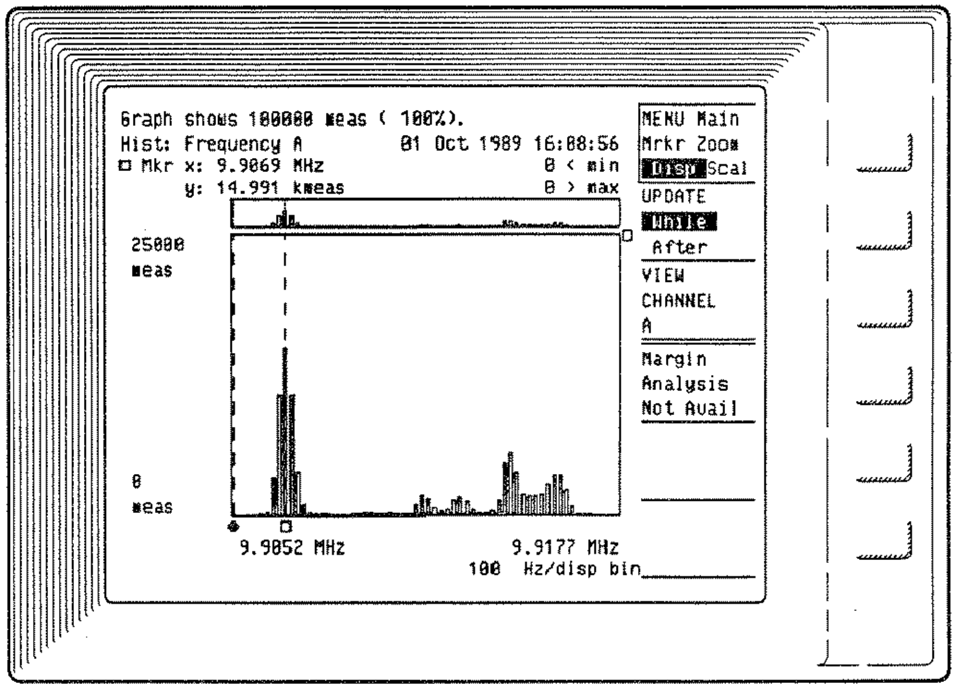


Figure 16-5. Display Options Menu

Update

UPDATE
While
After

This feature is available in the following instances:

- for Histogram graphs when the measurement sequence is multi-block and the total number of measurements exceeds the memory size (text on the Function menu reads, "Results will be most recently acquired block"). At the completion of the measurement sequence, the Histogram graph always contains the cumulative results.

  1. UPDATE While — will update the graph and display the accumulated results after each block is acquired. This mode is often referred to as a "growing histogram". It is useful for observing trends after only a few blocks to help determine if the measurement is appropriate.

  2. UPDATE After — will cause the graph to display the accumulated results only after the final block of the

measurement sequence is acquired. This typically results in a faster acquisition, since time is not taken to periodically update the display during acquisition.

- for Time Variation graphs when the measurement sequence is multi-block and the total number of measurements exceed the memory size (text on the Function menu reads, "Results will be most recently acquired block").

3. If the results are not averaged, 'Update While' will cause each block of data to be displayed as it is acquired. There is no accumulation of data across blocks. 'Update After' will cause only the last block of the measurement sequence to be displayed.

4. If the results are being averaged (see PRF, Frequency, PRI, and Period Measurements), 'UPDATE While' will cause a graph of the accumulated averaged results to be displayed after each block is acquired. The last block displayed represents the average of all the blocks acquired. 'UPDATE After' will cause only one graph to be displayed at the end of the measurement sequence. It will represent the average of all the blocks acquired.

View Channel

VIEW
CHANNEL
A B (A C) (B C)

Use this softkey to select the channel to graph when making dual-channel, dual-result measurements. These are:

- Frequency A&B, A&C, B&C (with Channel C option)
- Period A&B, A&C, B&C (with Channel C option)
- Totalize A&B

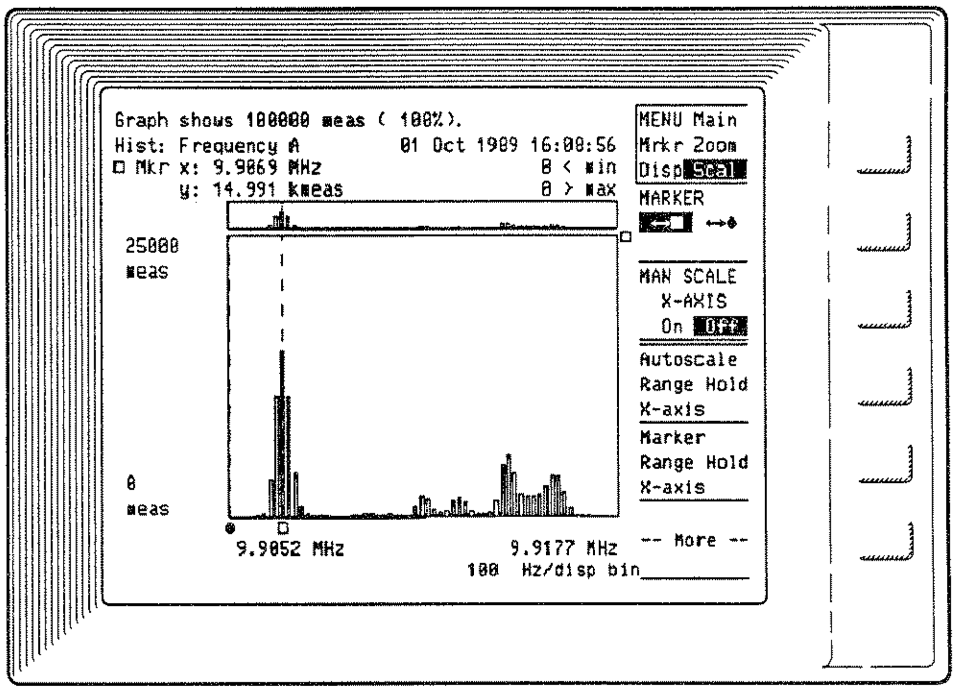
Only one channel can be graphed at a time. The softkey is used to specify which one to display. If the measurement does not provide dual results, the softkey reflects the current measurement channel, and no other selection is available.

SCALING OPTIONS

Scaling options allow you to set the scale limits for each of the graph types. When manual scaling is off, the graphs are automatically scaled. A general description of each of the scaling features is included here, but you should refer to the graph of interest in this chapter for a detailed description of how each feature applies to the specific graph type you are using.

The Scaling Option softkeys include two that affect the markers: Marker Selection and Marker Orientation. Refer to Marker Options for a description of their operation.

Figure 16-6. Scaling Options Menu



Yscale

YSCALE
Log Lin

This feature allows you to select between two scaling modes for the y-axis of Histogram graphs:

- LOG — the y-axis is displayed on a logarithmic scale
- LIN — the y-axis is displayed on a linear scale

Refer to Histogram Scaling Options for more information.

Manual Scale X-axis

MAN SCALE
X-AXIS
On Off

With Manual Scale X-Axis On:

- Histogram — you can set the x-axis minimum value and the bin width
- Time Variation — you can set the x-axis minimum and maximum values
- Event Timing — you can set the x-axis minimum and maximum values
- Entered numbers will default to predetermined values according to a "1-2-5" pattern.

Manual Scale Y-axis

MAN SCALE
Y-AXIS
On Off

With Manual Scale Y-Axis On:

- Histogram — you can set the y-axis maximum value
- Time Variation — you can set the y-axis minimum and maximum values
- Event Timing — there are no y-axis values for this type of graph
- Entered numbers will default to predetermined values according to a "1-2-5" pattern.

Autoscale Range Hold

Autoscale
Range Hold
X-axis (or Y-axis)

This feature is used to copy the current autoscale axis values as the manual scaling values. Then when manual scaling is turned on, the starting points for selecting new values are the autoscaled values. This is useful to acquire a set of data, using autoscale to determine the range. Then press this softkey and turn on manual scaling. All subsequent acquisitions appear on the same scale, so results are "visually" comparable.

NOTE

If Manual scaling is turned on and no endpoint values have been set (from previous numeric entry or Range Hold operations), the Autoscale Range Hold action automatically takes place.

Marker Range Hold

Marker
Range Hold
X-axis (or Y-axis)

This feature is used to copy the values of the current marker positions as the manual scaling values. Then when manual scaling is turned on, the portion of the graph that is bounded by the markers is expanded to fill the display. New axis values can be entered at this point, if desired. This is useful as a means to use the markers to define subsequent displays. As long as the data can be seen on the graph, it is much easier to use the markers to define the scaling limits, as opposed to entering discrete values. (Note: The HP 5373A still acquires all the data, but you cannot view it while manual scaling is on.)

HISTOGRAM GRAPH

The Histogram plots the number of occurrences of measurement values versus those measurement values. The x-axis of the Histogram covers the range of measurement values; the y-axis displays the scale for the number of measurements.

The x-axis is divided into discrete ranges of values, called bins; the y-axis indicates the number of measurements in each of the bins.

Comments:

The Histogram graph sorts data by measured value, so the order in which the data is collected is lost. Use the Time Variation graph to display the measured values as a function of time.

Figure 16-7 shows a Histogram graph with information highlighting the organization of the graph.

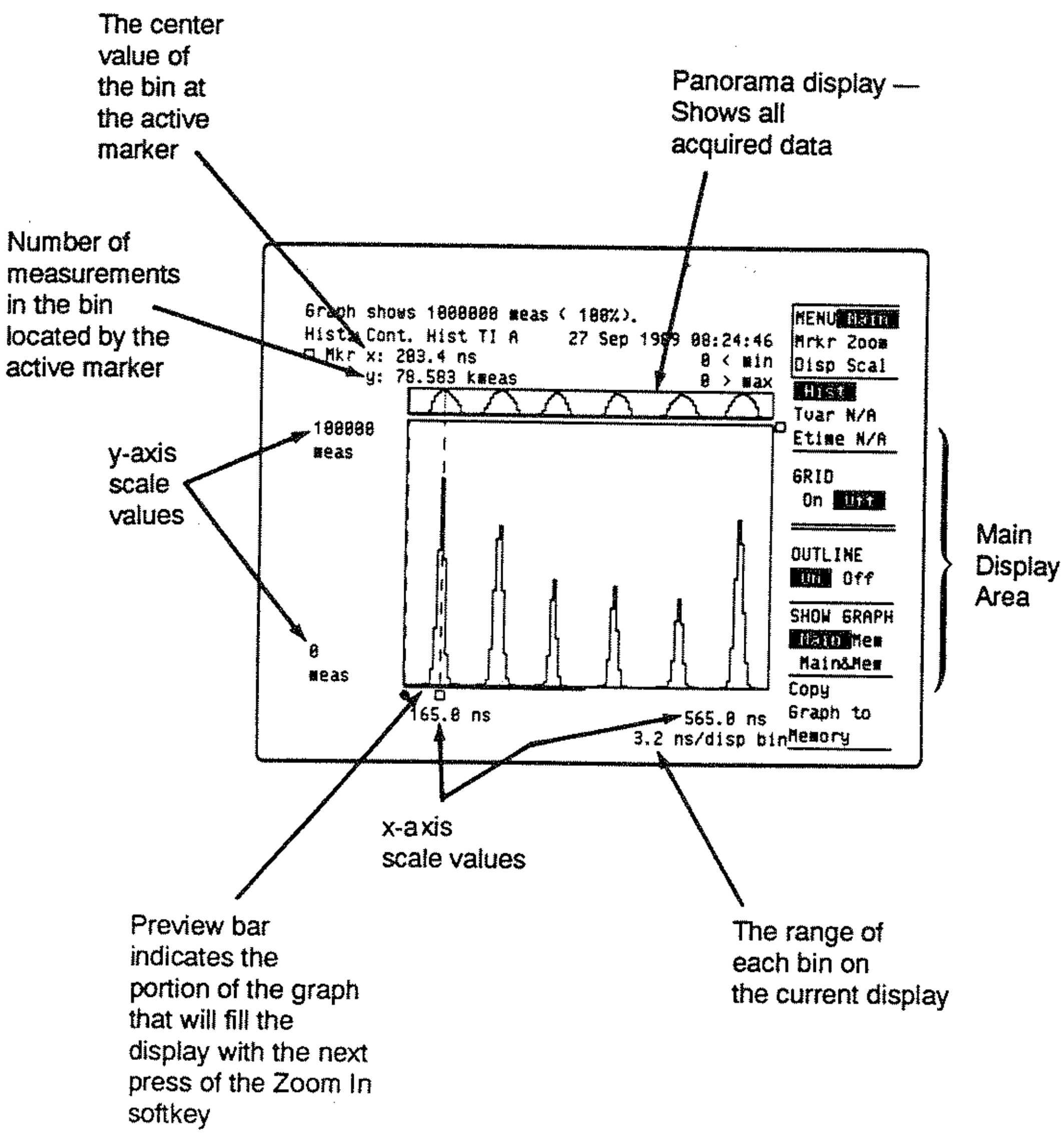


Figure 16-7. Histogram Graph Organization

Histogram Main Options

- Grid
- Outline

GRID:

- The spacing depends on the y-axis scaling mode (Yscale feature set on the Scaling Options menu). The mode can be Linear or Log.
- Linear — the graph is divided by four horizontal lines. A label appears to the left of the graph showing the number of measurements per division.
- Log — the horizontal line spacing is based on the decade values covered. For example, if y-axis is scaled 0 to 1000, grid lines appear at 1, 10, and 100 measurement points. Log is useful when large measurement samples are taken and bins with few values are of interest.

See *Figures 16-8* and *16-9* for a comparison of the Linear and Log scales using the same graph data.

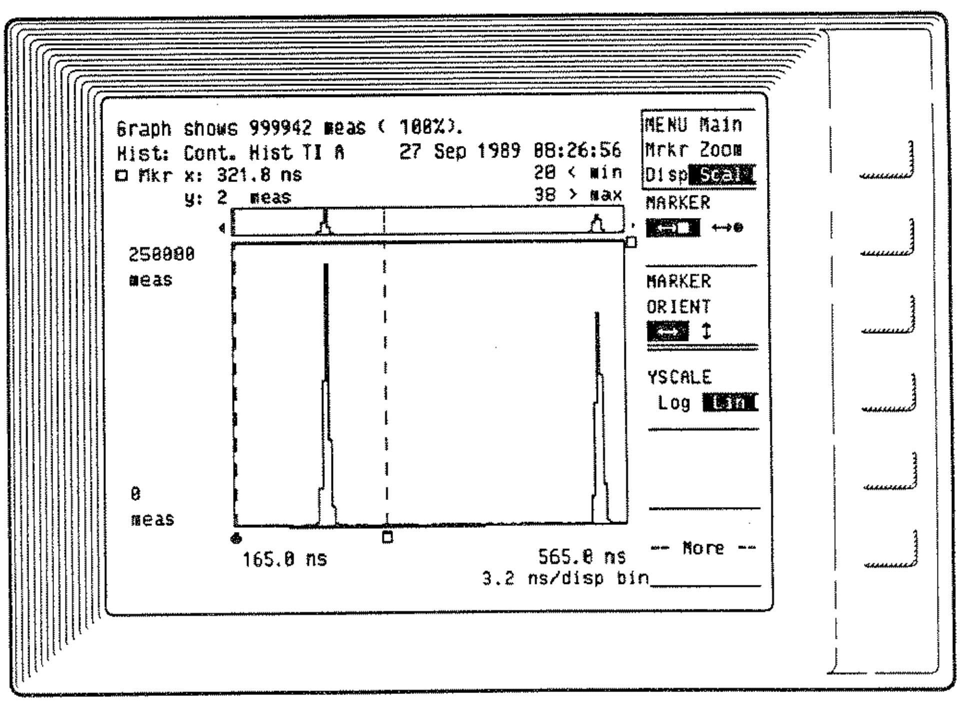


Figure 16-8. Histogram Linear Scale

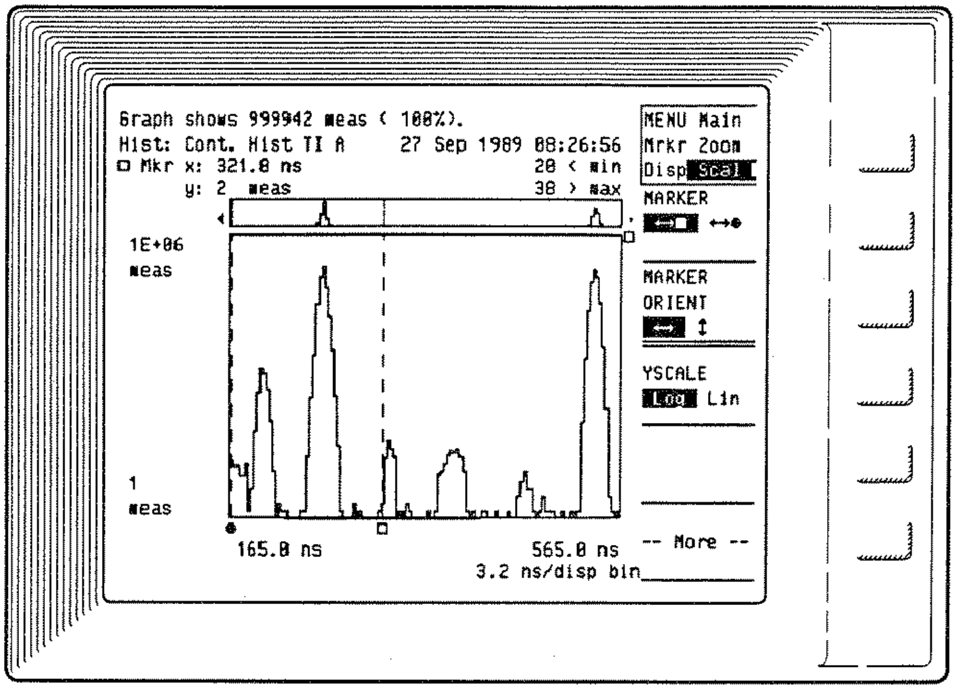


Figure 16-9. Histogram Log Scale (same data as Figure 16-8)

OUTLINE:

- OUTLINE On is the default condition. Each Histogram bin will have lines connecting the top of that bin to the top of adjoining bins. This way the graphs can be drawn faster.
- OUTLINE Off provides vertical lines drawn for each Histogram bin from the bin top to the x-axis of the graph.

Comments:

When using the SHOW GRAPH features to view two Histograms simultaneously, they are easier to distinguish if one is displayed with Outline On and one with Outline Off.

Histogram Marker Options

- Marker
- Delta
- Statistics
- Marker to Maximum
- Marker to Minimum

MARKER:

- The ↔□ ↔● markers provide an x-axis value for the bin at the marker and the number of measurements in the bin.
- The ↕□ ↕● markers display a number of measurements dependent on the position of the markers relative to the y-axis scale, not the measurement data.

DELTA:

- Delta on the ↔□ ↔● markers is the difference in the center value of the two bins at the markers (x-axis values), and the difference in the number of measurements in the two bins at the markers (y-axis values).
- Delta on the ↕□ ↕● markers is the y-axis difference in the position of the two markers.
- The measurement numbers associated with the delta calculations between the two markers are displayed in a message on the status line.

NOTE

Delta results are always calculated as the value of the active marker minus the value of the inactive marker. For example, if the x-axis position of the active marker is to the left of the inactive marker, the 'Delta x' value will always be negative.

STATISTICS:

- Four statistics values are displayed. They are: minimum, maximum, mean, and standard deviation. The values are based upon Histogram bin values between the two markers (including the bins at the markers).

NOTE

Histogram statistics (as opposed to the statistics available on the Numeric screen) are bin-value derived, not measurement-value derived. The reason is that for measurement sequences of more than one block, not all of the data is available to calculate statistics using every measurement value. The statistics displayed here (on the Graphic screen) will not precisely match those displayed on the Numeric screen for the same measurement sequence. This is because the histogram statistics are limited by bin resolution. All measurements are assumed to lie at the center of the histogram bin.

- Minimum: the center value of the left-most bin enclosed by the markers.
- Maximum: the center value of the right-most bin enclosed by the markers.
- Mean:
  1. The center value of each bin is multiplied by the number of measurements in that bin.
  2. The products of (1) are added together and then divided by the total number of measurements bounded by the markers.
- Standard Deviation: the standard formula is used, but the center value of each bin is used as the value of every measurement in that bin for the purposes of this calculation.
- The number of measurements used to calculate the statistics is displayed at the top of the display screen. It shows the number of measurements between the markers.

MOVE MARKER TO MAXIMUM:

- The active marker moves to the tallest bin (the one with the most measurements) on the portion of the graph that is currently displayed.

MOVE MARKER TO MINIMUM:

- The active marker moves to the shortest bin (the one with the least measurements) on the portion of the graph that is currently displayed. If any bin contains no measurements, that is the minimum.

Histogram Zoom Options

- Zoom In/Out

ZOOM IN:

- Pressing this softkey magnifies a portion of the graph, giving a close-up view of the data. The zoom action takes place around the active marker.
- Panorama display above the main display area always shows all the data that is available for viewing. There is a highlighted line segment under the panorama display that indicates the portion of the whole graph that is currently shown in the main display area.
- Use the **Return to Full Scale** softkey at any time to display all the measurement data that has been graphed.

ZOOM OUT:

- The **Zoom Out** softkey performs the reverse of the **Zoom In** softkey. Approximately twice as much of the graph will be displayed each time the **Zoom Out** softkey is pressed.

Comments:

You can zoom in on data of interest between two markers with a feature in the Scaling Options. Use the following steps:

1. Set markers to enclose data of interest.
2. Go to Scaling Options and press **Marker Range Hold X-axis** softkey.
3. Set Manual Scale to On.

Histogram Display Options

- Update
- View Channel

UPDATE:

The Update feature is available for Histograms when measurement sequences are multi-block AND the total number of measurements exceeds measurement memory. This is indicated by text on the Function menu that reads as follows:

1. "Results will be most recently acquired block"

OR

2. "Display Averaged Results from all blocks," with the "Averaged Results" field locked-out, that is, it is not selectable with the menu cursor.

Figure 16-10 shows a setup where UPDATE is not offered. *Figure 16-11* shows a setup where UPDATE While or After is available.

Figure 16-10. UPDATE is Not Available

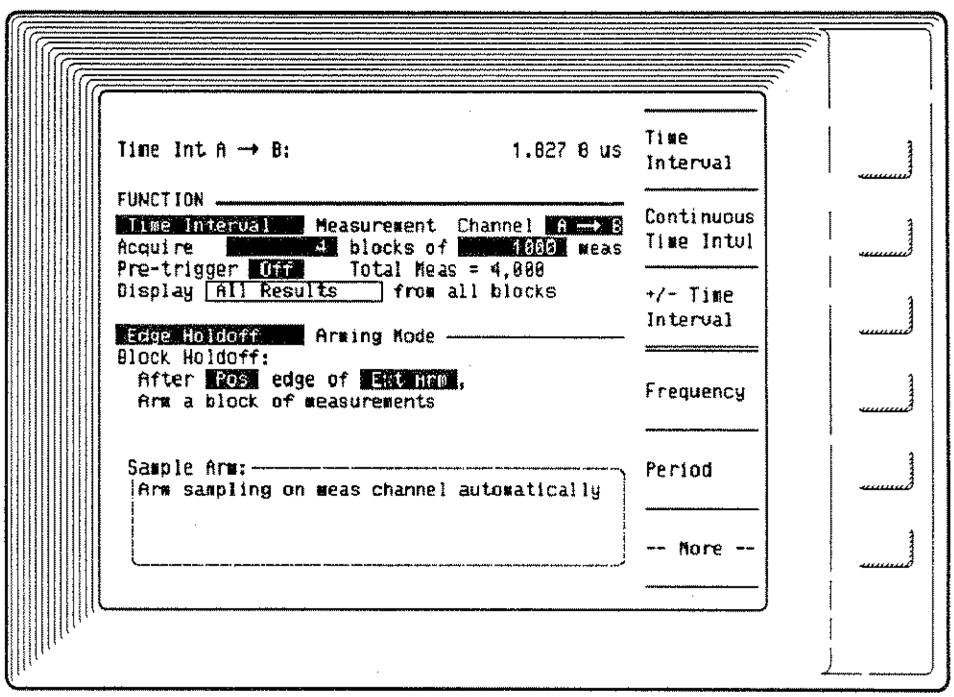
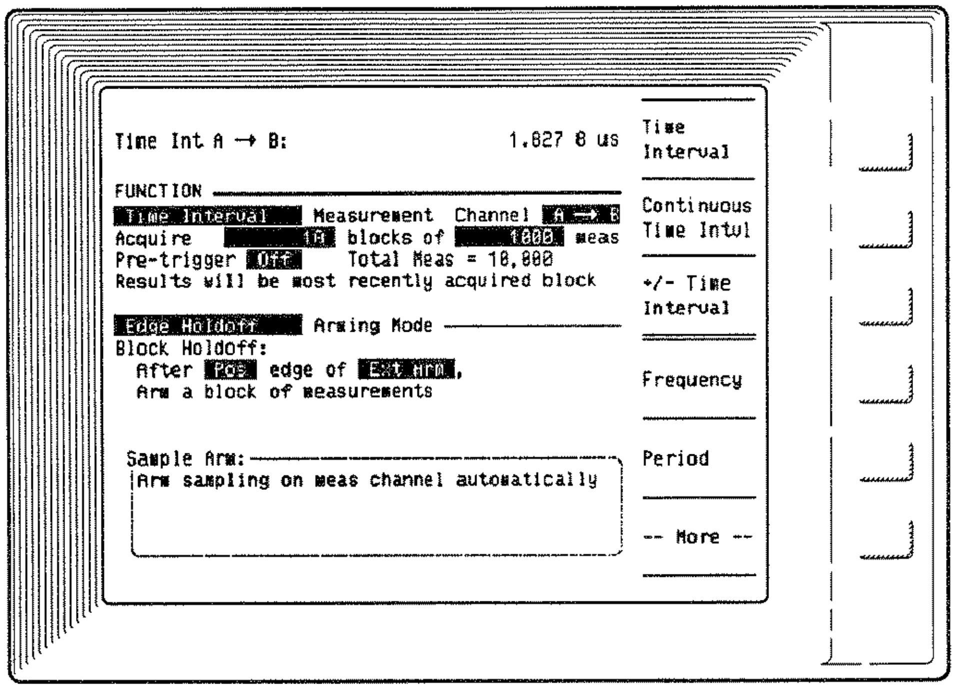


Figure 16-11.
UPDATE While or After
Selection is Available



- UPDATE While — the Histogram is updated after each block to reflect the cumulative data. This mode is sometimes referred to as a "growing histogram." It is useful for observing trends after only a few blocks to help determine if the measurement is appropriate.

NOTE

When making a multiple block measurement using autoscaling, the overall range of the x-axis is determined with the first block of data. If a subsequent block in the same measurement sequence has data that falls outside the range set after the first block, those data points will not be included in the Histogram.

When this happens, there will be an arrowhead to the left and/or right of the panorama display. The arrowhead indicates that data was collected outside the graph boundaries, and cannot be graphed. The number of measurements that fell outside the graph limits is listed above the panorama display (M < min, N > max).

To ensure that all data falls inside a given range on the Histogram, use manual scaling to set the graph boundaries.

This note applies only to non-Histogram measurements. Histogram measurements have no autoscaling feature. Refer to chapter 4, "Histogram Measurements," for more information.

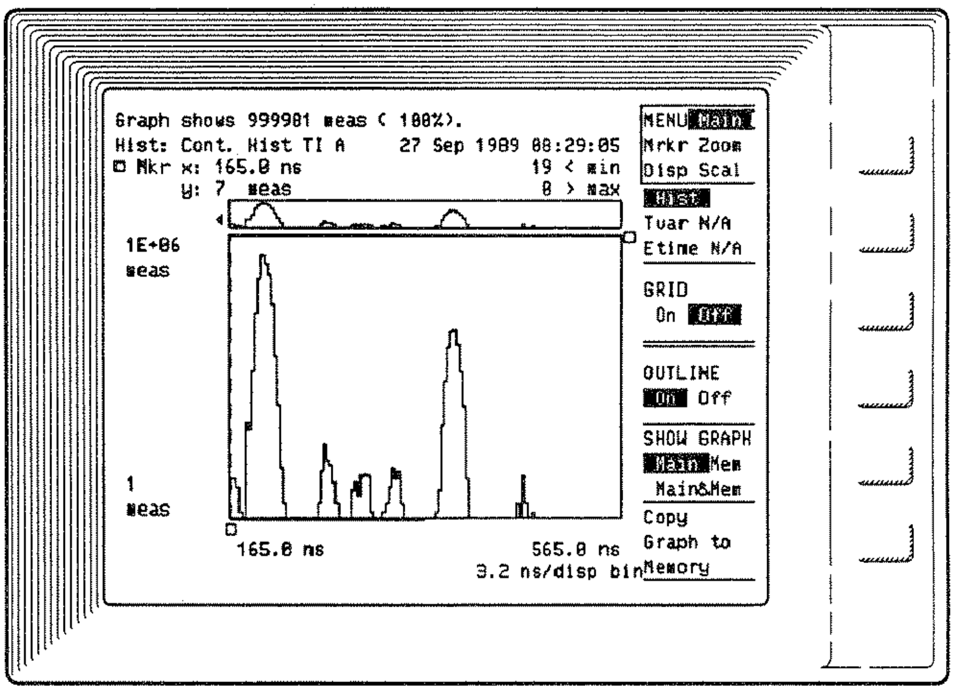
- UPDATE After — the Histogram is not displayed until all blocks of data have been collected. This is a faster mode of operation for multiple-block measurements because the graph is only drawn once. The disadvantage is that no results are observable until the end of the measurement sequence. For a large number of blocks, this could take quite some time. During the acquisition, the current number of blocks collected is displayed on the Numeric screen.

NOTE

When using autoscaling, the x-axis endpoints are determined based on only the first block of data. See the Note under Update While.

All the data from the measurement sequence is graphed in the Histogram, as long as all the data falls within the boundaries of the graph. There are a total of 2,000 bins for the Histogram. When data is not graphed, the number of measurements outside the Histogram bounds will be noted above the panorama display. See the example in *Figure 16-12.*

Figure 16-12. Not All Data Graphed



VIEW CHANNEL:

- For dual-channel, dual-result measurements, such as: Frequency or Period A&B, Totalize A&B, you can select one or the other channel to graph.

Histogram Scaling Options

- Log or Linear scale
- Manual Scaling

Histogram graphs can be scaled in both the x and y directions. The x-axis describes the range of measurement values. The y-axis describes the number of measurements. Bins are drawn along the x-axis, with the range of each bin also called, "bin width." The height of the bins are determined by the number of measurements falling within the range defined by each bin. For any data point on the graph:

- the x-axis coordinate is the center value of the data bin,
- the y-axis coordinate is the number of measurements in the bin.

Y-AXIS LOG OR LINEAR SCALE MODE:

- The y-axis scale can be set to Log or Linear mode. The default is Linear scaling. Log scaling is especially useful for large sample sizes, because the logarithmic scale tends to compress the large bin values and expand the small ones, allowing all components of the graph to be displayed at the same time. Large sample sizes are easily generated with the Histogram measurements. These measurements are described in chapter 4, "Histogram Measurements."

LINEAR AUTOSCALING:

- The y-axis minimum is defined as 0. The y-axis maximum is internally selected, based on the maximum bin value of the Histogram. All bin heights are scaled relative to that maximum value. The autoscaling algorithm defines y-axis values on a "1-2-5" pattern. For example, if the maximum bin height is 4, the y-axis maximum is 5; a height of 7 would force a scale maximum of 10; a height of 18 would force a scale maximum of 25. From 25, the progression of values is 50, 100, 250, 500, 1000, etc.

Comments:

When you enter manually scaled values for the y-axis, the y-axis maximum value will default to one of the pre-defined 1-2-5 pattern values. For example, if you enter 1200, the y-axis maximum value will default to 2500, the next higher pattern value.

- The x-axis limits are determined by the actual measurement values. The first bin will have a starting value less than, or equal to, the minimum measurement value. The last bin will have an ending value greater than, or equal to, the maximum measurement value.

NOTE

If you are making a measurement acquisition of multiple blocks, be aware that the overall x-axis limits are based upon the first block of data. It is possible that a widely varying input signal may not have all of its data graphed. The number of measurements not graphed will be shown above the panorama display. It will show the number of measurements below the minimum value and the number above the maximum value. Arrowheads will also appear alongside the panorama graph indicating that data occurred outside the boundaries of the graph.

LINEAR MANUAL SCALING:

- The y-axis minimum is defined as 0. The y-axis maximum is specified by the user. This is done by first setting the **MAN SCALE Y-AXIS** softkey to On. Press the **Y MAXIMUM** softkey and a numeric entry field will appear below the graph. All bin heights are scaled relative to the maximum y-axis scale value.

Range: Y-axis maximum must be a positive value ≥5. If a negative value or a positive value < 5 is entered, it will be changed to 5.

Y-axis maximum must be an integer value. If a non-integer is entered, it will be rounded up to the nearest integer.

The maximum value is 1E+12. If a greater value is entered, it will default to 1E+12.

Comments:

When you enter manually scaled values for the y-axis, the y-axis maximum value will default to one of the pre-defined 1-2-5 pattern values. For example, if you enter 1200, the y-axis maximum value will default to 2500, the next higher pattern value. Read the description for how the scale values are automatically set for more on the 1-2-5 scale pattern.

- For the x-axis, the user enters a minimum value and a bin width. There will always be 2,000 data bins available for graph data, so the span of the graph will be:

  2,000 x bin width

  and the ending value will be

  minimum value + (2,000 x bin width)

Error checking takes place to insure that the minimum value and the bin width satisfy the resolution requirements for the current measurement. For example, if a bin width less than the minimum resolution of the measurement is entered, the bin width will be increased as required. Also, the starting value actually used in scaling the graph will have to be the entered value rounded down to the nearest multiple of resolution.

LOG AUTO SCALING:

- The y-axis minimum is defined as 0. The y-axis maximum is internally selected, based on the maximum bin value of the Histogram. The maximum y-axis scale value will be the next power of 10 that is greater than the maximum bin value. For example, if the maximum bin value is 72, the maximum y-axis value is 100; a maximum bin value of 490 would force a scale maximum of 1000. All bin heights are scaled relative to the maximum graph value. Although zero is not defined for log scaled graphs, there needs to be a way to show that some bins contain no measurements. 0 appears where normally .9 appears on a Log scale graph. When the grid lines are displayed, the line representing 1 is just above the x-axis.
- The x-axis limits are determined by the actual measurement values. The first bin will have a starting value less than, or equal to, the minimum measurement

value. The last bin will have an ending value greater than, or equal to, the maximum measurement value.

NOTE

If you are making a measurement acquisition of multiple blocks, be aware that the overall x-axis limits are based upon the first block of data. It is possible that a widely varying input signal may not have all of its data graphed. The number of measurements not graphed will be shown above the panorama display. It will show the number of measurements below the minimum graph value and the number above the maximum graph value. Arrowheads will also appear alongside the panorama display indicating that data occurred outside the boundaries of the graph.

LOG MANUAL SCALING:

- The y-axis minimum is defined as 0. The y-axis maximum is specified by the user. This is done by first setting the **MAN SCALE Y-AXIS** softkey to On. Then pressing the **Y MAXIMUM** softkey will cause a numeric entry field to appear below the graph. All bin heights are scaled relative to the maximum y-axis scale value.

Range: Y-axis maximum must be a positive value ≥10. If a negative value or a positive value < 10 is entered, it will be changed to 10.

Y-axis maximum must be a power of ten. An entered value that is not a power of ten will be rounded up to the next largest power of ten.

The maximum value is 1E+12. If a greater value is entered, it will default to 1E+12.

- For the x-axis, the user enters a minimum value and a bin width. There will always be 2,000 data bins available for graph data, so the span of the graph will be:

  2,000 x bin width

  and the ending value will be

  minimum value + (2,000 x bin width)

Error checking takes place to insure that the minimum value and the bin width satisfy the resolution requirements for the current measurement. For example, if a bin width less than the minimum resolution of the measurement is entered, the bin width will be increased as required. Also, the starting value actually used in scaling the graph will have to be the entered value rounded down to the nearest multiple of resolution.

LIMIT LINES AND HISTOGRAM

Limit lines on histograms are two vertical lines which overlay the graph. Their positions are dictated by the limit values entered on the Math menu. One line marks the low limit, and one marks the high limit. Limit lines are displayed when:

- the Limits feature is enabled on the Math menu for the channel being measured
- the limit values are within the display range of the graph being viewed.

Comments:

If one or both limit lines fail to appear on the graph, check the graph scale to make sure the limit values are within those spanned by the graph.

TIME VARIATION GRAPH

The Time Variation graph plots measurement value versus the actual time of measurement. The x-axis covers the time span over which the measurements were acquired. The y-axis covers the measurement range.

Figure 16-13 shows a Time Variation graph with information on the organization of the graph.

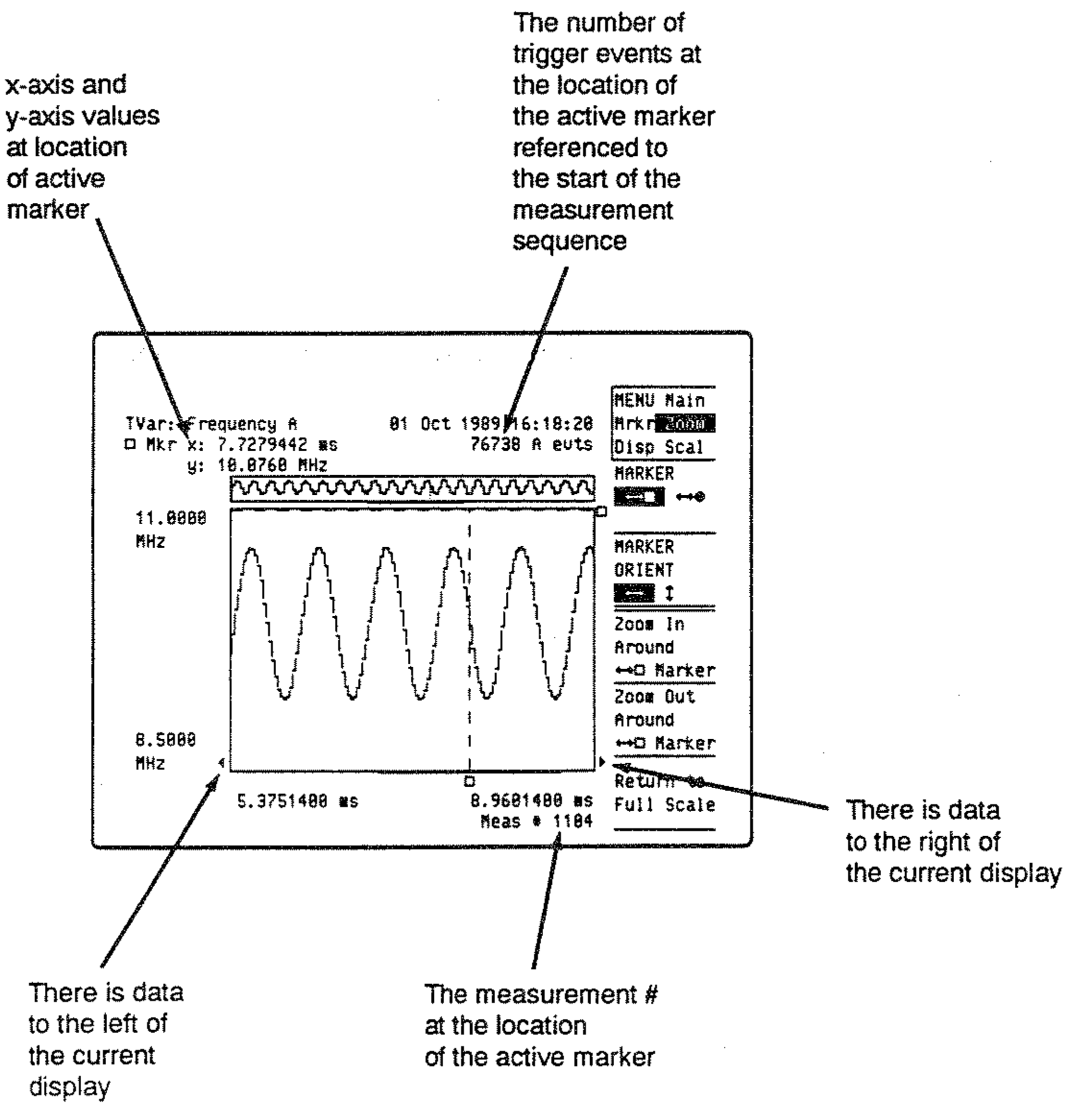


Figure 16-13. Time Variation Graph Organization

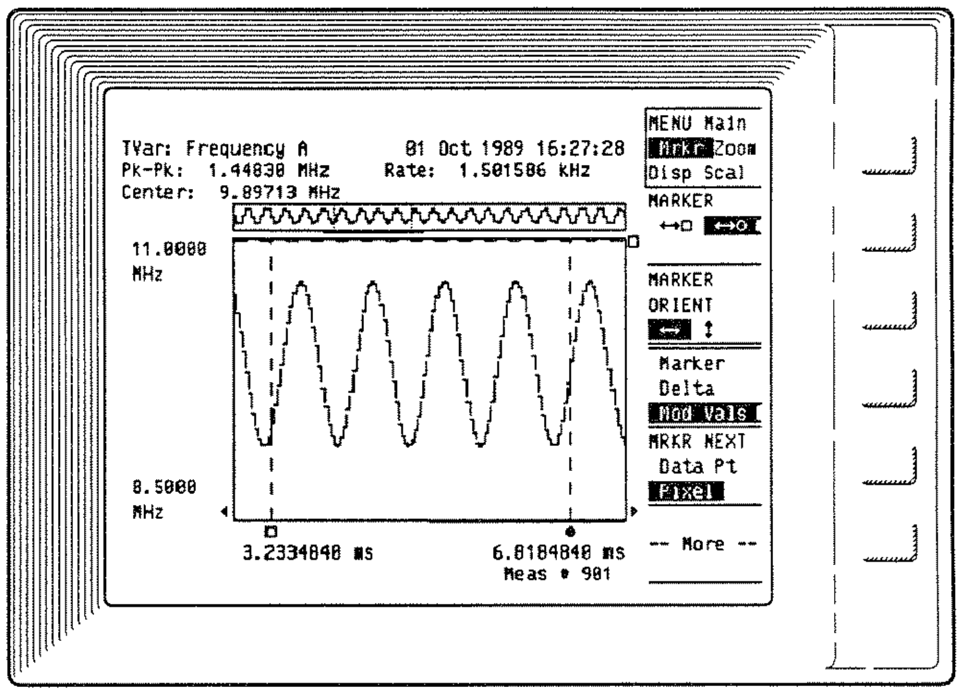
Time Variation Main Options

- Grid
- Connect Data

GRID:

- The graph is divided by four horizontal lines and nine vertical lines. The display shows a range of frequency, time, %, events, or degrees, per division along the y-axis. The type of units depends on the measurement function selected (see *Figure 16-14*).

