Errata

Title & Document Type: 5371A Operating Manual

Manual Part Number: 05371-90030

Revision Date: March 1990

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

O P E R A T I N G M A N U A L

HP 5371A
Frequency and Time Interval Analyzer

MANUAL APPLICABILITY

This manual applies directly to an HP 5371A having the serial number prefix listed below. If your instrument serial prefix number is higher than the one listed below, refer to the "Manual Updating Changes" included with this manual. If your instrument serial prefix number is lower than the one listed below, refer to HP 5371A Operating Manual having HP Part Number 05371-90012.

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

SERIAL NUMBER
Serial Number Prefix: 3018A

Edition 4
E0390

Manual Part Number 05371-90030
Microfiche Part Number 05371-90031

Printed MARCH 1990

HEWLETT PACKARD

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 Bureau of Standards, to the extent allowed by the Bureau'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.

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 Operating Manual, Appendix B, INSTALLATION.

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.
⏊ OR ⊥	Indicates terminal is connected to chassis when such connection is not apparent.
∿	Alternating current.
⎓	Direct current.

The **WARNING** sign 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.

The **CAUTION** sign 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.**

PRINTING HISTORY

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional pages and replacement pages to be merged into the manual by the user. Title page dates change only when a new edition or a new update is published.

Many product updates and improvements do not require manual changes and, conversely, manual corrections are sometimes independent of product changes. Therefore, there will not be a one-to-one correspondence between product updates and manual updates.

Edition 1	10/87	05371-90003	E1087
Edition 2	4/88	05371-90012	E0488
Edition 3	12/88	05371-90012	E1288
Edition 4	3/90	05371-90030	E0390

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INTRODUCTION

INTRODUCTION

INTRODUCTION

The Hewlett-Packard 5371A Frequency and Time Interval Analyzer makes both frequency and time interval measurements at rates of up to 10 million measurements-per-second. The 5371A analyzes this data, turning it into useful information by producing statistics, histograms, time variation graphs, and performing limit tests. The 5371A 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 5371A provides full HP-IB programmability, and a powerful set of arming and triggering features which allow you to precisely select waveform features to be measured.

The HP 5371A Key Features

The key features include:

- Up to 10 million measurements-per-second
- DC to 500 MHz frequency range
- –4.0 to +4.0 second time interval range
- 1 ns minimum pulse width
- 2 mV trigger level resolution
- Automatic voltage triggering
- 1000 measurement acquisition memory (4095 over HP-IB)
- Measurement arming by signal edge, time, events
- Hardcopy output to printer or plotter
- Ten front panel setup save/recall registers
- Fully programmable over the HP-IB

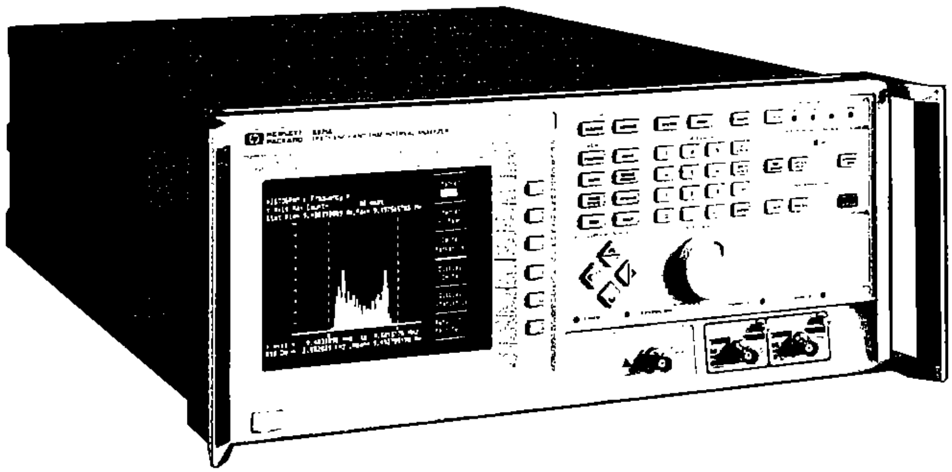
ACCESSORIES SUPPLIED

The HP 5371A Frequency and Time Interval Analyzer is supplied with a detachable power cable as shown in *Figure 1.* 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.

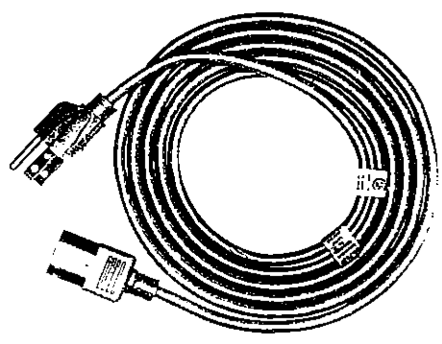
ACCESSORIES AVAILABLE

The following accessories are available for the HP 5371A:

- 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 05371-67001 Service Support Kit



HP 5371A



POWER CORD

Figure 1. HP 5371A Frequency and Time Interval Analyzer

OPTIONS AVAILABLE

The following options are available for the HP 5371A:

- 060 Rear Panel Inputs for Channels A, B (50Ω BNC), and External Arm (1 MΩ BNC). No pod selection available with Option 060.
- 908 Rack mount kit for mounting without front handles
- 910 Additional operating manual and programming manual
- 913 Rack mount kit for mounting with front handles
- 915 Service Manual (The Service Kit is required in order to troubleshoot to the component level, perform adjustments, and calibrate the HP 5371A.)
- 0KP Service Kit — The Service Kit includes the following:
  - Extender boards, cables, and probes
  - HP-IB operation verification disks
  - Service training video tape
  - Operating, programming, and service manuals
- W30 Extended Hardware Support provides two additional years of return-to-HP hardware-service support. Option W30 is available only at time of purchase. Service contracts are available from Hewlett-Packard for instruments that did not include Option W30 at time of purchase. For more information, contact your nearest Hewlett-Packard Sales and Support office (offices are listed at the back of this manual.)

HP 5371A 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. This unlisted serial number prefix indicates 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 in 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.

HOW TO USE THIS MANUAL

Aside from Section 1, GETTING STARTED, this manual is organized as a reference manual. The measurement functions are covered first:

- Time Interval Measurements
- Frequency/Period Measurements
- Specialized Measurements

Following this is a description of each of the arming modes:

- Arming

Then, front panel features are described:

- Front Panel Overview

And each menu selection key is described its own section:

- Function
- Input
- Math
- Instrument State
- System
- Test
- Help

Measurement results are reviewed:

- Numeric Results
- Graphic Results

The rear panel is then described:

- Rear Panel

Then, operation verification and testing to the instrument's specifications:

- Performance Tests

And finally, appendices describing the following:

- Menu Reference Guide
- Installation
- Status and Error Messages
- Measurement Suggestions
- Specifications

1 GETTING STARTED

1 GETTING STARTED

SUMMARY

The purpose of this section is to provide a "hands-on" tutorial that will help you become familiar with most of the HP 5371A features. This section is designed to be completed in about two hours, but you may take more or less time depending on your objectives. If you do complete this section, you should be able to use the rest of this manual to help you be successful at using the HP 5371A for your applications.

This section introduces you to the HP 5371A by having you perform some basic tasks:

- By making some measurements and analyzing the results, you will become comfortable pressing the front-panel keys and learn how the front panel controls are organized.
- You will measure a signal with one of the more powerful arming setups.
- You will be better prepared to make the best use of this operating manual.

Information is presented in this section on two levels.

1. Step-by-step procedures to perform a series of tasks.
2. Associated information to explain more fully the action being taken, or comments on how a particular step fits into the overall instrument operation.

> This associated information is set off from the rest of the text by indentation and the use of a different type face. If your time is limited, refer to this information only when you want an explanation of the action being taken. It is recommended that you do read this text to get the full benefits of this Getting Started section.

So, let's get started.

UNPACK THE HP 5371A

ASSUMPTION: The 5371A is still in its packing carton. If the 5371A is already unpacked, go to "TURN ON THE 5371A."

1. Carefully remove the 5371A from its shipping carton.

> The weight of the instrument is 23.2 kg (51 lbs.), so you may need help lifting the 5371A from its shipping carton.

2. Save all packing material.

   You may need to reuse it. The carton and packing inserts will help protect your 5371A when it needs to be stored, or shipped somewhere else.

3. Keep the HP 5371A documentation near the instrument.

   The Operating Manual is written to help you understand and use the 5371A. Refer to it for specific questions about how particular functions operate.

TURN ON THE HP 5371A

ASSUMPTION: The 5371A is not plugged into a power outlet yet. If the 5371A is already plugged in, go to step 3 below.

1. Before applying power to the 5371A for the first time, check the voltage setting at the rear panel power module. Be sure it matches your local voltage supply.

   If your voltage supply is nominally 120V, you should see "120Vac" through the cutout in the power module cover. To change the setting, refer to Appendix B, INSTALLATION.

WARNING

Before energizing this unit, you must ensure that the chassis of the instrument is properly grounded. This precaution is to avoid the possibility of electrical shock which may result if the protective ground is defeated.

The HP 5371A is provided with a three-wire power cable. When this cable is connected to an appropriate ac power receptacle, it provides a ground for the instrument chassis.

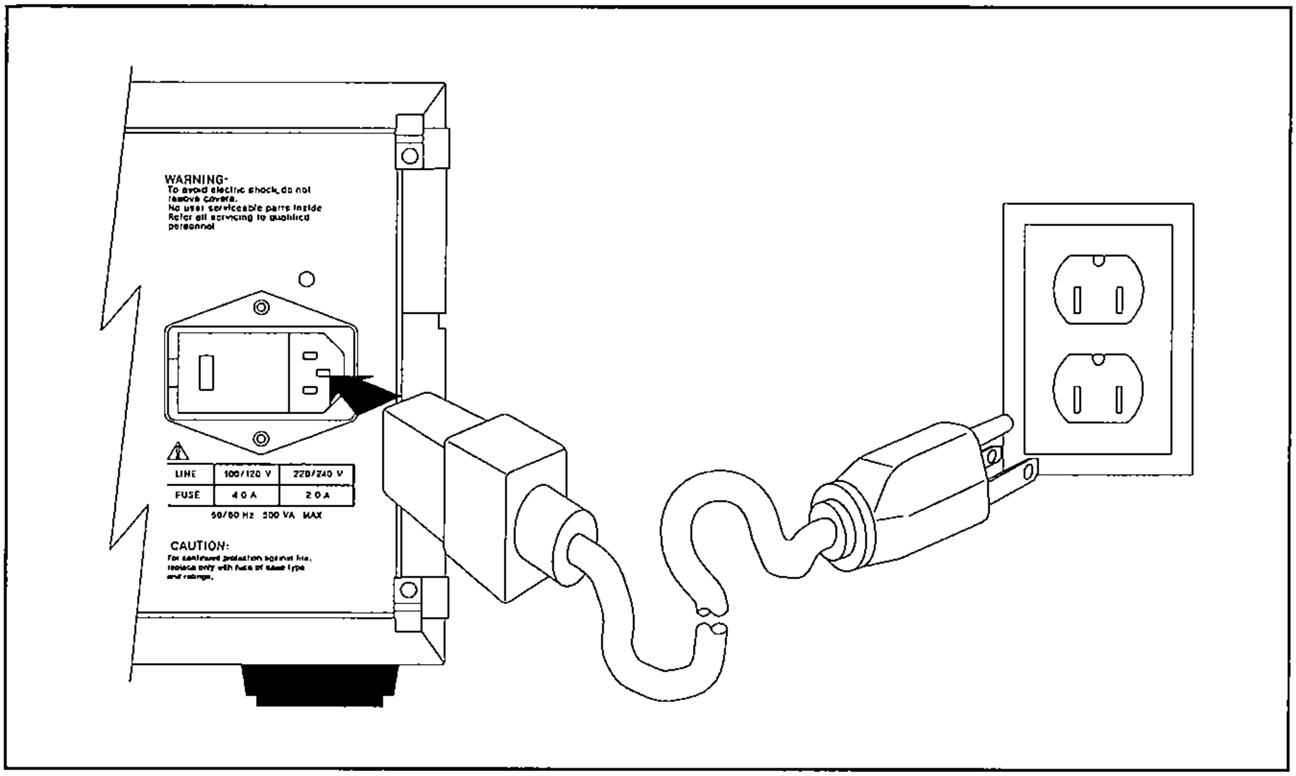


Figure 1-1. Rear Panel Power Module

2. Connect the power cord between the instrument and the power outlet. The standby LED will turn on.

   The Standby LED indicates that even without the HP 5371A being on, the internal timebase crystal is being kept at a controlled temperature. The crystal is inside an oven device that operates as long as the instrument is plugged into a power source. It does not matter whether the HP 5371A power switch is set to STBY or ON to keep the oven operating. This ensures that you have an extremely accurate reference source whenever you use the HP 5371A. [The reference timebase crystal stabilizes after a 24-hour warm-up period.]

3. Set power switch to ON.

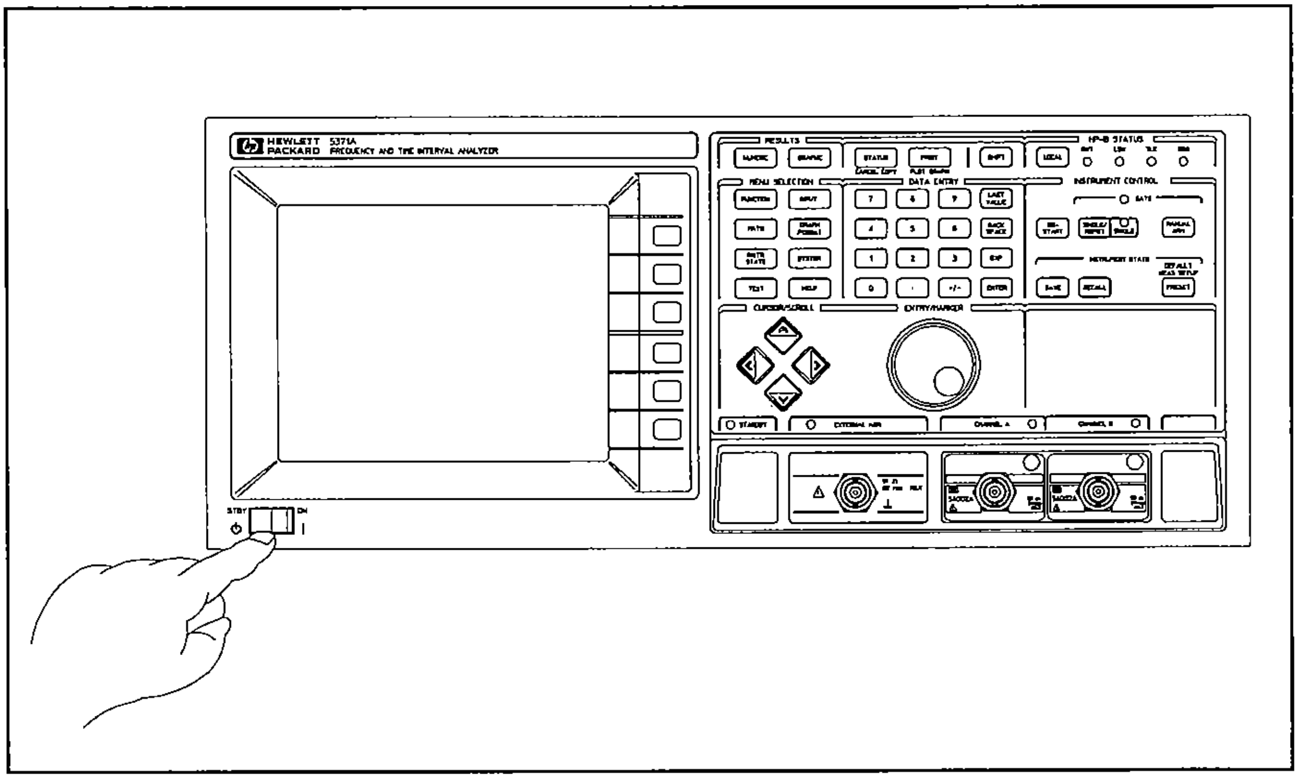


Figure 1-2. Front Panel Power Switch

The 5371A will run through some internal tests to make sure it is working correctly. The CRT displays,

PERFORMING SELF TEST...

The CRT (cathode ray tube) warm-up and instrument testing take 10-15 seconds. At the completion of the power-up testing, a FUNCTION menu screen will be displayed.

The HP 5371A can store instrument setups in memory. This information is preserved by battery power when the power cord is disconnected from the power source or when the instrument is set to Standby. During the turn-on procedure, the last selected measurement setup before power to the HP 5371A was interrupted is recalled and the measurement is restarted. The measurement and display memories are cleared.

If the power-on memory verification test fails, default settings normally selected by the PRESET key are used. A time interval measurement on the Channel A input signal is the default measurement.

In the next procedure, you will measure a signal that you provide. This exercise will give you a feel for how to make measurements with the HP 5371A and review the results.

MAKE SOME SIMPLE MEASUREMENTS

ASSUMPTION: The HP 5371A is powered-up and ready to use. If not, go back to TURN ON THE HP 5371A.

Equipment Requirements:

Set up a signal source with the following characteristics:

- A 50Ω output impedance
- A 1 MHz, square wave signal
- Nominal 100 mV p-p

NOTE

Set "2.5:1" attenuation for Channel A on the INPUT key screen if the amplitude of your signal is between 2 Volts and 5 Volts. Another alternative is to use a divider probe to reduce the amplitude of your signal below the 2 Volt limit for the 1:1 default attenuation setting.

1. Press the green PRESET key to place the HP 5371A into a default operating condition. The FUNCTION menu screen should look like the one shown below.

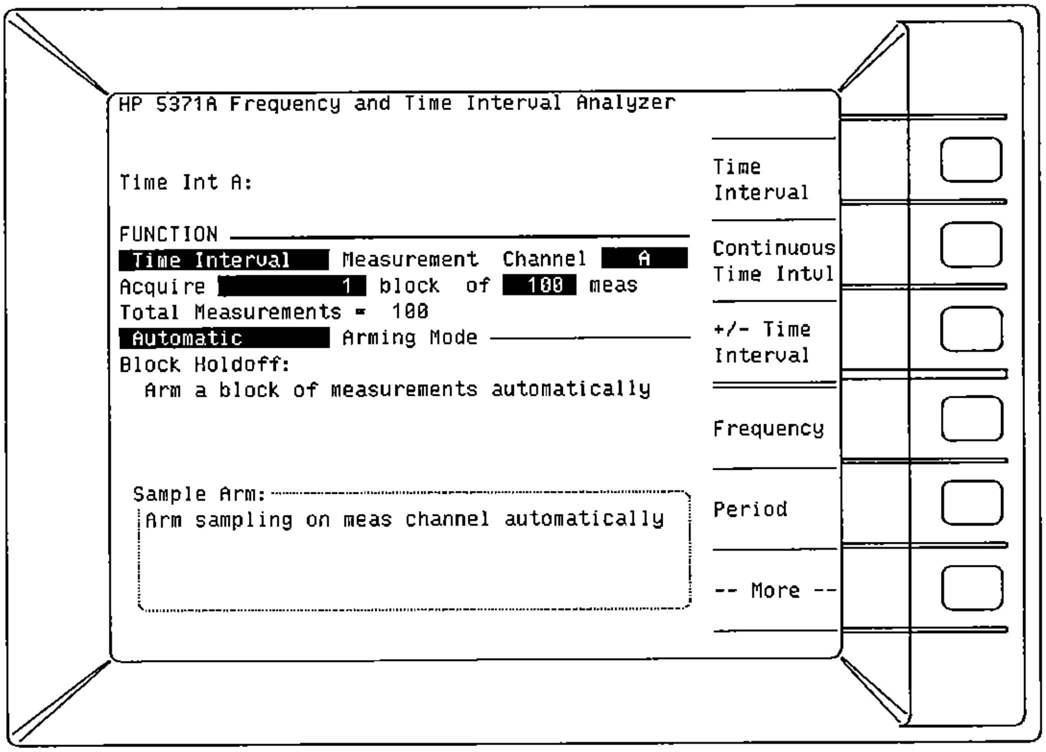


Figure 1-3. Preset Function Screen

2. Connect a BNC cable from your signal source to the HP 5371A front panel Channel A input.

The 5371A will begin measuring as soon as it's ready. The measurement is Time Interval on Channel A. A time interval measurement on a single channel measures the period of the input signal.

The top line of the CRT is reserved for the display of general information messages, error messages, and failures. It is called the Status Line. Just below the status line are the measurement lines. These two lines can display measurement data for one or two input channels simultaneously. For your first measurement, only the upper line will be used because you are making a one-channel measurement. You will see the type of measurement being made along with the value measured. In this case, the measurement line will read,

Time Int A: (approximately 1 μs)

The HP 5371A is making 100 measurements at a time. After each group of measurements, the data memory is cleared, and the process begins again.

3. Make a Frequency Measurement

The following measurement procedure introduces you to the menu screen controls. Included here is an overview of these controls.

The HP 5371A is operated by pressing a combination of "hardkeys," "softkeys," and "cursor keys."

HARDKEYS are the front panel keys with labels. For example, the MATH key, HELP key, and RESTART key are all hardkeys.

SOFTKEYS are the six keys just to the right of the CRT display. These softkeys are more flexible than the hardkeys because their functions change as the menu screens change.

There is a total of ten menu screen keys, two in the RESULTS group and eight in the MENU SELECTION group. If you haven't done so already, press some of the RESULTS and MENU SELECTION hardkeys and see how the options alongside the softkeys change.

The CURSOR KEYS are the four, diamond-shaped keys grouped below the menu screen keys. The cursor keys move what's called the "menu cursor."

The MENU CURSOR is the highlighting that moves on the display from menu field to menu field in response to pressing the cursor keys. As you use the cursor keys to move the menu cursor, notice how the softkey options change to show your choices for the menu field selected.

o PRESS: PRESET key

Pressing the PRESET key here brings you back to the starting point. Use the PRESET key whenever you find yourself lost among the different screens or if you just want to start over setting the operating characteristics of the HP 5371A. In case you accidentally press the PRESET key, you can retrieve your last instrument setup by pressing the RECALL key and "0" on the DATA ENTRY keypad. The current instrument setup is always stored away in Register "0" when the PRESET key is pressed.

The area of the display screen from the title of the screen (FUNCTION in this case) to the bottom of the display is called the Data Area. Most of the instrument operations are selected in the Data Area.

Instrument operations, such as measurement setups, input signal conditioning, math and graph default values, and HP-IB configuration, are selected through a combination of the menu screen hardkeys, softkeys, and cursor keys. Numeric values are entered using the DATA ENTRY keypad.

- PRESS: **More** softkey, if necessary, to display the softkey options listing Time Interval at the top.

  Displayed alongside the softkeys are the HP 5371A measurement types. Notice that the name of the current measurement, Time Interval, is displayed using extra-bright letters. This convention is used for the HP 5371A softkeys so you can identify the selected softkey option at a glance.

- PRESS: **Frequency** softkey

  Now the HP 5371A is displaying the frequency of the signal at the Channel A input. The default arming mode, Automatic, has been making measurements as quickly as possible. The next several steps have you change the arming mode demonstrating how you can set the time over which each measurement will be made.

- MOVE: Menu Cursor to "Arming Mode" field. (The fields are the inverse video boxes. They are referenced according to the upper and lower case words closest to them.)

- PRESS: Top softkey to select **Sample**

- PRESS: **Interval Sampling** softkey

  A 10 microsecond interval is the default setting for this arming mode. You can think of the interval as the gate time for a traditional counting instrument. The FUNCTION screen should look like the one shown in *Figure 1-4*.

  As you spend more time with the HP 5371A, you will see how the defaults work. Using the front panel, it is impossible to set an instrument parameter to an invalid condition for the measurement and input channels you have selected. As a result, parameters such as arming mode, measurement size, and channel setting on the FUNCTION screen and trigger event information on the INPUT screen may default to new values depending on how compatible the current setup is with the new one being selected. When this happens, a message will be displayed momentarily on the STATUS line of the display screen as a reminder.

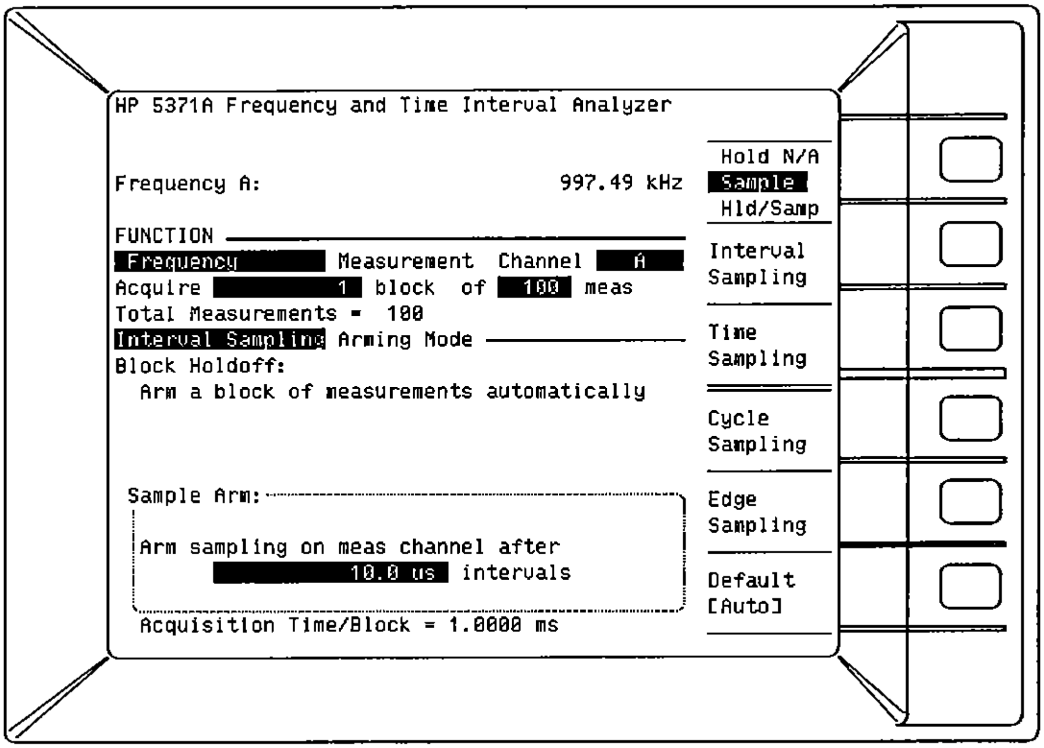


Figure 1-4. Frequency with Interval Sampling Screen

Since these instrument parameters are spread over a number of screens, a handy feature of the HP 5371A is the STATUS screen. Press the STATUS key, and at a glance you can see a summary of the FUNCTION, INPUT, and MATH screen settings. Return to the FUNCTION screen before continuing.

- O MOVE: Menu Cursor to "meas" field

  This will allow you to modify the number of measurements being collected.

- O PRESS: "1" on the Data Entry keypad

- O PRESS: ENTER

  This reduces the number of measurements per block to one.

O MOVE: Menu Cursor to "intervals" field

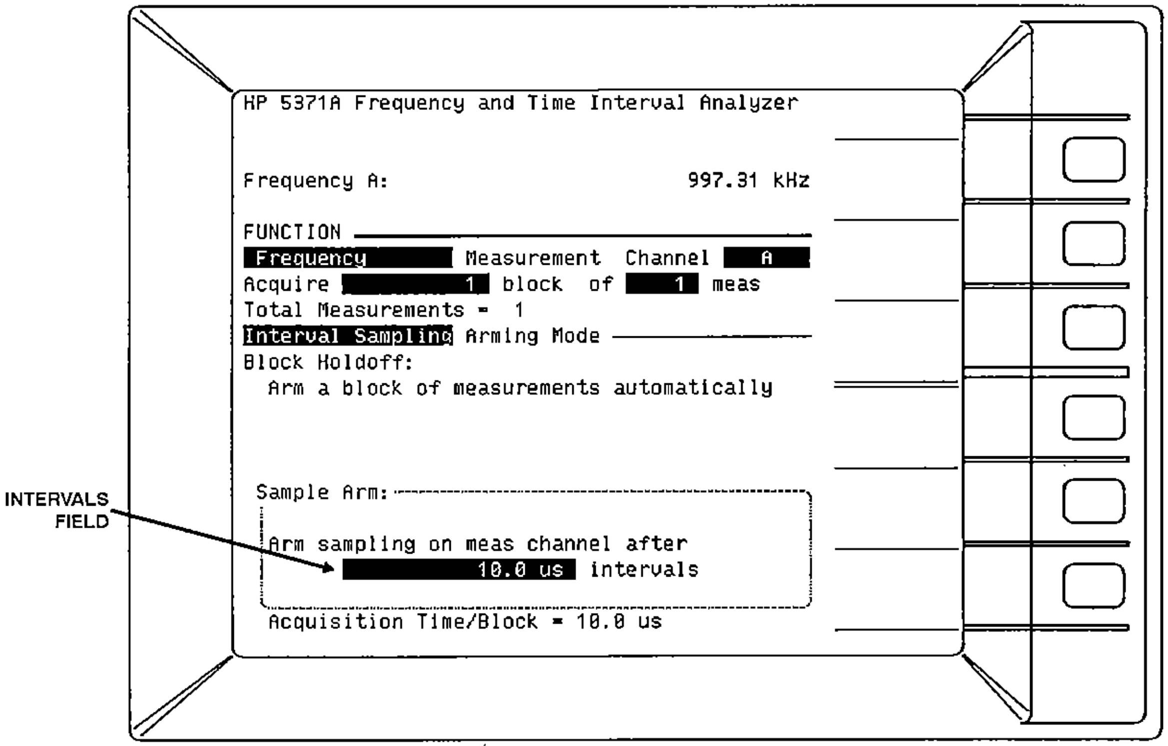


Figure 1-5. Intervals Field

O PRESS: "1" on the Data Entry keypad

O PRESS: ENTER

Each time numeric values are typed in from the numeric keypad, the ENTER key must be pressed to conclude an entry, unless you can use the numeric qualifier softkeys as explained below. You have now increased the resolution of the frequency measurement result by increasing the amount of time over which the frequency events are collected. The interval of each measurement has been increased from 10 microseconds to 1 second. The GATE LED should be flashing at a one second rate.