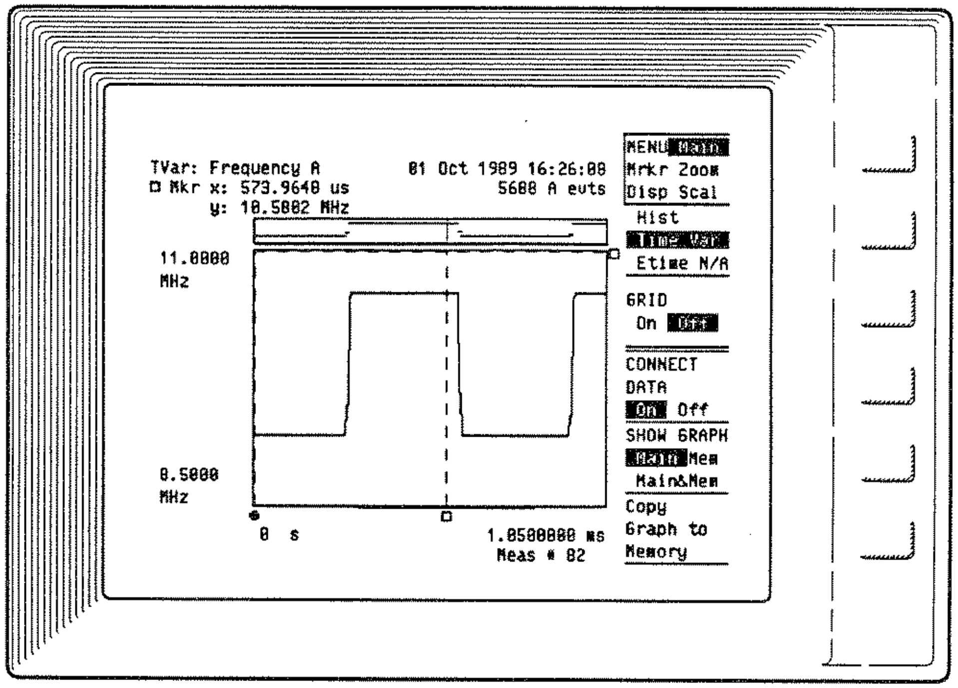
Figure 16-14. Time Variation Grid



CONNECT DATA:

- This feature provides a "connect-the-dots" display of the measurement data. No interpolation is done between data points. This is a linear connection of data points (see *Figure 16-15*).

Figure 16-15. Connect Data On



Time Variation Marker Options

- Marker
- Delta
- Modulation Analysis
- Marker Next
- Marker to Maximum
- Marker to Minimum

MARKER:

- The ↔□ ↔● markers provide an x-axis value of the time at which the measurement was acquired, and a y-axis value of the measurement result.
- The ↕□ ↕● markers display a y-axis position, expressed in measurement units. The readout is related to the value at the marker's position on the y-axis scale, not the measurement data.

DELTA:

- The delta information is presented for the portion of the graph data between the two markers.
- 'Delta x' for the ↔□ ↔● markers is the difference between the stop times at which the two measurements were acquired.
- 'Delta y' for the ↔□ ↔● markers is the difference in measurement values of the two measurements at the marker locations.
- Delta on the ↔□ ↔● markers also provides a count of the input events between markers. This is only for the measurement configurations that provide this data to the graph (see *Figure 16-16*).
- Delta on the ↕□ ↕ ● markers is the y-axis difference in the position of the two markers (see *Figure 16-17*).
- Status line displays the measurements that are the endpoints of the calculation.

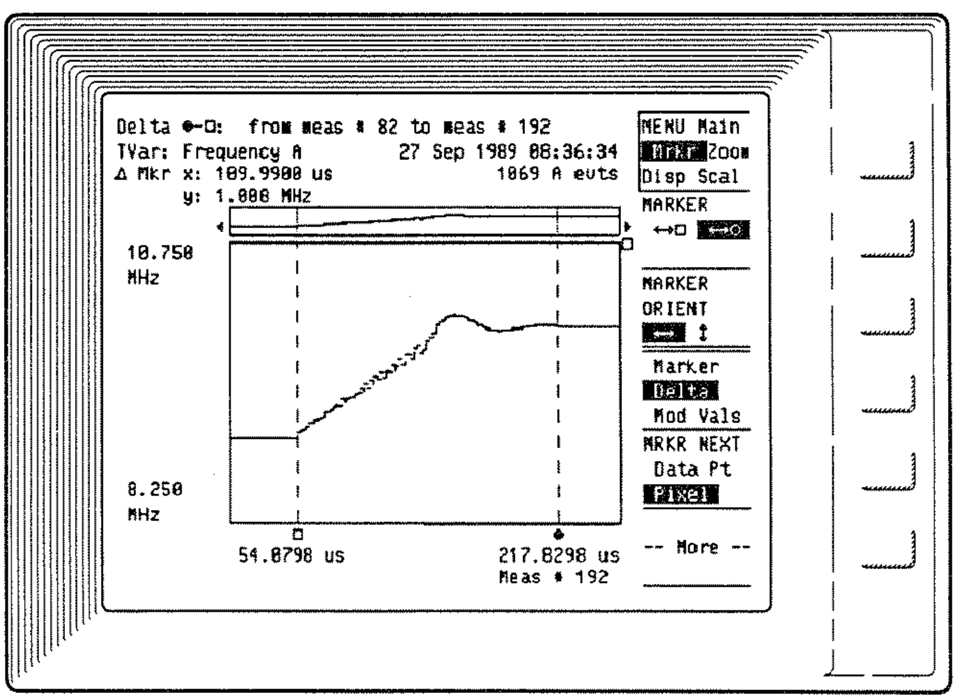
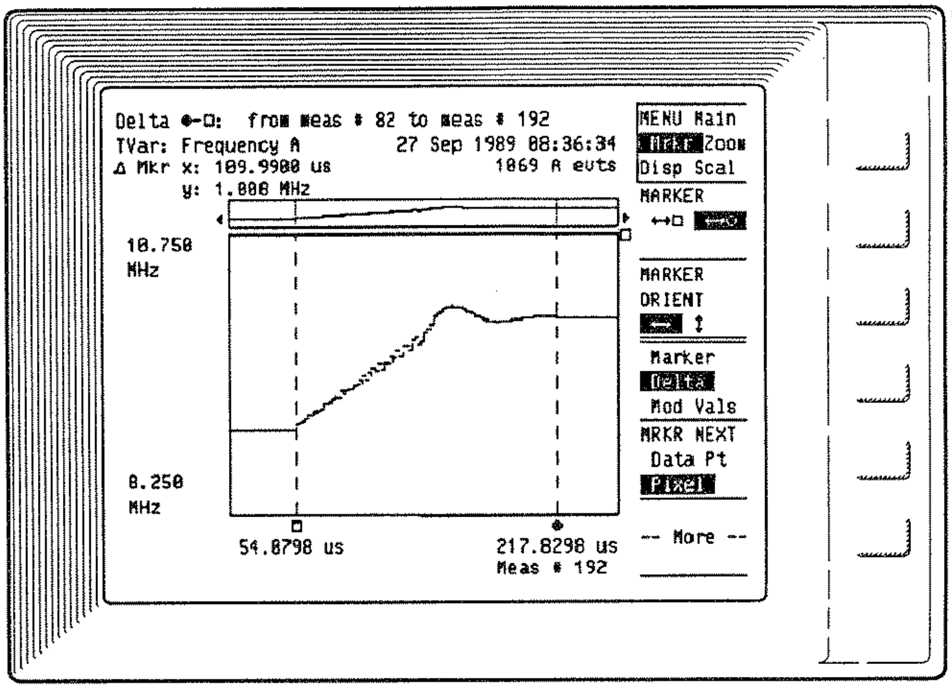


Figure 16-16. Time Variation X-axis Delta

*Figure 16-17.
Time Variation
Y-axis Delta*



NOTE

Delta results are always calculated as the value of the active marker minus the value of the inactive marker. For example, if the x-axis position of the active marker is to the left of the inactive marker, the 'Delta x' value will always be negative.

MODULATION ANALYSIS:

The Modulation Analysis feature provides the following modulation parameters for the Time Variation graph data: the peak-to-peak deviation, the modulation center value, and the average modulation rate.

- The modulation values are re-computed whenever the markers are moved or another measurement acquisition takes place.

Comments:

- The words, "not computable," will be displayed where the modulation rate normally appears when:

1. The ↔□ ↔● markers do not have at least one cycle of the modulating signal between them. The markers must encompass at least a pair of threshold crossings. A threshold is defined as 50% of the peak-to-peak deviation value.

2. The modulation on the portion of the signal bounded by the vertical markers does not exhibit periodic behavior.

Figure 16-18 shows an example of modulation analysis on a frequency modulated signal. Read the Technical Comment on the next page.

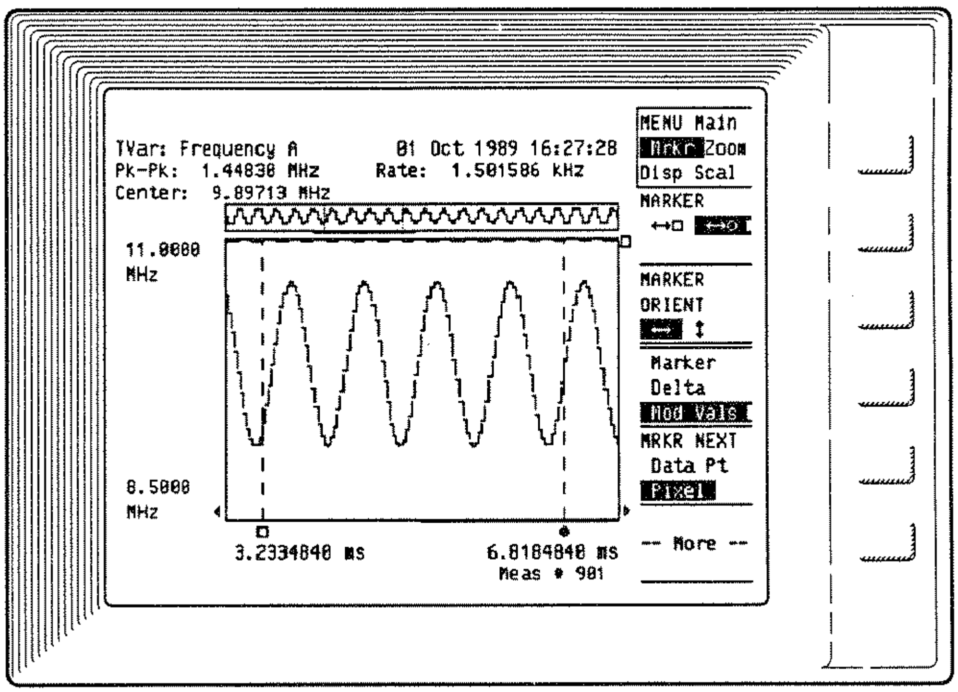


Figure 16-18. Modulation Analysis on a Sine Wave Modulated Signal

TECHNICAL COMMENT

Modulation Analysis Calculations:

All calculations include only the portion of the measurement data enclosed by the markers.

Pk-Pk (Peak-to-Peak Deviation) — The Pk-Pk Deviation is the difference between the peak upper value and peak lower value.

Center (Center Value) — The Center value is calculated as the simple mean of the maximum and minimum y-axis values.

Rate (Average Modulation Rate) — Simply stated, the modulation rate is calculated as follows:

$$\text{Modulation Rate} = \frac{\text{number of crossings of center value} - 1}{\text{time between first and last crossings}}$$

The numerator is the number of modulation periods within the range of analysis. For both the first and last center crossings, the time of the crossing is estimated by first determining a third-order polynomial fit of the data near the crossing, then solving for the time at which the polynomial intersects the center value.

A hysteresis of 10% of the pk-pk deviation is used in the crossing count determination. This reduces the possibility of erroneous mis-counts due to noisy modulations or measurement data near the resolution limit of the HP 5373A.

MARKER NEXT:

- Data Pt — the active marker moves from measurement to measurement. When many measurements are combined into the 125 data columns, such as for a measurement size of 1,000 results or more, marker movement may appear sluggish because it is moving among multiple measurements within each column. As you zoom in on a graph, the display columns have fewer and fewer data points within them, until only one data point is shown per column, or no data points are contained in a column.
- Pixel — the active marker moves from display column to display column. This can be a faster way of scrolling through the data when the data is concentrated on the

display. If multiple measurements are included in a column, the marker will only indicate the first measurement to occur in each column. This is evident from watching the 'Meas #' readout just below the graph x-axis values as the marker is scrolled across the display.

MOVE MARKER TO MAXIMUM:arker to maximum;Time Variation

- The active marker moves to the maximum data point on the portion of the graph currently displayed.

MOVE MARKER TO MINIMUM:

- The active marker moves to the minimum data point on the portion of the graph currently displayed.

Time Variation Zoom Options

- Zoom In
- Zoom Out

ZOOM IN:

- Pressing this softkey magnifies a portion of the graph, giving a close-up view of the data. The zoom action takes place around the active marker.
- The panorama display above the main display area always shows all the data that is available for viewing. There is a highlighted line segment under the panorama display that indicates the portion of the whole graph that is currently shown in the main display area.
- Use the **Return to Full Scale** softkey at any time to display all the measurement data that has been graphed.

ZOOM OUT:

- The **Zoom Out** softkey performs the reverse of the **Zoom In** softkey. Approximately twice as much of the graph will be displayed each time the **Zoom Out** softkey is pressed.

Comments:

You can zoom in on data of interest between two markers with a feature in the Scaling Options. Use the following steps:

1. Set markers to enclose data of interest.
2. Go to Scaling Options and press **Marker Range Hold X-axis** softkey.
3. Set Manual Scale to On.

Time Variation Display Options

- Update
- View Channel

UPDATE:

The Update feature is available for the Time Variation graph when measurement sequences are multi-block AND the total number of measurements exceeds measurement memory. This is indicated by text on the Function menu that reads as follows:

1. "Results will be most recently acquired block"

OR

2. "Display Averaged Results from all blocks," with the "Averaged Results" field locked-out, that is, it is not selectable with the menu cursor.

Figure 16-19 shows a setup where UPDATE is not offered. *Figure 16-20* shows a setup where UPDATE While or After is available.

Figure 16-19. UPDATE is Not Available

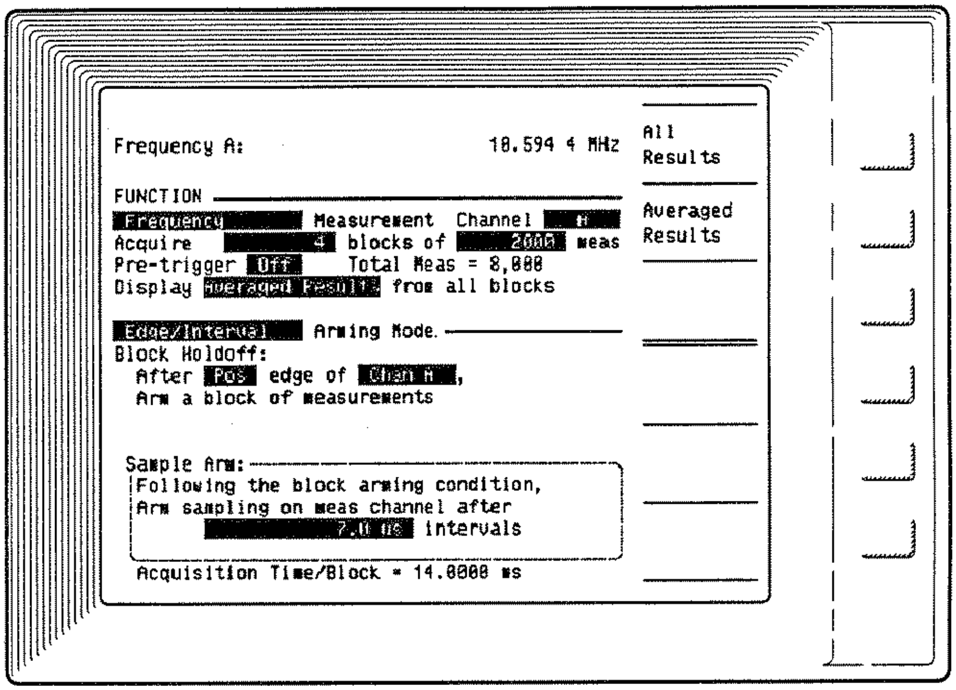
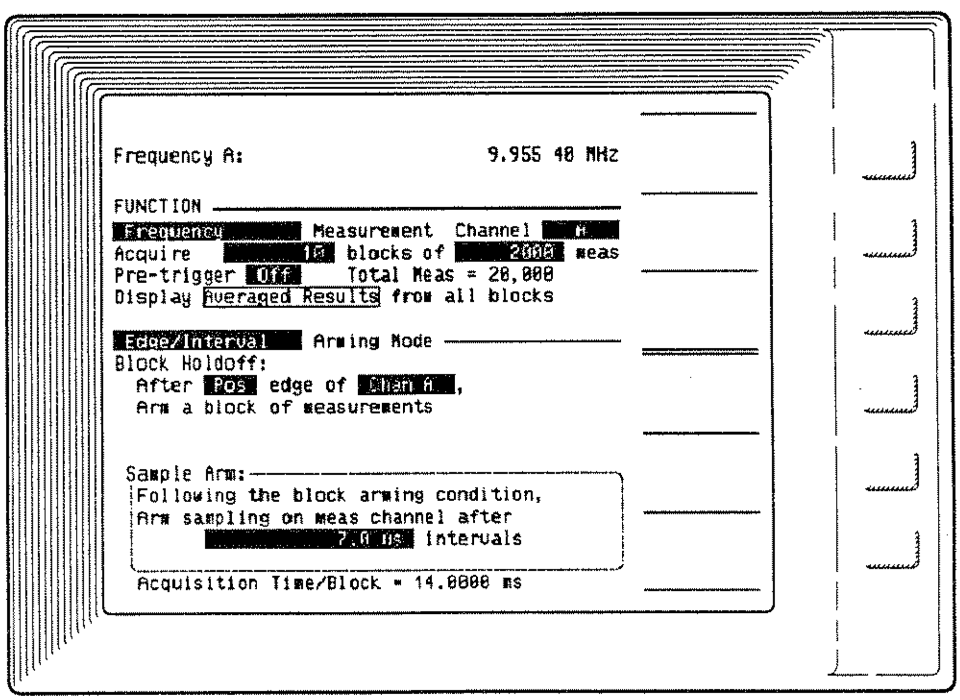


Figure 16-20. UPDATE While or After Selection is Available



- UPDATE While — the Time Variation graph is updated after each block to reflect the cumulative data. It is useful for observing trends after only a few blocks to help determine if the measurement is appropriate.
- UPDATE After — the Time Variation graph is not displayed until all blocks of data have been collected. This is a faster mode of operation for multiple-block measurements because the graph is only drawn once. The disadvantage is that no results are observable until the end of the measurement sequence. For a large number of blocks, this could take quite some time. During the acquisition, the current number of blocks collected is displayed on the Numeric screen.

VIEW CHANNEL:

- For dual-channel, dual-result measurements, such as Frequency or Period A&B, or Totalize A&B, you can select one or the other channel to graph.

Time Variation Scaling Options

For a description of each of the Scaling Options softkeys, see "Scaling Options" in this chapter.

AUTOSCALING:

- The x-axis values are determined by the time range delimited by the first and last measurements of the measurement sequence. The graph will fit within that range.
- The y-axis values are determined by the minimum and maximum measurement data values. The minimum and maximum y-axis values of the graph will be adjusted to values that enclose the actual measured values.

MANUAL SCALING:

- For the x-axis, the user may enter a minimum and maximum value. Note that the x-axis is only in terms of actual measurement time. Therefore, the minimum and maximum values must both be greater than, or equal to, zero. If a negative number is entered, it will default to zero.

- For the y-axis, the user may enter a minimum and maximum value. There are no limitations on negative values. If Math features are enabled, it is possible that measurement results will be negative. Also, negative results are possible for ±TI, Phase Deviation, Time Deviation, Frequency Deviation, and Difference measurement results for Frequency, Period, and Totalize.

BLOCK AVERAGING AND TIME VARIATION GRAPH

The HP 5373A has the capability of averaging multiple blocks of measurements. This is valuable for increasing the resolution of measurement sequences that have dynamic, repeating inputs. It is made possible by the ability of the HP 5373A to reference in time the different blocks of measurements. This is done by measuring the time from the event that arms a block of measurements to the first sample of that block. Review chapter 2, "PRF, Frequency, PRI, and Period Measurements" and chapter 5, "Arming," for a description of blocks of measurements, samples, and arming terms. IT IS IMPORTANT TO REALIZE THAT WHEN BLOCK AVERAGING IS ACTIVE, THE INDIVIDUAL BLOCK RESULTS ARE UNAVAILABLE.

The measurement configurations that reference the block of measurements to the block arming edge are listed below. This time reference is critical to the ability to "time-relate" multiple acquisitions of a repetitive modulated signal. The arming edge for the block must have a fixed relationship to the modulation on the input (an alignment of modulation vs. time). An example of this is: the reference edge is the voltage tuning step from a VCO and the measured signal is the VCO output.

The approach for averaging multiple blocks of measurements is: using the block arming edge as the time reference for each block that is acquired, the blocks are averaged together in both the x-axis (time) and y-axis (measured value) dimensions.

The averaging feature is selected on the Function menu. It is available for a specific set of measurement functions and arming modes. These setups reference the block of measurements to the block arming edge rather than the first sample of the block. This is necessary to properly time-relate multiple acquisitions of a repetitive input signal.

Measurements That Provide Averaged Results

Block Averaging is provided for the following measurement configurations:

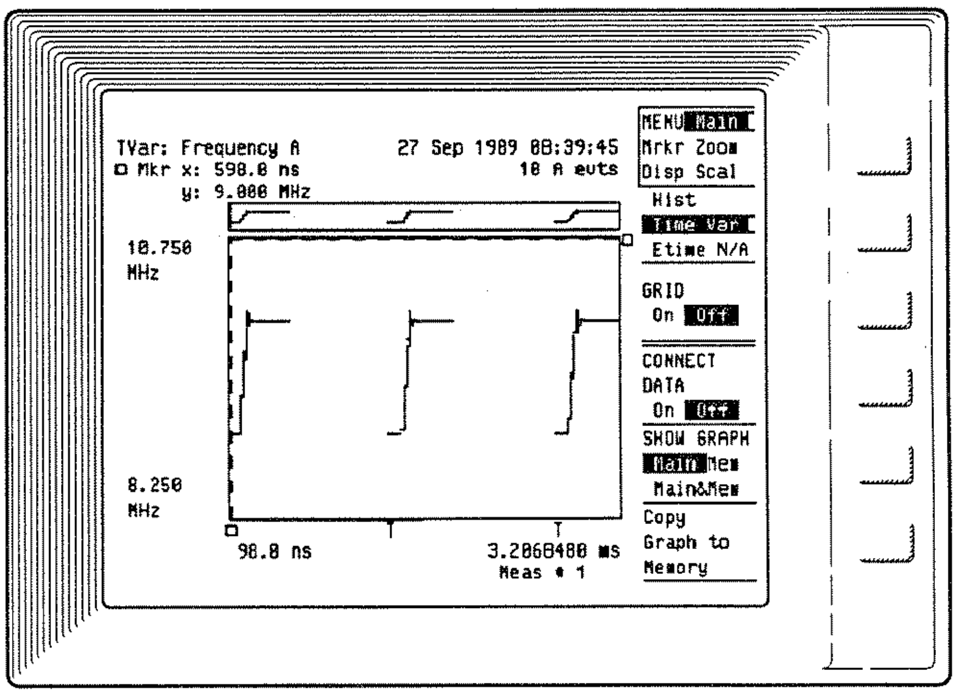
- A PRF, Frequency, PRI, or Period measurement sequence of multiple blocks with one of the following arming modes:
  - Edge Holdoff
  - Time Holdoff
  - Event Holdoff
  - Edge / Interval
  - Edge / Edge
  - Edge / Cycle
  - Time / Interval
  - Event / Interval
- A Continuous Time Interval measurement sequence of multiple blocks with one of the following arming modes:
  - Edge Holdoff
  - Time Holdoff
  - Event Holdoff
  - Edge / Interval
- A Phase or Phase Deviation measurement sequence of multiple blocks with one of the following marming modes:
  - Edge Holdoff
  - Edge Interval

If the total number of measurements in the acquisition exceeds the measurement memory, the Time Variation graph can be redrawn after each block. The feature that allows this selection is UPDATE on the Display Options menu. For measurement sequences exceeding the measurement memory size, the Numeric screen always displays a block of averaged results after each additional block is acquired. Each Time Variation graph display shows the average of the blocks accumulated up to that point. The final graph shows the averaged results of all the blocks. (See description of UPDATE under "Time Variation Display Options".)

Timing Information

The time reference at the beginning of each block is called a "time-stamp" of the block arming edge. The time value is labeled with a letter "T" on the Numeric screen results before the first measurement of a block. A "T" appears on the Time Variation graph only when "All Results" is selected on the Function menu in place of "Averaged Results." (The choice of "All Results" is only available for block averaged acquisitions when the total number of measurements [blocks × measurements per block] will fit in measurement memory.) *Figure 16-21* shows an example of a Time Variation graph with multiple time referenced blocks. Also, if the marker is on the time-stamp, the x-axis time will be displayed, the y-axis shows "(holdoff edge)", and the measurement number = "T".

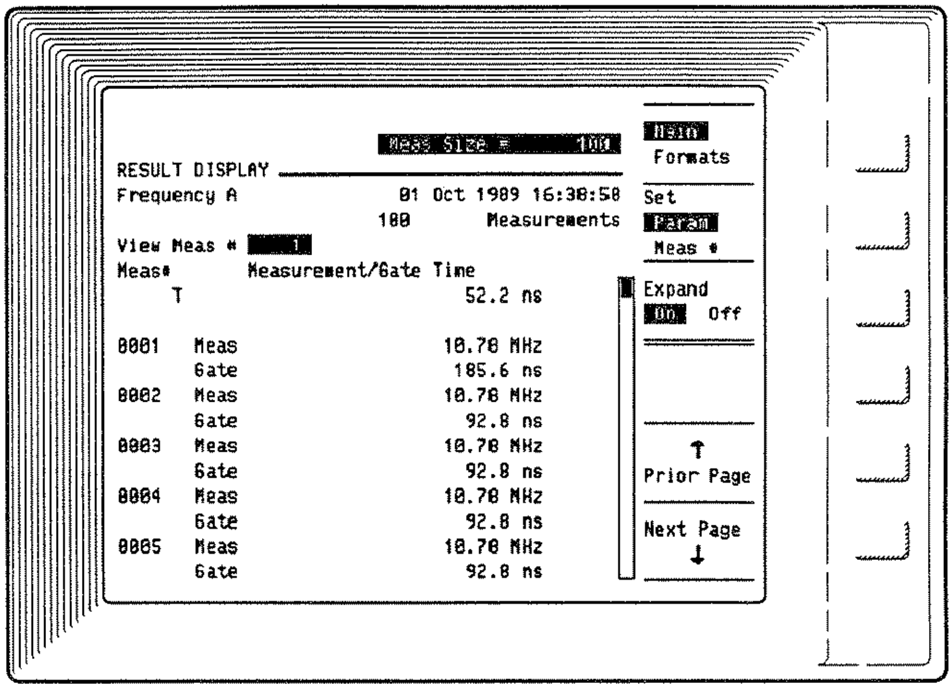
Figure 16-21.
All Results Selected for Measurement Results



NUMERIC SCREEN TIMING

The time from the block arming edge to the first sample of the measurement block is displayed on the Numeric screen preceded by the letter "T" (see *Figure 16-22*).

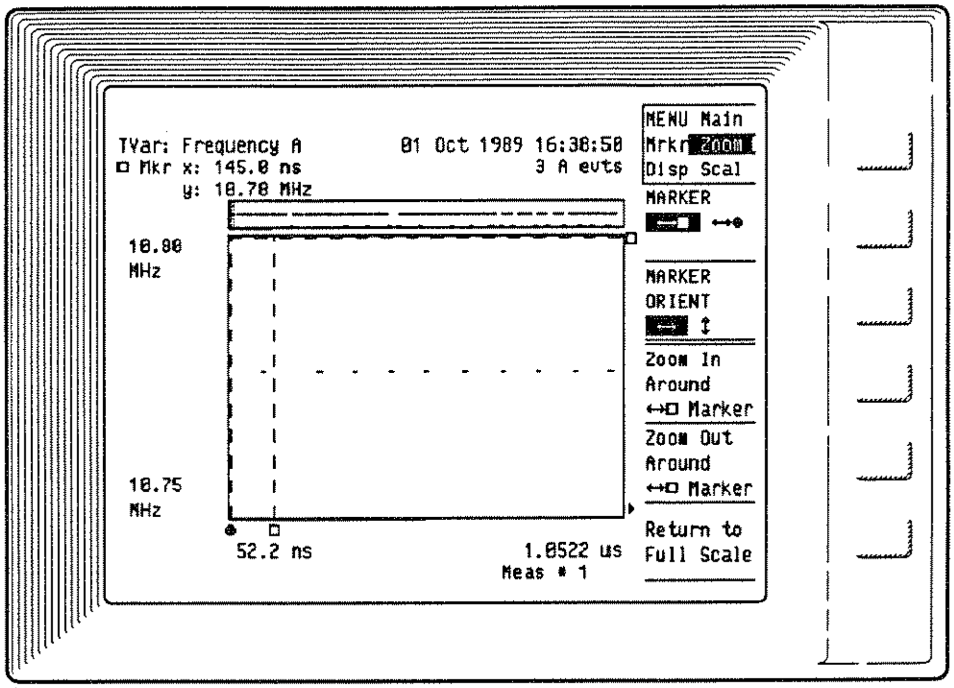
Figure 16-22. T = Time from Block Arming Edge to First Sample



TIME VARIATION GRAPH TIMING

The averaged data points on the Time Variation graph are positioned at the center of their measurement intervals. The time value (x-axis) of the first measurement of the block is (the time from the block arming edge to the first sample of the measurement block) PLUS (half the measurement interval of the first measurement). The x-axis time to the subsequent measurements is always the time from the block holdoff edge to the middle of the measurement interval located by the active marker. Compare the x-axis marker information of the first measurement in *Figure 16-23* to the time of the "T" value plus half the gate time of the first measurement in *Figure 16-22*.

Figure 16-23. Data Points are Located at the Center of Their Measurement Intervals



Limit Lines on Time Variation

Limit lines on Time Variation graphs are two horizontal lines which overlay the graph. Their positions are dictated by the limit values entered on the Math menu. One line marks the low limit, and one marks the high limit. Limit lines are displayed when:

- the Limits feature is enabled on the Math menu for the channel being measured,
- the limit values are within the display range of the graph being viewed.

Comments:

If one or both limit lines fail to appear on the graph, check the graph scale to make sure the limit values are within those spanned by the graph.

PRE-TRIGGER AND TIME VARIATION

When a measurement sequence uses Pre-trigger, the measurement where the pre-trigger event occurred is identified with a "P" on the x-axis (see *Figure 16-24*). For information on how to use Pre-trigger, see chapter 10, "Pre-trigger Menu."

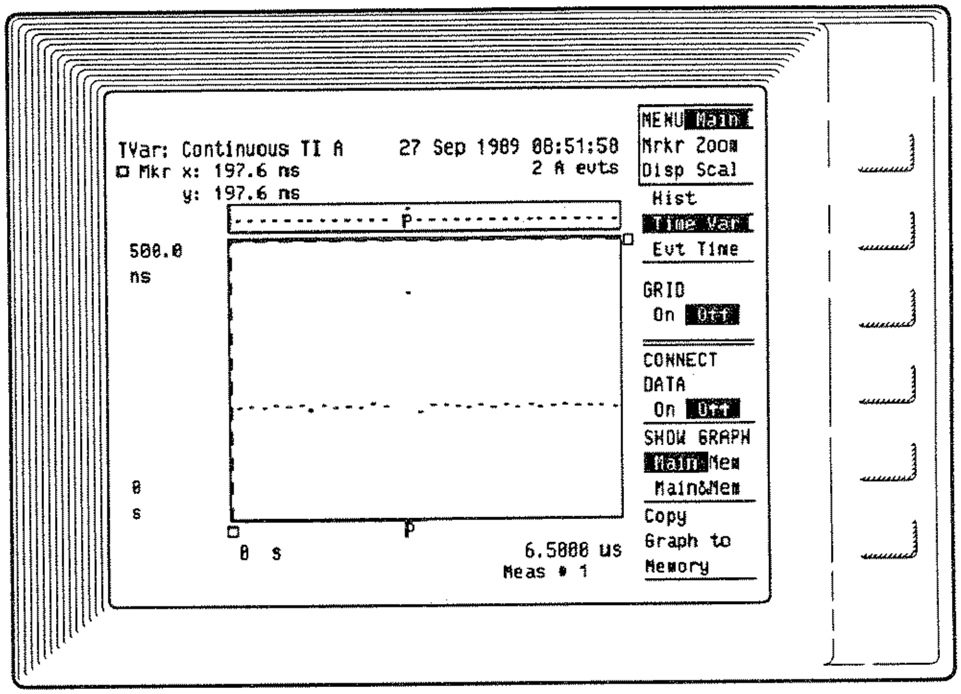
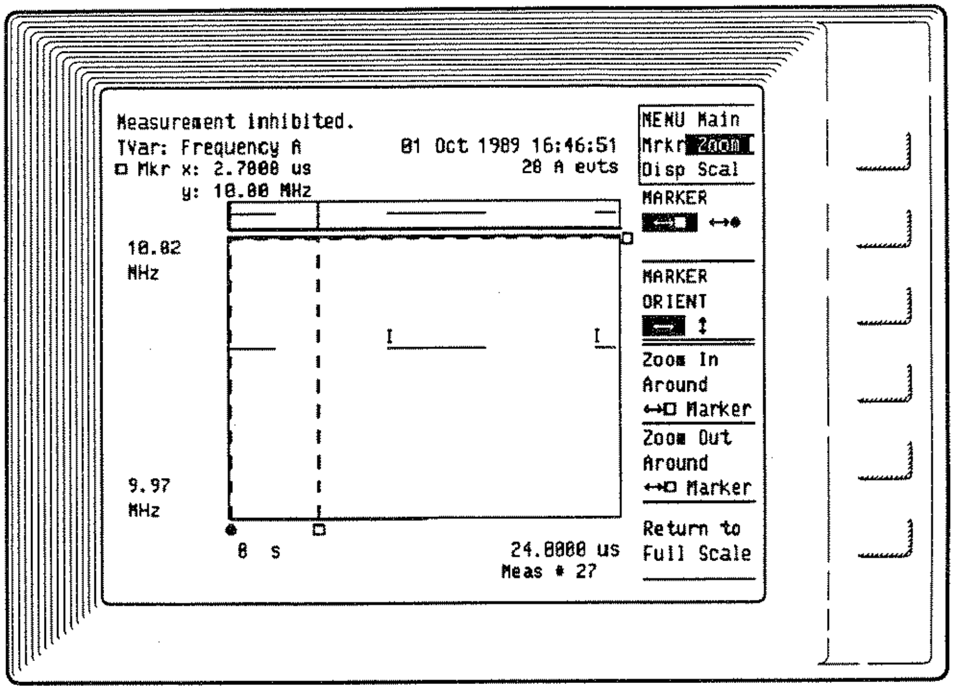


Figure 16-24. Pre-trigger on the Time Variation graph

MEASUREMENT INHIBIT ON TIME VARIATION

The Inhibit feature is used to selectively suppress the storage of measurement data. It is enabled on the Pre-trigger menu. The Inhibit signal polarity and voltage threshold are specified on the Pre-trigger menu. When the Inhibit feature is active, measurement data is not stored in measurement memory. Any input signal activity during Inhibit is not included in the measurement acquisition. The Time Variation graph shows an "I" to indicate measurements preceded or extended by Inhibit. Also, measurement number will have an "I" appended. Any measurements extended by Inhibit are not included in statistical or limit analysis. *Figure 16-25* shows a measurement sequence interrupted by Inhibit. For more on Inhibit, see chapter 10, "Pre-trigger Menu."

Figure 16-25. Measurement Inhibit on Time Variation Graph



EVENT TIMING GRAPH

The Event Timing graph plots the measurement start and stop values versus the actual time of the measurements. This graph is only available for time interval measurements (not PRF, Frequency, PRI, Period, or Totalize). The x-axis covers the time span over which the measurements were acquired. There is no y-axis for this graph; it is one-dimensional.

The graph is drawn as a single horizontal line, with short vertical lines (called ticks) above the horizontal line representing start measurement values, and the ticks below the horizontal line representing stop measurement values. For a given data point, the x-axis value is the actual start or stop time of the measurement relative to the first measurement in the sequence. For any x-axis value, there may be no ticks, a start tick, a stop tick, or both a start and a stop tick. Time-stamps, inhibits, and pre-trigger all appear on the Event Timing graph in the same way as for the Time Variation graph (T, I, P).

Figure 16-26 shows an Event Timing graph with information on the organization of the graph.

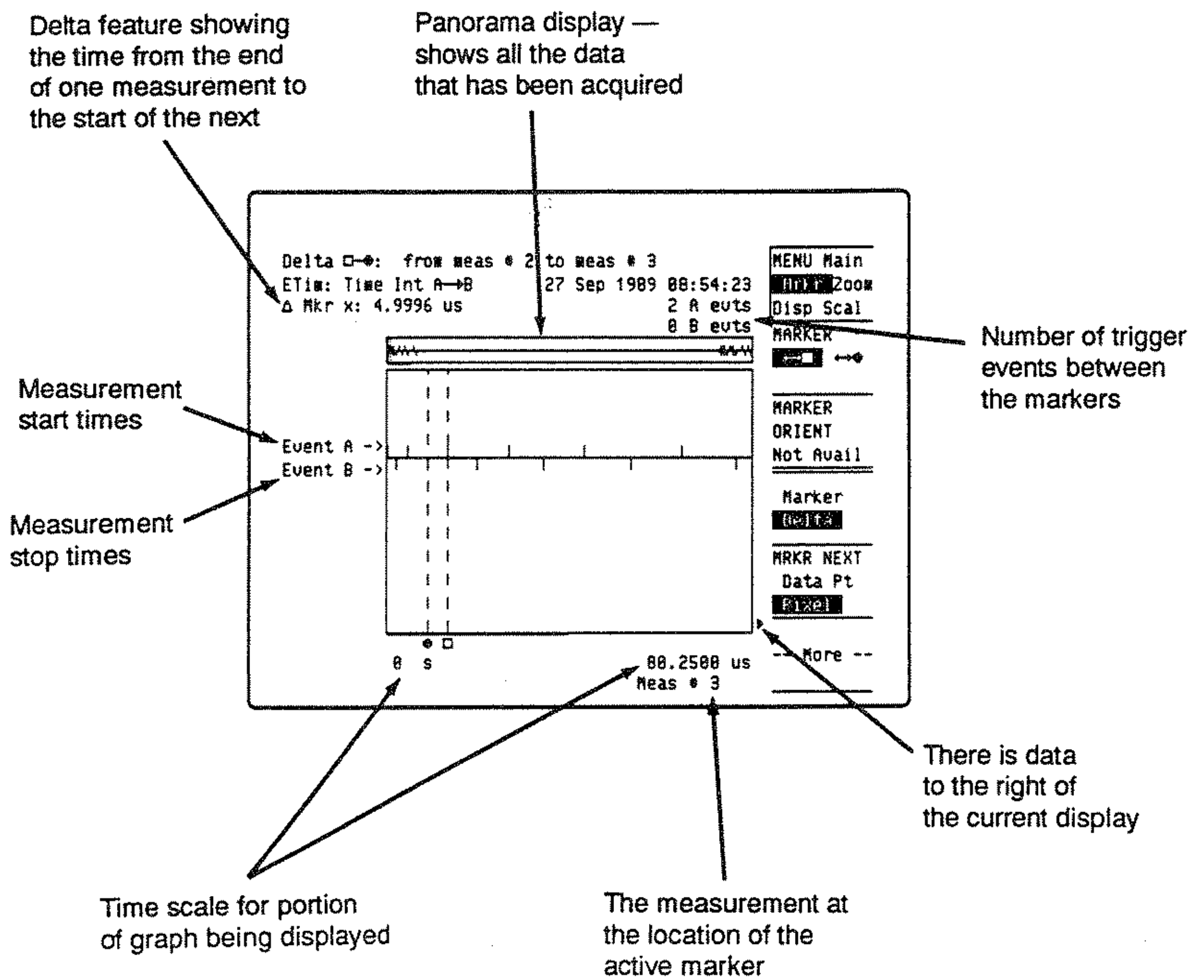


Figure 16-26. Event Timing Graph Organization

Event Timing Main Options

- Grid

GRID:

- The graph is divided by nine vertical lines. The spacing of the lines is not referenced to the displayed measurement results.

Event Timing Marker Options

- Marker
- Delta
- Marker Next

MARKER:

- Only ↔□ ↔● markers are available.
- The ↔□ ↔● markers provide an x-axis value that is the start or stop time of a measurement.

DELTA:

- Delta is the difference in time of the current marker positions.

MARKER NEXT:

- Data Pt — the active marker moves from measurement to measurement. When many measurements are combined into the 125 data columns, such as for a measurement size of 1,000 results or more, marker movement may appear sluggish because it is moving among multiple measurements within each column. As you zoom in on a graph, the display columns have fewer and fewer data points within them, until only one data point is shown per column, or no data points are contained in a column.
- Pixel — the active marker moves from display column to display column. This can be a faster way of scrolling through the data when the data is concentrated on the display. If multiple measurements are included in a column, the marker will only indicate the first measurement to occur in each column. This is evident from watching the 'Meas #' readout just below the graph x-axis values as the marker is scrolled across the display.

Event Timing Zoom Options

- Zoom In
- Zoom Out

ZOOM IN:

- There are 125 display columns across the graph area. When the number of measurements is such that they cannot all be assigned to individual display columns, only one measurement will be graphed per column. The graph must be zoomed in to resolve the overlapped data points into individual display columns.
- Pressing this softkey magnifies a portion of the graph, giving a close-up view of the data. The zoom action takes place around the active marker.
- The panorama display above the main display area always shows all the data that is available for viewing. There is a highlighted line segment under the panorama display that indicates the portion of the whole graph that is currently shown in the main display area.
- Use the **Return to Full Scale** softkey at any time to display all the measurement data that has been graphed.

ZOOM OUT:

- The **Zoom Out** softkey performs the reverse of the **Zoom In** softkey. Approximately twice as much of the graph will be displayed each time the **Zoom Out** softkey is pressed.

Comments:

You can zoom in on data of interest between two markers with a feature in the Scaling Options. Use the following steps:

1. Set markers to enclose data of interest.
2. Go to Scaling Options and press **Marker Range Hold X-axis** softkey.
3. Set Manual Scale to On.

Event Timing Display Options

There are no display options available for Event Timing graphs.

Event Timing Scaling Options

- Manual Scaling

AUTOSCALING:

- The x-axis values are determined by the time range delimited by the first and last measurements. The graph will fit within that range on the x-axis.

MANUAL SCALING:

- For the x-axis, the user may enter a minimum and maximum value. Note that the x-axis is only in terms of actual measurement time. Therefore, the minimum and maximum values must both be greater than, or equal to, zero. If a negative number is entered, it will default to 0.

PRESET VALUES

The following graphics conditions are set with the Preset key:

ALL GRAPHS:

- Displayed graph = Histogram
- X- and Y-axis Manual Scaling Off
- Active Marker = ↔ □
- Marker Display Mode = Marker
- GRID Off
- MARKER NEXT = Pixel
- SHOW GRAPH = Main
- Memory Graph cleared

HISTOGRAM:

- OUTLINE = On
- UPDATE = While
- YSCALE = Linear
- VIEW CHANNEL = A

TIME VARIATION:

- CONNECT DATA Off
- VIEW CHANNEL = A

SAVED PARAMETERS

The following parameters are stored when the instrument configuration is saved, or when the instrument is switched off:

- Graph type selected (Histogram or Time Variation or Event Timing)
- X- and Y-axis Manual Scaling status
- All Manual Scaling values
- Active marker and its orientation
- Marker Display Mode
- Grid status
- Marker locations
- Yscale mode
- Update mode
- Connect Data mode
- View Channel mode for Histogram and Time Variation

The following values are not saved:

- Memory Graph data
- Main Graph data
- Marker, delta, statistics, and modulation values from the graph data
- Event counts from the graph data
- Measurement number from the graph data
- Histogram underflow/overflow from the graph data
- Axes endpoints from the graph data

17

Contents of Chapter

17

PERFORMANCE TESTS

INTRODUCTION

This chapter contains procedures for testing the electrical performance of the HP 5373A Modulation Domain Pulse Analyzer, using specifications listed in Appendix E, as performance standards. Three types of testing are described: operation verification, complete performance testing, and HP-IB verification.

NOTE

If you are unfamiliar with the operation of the HP 5373A, you should review the HP 5373A Application Guide. This document is a "hands-on" tutorial which will help you become familiar with most of the instrument's features. By making the prescribed measurements and analyzing their results, you will be more comfortable pressing the front-panel keys and better understand the organization of the front panel controls.

OPERATION VERIFICATION

The Operation Verification is a set of tests which may be performed to give a high degree of confidence that the instrument is operating properly, without performing the complete Performance Tests. An Operation Verification is useful for incoming inspection, routine maintenance, and after instrument repair.

PERFORMANCE TESTS

The complete Performance Tests verify the specifications listed in *Table 17-2*. All tests can be performed without access to the inside of the instrument.

HP-IB VERIFICATION

The HP-IB Verification program exercises the instrument via the HP-IB interface. The program is written for a Series 200 or 300 HP 9000 as the controller. If the instrument successfully completes all phases of the verification program, there is a very high probability that the HP-IB interface is working properly. The HP-IB program is available on floppy disks, HP Part Number 05373-13502 (5 1/4 inch LIF formatted disk) and HP Part Number 05373-13501 (3 1/2 inch LIF formatted disk).

EQUIPMENT REQUIRED

The equipment required for all test procedures in this chapter is listed in *Table 17-1*. Any equipment that satisfies the required characteristics given in the table may be substituted for the recommended models.

Table 17-1. Equipment Required

INSTRUMENT	REQUIRED CHARACTERISTIC	RECOMMENDED MODEL
Synthesizer/Function Generator	DC to 10 MHz Frequency Range 45 mVp-p to 5 Vp-p Amplitude Range –2.5V to +2.5V DC Offset Range	HP 3325A
Synthesized Signal Generator	10 MHz to 2.0 GHz Frequency Range 12.6 mV rms to 707 mV rms Amplitude Range	HP 8663A
Digital Voltmeter	10 nV Resolution	HP 3458A
Pulse Generator	5 ns Pulse Width 280 mV p-p Amplitude 200 ns Period	HP 8161A
Attenuator	DC to 10 MHz Frequency Range 20 dB Attenuation	HP 8495D
Power Meter	100 MHz to 2 GHz	HP 436A
Power Sensor	100 MHz to 2 GHz –25 dBm to +7 dBm	HP 8481A
Power Splitter	100 MHz to 2 GHz	HP 11667A
Adapter	N(m)-to-BNC(f)	HP P/N 1250-0780
Adapter	Banana(m)-to-BNC(f)	HP 1251-2277
Adapter	BNC T-connector	HP 1250-0781
BNC Termination	50 ohm Feedthrough	HP 10100C
Adapters (2)	N(m)-to-SMA(f)	HP 1250-1250
Adapters (2)	N(m)-to-N(m)	HP 1250-0778
Cable	100 MHz to 2 GHz Frequency Range	Gore SN56181
Printer	ThinkJet	HP 2225A
Cable	HP-IB	HP 10833A

CALIBRATION CYCLE

The HP 5373A requires periodic verification of correct operation. Depending on use and environmental conditions, the HP 5373A should be checked using the Operation Verification and complete Performance Tests at least once a year.

TEST RECORD

Results of the Operation Verification, complete Performance Tests, and HP-IB Verification test should be recorded on a copy of the Performance Tests Record, located at the end of this chapter.

OPERATION VERIFICATION PROCEDURES

HP 5373A Setup

NOTE

Standard input pod configuration for the HP 5373A is an HP 53702A Envelope Pod for Channel A and an HP 54002A 50 Ω BNC input pod for Channel B.

These Operation Verification Procedures use only an HP 54002A pod (the standard HP 5373A Channel B pod) as the input pod for either channel being tested. If a second HP 54002A pod is available to you, you can remove the HP 53702A pod from the HP 5373A and insert the second HP 54002A pod in its place. This will save you the effort of moving a single HP 54002A pod from one channel to the other as you perform the operation verification.

With any non-HP 53702A pod (including the HP 54402A) installed as the CHANNEL A input, the FUNCTION menu "Measurement" field will display "Frequency" if the `PRF/Frequency` *softkey is pressed, or "Period" if the* `PRI/Period` *softkey is pressed.*

1. *Remove any HP 53702A Envelope Pod installed in the HP 5373A CHANNEL A or CHANNEL B input position.*
2. *Install a 50 Ω BNC input pod (HP 54002A) in the CHANNEL A input pod slot in the front panel. (You will be moving the one pod from one CHANNEL input to the other as you perform the operation verification.)*
3. *If more than one HP 54002A pod is available, install a second one as the CHANNEL B input pod.*
4. *Connect a 4-foot BNC cable from the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT to the HP 5373A Channel A input pod.*

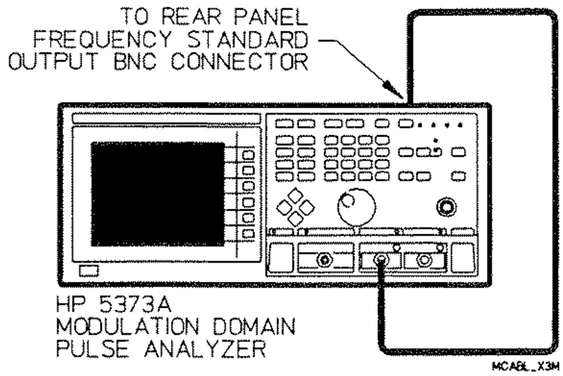


Figure 17-1. HP 5373A Operation Verification Setup

Power-Up Self Test and Diagnostics

1. Before connecting the power cord and switching on the instrument, be sure that the line voltage selector is properly set, the correct fuse is installed, and all safety precautions have been observed.

2. Connect the HP 5373A power cord to the primary power source, and set the STBY-ON power switch to ON. Verify the Power-up Self Test routine, as follows:

   a. After 3 seconds, the screen displays the words "Performing Self Test ..."

   b. After a few more seconds, and if there are no error or failure messages, the Function screen is displayed.

   c. If the HP 5373A displays an ERROR or FAILURE message, refer to the troubleshooting procedures in chapter 5 of the HP 5373A Service Manual. This chapter contains specific information about diagnostic failures.

3. Press Preset key.

4. Press Single/Repet key. The SINGLE LED should now be illuminated.

5. Press Test key.

6. Press "19" on the DATA ENTRY numeric keypad, and then press the Enter key.

7. Press the **Run** softkey.

8. Press the front-panel keys one at a time and verify the key name corresponds to the Front Panel Test "Key" field.

9. Move the Marker knob in both directions and verify the direction with the Front Panel Test "Key" field.

10. Press "21" on the DATA ENTRY numeric keypad, and then press the Enter key.

11. Press the **Run** softkey.

12. Verify that the CRT pattern covers the CRT display with a medium green color, and then press Test key.

13. Press "23" on the DATA ENTRY numeric keypad, and then press the Enter key.

14. Press the **Run** softkey.

15. After 30 seconds, verify that there are no Randomizer test failures, then press the **Stop** softkey.

Instrument Control

PRESET AND SHIFT-PRESET

1. Press Preset key.

NOTE

Pressing the Preset key at any time resets the HP 5373A parameters (measurement function, channel(s), block and measurement sizes, arming mode, input trigger setting(s), etc.) to a default measurement setup. If the Preset key is pressed by mistake, the last instrument setup can be retrieved by pressing the Recall key and then entering "0" on the DATA ENTRY numeric keypad. The instrument setup at the time Preset is selected is saved in storage register "0".

2. The Function screen should be displayed.

   Verify the following fields:

   "Measurement" field = Frequency
   "Channel" field = A
   "Arming Mode" field = Automatic

3. The GATE LED should be blinking rapidly, while the Channel A trigger LED is blinking at at a comparatively slower rate. (The TLK LED may be lighted, but will have no effect on the operation verification procedure.)

4. Press Shift and then press Preset key. (From now on this will be referred to as "Shift-Preset".) This presets the instrument to a set of default values and state.

5. The Default Measurement Setup screen, Numeric screen in Results/Statistics mode, should be displayed.

   Verify the following:

   Mean = 10.0 MHz
   Std Dev = 0 Hz

SINGLE/REPET AND RESTART

1. Press Single/Repet key.

2. The SINGLE LED will light and the GATE LED will turn off.

3. Press Restart key. (The HP 5373A will make one block of measurments each time this key is pressed.)

4. The GATE LED should light up briefly each time Restart key is pressed in the single mode. The values displayed are from the block of measurements initiated by pressing Restart key. There may be little or no change in the values shown because the HP 5373A is measuring its FREQUENCY STANDARD OUTPUT, a very precise source.

MANUAL ARMING

1. Press Preset key.

2. Press the **`More`** softkey.

3. Press the **`Totalize`** softkey.

4. Move the cursor to the "Arming Mode" field.

5. Press the top softkey until **`Hld/Samp`** is highlighted, and then press the **`Manual`** softkey.

6. Press Manual Arm key, wait about 1 second, and press Manual Arm key again.

NOTE

Press Restart before initializing a new Totalize measurement.

7. The value displayed in the top right of the function screen should be proportional to the amount of time you waited before pressing Manual Arm key the second time in Step 6. For a one-second time interval, the result should be 10.000 000 M.

Measurement Functions

NOTE

The Time Interval measurement function is tested by the Instrument Control Block procedures (performed earlier in the Operation Verification) and therefore is not tested in the following procedures. In addition, Rise Time, Fall Time, Phase, Duty Cycle, Pulse Width, Pulse Offtime, and Pulse Repetition Interval (PRI) or Period measurements are also not tested directly since they are variations of the measurements tested below.

±TIME INTERVAL MEASUREMENT

1. Press Preset key.
2. Press the **±Time Interval** softkey.
3. Press Input key.
4. Press the **Common** softkey.
5. Press the Single/Repet key. The SINGLE LED should now be illuminated.
6. The result displayed should be 0 s ±200 ps.

FREQUENCY MEASUREMENTS

1. Press Preset key.
2. Move the cursor to the "Channel" field.
3. Press the **More** softkey until **A&B** is a menu selection option.

4. Press the **A&B** softkey.
5. Press the Input key.
6. Press the **Common** softkey.
7. The measurements shown at the top of the display should both be between 9.99 MHz and 10.01 MHz.

ENVELOPE POWER MEASUREMENTS

1. Move the cursor to the "Measurement" field.
2. Press the **More** softkey until **Envelope Power** is a menu selection option.
3. Press the **Envelope Power** softkey.
4. The maximum should be above 4.0 dBm. The minimum should be above 0.88 dBm.
5. Move the cursor to the "Channel" field.
6. Press the **B** softkey.
7. The maximum should be above 4.0 dBm. The minimum should be above 0.88 dBm

Arming Modes

NOTE

An arming mode only needs to be tested in one measurement function to ensure correct operation.

FREQUENCY ARMING MODES

1. Press Preset key.
2. Move the cursor to the "Arming Mode" field.
3. Press the following softkeys and verify that the values displayed at the top of the Function screen are approximately the same as those below:

Edge Holdoff	10.00 MHz
Time Holdoff	10.00 MHz
Event Holdoff	10.00 MHz

4. Press the top softkey until **Sample** is highlighted and continue:

Interval Sampling	10.000 0 MHz
Time Sampling	10.000 000 000 MHz
Cycle Sampling	10.000 MHz
Edge Sampling	10.000 MHz

5. Press the top softkey until **Hld/Samp** is highlighted and continue:

Edge/Interval	10.000 0 MHz
Edge/Time	10.000 000 000 MHz
Edge/Edge	10.000 MHz

6. Press the **More** softkey and continue:

Edge/Cycle	10.000 MHz
Edge/Event	10.000 MHz
Time/Interval	10.000 0 MHz

7. Press the **More** softkey and continue:

Time/Time	10.000 000 000 MHz
Event/Interval	10.000 0 MHz
Event/Event	10.000 MHz
Externally Gated	10.00 MHz

±TIME INTERVAL ARMING MODES

1. Press Preset key.
2. Press Input key.
3. Press the **Common** softkey.
4. Press Function key.
5. Press the **±Time Interval** softkey.
6. Move the cursor to the "Arming Mode" field.
7. Press the top softkey until **Sample** is highlighted.

8. Press the following softkeys and verify that the values displayed at the top of the Function screen are approximately the same as those below:

Parity Sampling	0 s ±200 ps
Repetitive Edge	0 s ±200 ps

9. Press the **More** softkey and continue:

Repetitive Edge/Parity	0 s ±200 ps
Random Sampling	0 s ±200 ps

10. Press the top softkey until **Hld/Samp** is highlighted and continue:

Edge/Parity	0 s ±200 ps

11. Press the **More** softkey and continue:

Edge/Random	0 s ±200 ps

Input Menu

SEPARATE/COMMON INPUT

1. Press Preset key.
2. Press the **More** softkey until **Time Interval** is a menu selection option.
3. Press the **Time Interval** softkey.
4. The result at the top of the display should be 100.0 ±0.2 ns.
5. Move the cursor to the "Channel" field.
6. Press the **A→ B** softkey.
7. Press Input key.
8. Press the **Common** softkey.
9. The result displayed at the top right corner of the screen should be 100 ±2 ns.

TRIGGER SLOPE

1. Move the cursor down to the Channel A "Slope" field and press the **Neg softkey.**

2. The result displayed at the top-right corner should now read approximately 50 ns ±4 ns.

CHANNEL B INPUT

NOTE

This part of the procedure is written as if you have only one HP 54002A 50 Ω BNC input pod available and it is installed as HP 5373A CHANNEL A input. If you are using two HP 54002A pods in your HP 5373A, you need not perform the steps below that relate to moving the input pod from one HP 5373A channel to the other.

1. Set the STBY-ON power switch to STBY.

2. Disconnect the BNC cable from the 50 Ω BNC input pod at CHANNEL A.

3. Remove the 50 Ω BNC input pod from the CHANNEL A input and install it as the CHANNEL B input.

4. Connect the BNC cable to the of the HP 54002A pod installed as the HP 5373A CHANNEL B input.

5. Set the STBY-ON power switch to ON.

6. Press the Preset key.

7. Move the cursor to the "Channel" field.

8. Press the **More** softkey until **B** is a menu selection option.

9. Press the **B** softkey.

10. The measurement result shown at the top of the display must be between 9.99 MHz and 10.01 MHz.

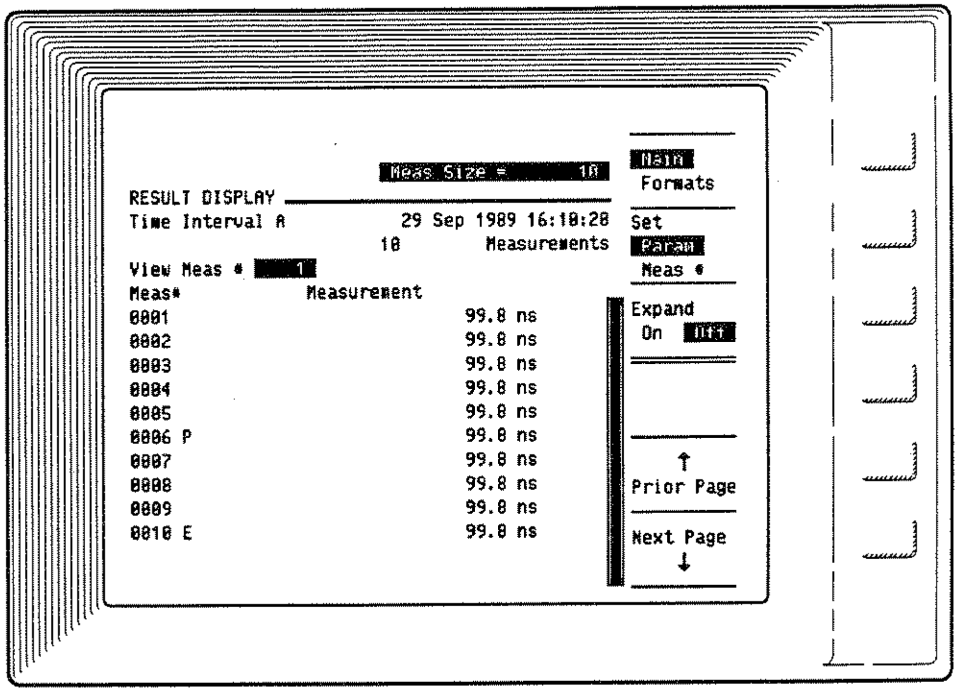
11. If you are working in a single-HP 540002A-pod environment, use the pod removal/installation instructions in the first five steps of this procedure as general instructions for removing the pod from one channel (CHANNEL B) and installing it in the other (CHANNEL A).

Measurement Control

PRE-TRIGGER, TI DETECT OUTPUT, AND MEASUREMENT INHIBIT INPUT

1. Press Preset key.
2. Press the **More** softkey until **Time Interval** is a menu selection option.
3. Press the **Time Interval** softkey.
4. Press Single/Repet key. The SINGLE LED should now be illuminated.
5. Move the cursor to the "meas" field.
6. Press "10" on the DATA ENTRY numeric keypad, and then press the Enter key.
7. Move the cursor to the "Pre-trigger" field.
8. Press the **Pretrigger On** softkey.
9. Press Pre-trigger key.
10. Press the **External Arm** softkey and verify the GATE LED is ON (verifies the pre-trigger condition is being met).
11. Connect a BNC cable from the rear-panel TI Detect output to the External Arm input.
12. Press Numeric key. The Numeric screen should display 10 measurements with the pre-trigger event (P event on display) at either measurement 5 or 6, as shown in *Figure 17-2.*
13. Press Pre-trigger key.
14. Press the **Time Interval** softkey.
15. Move the cursor to the TI Detect interval field (the current value of this field should be 0 s).
16. Press "105" on the DATA ENTRY numeric keypad, and then press the **ns** softkey. The top of the display should read "Waiting for pre-trigger..."

Figure 17-2. Numeric Display of Pre-trigger Measurement Result



17. Press "95" on the DATA ENTRY numeric keypad, and then press the **ns** softkey. The top of the display should read a measured result of 100 ±0.2 ns.

18. Move the cursor to the "Inhibit" field.

19. Press the **On** softkey. The top of the display should a measured result of 100 ±0.2 ns.

20. Move the cursor to the "inhibit input is" field.

21. Press the **Inhibit Below threshold** softkey. The top of the display should read "Measurement inhibited".

22. Disconnect the BNC cable from the rear-panel TI Detect output and the External Arm input.

HP-IB and Print

NOTE

Disconnect HP-IB interface cables that may be connected between the HP 5373A and an external controller before proceeding with the "HP-IB and Print" test.

1. Press Preset key.

2. Press Single/Repet key. the SINGLE LED should now be illuminated.

3. Press System key.

4. Press the **Talk Only** softkey.

5. Move the cursor to the "Print" field.

6. Press the **Display** softkey.

7. Connect an HP-IB cable from the HP 5373A rear-panel HP-IB Connector to an HP 2225A ThinkJet printer (or other similar HP-IB graphics printer).

8. Locate the row of switches on the rear panel of the printer. Set the switch that will enable the LISTEN ONLY mode for the printer (for the HP 2225A, set switch #2 up).

9. Connect the HP 2225A power cord to the primary power source, and set the power switch to ON.

10. Press HP 5373A Restart key.

11. Press Graphic key.

12. Press Print key. The printer should print a copy of the Graphic screen.

PERFORMANCE TEST PROCEDURES

Table 17-2 lists a summary of the complete performance tests and the specifications tested.

Table 17-2. Specifications Tested by Performance Tests

PAGE NO.	TEST DESCRIPTION	SPECIFICATIONS TESTED
17-3	Operation Verification	Overall HP 5373A Operation
17-19	CHANNEL A AND B TESTS	
	Frequency Range	125 mHz to 500 MHz
	Dynamic Range	45 mVp-p to 2 Vp-p
	Signal Operating Range	–2 Vdc to +2 Vdc
	Manual Trigger Accuracy	20 mV ±1% of setting
	Auto Trigger Tests	
	Frequency Range	1 kHz to 200 MHz
	Accuracy	±20% pk-pk amplitude
	Signal Op. Range	–2 Vdc to +2 Vdc
	Sensitivity	45 mVp-p with min pulse width
	Minimum Pulse Width	1 ns with 45 mVp-p amplitude
		1.5 ns with 45 mVp-p amp (Holdoff Arming)
17-37	EXTERNAL ARM TESTS	
	FRONT PANEL TESTS	
	Frequency Range	DC to 100 MHz
	Dynamic Range	140 mVp-p to 5 Vp-p
	Signal Operating Range	–5 Vdc to +5 Vdc
	Trigger Accuracy	±20 mV or ±10% of setting, whichever is greater
	Sensitivity	140 mVp-p with 5 ns pulse
	Minimum Pulse Width	5 ns with 140 mVp-p amplitude
	REAR PANEL TESTS	
	Frequency Range	DC to 100 MHz
	Dynamic Range	280 mVp-p to 5 Vp-p (DC to 20 MHz)
		280 mVp-p to 2.5 Vp-p (20 MHz to 100 MHz)
	Signal Operating Range	–5 Vdc to +5 Vdc
	Trigger Accuracy	±20 mV or ±10% of setting, whichever is greater
	Sensitivity	280 mVp-p with 5 ns pulse
	Minimum Pulse Width	5 ns with 280 mVp-p amplitude
17-48	CHANNEL C TESTS	
	Frequency Range	100 MHz to 2 GHz
	Dynamic Range:	
	100 MHz to 1.5 GHz	–25 dBm to 7 dBm
	>1.5 GHz to 2.0 GHz	–20 dBm to 7 dBm
	Sensitivity:	
	100 MHz to 1.5 GHz	–25 dBm
	>1.5 GHz to 2.0 GHz	–20 dBm
17-52	HP-IB Operation Verification Program	Overall HP-IB Operation

Equipment Preliminary Setup

NOTE

Standard input pod configuration for the HP 5373A is an HP 53702A Envelope Pod for Channel A and an HP 54002A 50 Ω BNC input pod for Channel B.

These Performance Test Procedures use only an HP 54002A pod (the standard HP 5373A Channel B pod) as the input pod for either channel being tested. If a second pod is available to you, you can remove the HP 53702A pod from the HP 5373A and insert the second HP 54002A pod in its place. This will save you the effort of moving a single HP 54002A pod from one channel to the other as you perform through the operation verification.

Input Pod Exchange Procedure

NOTE

When you move an Input Pod from one CHANNEL to the other, or when you install a different pod, be sure to refer to this procedure.

1. Set the STBY-ON power switch to STBY.
2. Disconnect any cable connected to the input of the 50 Ω input pod (HP 54002A).
3. Loosen the screw that locks the pod in place in the HP 5373A's front panel.
4. Remove the pod from the HP 5373A.
5. Install the pod in its new position and tighten the screw that locks it in place.
6. Connect your signal source cable to the pod's BNC input connector.
7. Set the STBY-ON power switch to ON.

   If only one pod is installed, the HP 5373A will display

   ```
   POD MISSING  A:[XXXXX]  B:[XXXXX]
   (Press any key to continue)
   ```

8. Press any key to continue.

HP 5373A PRELIMINARY SETUP

1. Connect a 4-foot BNC cable from the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT to the HP 5373A Channel A input pod.

2. Disconnect any HP-IB cables from the rear panel.

3. Before connecting the power cord and switching on the instrument, be sure the line voltage selector is properly set, the correct fuse is installed, and all safety precautions have been observed.

4. Connect the HP 5373A power cord to the primary power source, and set the STBY-ON power switch to ON. Verify the Power-Up Self Test routine, as follows:

5. After 3 seconds, the screen displays the words "Performing Self Test ..."

6. After a few more seconds, and if there are no error or failure messages, the Function screen is displayed. The CRT will display the message "Waiting for input signal..." if no input signal is present.

7. If the HP 5373A displays an ERROR or FAILURE message, refer to the troubleshooting procedures in chapter 5 of the HP 5373A Service Manual. This chapter contains specific information about diagnostic failures.

8. Press Instrument State key. If the write protection for any register 1 through 9 is ON, use the **`Off`** softkey to turn off the write protection.

TEST EQUIPMENT PRELIMINARY SETUP

1. Disconnect any HP-IB cables from the rear panels.

2. Connect the power cords to the primary power source, and allow at least twenty minutes warmup before using the instruments.

3. Set the power switch from STBY to ON.

4. If the display indicates that there are any errors, refer to the appropriate operating manual.

CHANNEL A AND B TESTS

Specifications Tested:

125 mHz to 500 MHz Frequency Range
45 mVp-p to 2 Vp-p Dynamic Range

–2 V to +2 V Signal Operating Range

20 mV ± 1% of setting Manual Trigger Accuracy

AUTO TRIGGER TESTS

1 kHz to 200 MHz Frequency Range
200 mVp-p to 2 Vp-p Dynamic Range
±20% of pk-pk amplitude Accuracy
–2 V to +2 V Signal Operating Range

45 mVp-p Sensitivity at minimum pulse width
1 ns Minimum Pulse Width at minimum amplitude
1.5 ns Min Pulse Width at minimum amplitude (Holdoff Arming)

Equipment:

HP 3325A Synthesizer/Function Generator
HP 8663A Synthesized Signal Generator

Description: The Channel A and B Tests consist of five separate test procedures, which verify the above specifications. The first test verifies both the frequency range and dynamic range. The second test verifies the signal operating range. The third test verifies the manual trigger accuracy. The fourth test verifies the auto trigger frequency range, dynamic range, accuracy, and signal operating range. The fifth test (optional) verifies both the sensitivity and minimum pulse width.

HP 5373A Configuration Setup

NOTE

This procedure sets the HP 5373A Function and Input menus to specific configurations which will be used in the Channel A and B Tests. The configurations are stored in memory using the Save key, and are then recalled from memory during the Performance Tests using the Recall key.

1. Press Preset key.

2. Move the cursor to the "meas" field.

3. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.
4. Move the cursor to the "Arming Mode" field.
5. Press the top softkey until **`Sample`** is highlighted.
6. Press the **`Interval Sampling`** softkey.
7. Move the cursor to the Sample Arm "intervals" field.
8. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.
9. Press Input key.
10. Move the cursor to the Channel A "Mode" field.
11. Press the **`Manual Trig`** softkey.
12. Move the cursor to the Channel B "Mode" field.
13. Press the **`Manual Trig`** softkey.
14. Press Single/Repet key. The SINGLE LED should now be illuminated.
15. Press Save key, and then enter "1" on the DATA ENTRY numeric keypad.
16. Press Function key.
17. Move the cursor to the "Channel" field.
18. Press the **`More`** softkey.
19. Press the **`B`** softkey.
20. Press Save key, and then enter "2" on the DATA ENTRY numeric keypad.
21. Press the **`More`** softkey until **`A&B`** is a menu selection option.
22. Press the **`A&B`** softkey.
23. Press Input key.
24. Move the cursor to the "Input Channels" field.

25. Press the **Common softkey.**
26. Press Save key, and then enter "3" on the DATA ENTRY numeric keypad.
27. Move the cursor to the Channel A "Level" field.
28. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.
29. Move the cursor to the Channel B "Level" field.
30. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.
31. Press Save key, and then enter "4" on the DATA ENTRY numeric keypad.
32. Press "–1" on the DATA ENTRY numeric keypad, and then press the Enter key.
33. Move the cursor to the Channel A "Level" field.
34. Press "–1" on the DATA ENTRY numeric keypad, and then press the Enter key.
35. Press Save key, and then enter "5" on the DATA ENTRY numeric keypad.
36. Press ".998" on the DATA ENTRY numeric keypad, and then press the Enter key.
37. Move the cursor to the Channel B "Level" field.
38. Press ".998" on the DATA ENTRY numeric keypad, and then press the Enter key.
39. Move the cursor to the "Input Channels" field.
40. Press the **Separate** softkey.
41. Move the cursor to the Channel A "Hysteresis" field.
42. Press the **Max** softkey.
43. Move the cursor to the Channel B "Hysteresis" field.
44. Press the **Max** softkey.

45. Press Function key.
46. Press the **More** softkey.
47. Press the **A** softkey.
48. Press Single/Repet key. The SINGLE LED should now be off.
49. Press Save key, and then enter "6" on the DATA ENTRY numeric keypad.
50. Press the **More** softkey.
51. Press the **B** softkey.
52. Press Save key, and then enter "7" on the DATA ENTRY numeric keypad.
53. Press Preset key.
54. Press the **More** softkey until **Peak Amplitude** is a menu selection option.
55. Press the **Peak Amplitude** softkey.
56. Press Single/Repet key. The SINGLE LED should now be illuminated.
57. Press Save key, and then enter "8" on the DATA ENTRY numeric keypad.
58. Move the cursor to the "Channel" field.
59. Press the **B** softkey.
60. Press Save key, and then enter "9" on the DATA ENTRY numeric keypad.

NOTE

The Function and Input menus for each configuration are presented on the following pages. All configurations are in the Single mode (SINGLE LED illuminated) except configurations 6 and 7, which are in the Repet mode.