O PRESS: "1", "0" on the Data Entry keypad

O PRESS: **us** softkey

You have changed the sampling interval back to 10 microseconds. When you use the softkey numeric qualifiers, there is no need to press the ENTER key.

- PRESS: PRESET key

  You have returned again to a Time Interval on Channel A measurement.

  Up until now, the HP 5371A has been in a free-run mode. It has been making measurements as soon as it is ready. One way to have control over when the HP 5371A measures is to select the SINGLE acquisition mode. This will be handy for halting the HP 5371A after a measurement sequence so you can view and analyze the collected data.

4. Select the SINGLE acquisition mode

- PRESS: SINGLE/REPET key

  The HP 5371A makes 100 measurements and stops. The SINGLE LED will turn on. Note that the GATE LED is off now instead of constantly flashing as in the REPETITIVE mode.

- PRESS: RESTART key

  The HP 5371A makes 100 measurements each time the RESTART key is pressed while in the SINGLE acquisition mode.

  A powerful aspect of the HP 5371A is the ability to measure, store, and analyze a group of measurements. The following steps have you examine some of the statistics and graphics features.

- PRESS: SINGLE/REPET key (to turn off SINGLE acquisition mode)

  The HP 5371A is now making a group of 100 measurements, repetitively. On the FUNCTION menu screen, you can see only one measurement result. This is the first one of the group. The next step demonstrates how to view the rest of the collected data.

5. Review Measurement Data.

- PRESS: NUMERIC key

  The first twelve measurements of each block are displayed. One purpose of the NUMERIC screen is to list the measurements you have collected. This screen can also display statistical data, data that falls outside specified limits, gate data for frequency/period/totalize measurements, and number of missed events for time interval measurements.

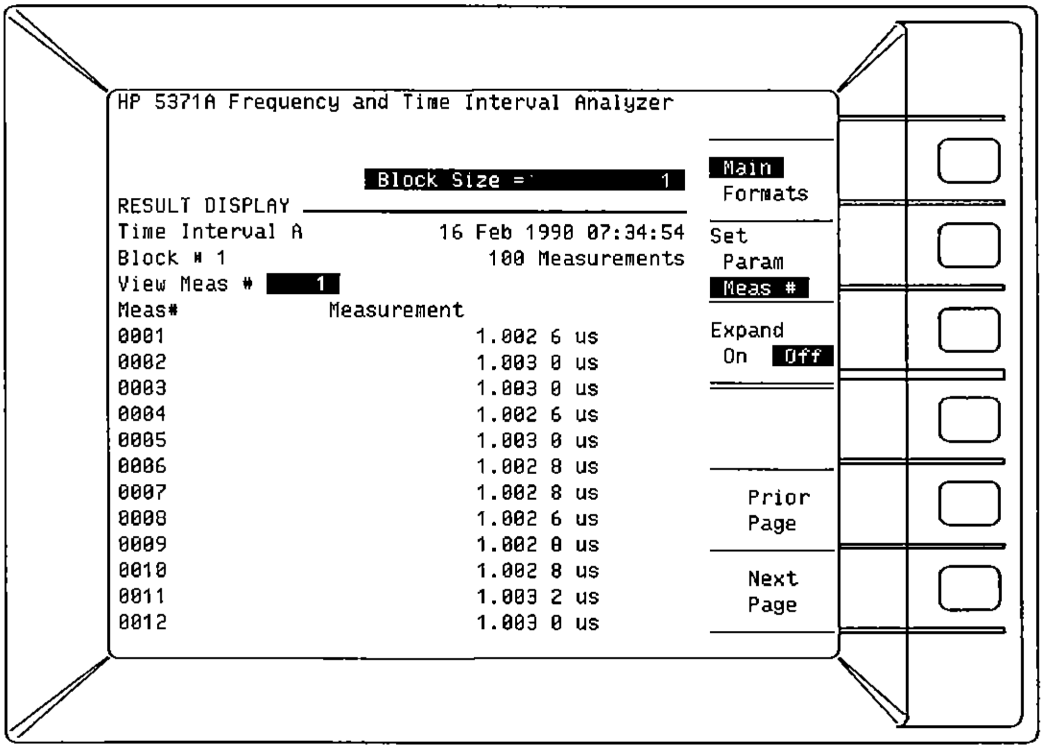


Figure 1-6. Measurement Results

  This screen displays the type of measurement, along with the date and the time that each group of measurements is completed. The clock updates at the completion of each measurement cycle. For this setup, it is after each block of 100 measurements.

- PRESS: SINGLE/REPET key (turns on SINGLE acquisition mode) The HP 5371A will make 100 measurements and stop.

You can see the first twelve measurements of the 100. To see the remaining 88 measurements:

- O PRESS: **Next Page** softkey (to see measurements 13-24)

- O PRESS: **Next Page** softkey again (to see measurements 25-36)

The measurements can also be scrolled one at a time, up or down, using the up and down cursor keys.

Select a particular measurement result for viewing:

- O PRESS: **Set** softkey to select **Meas #**

The Set softkey alternates between "Meas #" and "Param" options. When a softkey can select one of two options, the currently selected function is shown with inverse video. The softkey operates as a toggle switch.

Another way to move the Menu Cursor to the "View Meas #" field is with the right or left cursor key.

- O PRESS: The number of the measurement result you want to see on the DATA ENTRY keypad (1 to 100)

- O PRESS: ENTER

The selected measurement moves to the top of the result list.

Another way to move (scroll) the list of measurements and data up or down is with the up or down CURSOR/SCROLL key.

When "Meas #" is selected, you can also scroll the list up or down via the ENTRY/MARKER knob.

6. Review Mathematical Data

Now that you have all this measurement data, let's look at some of the analysis features available. You can easily do statistical calculations by enabling the statistics functions on the MATH screen as follows:

- PRESS: MATH key
- MOVE: Menu Cursor to the Channel A Statistics field
- PRESS: **On** softkey

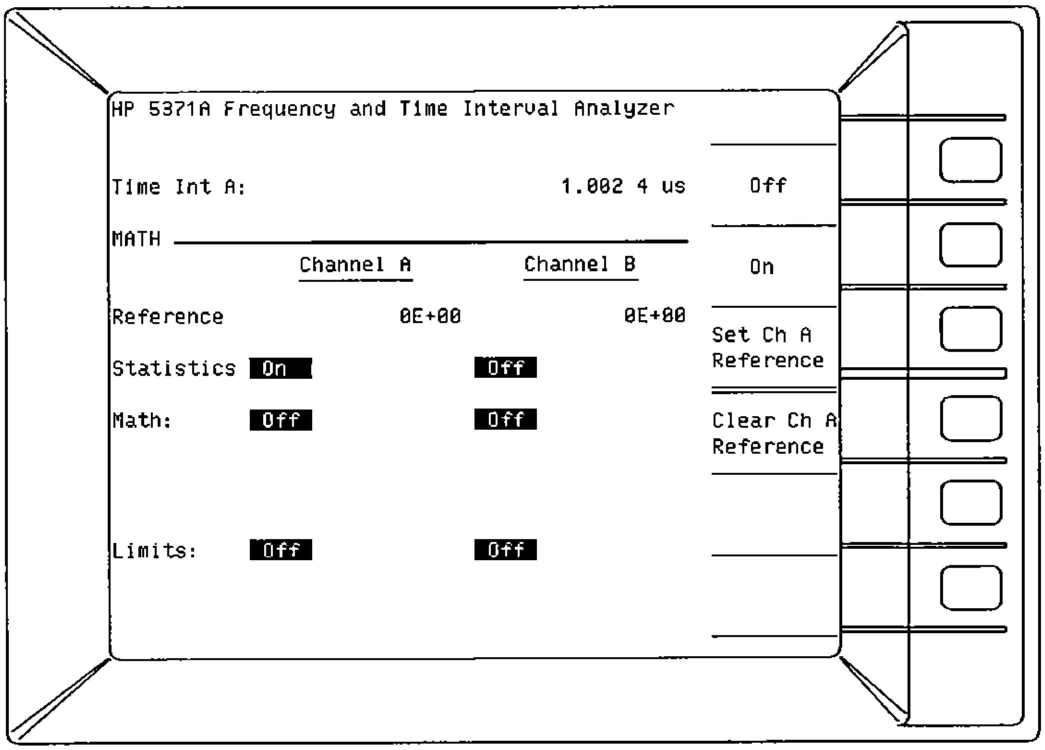


Figure 1-7. Math Screen

- PRESS: NUMERIC key
- PRESS: Top softkey to select **Formats**

o PRESS: **Statistics** softkey

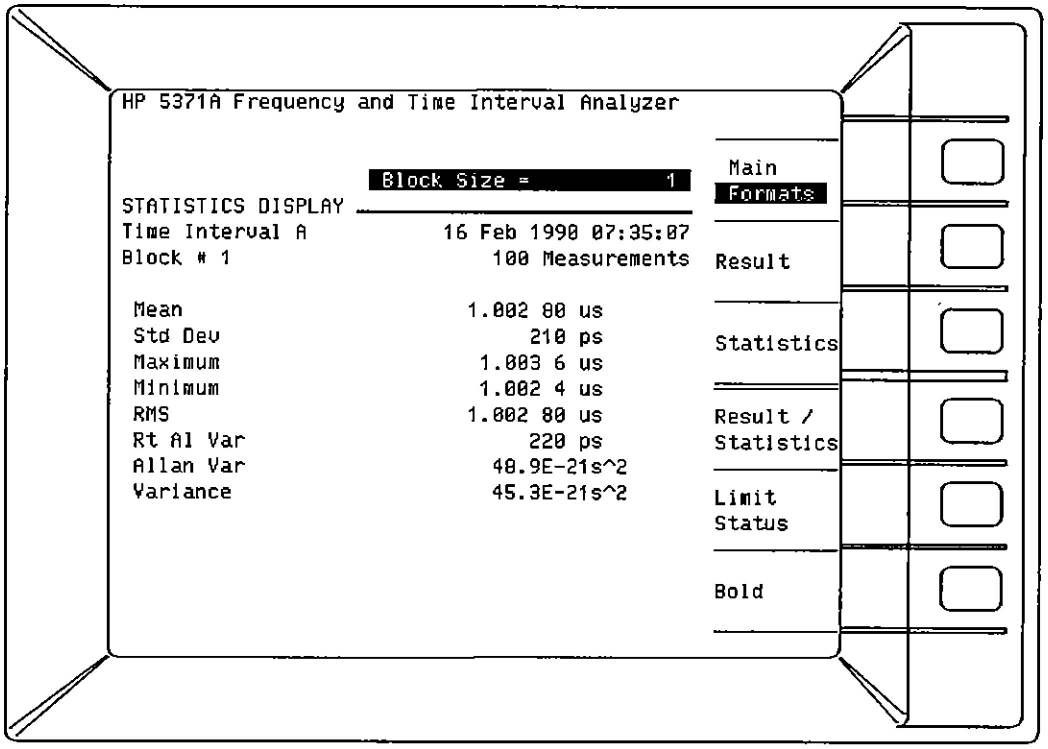


Figure 1-8. Statistics Screen

Eight statistical values are displayed:

- Mean
- Standard Deviation
- Maximum
- Minimum
- RMS
- Root Allan Variance
- Allan Variance
- Variance

You can find an explanation of each of these statistical functions in Section 9, MATH MENU. To view results and statistics together:

o PRESS: **Result/Statistics** softkey

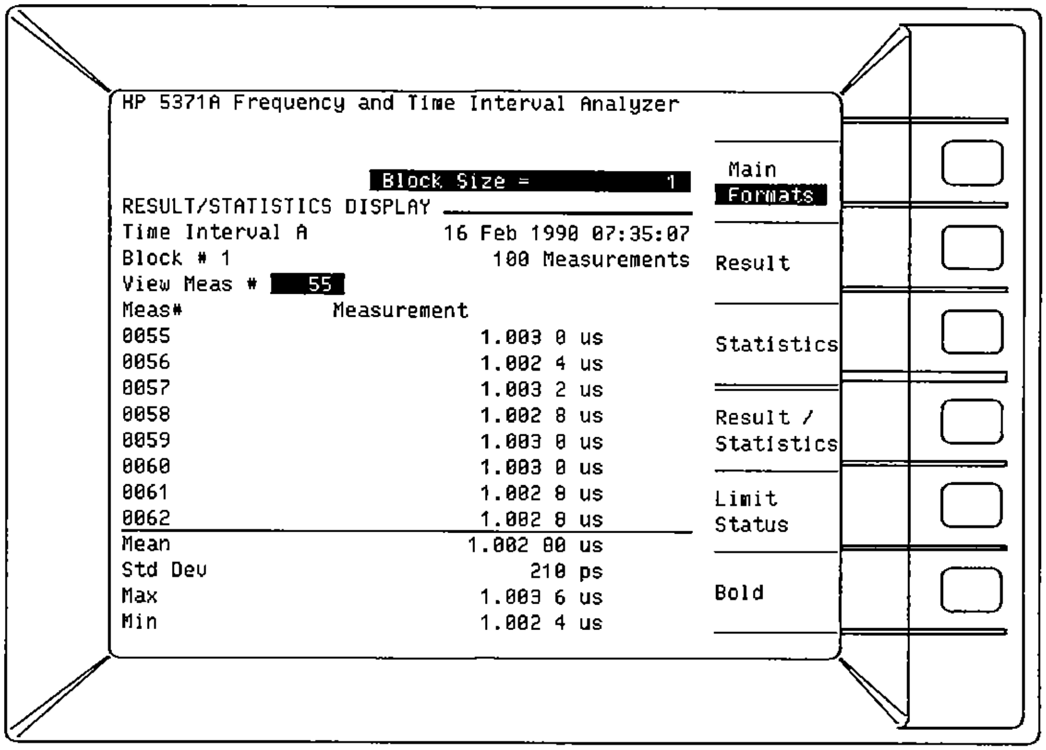


Figure 1-9. Results with Statistics

Now you can view eight measurements and four statistical functions. In this case, the statistical results include only the data from the group of 100 measurements. Cumulative statistics will be performed on the total number of measurements as defined by the number of blocks and the measurement size on the FUNCTION screen. In most cases, the upper limit is two billion measurements.

o PRESS: **Result** softkey

12 measurements are once again displayed.

o PRESS: Top softkey to select **Main**

o PRESS: **Expand** softkey to select **On**

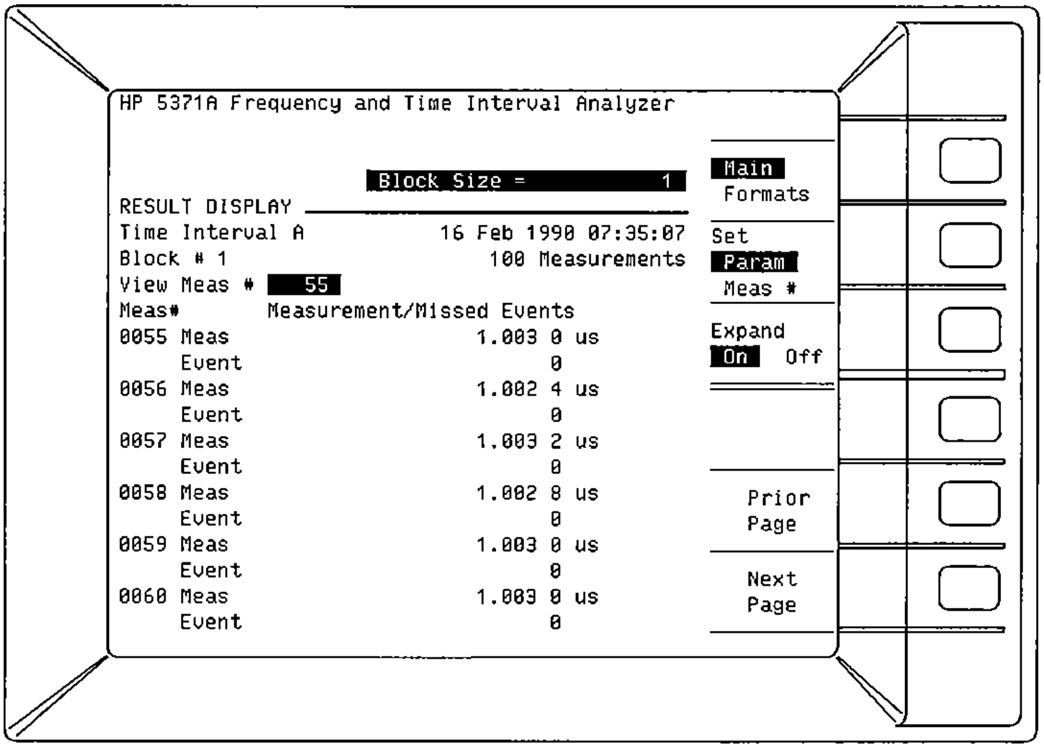


Figure 1-10. RESULT DISPLAY —Expanded Data On

You can now see the measurements along with the number of missed events. For this measurement, there are no missed events. Missed events are defined as those trigger events that do not have their time of occurrence recorded.

As shown in the diagram below, all of the trigger events are "time-stamped" in this Time Interval A measurement. Every other period is measured, but because the time of every trigger event is known, the time between measurements is also available. This information is provided on the Event Timing graph as demonstrated later in this section.

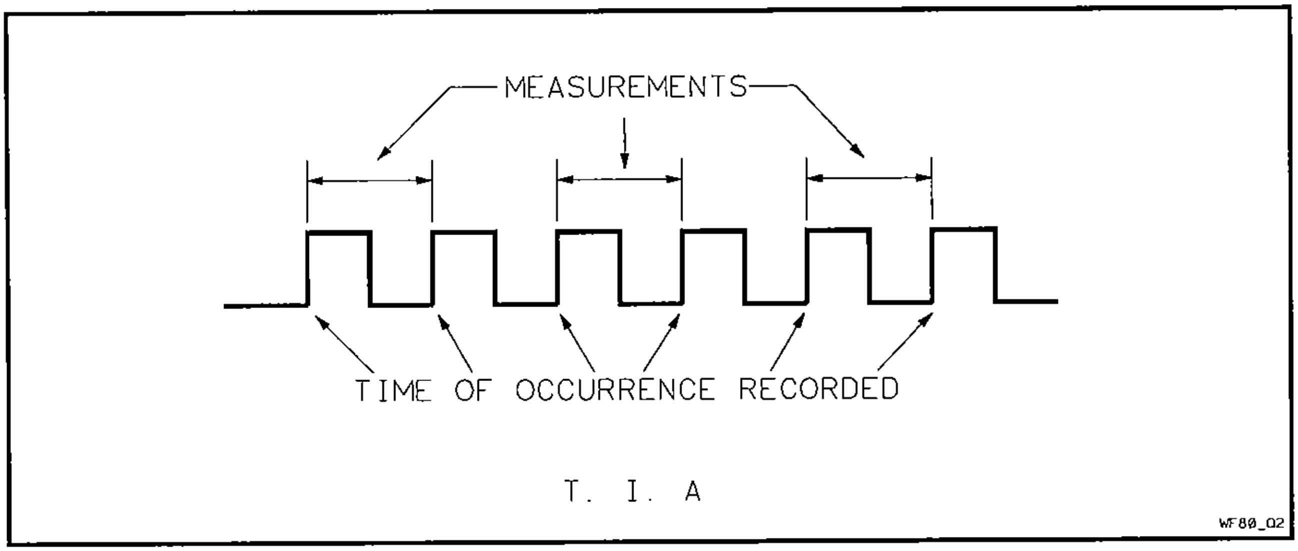


Figure 1-11. Time-Stamped Events

Later on in this section, you will make a continuous time interval measurement and compare it to this traditional time interval measurement.

7. Review Graphical Data

o PRESS: GRAPHIC key

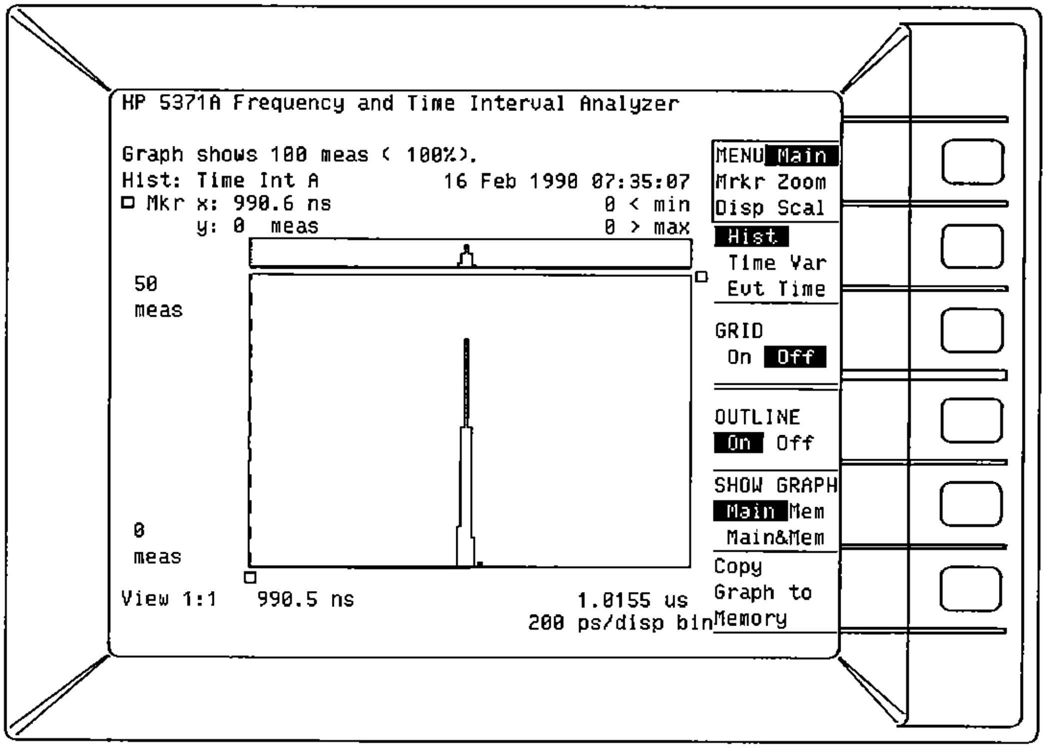


Figure 1-12. Histogram Graph

A Histogram of the group of measurements most recently collected will be displayed. You are now looking at a graphical representation of the data you have collected.

A Histogram is a graphic representation for analyzing a distribution of measurements. The vertical rectangles have a width that corresponds to a value or range of values (usually called bins) and a height that corresponds to the number of occurrences of values within that range.

O PRESS: Softkey second from the top to highlight **Time Var**

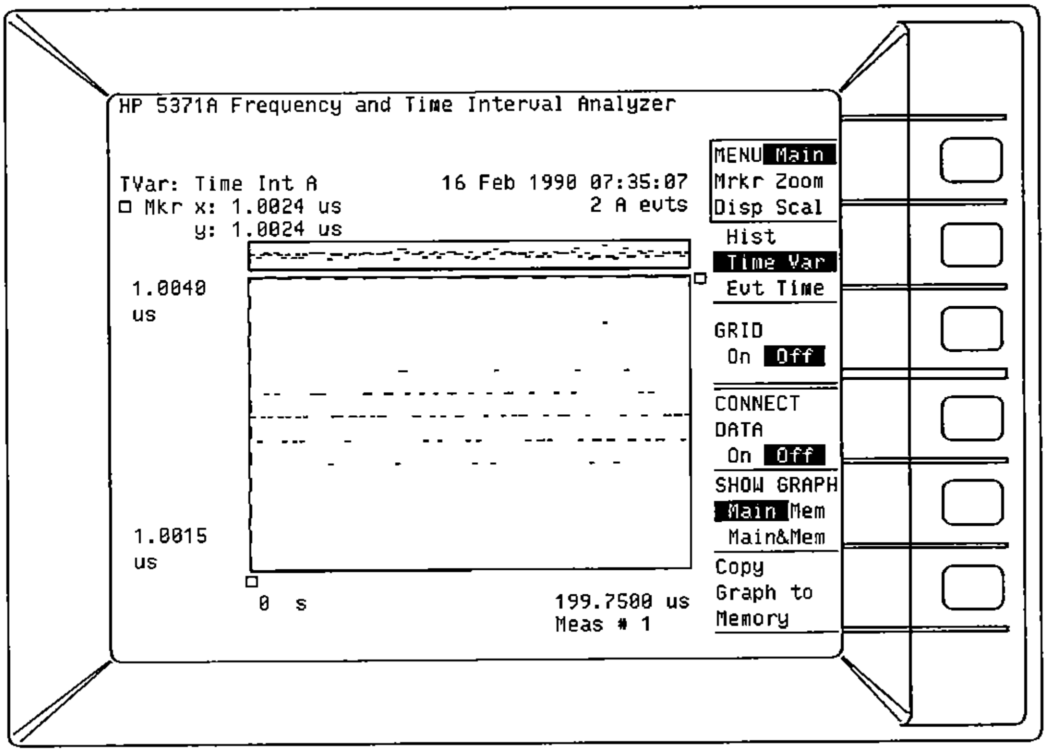


Figure 1-13. Time Variation Graph

Time Variation is another way of graphically representing your measurement data. It shows the variation in measured values as a function of time, i.e., the vertical Y-axis indicates measured values and the horizontal X-axis indicates when the value was measured. The graph is normally auto-scaled. This means the graph is scaled to fit the measured values.

O PRESS: Softkey second from the top to highlight **Evt Time**

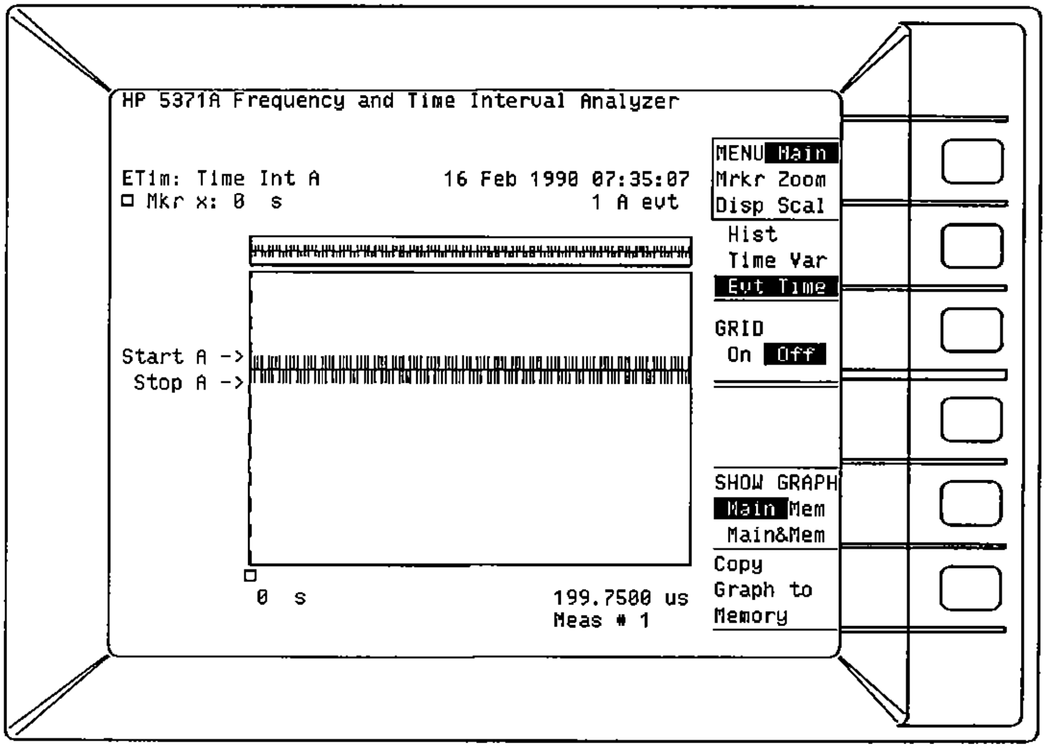


Figure 1-14. Event Timing Graph

The third way the 5371A graphically represents data is Event Timing. This graph lets you analyze a large number of measurements visually. You can quickly pick out measurements of interest.

You need to use some of the 5371A features to see details on this graph.

O PRESS: **MENU** softkey to select **Zoom**

O MOVE: The active marker using the ENTRY/MARKER knob. Notice the bright line at the bottom of the graph that moves with the marker. This line shows the portion of the displayed signal that will fill the screen when the **Zoom In** softkey is pressed.

O PRESS: **Zoom In** softkey once

You are now viewing about half of the total captured signal. The bright line at the marker underlines what will fill the display area should you press the zoom softkey again. Notice also the smaller graph area above the main display area. This is called the "panorama graph." This area always displays all the acquired graph data. There is another bright line visible at the bottom of the panorama graph. It shows the portion of the captured signal that is currently displayed in the main graph area below.

O PRESS: **Zoom In** softkey three times

Lines going up from the horizontal line are measurement start ticks, lines going down from the horizontal line are measurement stop ticks.