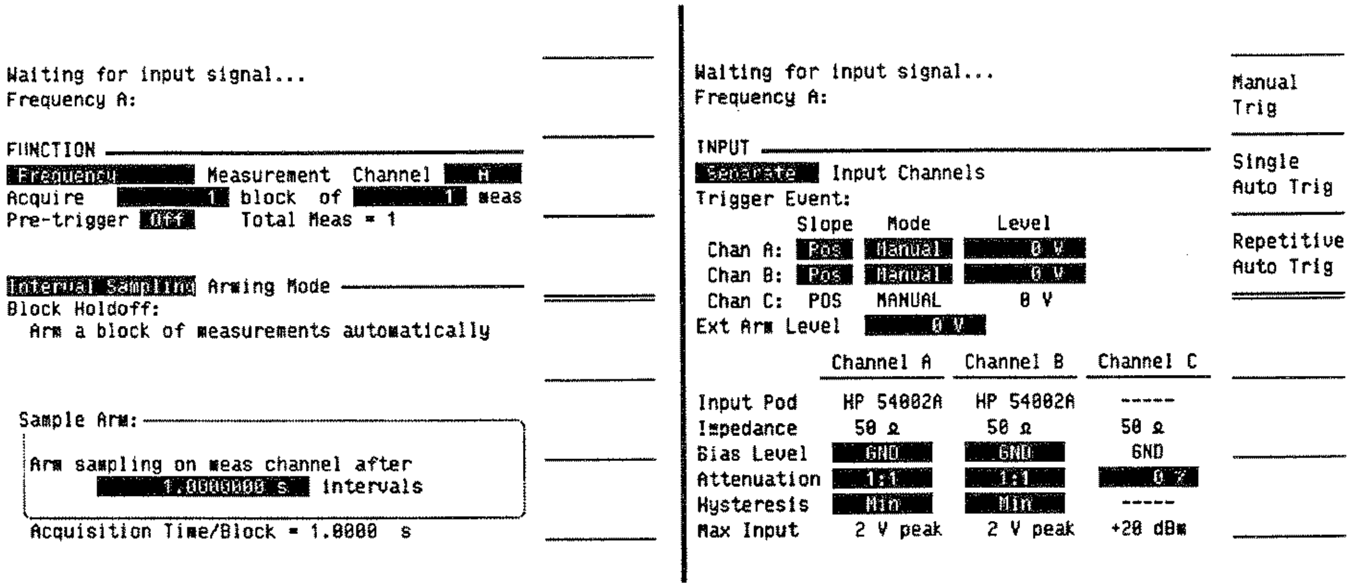


Figure 17-3. Channel A and B Configuration 1

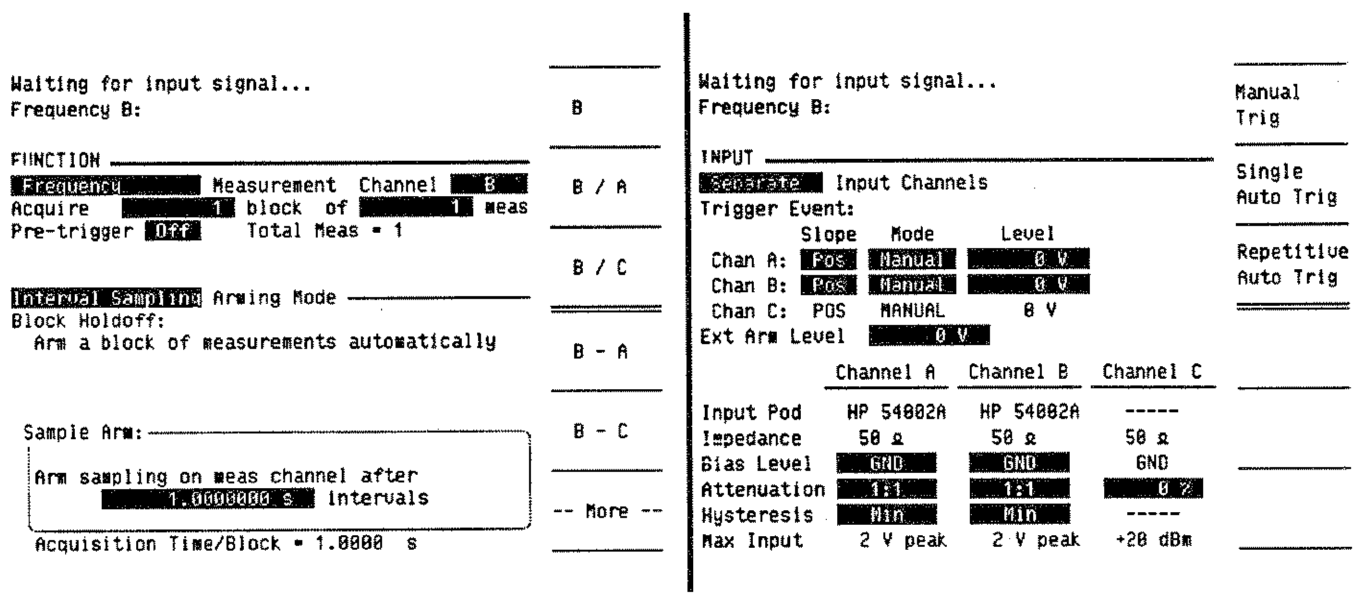


Figure 17-4. Channel A and B Configuration 2

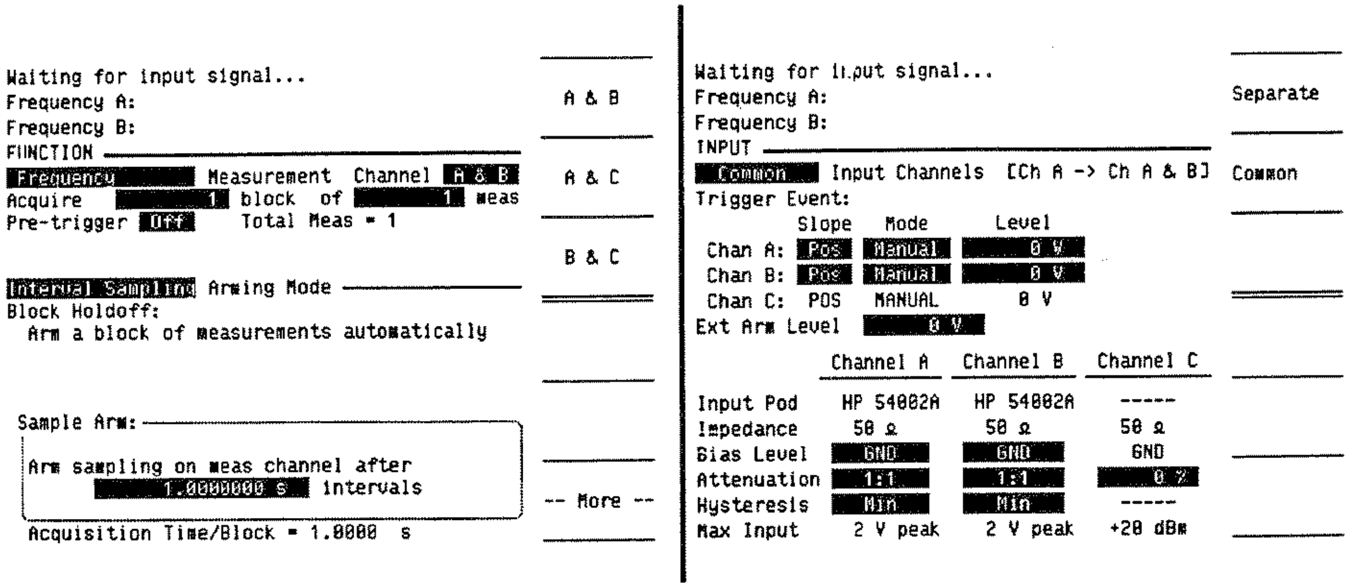


Figure 17-5. Channel A and B Configuration 3

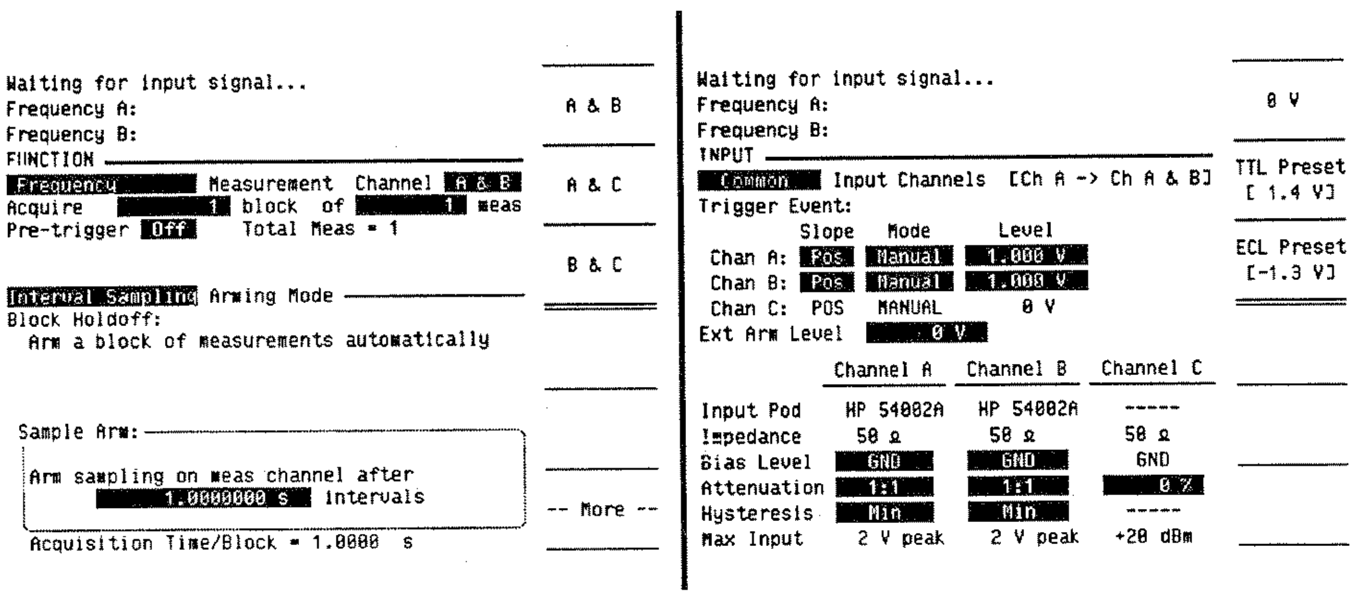


Figure 17-6. Channel A and B Configuration 4

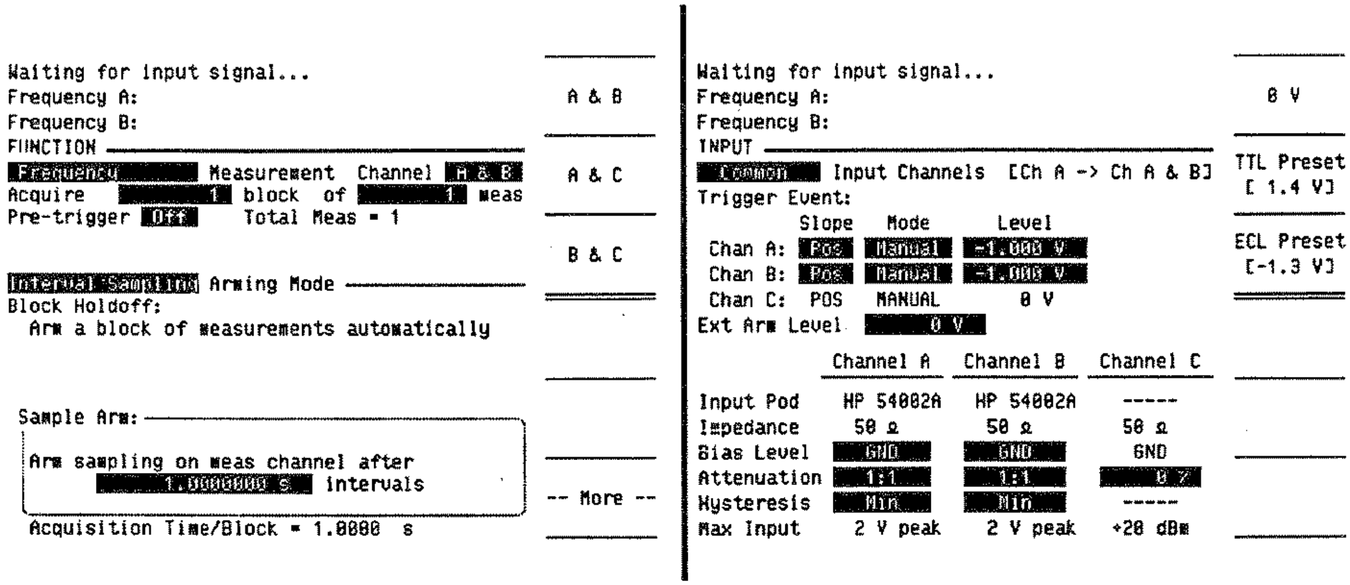


Figure 17-7. Channel A and B Configuration 5

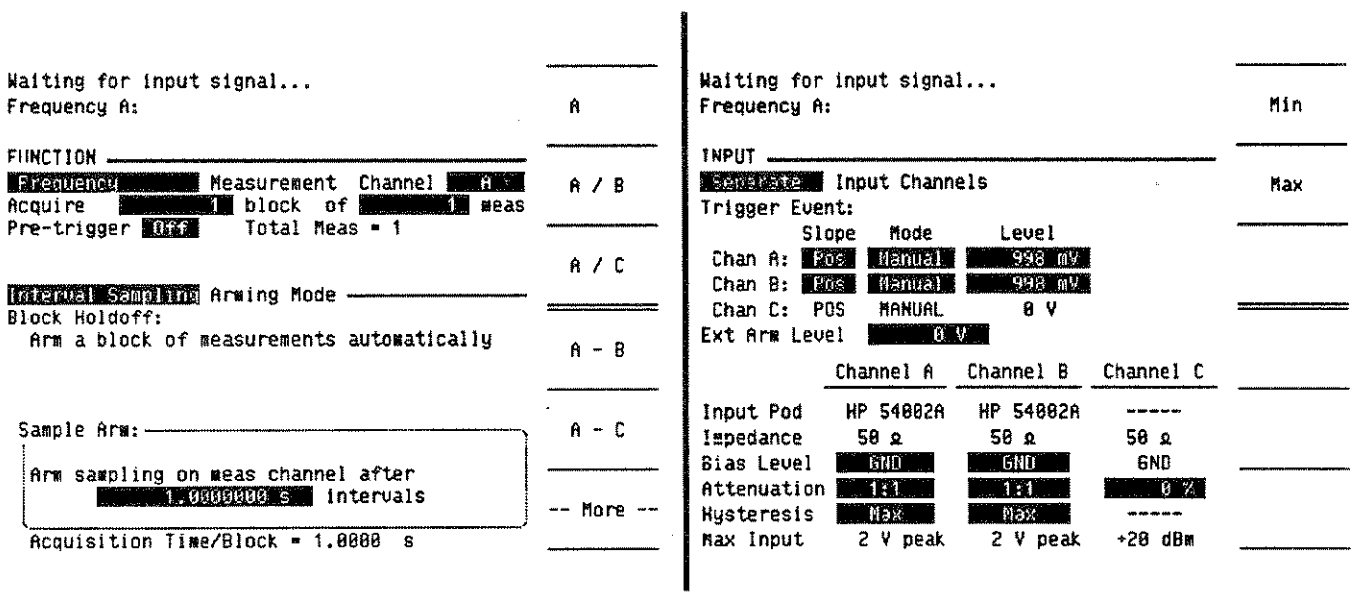


Figure 17-8. Channel A and B Configuration 6 (Repet mode)

```
Waiting for input signal...
Frequency B:

FUNCTION
Frequency    Measurement  Channel  B
Acquire          1  block  of      1  meas
Pre-trigger  Off      Total Meas = 1

Internal Sampling  Arming Mode
Block Holdoff:
  Arm a block of measurements automatically

 Sample Arm:
  Arm sampling on meas channel after
       1.0000000 s   intervals
 Acquisition Time/Block = 1.0000  s
```

```
B
B / A
B / C
B - A
B - C
-- More --
```

```
Waiting for input signal...
Frequency B:

INPUT
Separate  Input Channels
Trigger Event:
           Slope   Mode      Level
 Chan A:   Pos    Manual    998 mV
 Chan B:   Pos    Manual    998 mV
 Chan C:   POS    MANUAL      0 V
Ext Arm Level     0 V
                 Channel A   Channel B   Channel C
Input Pod        HP 54002A   HP 54002A   -----
Impedance          50 Ω        50 Ω        50 Ω
Bias Level         GND         GND         GND
Attenuation        1:1         1:1         0 %
Hysteresis         Max         Max         -----
Max Input        2 V peak    2 V peak    +20 dBm
```

```
Min
Max
```

Figure 17-9. Channel A and B Configuration 7 (Repet mode)

```
Max Amplitude A:                          2 mV
Min Amplitude A:                          2 mV
FUNCTION
Peak Amplitude  Measurement  Channel   A
Acquire          1  block  of        1  meas
Pre-trigger  Off      Total Meas = 1

Automatic          Arming Mode
Block Holdoff:
  Arm a block of measurements automatically

 Sample Arm:
 Arm sampling on meas channel automatically
```

```
Duty Cycle
Phase
Phase Deviation
Time Deviation
Peak Amplitude
-- More --
```

```
Max Amplitude A:                              2 mV
Min Amplitude A:                              2 mV
INPUT
Separate  Input Channels
Trigger Event:
           Slope   Mode       Level
 Chan A:   Pos    Sgl Auto    50 %  =    2 mV
 Chan B:   Pos    Sgl Auto    50 %  =    0 V
 Chan C:   POS    MANUAL       0 V
Ext Arm Level      0 V
                 Channel A   Channel B   Channel C
Input Pod        HP 54002A   HP 54002A   -----
Impedance          50 Ω        50 Ω        50 Ω
Bias Level         GND         GND         GND
Attenuation        1:1         1:1         0 %
Hysteresis         Min         Min         -----
Max Input        2 V peak    2 V peak    +20 dBm
```

```
Separate
Common
```

Figure 17-10. Channel A and B Configuration 8

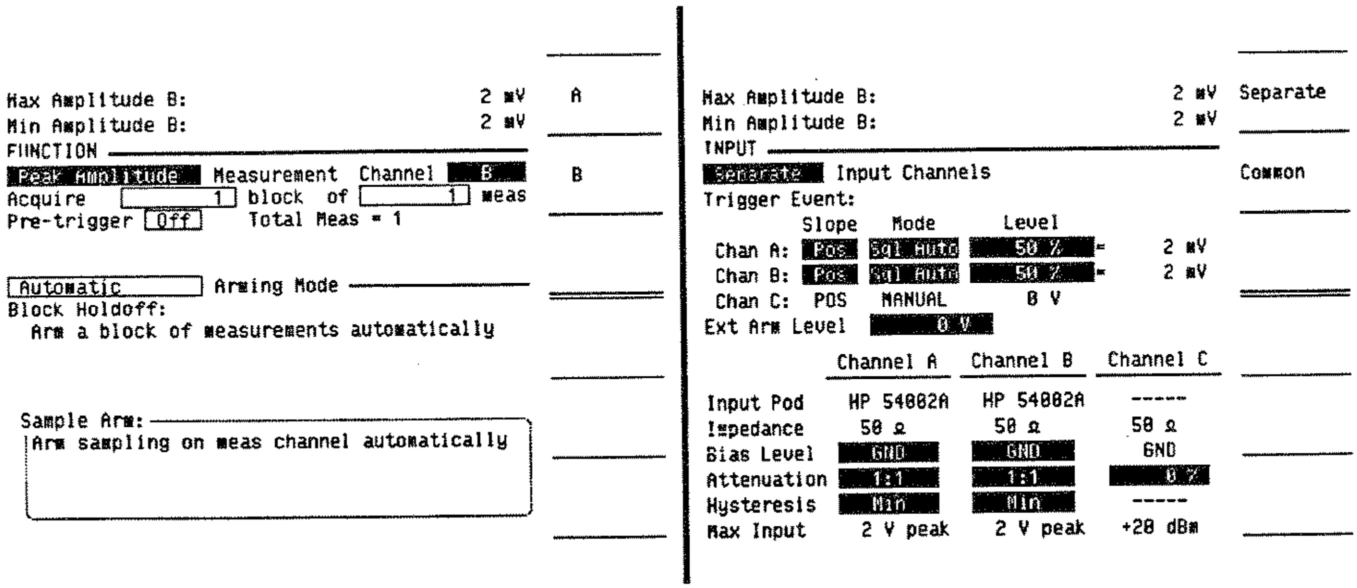


Figure 17-11. Channel A and B Configuration 9

Channel A and B Frequency and Dynamic Ranges Test

Specifications Tested: 125 mHz to 500 MHz
45 mVp-p to 2 Vp-p

HP 3325A SETUP

1. Press the FREQ key, enter ".125", and press Hz key.
2. Press the AMPTD key, enter "45", and press mV key.
3. Press the DC OFFSET key, enter "0", and press mV key.
4. Select the sine wave (20 MHz) function.
5. Connect a BNC cable from the SIGNAL output to the HP 5373A Channel A input pod.
6. Connect a BNC cable from the rear-panel EXT REF IN to the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT (the HP 3325A front-panel EXT REF LED should be illuminated).

HP 8663A SETUP

1. Press the FREQUENCY key, enter "500", and press MHz key.
2. Press the AMPLITUDE key, enter "15", and press mV key.
3. Attach a N(m)-to-BNC(f) adapter (HP # 1250-0780) to the RF OUTPUT connector.

FREQUENCY RANGE AND DYNAMIC RANGE TEST PROCEDURE

1. Press Recall key, and then enter "1" on the DATA ENTRY numeric keypad.

NOTE

The HP 5373A requires 8 seconds to perform each 0.125 Hz test.

2. After 8 seconds, the top of the HP 5373A CRT should display a result for Channel A. Enter this value on the Performance Test Record.
3. Press the HP 3325A AMPTD key, enter "2", and press VOLT key.
4. Press the HP 3325A square wave (10 MHz) function key.
5. Press HP 5373A Restart key.
6. After 8 seconds, the top of the HP 5373A CRT should display a result for Channel A. Enter this value on the Performance Test Record.
7. Remove the 50 Ω BNC input pod from its current CHANNEL location and install it as the CHANNEL B input. (See the Input Pod Exchange Procedure above.)
8. Press Recall key, and then enter "2" on the DATA ENTRY numeric keypad.
9. After 8 seconds, the top of the HP 5373A CRT should display a result for Channel B. Enter this value on the Performance Test Record.
10. Press the HP 3325A AMPTD key, enter "45", and press the mV key.

11. Select the sine wave (20 MHz) function.
12. Press the HP 5373A Restart key.
13. After 8 seconds, the top of the HP 5373A CRT should display a result for Channel B. Enter this value on the Performance Test Record.
14. Disconnect the BNC cable end from the HP 3325A SIGNAL output, and connect it to the HP 8663A RF OUTPUT.
15. Disconnect the BNC cable end from the HP 3325A rear-panel EXT REF IN, and connect it to the HP 8663A rear-panel time base input.
16. Remove the 50 Ω BNC input pod from its current CHANNEL location and install it as the CHANNEL A input. (See the Input Pod Exchange Procedure above.)
17. Press Numeric key.
18. Press Recall key, and then enter "3" on the DATA ENTRY numeric keypad.
19. The HP 5373A CRT should display results for both Channel A and B. Enter these values on the Performance Test Record.
20. Press the HP 8663A AMPLITUDE key, enter "10", and press +dBm key (The +10 dBm amplitude is equivalent to 2 Vp-p).
21. Press HP 5373A Restart key.
22. The HP 5373A CRT should display results for both Channel A and B. Enter these values on the Performance Test Record.

Channel A and B Signal Operating Range Test

Specification Tested:
–2 Vdc to +2 Vdc

HP 3325A SETUP

1. Press the FREQ key, enter "10", and press MHz key.

2. Press the AMPTD key, enter "2", and press VOLT key.
3. Press the DC OFFSET key, enter "1", and press VOLT key.
4. Select the sine wave (20 MHz) function key.
5. Connect a BNC cable from the SIGNAL output to the HP 5373A Channel A input pod.
6. Connect a BNC cable from the rear-panel EXT REF IN to the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT.

SIGNAL OPERATING RANGE TEST PROCEDURE

1. Press Recall key, and then enter "4" on the DATA ENTRY numeric keypad.
2. The HP 5373A CRT should display results for both Channel A and B. Enter these values on the Performance Test Record.
3. Press the HP 3325A DC OFFSET key, enter "–1", and press VOLT key.
4. Press Recall key, and then enter "5" on the DATA ENTRY numeric keypad.
5. The HP 5373A CRT should display results for both Channel A and B. Enter these values on the Performance Test Record.

Channel A and B Manual Trigger Accuracy Test

Specification Tested:
20 mV ±1% of setting

HP 3458A SETUP

1. Connect a Banana-to-BNC adapter to the 2-wire input.

HP 3325A SETUP

1. Press the FREQ key, enter "10", and press kHz key.
2. Press the AMPTD key, enter "1.0", and press VOLT key.
3. Connect a BNC T-Connector to the SIGNAL ouput.

4. Connect a BNC cable from one end of the BNC T-Connector to the HP 5373A Channel A input pod.

5. Connect a BNC cable from one end of the BNC T-Connector to the HP 3458A Multimeter.

6. Connect a BNC cable from the rear-panel EXT REF IN to the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT.

MANUAL TRIGGER ACCURACY TEST PROCEDURE

1. Press Recall key, and then enter "6" on the DATA ENTRY numeric keypad.

2. Press the HP 3325A DC OFFSET key, enter "998", and press mV key.

3. Press HP 5373A Math key.

4. Press the **Set Ch A Reference** softkey.

5. Move the cursor to the Channel A "Limits" field.

6. Press the **On** softkey.

7. Move the cursor to the Channel A "Low Limit" field.

8. Press "–100" on the DATA ENTRY numeric keypad, and then press the Enter key.

9. Move the cursor to the Channel A "High Limit" field.

10. Press "100" on the DATA ENTRY numeric keypad, and then press the Enter key.

11. Press the HP 3325A DC OFFSET key, enter "1.45", and then press VOLT key.

12. Press Numeric key.

13. Using the HP 3325A MODIFY keys, increase the DC OFFSET to the maximum level that allows all measurements to "Pass" the Limit test (The "Limit" test displays either "Pass", "High", or "Low", depending on whether the measurement was within the limits, greater than the high limit, or below the low limit, respectively). Begin the test by incrementing in 10 mV steps until the

"High" or "Low" limit is displayed. Then, decrease the DC OFFSET 10 mV, and finally increase in 1 mV steps to the maximum level that allows all measurements to "Pass". Record the DC OFFSET value, from the HP 3458A display, on the Performance Test Record.

14. Press the HP 3325A DC OFFSET key, enter "550", and press mV key.

15. Using the HP 3325A MODIFY keys, decrease the DC OFFSET to the minimum level that allows all measurements to "Pass" the Limit test. Begin the test by decrementing in 10 mV steps until the "High" or "Low" limit is displayed. Then, increase the DC OFFSET 10 mV, and finally decrease in 1 mV steps to the minimum level that allows all measurements to "Pass". Record the DC OFFSET value, from the HP 3458A display, on the Performance Test Record.

16. Calculate the average of the two recorded DC OFFSET values, and then subtract 998 mV (HP 5373A trigger level) from the average. Record this result on the Performance Test Record.

17. Remove the 50 Ω BNC input pod from its current CHANNEL location and install it as the CHANNEL B input. (See the Input Pod Exchange Procedure above.)

18. Press Recall key, and then enter "7" on the DATA ENTRY numeric keypad.

19. Repeat the above procedure for Channel B (Begin at Step 2).

20. Remove the 50 Ω BNC input pod from its current CHANNEL location and install it as the CHANNEL A input. (See the Input Pod Exchange Procedure above.)

Channel A and B Auto Trigger Tests

Specifications Tested:
1 kHz to 200 MHz Frequency Range
200 mVp-p to 2 Vp-p Dynamic Range
±20% of pk-pk amplitude Accuracy
–2 V to +2 V Signal Operating Range

HP 3325A SETUP

1. Press the FREQ key, enter "1", and press kHz key.
2. Press the DC OFFSET key, enter "0", and press mV key.
3. Press the AMPTD key, enter "200", and press mV key.
4. Connect a BNC cable from the SIGNAL output to the HP 5373A Channel A input pod.
5. Connect a BNC cable from the rear-panel EXT REF IN to the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT.

HP 8663A SETUP

1. Press the FREQUENCY key, enter "200", and press MHz key.
2. Press the AMPLITUDE key, enter "71", and press mV key.

AUTO TRIGGER TEST PROCEDURE

1. Press Recall key, and then enter "8" on the DATA ENTRY numeric keypad.
2. The HP 5373A CRT should display maximum and minimum results for Channel A. Enter these values on the Performance Test Record.
3. Press the HP 3325A AMPTD key, enter "2", and press VOLT key.
4. Press the HP 3325A DC OFFSET key, enter "1", and press VOLT key.
5. Press HP 5373A Restart key.
6. The HP 5373A CRT should display results for Channel A. Enter these values on the Performance Test Record.

7. Press the HP 3325A DC OFFSET key, enter "–1", and press VOLT key.

8. Press HP 5373A Restart key.

9. The HP 5373A CRT should display results for Channel A. Enter these values on the Performance Test Record.

10. Remove the 50 Ω BNC input pod from its current CHANNEL location and install it as the CHANNEL B input. (See the Input Pod Exchange Procedure above.)

11. Press Recall key, and then enter "9" on the DATA ENTRY numeric keypad.

12. The HP 5373A CRT should display results for Channel B. Enter these values on the Performance Test Record.

13. Press the HP 3325A DC OFFSET key, enter "1", and press VOLT key.

14. Press HP 5373A Restart key.

15. The HP 5373A CRT should display results for Channel B. Enter these values on the Performance Test Record.

16. Press the HP 3325A DC OFFSET key, enter "0", and press mV key.

17. Press the HP 3325A AMPTD key,enter "200", and press mV key.

18. The HP 5373A CRT should display maximum and minimum results for Channel B. Enter these values on the Performance Test Record.

19. Disconnect the BNC cable end from the HP 3325A SIGNAL output, and connect it to the HP 8663A RF OUTPUT.

20. Disconnect the BNC cable end from the HP 3325A rear-panel EXT REF IN, and connect it to the HP 8663A rear-panel time base input.

21. Press HP 5373A Restart key.

22. The HP 5373A CRT should display results for Channel B. Enter these values on the Performance Test Record.

23. Press the HP 8663A AMPLITUDE key, enter "10", and press +dBm key (The +10 dBm amplitude is equivalent to 2 Vp-p).

24. Press HP 5373A Restart key.

25. The HP 5373A CRT should display results for Channel B. Enter these values on the Performance Test Record.

26. Remove the 50 Ω BNC input pod from its current CHANNEL location and install it as the CHANNEL A input. (See the Input Pod Exchange Procedure above.)

27. Press Recall key, and then enter "8" on the DATA ENTRY numeric keypad.

28. The HP 5373A CRT should display results for Channel A. Enter these values on the Performance Test Record.

29. Press the HP 8663A Amplitude key, enter "71" and press mV key.

30. Press HP 5373A Restart key.

31. The HP 5373A CRT should display results for Channel A. Enter these values on the Performance Test Record.

Channel A and B Sensitivity and Minimum Pulse Width Test (optional)

NOTE

The Sensitivity and Minimum Pulse Width Test is an optional performance test. This test requires a 1 ns pulse generator, which is not required for other tests.

Specifications Tested:

45 mV p-p at minimum pulse width
1 ns at minimum amplitude
1.5 ns at minimum amp. (Holdoff Arm.)

HP 8131A SETUP

1. Press the AUTO/TRIG/GATE key, until the **AUTO** LED is ON.

2. Press the Channel 1 DOUB/DELAY key until both the **DELAY** LED and key LED are ON.

3. Use the vernier keys to input "0 ps".

4. Press the Channel 1 DCYC/WIDTH key until both the **DCYC** LED and key LED are ON.

5. Use the vernier keys to input "1%".

6. Press the Channel 1 DCYC/WIDTH key until both the **WIDTH** LED and key LED are ON.

7. Use the vernier keys to input "1.00 ns".

8. Press the Channel 1 AMPL/HIGH key until both the **AMPL** LED and key LED are ON.

9. Use the vernier keys to input ".45 V".

10. Press the Channel 1 OFFS/LOW key until both the **OFFS** LED and key LED are ON.

11. Use the vernier keys to input "0 V".

12. Press the COUNT/PERIOD key until both the **PERIOD** LED and key LED are ON.

13. Use the vernier keys to input "100 ns".

14. Enable the Channel A output by ensuring the DISABLE, LIMIT, and COMP LEDs are off.

15. Connect an SMA cable from the Channel 1 OUTPUT to the HP 8495D Attenuator (set at 0 dB attenuation).

16. Connect an SMA(m)-to-BNC(f) adapter to the HP 8495D output.

17. Connect a BNC cable from the HP 8495D to the HP 5373A Channel A input pod.

18. Connect an SMA(m)-to-BNC(f) adapter to the HP 8131A EXT INPUT.

19. Connect a BNC cable from the HP 8131A EXT INPUT to the HP 5373A FREQUENCY STANDARD OUTPUT.

20. Press the AUTO/TRIG/GATE key until the TRIG LED is ON.

21. Press the Positive Slope EXT INPUT key until the key LED is ON.

HP 5373A SETUP

1. Press Preset key.
2. Press the **±Time Interval** softkey.
3. Press Input key.
4. Press the **Common** softkey.
5. Move the cursor to the Channel A "Mode" field.
6. Press the **Manual Trig** softkey.
7. Move the cursor to the Channel B "Mode" field.
8. Press the **Manual Trig** softkey.
9. Press Single/Rept key. The SINGLE LED should now be illuminated.
10. Press Math key.
11. Press the **On** softkey (enables Channel A statistics).
12. Press Restart key.
13. Press the **Set Ch A Reference** softkey.
14. Press Input key.
15. Move the cursor to the Channel B "Slope" field.
16. Press the **Neg** softkey.

SENSITIVITY AND MINIMUM PULSE WIDTH TEST PROCEDURE

1. Set the HP 8495D to 20 dB attenuation.
2. Press HP 5373A Restart key.
3. The top of the HP 5373A CRT should display a ±Time Interval A→B result. Enter the absolute value of this result on the Performance Test Record.
4. Press the HP 8131A Channel 1 DCYC/WIDTH key until both the WIDTH LED and key LED are ON.

5. Use the vernier keys to input "1.50 ns".
6. Press Function key.
7. Move the cursor to the "Arming Mode" field.
8. Press the **`Edge Holdoff`** softkey.
9. Move the cursor to the Block Holdoff "edge" field.
10. Press the **`Neg`** softkey.
11. The top of the HP 5373A CRT should display a ±Time Interval A→B result. Enter the absolute value of this result on the Performance Test Record.

EXTERNAL ARM INPUT TESTS

HP 5373A Configuration Setup

NOTE

This procedure sets the HP 5373A Function and Input menus to specific configurations which will be used in the External Arm Input Tests. The configurations are stored in memory using the Save key, and are then recalled from memory during the Performance Tests using the Recall key.

1. Press Preset key.
2. Press the **`PRF/Frequency`** softkey.
3. Move the cursor to the "meas" field.
4. Press "2" on the DATA ENTRY numeric keypad, and then press the Enter key.
5. Move the cursor to the "Arming Mode" field.
6. Press the top softkey until **`Hld/Samp`** is highlighted.
7. Press the **`Edge/Edge`** softkey.
8. Move the cursor to the Block Holdoff "Channel" field.

9. Press the **Ext Arm** softkey.
10. Move the cursor to the Sample Arm "Channel" field.
11. Press the **Ext Arm** softkey.
12. Press Numeric key.
13. Press the **Expand** softkey until **On** is highlighted.
14. Press Single/Repet key. The SINGLE LED should now be illuminated.
15. Press Save key, and then enter "1" on the DATA ENTRY numeric keypad.
16. Press Input key.
17. Move the cursor to the Ext Arm "Level" field.
18. Press "2.5" on the DATA ENTRY numeric keypad, and then press the Enter key.
19. Press Save key, and then enter "2" on the DATA ENTRY numeric keypad.
20. Press "–2.5" on the DATA ENTRY numeric keypad, and then press the Enter key.
21. Press Save key, and then enter "3" on the DATA ENTRY numeric keypad.
22. Press "100" on the DATA ENTRY numeric keypad, and then press the **mV** softkey.
23. Press Function key.
24. Move the cursor to the "Arming Mode" field.
25. Press the top softkey until **Holdoff** is highlighted.
26. Press the **Edge Holdoff** softkey.
27. Press Save key, and then enter "4" on the DATA ENTRY numeric keypad.

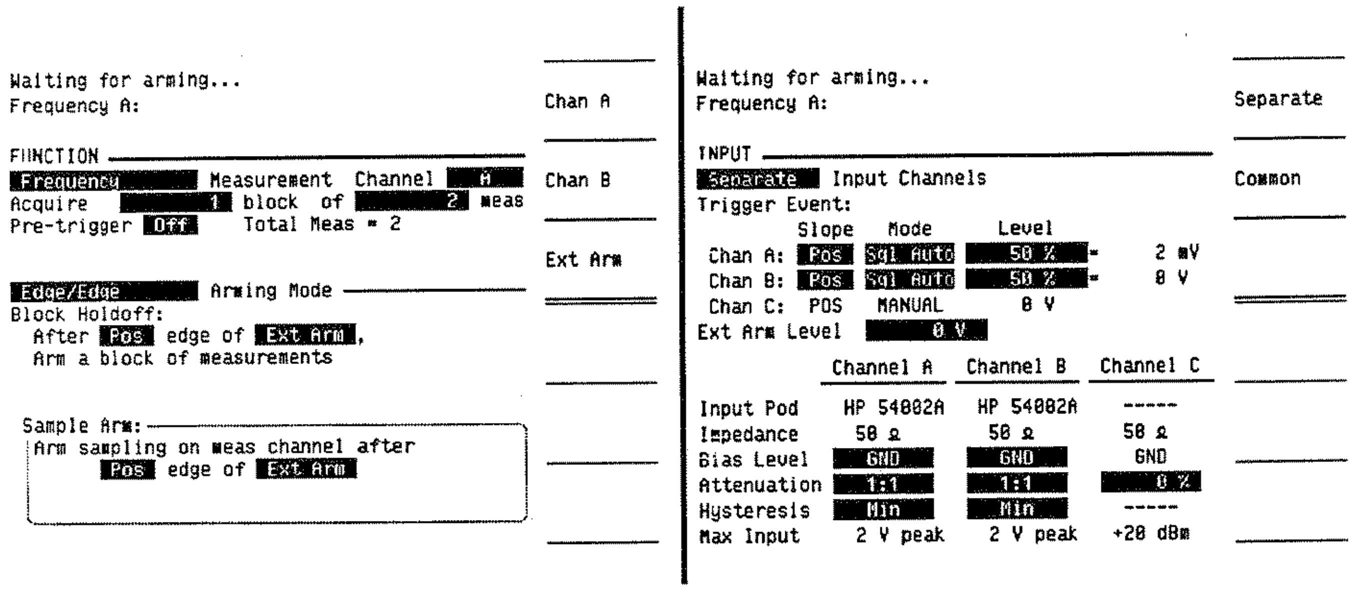


Figure 17-12. External Arm Input Configuration 1

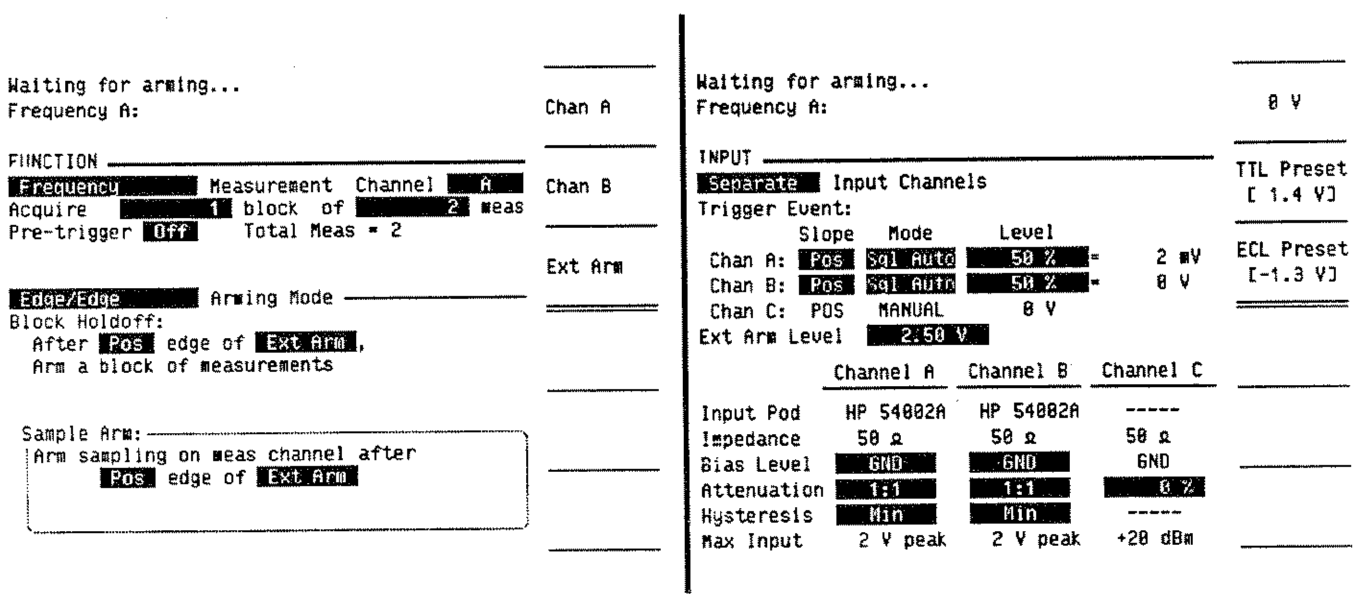


Figure 17-13. External Arm Input Configuration 2

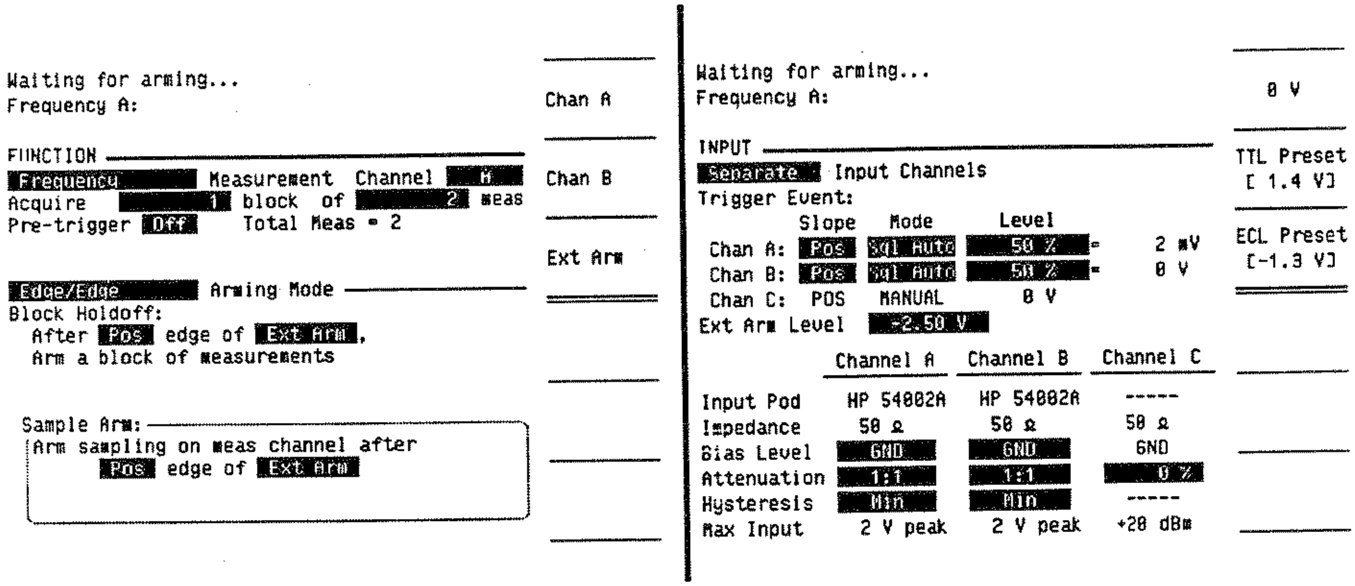


Figure 17-14. External Arm Input Configuration 3

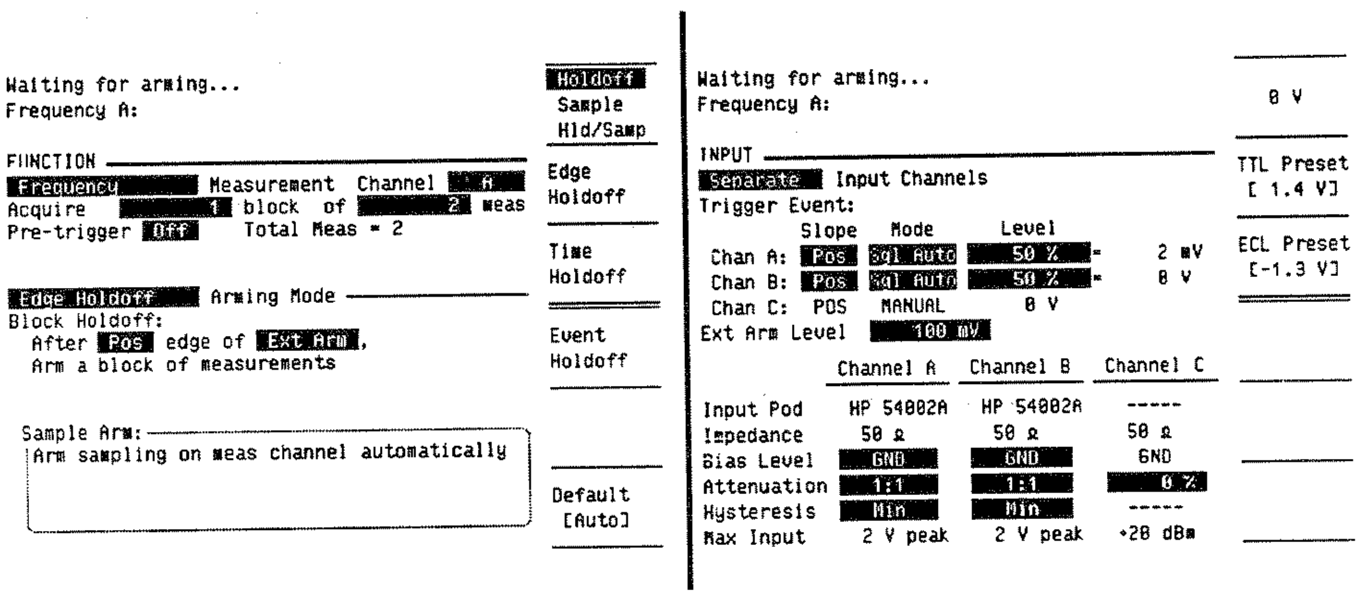


Figure 17-15. External Arm Input Configuration 4

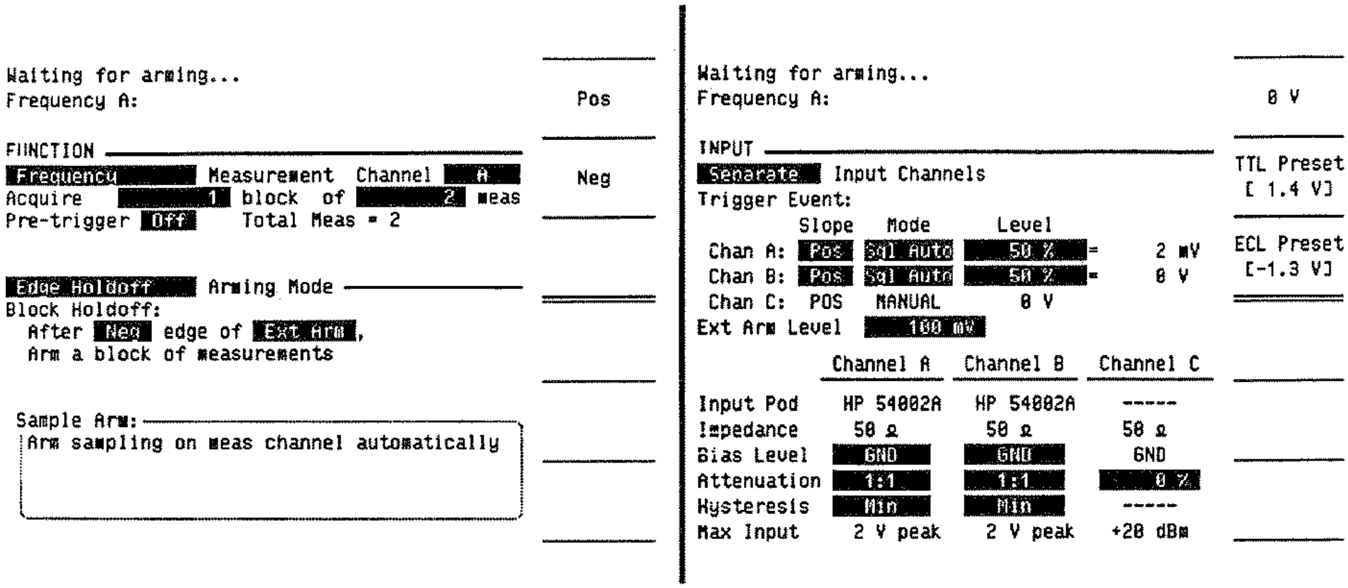


Figure 17-16. External Arm Input Configuration 5

28. Move the cursor to the Block Holdoff "edge" field.
29. Press the **Neg** softkey.
30. Press Save key, and then enter "5" on the DATA ENTRY numeric keypad.

NOTE

The Function and Input menus for each configuration are presented on the following pages. All configurations are in the single mode (SINGLE LED illuminated).

NOTE

Rear-panel input for Channel A, B, C, or External Arm, is not available in the HP 5373A.