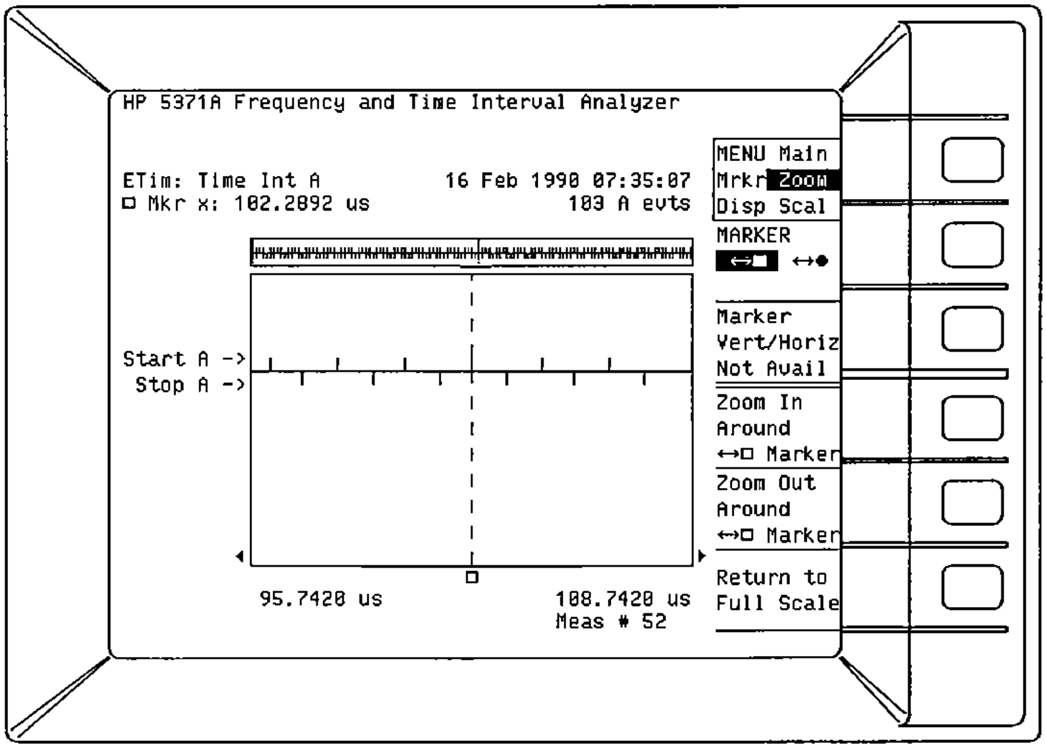


Figure 1-15. Zoomed in on Event Timing Graph

Now that you can see individual timing marks:

o PRESS: **MENU** softkey to select **Mrkr**

o PRESS: **More** softkey to display additional softkey options

o PRESS: **Move (inactive marker) to (active marker) Location**

This moves the inactive marker 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.

Only one marker can be active at any time. Move the marker with the ENTRY/MARKER knob; select the marker with the MARKER softkey. The inverse video box indicates which marker is active. The marker's location can be read on the display above the graph.

o PRESS: **MARKER** softkey to select the ↔□ marker.

o MOVE: ↔□ marker to some start tick (line going up from the horizontal line) by rotating the ENTRY/MARKER knob on the front panel.

- PRESS: **MARKER** softkey to select the ↔● marker
- MOVE: ↔● marker to the first stop tick (line going down from the horizontal line) after the ↔□ marker.
- PRESS: **More** softkey to display other softkey options
- PRESS: Softkey to select **Delta** to turn on Delta function.

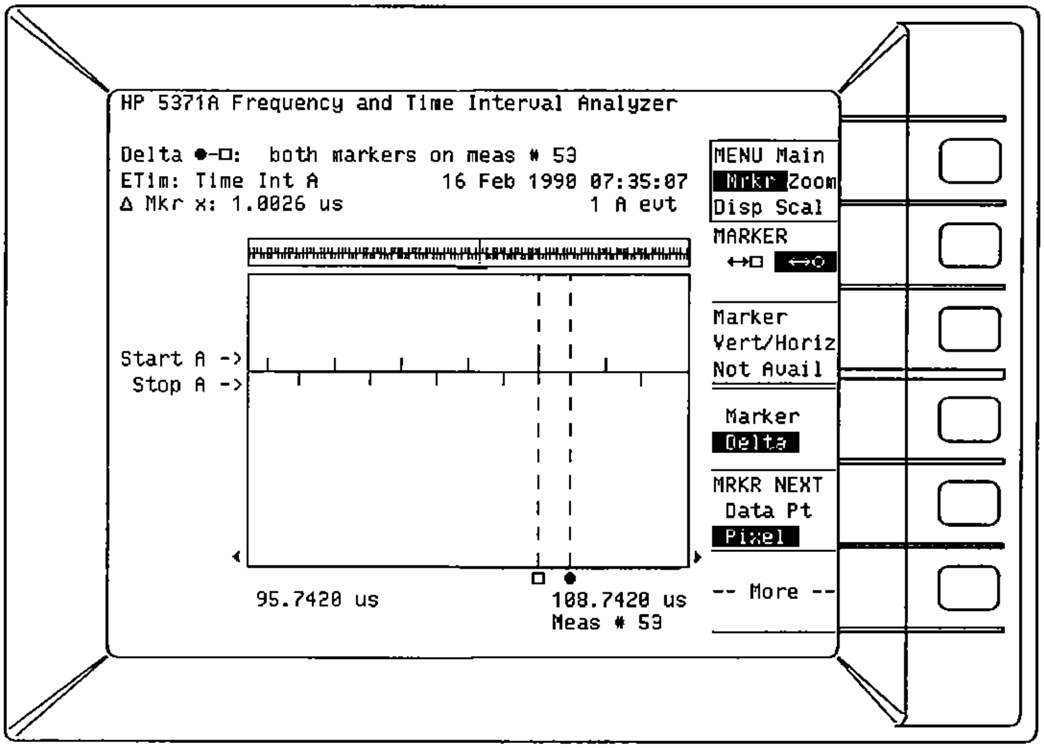


Figure 1-16. Start to Stop Delta

The time from one marker to the next is displayed above the graph. This time from a start to the following stop is approximately 1 μs.

- MOVE: ↔● marker to the next start tick.

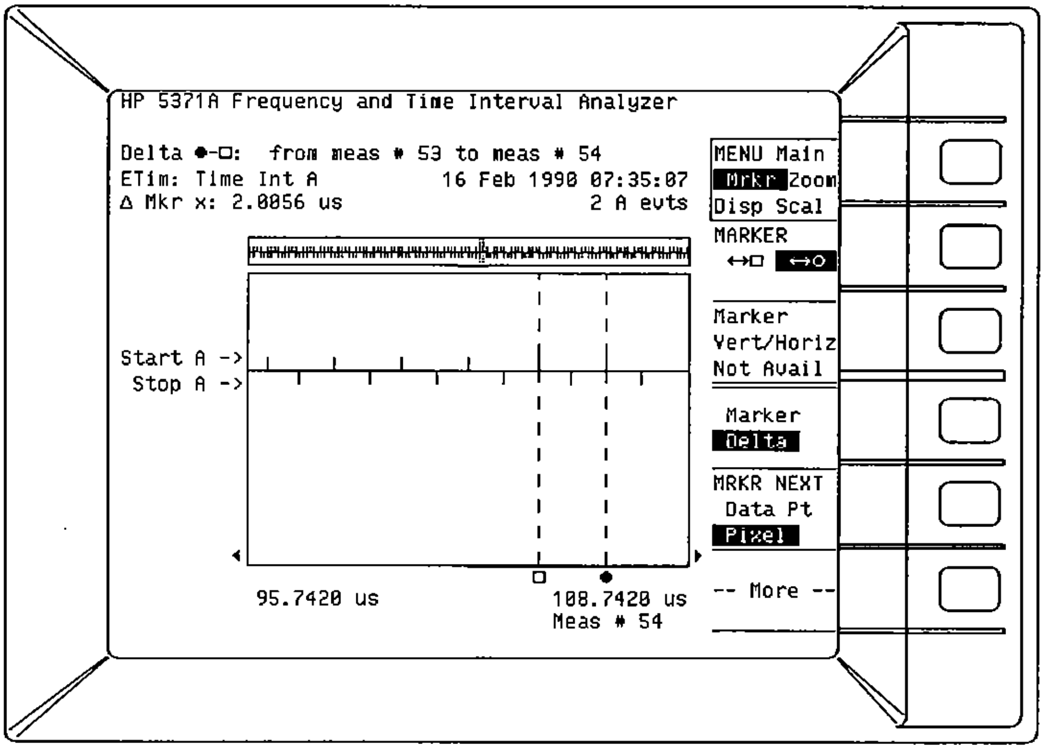


Figure 1-17. Start to Start Delta

Notice that the time from a start tick to the following start is approximately 2 μs. This agrees with the earlier description that every other period is being measured. (See *Figure 1-11*).

Now use the markers to show the time from a stop tick to the start tick of the next measurement.

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.

You should measure the Delta as approximately 1 μs. This is the time between measurements.

MAKE A CONTINUOUS TIME INTERVAL MEASUREMENT

Another kind of time interval measurement is called Continuous Time Interval. As the name implies, this measurement measures time intervals back-to-back. The measurements are adjacent with no pause between measurements.

Every interval is measured at up to a 10 MHz rate (this is a time interval of 100 ns). Above this 10 MHz rate, the HP 5371A can measure no faster than on the trigger event after every 100 ns.

To contrast this with the previous time interval measurements, follow the steps below. ASSUMPTION: The HP 5371A is powered-up and ready to use. If not, go back to TURN ON THE HP 5371A. Also, you should have completed MAKE SOME SIMPLE MEASUREMENTS.

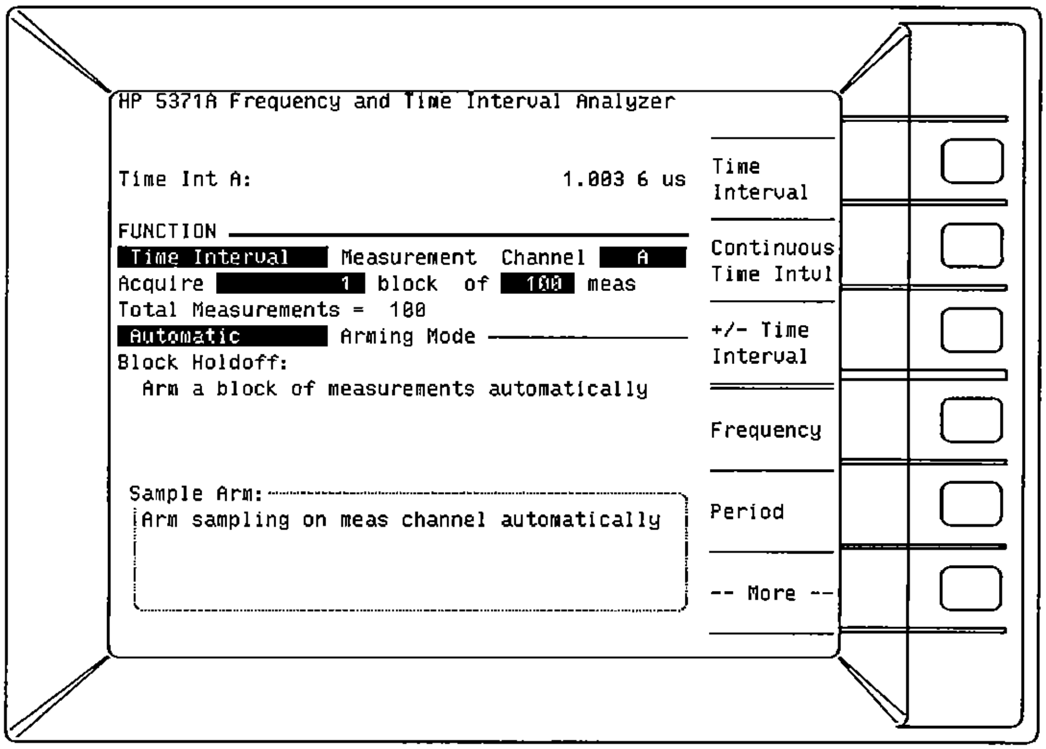


Figure 1-18. Preset Function Screen

1. Press the PRESET key to place the HP 5371A into a default operating condition. The FUNCTION menu should look like the one shown in *Figure 1-18.*

2. Connect your 1 MHz square wave signal to the front-panel Channel A input.

3. Make a Continuous Time Interval Measurement

- PRESS: **Continuous Time Intvl** softkey

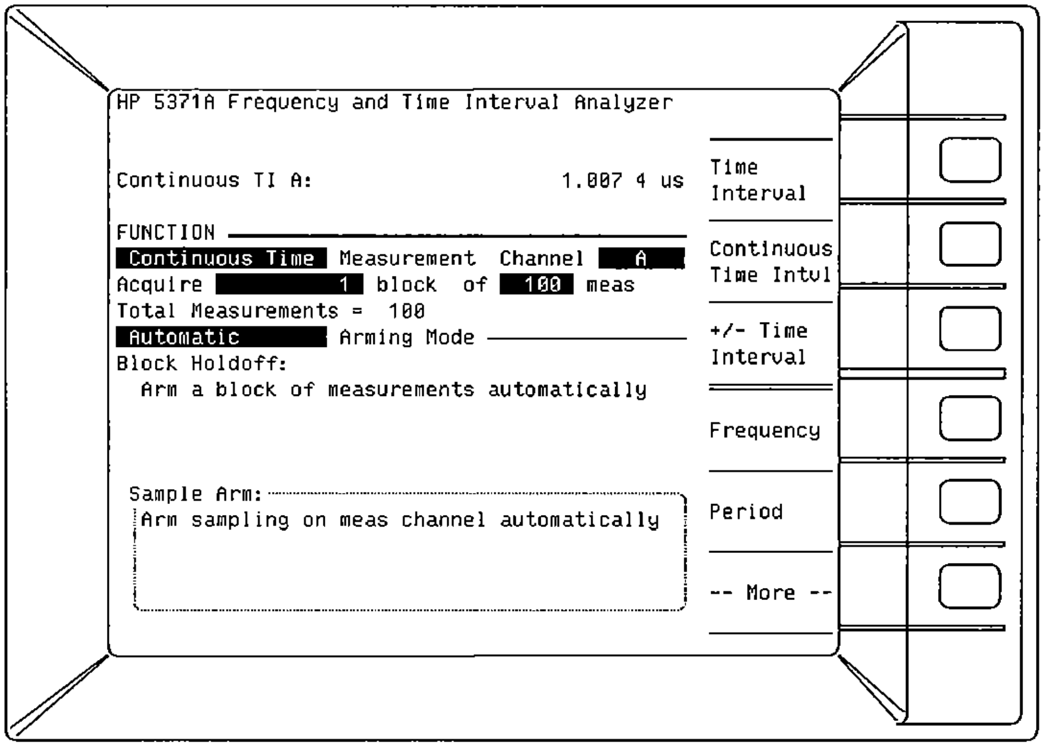


Figure 1-19. FUNCTION DISPLAY — Continuous Time Interval

- PRESS: SINGLE/REPET key (to turn on SINGLE acquisition mode)

- PRESS: NUMERIC key

o PRESS: **Expand** softkey to select **On**

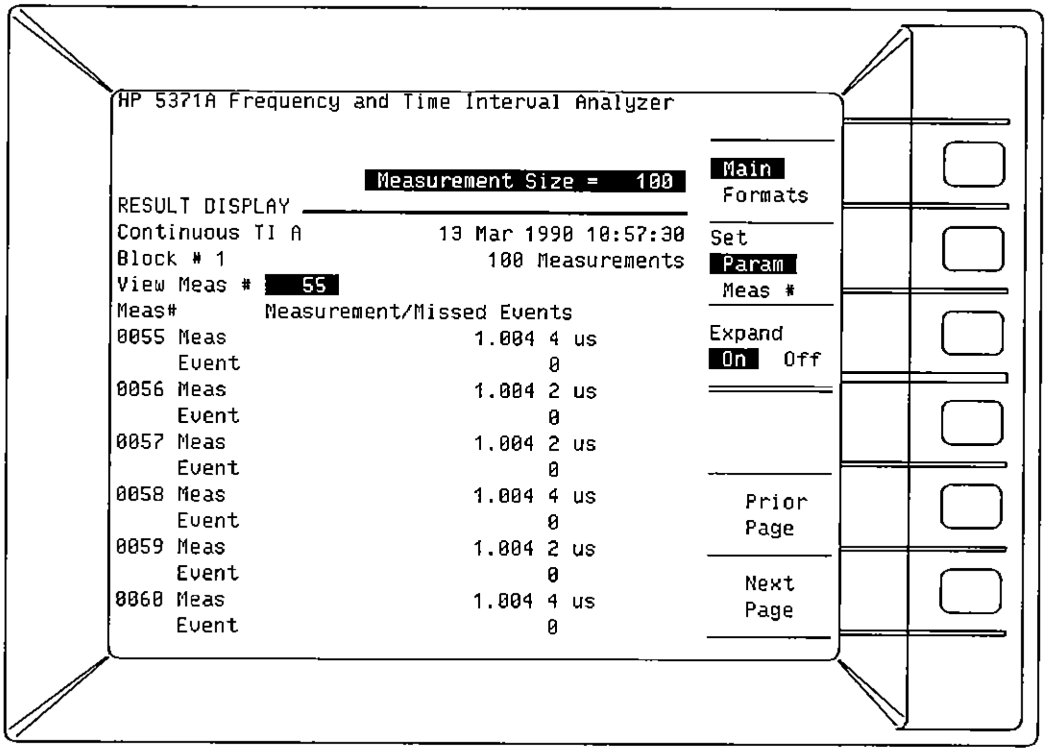


Figure 1-20. RESULT DISPLAY —Continuous Time Interval, Expanded Data On

For this measurement, the expanded data shows a missed event count of zero for a 1 µs measurement. In this case, every period of your input signal is measured.

o PRESS: GRAPHIC key

o PRESS: Softkey second from the top to highlight **Time Var**

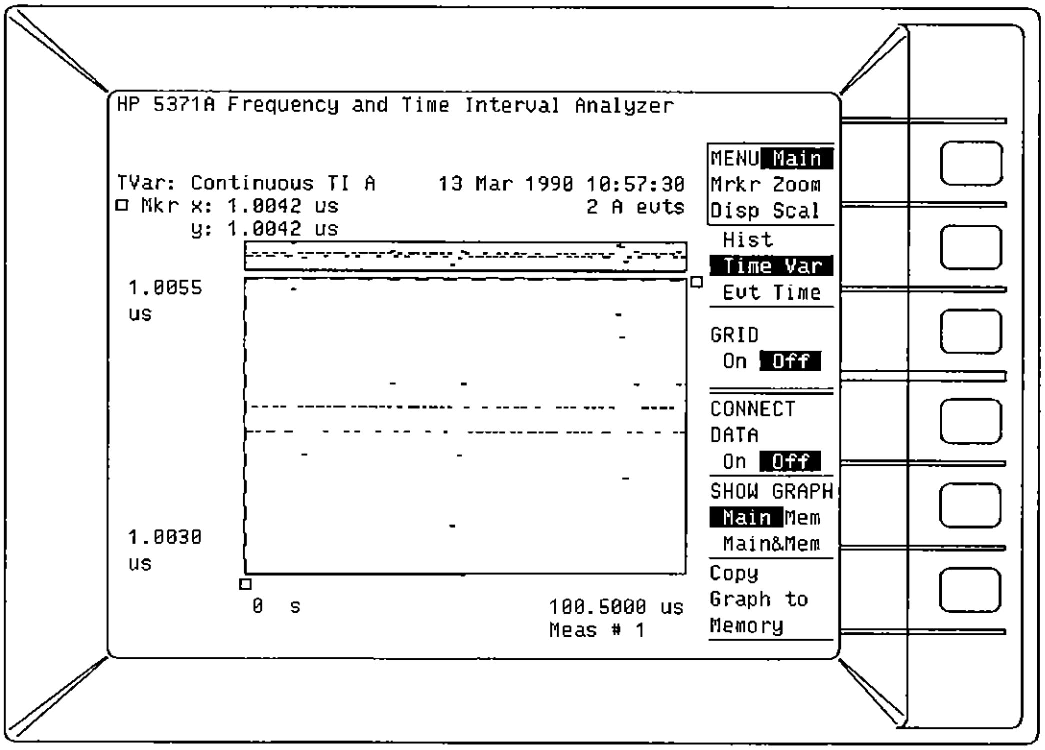


Figure 1-21. Continuous Time Interval Time Variation Graph

See that the X-axis scale displays 0 to approximately 100 µs. This indicates that the 100 measurements were made in 100 microseconds. That's 100 x 1 µs. Every single time interval was measured.

o PRESS: **CONNECT DATA** softkey to select **On**.

Connecting the data points may show data relationships that were not previously apparent. Making a printout with data connected and another with the data not connected and then placing the second over the first provides an illustration of this.

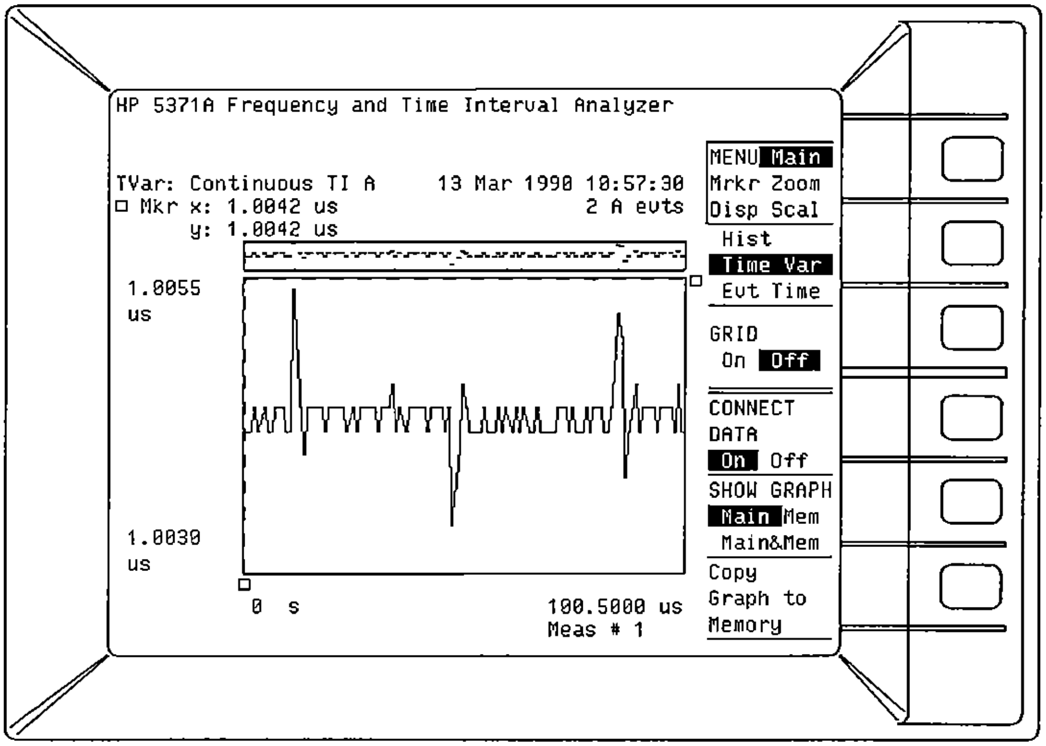


Figure 1-22. Time Variation Graph with Data Connected

- PRESS: Softkey second from the top to highlight **Evt Time**
- PRESS: **MENU** softkey to select **Zoom**
- PRESS: **Zoom In** softkey three times

Lines going up from the horizontal line are measurement start ticks, lines going down from the horizontal line are measurement stop ticks. See how the start and stop ticks line up? This shows that the end of one measurement is the beginning of the next.

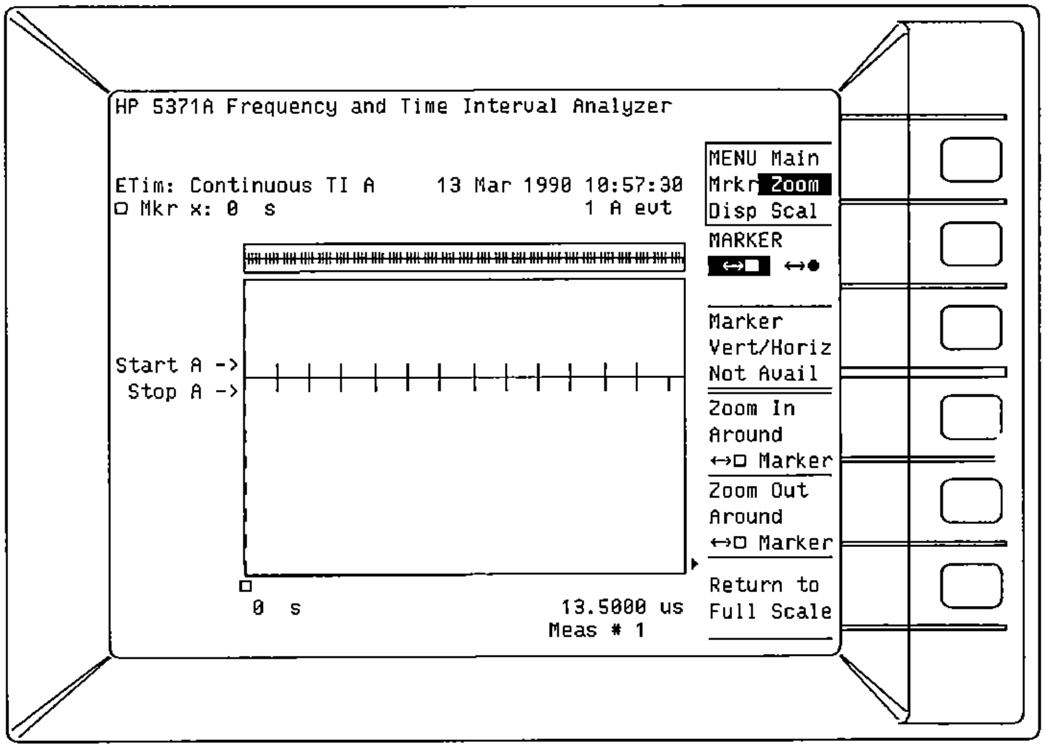


Figure 1-23. Continuous Time Interval Zoom Screen

Now that you can see individual timing marks:

- PRESS: **MENU** softkey to select **Mrkr**
- MOVE: ↔□ marker to a start/stop tick
- PRESS: **MARKER** softkey to select the ↔● marker
- MOVE: ↔● marker to the next start/stop tick

O PRESS: Softkey to select **Delta** to turn on the Delta function.

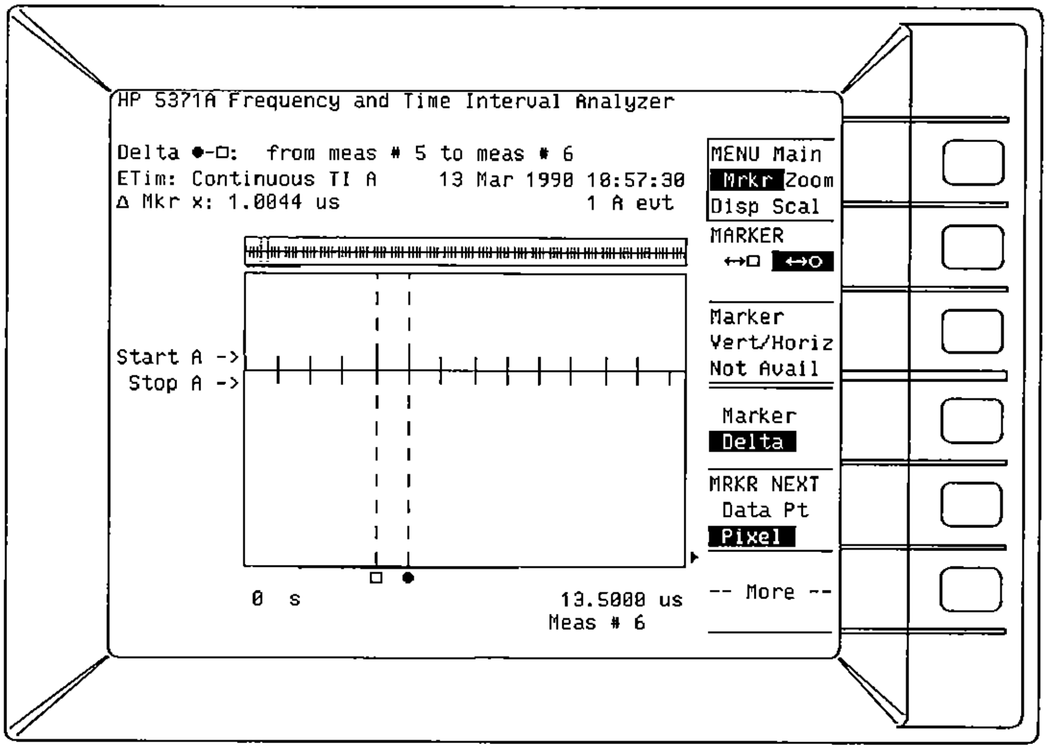


Figure 1-24. Continuous Time Interval Delta

The time between the two markers is displayed. The difference can be read on the display above the graph. The time of each measurement is approximately 1 μs.

While this display is on the screen, you can do some experimenting on your own to learn a bit more about how the HP 5371A works. Here are some things to try:

- Watch the top line ("Delta ...") and the third line ("Δ Mkr x: ...") as you move the active marker.
- Note how the markers move in "**Pixel**" mode.
- Note the top line and the third line values when you place each marker between two start/stop ticks, then note the marker behavior when you press **MRKR NEXT** to select **Data Pt.**
- Note how the markers move in "**Data Pt**" mode.
- Note the appearance of the start/stop ticks as you move the active marker to the right-hand edge of the display, then keep turning the ENTRY/MARKER knob clockwise.

As the data scrolls across the display, the left-most tick changes from being a start/stop tick to being a start-only tick. Similarly, the right-most tick changes from being a stop-only tick to being a start/stop tick. These changes occur as portions of the measurements delimited by these ticks move out of the display area.

MAKE A MORE COMPLEX MEASUREMENT

You have been making measurements with very simple arming modes up to this point. Now we can take a look at one of the more involved arming setups.

The following procedure describes each step in preparing the HP 5371A to make a measurement. This measurement does not make use of statistics or graphics, but it does involve a more complex arming mode than that demonstrated up to this point.