Front Panel External Arm Input Tests

Specifications Tested:

DC to 100 MHz Frequency Range
140 mV p-p to 5 Vp-p Dynamic Range

–5 V to +5 V Signal Operating Range

±20m V or ±10% of setting Trigger Accuracy

140 mV p-p Sensitivity at min pulse width
5 ns Minimum Pulse Width at min amplitude

Equipment:
HP 3325B Synthesizer/Function Generator
HP 8663A Synthesized Signal Generator
HP 8161A Pulse Generator

Description: The External Arm Input Tests consists of four separate test procedures, which verify the above specifications. The first test verifies both the frequency range and dyanamic range, the second test verifies the signal operating range, the third test verifies the trigger accuracy, and the fourth test verifies both the sensitivity and minimum pulse width.

External Arm Input Frequency and Dynamic Ranges Test

Specifications Tested:
DC to 100 MHz
140 mVp-p to 5 Vp-p

NOTE

The low frequency range (DC) specification is tested in the trigger accuracy test.

HP 5373A SETUP

1. Connect a 50 ohm feedthrough termination to the External Arm input.
2. Connect a BNC T-connector to the rear-panel FREQUENCY STANDARD OUTPUT.
3. Connect a BNC cable from one end of the T-connector to the Channel A input pod.

HP 3325A SETUP

1. Press the FREQ key, enter "1", and press Hz key.
2. Press the DC OFFSET key, enter "0", and press mV key.
3. Press the AMPTD key, enter "140", and press mV key.
4. Select the sine wave (20 MHz) function.
5. Connect a BNC cable from the SIGNAL output to the HP 5373A External Arm input.
6. Connect a BNC cable from the rear-panel EXT REF IN to the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT (the HP 3325A front-panel EXT REF LED should be illuminated).

HP 8663A SETUP

1. Press the FREQUENCY key, enter "100", and press MHz key.
2. Press the AMPLITUDE key, enter "50", and press mV key.
3. Attach a N(m)-to-BNC(f) adapter (HP # 1250-0780) to the RF OUTPUT connector.

FREQUENCY RANGE AND DYNAMIC RANGE TEST PROCEDURE

1. Press Recall key, and then enter "1" on the DATA ENTRY numeric keypad.
2. Press Numeric key.
3. Move the cursor to the "View Meas #" field.
4. Press "3" on the DATA ENTRY numeric keypad, and then press the Enter key.
5. The HP 5373A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.
6. Press the HP 3325A AMPTD key, enter "5", and press VOLT key.
7. Press the HP 3325A square wave (10 MHz) function key.
8. Press HP 5373A Restart key.
9. The HP 5373A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.
10. Disconnect the BNC cable end from the HP 3325A SIGNAL output, and connect it to the HP 8663A RF OUTPUT.
11. Disconnect the BNC cable end from the HP 3325A rear-panel EXT REF IN, and connect it to the HP 8663A rear-panel time base input.
12. Press Restart key.

13. The HP 5373A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.

External Arm Input Signal Operating Range Test

Specification Tested:
–5 Vdc to +5 Vdc

HP 3325A SETUP

1. Press the FREQ key, enter "10", and press MHz key.
2. Press the AMPTD key, enter "5", and press VOLT key.
3. Press the DC OFFSET key, enter "2.5", and press VOLT key.
4. Select the sine wave (20 MHz) function.
5. Connect a BNC cable from the SIGNAL output to the HP 5373A External Arm input.
6. Connect a BNC cable from the rear-panel EXT REF IN to the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT.

SIGNAL OPERATING RANGE TEST PROCEDURE

1. Press Recall key, and then enter "2" on the DATA ENTRY numeric keypad.
2. The HP 5373A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.
3. Press the HP 3325A DC OFFSET key, enter "–2.5", and press VOLT key.
4. Press Recall key, and then enter "3" on the DATA ENTRY numeric keypad.
5. The HP 5373A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.

External Arm Input Trigger Accuracy Test

Specifications Tested:
±20 mV or 10% of setting, whichever is greater.

NOTE

This test also verifies the low frequency range (DC) specification.

HP 3458A SETUP

1. Connect a Banana-to-BNC adapter to the 2 wire input.

HP 3325A SETUP

1. Press the sine wave (20 MHz) function (enables the DC only mode).
2. Press the DC OFFSET key, enter "80, and press mV key.
3. Connect a BNC T-connector to the SIGNAL output.
4. Connect a BNC cable from one end of the T-connector to the HP 5373A External Arm input.
5. Connect a BNC cable from one end of the T-connector to the HP 3458A Multimeter.
6. Connect a BNC cable from the rear-panel EXT REF IN to the HP 5373A rear-panel FREQUENCY STANDARD OUTPUT.

TRIGGER ACCURACY TEST PROCEDURE

1. Press Recall key, and then enter "4" on the DATA ENTRY numeric keypad.
2. Using the HP 3325A MODIFY keys, increase the DC OFFSET in 1 mV increments until the GATE LED goes off. Record the DC OFFSET value, from the HP 3458A dispaly, on the Performance Test Record.
3. Press the HP 3325A DC OFFSET key, enter "120", and press mV key.
4. Press Recall key, and then enter "5" on the DATA ENTRY numeric keypad.
5. Using the HP 3325A MODIFY keys, decrease the DC OFFSET in 1 mV increments until the GATE LED goes off.

Record the DC OFFSET value, from the HP 3458A display, on the Performance Test Record.

6. Calculate the average of the two recorded DC OFFSET values, and then subtract 100 mV (HP 5373A Ext Arm trigger level) from the average. Record this result on the Performance Test Record.

External Arm Input Sensitivity and Minimum Pulse Width Test

Specifications Tested:
140 mVp-p at minimum amplitude
5 ns at minimum amplitude

HP 8161A SETUP

1. Press the PERIOD key, enter "200" on the CHANNEL/DATA keys, and then press ns key.
2. Press the DELAY key, press CHANNEL A key, enter "0" on the CHANNEL/DATA keys, and then press ns key.
3. Press the WIDTH key, press CHANNEL A key, enter "5" on the CHANNEL/DATA keys, and then press ns key.
4. Press the LEE key, press CHANNEL A key, enter "1.3" on the CHANNEL/DATA keys, and then press ns key.
5. Press the TRE key, press CHANNEL A key, enter "1.3" on the CHANNEL/DATA keys, and then press ns key.
6. Press the HIL key, press CHANNEL A key, enter ".07" on the CHANNEL/DATA keys, and then press V key.
7. Press the LOL key, press CHANNEL A key, enter "–.07" on the CHANNEL/DATA keys, and then press V key.
8. Enable the Channel A output by ensuring the DISABLE LED is off.
9. Connect a BNC cable from OUTPUT A to the HP 5373A External Arm Input.

SENSITIVITY AND MINIMUM PULSE WIDTH TEST PROCEDURE

1. Press Recall key, and then enter "1" on the DATA ENTRY numeric keypad.

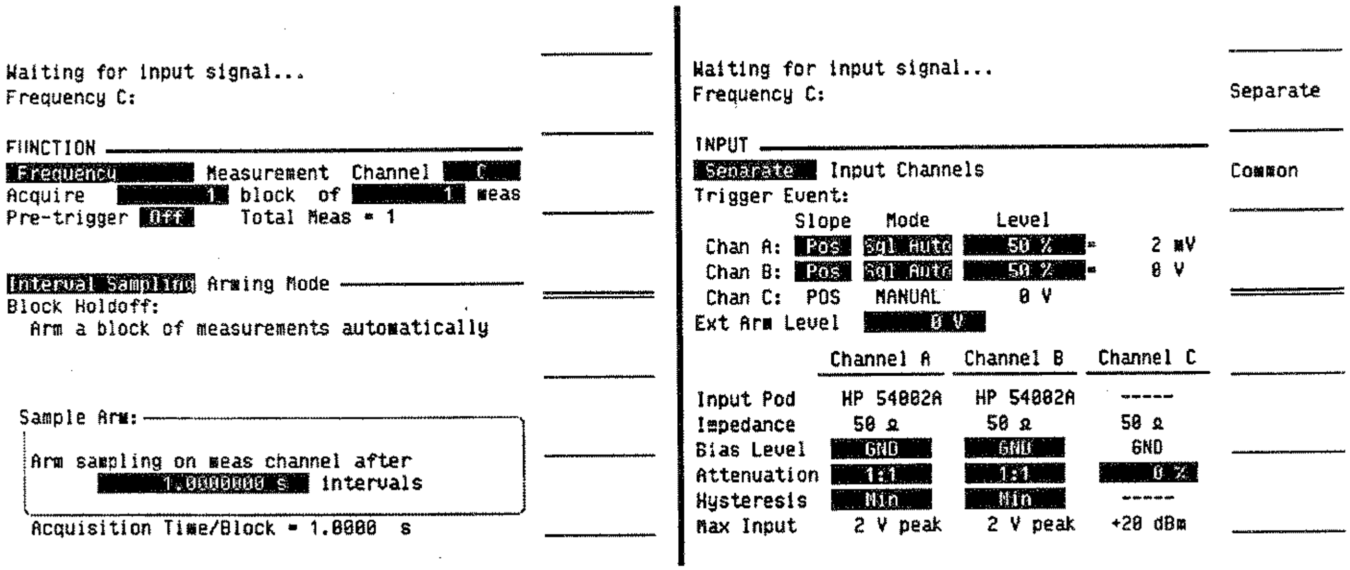


Figure 17-17. Channel C Configuration

2. The HP 5373A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.

CHANNEL C TESTS

Specifications Tested:
100 MHz to 2.0 GHz Frequency Range
–25 dBm to 7 dBm Dynamic Range
–25 dBm Sensitivity

Equipment:
HP 8663A Synthesized Signal Generator
HP 436A Power Meter
HP 8481A Power Sensor
HP 11667A Power Splitter
2 HP 1250-1250 N(m)-to-SMA(f) Adapters
2 HP 1250-0778 N(m)-to-N(m) Adapters
SMC cable (Gore SN 56181)

Description: The Channel C Tests consists of one test procedure, which verifies the above specifications. This test procedure is for the option 030 2 GHz C-Channel.

NOTE
Perform the calibration procedures on the HP 436A.

HP 5373A Configuration Setup

1. Press Preset key.
2. Press **PRF/Frequency** softkey.
3. Move the cursor to the "Channel" field.

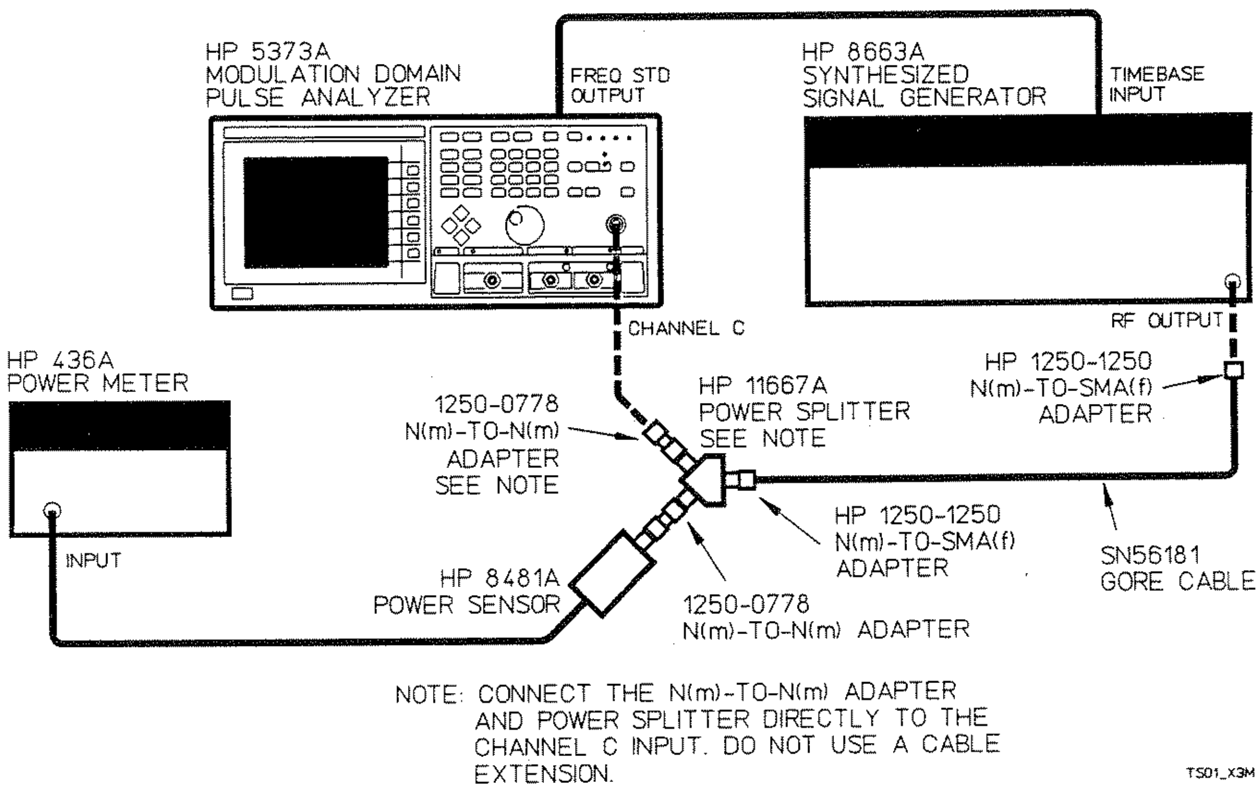


Figure 17-18. Channel C Test Setup

4. Press the **More** softkey until C is a menu selection option.
5. Press the **C** softkey.
6. Move the cursor to the "meas" field.
7. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.

8. Move the cursor to the "Arming Mode" field.

9. Press the top softkey until **`Sample`** is highlighted.

10. Press the **`Interval Sampling`** softkey.

11. Move the cursor to the Sample Arm "intervals" field.

12. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.

13. Press Single/Repet key. The SINGLE LED should now be illuminated.

Frequency Range/ Dynamic Range/ Sensitivity Test

HP 5373A SETUP

1. Set up the HP 5373A as shown in *Figure 17-18.*

HP 8663A SETUP

1. Press the FREQUENCY key, enter "100", and press MHz key.

2. Press the AMPLITUDE key, enter "25", and press -dBm key.

FREQUENCY RANGE/DYNAMIC RANGE/SENSITIVITY TEST PROCEDURE

1. Adjust the HP 8663A amplitude until the HP 436A display reads –25 dBm.

2. Press HP 5373A Numeric key.

3. Press HP 5373A Restart key.

4. The HP 5373A CRT should display a result for Channel C. Enter this value on the Performance Test Record.

5. Adjust the HP 8663A amplitude until the HP 436A display reads +7 dBm.

6. Press HP 5373A Restart key.

7. The HP 5373A CRT should display a result for Channel C. Enter this value on the Performance Test Record.

8. Recalibrate the HP 436A Power Meter with a calibration factor of 99%.

9. Press the HP 8663A FREQUENCY key, enter "1.5", and press GHz key.

10. Adjust the HP 8663A amplitude until the HP 436A display reads –25 dBm.

11. Press HP 5373A Restart key.

12. The HP 5373A CRT should display a result for Channel C. Enter this value on the Performance Test Record.

13. Adjust the HP 8663A amplitude until the HP 436A display reads +7 dBm.

14. Press HP 5373A Restart key.
15. The HP 5373A CRT should display a result for Channel C. Enter this value on the Performance Test Record.
16. Press the HP 8663A FREQUENCY key, enter "1.55", and press GHz key.
17. Adjust the HP 8663A amplitude until the HP 436A display reads –20 dBm.
18. Press HP 5373A Restart key.
19. The HP 5373A CRT should display a result for Channel C. Enter this value on the Performance Test Record.
20. Adjust the HP 8663A amplitude until the HP 436A display reads +7 dBm.
21. Press HP 5373A Restart key.
22. The HP 5373A CRT should display a result for Channel C. Enter this value on the Performance Test Record.
23. Recalibrate the HP 436A Power Meter with a calibration factor of 98%.
24. Press the HP 8663A FREQUENCY key, enter "2.0", and press GHz key.
25. Adjust the HP 8663A amplitude until the HP 436A display reads –20 dBm.
26. Press HP 5373A Restart key.
27. The HP 5373A CRT should display a result for Channel C. Enter this value on the Performance Test Record.
28. Adjust the HP 8663A amplitude until the HP 436A display reads +7 dBm.
29. Press HP 5373A Restart key.
30. The HP 5373A CRT should display a result for Channel C. Enter this value on the Performance Test Record.

THE HP 5373A PERFORMANCE TESTS ARE NOW COMPLETE.

Table 17-3. HP-IB Operation Verification Program

```
10  ! This program verifies the operation of the HP 5373A HP-IB
20  !
30  ! HP-IB OPERATIONAL VERIFICATION PROGRAM
40  ! Engineer Name: JWE
50  ! DATE:December 05, 1990
60  ! REVISION A.00.10
70  !
80  !---------------------------------------------------------------------
90  !                 VARIABLE DECLARATIONS
100 !---------------------------------------------------------------------
110   OPTION BASE 1
120   DIM Horiz_char$[1],Inst_id$[9],Pgm_title$[80]
130   DIM Title$[80],Prompt_line$[80]
140   DIM Destination$[7],Dummy$[1],Machine$[12],Serial_number$[40]
150   INTEGER Max_test,Max_options,Checkpoint,Isc,Inst_address,Print_address,New
_address,I
160   !-------------------------------------------------------------
170   !          VARIABLE ASSIGNMENTS
180   !-------------------------------------------------------------
190   Isc=7                        ! Select code of the HP-IB card (7 is usual)
200   Max_test=4                   ! Enter highest checkpoint you'll have (30 max)
210   Max_option=0                 ! Enter highest number of hardware options
220                                ! Enter "0" if no options
230   Inst_id$="5373A"             ! Enter the HP Model # of your instrument
240   Pgm_title$="HP-IB Operational Verification"
250                                ! Name of the program for Display/Print
260   Analyzer=(Isc*100)+3    ! Default addr of instrument under test (703)
270   Print_address=(Isc*100)+1  ! Default address of printer (701)
280   Horiz_char$="-"              ! Char used in title lines (Suggest using "-")
290 Initialize:!
300   OFF TIMEOUT
310   PRINTER IS CRT
320   !
330   Machine$=SYSTEM$("SYSTEM ID")
340   IF (SYSTEM$("SERIAL NUMBER")="111111111111" AND VAL(SYSTEM$("VERSION: BASI
C"))=5.1) THEN
350   ! Above line will detect if this is a BASIC Language Processor in a
360   ! MS-DOS PC. BASIC 5.0 with Serial # 111111111111 implies that the
370   ! function key mapping will be k0-k9, as in the classic 9836x machine.
380     Machine$="1111"
390   END IF
400   !
410   CONTROL KBD,1;0
420   CONTROL KBD,2;1              ! User 1 labels
430   GOSUB Clean_screen           ! Clear screen + home cursor
440   GRAPHICS OFF
450   ALPHA ON
460   CONTROL CRT,12;1 ! Key labels off
470   RESET Isc
480   !-----------------------------------------------------------------
490   !          Automatically set up needed arrays
500   !-----------------------------------------------------------------
510   ALLOCATE Test_name$(Max_test)[33]
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
520    ALLOCATE Test_type$(Max_test)[3]
530    ALLOCATE Test_results$(Max_test)[30]
540    !
550    ! Initialize test results array to "Not Performed"
560    !
570    FOR I=1 TO Max_test
580      Test_results$(I)="Not Performed"
590      Test_type$(I)="000"              ! Set to standard instrument test
600    NEXT I
610    !
620    Test_name$(1)="Self Test"
630    Test_name$(2)="Bus Integrity"
640    Test_name$(3)="Status Registers"
650    Test_name$(4)="Data Transfer"
660 Program_start:!
670    ON ERROR GOTO Error_exit
680    GOSUB Clean_screen
690    Title$="Serial Number of Instrument"
700    GOSUB Sub_title
710    GOSUB Horiz_line
720    PRINT
730    PRINT "Enter serial number of instrument under test, using the format 1234
A56789."
740    INPUT "Serial Number: ",Serial_number$
750    IF LEN(TRIM$(Serial_number$))<>10 THEN GOTO Program_start
760    Serial_number$=UPC$(TRIM$(Serial_number$[1,10]))
770    !
780    IF Max_option=0 THEN GOTO Set_address        ! No options available
790    GOSUB Clean_screen
800    Title$="Options Installed"
810    GOSUB Sub_title
820    GOSUB Horiz_line
830    PRINT
840    PRINT "Select each option from the table below. When finished, select ""X"
".".
850    PRINT
860 Option_menu:  !
870    FOR I=1 TO Max_option
880      IF Option_num$(1,I)<>"    " THEN
890        PRINT VAL$(I);" - ";Option_num$(1,I);" ";Option_name$(I)
900      END IF
910    NEXT I
920    PRINT
930    PRINT "X - Finished with selections."
940    PRINT
950    !
960    PRINT "Selected option(s): ";
970    LOOP
980 Try_again:  !
990      INPUT "Number or ""X"" ",A$
1000   EXIT IF UPC$(A$)="X"
1010     IF (NUM(A$)<48 OR NUM(A$)>57) THEN GOTO Try_again
1020     IF (1>VAL(A$) OR VAL(A$)>Max_option) THEN GOTO Try_again
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
1030    PRINT Option_num$(1,VAL(A$));" ";
1040    Option_num$(2,VAL(A$))="Y"
1050  END LOOP
1060  PRINT
1070  !
1080  FOR I=1 TO Max_option
1090    IF Option_num$(2,I)="Y" THEN GOTO Skip1
1100    FOR J=1 TO Max_test
1110      IF Test_type$(J)=Option_num$(1,I) THEN
1120        Test_results$(J)="Skip, Option "&Option_num$(1,I)&" not selected"
1130        Test_name$(J)=Test_results$(J)
1140      END IF
1150    NEXT J
1160 Skip1: !
1170  NEXT I
1180 Set_address: !
1190  GOSUB Clean_screen
1200  Title$="Setting the HP-IB Address of the "&Inst_id$
1210  GOSUB Sub_title
1220  GOSUB Horiz_line
1230  Destination$="counter"
1240  Inst_address=703
1250  PRINT "The instrument HP-IB address is assumed to be ";VAL$(Inst_address);
". Would you like to change it?"
1260  SELECT Machine$
1270  CASE "9836A","9836C"
1280    ON KEY 0 LABEL "YES" GOTO Change_address
1290    ON KEY 5 LABEL "   " GOTO Change_address
1300    ON KEY 4 LABEL " NO" GOTO Set_up_printer
1310    ON KEY 9 LABEL "   " GOTO Set_up_printer
1320  CASE ELSE
1330    ON KEY 1 LABEL "   YES   " GOTO Change_address
1340    ON KEY 8 LABEL "   NO    " GOTO Set_up_printer
1350  END SELECT
1360  GOTO Wait_for_key
1370!*********************************************************
1380 Set_up_printer:!
1390  Destination$="printer"
1400  GOSUB Clean_screen
1410  Title$="Selecting a Printer"
1420  GOSUB Sub_title
1430  GOSUB Horiz_line
1440  PRINT "Do you have a printer attached to the HP-IB?"
1450  SELECT Machine$
1460  CASE "9836A","9836C"
1470    ON KEY 0 LABEL "YES" GOTO Find_printer
1480    ON KEY 5 LABEL "   " GOTO Find_printer
1490    ON KEY 4 LABEL " NO" GOTO Use_the_crt
1500    ON KEY 9 LABEL "   " GOTO Use_the_crt
1510  CASE ELSE
1520    ON KEY 1 LABEL "   YES   " GOTO Find_printer
1530    ON KEY 8 LABEL "   NO    " GOTO Use_the_crt
1540  END SELECT
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
1550  GOTO Wait_for_key
1560 Use_the_crt: !
1570  Print_address=CRT
1580  GOTO Here_we_go
1590 Find_printer: !
1600  PRINT "The printer HP-IB address is assumed to be ";VAL$(Print_address);".
 Would you like to change it?"
1610  PRINT
1620  SELECT Machine$
1630  CASE "9836A","9836C"
1640    ON KEY 0 LABEL "   YES    " GOTO Change_address
1650    ON KEY 5 LABEL "          " GOTO Change_address
1660    ON KEY 4 LABEL "    NO    " GOTO Test_printer
1670    ON KEY 9 LABEL "          " GOTO Test_printer
1680  CASE ELSE
1690    ON KEY 1 LABEL "   YES  " GOTO Change_address
1700    ON KEY 8 LABEL "   NO   " GOTO Test_printer
1710  END SELECT
1720  GOTO Wait_for_key
1730  !**************************************************
1740 Change_address:! Change address of the device
1750  IF Destination$="printer" THEN
1760    PRINT "CAUTION! Do not set printer address the same as instrument addres
s ";VAL$(Inst_address);"!"
1770  END IF
1780  CONTROL CRT,12;1
1790  DISP "Enter the new address of the "&Destination$&", or 0 to restart progr
am. ";
1800  INPUT "",New_address
1810  IF New_address=0 THEN GOTO Program_start
1820  IF ((New_address>(Isc*100) AND New_address<(Isc*100+31) AND NOT New_addres
s=(Isc*100+21)) OR New_address=26) THEN
1830    SELECT Destination$
1840    CASE "counter"
1850      Inst_address=New_address
1860      GOTO Set_up_printer
1870    CASE "printer"
1880      IF (New_address<>Inst_address) THEN
1890        Print_address=New_address
1900        GOTO Test_printer
1910      ELSE
1920        DISP VAL$(New_address);" conflicts with the instrument address. Chan
ge printer address."
1930        BEEP 600,.3
1940        WAIT 2
1950        GOTO Change_address
1960      END IF
1970    END SELECT
1980  ELSE
1990    DISP VAL$(New_address);" is invalid. Try again."
2000    BEEP 600,.3
2010    WAIT 2
2020    GOTO Change_address
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
2030  END IF
2040  !*******************************************************************
2050 Test_printer:!
2060  ON ERROR GOTO No_print_respon
2070  ON TIMEOUT Isc,2 GOTO No_print_respon
2080  OUTPUT Print_address USING "#,K";" "      !Test for a response
2090  OFF TIMEOUT
2100  OFF ERROR
2110  GOTO Here_we_go
2120 No_print_respon:!
2130  DISP (Print_address);" not responding. Check that printer is on and proper
ly configured."
2140  BEEP 600,.3
2150  WAIT 3
2160  GOTO Change_address
2170  !******************************************************
2180 Here_we_go:    !
2190  GOSUB Clean_screen
2200  GOSUB Menu
2210  GOSUB Ready_start
2220  IF VAL(SYSTEM$("PRINTER IS"))=Print_address THEN GOTO Already_printed
2230  PRINT
2240  PRINT "Would you like a hardcopy of the checkpoint summary?"
2250  PRINT
2260  SELECT Machine$
2270  CASE "9836A","9836C"
2280    ON KEY 0 LABEL "    YES   " GOTO Print_menu
2290    ON KEY 5 LABEL "          " GOTO Print_menu
2300    ON KEY 4 LABEL "     NO   " GOTO Already_printed
2310    ON KEY 9 LABEL "          " GOTO Already_printed
2320  CASE ELSE
2330    ON KEY 1 LABEL "   YES   " GOTO Print_menu
2340    ON KEY 8 LABEL "   NO    " GOTO Already_printed
2350  END SELECT
2360  GOTO Wait_for_key
2370 Print_menu:!
2380  PRINTER IS Print_address
2390  GOSUB Menu
2400 Already_printed:!
2410  PRINTER IS CRT
2420  GOSUB Clean_screen
2430  Title$="MAKE THE CONNECTION"
2440  GOSUB Sub_title
2450  GOSUB Horiz_line
2460  PRINT
2470  PRINT
2480  PRINT "Connect the HP 5373A to an HP series 200/300 computer with BASIC lo
aded."
2490  PRINT
2500  PRINT "Install HP 54002A 50 ohm pod in CHANNEL A input. NOTE: you must als
o have a pod "
2510  PRINT "installed in CHANNEL B.   "
2520  PRINT
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
2530  PRINT "Connect rear-panel 10 MHz FREQUENCY STANDARD output to CHANNEL A in
put. "
2540  PRINT
2550  PRINT "Turn the HP 5373A power to ON. Wait until FUNCTION screen is displa
yed. "
2560  PRINT "NOTE: you may hve to press the FUNCTION hardkey in order to get a F
UNCTION "
2570  PRINT "screen displayed."
2580  GOSUB Ready_start
2590  GOTO First_check
2600  !*******************************************************************
2610  !     START OF CHECKPOINT TESTS
2620  !*******************************************************************
2630  !
2640 C1: ! Checkpoint 1 begins here
2650  Title$=Test_name$(Checkpoint)
2660  GOSUB Print_title
2670  ! The following commands will exercise the Self Tests portion of the unit.
2680  OUTPUT Analyzer;"CLE;PRES;MEAS;FUNC TINT"
2690  OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 1"""
2700  OUTPUT Analyzer;"DIAG;TEST,1"
2710  DISP "Performing Test 1."
2720  WAIT 10  !  WAIT FOR SELF-TEST TO COMPLETE
2730 Not_ready: !
2740  OUTPUT Analyzer;"TEST?"
2750  WAIT .2
2760  ENTER Analyzer;Result$
2770  IF Result$=" 0 [ ] No new test data" THEN GOTO Not_ready
2780  IF Result$=" 1 [P] Self Test PASSED" THEN
2790    GOSUB Print_2
2800    PRINT "TEST 1 FAILED, TEST ABORTED"
2810    PRINT "' 1 [P] Self Test PASSED' SHOULD BE RETURNED"
2820    PRINT "RESULT IS:  ";Result$
2830    GOTO Record_results
2840  END IF
2850  GOSUB Print_2
2860  PRINT "TEST 1 Self-Test Status : PASSED"
2870  OUTPUT Analyzer;"STOP;DSP,""TEST 1 PASSED"""
2880  GOTO Record_results
2890  ! End of C1
2900  !
2910 C2: !
2920  Title$=Test_name$(Checkpoint)
2930  GOSUB Print_title
2940  ! The following commands will exercise the Ability of the bus to send and
2950  ! receive data.
2960  DIM Send$[200]
2970  OUTPUT Analyzer;"CLE;PRES"
2980  OUTPUT Analyzer;"MEAS;FUNC FREQ"
2990  OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 2"""
3000 DISP "Performing Test 2."
3010  WAIT 2
3020  FOR Number=40 TO 127
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
3030     Send$="DSP,"&""""&CHR$(Number)&" TESTING"&""""&";DSP?"
3040     OUTPUT Analyzer;Send$
3050     WAIT .2
3060     ENTER 703;Result$
3070     IF Result$<>CHR$(Number)&" TESTING" THEN
3080       GOSUB Print_2
3090       PRINT "TEST 2 FAILED, TEST ABORTED"
3100       OUTPUT Analyzer;"DSP,""TEST 2 FAILED, TEST ABORTED"""
3110       PRINT "CHARACTER RETURNED IS ";Result$
3120       PRINT "SHOULD BE: ";CHR$(Number)
3130       GOTO Record_results
3140     END IF
3150   NEXT Number
3160   GOSUB Print_2
3170   PRINT "TEST 2 Bus Integrity    : PASSED"
3180   OUTPUT Analyzer;"DSP,""TEST 2 PASSED"""
3190   GOTO Record_results
3200   !
3210 C3: !
3220   Title$=Test_name$(Checkpoint)
3230   GOSUB Print_title
3240   ! The operation of the status registers is verified in these tests.
3250   INTEGER Value,Twopower
3260   OUTPUT Analyzer;"CLE;PRES;MEAS;FUNC,TINT"
3270   GOSUB Print_2
3280   DISP "Performing HP-IB Verification Test 3.1"
3290   OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 3.1"""
3300   FOR Value=0 TO 7
3310     Twopower=2^Value
3320     Send$="*ESE,"&VAL$(Twopower)&";*ESE?"
3330     OUTPUT Analyzer;Send$
3340     WAIT .2
3350     ENTER Analyzer;Result
3360     IF Twopower<>Result THEN
3370       GOSUB Print_2
3380       PRINT "FAILED TEST 3.1, TEST ABORTED"
3390       OUTPUT Analyzer;"DSP,""FAILED TEST 3.1, TEST ABORTED"
3400       PRINT "RETURNED VALUE OF EVENT STATUS REG IS:"
3410       PRINT Result
3420       PRINT "IT SHOULD BE:"
3430       PRINT Twopower
3440       GOTO Record_results
3450     END IF
3460   NEXT Value
3470   GOSUB Clean_screen
3480   GOSUB Print_2
3490   DISP "Performing HP-IB Verification Test 3.2"
3500   OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 3.2"""
3510   FOR Value=0 TO 9
3520     Twopower=2^Value
3530     Send$="*HSE,"&VAL$(Twopower)&";*HSE?"
3540     OUTPUT Analyzer;Send$
3550     WAIT .2
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
3560     ENTER Analyzer;Result
3570     IF Result<>Twopower THEN
3580       GOSUB Print_2
3590       PRINT "TEST 3.2 FAILED, TEST ABORTED"
3600       OUTPUT Analyzer;"DSP,""TEST 3.2 FAILED, TEST ABORTED"
3610       PRINT "RETURNED VALUE OF H.W. STATUS IS:"
3620       PRINT Result
3630       PRINT "IT SHOULD BE:"
3640       PRINT Twopower
3650       GOTO Record_result
3660     END IF
3670   NEXT Value
3680   GOSUB Clean_screen
3690   GOSUB Print_2
3700   DISP "Performing HP-IB Verification Test 3.3"
3710   OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 3.3"""
3720   OUTPUT Analyzer;"*HSR?"
3730   WAIT .2
3740   ENTER Analyzer;Result
3750   IF Result<>0 AND Result<>32 AND Result<>1024 AND Result<>1056 THEN
3760     GOSUB Print_2
3770     PRINT "TEST 3.3 FAILED, TEST ABORTED"
3780     OUTPUT Analyzer;"DSP,""TEST 3.3 FAILED, TEST ABORTED"""
3790     PRINT "H.W. STATUS REG SHOULD RETURN 0,32,1024, OR 1056.  IT IS: ";Resul
t
3800     GOTO Record_results
3810   END IF
3820   GOSUB Clean_screen
3830   GOSUB Print_2
3840   DISP "Performing HP-IB Verification Test 3.4"
3850   OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 3.4"""
3860   OUTPUT Analyzer;"*ESR?"
3870   WAIT .2
3880   ENTER Analyzer;Result
3890   IF Result<>128 AND Result<>64 AND Result<>0 THEN
3900     GOSUB Print_2
3910     PRINT "TEST 3.4 FAILED, TEST ABORTED"
3920     OUTPUT Analyzer;"DSP,""TEST 3.4 FAILED, TEST ABORTED"""
3930     PRINT "EVENT STATUS REG. SHOULD RETURN 128, 64 , or 0; IT IS: ";Result
3940     GOTO Record_results
3950   END IF
3960 Test_3_5:!
3970   GOSUB Clean_screen
3980   GOSUB Print_2
3990   DISP "Performing HP-IB Verification Test 3.5"
4000   OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 3.5"""
4010   OUTPUT Analyzer;"INT;MTV,1;INP;SOUR,A;TRIG,MAN;LEV,2"
4020   WAIT 3
4030   OUTPUT Analyzer;"*HSR?"
4040   WAIT .2
4050   ENTER Analyzer;Result
4060   IF Result<>256 AND Result<>1056 THEN
4070     GOSUB Print_2
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
4080    PRINT "TEST 3.5 FAILED, TEST ABORTED"
4090    OUTPUT Analyzer;"DSP,""TEST 3.5 FAILED, TEST ABORTED"
4100    PRINT "H.W. STATUS REG SHOULD RETURN 256 OR 1056, IT IS: ";Result
4110    GOTO Record_results
4120  END IF
4130  GOSUB Clean_screen
4140  GOSUB Print_2
4150  DISP "Performing HP-IB Verification Test 3.6"
4160  OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 3.6"""
4170  OUTPUT Analyzer;"LOC"
4180  OUTPUT Analyzer;"*ESR?"
4190  WAIT .2
4200  ENTER Analyzer;Result
4210  OUTPUT Analyzer;"CLE;PRES;MEAS;FUNC TINT"
4220  IF Result<>64 THEN
4230    GOSUB Print_2
4240    PRINT "TEST 3.6 FAILED, TEST ABORTED"
4250    OUTPUT Analyzer;"DSP,""TEST 3.6 FAILED, TEST ABORTED"""
4260    PRINT "EVENT STATUS REGISTER SHOULD RETURN 64, IT IS:";Result
4270    GOTO Record_results
4280  END IF
4290  GOSUB Clean_screen
4300  GOSUB Print_2
4310  PRINT "TEST 3 Status Registers : PASSED"
4320  OUTPUT Analyzer;"DSP,""TEST 3 PASSED"""
4330  GOTO Record_results
4340    !
4350 C4: !
4360  Title$=Test_name$(Checkpoint)
4370  GOSUB Print_title
4380  ! Tests the ability of the 5373A to transmit and receive data.
4390 DISP "Performing Test 4."
4400  OUTPUT Analyzer;"CLE;PRES"
4410  OUTPUT Analyzer;"MEAS;FUNC FREQ"
4420  OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION      TEST 4"""
4430  OUTPUT Analyzer;"NUM;PRINT,BOLD;MENU,NUM"
4440  OUTPUT Analyzer;"DSP,""HP-IB VERIFICATION     TEST 4"""
4450  OUTPUT Analyzer;"*TRG"
4460  ENTER Analyzer USING "#,K";Read_it
4470  IF Read_it<9.9E+6 OR Read_it>1.1E+7 THEN
4480    GOSUB Print_2
4490    PRINT "TEST 4 FAILED, TEST ABORTED"
4500    OUTPUT Analyzer;"DSP,""TEST 4 FAILED, TEST ABORTED"""
4510    PRINT "VALUE RETURNED IS ";Read_it
4520    GOTO Record_results
4530  END IF
4540  GOSUB Print_2
4550  PRINT "TEST 4 Data Transfer     : PASSED"
4560  WAIT 3
4570  OUTPUT Analyzer;"DSP,""TEST 4 PASSED"";LOC"
4580  GOTO Record_results
4590 !##############################################################
4600 !#    DO NOT CHANGE ANY OF THE CODE BELOW THIS POINT!!!         #
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
4610 !##############################################################
4620 First_check: ! Determines the first checkpoint to execute
4630  GOSUB Clean_screen
4640  GOSUB Menu
4650  PRINT "Press the softkey to select the desired test."
4660  PRINT
4670  SELECT Machine$
4680  CASE "9836A","9836C"
4690    PRINT "FIRST  - Press K0 to start testing at test #1, or"
4700    PRINT "GOTO # - Press K1 to select any test, or"
4710    PRINT "EXIT   - Press K4 to end the program."
4720    ON KEY 0 LABEL "   FIRST" GOTO First_test
4730    ON KEY 5 LABEL "        " GOTO First_test
4740    ON KEY 1 LABEL "  GOTO #" GOTO Test_entry
4750    ON KEY 6 LABEL "        " GOTO Test_entry
4760    ON KEY 4 LABEL "   EXIT" GOTO Exit_test
4770    ON KEY 9 LABEL "       " GOTO Exit_test
4780  CASE ELSE
4790    PRINT "FIRST  - Press K1 to start testing at test #1, or"
4800    PRINT "GOTO # - Press K4 to select any test, or"
4810    PRINT "EXIT   - Press K8 to end the program."
4820    ON KEY 1 LABEL " FIRST " GOTO First_test
4830    ON KEY 4 LABEL " GOTO #" GOTO Test_entry
4840    ON KEY 8 LABEL "  EXIT " GOTO Exit_test
4850  END SELECT
4860  ! Keys vertically adjacent to each other are active with label shown...
         this allows user to hit shifted or unshifted key.
4870  GOTO Wait_for_key
4880  !************************************************************
4890 Next_checkpt: ! Determine next checkpoint to be executed
4900  IF Checkpoint=Max_test+1 THEN RETURN
4910  GOSUB Clean_screen
4920  GOSUB Menu
4930  PRINT "Current test: ";Checkpoint;" ";Test_name$(Checkpoint)
4940  PRINT
4950  PRINT "Press the appropriate softkey to select the desired test..."
4960  PRINT
4970  SELECT Machine$
4980  CASE "9836A","9836C"
4990    PRINT "GOTO # - Press K1 to select an any test, or"
5000    PRINT "NEXT   - Press K2 to perform the next test, or"
5010    PRINT "REPEAT - Press K3 to repeat this test, or"
5020    PRINT "EXIT   - Press K4 to end the program."
5030    ON KEY 1 LABEL "  GOTO #" GOTO Test_entry
5040    ON KEY 6 LABEL "        " GOTO Test_entry
5050    ON KEY 2 LABEL "   NEXT " GOTO Next_test
5060    ON KEY 7 LABEL "        " GOTO Next_test
5070    ON KEY 3 LABEL "  REPEAT" GOTO Repeat_test
5080    ON KEY 8 LABEL "        " GOTO Repeat_test
5090    ON KEY 4 LABEL "   EXIT " GOTO Exit_test
5100    ON KEY 9 LABEL "        " GOTO Exit_test
5110  CASE ELSE
5120    PRINT "NEXT   - Press K2 to perform the next test, or"
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
5130     PRINT "GOTO # - Press K4 to select any test, or"
5140     PRINT "REPEAT - Press K5 to repeat this test, or"
5150     PRINT "EXIT   - Press K8 to end the program."
5160     ON KEY 2 LABEL "  NEXT " GOTO Next_test
5170     ON KEY 4 LABEL " GOTO #" GOTO Test_entry
5180     ON KEY 5 LABEL " REPEAT" GOTO Repeat_test
5190     ON KEY 8 LABEL "  EXIT " GOTO Exit_test
5200   END SELECT
5210   GOTO Wait_for_key
5220   !**************************************************
5230 Record_results: !
5240   BEEP 800,.02
5250   PRINT "Press the appropriate softkey to record the results of test ";VAL$(
Checkpoint);"."
5260   GOSUB Clear_keys
5270   SELECT Machine$
5280   CASE "9836A","9836C"
5290     ON KEY 0 LABEL "  PASS " GOTO Pass_test
5300     ON KEY 5 LABEL "       " GOTO Pass_test
5310     ON KEY 4 LABEL "  FAIL " GOTO Fail_test
5320     ON KEY 9 LABEL "       " GOTO Fail_test
5330   CASE ELSE
5340     ON KEY 1 LABEL "  PASS " GOTO Pass_test
5350     ON KEY 8 LABEL "  FAIL " GOTO Fail_test
5360   END SELECT
5370   GOTO Wait_for_key
5380 Too_long:  !
5390   PRINT "HP-IB TIMEOUT, TESTING ABORTED"
5400   PRINT "CHECK:"
5410   PRINT "      1.CABLES"
5420   PRINT "      2.OTHER INSTRUMENTS ON BUS"
5430   PRINT "      3.ADDRESS SETTINGS"
5440   PRINT "      4.CHECK HP-IB ISC =7   "
5450   PRINT "      5.HANDSHAKE SIGNALS WITH BUS ANALYZER"
5460   STOP
5470   !
5480   !
5490 Pass_test: !
5500   Test_results$(Checkpoint)="PASS"
5510   GOTO Next_checkpt
5520 Fail_test: !
5530   Test_results$(Checkpoint)="FAIL"
5540   GOTO Next_checkpt
5550   !*******************************************************
5560   ! THESE ARE CALLED TO BRANCH TO THE VARIOUS CHECKPOINTS
5570   !*******************************************************
5580 First_test: !
5590   GOSUB Labels_off
5600   Checkpoint=1
5610   GOTO Branch_checkpt
5620 Test_entry: !
5630   GOSUB Labels_off
5640   PRINT
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
5650  DISP "Enter a test number, 1 to "&VAL$(Max_test)&". ";
5660  INPUT "",Checkpoint
5670  IF (Checkpoint<1) OR (Checkpoint>Max_test) THEN GOTO Integer_error
5680  Checkpoint=Checkpoint
5690  GOTO Branch_checkpt
5700 Integer_error: !
5710  DISP "Please enter only integers from 1 through ";VAL$(Max_test);"."
5720  BEEP 400,.5
5730  WAIT 2
5740  GOTO Test_entry
5750 Exit_test: !
5760  Checkpoint=0
5770  GOTO Branch_checkpt
5780 Next_test: !
5790  GOSUB Labels_off
5800  Checkpoint=Checkpoint+1
5810  GOTO Branch_checkpt
5820 Repeat_test: !
5830  GOSUB Labels_off
5840  Checkpoint=Checkpoint
5850  GOTO Branch_checkpt
5860  !*******************************************************
5870 Branch_checkpt: !
5880  IF (Checkpoint=0 OR Checkpoint=Max_test+1) THEN GOTO Print_results
5890  ON Checkpoint GOTO C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15,C16,
C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30
5900  !*******************************************************
5910 Print_it: ! Enter here if printer attached
5920  GOSUB Clean_screen
5930  PRINTER IS Print_address
5940 Crt_print: ! Enter here if no printer attached
5950  GOSUB Clean_screen              ! Clear screen + home cursor
5960  Title$="CHECKPOINT RESULTS"
5970  GOSUB Sub_title
5980  PRINT "Device: ";Inst_id$;" at address ";VAL$(Inst_address)
5990  PRINT "Serial Number: ";Serial_number$;" Options installed: ";
6000  !
6010  IF Max_option>0 THEN
6020    FOR I=1 TO Max_option
6030      IF Option_num$(2,I)="Y" THEN
6040        PRINT Option_num$(1,I);" ";
6050      END IF
6060    NEXT I
6070  END IF
6080  PRINT
6090  !
6100  PRINT
6110  FOR I=1 TO Half_max_test
6120    PRINT "   ";VAL$(I);TAB(8);Test_results$(I);
6130    IF (2*I)<=Max_test THEN
6140      PRINT TAB(40);VAL$(I+Half_max_test);TAB(44);Test_results$(I+Half_max_t
est)
6150    ELSE
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
6160     PRINT
6170    END IF
6180  NEXT I
6190  PRINT
6200  IF Print_address<>CRT THEN OUTPUT Print_address;CHR$(12) ! Form feed
6210  PRINTER IS CRT
6220  LOCAL Isc
6230  GOTO Final_exit
6240  !******************************************************
6250 Final_exit: !
6260  DISP "HP-IB VERIFICATION DONE"
6270  GOTO Exit_opver
6280  !******************************************************
6290 Error_exit: !
6300  BEEP 500,.4
6310  PRINT ERRM$
6320  !******************************************************
6330 Exit_opver: !
6340  RESET Isc
6350  STOP        ! Mail program ends here
6360  !*************************************************************
6370  ! UTILITY SUBROUTINES SECTION
6380  !*************************************************************
6390 Clean_screen: !
6400  GOSUB Clear_keys
6410  OUTPUT KBD;CHR$(255)&"K";                  ! Clear screen + home cursor
6420  RETURN
6430  !*************************************************************
6440 Labels_off:CONTROL CRT,12;1
6450  RETURN
6460  !*************************************************************
6470 Key_trap: !
6480  DISP "Wrong key pressed. Try again.";CHR$(7)
6490  RETURN
6500  !****************************************************
6510 Wait_for_key: !
6520  CONTROL CRT,12;0             ! Turn Labels on
6530  DISP
6540 Loop:GOTO Loop
6550  !**********************************************************
6560 Ready_start: !
6570  BEEP 800,.03
6580  GOSUB Proceed_key
6590  RETURN
6600  !***********************************************
6610 Print_2: !
6620  PRINT
6630  PRINT
6640  RETURN
6650  !***********************************************
6660 Print_title: ! Display checkpoint title
6670  GOSUB Clean_screen
6680  PRINT
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
6690  Title$="Test "&VAL$(Checkpoint)&" "&(Test_name$(Checkpoint))
6700  GOSUB Sub_title
6710  GOSUB Horiz_line
6720  BEEP 800,.03
6730  PRINT "Press PROCEED to start the test."
6740  GOSUB Proceed_key
6750  GOSUB Clean_screen
6760  RETURN
6770  !**********************************************************
6780 Sub_title: !
6790  PRINT
6800  ! The following line provides for centering the title.
6810  PRINT TAB(INT((80-(LEN(TRIM$(Title$))))/2));Title$
6820  RETURN
6830  !***************************************************************
6840 Horiz_line: !
6850  PRINT RPT$(Horiz_char$,80)
6860  RETURN
6870  !****************************************************************
6880 Proceed_key: !
6890  GOSUB Clear_keys
6900  SELECT Machine$
6910  CASE "9836A","9836C"
6920    ON KEY 0 LABEL " PROCEED " GOTO Proceed
6930    ON KEY 5 LABEL "         " GOTO Proceed
6940  CASE ELSE
6950    ON KEY 1 LABEL "PROCEED " GOTO Proceed
6960  END SELECT
6970  GOTO Wait_for_key
6980 Proceed: !
6990  RETURN
7000  !****************************************************************
7010 Print_results: !
7020  PRINTER IS CRT
7030  GOSUB Clean_screen
7040  IF Print_address<>CRT THEN
7050    PRINT "Do you wish to have a hardcopy of the results?"
7060    PRINT
7070    PRINT "NOTE: Printer address assumed to be ";VAL$(Print_address);"."
7080    SELECT Machine$
7090    CASE "9836A","9836C"
7100      ON KEY 0 LABEL "    YES" GOTO Print_it
7110      ON KEY 5 LABEL "       " GOTO Print_it
7120      ON KEY 4 LABEL "     NO" GOTO Crt_print
7130      ON KEY 9 LABEL "       " GOTO Crt_print
7140    CASE ELSE
7150      ON KEY 1 LABEL "  YES" GOTO Print_it
7160      ON KEY 8 LABEL "   NO" GOTO Crt_print
7170    END SELECT
7180    GOTO Wait_for_key
7190  ELSE
7200    GOTO Crt_print
7210  END IF
```