ASSUMPTION: The HP 5371A is powered-up and ready to use. If not, go back to TURN ON THE HP 5371A. Also, it is recommended that you complete MAKING SOME SIMPLE MEASUREMENTS and MAKING A CONTINUOUS TIME INTERVAL MEASUREMENT before performing this exercise.

OBJECTIVE: Measure the frequency of specified pulses in a data stream.

METHOD: We need to delay the measurement by a number of events until we get to the portion of the signal in which we are interested. Let's assume our example signal is repetitive and changes frequency at known points. Your 1 MHz frequency will simulate this signal.

We will delay the measurement for 100 events and then measure the frequency of the next 500 events. An event is a trigger event as defined on the INPUT screen. For this measurement, the trigger event is the midpoint of a positive slope of the input signal.

In this case the signal to be measured will also arm the start of the measurement and arm the stop of the measurement. This will let us use your 1 MHz signal for this measurement. Three different signals could be used to make this measurement. One signal could be used to arm the measurement. Another could be used to determine the measurement start, and a third to arm the stop of the measurement. Or, an External Arm signal could be used as a reference for the measurement delay events. A second signal could be used to arm the start and stop of the measurement.

STEPS:

1. Connect a BNC cable from your signal source to the front panel Channel A input.

2. Configure the FUNCTION screen:

   - PRESS: PRESET key
   - PRESS: SINGLE/REPET key
   - PRESS: **Frequency** softkey
   - MOVE: Menu Cursor to "meas" field
   - PRESS: "1" on the Data Entry keypad
   - PRESS: ENTER

- MOVE: Menu Cursor to Arming Mode field
- PRESS: Top softkey to select **Hld/Samp**
- PRESS: **More** softkey until **Event/Event** softkey is listed as an option
- PRESS: **Event/Event** softkey
- MOVE: Menu cursor to the “Count” field under “Start Arm”
- PRESS: “1”, “0”, “0” and ENTER key

  As soon as the ENTER key is pressed, the measurement starts. Notice the incorrect measurement result on the display screen. This is because both the start and stop arm event counts begin at the same time. Only the number of stop arm events that exceeds the start arm events will be counted. For this reason, you need to add the start arm event count to the number of events over which you want the measurement to be made. This sum becomes the stop arm event count. The 100 start arm events are added to the 500 measurement events to equal a value of 600 that will be entered as the stop arm count in the next step.

- MOVE: Menu Cursor to the “Count” field under “Stop Arm”
- PRESS: “6”, “0”, “0” and ENTER key

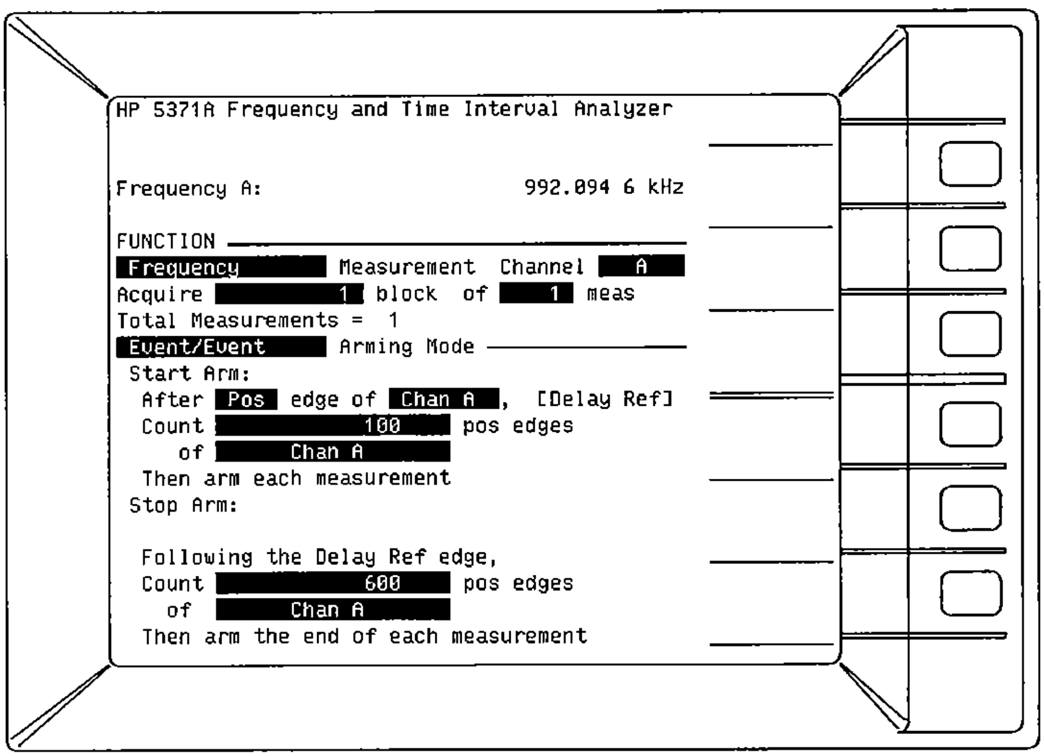


Figure 1-25. Event/Event Frequency Setup

A new measurement begins as soon as the ENTER key is pressed. The next edge of the Channel A signal prepares the HP 5371A to begin counting the start arm events and the stop arm events. It is important to remember that both event counts are referenced to the same edge.

At the end of 100 events, the measurement is armed to start on the next trigger event of Channel A. The measurement stops after 500 additional events are counted.

- PRESS: NUMERIC key
- PRESS: **Expand** softkey to select **On**

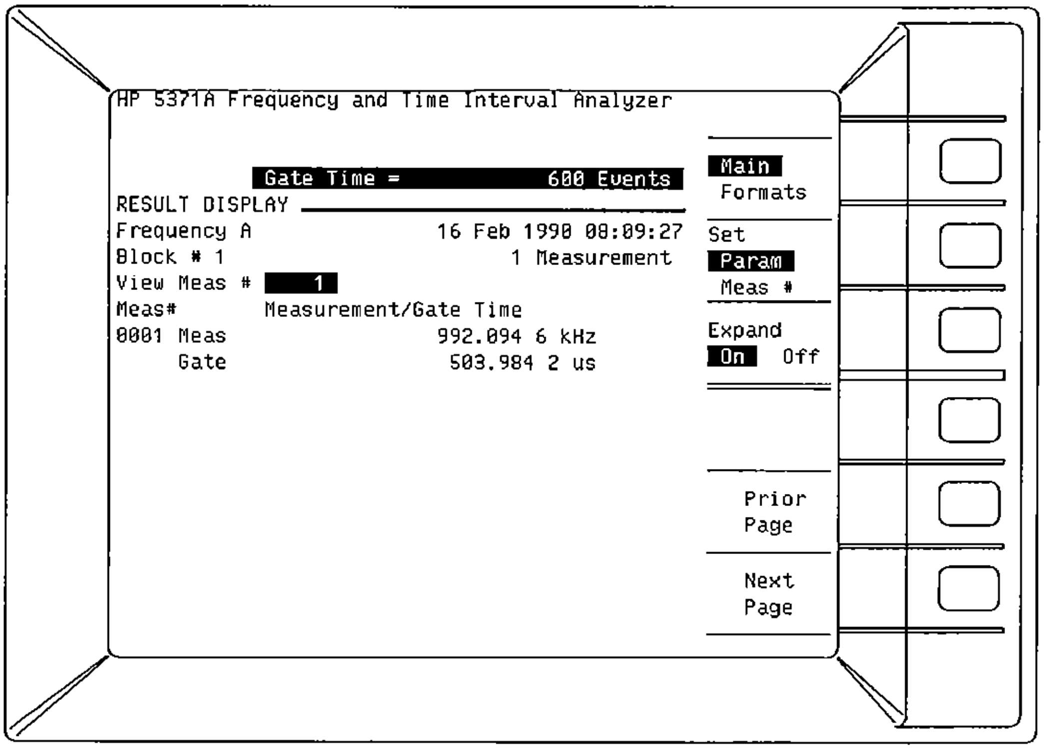


Figure 1-26. Frequency Measurement, Event/Event Arming, Expanded Data On

You can see we measured a frequency of approximately 1 MHz with a gate time of 500 microseconds. 500 microseconds is equal to five hundred 1 MHz periods.

This completes the Getting Started section. Now that you have a feel for how to operate the HP 5371A, use the table on the next page to help you decide where next to go in the operating manual.

WHERE TO GO FROM HERE

Table 1-1. Operating Manual Summary

OPERATING MANUAL	DESCRIPTION
Sections 2,3,4	Detailed information about how the HP 5371A makes specific measurements.
Section 5	Explanation of the arming modes.
Sections 6 and 17	Summary of front and rear panel operating information.
Sections 7 to 16	Operating information organized by front panel key label.
Section 18	Procedures for verifying correct operation and testing instrument performance to specifications.
Appendix A	Menu trees for NUMERIC, GRAPHIC, INPUT, MATH, and SYSTEM menus.
Appendix B	Instructions on preparing the HP 5371A for use.
Appendix C	Displayed status and error messages.
Appendix D	Ideas, hints, suggestions to help you be more efficient at making measurements using the HP 5371A.
Appendix E	Instrument Specifications.

2 TIME INTERVAL MEASUREMENTS

2 TIME INTERVAL MEASUREMENTS

SUMMARY

This section describes the following:

- Time Interval measurements
- Continuous Time Interval measurements
- ±Time Interval measurements
- The available arming modes for each time interval measurement
- An illustration of each of the time interval arming modes

TERMS USED HERE

- **Sample Rate:** Sample Rate is the rate at which data is stored into memory of the HP 5371A. When the time interval rate exceeds the sample rate, the way data is collected changes. These changes are shown in TIME INTERVAL DESCRIPTIONS below.
- **Sample:** A sample is a data point.
- **Measurement:** A measurement consists of two successive samples.
- **Block:** A block is a group of measurements.
- **Block Size:** Block Size is the number of blocks of measurements that will be collected.
- **Measurement Size:** Measurement size is the number of measurements within a block. If the number of blocks is one, the number of measurements to be acquired is the same as the measurement size. The measurement size multiplied by the number of blocks gives you the total number of measurements for any measurement setup.
- **Trigger Event:** The trigger event is a point on a Channel A or B signal edge that triggers the HP 5371A to start a measurement, take a sample, or end a measurement. The event is defined by setting a slope, a trigger level, and a trigger mode on the INPUT menu screen.
- **Block Holdoff:** Block Holdoff specifies the conditions that must be satisfied before a trigger event can initiate a block of measurements. (For continuous gating measurements.)
- **Sample Arm:** Sample Arm specifies the conditions that must be satisfied before each of the samples within a block can be acquired. (For continuous gating measurements.)

- **Start Arm:** Start Arm specifies the conditions that must be satisfied before a trigger event can initiate a measurement. (For non-continuous gating measurements.)
- **Stop Arm:** Stop Arm specifies the conditions that must be satisfied before a trigger event can end a measurement. (For non-continuous gating measurements.)

TIME INTERVAL DESCRIPTIONS

A time interval is the amount of time between any two events. The HP 5371A measures time intervals in three ways.

Time Interval

TIME INTERVAL measures positive time intervals on one channel, or from one channel to another channel.

A time interval can be measured on Channel A or Channel B (this is similar to a period measurement), from Channel A to Channel B, or from Channel B to Channel A. For two-channel measurements, the sequence of channel designations sets the order for measuring the interval. For example, the time interval measured from Channel B to Channel A will always start with an edge of B and end on a subsequent edge of A.

Every time interval will be captured by the HP 5371A up to a sample rate of 5 MHz for either one or two-channel measurements. 5 MHz is the sample rate for Time Interval measurements. When the time between time intervals is less than 200 ns (>5 MHz rate), some time intervals will be missed between measurements. The number of intervals missed can be displayed on the NUMERIC screen by selecting the Gate Data ON softkey option.

T.I. MEASUREMENT MODE SUMMARY

Channels: A, B, A→B, B→A

Sample Rate: 5 MHz (200 ns)

When Sample Rate is Exceeded: Some time intervals are missed. The number of events missed can be displayed on the NUMERIC screen. An event is defined on the INPUT screen.

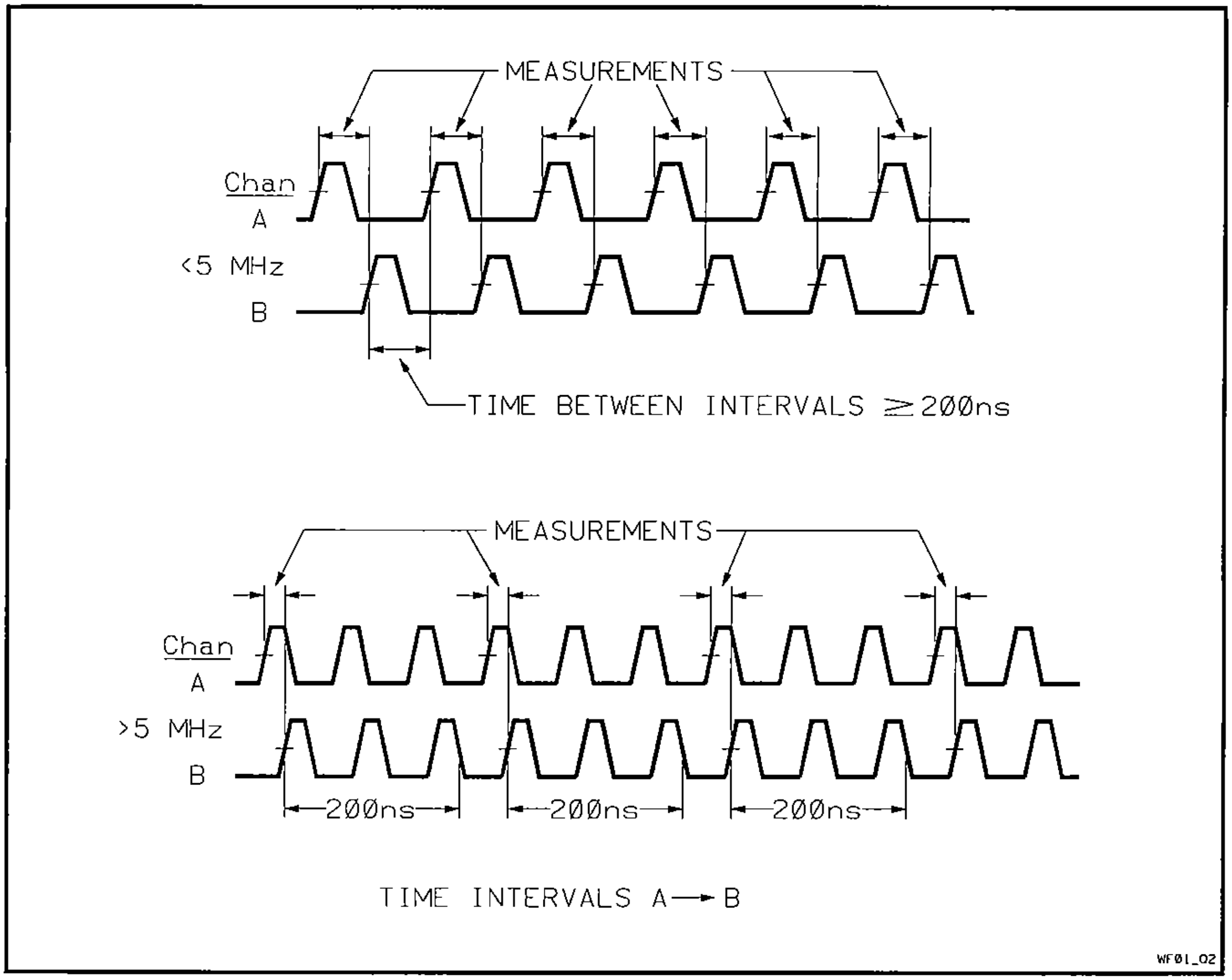


Figure 2-1. Time Intervals Above and Below the Sample Rate

Continuous Time Interval

CONTINUOUS TIME INTERVAL measures time intervals without interruption on one channel only.

Continuous time intervals (C.T.I.) are back-to-back measurements. There is no pause between the end of one time interval measurement and the beginning of the next. For continuous time interval measurements, every individual time interval will be captured up to a sample rate of 10 MHz. The sample rate is 10 MHz for C.T.I. measurements. When the time interval being measured is less than 100 ns (>10 MHz rate), more than one interval will be included in each measurement. The number of events missed for each measurement can be displayed on the NUMERIC screen by selecting the Gate Data ON softkey option. An event is defined on the INPUT screen.

Continuous Time Interval measurements can only be made on either Channel A or Channel B input signals.

CONTINUOUS T.I. MEASUREMENT MODE SUMMARY

Channels: A, B

Sample Rate: 10 MHz (100 ns)

When Sample Rate is Exceeded: Measurement samples are taken no faster than every 100 ns. A sample marks the end of one measurement and the start of the next. For example, measuring the time interval of a 50 MHz input signal, one measured time interval (100 ns) is made up of 5 individual intervals. That is the number of 20 ns (50 MHz) events occurring during the 100 ns sample rate "window." The number of missed events for each measurement can be displayed on the NUMERIC screen. An event is defined on the INPUT screen.

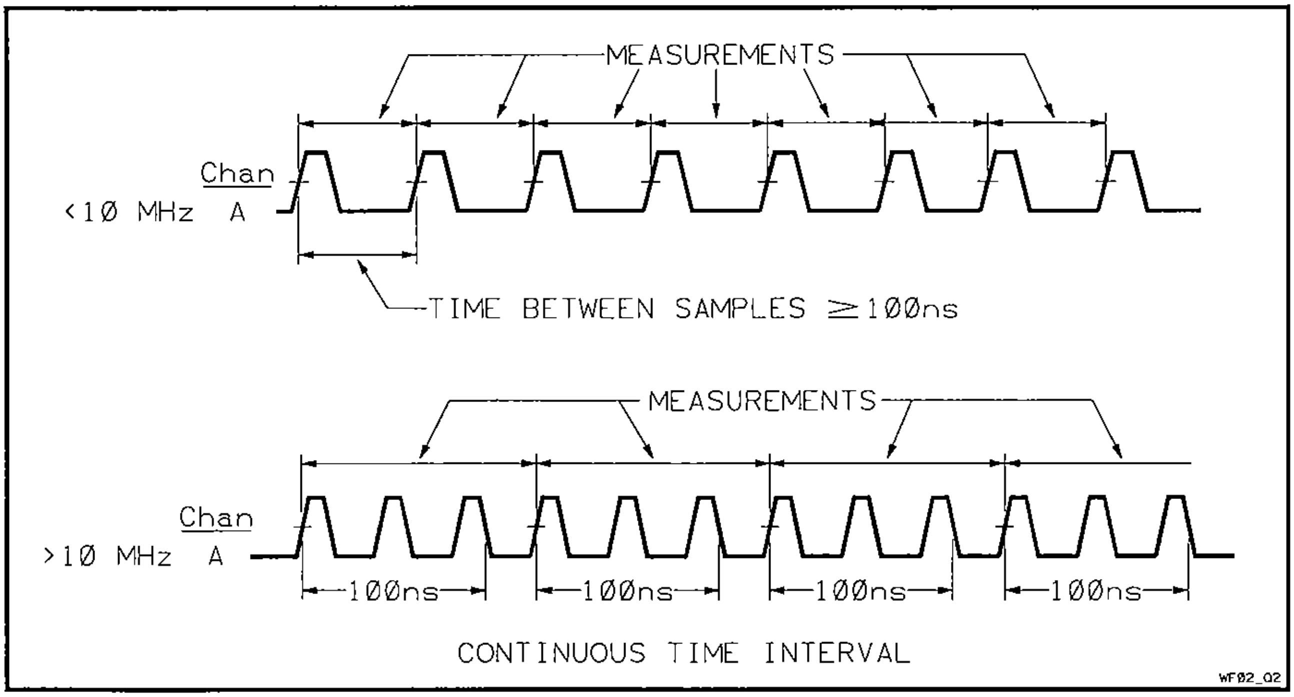


Figure 2-2. Continuous Time Intervals Above and Below the Sample Rate

±Time Interval

±TIME INTERVAL measures positive or negative time intervals on one channel, or from one channel to another channel.

A time interval can be measured on Channel A or Channel B (this is similar to a period measurement), from Channel A to Channel B, or from Channel B to Channel A. It does not matter which channel edge occurs first for ±time intervals. A negative result means that the edge on the second channel started the measurement.

Every time interval will be captured by the HP 5371A up to a sample rate of 5 MHz for one and two-channel measurements. The sample rate is 5 MHz for one and two-channel ±T.I. measurements. When the time between time intervals is less than 200 ns (>5 MHz rate), some time intervals will be missed between measurements. The number of events missed can be displayed on the NUMERIC screen by selecting the Gate Data ON softkey option. An event is defined on the INPUT screen.

±T.I. MEASUREMENT MODE SUMMARY

Channels: A, B, A→B, B→A

Sample Rate: 5 MHz (200 ns)

When Sample Rate is Exceeded: Some time intervals are missed. The number of events missed can be displayed on the NUMERIC screen.

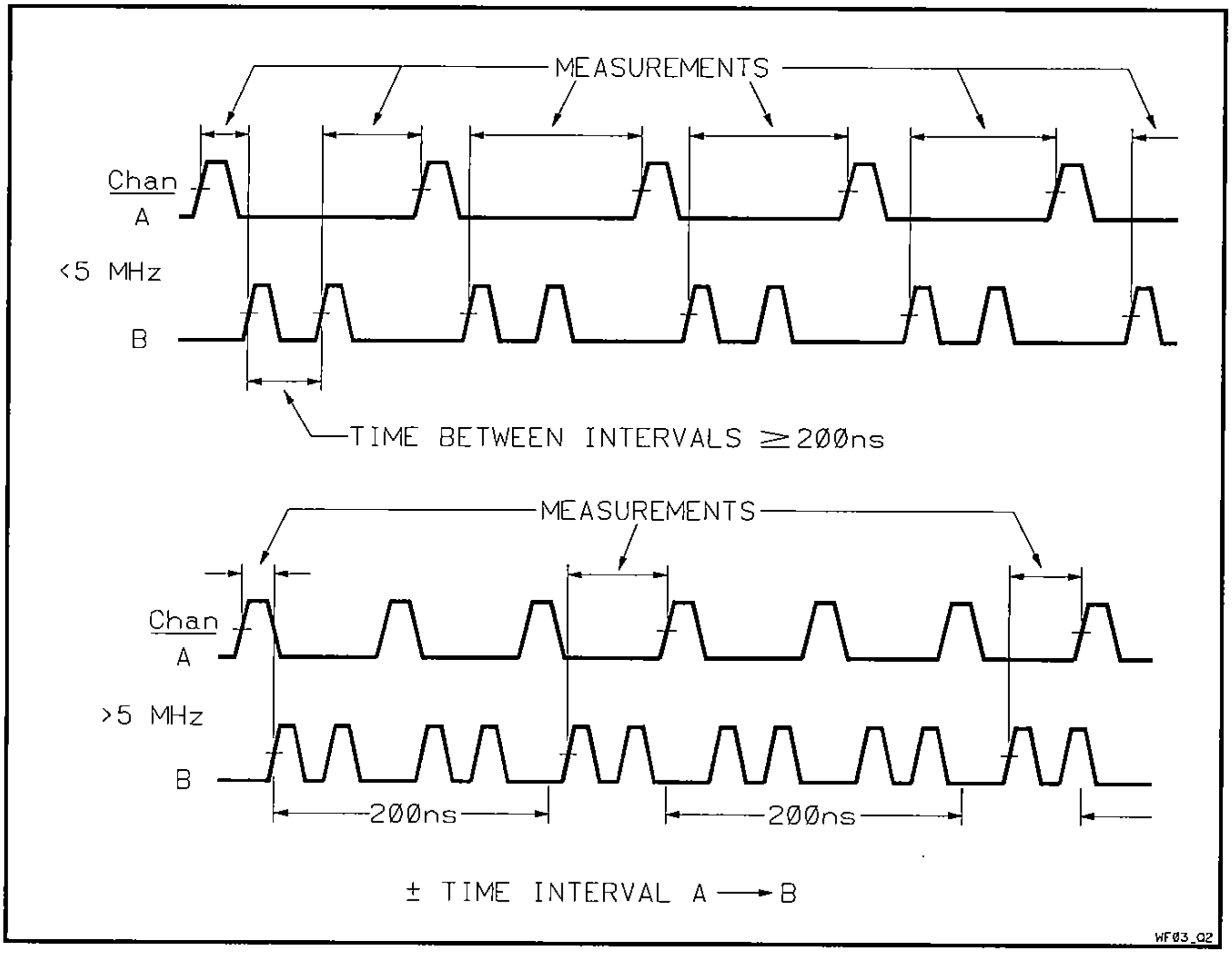


Figure 2-3. ± Time Intervals Above and Below the Sample Rate

T.I. MEASUREMENT SUGGESTIONS

Before you connect your signal to the HP 5371A, think about the measurement you want to make.

For example, the HP 5371A has very sensitive input circuitry. Too much noise on your signal can cause false triggering.

Other considerations for time interval measurements might be:

1. Do you need to measure a time interval where the signal edges are closer than 10 ns?

   If so, make a ±TIME INTERVAL measurement. This measurement type offers more two-channel arming modes than TIME INTERVAL or CONTINUOUS TIME INTERVAL. One-channel arming modes are more limited.

2. Do you want to measure every interval on one channel continuously?

   If so, make a CONTINUOUS TIME INTERVAL measurement. This measurement type has the advantage of capturing every interval when the time interval is below the sample rate (100 ns), but only time intervals on one channel can be measured. This is essentially a period measurement.

   For more information on general measurement hints, refer to Appendix D, MEASUREMENT SUGGESTIONS.

MEASUREMENT SETUP SUMMARY

Listed below is a summary of the front panel menu screens and the instrument parameters that can be specified on each screen. The listing is grouped into Measurement Setup and Measurement Review menu screens. After reviewing this information, you will see the relationship between the different HP 5371A menu screens. For example, statistics are viewed on the NUMERIC screen, but enabled on the MATH screen.

The FUNCTION, INPUT, MATH, AND GRAPHIC screen settings all help determine what you will see on the NUMERIC and GRAPHIC screens. Use the STATUS key to see a summary of HP 5371A settings.

FOR YOUR MEASUREMENT SETUP:

On this menu screen	You can specify
FUNCTION	Measurement type Measurement channel Number of blocks Number of measurements per block Arming mode
INPUT	Separate or common inputs Trigger slope, trigger level External arm level Bias level Attenuation
MATH	Statistics on/off Math values Reference set/clear Limit values
GRAPHIC	Histogram graph parameters Time variation graph parameters Event timing graph parameters

FOR YOUR MEASUREMENT REVIEW:

On this result screen	You can specify
NUMERIC	Measurement results only Statistics results only Measurements and statistics Measurements and # of missed events Summary of limit results Enlarged numeric result display
GRAPHIC	Histogram graph Time variation graph Event timing graph Marker features Zoom features Display features Scaling Features

TIME INTERVAL ARMING MODES

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

TIME INTERVAL

A
B
A→B
B→A

AUTOMATIC	EDGE HOLDOFF	INTERVAL SAMPLING	EDGE/INTERVAL
	TIME HOLDOFF	REPETITIVE EDGE	
	EVENT HOLDOFF		

CONTINUOUS TIME INTERVAL

A
B

AUTOMATIC	EDGE HOLDOFF	INTERVAL SAMPLING	EDGE/INTERVAL
	TIME HOLDOFF	REPETITIVE EDGE	
	EVENT HOLDOFF		

±TIME INTERVAL

A→B
B→A

AUTOMATIC	EDGE HOLDOFF	INTERVAL SAMPLING	EDGE/INTERVAL
		PARITY SAMPLING	EDGE/EVENT
		REPETITIVE EDGE	EDGE/PARITY
		REP. EDGE/PARITY	TIME/TIME
			EVENT/EVENT

A
B

EDGE/EVENT
TIME/TIME
EVENT/EVENT

TIME INTERVAL ARMING MODE EXAMPLES

Shown below are the three types of time interval measurements along with a timing diagram to illustrate each available arming mode. In all cases, the rate of events to be measured is assumed to be below the sample rate. The sample rate is 5 MHz for Time Interval and ±Time Interval; it is 10 MHz for Continuous Time Interval. Refer to the diagrams included under "TIME INTERVAL DESCRIPTIONS" for an illustration of what happens when the sample rate is exceeded. The trigger event is always on the positive slope for these examples.

Time Interval Measurements

TIME INTERVAL | AUTOMATIC

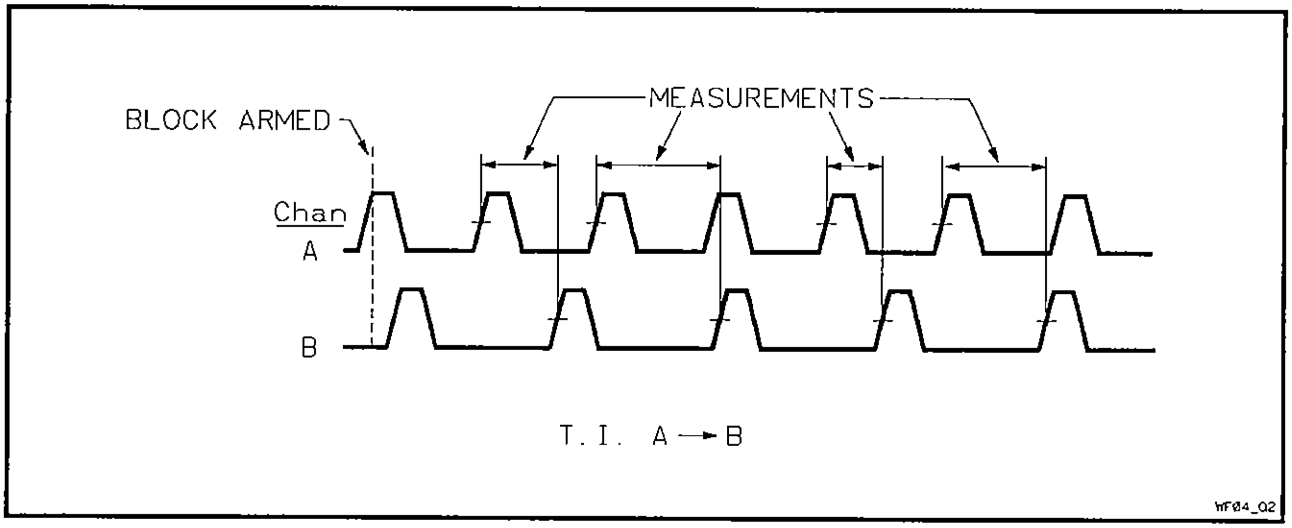


Figure 2-4. Time Interval | Automatic

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are then taken on the trigger event of signals being measured as quickly as possible. Four measurements are shown.