Table 17-3. HP-IB Operation Verification Program (Continued)

```
7220  RETURN
7230  !************************************************************
7240 Clear_keys: !
7250  ON KEY 0 LABEL "            " GOSUB Key_trap
7260  ON KEY 1 LABEL "            " GOSUB Key_trap
7270  ON KEY 2 LABEL "            " GOSUB Key_trap
7280  ON KEY 3 LABEL "            " GOSUB Key_trap
7290  ON KEY 4 LABEL "            " GOSUB Key_trap
7300  ON KEY 5 LABEL "            " GOSUB Key_trap
7310  ON KEY 6 LABEL "            " GOSUB Key_trap
7320  ON KEY 7 LABEL "            " GOSUB Key_trap
7330  ON KEY 8 LABEL "            " GOSUB Key_trap
7340  ON KEY 9 LABEL "            " GOSUB Key_trap
7350  RETURN
7360  !************************************************************
7370 Menu: !
7380  GOSUB Clean_screen
7390  Title$=Pgm_title$
7400  GOSUB Sub_title
7410  PRINT "P-Passed, F-Failed, N-Not Performed, S-Skipped. Option not selected
"
7420  PRINT
7430  PRINT "Test";TAB(10);"Test";TAB(20);"Test"
7440  PRINT "Number";TAB(10);"Status";TAB(20);"Name"
7450  PRINT
7460  FOR I=1 TO Max_test
7470    PRINT VAL$(I);TAB(10);Test_results$(I)[1;1];TAB(20);Test_name$(I)
7480  NEXT I
7490  GOSUB Horiz_line
7500  RETURN
7510  !******************************************************
7520  END
```

HP-IB VERIFICATION PROGRAM

The HP-IB Operation Verification Program checks the HP 5373's ability to transmit and receive HP-IB messages. During this verification program, the analyzer's HP-IB data input/output bus, control, and handshake lines are checked. Only the HP 5373A, an HP Series 200 or 300 Computer, and applicable HP-IB interface cable are required for the test setup. The validity of the test results is based on the following assumptions:

- The HP 5373A operates correctly from the front panel. This can be verified by performing the "HP 5373A Operation Verification Tests" found earlier in this chapter.
- The controller being used can properly execute HP-IB commands.

The HP 5373A's device address (primary address) is 03 and may be changed from the front panel through the System menu. The address setting applies to both the Talk/Listen and Talk Only modes. For the HP Series 200 or 300 Computers the HP-IB interface select code is 7.

NOTE

The device address is retained in non-volatile memory. If the address is not recallable due to a battery or memory failure, a default value of 3 will be selected. The user can not alter the default address.

If all of the checks performed by the program listed in *Table 17-3* are successful, the HP 5373A's HP-IB capability can be considered to be performing properly. This program does not check to see if ALL of the analyzer's program commands are being properly interpreted and executed by the HP 5373A. However, if the front panel operation is confirmed to be working properly and its HP-IB capability operates correctly, then there is high probability that the analyzer will respond properly to all of its program commands.

After successful completion of the HP-IB Operation Verification Test presented in *Table 17-3*, mark **"PASS"** or **"FAIL"** on the "HP 5373A Performance Test Record" located at the end of this chapter.

THE HP 5373A HP-IB OPERATION VERIFICATION IS NOW COMPLETE.

HP 5373A PERFORMANCE TEST RECORD (Page 1 of 5)

HEWLETT-PACKARD MODEL 5373A
FREQUENCY AND TIME INTERVAL ANALYZER

Repair/Work Order No. ______________

Serial Number: ______________

Temperature: ______________

Test Performed By: ______________

Relative Humidity: ______________

Date: ______________

Post-Calibration Test: ☐

Pre-Calibration Test: ☐

Notes: ______________

Recommended Instrument	Test		Results Minimum	Actual	Maximum
	Operation Verification		Pass ______		Fail ______
	HP-IB Verification		Pass ______		Fail ______
	CHANNEL A AND B TESTS				
	Frequency Range/ Dynamic Range				
3325A	.125 Hz	Freq: Chan A	121.000 000 000 mHz	______	129.000 000 000 mHz
	45 mVp-p	Chan B	121.000 000 000 mHz	______	129.000 000 000 mHz
	0 V Offset				
3325A	.125 Hz	Freq: Chan A	124.930 000 000 mHz	______	125.070 000 000 mHz
	2 Vp-p	Chan B	124.930 000 000 mHz	______	125.070 000 000 mHz
	0 V Offset				
	(Square Wave)				
8663A	500 MHz	Freq: Chan A	499.999 999 90 MHz	______	500.000 000 10 MHz
	15 mVrms (45 mVp-p)	Chan B	499.999 999 90 MHz	______	500.000 000 10 MHz
	0 V Offset				
8663A	500 MHz	Freq: Chan A	499.999 999 90 MHz	______	500.000 000 10 MHz
	10 dBm (2 Vp-p)	Chan B	499.999 999 90 MHz	______	500.000 000 10 MHz
	0 V Offset				
	Signal Operating Range				
3325A	10 MHz	Freq: Chan A	9.999 999 800 MHz	______	10.000 000 200 MHz
	2 Vp-p	Chan B	9.999 999 800 MHz	______	10.000 000 200 MHz
	1 V Offset				
3325A	10 MHz	Freq: Chan A	9.999 999 800 MHz	______	10.000 000 200 MHz
	2 Vp-p	Chan B	9.999 999 800 MHz	______	10.000 000 200 MHz
	–1 V Offset				

HP 5373A PERFORMANCE TEST RECORD (Page 2 of 5)

HEWLETT-PACKARD MODEL 5373A
FREQUENCY AND TIME INTERVAL ANALYZER

Recommended Instrument	Test	Results Minimum	Actual	Maximum
	CHANNEL A AND B TESTS (Continued)			
	Manual Trigger Accuracy			
3325A	10 KHz 1 Vp-p Variable Offset — Chan A		Max. Trigger Level ______ Min. Trigger Level ______	
	Chan A Trigger Level Accuracy*	−29.98 mV	______	+29.98 mV
	Chan B		Max. Trigger Level ______ Min. Trigger Level ______	
	Chan B Trigger Level Accuracy*	−29.98 mV	______	+29.98 mV
	Auto Trigger Frequency Range/Dynamic Range/ Accuracy/Signal Operating Range			
3325A	1 KHz 200 mVp-p 0 V Offset — PkAmp Chan A			
	Max.	−14.44 dBm	______	−7.08 dBm
	Min.	−14.44 dBm	______	−7.08 dBm
	PkAmp Chan B			
	Max.	−14.44 dBm	______	−7.08 dBm
	Min.	−14.44 dBm	______	−7.08 dBm
3325A	1 KHz 2 Vp-p 1 V Offset — PkAmp Chan A			
	Max.	14.08 dBm	______	17.6 dBm
	Min.	−37.495 dBm	______	2.04 dBm
	PkAmp Chan B			
	Max.	14.08 dBm	______	17.6 dBm
	Min.	−37.495 dBm	______	2.04 dBm

$$\text{* TRIGGER LEVEL ACCURACY} = \left[\frac{\text{MAX. TRIGGER LEVEL} + \text{MIN. TRIGGER LEVEL}}{2}\right] - 998\text{mV}$$

HP 5373A PERFORMANCE TEST RECORD (Page 3 of 5)

HEWLETT-PACKARD MODEL 5373A
FREQUENCY AND TIME INTERVAL ANALYZER

Recommended Instrument	Test		Results: Minimum	Results: Actual	Results: Maximum
	CHANNEL A AND B TESTS (Continued)				
3325A	1 KHz	PkAmp Chan A			
	2 Vp-p	Max.	−37.495 dBm	________	2.04 dBm
	−1 V Offset	Min.	14.08 dBm	________	17.6 dBm
		PkAmp Chan B			
		Max.	−37.495 dBm	________	2.04 dBm
		Min.	14.08 dBm	________	17.6 dBm
8663A	200 MHz	PkAmp Chan A			
	71 mVrms (200 mVp-p)	Max.	−14.44 dBm	________	−7.08 dBm
	0 V Offset	Min.	−14.44 dBm	________	−7.08 dBm
		PkAmp Chan B			
		Max.	−14.44 dBm	________	−7.08 dBm
		Min.	−14.44 dBm	________	−7.08 dBm
8663A	200 MHz	PkAmp Chan A			
	10 dBm (2 Vp-p)	Max.	5.56 dBm	________	13 dBm
	0 V Offset	Min.	5.56 dBm	________	13 dBm
		PkAmp Chan B			
		Max.	5.56 dBm	________	13. dBm
		Min.	5.56 dBm	________	13 dBm
	Sensitivity/ Minimum Pulse Width (optional)				
8131A	1.0 ns Pulse 100.0 ns Period 45 mVp-p 0 V Offset	±TI Chan A	700 ps	________	1.3 ns
8131A	1.5 ns Pulse 100.0 ns Period 45 mVp-p 0 V Offset	±TI Chan A	1.2 ns	________	1.8 ns

HP 5373A PERFORMANCE TEST RECORD (Page 4 of 5)

HEWLETT-PACKARD MODEL 5373A
FREQUENCY AND TIME INTERVAL ANALYZER

Recommended Instrument	Test		Results: Minimum	Results: Actual	Results: Maximum
	EXTERNAL ARM TESTS*				
	Frequency Range/ Dynamic Range				
3325A	1 Hz 140 mVp-p 0 V Offset	Gate Time	993.000 000 0 ms	______	1.007 000 000 0 s
3325A	1 Hz 5 Vp-p 0 V Offset (Square Wave)	Gate Time	993.000 000 0 ms	______	1.007 000 000 0 s
8663A	100 MHz 50 mVrms (140 mVp-p) 0 V Offset	Gate Time	99.8 ns	______	100.2 ns
	Signal Operating Range				
3325A	10 MHz 5 Vp-p 2.5 V Offset	Gate Time	199.8 ns	______	200.2 ns
3325A	10 MHz 5 Vp-p –2.5 V Offset	Gate Time	199.8 ns	______	200.2 ns
	Trigger Accuracy				
3325A	Variable Offset	Ext Arm		Max. Trigger Level ______ Min. Trigger Level ______	
		Ext Arm Trigger Level Accuracy†	–20 mV	______	+20 mV

* A 50Ω feedthrough termination must be connected to the External Arm input.

† TRIGGER LEVEL ACCURACY = $\left[\frac{\text{MAX. TRIGGER LEVEL} + \text{MIN. TRIGGER LEVEL}}{2}\right] - 100\text{mV}$

HP 5373A PERFORMANCE TEST RECORD (Page 5 of 5)

HEWLETT-PACKARD MODEL 5373A FREQUENCY AND TIME INTERVAL ANALYZER					
Recommended Instrument	Test		Results		
			Minimum	Actual	Maximum
	OPTION 030 **CHANNEL C TESTS**				
	Frequency Range/ Dynamic Range/ Sensitivity				
8663A	100 MHz –25 dBm	Freq: Chan C	99.999 999 96 MHz	______	100.000 000 04 MHz
	100 MHz +7 dBm	Freq: Chan C	99.999 999 98 MHz	______	100.000 000 02 MHz
	1.5 GHz –25 dBm	Freq: Chan C	1.499 999 999 7 GHz	______	1.500 000 000 3 GHz
	1.5 GHz +7 dBm	Freq: Chan C	1.499 999 999 7 GHz	______	1.500 000 000 3 GHz
	1.55 GHz –20 dBm	Freq: Chan C	1.549 999 999 7 GHz	______	1.550 000 000 3 GHz
	1.55 GHz +7 dBm	Freq: Chan C	1.549 999 999 7 GHz	______	1.550 000 000 3 GHz
	2.0 GHz –20 dBm	Freq: Chan C	1.999 999 999 6 GHz	______	2.000 000 000 4 GHz
	2.0 GHz +7 dBm	Freq: Chan C	1.999 999 999 6 GHz	______	2.000 000 000 4 GHz

A

Contents of Appendix

APPENDIX

A

A GUIDE TO THE FUNCTION MENU

INTRODUCTION

Use this series of three menu maps to help understand the effects of the arming mode and the measurement size on the type of results that are available from the HP 5373A. These menu maps should be used as a guide. They are limited to showing single-channel measurements for the major measurement functions. The principles documented can be applied to the other measurement functions, once you understand the characteristics of those functions.

The following chapters of the Operating Manual should be used as reference material for this guide:

- Chapter 1, Time Interval Measurements
- Chapter 2, PRF, Frequency, PRI, and Period Measurements
- Chapter 7, Function Menu
- Chapter 10, Pre-trigger Menu

OVERVIEW OF MENU MAPS

The flowchart on the next page directs you to one of the menu maps depending on the size of the measurement and the kind of results you want. The purpose of each map is described briefly here:

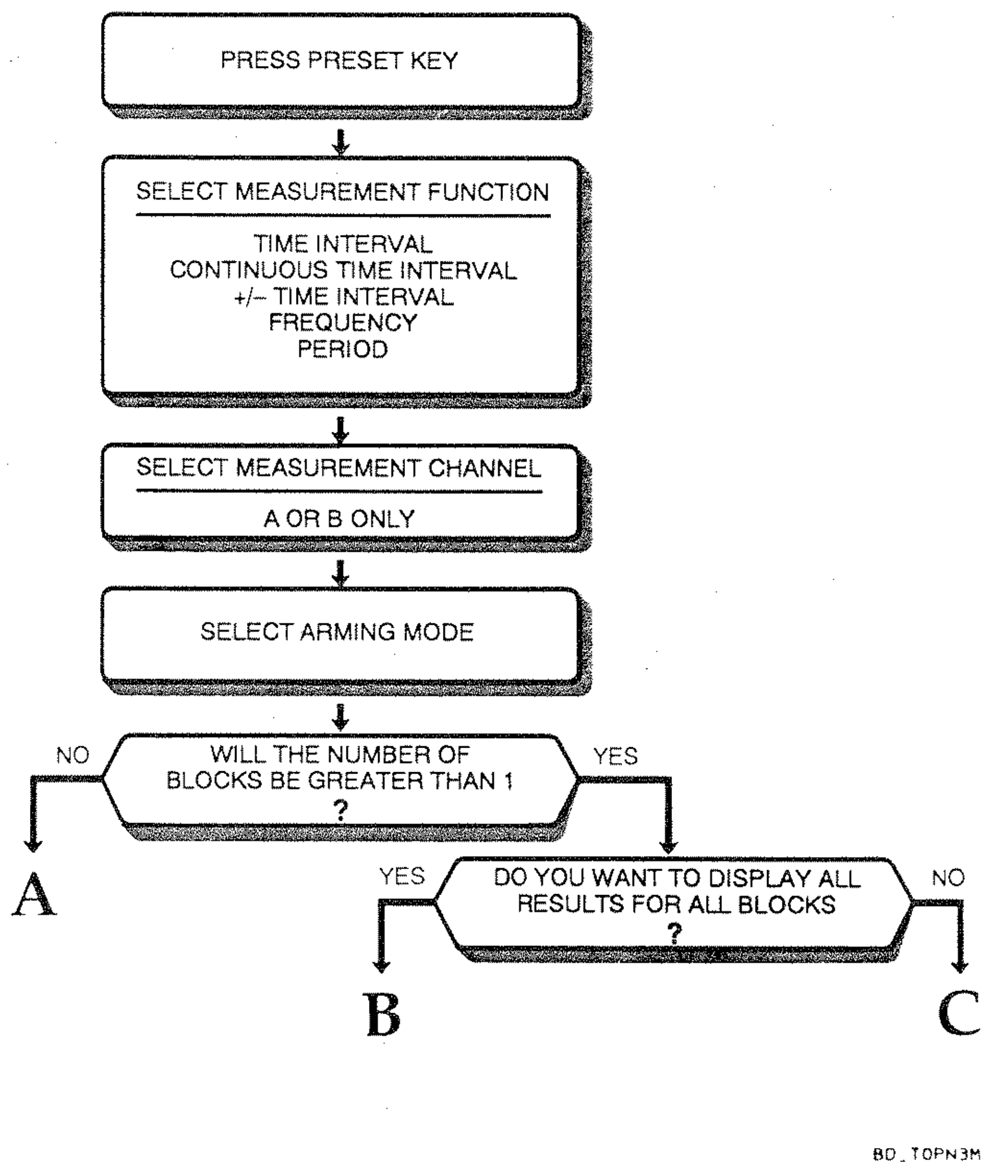
- Menu Map A — This menu helps you to select the maximum number of measurements per block for a single-block measurement. All results are available for numeric and graphic analysis.
- Menu Map B — This menu helps you to select the maximum number of measurements per block for a multiple-block measurement so that all results are available for numeric and graphic analysis. It also shows the arming modes that provide averaging of results.

- Menu Map C — This menu covers the situations where measurement memory could be exceeded as a result of the multiple-block measurement size. When all the measurements will not fit in memory, not all results are available for review. There are times when this is preferrable to using smaller measurement sizes. Some advantages are:
  - All the measurement values are included in statistics.
  - All the measurement values are included in limit testing.
  - All measurement values are included in Histogram graphs.
  - When averaging, the final block of measurements includes all the measurement values from each of the blocks.
  - Pre-trigger on multiple blocks provides the advantage of repeated execution of the block holdoff condition while waiting for the pre-trigger event. This sets a reference for each block of measurement data.

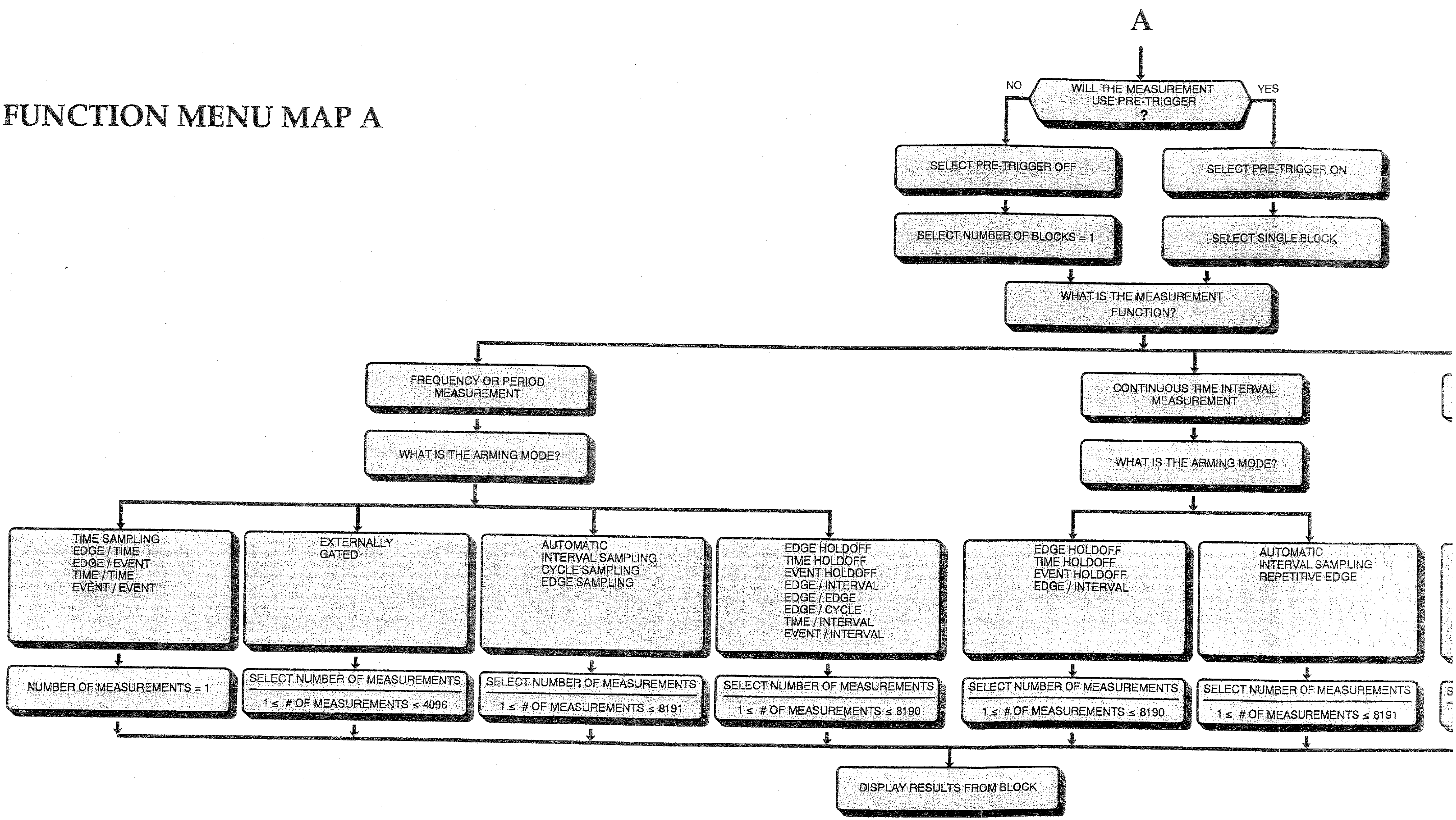
See the Following Pages for Menu Maps

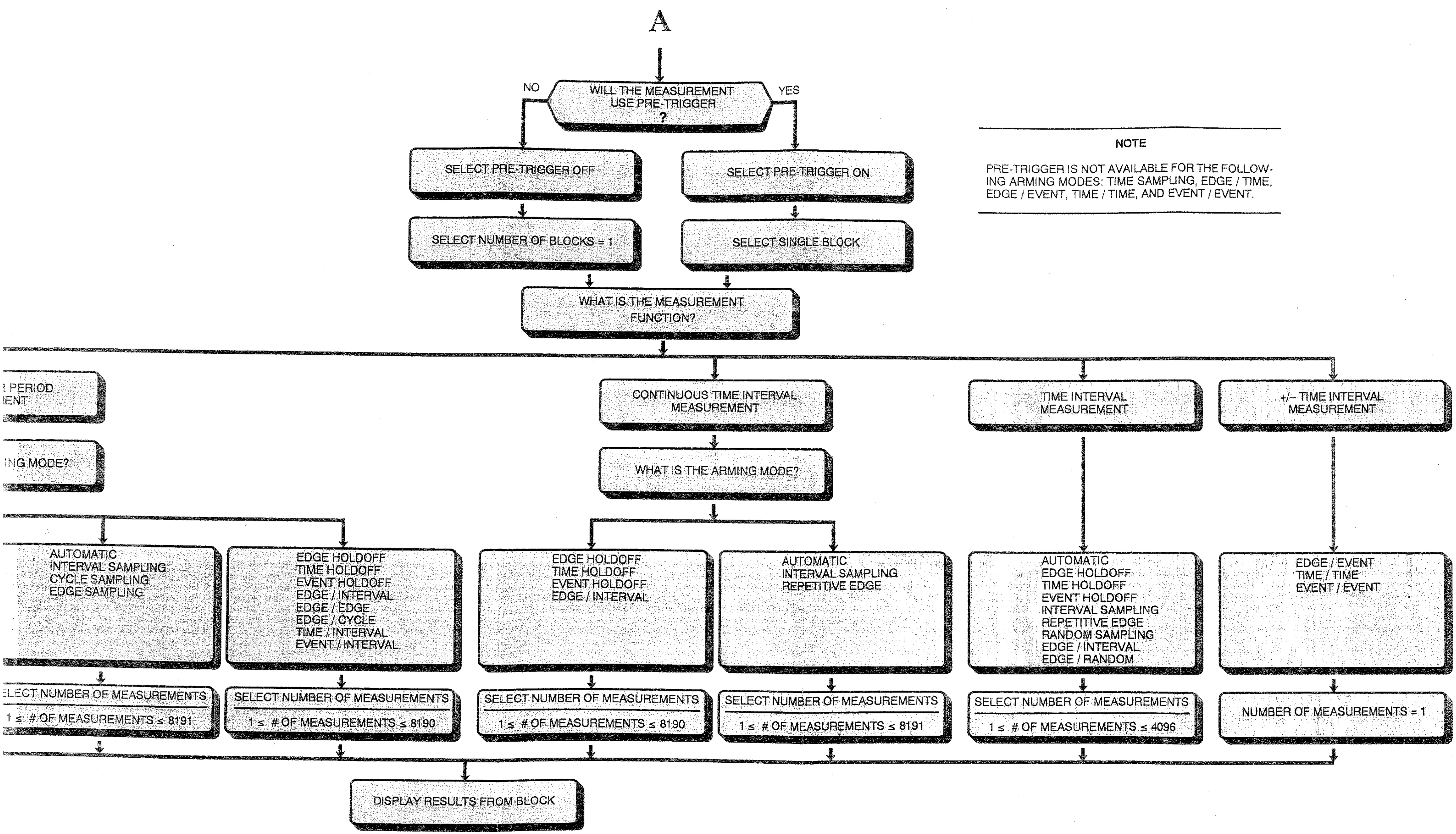
FUNCTION MENU GUIDE

To Select a Menu Map:



FUNCTION MENU MAP A

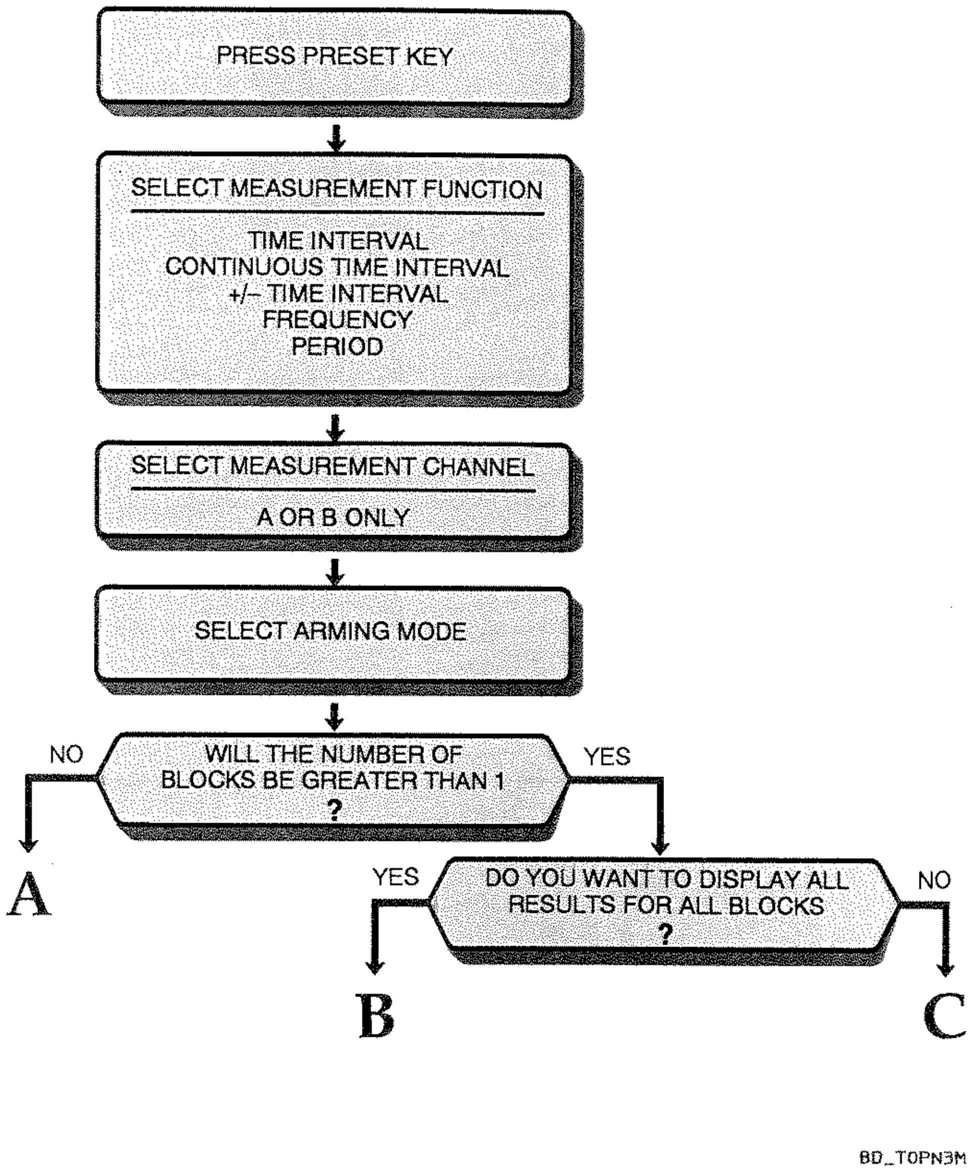




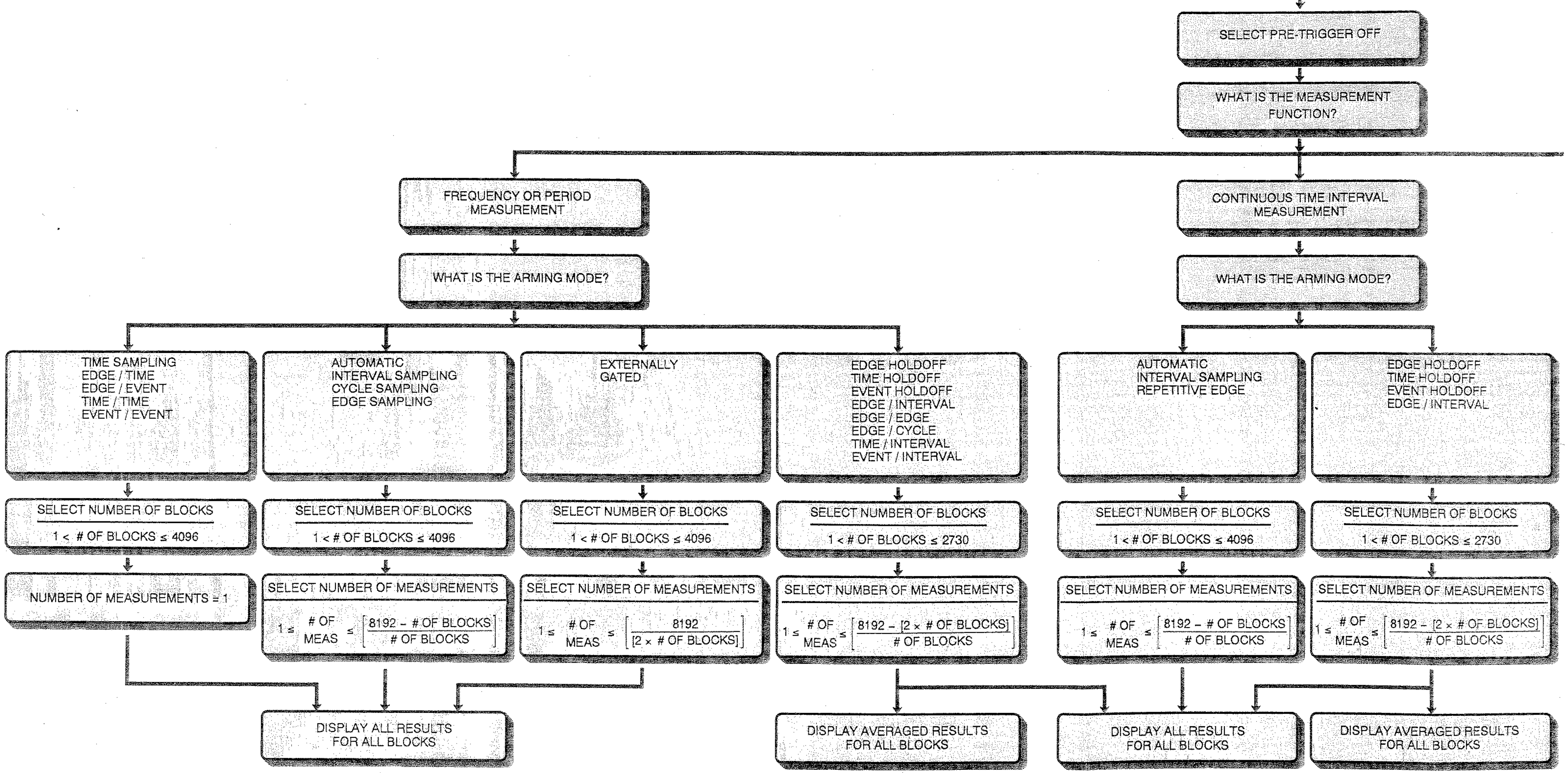
Function Menu Map A

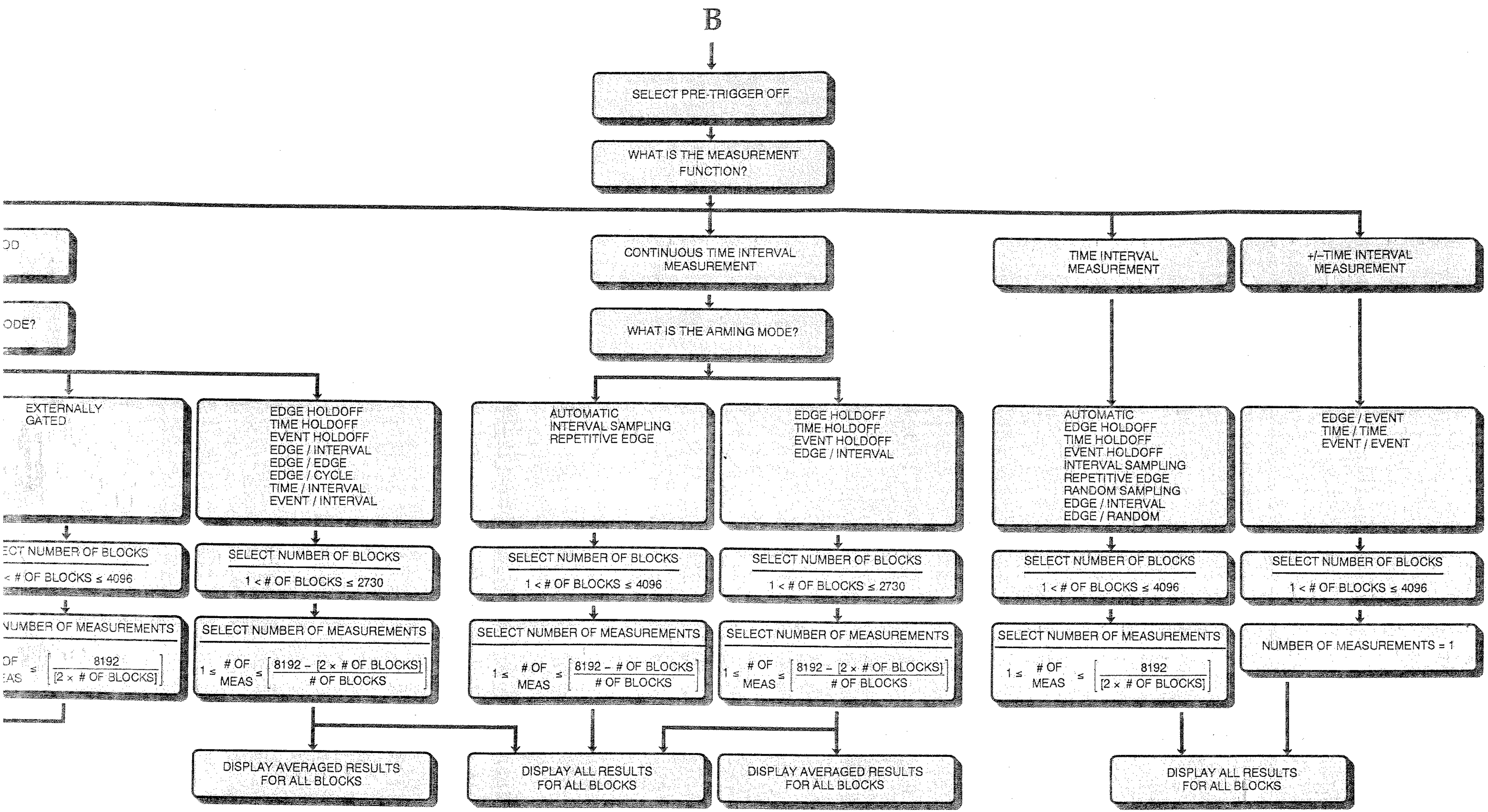
FUNCTION MENU GUIDE

To Select a Menu Map:



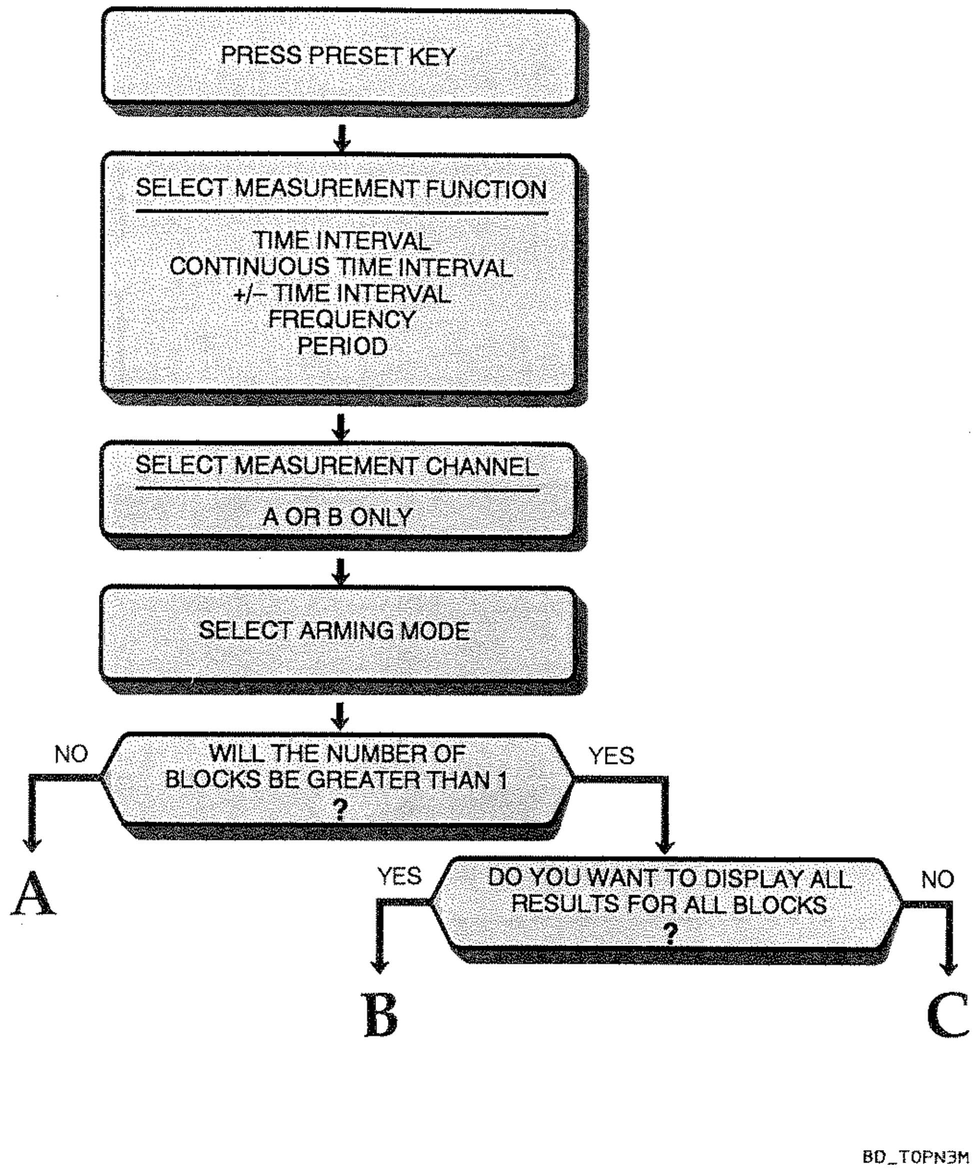
FUNCTION MENU MAP B



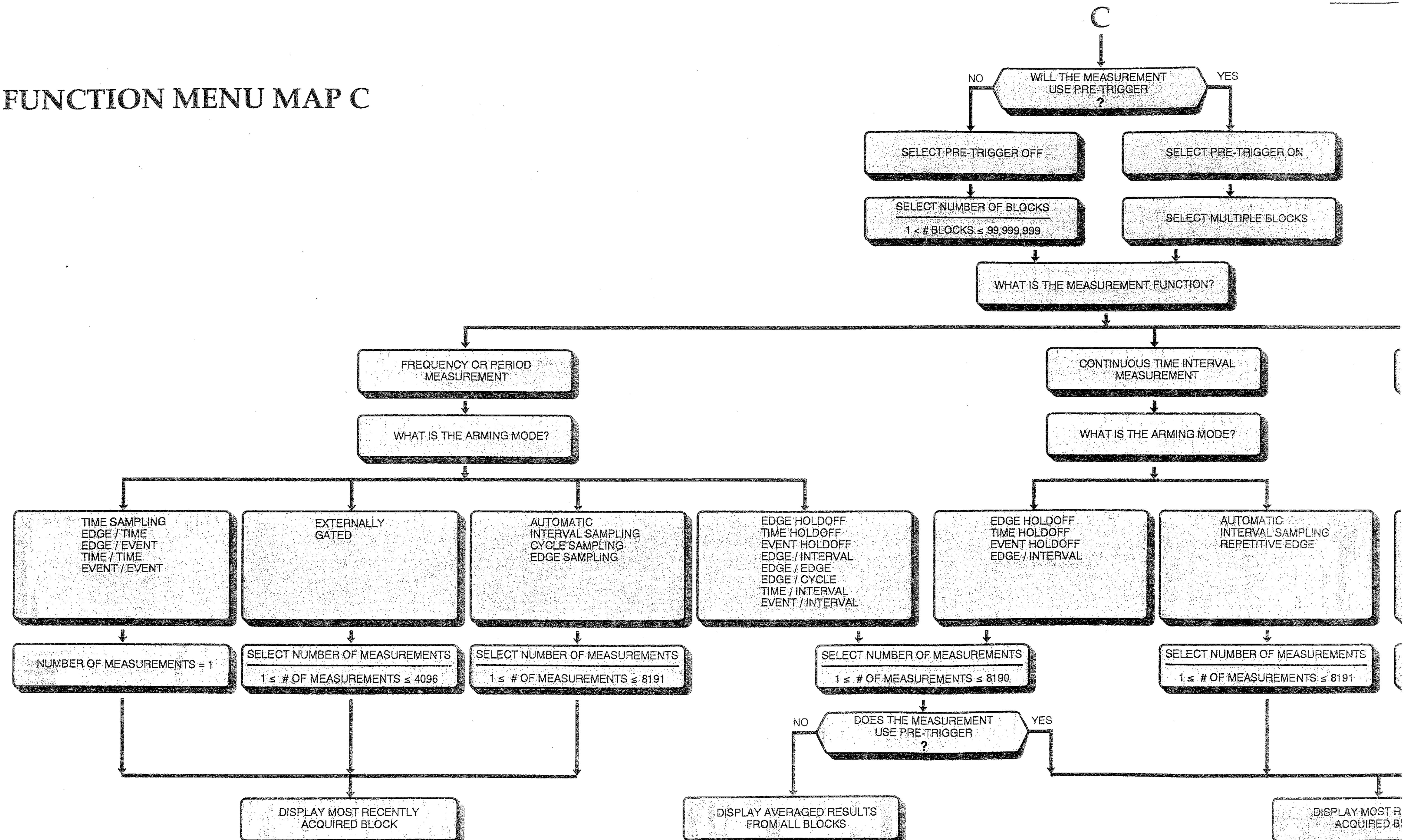

B
SELECT PRE-TRIGGER OFF
WHAT IS THE MEASUREMENT FUNCTION?
OD
ODE?
CONTINUOUS TIME INTERVAL MEASUREMENT
TIME INTERVAL MEASUREMENT
+/–TIME INTERVAL MEASUREMENT
WHAT IS THE ARMING MODE?
EXTERNALLY GATED
EDGE HOLDOFF
TIME HOLDOFF
EVENT HOLDOFF
EDGE / INTERVAL
EDGE / EDGE
EDGE / CYCLE
TIME / INTERVAL
EVENT / INTERVAL
AUTOMATIC
INTERVAL SAMPLING
REPETITIVE EDGE
EDGE HOLDOFF
TIME HOLDOFF
EVENT HOLDOFF
EDGE / INTERVAL
AUTOMATIC
EDGE HOLDOFF
TIME HOLDOFF
EVENT HOLDOFF
INTERVAL SAMPLING
REPETITIVE EDGE
RANDOM SAMPLING
EDGE / INTERVAL
EDGE / RANDOM
EDGE / EVENT
TIME / TIME
EVENT / EVENT
ECT NUMBER OF BLOCKS
< # OF BLOCKS ≤ 4096
SELECT NUMBER OF BLOCKS
1 < # OF BLOCKS ≤ 2730
SELECT NUMBER OF BLOCKS
1 < # OF BLOCKS ≤ 4096
SELECT NUMBER OF BLOCKS
1 < # OF BLOCKS ≤ 2730
SELECT NUMBER OF BLOCKS
1 < # OF BLOCKS ≤ 4096
SELECT NUMBER OF BLOCKS
1 < # OF BLOCKS ≤ 4096
NUMBER OF MEASUREMENTS
OF EAS ≤ [8192 / (2 × # OF BLOCKS)]
SELECT NUMBER OF MEASUREMENTS
1 ≤ # OF MEAS ≤ [(8192 – (2 × # OF BLOCKS)) / # OF BLOCKS]
SELECT NUMBER OF MEASUREMENTS
1 ≤ # OF MEAS ≤ [(8192 – # OF BLOCKS) / # OF BLOCKS]
SELECT NUMBER OF MEASUREMENTS
1 ≤ # OF MEAS ≤ [(8192 – (2 × # OF BLOCKS)) / # OF BLOCKS]
SELECT NUMBER OF MEASUREMENTS
1 ≤ # OF MEAS ≤ [8192 / (2 × # OF BLOCKS)]
NUMBER OF MEASUREMENTS = 1
DISPLAY AVERAGED RESULTS FOR ALL BLOCKS
DISPLAY ALL RESULTS FOR ALL BLOCKS
DISPLAY AVERAGED RESULTS FOR ALL BLOCKS
DISPLAY ALL RESULTS FOR ALL BLOCKS

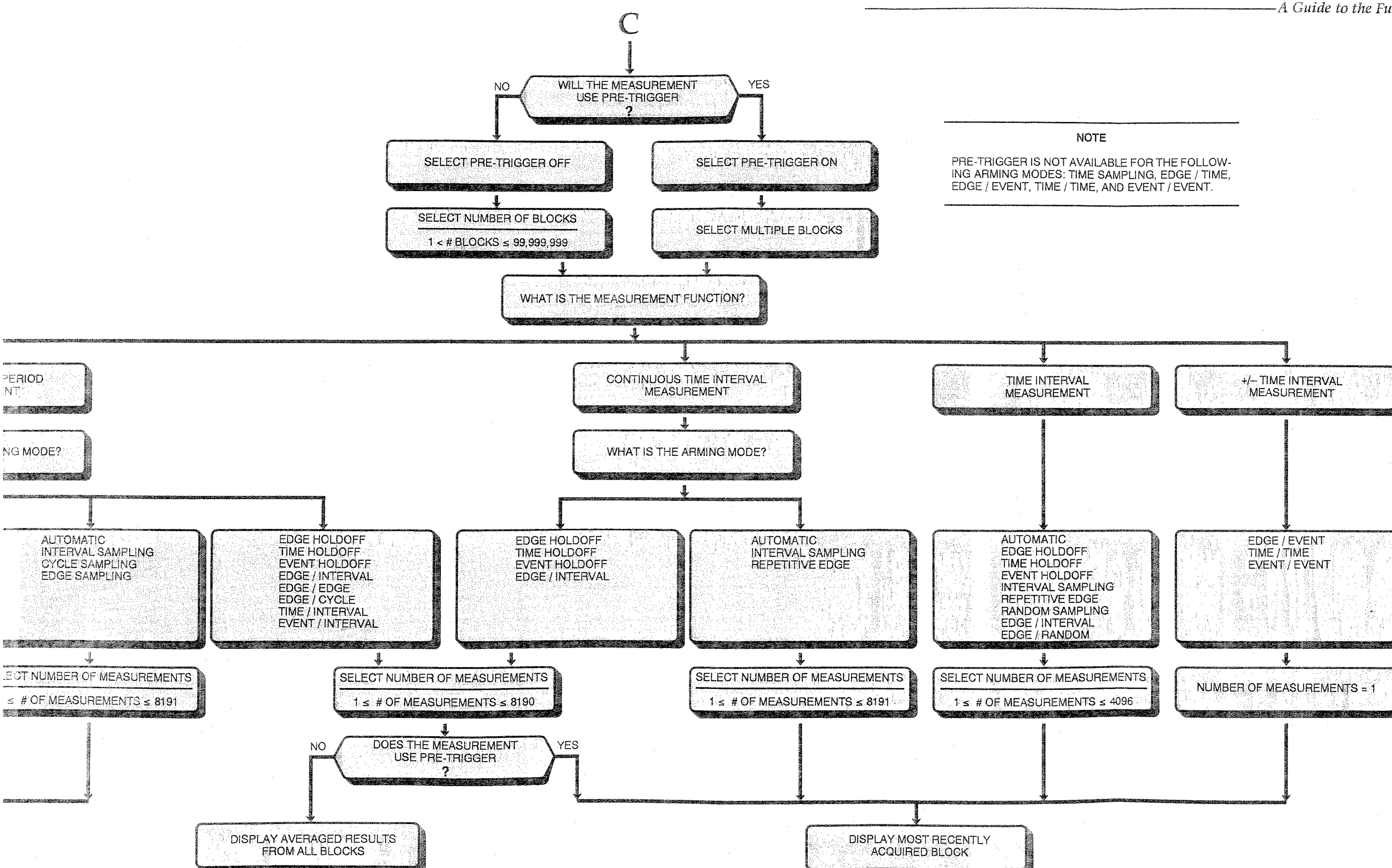
FUNCTION MENU GUIDE

To Select a Menu Map:



FUNCTION MENU MAP C





NOTE

PRE-TRIGGER IS NOT AVAILABLE FOR THE FOLLOWING ARMING MODES: TIME SAMPLING, EDGE / TIME, EDGE / EVENT, TIME / TIME, AND EVENT / EVENT.

B

Contents of Appendix

APPENDIX

B

UNPACKING AND INSTALLING

INTRODUCTION

This section provides installation instructions including unpacking, initial inspection, storage, and shipment information for the HP 5373A Modulation Domain Pulse Analyzer.

UNPACKING AND INSPECTION

WARNING

TO AVOID HAZARDOUS ELECTRIC SHOCK, DO NOT PERFORM ELECTRICAL TESTS WHEN THERE ARE SIGNS OF SHIPPING DAMAGE TO ANY PORTION OF THE OUTER ENCLOSURE (COVERS, PANELS, CONNECTORS, LEDS, ETC.).

Inspect the shipping container and cushioning material for damage. If damage is evident, keep the packing materials until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument or some component fails the performance tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The HP office will arrange for repair or replacement at HP's option without waiting for a claim settlement.

PREPARATION FOR USE

Operating Environment

TEMPERATURE. The instrument may be operated in temperatures from 0°C to 40°C.

Bench Operation

The instrument has plastic feet and folding tilt stands for convenience in bench operation. The plastic feet are shaped to facilitate self-alignment when stacking instruments.

WARNING

THE HP 5373A WEIGHS 25.5 KG (56 LBS). CARE MUST BE TAKEN WHEN LIFTING THE INSTRUMENT TO AVOID PERSONAL INJURY. USE EQUIPMENT SLIDES WHEN RACK MOUNTING (FOR DETAILS, REFER TO PARAGRAPH TITLED "RACK MOUNTING KITS").

Power Requirements

The HP 5373A can operate from power sources of 100-, 120-, 220-, or 240-volt ac, +10%, –10%, 50 to 60 Hertz for all voltages, 400 Hertz for 100- and 120-volt ac. Maximum power consumption is 500 volt-amperes.

WARNING

THIS IS A SAFETY CLASS I PRODUCT PROVIDED WITH A PROTECTIVE EARTH TERMINAL. AN UNINTERRUPTIBLE SAFETY EARTH GROUND MUST BE PROVIDED FROM THE MAINS POWER SOURCE TO THE PRODUCT INPUT WIRING TERMINALS, POWER CORD, OR SUPPLIED POWER CORD SET. WHENEVER IT IS LIKELY THAT THE PROTECTION HAS BEEN IMPAIRED, THE INSTRUMENT MUST BE MADE INOPERATIVE AND BE SECURED AGAINST ANY UNINTENDED OPERATION.

IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN EXTERNAL AUTOTRANSFORMER FOR VOLTAGE REDUCTION, MAKE SURE THAT THE COMMON TERMINAL IS CONNECTED TO THE EARTHED POLE OF THE POWER SOURCE. FAILURE TO GROUND THE INSTRUMENT CAN RESULT IN PERSONAL INJURY. REFER TO THE PARAGRAPH TITLED "Power Cable".

Line Voltage and Fuse Selection

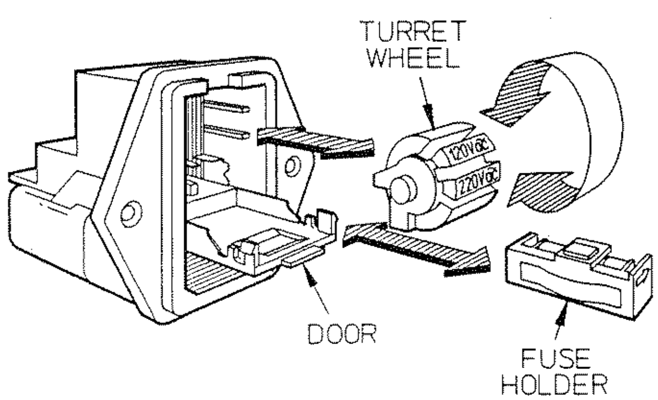
CAUTION

BEFORE PLUGGING THIS INSTRUMENT into the Mains (line) voltage, be sure the correct line voltage and fuse have been selected. You must set the voltage selector turret wheel correctly to adapt the HP 5373A to the power source as described in the following paragraph.

The HP 5373A is equipped with a power module (on the rear panel) that contains a turret wheel line voltage selector to select 100-, 120-, 220-, or 240-volt ac operations as shown in *Figure B-1*. Before applying power to the 5373A, the turret wheel selector must be set to the correct position and the correct fuse must be installed as described in the following paragraphs.

Power line connections are selected by the position of the plug-in turret wheel in the module. The correct-value fuse, with a 250-volt rating, must be installed before the turret wheel is inserted. This instrument uses a 4A fuse (HP Part Number 2110-0055) for 100/120-volt operation and a 2A fuse (HP Part Number 2110-0002) for 220/240-volt operation.

To change the line voltage, first disconnect the power cord from the module and then follow the instructions in *Figure B-1*.



SELECTION OF OPERATING VOLTAGE

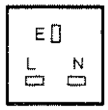
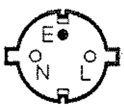
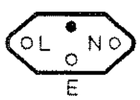
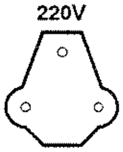
1. Using a small, flat-head screwdriver, snap open the power module door to access the fuse and turret wheel.
2. REMOVE the turret wheel before turning to desired voltage. DO NOT turn turret wheel while installed in module. Push wheel firmly into module slot.
3. To change or install fuse, pull fuse holder and reinsert fuse in holder, using caution to select correct fuse value. Re-insert fuse and holder.
4. Close the power module door. The selected operating voltage is displayed in module window.

Figure B-1. Line Voltage Selection with Power Module Turret Wheel.

Power Cable

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination. Refer to *Table B-1* for the part number of the power cables and mains plugs available.

Table B-1. AC Power Cables Available

Plug Type	Cable HP Part No.	*CD	Plug Description	Cable Length (Inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	0 6	Straight **BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Rhodesia, Singapore
250V 	8120-1369 8120-0696	0 4	Straight **NZSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	7 2	Straight **CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe, Egypt, (Unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676 8120-4753	5 5 7 1 6 2	Straight **NEMA5-15P 90° Straight **NEMA5-15P Straight **NEMA5-15P 90° Straight **NEMA5-15P Straight **NEMA5-15P	80 80 36 80 80 30 90	Black Black Black Jade Gray Jade Gray Jade Gray Dark Gray	United States, Canada, 100V or 200V, Mexico, Philippines, Taiwan, Saudi Arabia, Japan
250V 	8120-2104	3	Straight **SEV1011 1959-24507 Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight **NEMA6-15P			United States, Canada
220V 	8120-2956 8120-2957	2 3	Straight **DHCK 107 90°	79 79	Gray Gray	Denmark
220V 	8120-4211 8120-4600		Straight 90°		Gray Gray	South Africa, India

*CD = Check Digit (refer to Replaceable Parts in Service Manual).

**Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.

E = Earth Ground L = Line N = Neutral

HEWLETT-PACKARD INTERFACE BUS (HP-IB)

HP-IB Interconnections

HEWLETT-PACKARD INTERFACE BUS. Interconnection data concerning the rear panel HP-IB connector is provided in *Figure B-2*. This connector is compatible with the HP10833A/B/C/D HP-IB cables. The HP-IB system allows interconnection of up to 15 (including the controller) HP-IB compatible instruments. The HP-IB cables have identical "piggy-back" connectors on both ends so that several cables can be connected to a single source without special adapters or switch boxes. System components and devices may be connected in virtually any configuration desired. There must, of course, be a path from the controller to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack produces great leverage which can damage the connector mounting. Be sure each connector is firmly (finger tight) screwed in place to keep it from working loose during use.

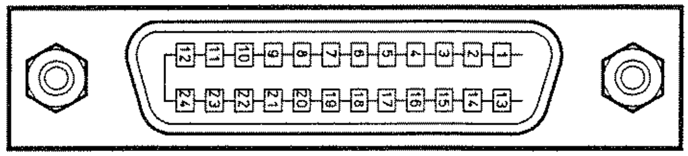
CABLE LENGTH RESTRICTIONS. To achieve design performance with the HP-IB, proper voltage levels and timing relationship must be maintained. If the system cable is too long, the lines cannot be driven properly. Therefore, when interconnecting an HP-IB system, it is important to observe the following rules:

a. The total cable length for the system must be equal to or less than 2 meters (6.6 feet) times the total number of devices connected to the bus.

b. The total cable length for the system must be less than or equal to 20 meters (65.6 feet).

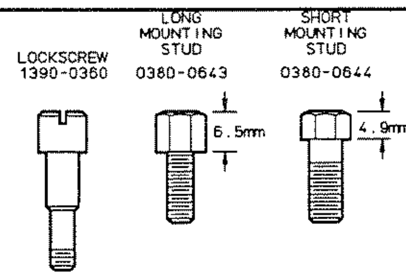
c. The total number of instruments connected to the bus must not exceed 15.

PIN	LINE	
1	DIO1	
2	DIO2	
3	DIO3	
4	DIO4	
13	DIO5	
14	DIO6	
15	DIO7	
16	DIO8	
5	EOI	
17	REN	
6	DAV	
7	NRFD	
8	NDAC	
9	IFC	
10	SRQ	
11	ATN	
12	SHIELD-CHASSIS GROUND	
18	P/O TWISTED PAIR WITH PIN 6	THESE PINS ARE INTERNALLY GROUNDED
19	P/O TWISTED PAIR WITH PIN 7	
20	P/O TWISTED PAIR WITH PIN 8	
21	P/O TWISTED PAIR WITH PIN 9	
22	P/O TWISTED PAIR WITH PIN 10	
23	P/O TWISTED PAIR WITH PIN 11	
24	ISOLATED DIGITAL GROUND	



CAUTION

The 5373A contains metric threaded HP-IB cable mounting studs as opposed to English threads. Metric threaded HP 10833A, B, C, or D HP-IB cable lockscrews must be used to secure the cable to the instrument. Identification of the two types of mounting studs and lockscrews is made by their color. English threaded fasteners are colored silver and metric threaded fasteners are colored black. DO NOT mate silver and black fasteners to each other or the threads of either or both will be destroyed. Metric threaded HP-IB cable lockscrew illustration and part number follow.



Logic Levels

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0V dc to 0.4V dc and the false (0) state is +2.5V dc to +5.0V dc.

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10631A, 1 metre (3.3 ft.), HP 10631B, 2 metres (6.6 ft),
HP 10631C, 4 metres (13.2 ft.), HP 10631D, 1/2 metre (1.6 ft.).

Cabling Restrictions

1. A Hewlett-Packard Interface Bus System may contain no more than 2 metres (6.6 ft.) of connecting cable per instrument.
2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus System is 20.0 metres (65.6 ft.)
3. The maximum number of instruments in one system is fifteen.

Figure B-2. Hewlett-Packard Interface Bus Connection.

HP-IB Address Selection

The HP-IB device address of the HP 5373A is selected from the front panel through the System menu. The address applies to both the talk and listen functions. The selectable addresses are from 0 to 30. Instructions for selecting the address are provided in chapter 12, "System Menu," of the *Operating Manual.*

The device address is retained in non-volatile memory. If the battery or memory fails, the address defaults to "3".

HP-IB Descriptions

A description of the Hewlett-Packard Interface Bus (HP-IB) is provided in the *HP5373A Programming Manual.* Study of the information in the Programming Manual is necessary if you are not familiar with HP-IB concepts. Additional information concerning the design criteria and operation of the bus is available in IEEE Standard 488-1987, titled *Standard Digital Interface for Programming Instrumentation.*

RACK MOUNTING KITS

The available rack mount kits are:

- Option 908 Rack Mount Flange Kit — without front carrying handles
- Option 913 Rack Mount Flange Kit — with front carrying handles

In the Option 908 rack mount kit, handles are not supplied; thus, this rack mount kit supplies the hardware required to mount the HP 5373A in a standard rack with the flanges only. In the Option 913 rack mount kit, handles are supplied; thus, this rack mount kit supplies the hardware required to mount the HP 5373A in a standard rack with flanges and handles.

The rack mounting contents and detailed installation instructions are provided with each rack mount kit. If a kit was not ordered with the instrument, it can be ordered through your nearest HP Sales and Support Office by using the following part numbers: HP Part Number 5061-9678 for Option 908 or HP Part Number 5061-9772 for Option 913.

A Rack Slide-Mount Kit (HP Part Number 1494-0059) is also available. The rack slide lessens the need to lift the HP 5373A, which weighs 25.5 kg (56 lbs).

STORAGE AND SHIPMENT

Environment

The instrument may be stored or shipped in environments within the following limits:

TEMPERATURE .... – 40° to 75° C (– 40° to 167° F)
HUMIDITY ....Up to 95%
ALTITUDE ....15,240 meters (50,000 feet)

The instrument should also be protected from temperature extremes which cause condensation within the instrument.

Packaging

ORIGINAL PACKAGING

Container and materials identical to those used in factory packaging are available through Hewlett-Packard for servicing; attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

OTHER PACKAGING

The following general instructions should be used for repacking with commercially available materials:

a. Wrap instrument in heavy paper or plastic. If shipping to Hewlett-Packard office or service center, attach tag indicating type of service required, return address, model number, and full serial number.

b. Use strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use a layer of shock-absorbing material 70 to 100 mm (3- to 4-inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside container. Protect control panel with cardboard.

d. Seal shipping container securely.

e. Mark shipping container FRAGILE to ensure careful handling.

f. In any correspondence, refer to instrument by model number and full serial number.

C

Contents of Appendix

APPENDIX

C

STATUS AND ERROR MESSAGES

INTRODUCTION

Five types of messages appear on the CRT Status Line of the HP 5373A to indicate errors, failures, and general information. This appendix contains a complete list of all messages in alphabetical order. The messages have a priority order; from the lowest to the highest priority, they are:

- Static Status Messages
- Momentary Status Messages
- Momentary Warning Messages
- Static Error Messages
- Static Failure Messages

These messages are acknowledged in different ways, depending on whether the instrument can continue operating and making measurements. Some messages are only warnings, and normal operation can continue without user response. Others are intended to notify the user that operation has been suspended until the error condition is acknowledged and/or corrected.

Displayed messages are replaced with ones of higher priority. For example, a Static Error Message will overwrite a Momentary Warning Message. If another message occurs with the same priority as the current message, overwriting occurs only if both are Status or if both are Momentary messages. Otherwise, the second message will be ignored.

STATIC STATUS MESSAGES

These are information messages to inform you of the condition of the instrument. Static Status Messages are cleared when the condition in the instrument changes, or when the RESTART key is pressed.

MOMENTARY STATUS MESSAGES

These are information messages to alert you to a particular condition in the instrument. They will clear automatically after three seconds.

MOMENTARY WARNING MESSAGES

These are warning messages to alert you to an illegal operation that was attempted. They will clear automatically after three seconds. Examples of actions that generate a Momentary Warning Message are: pressing an undefined softkey, or pressing a non-numeric key while entering a numeric value. An error number will be placed in the Error Queue for each Momentary Warning Message.

STATIC ERROR MESSAGES

Static errors convey improper operating states or errors generated by HP-IB. Pressing a valid key clears these errors. HP-IB errors are cleared on the transition from REMOTE to LOCAL. Examples of Static Errors are: sending an invalid HP-IB command, or attempting to query the instrument while it is in Binary output mode. An error number will be placed in the Error Queue for each Static Error Message.

STATIC FAILURE MESSAGES

These are failures which prevent the instrument from operating properly. They convey "catastrophic" hardware-related failure conditions. Static failures must be acknowledged by pressing the RESTART key or by correcting the failure condition. Examples of Static Failures are: applying too much voltage to the Channel A or B input pods, or neglecting to power-down the instrument before removing one of the input pods. An error number will be placed in the Error Queue for each Static Failure Message.

ERROR QUEUE QUERY COMMAND

The Error Queue query command ("ERR?") allows an HP-IB system controller to request the contents of the HP 5373A's Error Queue. The Error Queue contains a maximum of 16 error numbers, represented by integer values, which identify operator or hardware errors. If more than 16 errors have been queued but not queried, then the 16th one is replaced with Error -350 (which is the HP standard error number indicating that "too many errors have occurred"). Successively sending the query "ERR?" returns error numbers in the order that they occurred, until the queue is empty. Additional queries return an error of "0" until another error condition is generated. Only messages of the type Momentary Warning, Static Error and Static Failure have error numbers that are entered into the Error Queue.

STATUS AND ERROR MESSAGE DESCRIPTIONS

The following list describes the HP 5373A system-wide status and error messages in alphabetical order. HP standard numbers, which are consistently defined for all HP instruments, are listed under "Error", and are preceded with a minus sign (for example, "Error -120: Numeric argument error"). All of the other error messages with positive numbers are unique to the HP 5373A. Messages with numbers are used to indicate actual events which have occurred which should be logged in the Error Queue. Messages without error numbers are intended for status information only.

Note that there are also some localized messages in the Graphics screens which are not covered here in detail. Those messages are intended to give the user feedback on the current Graph status, but are not generally considered errors of global concern, and do not generate error number entries in the Error Queue. Examples are: the number of measurements between the markers, the status indication while the graph display is being recalculated (due to a GRAPhic command), or an indication that some action has completed (such as a Graph copy to memory). These messages are considered to be self-explanatory and therefore are not listed here.

Abort only allowed in Single

Type: Momentary Status   *Associated With:* Measurement

This message occurs when the "ABORT" HP-IB command is received or the Abort (MANUAL ARM) key is pressed while the HP 5373A is in the Repetitive Sample mode. The Abort command is valid only when the HP 5373A is in Single Sample mode, so no action takes place.

Acquiring measurement data

Type: Static Status   *Associated With:* System Operation

This message occurs while the HP 5373A is acquiring measurement data. It is erased when the acquisition process is complete.

Alternate Timebase selected. Press RESTART.

Type: Static Failure   *Associated With:* Rear Panel External Reference Input
Error Number: 105

The HP 5373A will display this message and stop the measurement process when an external timebase reference is connected to, or disconnected from, the rear panel EXTERNAL

INPUT connector. Press the front panel RESTART key or send the HP-IB "RESTART" command to restart measurements. If the message was caused by connecting the external reference, the restarted measurements will be based on that external reference, otherwise, they will be based on the Internal Timebase.

Arming has changed.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs when the Arming selection has been changed to resolve conflict with another parameter that has been entered (such as changing Measurement Function).

Arming parameter changed.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs when an Arming parameter has been changed to resolve conflict with another parameter that has been entered. Examples of Arming parameters that might be changed are: Arming channel or delay value.

Arming value changed by Fast Meas mode.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs when an Arming value has been changed to accomodate the Fast Measurement mode. This mode restricts arming to occur within 131 μsec.

Arming, input parameters changed.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs when both the Arming selection and one or more Input menu parameters have been changed to resolve conflict with another parameter that has been entered. Examples of Input menu parameters that might change are: Trigger Mode, Trigger Slope or Trigger Level.

Arming, measurement source have changed.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs when both the Arming selection and Measurement Source channel have been changed to resolve conflict with the Measurement Function that has been entered.

Binary output turned off.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs when the instrument is in the Binary output mode, and the Envelope Power or Amplitude Modulation function has been selected. Binary output mode is not supported for Envelope Power or Amplitude Modulation measurements. The instrument defaults to ASCII output mode.

Block or Measurement size changed.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs if a Block Size or Measurement Size is entered which causes the total number of measurements to exceed 2E+15. This is applicable to Histogram TI modes in particular. When this happens, the entered parameter is allowed, but the other is defaulted to keep the total acquisition size less than 2E+15 measurements. For example, if the Measurement Size is 20,000,000 measurements, the maximum Block Size enterable is 99,999,999 (to insure that the total is less than 2E+15). If the Measurement Size is increased (so that it is greater than 20,000,000), the corresponding Block Size is decreased to keep the total less than 2E+15 measurements.

Calculating measurements.

Type: Static Status *Associated With:* System Operation

This message is displayed while the HP 5373A is calculating the measurement results. It is erased when the calculation process is complete.

Decimal point entry disallowed.

Type: Momentary Status *Associated With:* Numeric Entry

This message occurs when a decimal point is not allowed at this point in the current numeric entry sequence, because the exponent value has already been specified (e.g. the value currently being entered is "1.2E+01").

Decimal point previously entered.

Type: Momentary Status *Associated With:* Numeric Entry

This message occurs when a decimal point is not allowed at this point in the current numeric entry sequence, because a decimal point has already been entered (e.g. the value currently being entered is "1.2").

Enter register number.

Type: Static Status *Associated With:* Save/Recall

This message appears after pressing the SAVE or RECALL keys, prompting the user to select one of the saved configuration registers.

Error -100: Unrecognized command.

Type: Static Error *Associated With:* Standard HP Error

This message occurs when an invalid command has been sent via HP-IB. Examples are: commands not valid for the currently specified subsystem, commands not allowed for the current measurement setup, or commands containing syntax errors.

Error -120: Numeric Argument error.

Type: Static Error *Associated With:* Standard HP Error

This message occurs when an attempt has been made to enter a Stop arming value less than the corresponding Start arming value in TIME/TIME or EVENT/EVENT Arming modes. Examples are: entering a Start time greater than a Stop time, or entering a Start event count greater than a Stop event count.

Error -151: Query not allowed. Binary format.

Type: Static Error *Associated With:* Standard HP Error

This message occurs when output data is requested from the HP 5373A while it is in the Binary output mode. The HP 5373A cannot be queried or send formatted numeric data via HP-IB while in Binary output mode. To process queries, switch to ASCII or Floating Point output modes.

Error 100: No Listeners on bus.

Type: Momentary Warning *Associated With:* HP-IB

This message occurs when there are no listeners present on the bus, and an attempt has been made to have the HP 5373A send output. This is specific to the Talk/Listen mode of operation.

Error 101: Talker, no listeners.

Type: Momentary Warning *Associated With:* HP-IB

This message occurs when the HP 5373A is addressed to talk, but there are no listeners present on the bus. This is specific to the Talk-only mode of operation.

Error 102: Bus conflict: Talk-only.

Type: Static Error *Associated With:* HP-IB

This message occurs when an attempt is made to send HP-IB commands to the HP 5373A while it is in Talk-Only mode. The instrument cannot accept commands via HP-IB while in this mode. To allow the HP 5373A to accept commands, return to Talk/Listen mode.

Error 103: Key ignored in Remote.

Type: Momentary Warning *Associated With:* HP-IB

This message occurs when a front panel key is pressed while the HP 5373A is in Remote mode. While in Remote, all front panel keys except LOCAL are disabled.

Error 104: Key ignored in LLO.

Type: Momentary Warning *Associated With:* HP-IB

This message occurs when the LOCAL key is pressed while the HP 5373A is in Remote, and in Local Lockout mode. In Local Lockout mode, the LOCAL key is disabled.

Error 107: Timebase unlocked. Press RESTART.

Type: Static Failure *Associated With:* Hardware Error

This message occurs when the oscillator is out of lock. Any measurements made while this message is on the screen may not be accurate.

Error 108: Ch A and B Overvoltage.

Type: Static Failure *Associated With:* Hardware Error

This message occurs when an overvoltage condition is present on both Input Channels A and B. To correct this error, change the signal Trigger Level, Bias or Attenuation on the Input menu.

Error 109: Ch A Overvoltage.

Type: Static Failure *Associated With:* Hardware Error

This message occurs when an overvoltage condition is present on Input Channel A. To correct this error, change the signal Bias or Attenuation on the Input menu.

Error 110: Ch B Overvoltage.

Type: Static Failure *Associated With:* Hardware Error

This message occurs when an overvoltage condition is present on Input Channel B. To correct this error, change the signal Bias or Attenuation on the Input menu.

Error 111: Power-down before removing pods.

Type: Static Failure *Associated With:* Hardware Error

This message occurs when an input pod is removed while the HP 5373A is powered on. The instrument should be powered down before input pods are removed.

Error 130: Only graphs can be plotted.

Type: Momentary Warning *Associated With:* Plot

This message occurs when an attempt is made to plot a display other than Graphics. Plots are only allowed of Graphic displays. To get a hardcopy of any other menu, use the PRINT function, which outputs the current display to an attached printer.

Error 131: Plot/meas data conflict.

Type: Momentary Warning *Associated With:* Plot

This message occurs when the PLOT key is pressed while Graphics are available, but the output source chosen on the System menu is Measurement instead of Display. In this case, the HP 5373A has been configured to output measurement results instead of display data. Set the output source to Display before plotting.

Error 140: Register protected.

Type: Momentary Warning *Associated With:* Save/Recall

This message occurs when an attempt was made to save the current instrument configuration to a register that is protected. Save to another register, or unprotect the desired register on the Instrument State Menu.

Error 141: Register not saved yet.

Type: Momentary Warning *Associated With:* Save/Recall

This message occurs when an attempt has been made to recall a saved instrument configuration from a register that has not yet been saved.

Error 142: Register out of range.

Type: Momentary Warning *Associated With:* Save/Recall

This message occurs when a register number outside the valid range has been entered. Valid register numbers are 0-9 for RECALL, and 1-9 for SAVE or ERASE.

Error 150: Parameter conflict.

Type: Static Error *Associated With:* HP-IB

This message occurs when an HP-IB command was sent which conflicts with the current instrument configuration.

Error 160: Out of sensitivity cal.

Type: Static Failure *Associated With:* Hardware Error

This message occurs when the HP 5373A has lost its battery-stored memory and the sensitivity calibration factors have been lost. When this occurs, the factors are set to defaults, and the HP 5373A needs calibration.

Events occurred which were not timed.

Type: Momentary Status *Associated With:* Measurement

This message occurs when the measurement acquisition process is not able to timestamp every event sample individually. All measurement results displayed are still valid in this case; no user-intervention is required.

Exponent entry disallowed.

Type: Momentary Status *Associated With:* Numeric Entry

This message occurs for one of two reasons: an attempt was made to enter an integer parameter using exponent format, but the menu field is too small to adequately handle that format (not enough space to specify digits plus the "E+00" notation), or the EXP key was pressed without having entered any digits in the current numeric entry sequence.

Exponent disallowed due to mantissa.