TIME INTERVAL | EDGE HOLDOFF

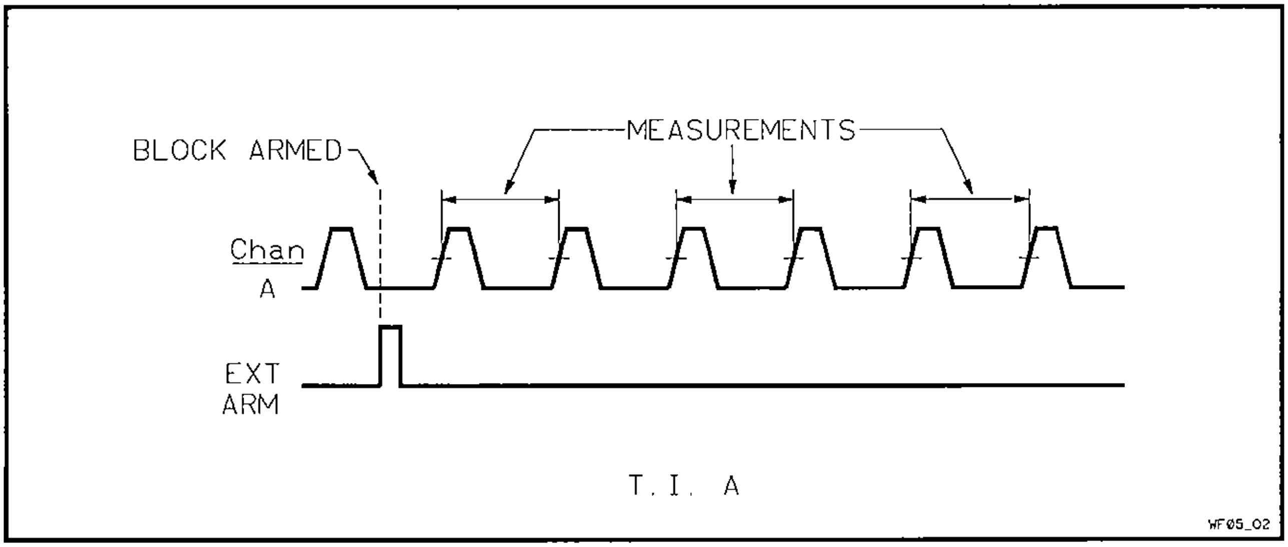


Figure 2-5. Time Interval | Edge Holdoff

DESCRIPTION:

- Block of measurements is armed after a POS edge on EXT ARM.
- Samples are then taken on the trigger event of Channel A as quickly as possible. Three measurements are shown.

TIME INTERVAL | TIME HOLDOFF

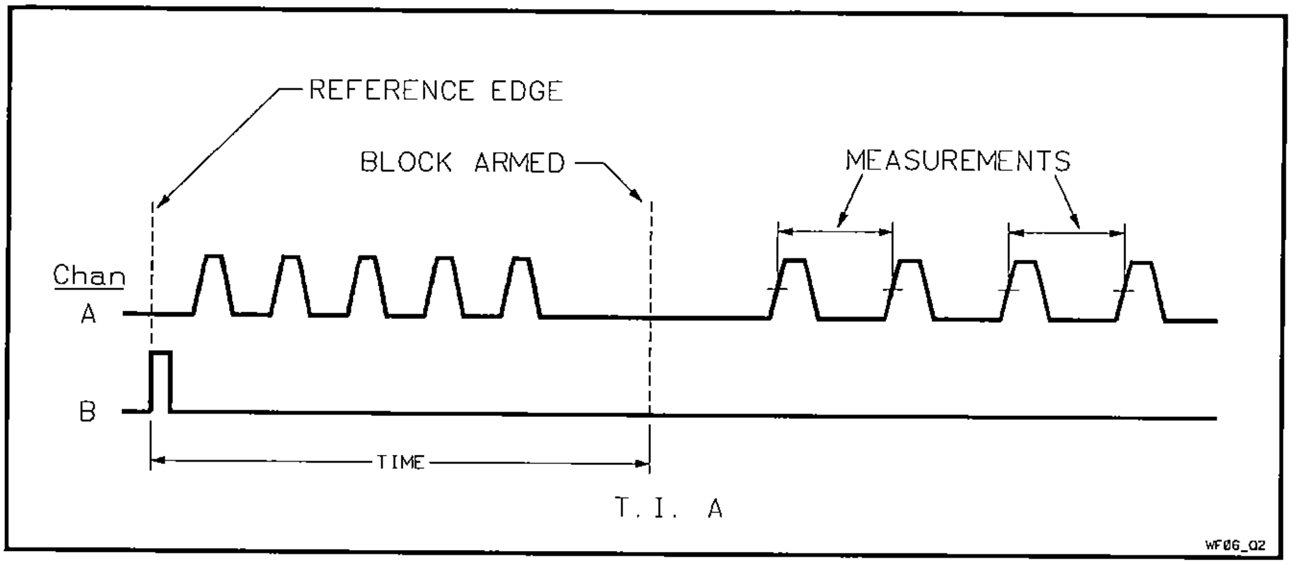


Figure 2-6. Time Interval | Time Holdoff

DESCRIPTION:

- Block of measurements is armed after a time delay. The start of the time delay is referenced to a POS edge on Channel B.
- Samples are then taken on the trigger event of Channel A as quickly as possible. Two measurements are shown.

  TIME = 2 ns to 8.0 s with a 2 ns resolution

TIME INTERVAL | EVENT HOLDOFF

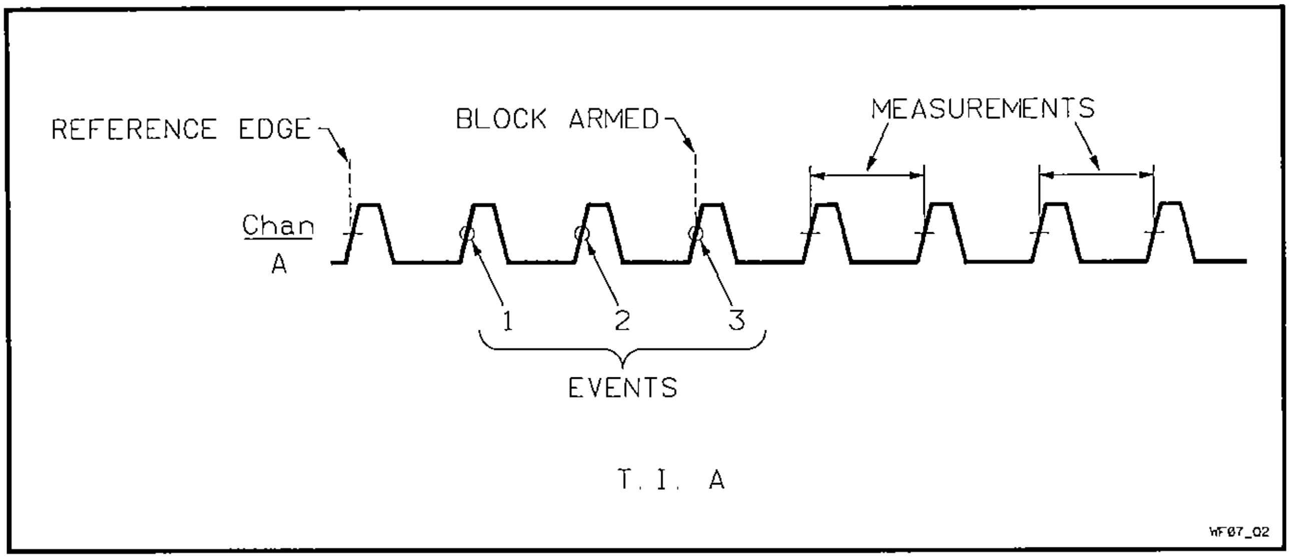


Figure 2-7. Time Interval | Event Holdoff

DESCRIPTION:

- Block of measurements is armed after an event delay. The start of the three-event delay is referenced to a POS edge on Channel A.
- Samples are then taken on the trigger event of Channel A as quickly as possible. Two measurements are shown.

  EVENTS = 0 to 4,000,000,000 on Channel A or B

TIME INTERVAL | INTERVAL SAMPLING

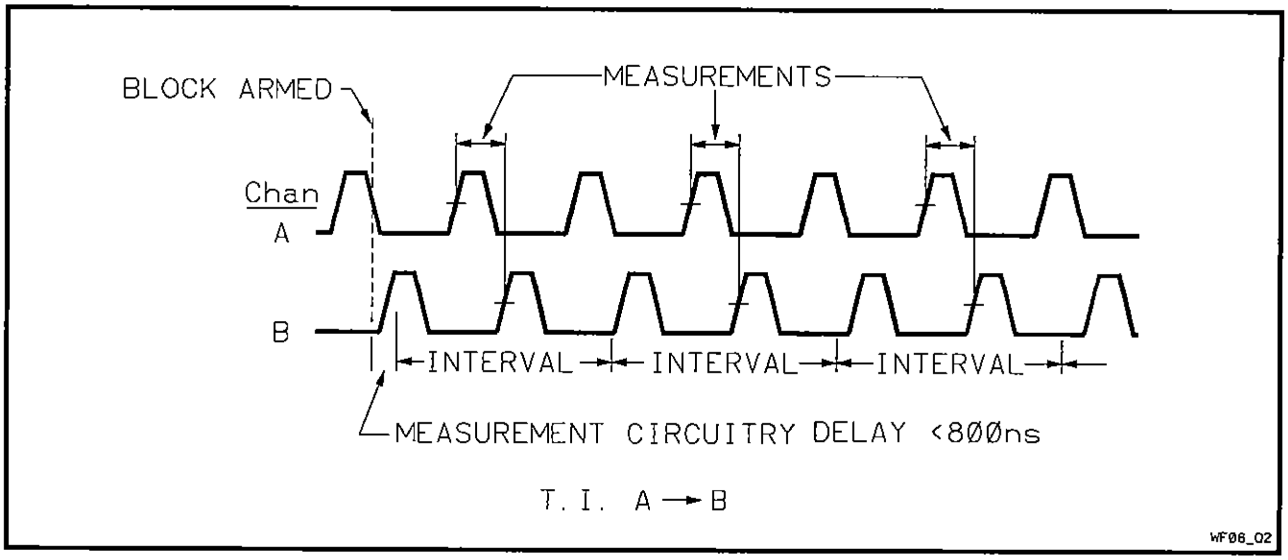


Figure 2-8. Time Interval | Interval Sampling

DESCRIPTION:

- Block of measurements is armed 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. In this case, the sample interval sets the time between measurements. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 2-1. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

TIME INTERVAL | REPETITIVE EDGE

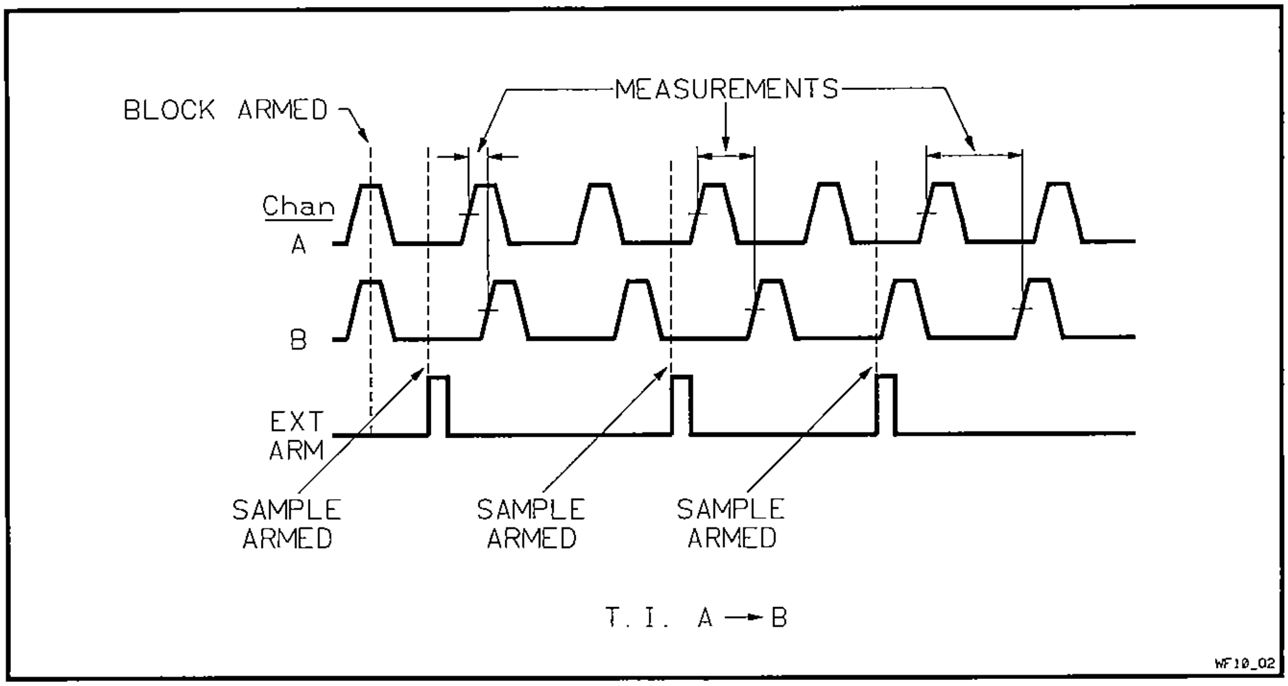


Figure 2-9. Time Interval | Repetitive Edge

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are armed after a POS edge on EXT ARM. One measurement is taken per arming edge. An edge is required before each measurement. Three measurements are shown.

TIME INTERVAL | EDGE/INTERVAL

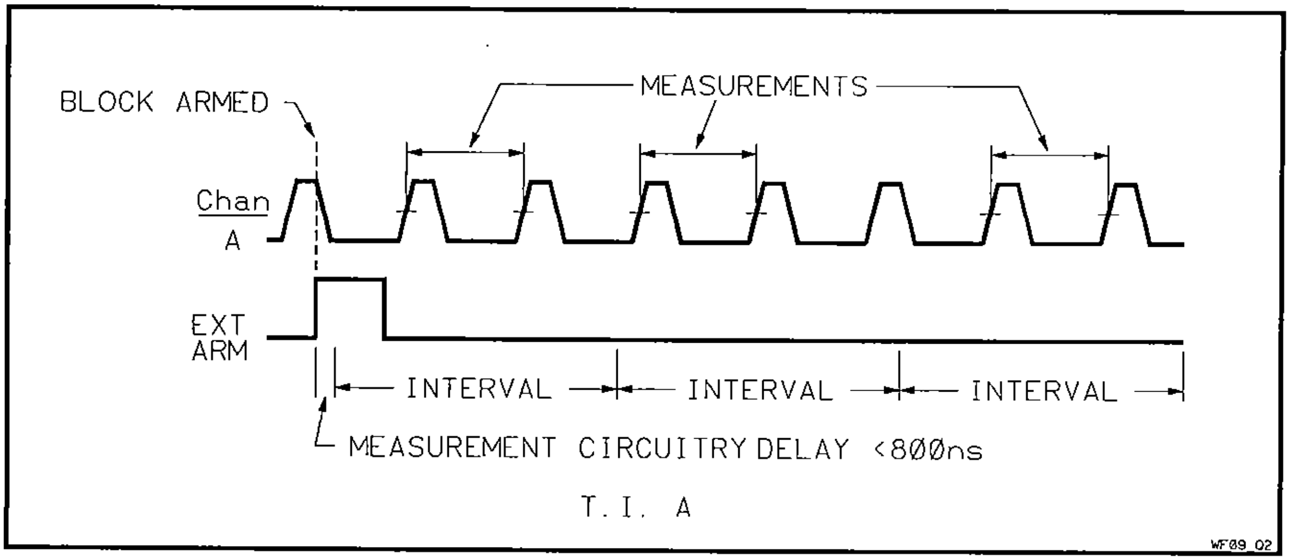


Figure 2-10. Time Interval | Edge/Interval

DESCRIPTION:

- Block of measurements is armed after a POS edge on EXT ARM.
- For Time Interval measurements, one measurement is taken per interval when the specified sample interval is longer than the time interval measured. In this case, the sample interval sets the time between measurements. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 2-2. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

Continuous Time Interval Measurements

CONTINUOUS TIME INTERVAL | AUTOMATIC

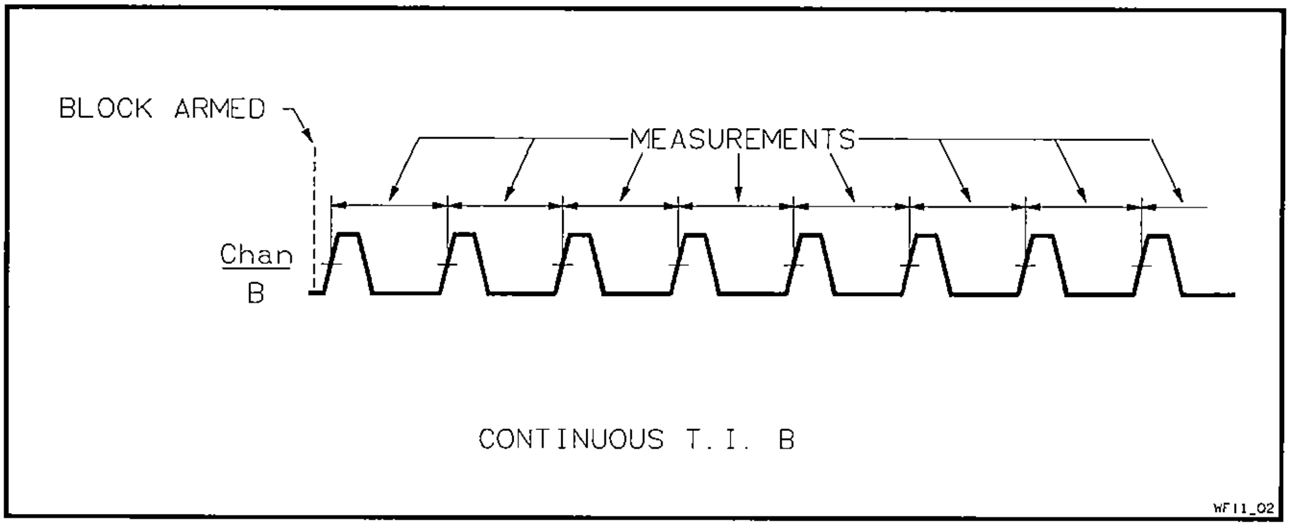


Figure 2-11. Continuous Time Interval | Automatic

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are then taken on the trigger event of Channel B as quickly as possible. Seven measurements are shown.

CONTINUOUS TIME INTERVAL | EDGE HOLDOFF

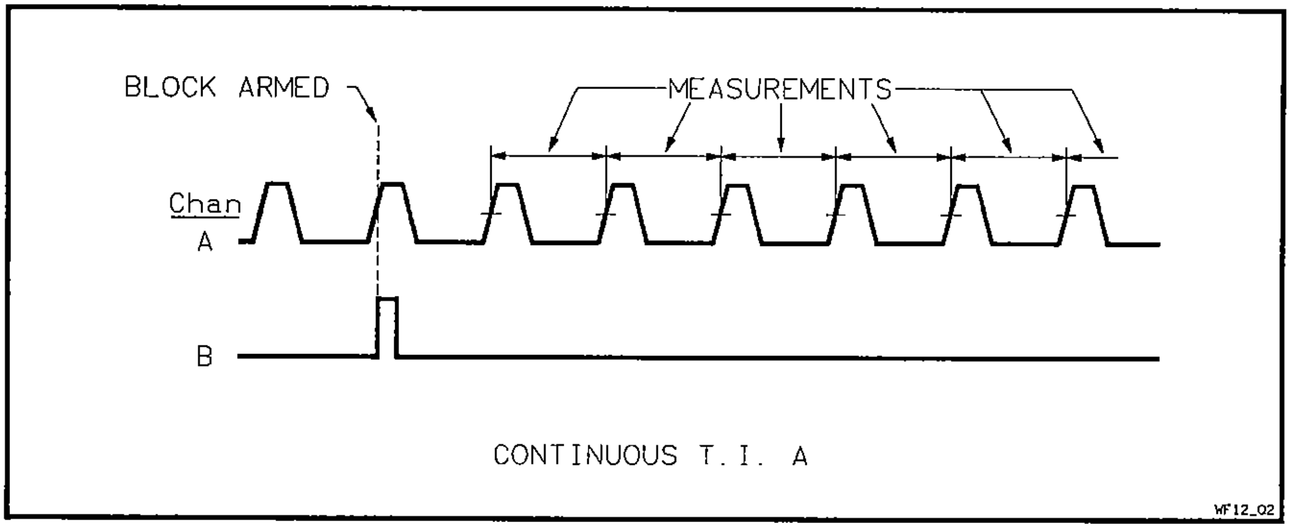


Figure 2-12. Continuous Time Interval | Edge Holdoff

DESCRIPTION:

- Block of measurements is armed after a POS edge on Channel B.
- Samples are then taken on the trigger event of Channel A as quickly as possible. Five measurements are shown.

CONTINUOUS TIME INTERVAL | TIME HOLDOFF

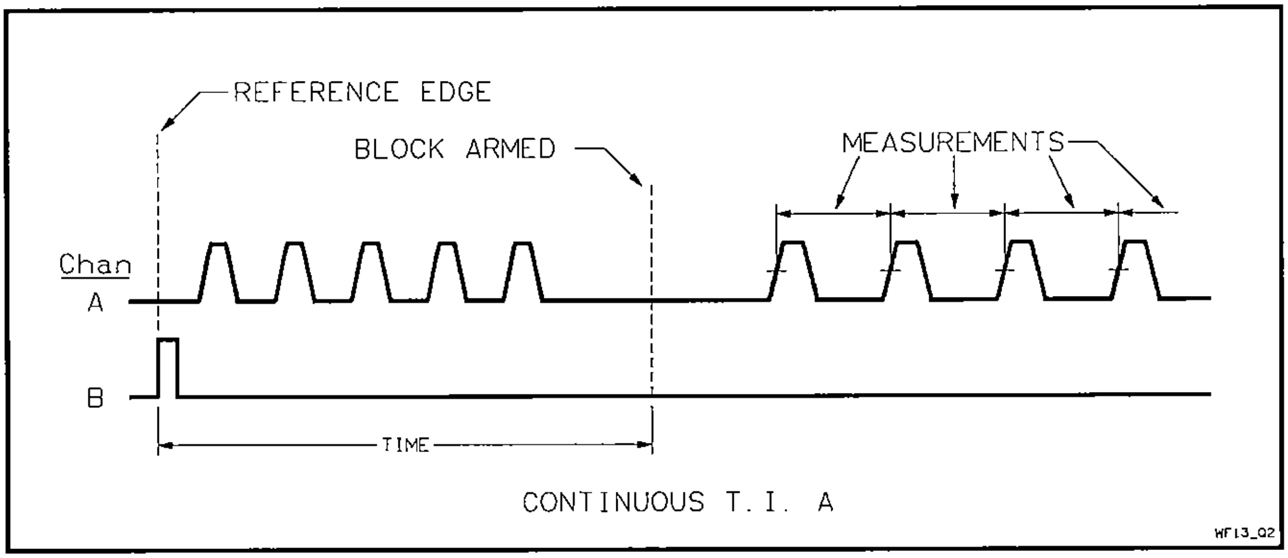


Figure 2-13. Continuous Time Interval | Time Holdoff

DESCRIPTION:

- Block of measurements is armed after a time delay. The start of the time delay is referenced to a POS edge on Channel B.
- Samples are then taken on the trigger event of Channel A as quickly as possible. Three measurements are shown.

TIME = 2 ns to 8.0 s with 2 ns resolution

CONTINUOUS TIME INTERVAL | EVENT HOLDOFF

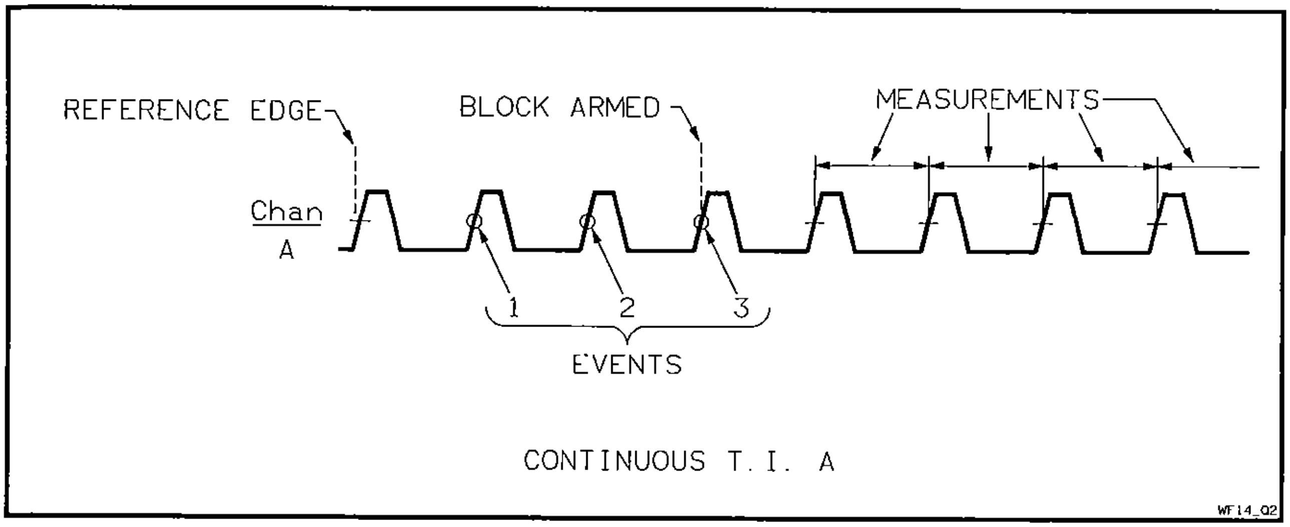


Figure 2-14. Continuous Time Interval | Event Holdoff

DESCRIPTION:

- Block of measurements is armed after an event delay. The start of the three-event delay is referenced to a POS edge on Channel A.
- Samples are then taken on the trigger event of Channel A as quickly as possible. Three measurements are shown.

EVENTS = 0 to 4,000,000,000 on Channel A or B

CONTINUOUS TIME INTERVAL | INTERVAL SAMPLING

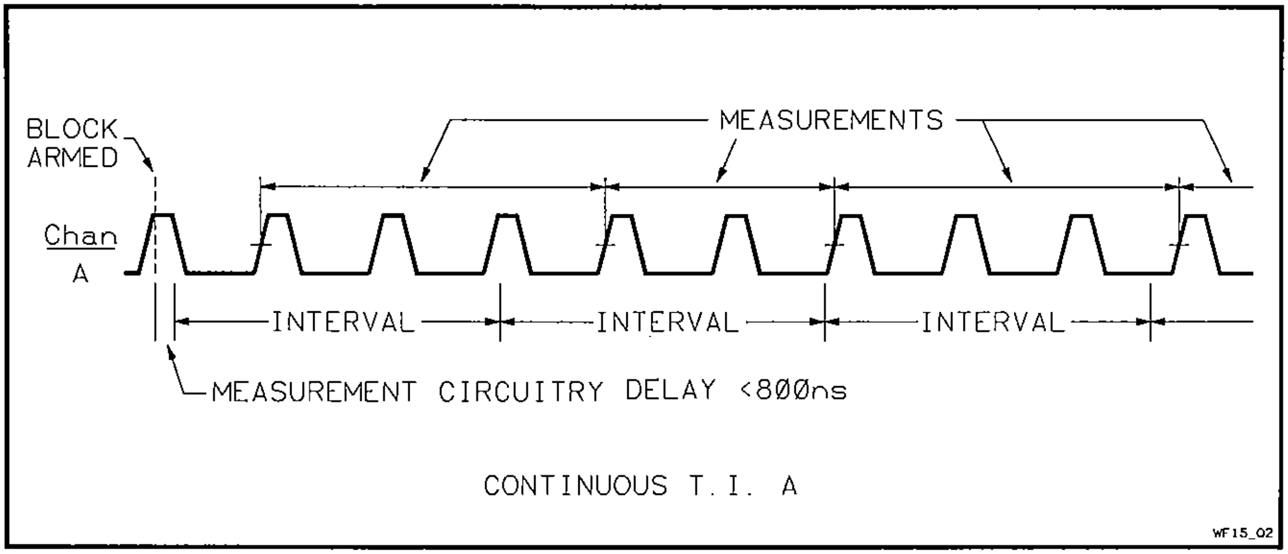


Figure 2-15. Continuous Time Interval | Interval Sampling

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are then taken on the trigger event of Channel A after each specified sample interval. The first sample is taken on 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.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 2-3. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

CONTINUOUS TIME INTERVAL | REPETITIVE EDGE

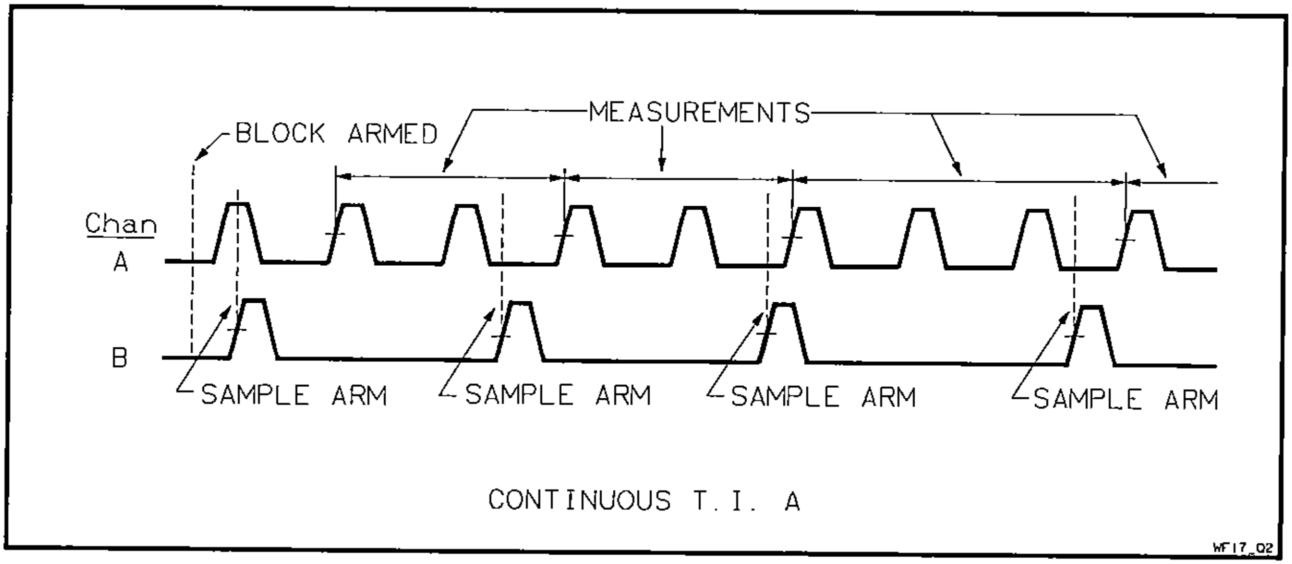


Figure 2-16. Continuous Time Interval | Repetitive Edge

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are armed after a POS edge on Channel B. One sample is taken per arming edge. An edge is required before each sample. Three measurements are shown.

CONTINUOUS TIME INTERVAL | EDGE/INTERVAL

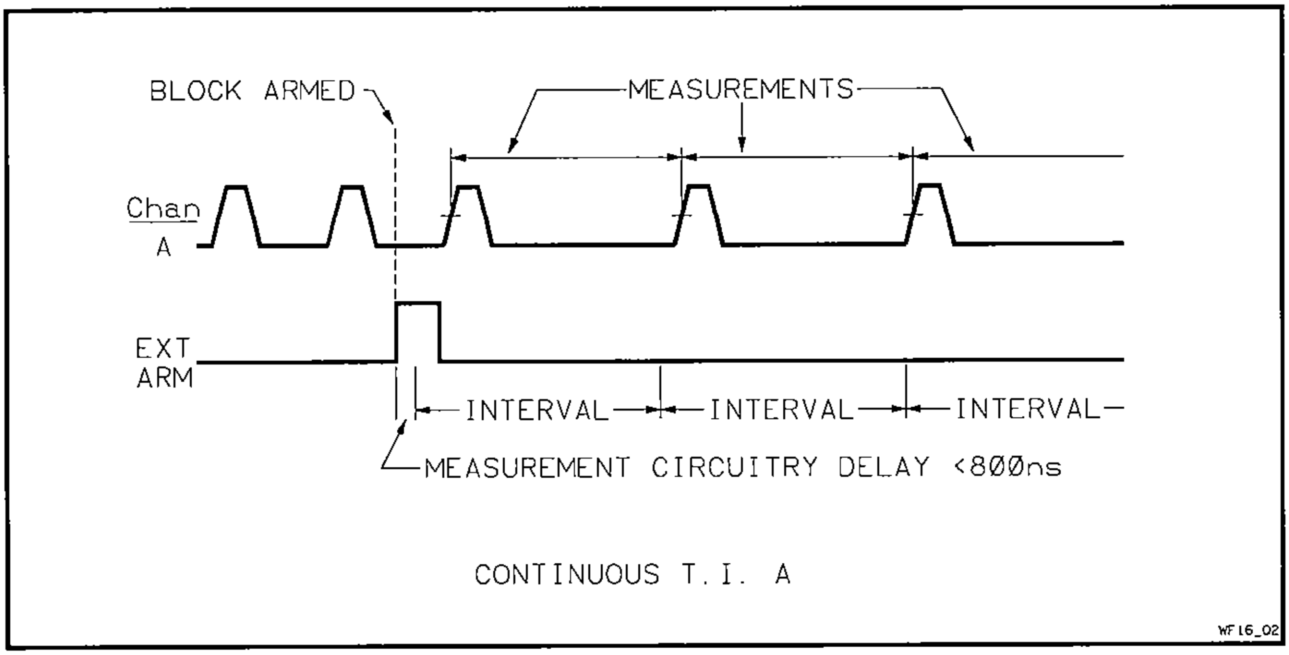


Figure 2-17. Continuous Time Interval | Edge/Interval

DESCRIPTION:

- Block of measurements is armed after a POS edge on EXT ARM.
- Samples are then taken on the trigger event of Channel A after each specified sample interval. The first sample is taken on 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. Two measurements are shown.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 2-4. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

±Time Interval Measurements

±TIME INTERVAL | AUTOMATIC

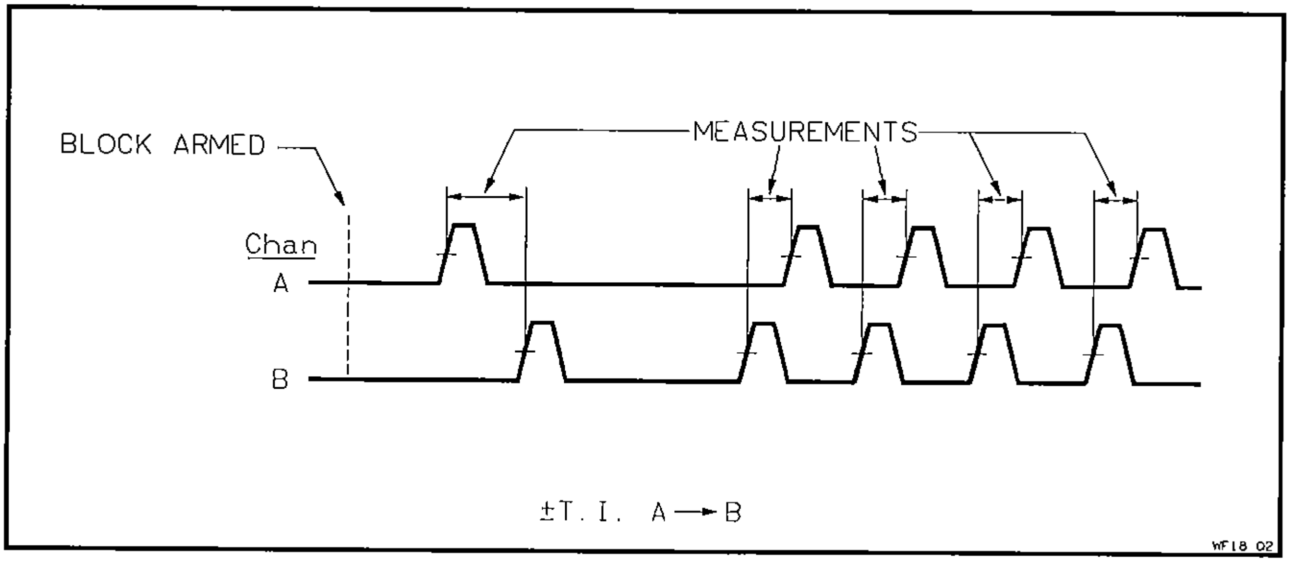


Figure 2-18. ±Time Interval | Automatic

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are then taken on the trigger event of signals being measured as quickly as possible. Four measurements are shown.

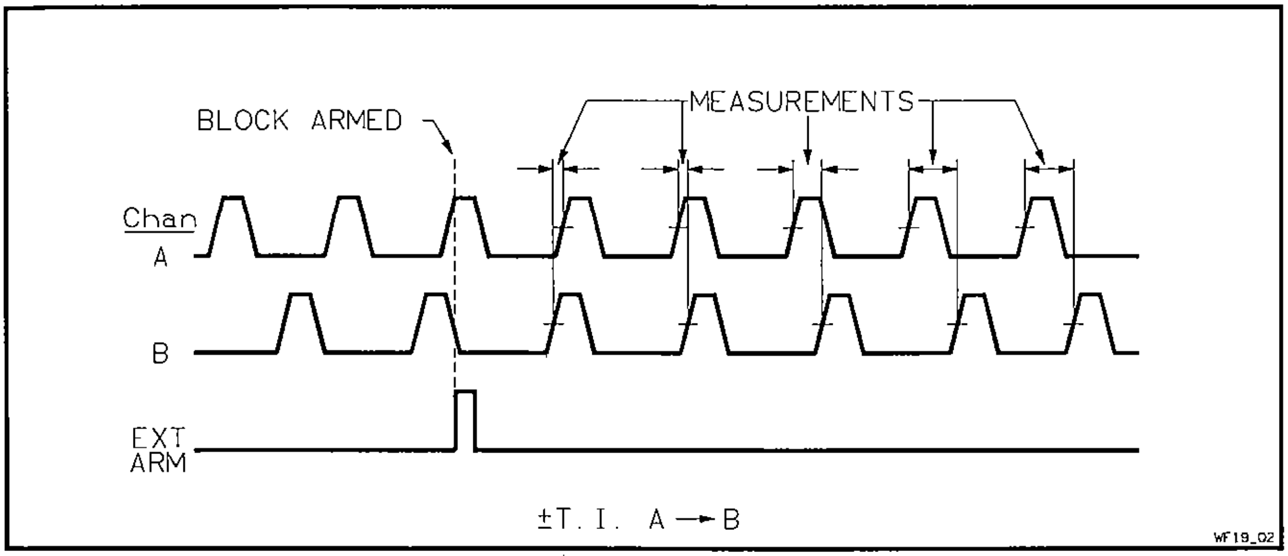


Figure 2-19. ±Time Interval | Edge Holdoff

DESCRIPTION:

- Block of measurements is armed after a POS edge on EXT ARM.
- Samples are then taken on the trigger event of signals being measured as quickly as possible. Five measurements are shown.

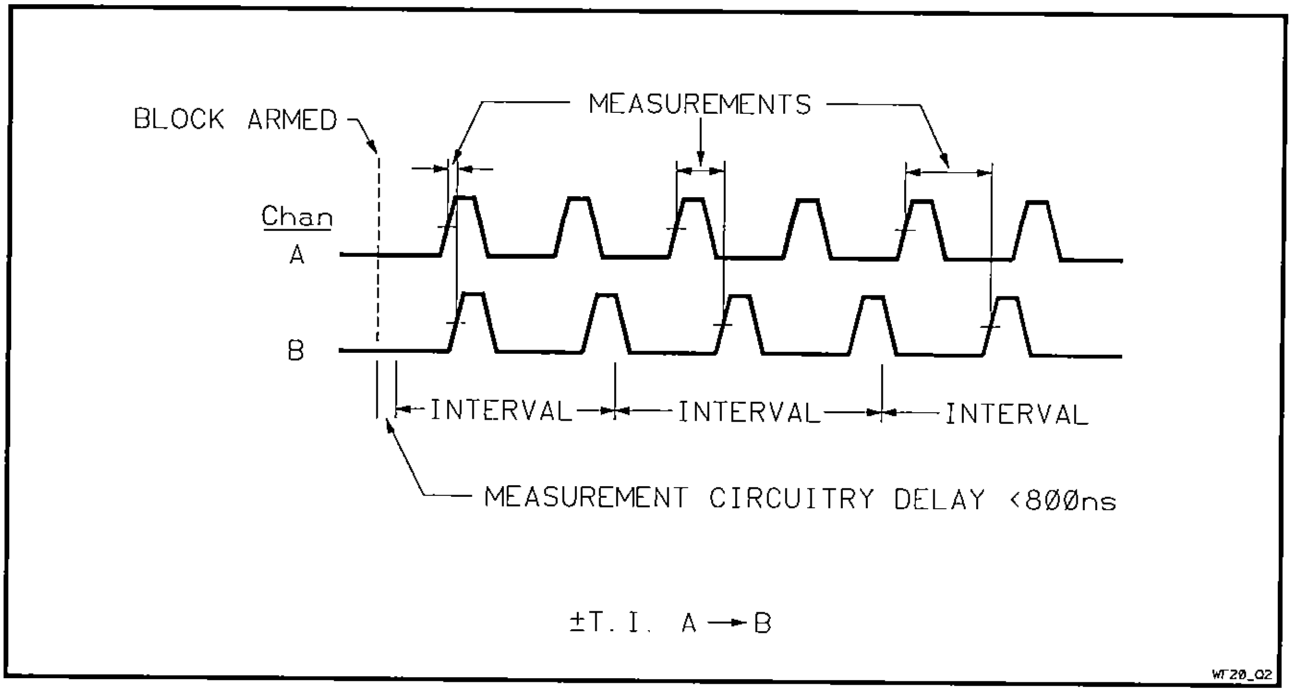


Figure 2-20. ±Time Interval | Interval Sampling

DESCRIPTION:

- Block of measurements is armed 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. In this case, the sample interval sets the time between measurements. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 2-5. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

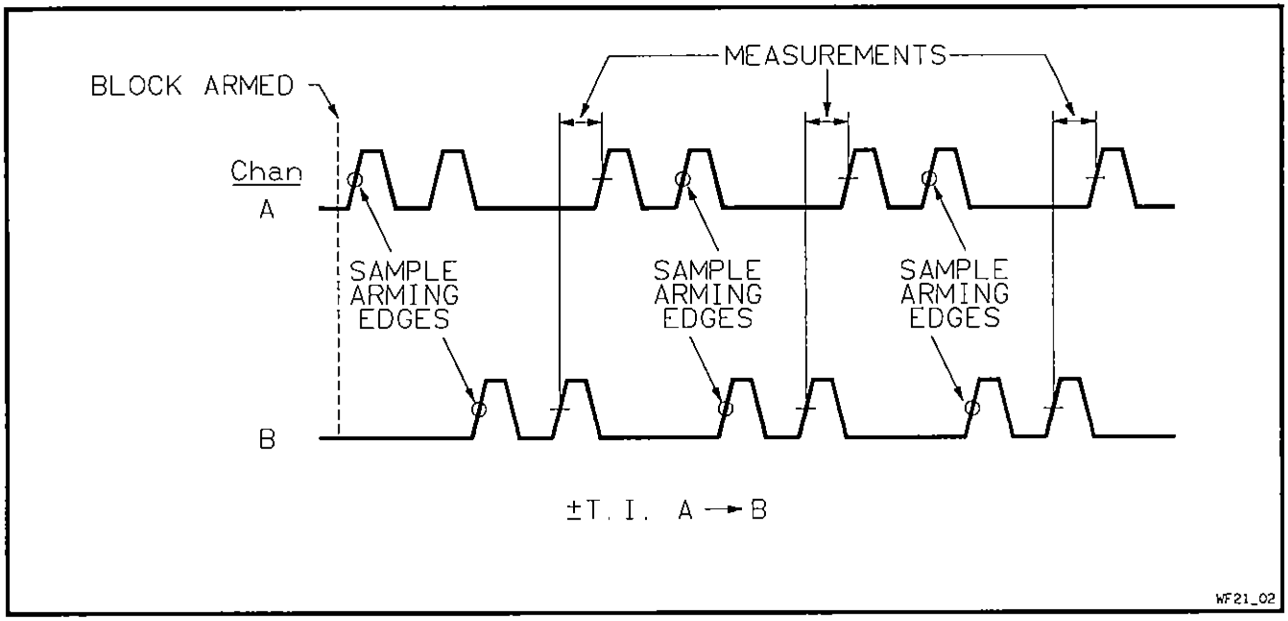


Figure 2-21. ±Time Interval | Parity Sampling

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- For ±Time Interval measurements, one measurement is taken following a trigger event on each of the two input channels. Three measurements are shown.

NOTE

For Parity Sampling ("Parity" = two Sample Arming Edges) –

During a 200 ns interval after every measurement, parity edge detection operates according to the following rules:

1. If an unequal number of edges occur on the two input channels, (for example, 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 these examples) 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 input 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 input channels is required after the 200 ns interval, to satisfy the parity condition for the next measurement.

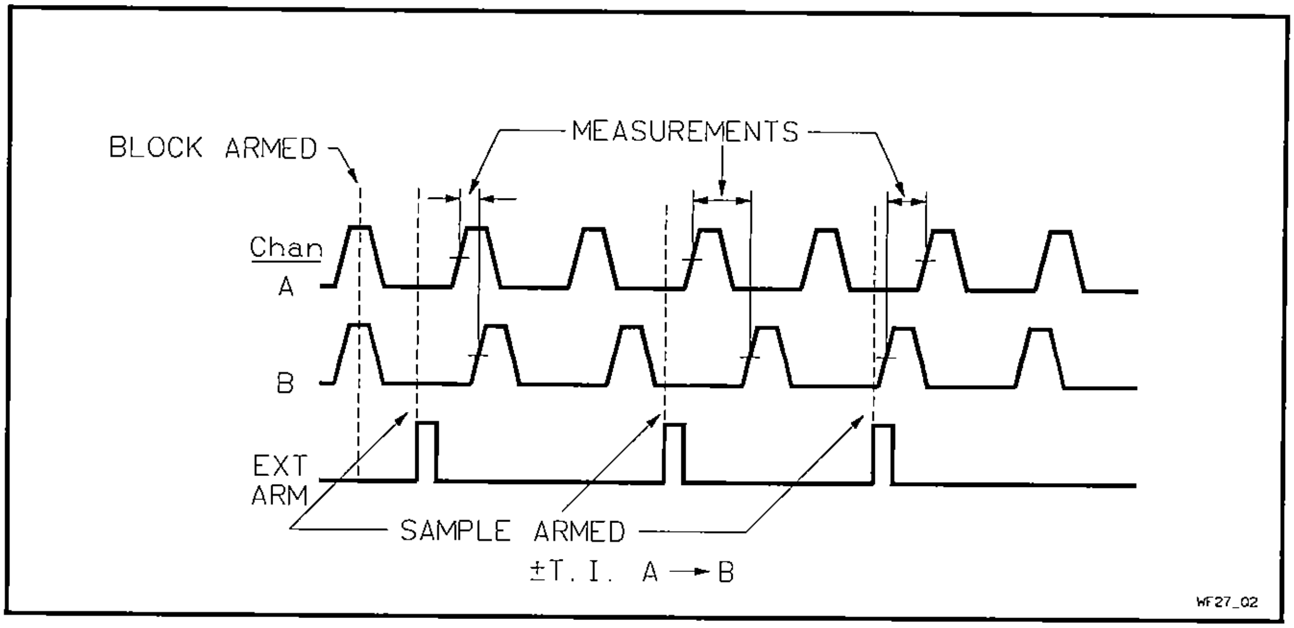


Figure 2-22. ±Time Interval | Repetitive Edge

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are armed after a POS edge on EXT ARM. One measurement is taken per arming edge. An edge is required before each measurement. Three measurements are shown.

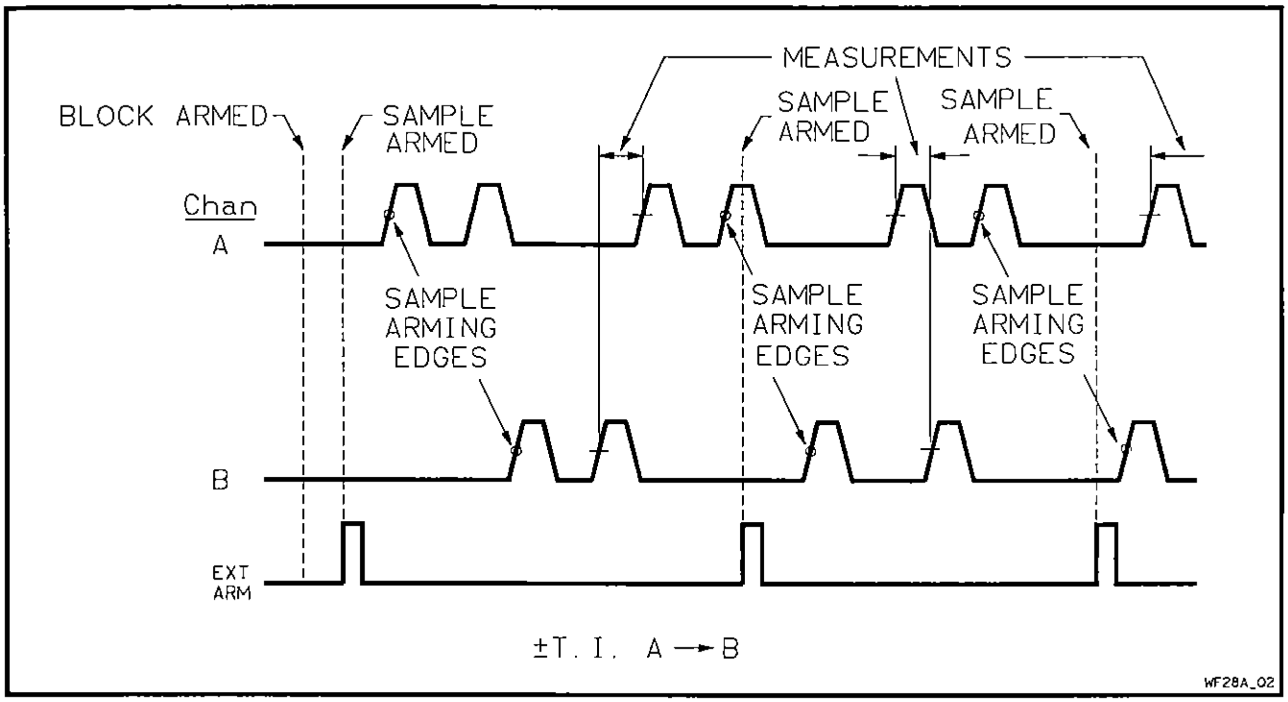


Figure 2-23. ±Time Interval | Repetitive Edge/Parity

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are armed after a POS edge on EXT ARM. Then, one measurement is taken following a trigger event on each of the two input channels. Two measurements are shown.

NOTE

For Repetitive Edge/Parity ("Parity" = two Sample Arming Edges) –

Before every Sample Armed signal and during a 200 ns interval after every measurement, parity edge detection operates according to the following rules:

1. If an unequal number of edges occur on the two input channels, (for example, 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 these examples) is needed after the Sample Armed signal and 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 input 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 input channels is needed after the Sample Armed signal and after the 200 ns interval, to satisfy the parity condition required for the next measurement.

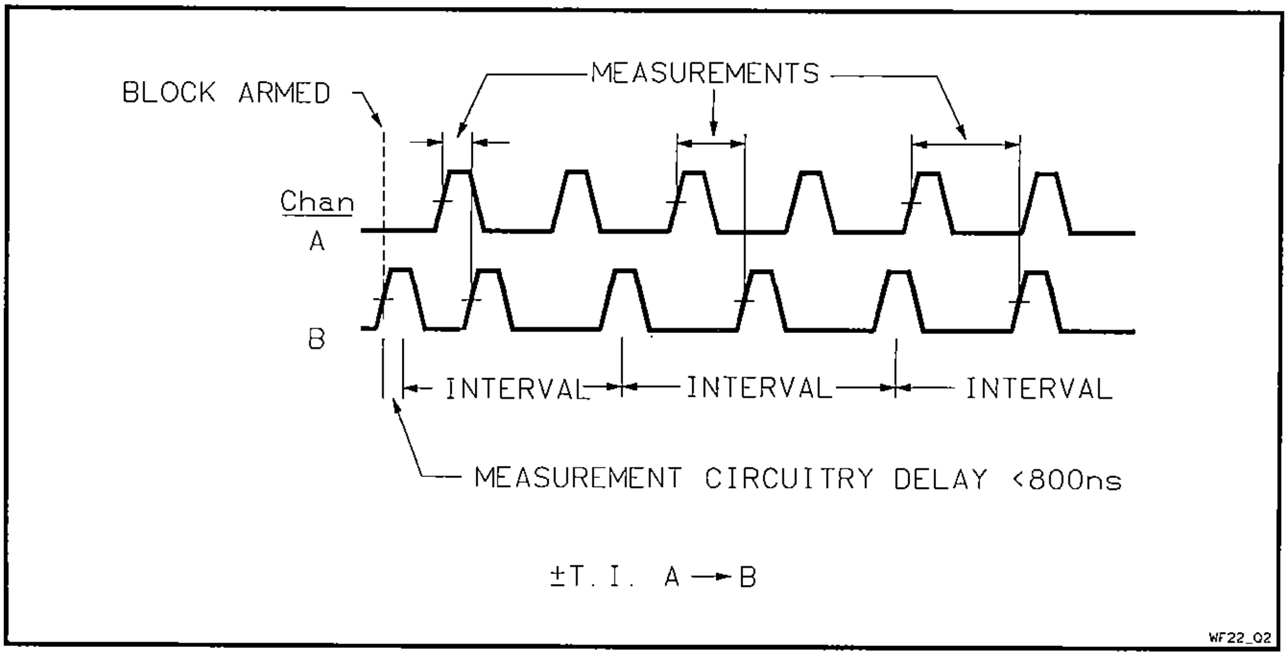


Figure 2-24. ±Time Interval | Edge/Interval

DESCRIPTION:

- Block of measurements is armed after a POS edge on Channel B.
- For ±Time Interval measurements, one measurement is taken per interval when the specified sample interval is longer than the time interval measured. In this case, the sample interval sets the time between measurements. The sample interval is repetitive and asynchronous with the signal being measured. Three measurements are shown.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 2-6. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

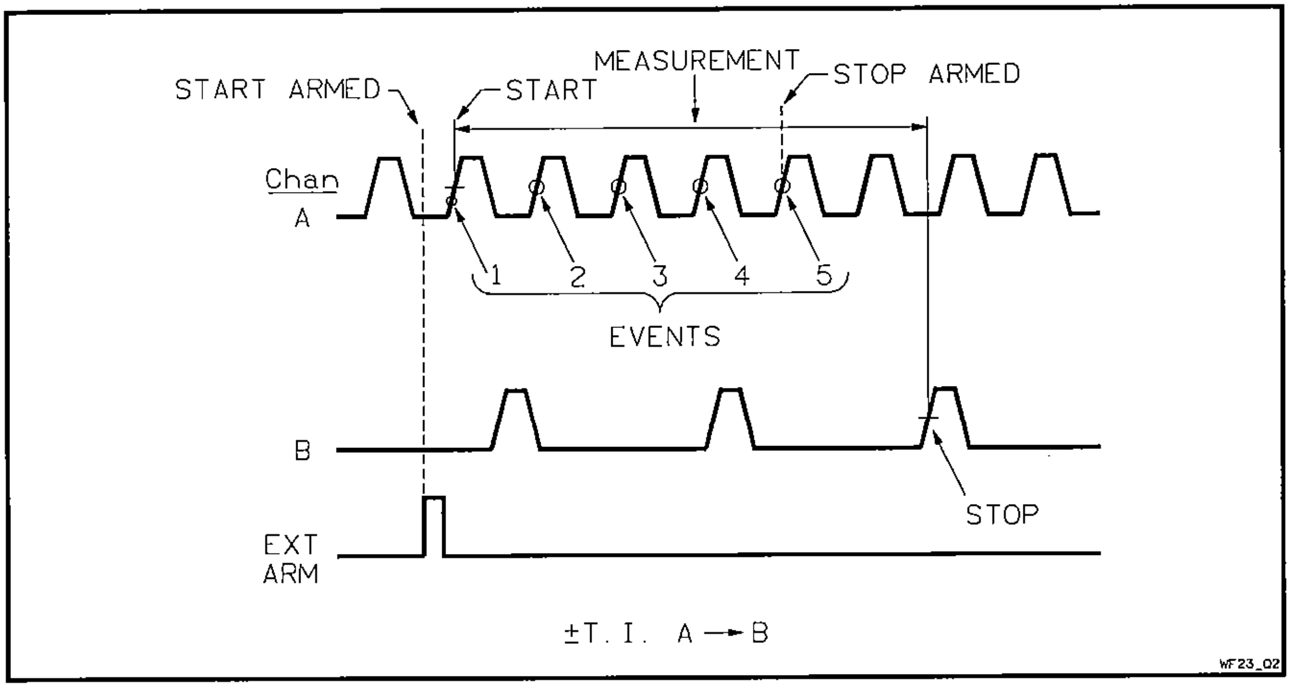


Figure 2-25. ±Time Interval | Edge/Event

DESCRIPTION:

- Start of measurement is armed after a POS edge on EXT ARM.
- Measurement starts on the next trigger event after the arming edge.
- Measurement ends on the trigger event following the specified number of events on Channel A.

  EVENT = 0 to 4,000,000,000 on Channel A or B

NOTE

Total period of Stop Arm events should not exceed 8.0 s.