Type: Momentary Status *Associated With:* Numeric Entry

This message occurs if there is not enough space left in the numeric entry field to show "E+00" when the EXP key is pressed. In this case, the exponent entry mode is valid for the parameter in question, but there is not enough space left in the field because too many digits have already been entered.

There must be at least four character spaces available to show "E+xx" in the field. The BACKSPACE key may be used to clear enough character spaces to allow exponent entry.

Gate open.

Type: Static Status *Associated With:* Manual Totalize Measurement

This message appears while the manually controlled gate is open during a Manually armed Totalize measurement. When the gate is closed to complete the measurement, the message is erased and the measurement result is displayed.

Graphics not allowed for this meas.

Type: Momentary Status *Associated With:* Manual Totalize, Envelope Power, or Amplitude Modulation Measurements

Graphics displays are not allowed when the HP 5373A is making Envelope Power, Amplitude Modulation, or Manually armed Totalize measurements.

HP 5373A Graphics command no longer used.

Type: Momentary Warning *Associated With:* HP-IB *Error Number:* 120

This message occurs if an unsupported HP 5371A Graphics command is sent via HP-IB. See Appendix F for details on how HP 5371A commands may be translated into equivalent HP 5373A commands.

Inhibit usage may distort results.

Type: Momentary Status *Associated With:* Inhibit function

When the Inhibit function is activated, the requested number of measurements will be made, but not all results may be valid. The Numeric screen and Graphics displays indicate which measurements have been inhibited during the measurement sequence.

Input line truncated to first 80 chars.

Type: Momentary Status *Associated With:* HP-IB

This message occurs when an HP-IB string of more than 80 characters is entered from the controller. The parser truncates the string to the first 80 characters, and continues processing.

Input parameters may have changed.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs when parameters on the Input menu have been changed to resolve conflict with another parameter that has been entered. In this case, no Arming mode or Arming parameter changes have occurred.

Interval sample value changed to 131 μs.

Type: Momentary Status *Associated With:* Parameter Coupling

This message occurs when Fast Measurement mode is selected, causing an out-of-limits condition for the interval sample value. 131 μsec is the maximum interval sample value allowed in Fast Measurement mode.

Measurement Aborted.

Type: Momentary Status *Associated With:* Measurement

This message occurs when the "ABORT" HP-IB command is received or the Abort (MANUAL ARM) key is pressed while a measurement is in progress, and enough samples have been taken to give at least one valid measurement result. The Abort command is valid only when the HP 5373A is in Single Sample mode.

Measurement Inhibited.

Type: Static Status *Associated With:* Measurement

This message occurs when Inhibit mode is activated, and at least one measurement in the last acquisition sequence was inhibited.

Measurement terminated, no data.

Type: Momentary Status *Associated With:* Measurement

This message occurs when the "ABORT" HP-IB command is received or the Abort (MANUAL ARM) key is pressed while a measurement is in progress, and not enough samples have been taken to give at least one valid measurement result. The Abort command is valid only when the HP 5373A is in Single mode.

No digits specified, entry aborted.

Type: Momentary Status *Associated With:* Numeric Entry

This message occurs when the ENTER key is pressed, without having specified a numeric value containing any digits.

Non-numeric key ignored.

Type: Momentary Status *Associated With:* Numeric Entry

This message occurs in numeric entry when pressing any non-numeric key before pressing ENTER or LAST VALUE. Non-numeric keys are keys other than 0 to 9, . (decimal point), EXP, +/-, or BACKSPACE.

Not in Talk-only.

Type: Momentary Status *Associated With:* Print/Plot Graph keys

This message occurs when an attempt is made to print a screen or plot a graph without first setting the HP 5373A to Talk-Only mode on the System menu screen.

Number must be positive.

Type: Momentary Status *Associated With:* Numeric Entry

This mesage occurs when an attempt is made to change an enterable parameter to a negative value, and that parameter is only allowed to be positive. Examples are: Measurement Size, or Arming on event or time values.

Numeric entry aborted.

Type: Momentary Status *Associated With:* Numeric Entry

This message occurs when the LAST VALUE key is pressed. The parameter that was being entered is restored to its previous value.

Out of Range: see Meas mode on System menu.

Type: Momentary Status *Associated With:* Parameter Conflict

This message occurs when a parameter value is entered which cnflicts with the limitations of Fast Measurement mode. However, the parameter value may be within the valid range for Normal Measurement mode (Measurement mode is selectable on the System menu).

Plot/Print aborted.

Type: Momentary Status — *Associated With:* Plot/Print

The current plot or print output action in progress has been canceled (at user request).

Pre-trigger precedes data.

Type: Momentary Status — *Associated With:* Measurement

This message appears when a block of data has been captured due to a Pre-trigger but the point where the Pre-trigger occurred precedes the block of data shown.

Response timeout occurred.

Type: Momentary Warning — *Associated With:* System Operation — *Error Number:* -303

This message occurs when the Response Timeout feature is enabled and a measurement is in progress but has not completed within the specified time period. The instrument will proceed with the measurement acquisition to completion if possible.

Result format must be ASCII, see System menu.

Type: Momentary Status — *Associated With:* HP-IB

This message occurs when an attempt is made to send data out on the HP-IB while in Talk Only, and the output format is binary or floating point. The output format should be changed to ASCII on the System menu.

Sending output to plotter...

Type: Static Status — *Associated With:* Plot

This message occurs while the current Graphics screen display is being output to the attached plotter.

Sending output to printer...

Type: Static Status — *Associated With:* Print

This message occurs while the current screen display is being output to the attached printer.

Source channel has changed.

Type: Momentary Status   *Associated With:* Parameter Coupling

This message occurs when the Measurement Source channel has been changed to resolve conflict with another parameter that has been entered (such as changing the Measurement Function).

Source, input parameters changed.

Type: Momentary Status   *Associated With:* Parameter Coupling

This message occurs when the Measurement Source channel and one or more Input menu parameters have been changed to resolve conflict with another parameter that has been entered (such as changing the Measurement Function).

Stop Arming precedes Start Arming.

Type: Momentary Status   *Associated With:* Parameter Validation

This message appears when the Stop Arming value is less than the Start Arming value. The stop arm will thus occur before the start arm. If you are making ±Time Interval measurements, expect negative results.

Undefined key.

Type: Momentary Status   *Associated With:* Key entries

This message occurs when an invalid or undefined key is pressed. An example is an undefined softkey.

Value out of range: set to limit.

Type: Momentary Status   *Associated With:* Numeric Entry

This message occurs when parameter values have been altered to resolve conflict with the selection of Fast Measurement mode.

Value out of range: set to maximum.

Type: Momentary Status   *Associated With:* Numeric Entry

This message occurs when the entered parameter value is above the maximum allowable value. The parameter is defaulted to that maximum value.

Value out of range: set to minimum.

Type: Momentary Status *Associated With:* Numeric Entry

This message occurs when the entered parameter value is below the minimum allowable value. The parameter is defaulted to that minimum value.

Waiting for arming...

Type: Static Status *Associated With:* Measurement Status

This message occurs when the HP 5373A is waiting for the specified arming event to occur, before making the first measurement.

Waiting for input signal...

Type: Static Status *Associated With:* Measurement Status

This message occurs when the HP 5373A has met the specified arming condition, and is waiting for measurements to begin (no input signal has been detected).

Waiting for Manual Arm...

Type: Static Status *Associated With:* Measurement Status

This message appears when a Totalize measurement with Manual arming is stared. The HP 5373A is waiting for the MANUAL ARM key to be pressed which will open the gate.

Waiting for Pre-trigger...

Type: Static Status *Associated With:* Measurement Status

This message occurs when the HP 5373A is waiting for the specified Pre-trigger condition to occur, before making a block of measurements.

Waiting for Start Arming...

Type: Static Status *Associated With:* Measurement Status

This message appears when the measurement in progress is waiting for the start arm to occur.

Waiting for Stop Arming...

Type: Static Status *Associated With:* Measurement Status

This message appears when the measurement in progress is waiting for the stop arm to occur.

WARNING: Both frequencies out of auto-trigger range.

Type: Momentary Warning *Associated With:* System Operation *Error Number:* 182

This message occurs when the instrument is in Auto-trigger mode, and the input signals on both Channel A and B are outside the Auto-trigger frequency range. One input signal is below 1 kHz and one signal is above 200 MHz.

WARNING: Frequency too high for auto-trigger.

Type: Momentary Warning *Associated With:* System Operation *Error Number:* 180

This message occurs when the instrument is in Auto-trigger mode, and the input signal is above 200 MHz. The Auto-trigger frequency range is 1 kHz to 200 MHz.

WARNING: Frequency too low for auto-trigger.

Type: Momentary Warning *Associated With:* System Operation *Error Number:* 181

This message occurs when the instrument is in Auto-trigger mode, and the input signal is below 1 kHz. The Auto-trigger frequency range is 1 kHz to 200 MHz.

D

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10:1 PROBE CALIBRATION PROCEDURE

INTRODUCTION

This procedure should be performed when a 10017A oscilloscope probe is used in place of the 10:1 probe on the HP 54003A 1-MΩ pod. The HP 54003-616171 probe, received with the HP 54003A pod, is matched to the pod at the factory. Should that probe need to be readjusted or replaced by an HP 10017A scope probe, perform this procedure before using the probe for measurements. If the probe is not calibrated for use with the HP 54003A pod, triggering errors may occur.

Equipment Required:

HP 3325A Synthesizer/Function Generator or equivalent
HP 1250-1454 (Probe tip to BNC adapter)
50Ω Feedthrough

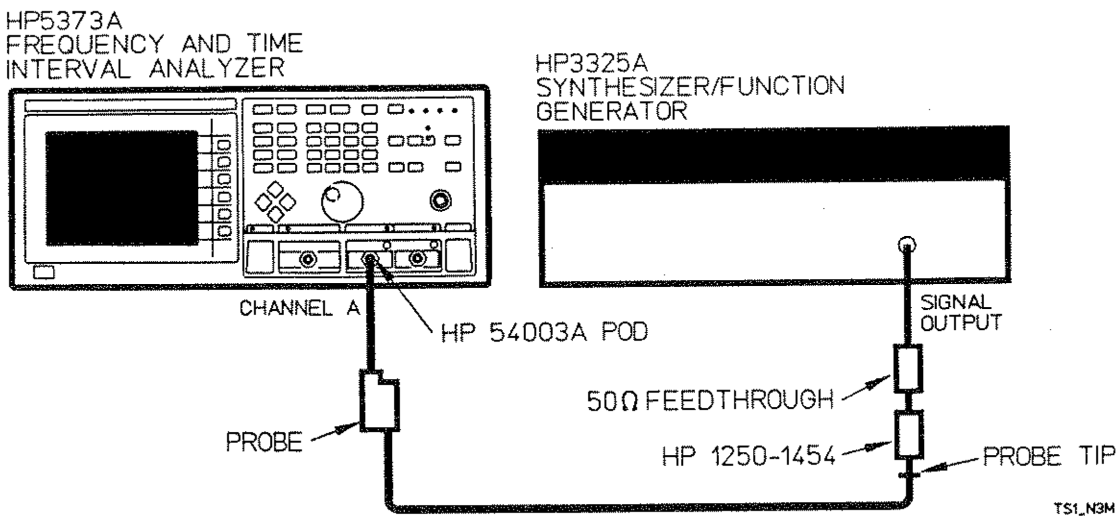

Figure D-1. HP 10017A 10:1 Probe Calibration Setup

Procedure:

1. Connect the test equipment as shown above.
2. Set HP 3325A to output a 2 kHz, 5 Vp-p Square Wave, with no DC offset.
3. Set HP 5373A to Envelope Power measurement function.
4. Adjust probe capacitor until the peak readings reach a maximum and stop increasing.
5. Adjust probe capacitor in the opposite direction from step 4 until peak readings on HP 5373A reach a minimum and stop decreasing.
6. Adjust probe capacitor in the opposite direction from step 5 until peak readings on HP 5373A just start to increase.

The calibration procedure is completed.

Goal: to adjust capacitor to the point where peak readings just start to increase.

Comment: Any square wave generator can be used providing the overshoot/undershoot is less than 1%.

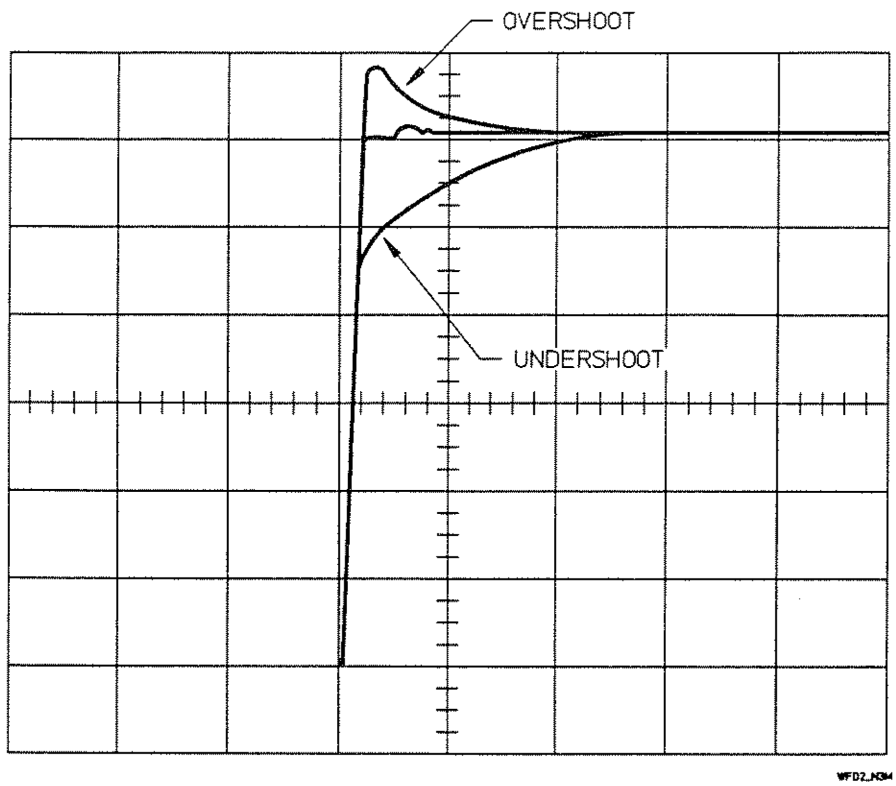

Figure D-2. Example of Overshoot and Undershoot

The calibration procedure helps eliminate overshoot and undershoot resulting from the use of an uncalibrated probe with the HP 54003A pod. An uncalibrated probe can produce triggering errors causing the HP 5373A to make erroneous measurements.

During the calibration procedure, the shape of the waveform being measured by the HP 5373A is changing. As the probe capacitor is adjusted, the waveform, if viewed on an oscilloscope, would be similar to the waveforms shown in *Figure D-2*.

The signal from the probe being calibrated:

- approaches overshoot in step 4;
- approaches undershoot in step 5;
- approaches a flat response in step 6.

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APPENDIX

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SPECIFICATIONS

WARRANTED SPECIFICATIONS

The HP 5373A is normally configured with an HP 53702A envelope detector pod in channel A and an HP 54002A 50 ohm pod in channel B. The listed specifications are for the HP 5373A configured with two HP 54002A 50 ohm pods. This allows users who have their own envelope detectors to know the capabilities of the basic instrument. The HP 53702A envelope detector pod specifications are listed in the input section. These specifications need to be taken into account when using the HP 53702A. The HP 5373A has two measurement modes — Normal and Fast. If there are differences in the two modes, parameters pertaining to the FAST mode will be contained in brackets [ ].

Measurements

Frequency/PRF: Ch A & B: 125 mHz [8 kHz] to 500 MHz
Ch C: 100 MHz to 2 GHz

Period/PRI: Ch A & B: 2 nsec to 8 sec [131 μsec]
Ch C: 0.5 nsec to 10 nsec

For a single measurement:

Least Significant Digit Displayed:

$$\pm \frac{200\text{ ps}}{\text{Sample Interval}} \times [\text{Period or Frequency}]$$

Resolution: $$\pm \frac{150\text{ ps rms} + (1.4 \times \text{Trigger Error})}{\text{Sample Interval}} \times [\text{Period or Frequency}]$$

Accuracy: ± Resolution ± (Time Base Aging x [Period or Frequency])

Mean Estimation for Average Measurements

rms Resolution:
Continuous Measurements (Number of Measurements Per Block ≥3):

$$\frac{\sqrt{13.5} \times (150\text{ ps rms} + 1.4 \times \text{Trigger Error})}{(\#\text{ of Blocks})^{(1/2)} \times (\#\text{ of Meas/Block})^{(3/2)} \times \text{Sample Interval}} \times [\text{Period or Frequency}]$$

All other Measurements:
N = number of measurements averaged

$$\frac{150\text{ ps rms} + (1.4 \times \text{Trigger Error})}{\text{Sample Interval} \times \sqrt{N}} \times [\text{Period or Frequency}]$$

Accuracy: ± Resolution ± (Time Base Aging x [Period or Frequency])

WARRANTED SPECIFICATIONS (Continued)

Pulse Width/Off Time Ch. A: 10 nsec to 8.0 sec

Least Significant Digit Displayed: N = number of measurements averaged

$$\pm \frac{200\text{ ps}}{\sqrt{N}}$$

Resolution: $$\pm \frac{150\text{ ps rms} \pm \text{Start Trigger Error} \pm \text{Stop Trigger Error}}{\sqrt{N}}$$

Accuracy: ± Resolution ± (Time Base Aging x [Pulse Width or Offtime]) ± Trigger Level Timing Error ± 1 nsec Systematic Error

Duty Cycle Ch A: 0% to 100% (provided pulse width is >1 nsec, and the signal period is:

< 1 msec (auto trigger)
< 2 sec [32.5 µsec] (manual trigger)

Repetition Rate: ≥ 0.5 Hz

Time between pulses: ≥ 8 nsec

Least Significant Digit Displayed: N = number of measurements averaged

$$\pm \frac{200\text{ ps}}{\text{Period}} \times 100\%$$

Resolution:

$$\pm \text{Duty Cycle} \times (150\text{ ps rms} \pm (1.4 \times \text{Trigger Error})) \times \sqrt{\frac{1}{(T_2 - T_1)^2} + \frac{1}{(T_3 - T_1)^2}}$$

Accuracy: $$\pm \text{Resolution} \pm \frac{\text{Trigger Level Timing Error} \pm 1\text{ nsec}}{\text{Period}} \times 100\%$$

Rise/Fall Time Ch. A: 1 nsec to 100 usec transitions (auto trigger)

Repetition Rate: ≥ 0.5 Hz

Time between pulses: ≥ 8 nsec

Least Significant Digit Displayed: N = number of measurements averaged

$$\pm \frac{200\text{ ps}}{\sqrt{N}}$$

Resolution: $$\pm \frac{150\text{ ps rms} \pm \text{Start Trigger Error} \pm \text{Stop Trigger Error}}{\sqrt{N}}$$

Accuracy: ± Resolution ± (Time Base Aging x [Rise Time or Fall Time]) ± Trigger Level Timing Error ± 1 nsec Systematic Error

WARRANTED SPECIFICATIONS (Continued)

Peak Envelope Power

HP 53702A (Pulse only, ON/OFF Ratio ≥ 15 dB)

Input Range	– 10.0 dBm to +6.0 dBm
Frequency Range	40 MHz to 500 MHz
Accuracy	± 2.0 dB

HP 54002A (Pulse and cw)

Input Range	–10.0 dBm to 10 dBm
Frequency Range	1 kHz to 200 MHz
Accuracy	± 2.0 dB

Input Characteristics

Channel A:
The following refers to an HP 5373A with an HP 53702A envelope pod installed. All measurements are referenced to an input of 0 dBm at 275 MHz.

Frequency Range:	30 MHz to 500 MHz
Flatness:	± 1.0 dB (40 MHz to 500 MHz)
Gain:	0 dB ± 0.5 dB
AM Range:	20% to 85%
AM Accuracy:	2.0 %
AM Frequency Range:	1 kHz to 9 MHz (typ)
Rise/Fall Time:	≤ 30 nsec
Minimum Pulse Width:	≤ 100 nsec
Minimum Off Time:	≤ 100 nsec
DC Output Voltage:	< 10 mv
Coupling:	ac
Input Impedance (nominal):	50 ohms
Max. Input Level:	+20 dBm

Channel B:
The following refers to an HP 5373A with an HP 54002A pod installed.

Range:	dc coupled to 500 MHz
Sensitivity:	-23.5 dBm (X 1 atten., minimum hysteresis) -27.0 dBm (typical)

WARRANTED SPECIFICATIONS (Continued)

Hysteresis control is available to reduce input sensitivity to trigger noise.

Dynamic Range:	X1: -23.5 dBm to +10 dBm X2.5: -14.8 dBm to +18 dBm
Coupling:	dc
Input Impedance (nominal):	50 ohms
Max. Input Level:	+16 dBm (X1 attenuation) +24 dBm (X2.5 attenuation)

Channel C:

Range:	100 MHz to 2000 MHz (divide by 4 prescale)
Sensitivity (0 dB atten):	-25 dBm (100 MHz to 1.5 GHz) -20 dBm (1.5 GHz to 2 GHz)
Dynamic Range:	-25 dBm to +7 dBm (100 MHz to 1.5 GHz) -20 dBm to +7 dBm (1.5 GHz to 2 GHz)
Trigger Level:	Fixed at 0V NOMINAL
Coupling:	ac
Input Impedance (nominal):	50 ohms (VSWR ≤ 2.5)
Max. Input Level:	+20 dBm

External Arm:

Range:	dc coupled to 100 MHz
Minimum Pulse Width:	5 nsec
Triggering Range:	±5 V adjustable in 20 mV steps
Input Impedance (nominal):	1M ohm, shunted by < 50 pf
Max. Input Level:	5 Vrms (±15 Vpk-pk, dc±peak ac)

Input Triggering Characteristics

		Manual Triggering	**Auto Trigger Single or Repetitive**
Voltage Range:			
HP 53702A		-2 Vdc to 0 Vdc	-2 Vdc to 0 Vdc
HP 54002A	X1	-2 Vdc to +2 Vdc	-2 Vdc to +2 Vdc
	X2.5	-5 Vdc to +5 Vdc	-5 Vdc to +5 Vdc
Frequency Range:			
HP 53702A		dc to 2 MHz	1 kHz to 2 MHz
HP 54002A		dc to 500 MHz	1 kHz to 200 MHz

WARRANTED SPECIFICATIONS (Continued)

Resolution:

HP 53702A	2 mV NOMINAL	1% steps (2mV min)
HP 54002A X1	2 mV NOMINAL	1% steps (2mV min)
X2.5	5 mV NOMINAL	1% steps (5mV min)
Accuracy:	20 mV±1% of setting	±20% of pk-pk amplitude (200 mV pk-pk minimum)

Measurement Control

Event Holdoff or Sample: 0 to 4^9 events (65,000 events with fast meas. mode)

Time Holdoff or Sample: 2 nsec to 8.0 sec (131 usec with fast meas. mode)

Edge Holdoff or Sampling: HP 5373A becomes armed after a delay from edge as follows:

<15 nsec Ext Arm arms A or B
<8 nsec B arms A, A arms B
<5 nsec A arms A, B arms B

Interval Sampling: 100 nsec to 8 sec (131 usec with fast meas. mode)

Cycle Sampling: Cycles of input signal or 500 MHz time base in discrete steps: 2^4, 2^8, 2^{12}, 2^{16}, 2^{20}, 2^{24}, 2^{28} (2^4, 2^8, 2^{12} with fast mode).

Random Sampling: Start of subsequent measurement delayed by a random number of events between 6 and 17 on channel A. Maximum input frequency 100 MHz.

Inhibit Input: Rear panel input will inhibit memory acquisition when signal is above/below threshold (programmable from front panel, or HP-IB). Inhibit is independent of other arming and sampling.

Pre-trigger: Measurement can be acquired before and after a pre-trigger event. These include an edge on the external arm channel for PRI/frequency, PRI/Period, or time interval measurements or a detected time interval value for time interval measurements.

WARRANTED SPECIFICATIONS (Continued)

Memory

1-8191 Measurements	1-4096 Measurements	1-4095 Measurements	1-2048 Measurements	1 meas. Measurements
Single channel fPRI/Frequency or PRI/Period Phase Deviation Time Deviation Frequency Deviation Continuous time interval (8190 measurements if edge, time, or event holdoff is used)	Time interval ± Time interval Rise/fall time Pulse width Off-time Externally gated single channel PRI/Frequency	Two channel PRI/Frequency Two channel PRI/Period Two channel phase Duty cycle Totalize (except when using extenal gate)	Totalize with external gate	All non-continuous measurements (refer to arming table, HP 5372A Specification Guide)

Rear Panel

Frequency Standard Output: 10 MHz, short term stability not specified

Frequency Standard Input: 1, 2, 5, or 10 MHz input

Gate Outputs: Falling TTL edge indicates measurement sample.

Delay Outputs: Falling TTL edge indicates completion of holdoff arming.

Inhibit Input: Programmable input level suppresses measurement acquisition.

TI Detect: Output is low for duration of out-of-range measurement.

FastPort Outputs (opt 020): Three 40 pin connectors provide unprocessed data directly from count hardware. 16 bits of data and 1 strobe for each connector.

WARRANTED SPECIFICATIONS (Continued)

Time Base

Type: 10 MHz ovenized oscillator

Aging Rate: < 5^{-10}/day, after 24 hour warm-up
< 1^{-7}/year for continuous operation

Short Term Stability: < 1^{-10} for 1 second average

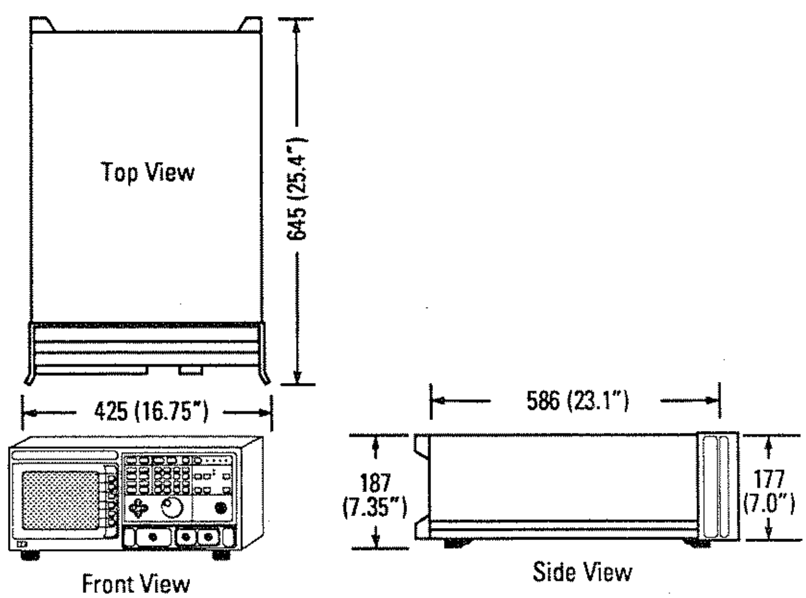
Warm-up Time: < 5^{-10} of final value,
10 minutes after turn-on at 25 C

General

Power Requirements: 100, 120, 220, or 240 Vac (±10%); 50, 60 Hz
500 VA max. 400 Hz for 100 and 120 Vac

Weight: Net, 23.2 kg (56 lbs) Shipping, 33.2 kg (80 lbs)

Operating Temperature: 0 to 40 C



Note: For measurements not described here, a complete description of specifications, as well as, operations characteristics, may be found in the HP 5372A Specification Guide (HP literature number 5952-8012. Measurements described in the data sheet supersede those in the Specification Guide for the HP 5373A.

Measurement Uncertainty Definitions

All measured values have associated uncertainties. The following are definitions of terms used to describe these uncertainties. For frequency and time interval measurements and other specific implementations (i.e. rise time, pulse width, duty cycle, etc.) this measurement uncertainty is composed of three factors: Least Significant Digit (LSD), Resolution, and Accuracy.

Least Significant Digit, Resolution, and Accuracy

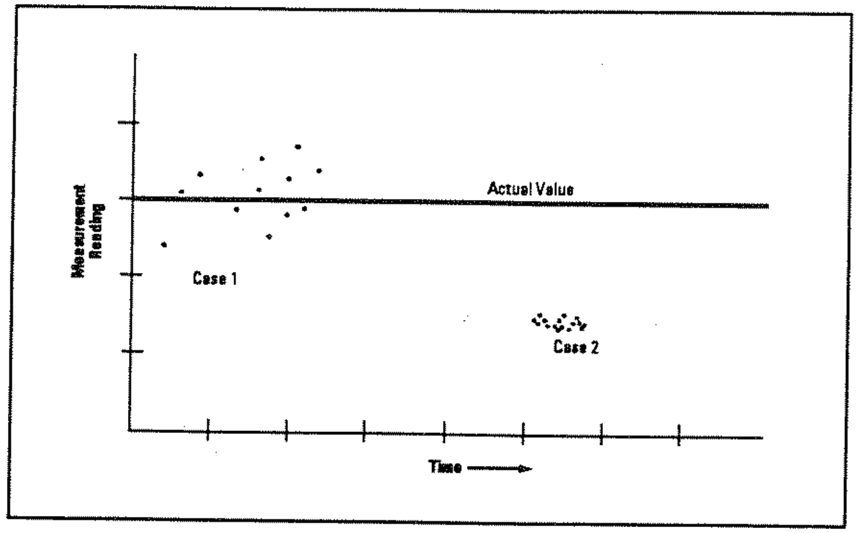
Least Significant Digit is the smallest incremental value displayed in a measurement. The LSD for the HP 5373A is 200 ps, therefore, the smallest displayed increment that two single-shot time interval measurements will differ by is 200 ps.

Resolution is the smallest difference in measurements that the instrument can discern. Measurement resolution is of primary concern when comparing data gathered by a single instrument; in other words, the meaning of results when compared against one another. Resolution describes uncertainty due to random effects, including short-term oscillator stability, trigger error, and the internal noise of the instrument itself. Since these effects are random, the resolution uncertainty is specified on an rms basis rather than a peak value. The time interval single-shot resolution of the HP 5373A is 150 ps rms. Resolution can also be improved by averaging single measurements, or in the case of frequency and period measurements, by increasing the measurement gate time as well as averaging measurements.

Accuracy is defined to be the combination of random uncertainties and systematic or bias uncertainties in a measurement. Accuracy is of primary concern when comparing data in an absolute sense, such as one production test station to the next. Systematic uncertainties include differential channel delay, long term drift or time base oscillator aging, and Trigger Level Timing Error. These uncertainties may be measured and removed from subsequent measurement data by subtracting the measured bias. Two methods are available to do this with the HP 5373A:

1) the Set Reference feature for each input channel, or
2) the HP J06-59992A Time Interval Calibrator.

Accuracy = Random Errors + Systematic Errors



Case 1 shows the results of random uncertainties (resolution) limiting measurement precision. Case 2 shows the results of systematic uncertainty limiting measurement precision. Accuracy specifications must include both systematic and random effects.

Trigger Error and Trigger Level Timing Error

Resolution and accuracy equations consist of two terms which describe uncertainties due specifically to triggering. These terms are separated from others since they are, in general, dependent upon the user's signal. The following describes these input trigger uncertainties.

Trigger Error is a random uncertainty caused by noise on the input signal. Trigger Error can be minimized by careful grounding and shielding techniques to minimize noise, and maintaining as high a signal slew rate as possible for the input to the HP 5373A. The following equation is used to quantify trigger error.

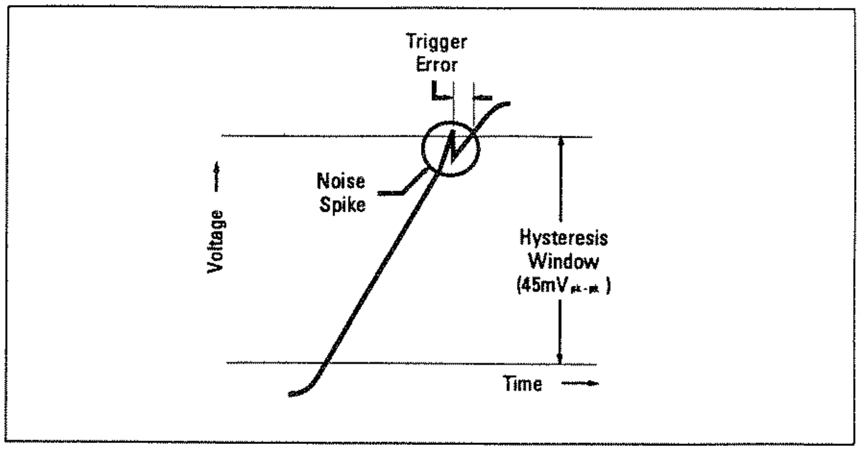
$$\text{Trigger Error} = \frac{\sqrt{(E_{amp})^2 + (E_n)^2}}{\text{Input Signal Slew Rate}}$$

Where:

E_{amp} is the typical rms input amplifier noise (200 µV rms typical).

E_n is the rms noise of the input signal over a 500 MHz bandwidth.

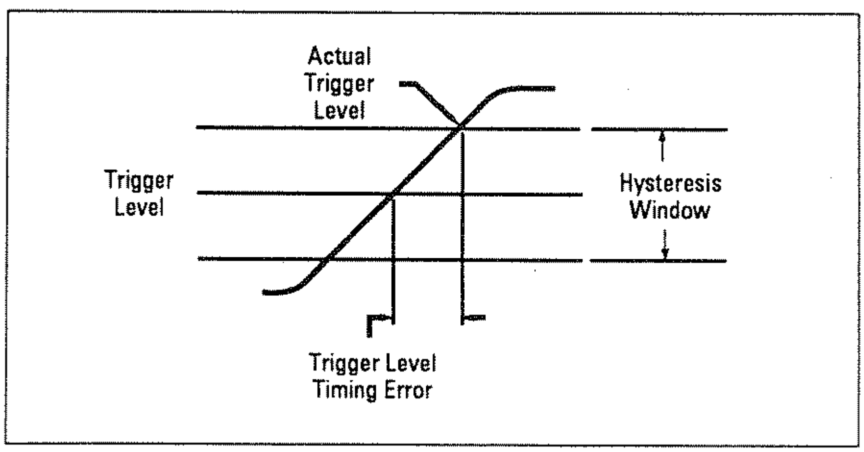
The input signal slew rate value is determined at the trigger point.



Trigger Error is due to noise on the input signal. Here a noise spike causes an 'early' trigger.

Trigger Level Timing Error is a systematic uncertainty due to the input hysteresis of the HP 5373A. Trigger Level Timing Error is a constant value for any particular signal and slew rate, but the effects will vary with amplitude and slew rate. Trigger Level Timing Error can be minimized by maintaining as high an input signal slew rate as possible, and can be removed by careful calibration with the HP J06-59992A Time Interval Calibrator.

$$\text{Trigger Level Timing Error} = \left(\frac{0.5 \times \text{Hysteresis Window}}{\text{Start Input Signal Slew Rate}} - \frac{0.5 \times \text{Hysteresis Window}}{\text{Stop Input Signal Slew Rate}} \right) \pm \frac{\text{Trigger Level Accuracy (start)}}{\text{Start Input Signal Slew Rate}} \pm \frac{\text{Trigger Level Accuracy (stop)}}{\text{Stop Input Signal Slew Rate}}$$



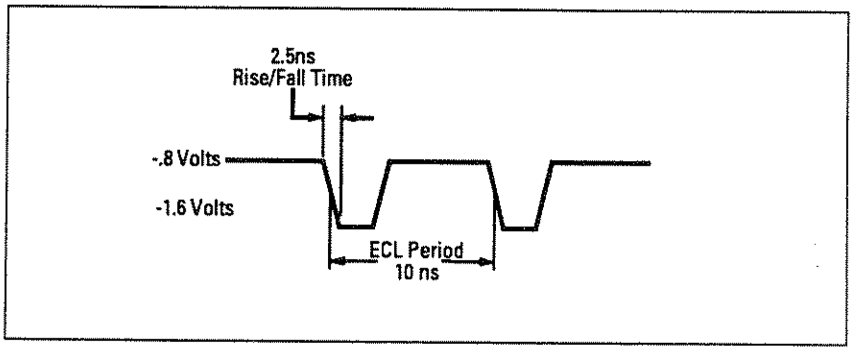
Trigger Level Timing Error is a systematic uncertainty. It is constant for any particular signal slew rate.

Example Measurements and Uncertainty Calculations

The following are measurement examples to illustrate the use of the measurement uncertainty equations for typical measurement applications. In these examples, the specific values have been entered into the complete equation. In practice, the associated graphs of these equations can be used to determine various uncertainties.

ECL Edge-to-Edge, or Single-Period Measurement

A single-shot period measurement is made from falling edge to falling edge of a ECL signal. The input signal has 1 mV rms of noise with a fall time of 2.5 ns over an 800 mV swing. The HP 54002A 50Ω input pod is used with a -2 volt termination. The measured value is 10.0 ns. It has been 1 month since the HP 5373A time base has been calibrated.



Measurement uncertainty example using Time Interval to measure from falling edge to falling edge of an ECL signal.

Least Significant Digit Displayed:

= ± 200 ps

Resolution:

= ± 150 ps rms ± Start Trigger Error ± Stop Trigger Error

$$= \pm 150 \text{ ps rms} \pm \frac{\sqrt{(200\ \mu\text{V rms})^2 + (1 \text{ mV rms})^2}}{0.32 \text{ V/ns}} \pm \frac{\sqrt{(200\ \mu\text{V rms})^2 + (1 \text{ mV rms})^2}}{0.32 \text{ V/ns}}$$

= ± 156 ps rms

Accuracy:

= ± Resolution ± (Time Base Aging x Pulse Width) ± Trigger Level Timing Error ± 1 ns Systematic Error

$$= \pm 156 \text{ ps rms} \pm (5 \times 10^{-10} \times 30 \text{ days} \times 10 \text{ ns}) \pm \left[\left(\frac{22.5 \text{ mV}}{0.32 \text{ V/ns}} - \frac{22.5 \text{ mV}}{0.32 \text{ V/ns}} \right) \pm \frac{24 \text{ mV}}{0.32 \text{ V/ns}} \pm \frac{24 \text{ mV}}{0.32 \text{ V/ns}} \right]$$

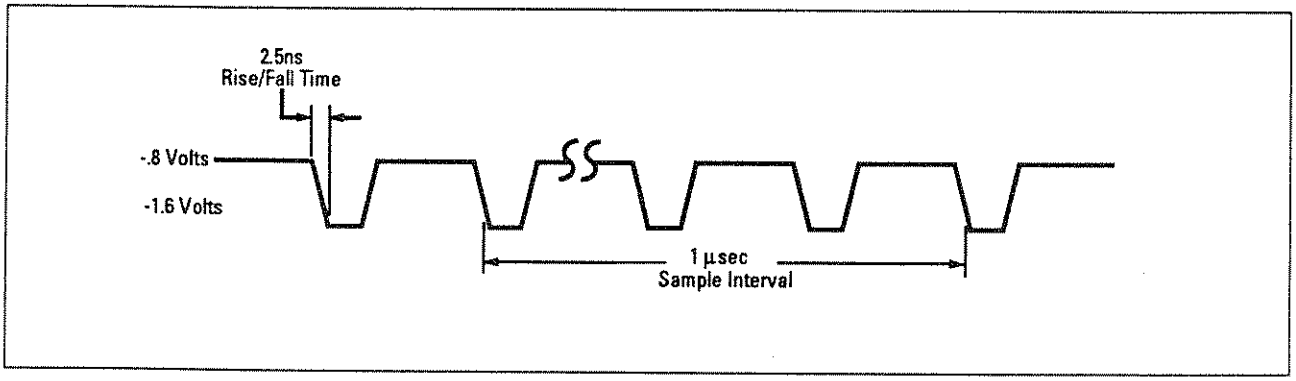
± 1 ns Systematic Error

= ± 1.31 ns

Note that a major portion of the measurement accuracy consists of the 1 ns systematic term. This can be reduced to less than 10 ps with careful calibration using the HP J06-59992A Time Interval Calibrator.

ECL Frequency Measurement

A Frequency measurement is made on a 100 MHz ECL signal with a 1 μs sample interval. The signal has 1 mV of noise with a transition time of 2.5 ns over an 800 mV swing. The HP 54002A 50Ω input pod is used with a -2 volt termination. It has been 1 month since the HP 5373A time base has been calibrated.



Measurement uncertainty example for a Frequency measurement on an ECL signal.

Least Significant Digit Displayed:

$$= \pm \frac{200 \text{ ps}}{\text{Sample Interval}} \times \text{Frequency}$$

$$= \pm \frac{200 \text{ ps}}{1\ \mu\text{s}} \times 100 \text{ MHz}$$

$$= \pm 20 \text{ kHz}$$

Resolution:

$$= \pm \frac{150 \text{ ps rms} + (1.4 \times \text{Trigger Error})}{\text{Sample Interval}}$$

$$= \pm \frac{150 \text{ ps rms} + \left(1.4 \times \frac{\sqrt{(200\ \mu\text{V rms})^2 + (1 \text{ mV rms})^2}}{0.32 \text{ V/ns}}\right)}{1\ \mu\text{s}} \times 100 \text{ MHz}$$

$$= \pm 15.4 \text{ kHz}$$

Accuracy:

$$= \pm \text{Resolution} \pm (\text{Time Base Aging} \times \text{Frequency})$$

$$= \pm 15.4 \text{ kHz} \pm (5 \times 10^{-10} \times 30 \text{ days} \times 100 \text{ MHz})$$

$$= \pm 15.4 \text{ kHz}$$

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Product Line Sales/Support Key

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A Analytical
CM Components
C Computer Systems
E Electronic Instruments & Measurement Systems
M Medical Products
P Personal Computation Products
* Sales only for specific product line
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IMPORTANT: These symbols designate general product line capability. They do not insure sales or support availability for all products within a line, at all locations. Contact your local sales office for information regarding locations where HP support is available for specific products.

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