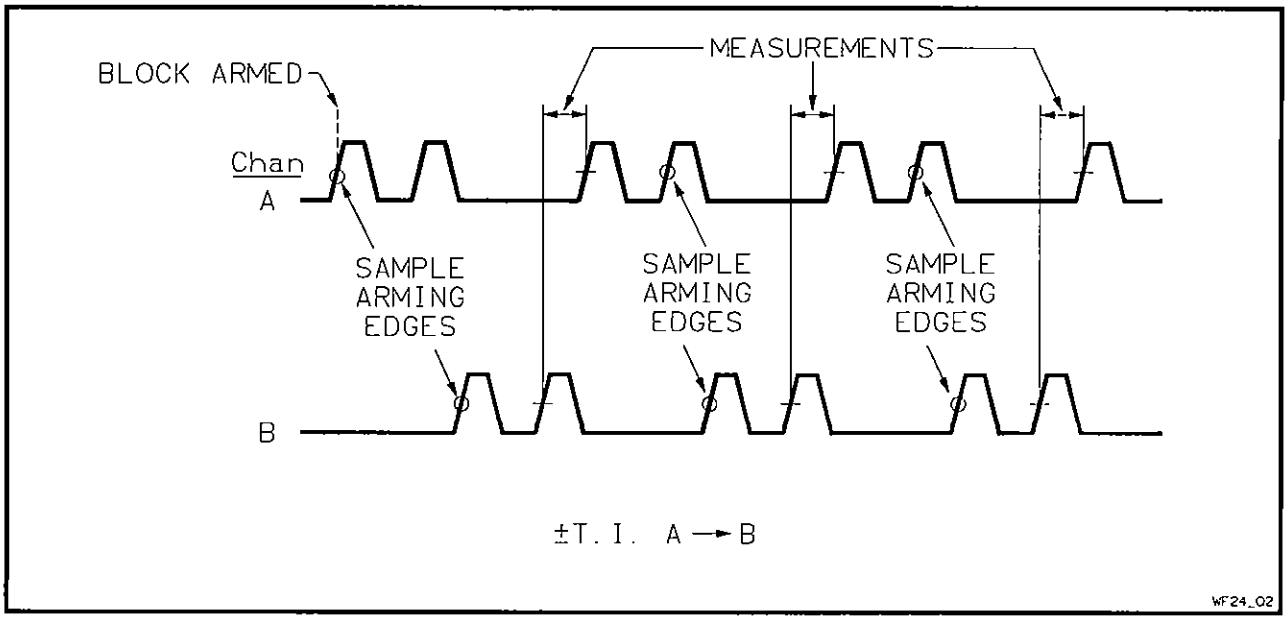


Figure 2-26. ±Time Interval | Edge/Parity

DESCRIPTION:

- Block is armed after a POS edge on Channel A.
- For ±Time Interval measurements, one measurement is taken following a trigger event on each of the two input channels. Three measurements are shown.

NOTE

For Edge/Parity ("Parity" = two Sample Arming Edges) –

Before the Block Armed signal and during a 200 ns interval after every measurement, parity edge detection operates according to the following rules:

1. If an unequal number of edges occur on the two input channels, (for example, 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 these examples) is needed after the Block Armed signal or 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 input 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 input channels is needed after the Block Armed signal or after the 200 ns interval, to satisfy the parity condition required for the next measurement.

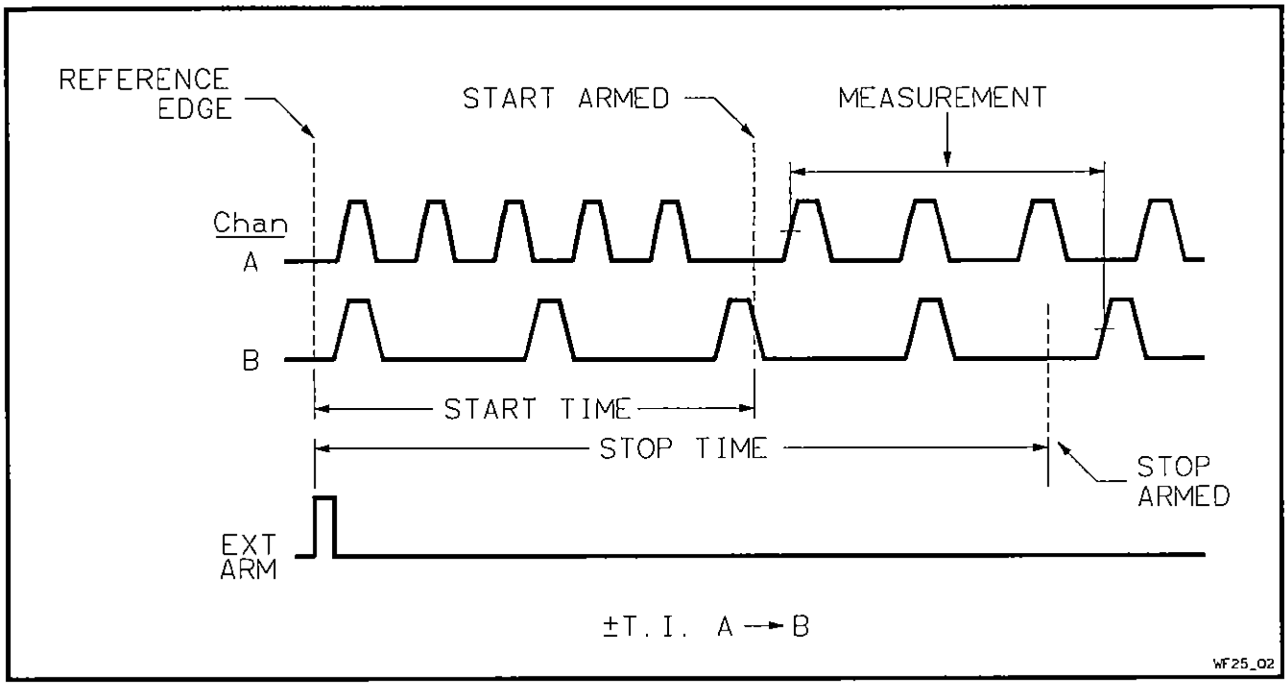


Figure 2-27. ±Time Interval | Time/Time

DESCRIPTION:

- Start of measurement is armed after a time delay. The start of the time delay is referenced to a POS edge on EXT ARM.
- Measurement starts on the 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.

TIME = 2 ns to 8.0 s with 2 ns resolution

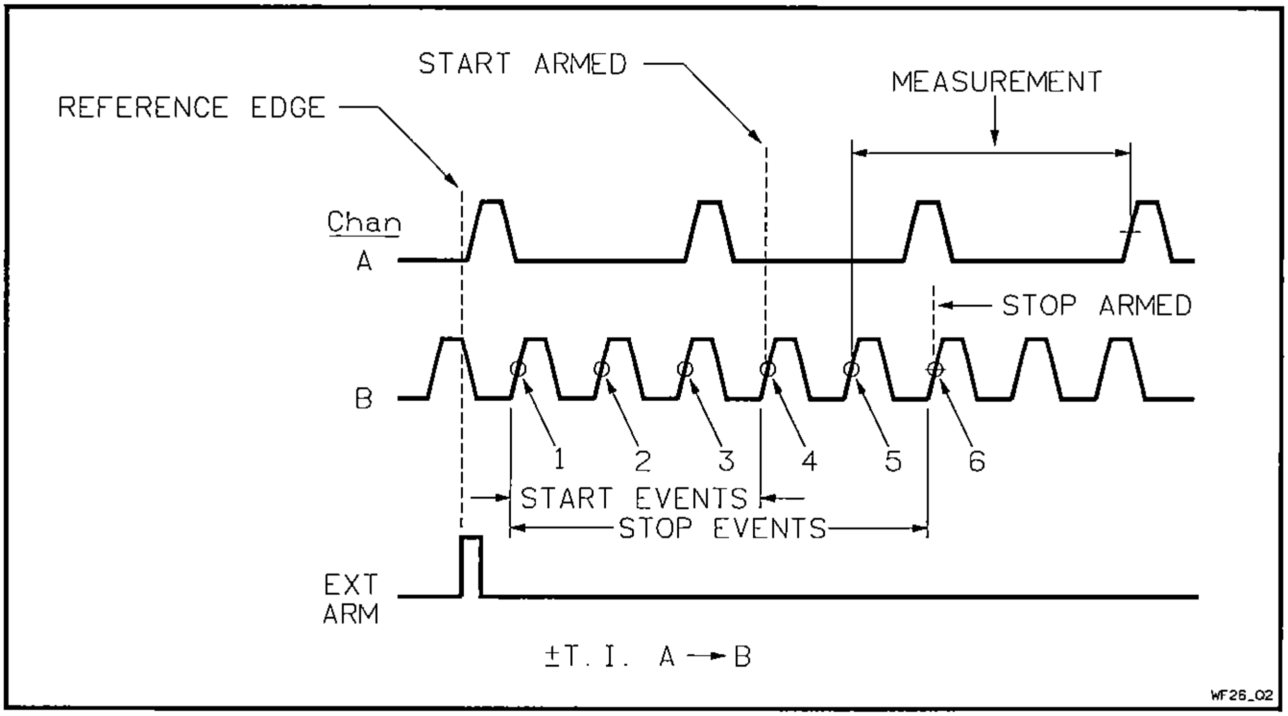


Figure 2-28. ± Time Interval | Event/Event

DESCRIPTION:

- Start of measurement is armed after an event delay. The start of the event delay is referenced to a POS edge on EXT ARM.
- Measurement starts on the trigger event following the end of the start event delay. The start delay is four events.
- Measurement stops on the trigger event following the end of the stop event delay. The stop delay is six events. The start and stop event delays are referenced to the same arming edge.

EVENT = 0 to 4,000,000,000 on Channel A or B

NOTE

Total period of Stop Arm events should not exceed 8.0 s.

3 FREQUENCY/PERIOD MEASUREMENTS

3 FREQUENCY/PERIOD MEASUREMENTS

SUMMARY

This section describes the following for Frequency and Period measurements:

- Gate time.
- The available channel options.
- The front panel keys used to select a measurement and review the results.
- The available arming modes for the selected measurement channel.
- An illustration of each of the frequency/period arming modes.

TERMS USED HERE

- **Gating:** Gating describes opening and closing of a measurement gate. When the gate is open, data is being collected. When the gate is closed no data is collected.
- **Continuous Gating:** Continuous gating describes a situation where the gate never really closes. Think of a register that is continually collecting data and periodically its contents are sampled for the time or the events that have occurred since the last sampling.
- **Non-continuous Gating:** Non-continuous gating is conventional gating. The measurement gate opens on a trigger event. The gate stays open a set amount of time, collecting data. The gate closes on a trigger event after the set time elapses. The measurement processing then derives an answer from this isolated data.
- **Reciprocal Counting:** Instruments using the reciprocal counting technique always make a period measurement on the input signal. The measurement begins on a trigger event of the input signal being measured. The measurement ends on a trigger event of the input signal. Frequency information can be computed by taking the reciprocal of the period measurement.
- **Sample:** A sample is a data point.
- **Measurement:** A measurement consists of two successive samples.
- **Block:** A block is a group of measurements.
- **Block Size:** Block Size is the number of blocks of measurements that will be collected.

ments to be acquired is the same as the measurement size. The measurement size multiplied by the number of blocks gives you the total number of measurements for any measurement setup.

- **Trigger Event:** The trigger event is a point on a Channel A or B signal edge that triggers the HP 5371A to start a measurement, take a sample, or end a measurement. The event is defined by setting a slope, a trigger level, and a trigger mode on the INPUT menu screen.

- **Block Holdoff:** Block Holdoff specifies the conditions that must be satisfied before a trigger event can initiate a block of measurements. (For continuous gating measurements.)

- **Sample Arm:** Sample Arm specifies the conditions that must be satisfied before each of the samples within a block can be acquired. (For continuous gating measurements.)

- **Start Arm:** Start Arm specifies the conditions that must be satisfied before a trigger event can initiate a measurement. (For non-continuous gating measurements.)

- **Stop Arm:** Stop Arm specifies the conditions that must be satisfied before a trigger event can end a measurement. (For non-continuous gating measurements.)

FREQUENCY

FREQUENCY allows measurements of frequencies from .125 Hz to 500 MHz applied to Channel A or B (.250 Hz to 500 MHz for two-channel measurements). The resolution of the measurement is controlled by the length of time the gate is open. The longer the gate time, the greater the number of displayed digits of resolution. The time that the gate is open is set in the Arming Mode portion of the FUNCTION screen.

PERIOD

PERIOD makes period measurements from 2 ns to 8.0 s (2 ns to 4.0 s for two-channel measurements). The signal can be applied to Channel A or B. The resolution of the measurement is controlled by the gate time. The time that the gate is open is set in the Arming Mode portion of the FUNCTION screen.

Frequency and Period Gate Time

For most of the frequency and period arming modes, a gate time is set by specifying a repetitive time interval, a high-precision time, an edge, or a number of edges. The edge source can be the signal being measured or another signal.

Because the HP 5371A employs a reciprocal counting technique, the actual gate time can be longer than the set time by one period of the measurement signal. All starting, sampling, and stopping of measurements takes place on the next trigger event of the signal being measured, after the set gate time ends. Frequency results are calculated by dividing the number of events by the amount of time over which the events were counted. Period results are calculated by dividing the amount of time over which these events were counted by the number of events counted. For both frequency and period, measurements are averaged whenever the gate time is greater than the period of the signal being measured.

For frequency and period measurements, the available arming modes and channel options are identical. The only difference between the two functions is how the measured result is computed from the count of events and time.

Frequency = EVENTS / TIME

Period = TIME / EVENTS

CHANNEL OPTIONS

The HP 5371A offers the same channel options for both frequency and period measurements. To indicate that the following descriptions apply to both frequency and period measurements, the term "Frequency/Period" is used. The channel options can be selected by first moving the menu cursor to the "Channel" field on the Function menu.

The maximum measurement size is 1000 measurements for all channel options except "A & B". Option "A & B" is limited to a measurement size of 500. The total measurements (Block Size × Measurement Size) can equal 2,000,000,000 for all Frequency/Period channel options.

Channel A

Frequency/Period can be measured on Channel A by selecting the "A" softkey.

Channel B

Frequency/Period can be measured on Channel B by selecting the "B" softkey.

Channels A & B

Frequency/Period can be measured on two channels simultaneously by selecting the "A & B" softkey.

Simultaneous Measurement Features:

- Full accuracy is provided for each of the measurement channels.
- Measurement and Gate Time data can be displayed for both channels on the NUMERIC screen.
- Histogram and Time Variation graphs can be displayed for both measurement channels on the GRAPHIC screen, but only one channel at a time. Select Channel A or B under the Display options of the GRAPHIC key.
- Statistics are available for both measurement channels.

NOTE For Simultaneous Measurements:

1. Both signals must be present before the Analyzer will begin a measurement.
2. The measurement size cannot exceed 500. The total number of measurements can still equal 2,000,000,000.
3. It is important to note that the measurement rate is set by the signal with the longer period, when it exceeds the set gate time. For example, imagine you are measuring the frequency of two signals simultaneously. One frequency is 10 MHz and the other is 1 Hz. The arming mode is Interval Sampling, and the interval is set to 600 ns. This configuration causes a measurement rate of approximately one measurement per second. It is the period of the slower signal that determines how quickly measurements can be taken.

Ratio A / B

The ratio of Frequency/Period measurements can be made by selecting the "A/B" softkey. The measurement result will be the ratio of the signal at Channel A to the signal at Channel B. The HP 5371A can display ratios of less than 1.

Ratio B / A

The only difference here, as compared to "A/B", is that the measurement result will be the ratio of the signal at Channel B to the signal at Channel A.

Sum A + B

The HP 5371A will display the sum of two Frequency/Period measurements if you select the "A + B" softkey. The frequency or period at Channel A will be added to the one at Channel B.

Difference A – B

The HP 5371A will display the difference of two Frequency/Period measurements if you select the "A – B" softkey. The frequency or period at Channel B will be subtracted from the one at Channel A.

Difference B – A

The HP 5371A will display the difference of two Frequency/Period measurements if you select the "B – A" softkey. The frequency or period at Channel A will be subtracted from the one at Channel B.

FREQUENCY/PERIOD MEASUREMENT SUGGESTIONS

Before you connect your signal to the HP 5371A, think about the measurement you want to make.

For example, the HP 5371A has very sensitive input circuitry. Too much noise on your signal can cause false triggering.

Other considerations for Frequency/Period measurements might be:

1. Do you want to make a frequency measurement without having to specify any setup parameters?

   If so, do the following:

   PRESS: FUNCTION

   MOVE: Menu cursor to the "Measurement" field

   PRESS: **FREQUENCY** softkey

   PRESS: SHIFT key and then PRESET key

   The HP 5371A will automatically be configured to measure the frequency of the signal at Channel A. The display will show a combination of results and statistics for the 50 measurements being taken. Histogram or Time Variation graphs can be displayed by pressing the GRAPHIC key.

2. Do you want to measure a Frequency/Period using as short a gate time as possible for frequencies over 10 MHz?

   If so, do the following:

   Select EVENT/EVENT SAMPLING arming and set the Start Count to 0 and the Stop Count to 1. Measure and count on the same channel.

3. Are you sure the signal conditioning controls and the trigger event settings are correct for the measurement you want to make?

   Check these settings on the INPUT menu screen.

   For more information on general measurement hints, refer to Appendix D, MEASUREMENT SUGGESTIONS.

MEASUREMENT SETUP SUMMARY

Listed below is a summary of the front panel menu screens and the instrument parameters that can be specified on each screen. The listing is grouped into Measurement Setup menu screens and Measurement Review menu screens. After reviewing this information, you will see the relationship between the different HP 5371A screens. For example, statistics are viewed on the NUMERIC screen, but enabled on the MATH screen.

The FUNCTION, INPUT, MATH, AND GRAPHIC screen settings all help determine what you will see on the NUMERIC and GRAPHIC screens. Use the STATUS key to see a summary of HP 5371A settings.

FOR YOUR MEASUREMENT SETUP:

On this menu screen	You can specify
FUNCTION	Measurement type Measurement channel Number of blocks Number of measurements per block Arming mode
INPUT	Separate or common inputs Trigger slope, trigger level External arm level Bias level Attenuation
MATH	Statistics on/off Math values Reference set/clear Limit values
GRAPHIC	Histogram graph parameters Time variation graph parameters Event timing graph parameters

FOR YOUR MEASUREMENT REVIEW:

On this result screen	You can specify
NUMERIC	Measurement results only Statistics results only Measurements and statistics Measurements and gate time Summary of limit results Enlarged numeric result display
GRAPHIC	Histogram graph Time variation graph Event timing graph Marker features Zoom features Display features Scaling Features

FREQUENCY/PERIOD ARMING MODES

Shown below are the measurement channels and arming modes available for Frequency/Period measurements.

FREQUENCY/PERIOD

A
B

AUTOMATIC	INTERVAL SAMPLING	EDGE/INTERVAL
	TIME SAMPLING	EDGE/TIME
	CYCLE SAMPLING	EDGE/EDGE
	EDGE SAMPLING	EXTERNALLY GATED
		EDGE/CYCLE
		EDGE/EVENT
		TIME/INTERVAL
		TIME/TIME
		EVENT/INTERVAL
		EVENT/EVENT

A&B
A/B
B/A
A+B
A-B
B-A

AUTOMATIC	INTERVAL SAMPLING	EDGE/INTERVAL
	EDGE SAMPLING	

FREQUENCY/PERIOD ARMING MODE EXAMPLES

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

Frequency/Period Measurements

Data is collected in the same way for both frequency and period measurements. For this reason, only arming mode examples of of frequency measurements are included here. The timing diagrams apply to period measurements as well.

FREQUENCY | AUTOMATIC

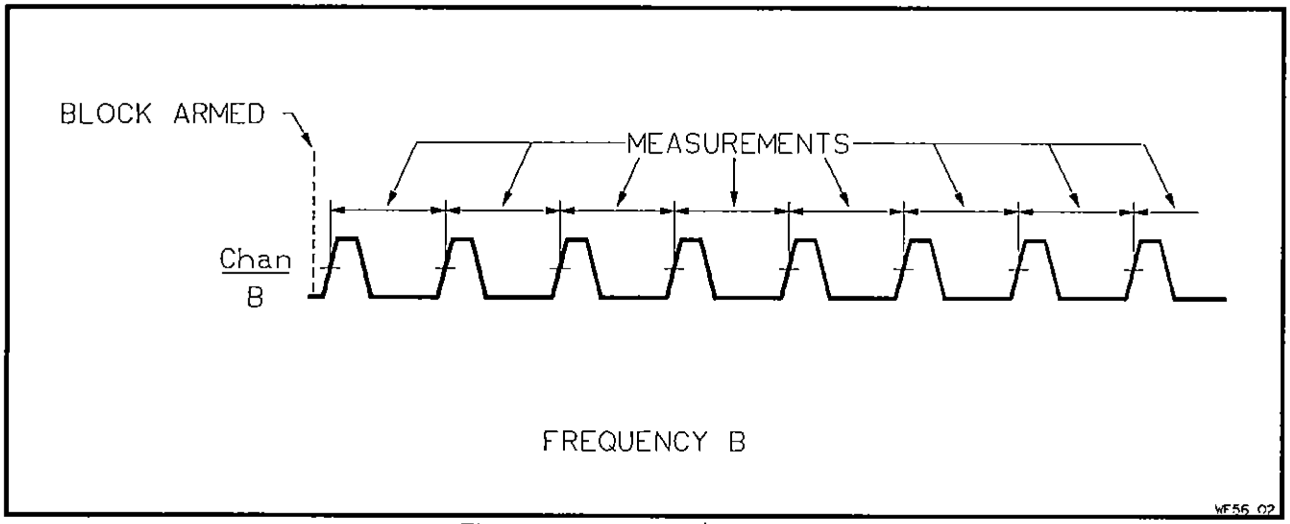


Figure 3-1. Frequency | Automatic

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are then taken on the trigger event of Channel B as quickly as possible. Seven measurements are shown.

FREQUENCY | INTERVAL SAMPLING

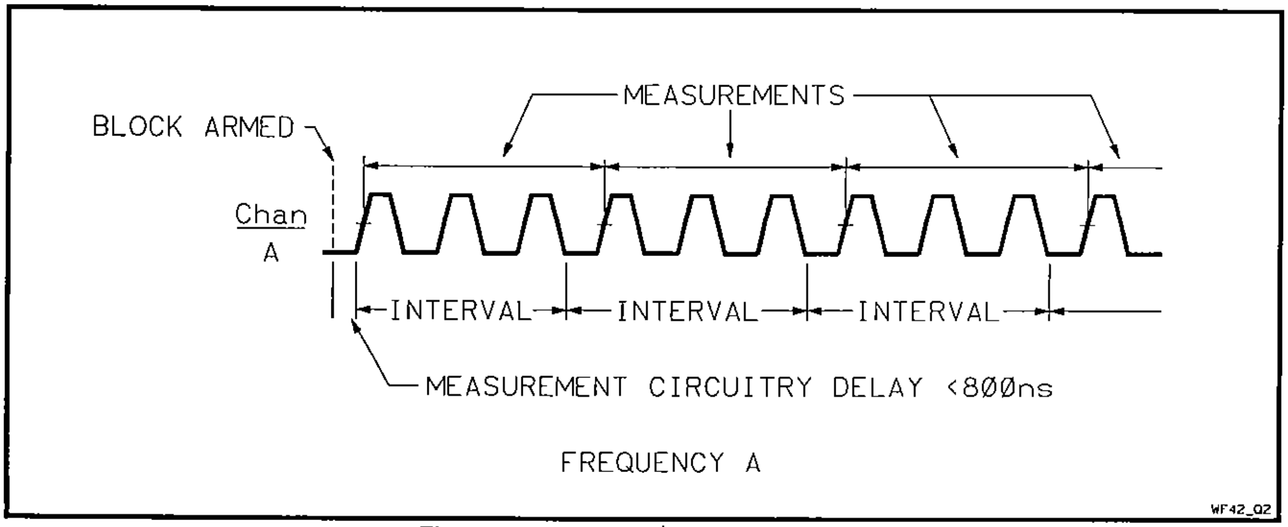


Figure 3-2. Frequency | Interval Sampling

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are then taken on the trigger event of Channel A after each specified sample interval. The first sample is taken on 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.

INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 3-1. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

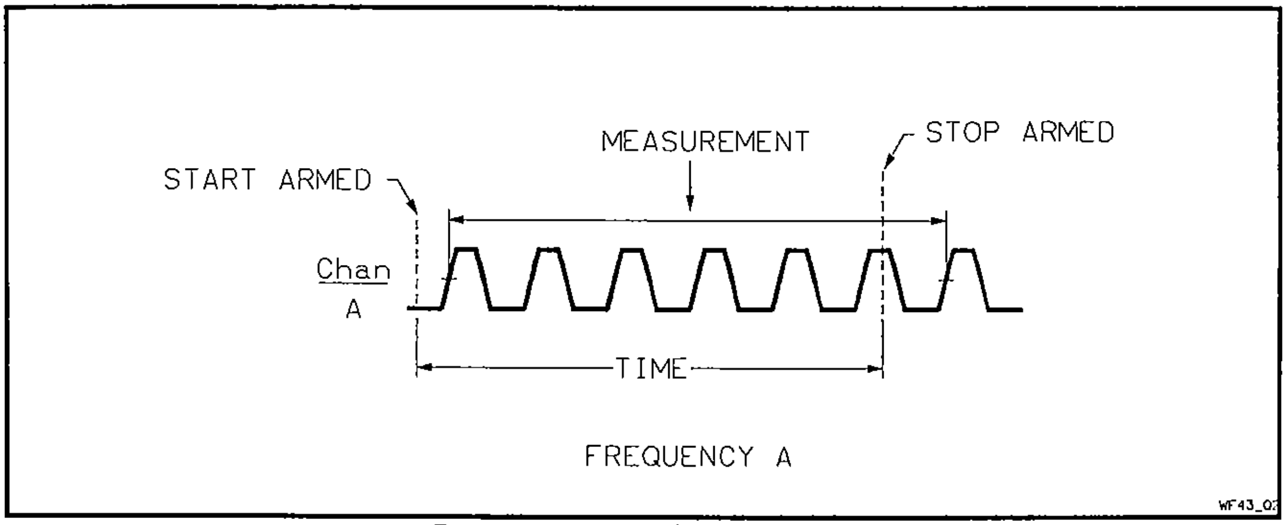


Figure 3-3. Frequency | Time Sampling

DESCRIPTION:

- Start of measurement is armed as soon as the Analyzer is ready.
- Measurement starts on the trigger event of Channel A following the start arm.
- Measurement ends on the trigger event following the end of the stop arm time delay. The time delay is referenced to the start arm signal.

TIME = 2 ns to 8.0 s with 2 ns resolution

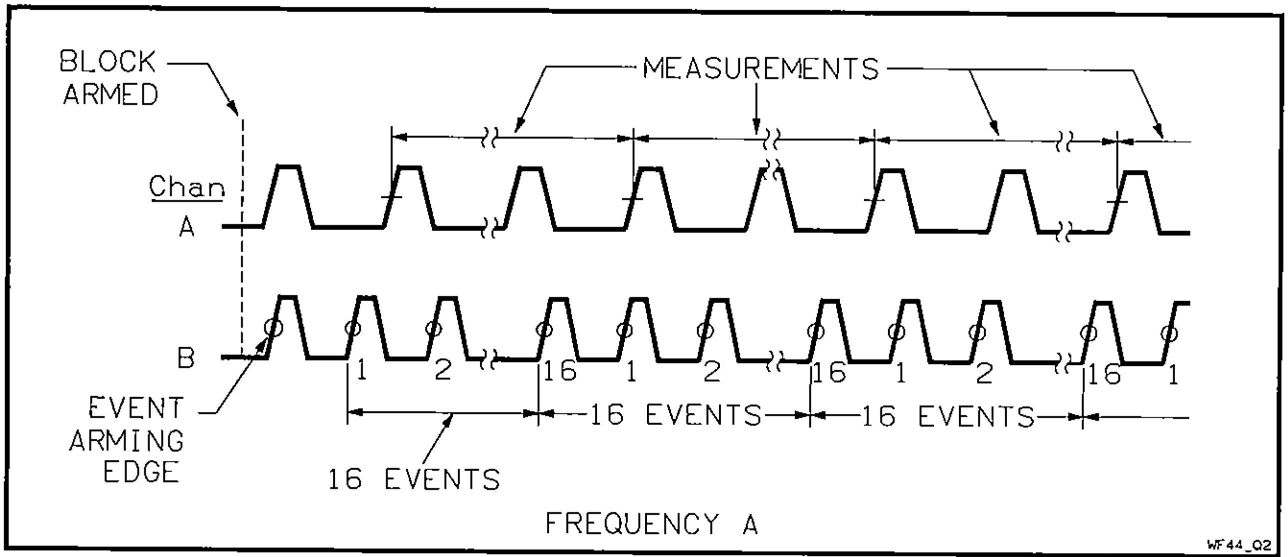


Figure 3-4. Frequency | Cycle Sampling

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- A trigger event on Channel B arms the start of the cycle count.
- 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 following the arming edge. Measurements end on the trigger event after each cycle interval. Three measurements are shown.
- Cycles can be counted on Channel A, B, or the 2 ns internal timebase.

CYCLE = 2^4, 2^8, 2^{12}, 2^{16}, 2^{20}, 2^{24}, 2^{28} (See cycle frequency limitation table below)

Table 3-2. Minimum Cycle Frequency

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

FREQUENCY | EDGE SAMPLING

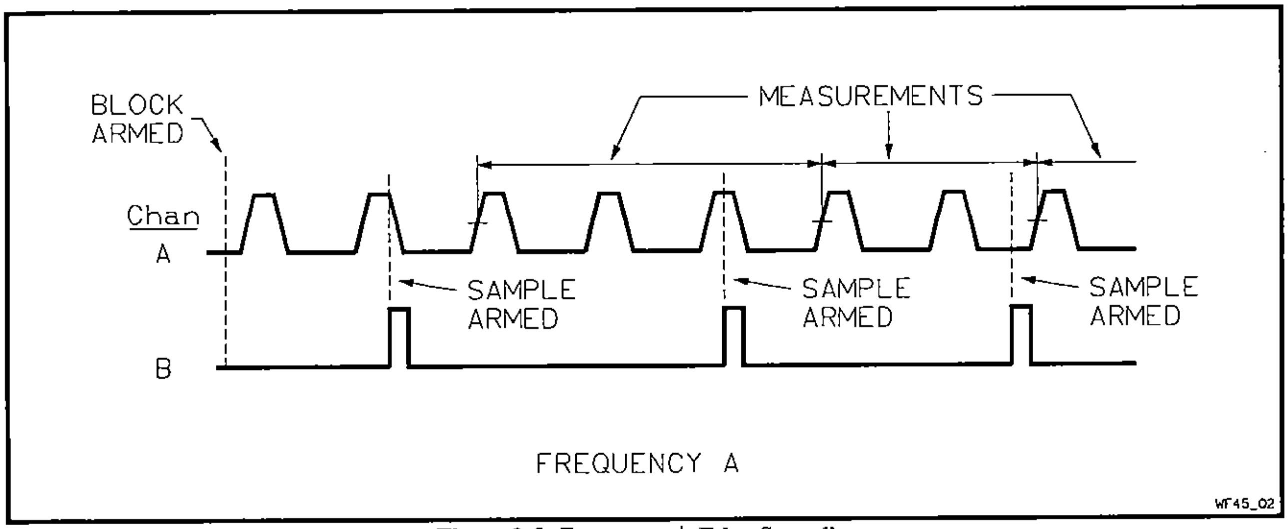


Figure 3-5. Frequency | Edge Sampling

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are armed after a POS edge on Channel B. One sample is taken per arming edge. An edge is required before each sample. Two measurements are shown.

NOTE

Period of Sample Arm signal should not exceed 8.0 s.

FREQUENCY | EDGE/INTERVAL

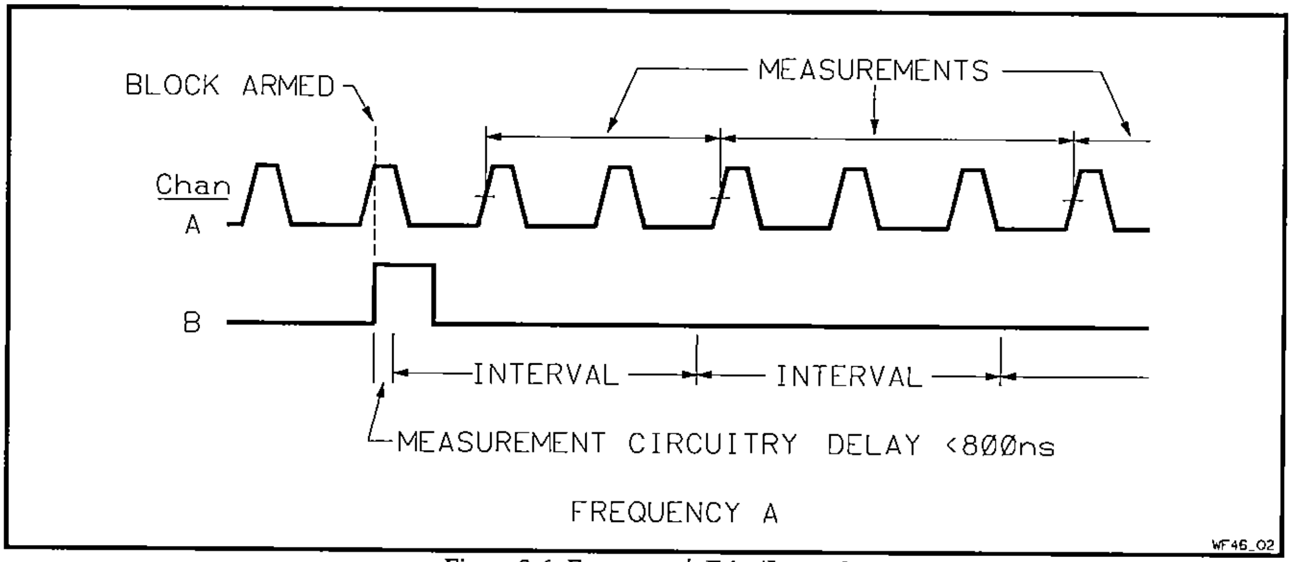


Figure 3-6. Frequency | Edge/Interval

DESCRIPTION:

- Block of measurements is armed after a POS edge on Channel B.
- Samples are then taken on the trigger event of Channel A after each interval. The first sample is taken on 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. Two measurements are shown.

INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 3-3. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

FREQUENCY | EDGE/TIME

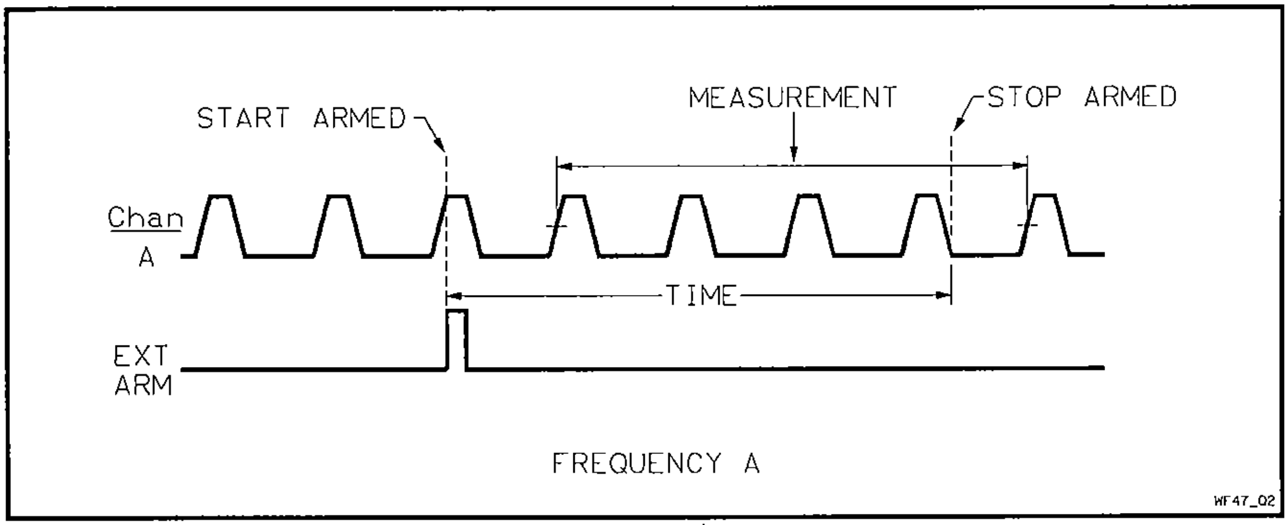


Figure 3-7. Frequency | Edge/Time

DESCRIPTION:

- Start of measurement is armed after a POS edge on EXT ARM.
- Measurement starts on the trigger event of Channel A following the start arm edge.
- Measurement ends on the trigger event following the end of the stop arm time delay. The stop arm time delay is referenced to the start arm edge.

TIME = 2 ns to 8.0 s with a 2 ns resolution

FREQUENCY | EDGE/EDGE

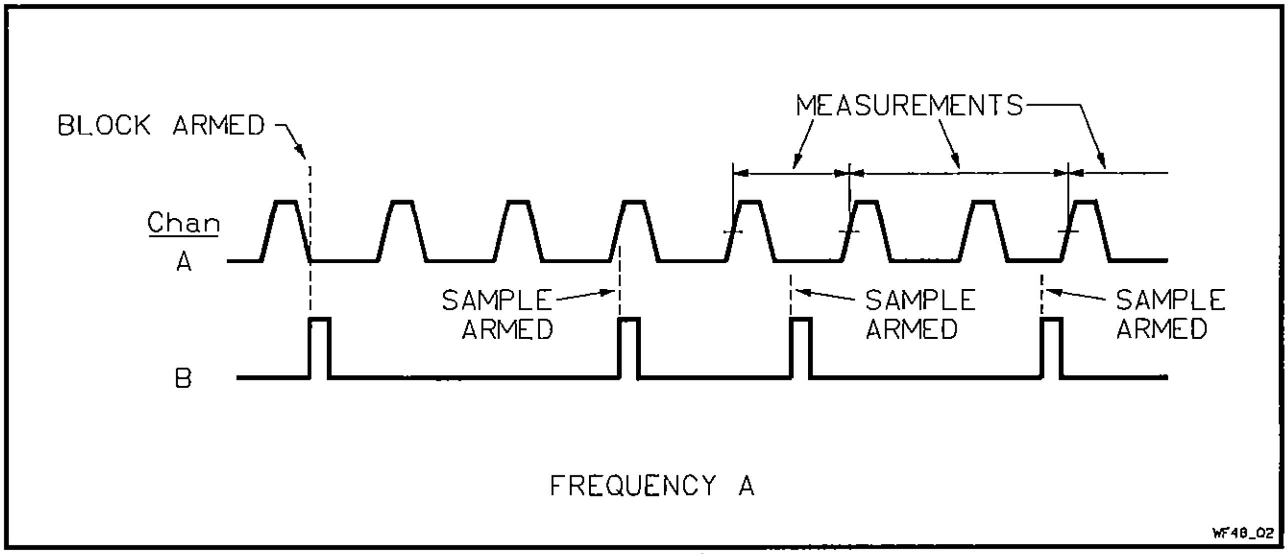


Figure 3-8. Frequency | Edge/Edge

DESCRIPTION:

- Block of measurements is armed after a POS edge on Channel B.
- Samples are armed after a POS edge on Channel B. One sample is taken per arming edge. An edge is required before each sample. Two measurements are shown.

NOTE

Period of Sample Arm signal should not exceed 8.0 s.

FREQUENCY | EXTERNALLY GATED

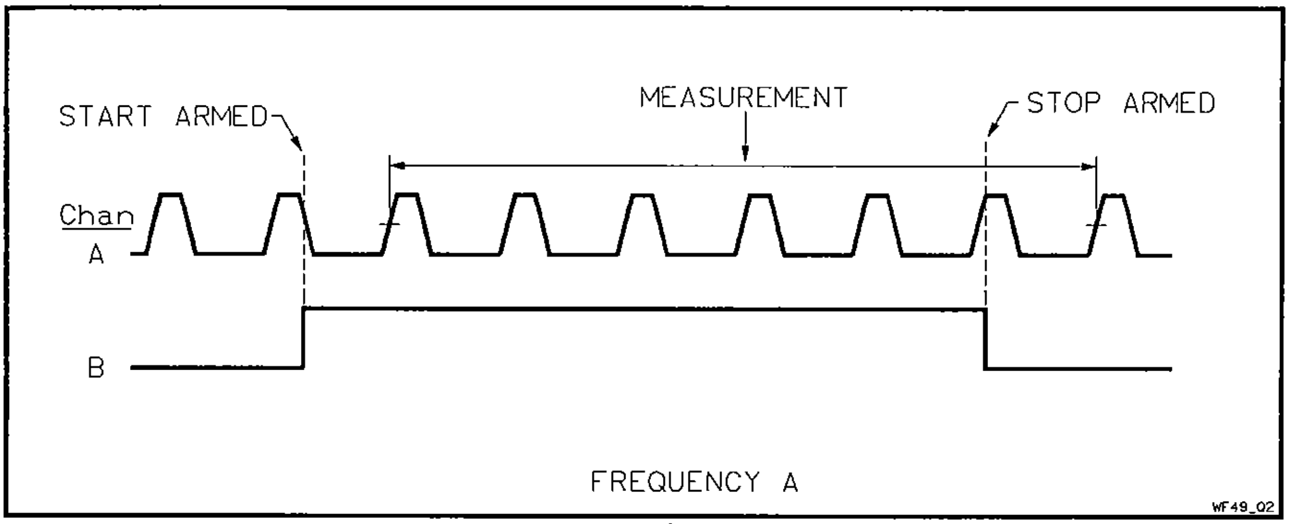


Figure 3-9. Frequency | Externally Gated

DESCRIPTION:

- Start of measurement is armed after a POS edge on Channel B.
- Measurement starts on the next trigger event of Channel A.
- Stop of measurement is armed after the opposite edge of the start arm signal.
- Measurement stops on the next trigger event of Channel A.

FREQUENCY | EDGE/CYCLE

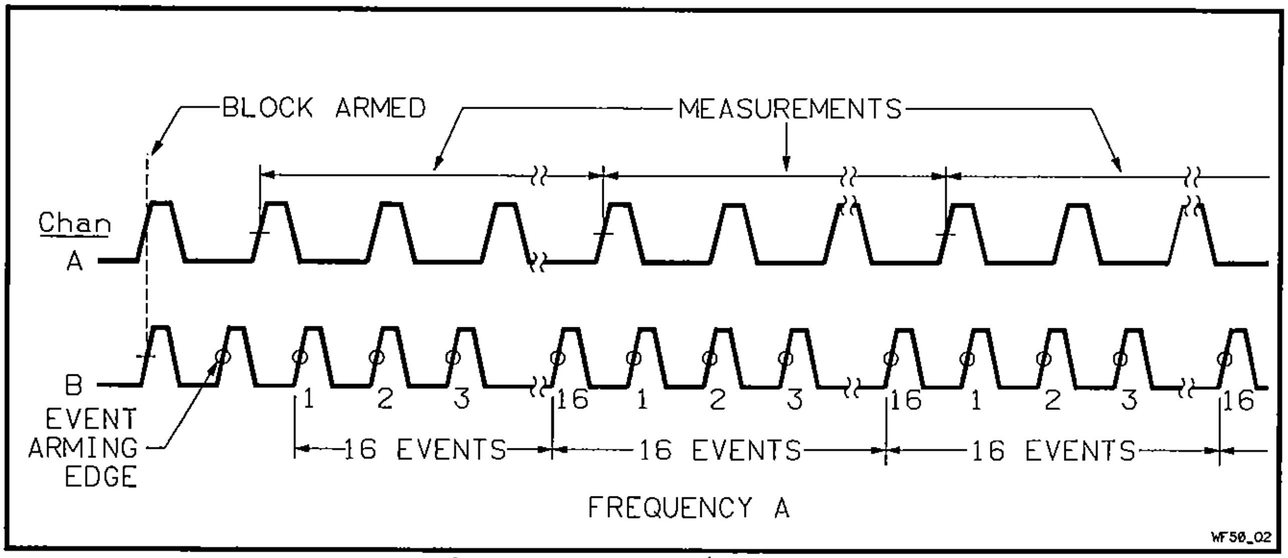


Figure 3-10. Frequency | Edge/Cycle

DESCRIPTION:

- Block of measurements is armed after a POS edge on Channel B.
- A trigger event on Channel B arms the start of the cycle count.
- 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.
- Cycles can be counted on Channel A, B, or the 2-ns internal timebase.

CYCLE = 2^4, 2^8, 2^{12}, 2^{16}, 2^{20}, 2^{24}, 2^{28} (See cycle frequency limitation table below)

Table 3-4. Minimum Cycle Frequency

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

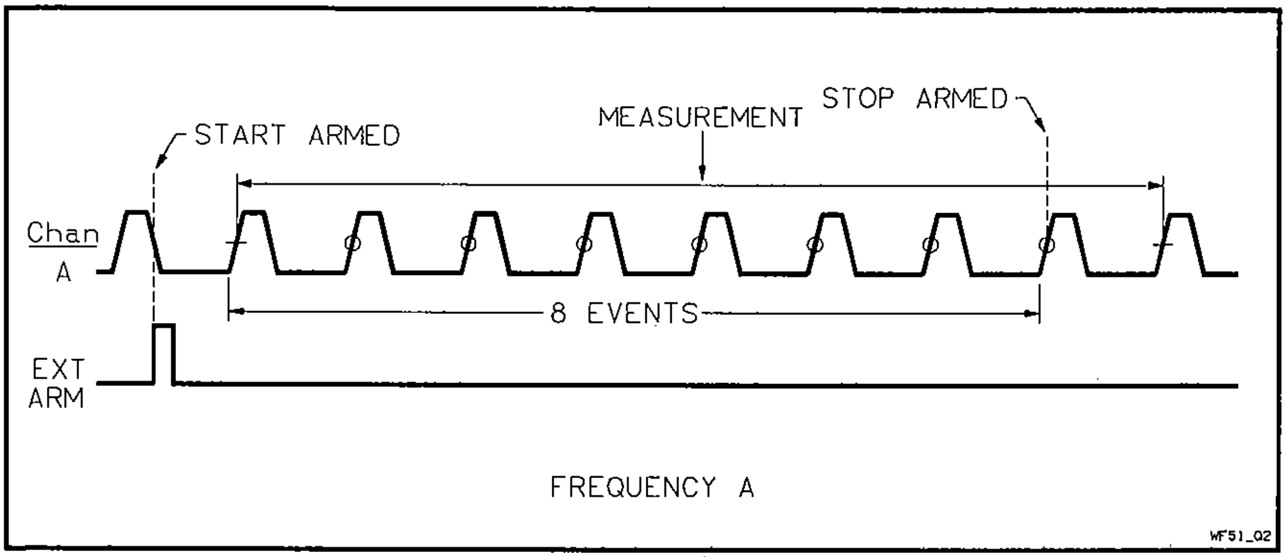


Figure 3-11. Frequency | Edge/Event

DESCRIPTION:

- Start of measurement is armed after a POS edge on EXT ARM.
- Measurement starts on the trigger event following the start arm edge.
- The start of the event count is on the next trigger event on Channel A. If you are counting and measuring on the same signal, as shown, the first counted event is also the start of the measurement.
- Measurement ends on the trigger event following the end of the stop arm event count. The stop delay is eight events.

EVENTS = 0 to 4,000,000,000 on Channel A or B

NOTE

Total period of Stop Arm events should not exceed 8.0 s.

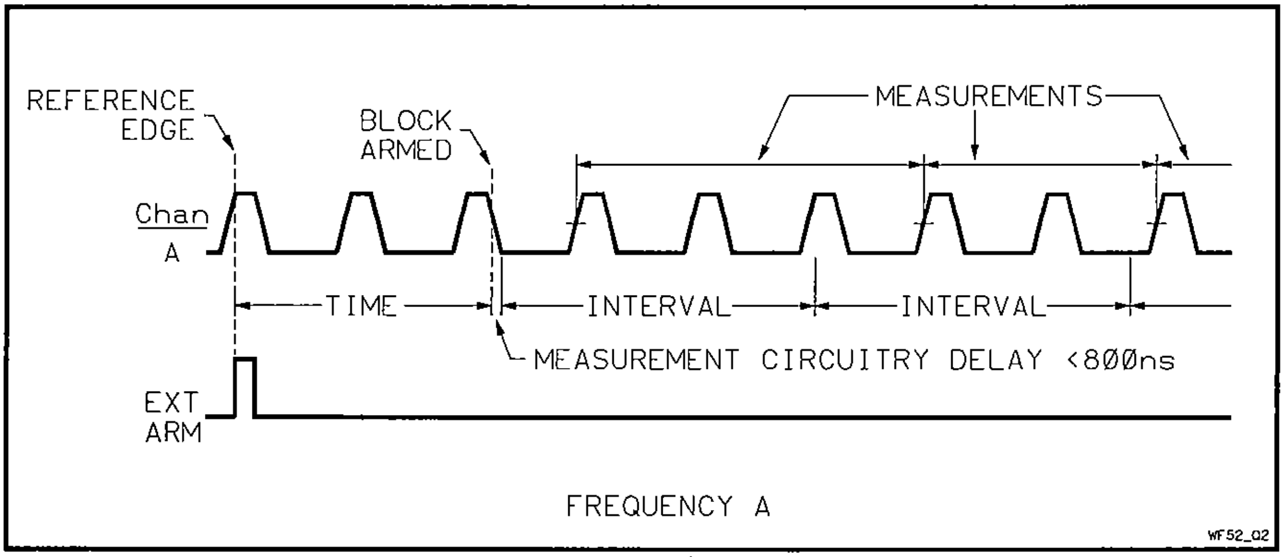


Figure 3-12. Frequency | Time/Interval

DESCRIPTION:

- Block of measurements is armed after a time delay. The start of the time delay is referenced to a POS edge on EXT ARM.

TIME = 2 ns to 8.0 s with 2 ns resolution

- Samples are then taken on the trigger event of Channel A after each specified sample interval. The first sample is taken on 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. Two measurements are shown.

INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 3-6. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

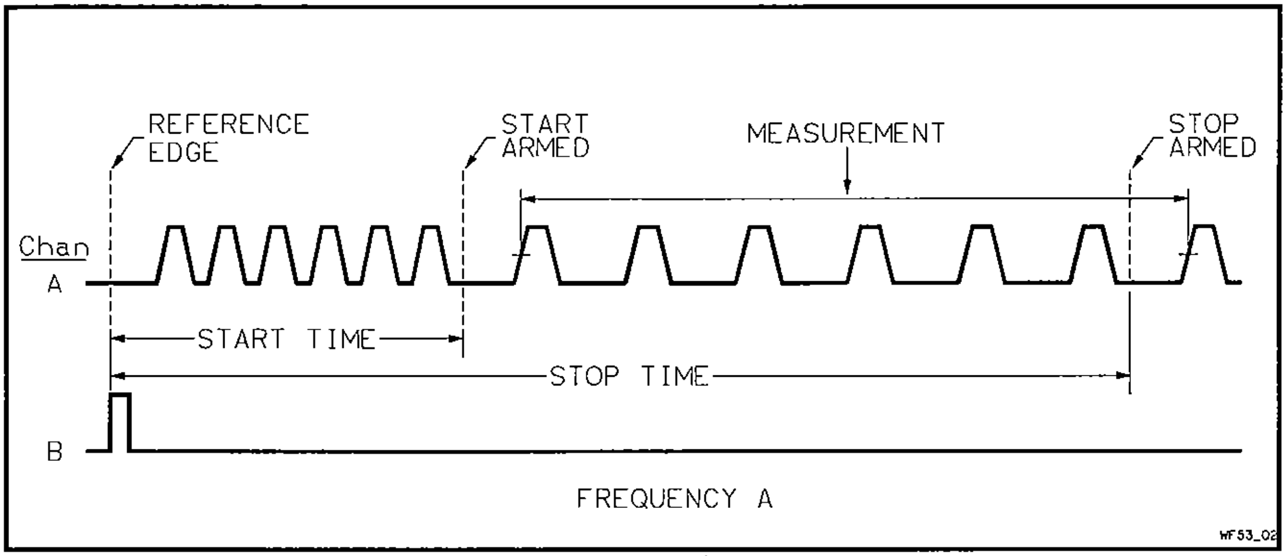


Figure 3-13. Frequency | Time/Time

DESCRIPTION:

- Start of measurement is armed after a time delay. The start of the time delay is referenced to a POS edge on Channel B.

TIME = 2 ns to 8.0 s with 2 ns resolution

- Measurement starts on the trigger event of Channel A, following the end of the start time delay.
- Measurement ends on the trigger event following the end of the stop arm time delay. The start and stop time delays are referenced to the same arming edge.

TIME = 2 ns to 8.0 s with 2 ns resolution

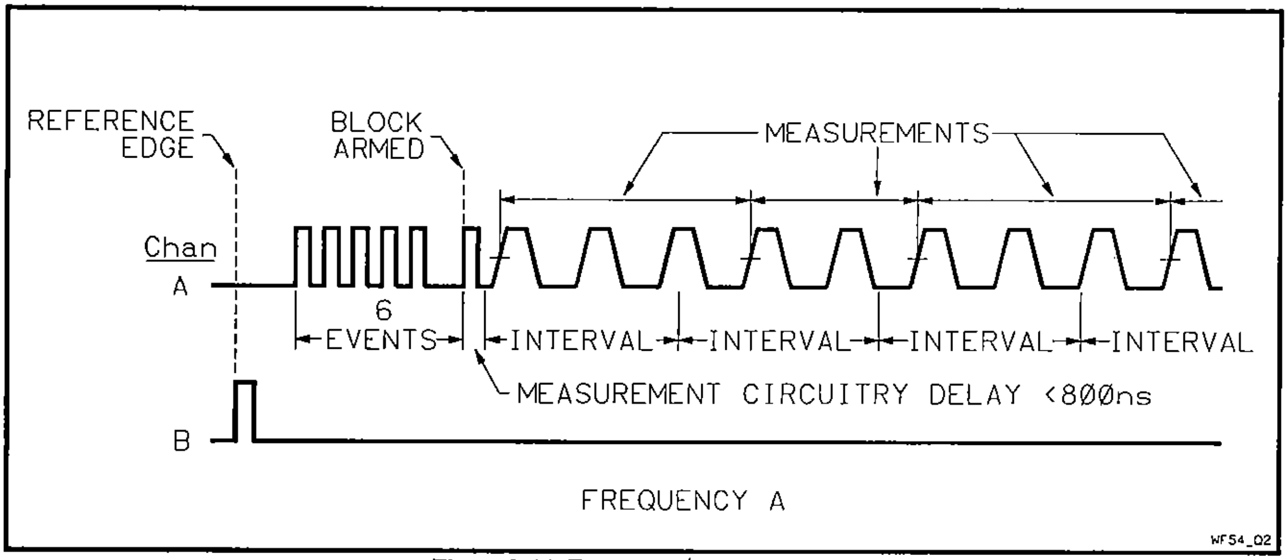


Figure 3-14. Frequency | Event/Interval

DESCRIPTION:

- Block of measurements is armed after an event delay. The start of the event delay is referenced to a POS edge on Channel B.

EVENTS = 0 to 4,000,000,000 on Channel A or B

- Samples are then taken on the trigger event of Channel A after each specified sample interval. The first sample is taken on 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.

INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 3-7. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 µsec
100 msec to 1 second: 20 µsec
1 second to 8.0 seconds: 200 µsec

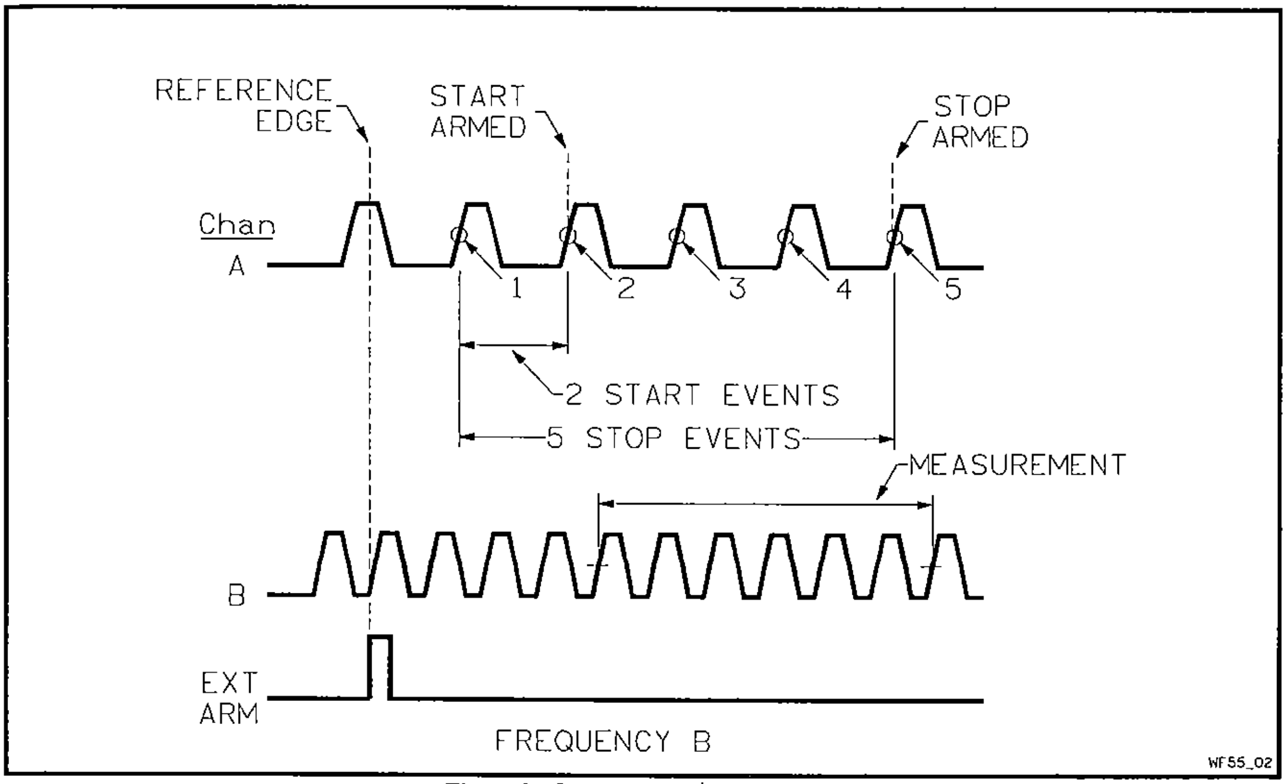


Figure 3-15. Frequency | Event/Event

DESCRIPTION:

- Start of measurement is armed after an event delay. The start of the event count is referenced to a POS edge on EXT ARM.

EVENTS = 0 to 4,000,000,000 on Channel A or B

- Measurement starts on the trigger event of Channel B, following the start arm event count. The start delay is two events.
- Measurement ends on 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 referenced to the same arming edge.

EVENTS = 0 to 4,000,000,000 on Channel A or B

NOTE

Total period of Stop Arm events should not exceed 8.0 s.

4 SPECIALIZED MEASUREMENTS

4 SPECIALIZED MEASUREMENTS

SUMMARY

Specialized Measurements is a category of HP 5371A functions that includes:

- Totalize
- Rise Time
- Fall Time
- Positive Pulse Width
- Negative Pulse Width
- Duty Cycle
- Phase
- Peak Amplitude

These measurement functions are called "Specialized Measurements" because they are more specific in what they can accomplish. Aside from the Totalize function, the specialized measurements use only one arming mode and allow the selection of only a limited number of other options. Details are included in the individual measurement descriptions that follow Totalize.

This section contains the following:

- A description of each of the measurements.
- The channel options available for each measurement.
- The front panel keys used to select a measurement and review the results.
- The available arming modes for the selected measurement channel.
- An illustration of each of the Totalize arming modes.

TERMS USED HERE

- **Gating:** Gating describes opening and closing of a measurement gate. When the gate is open, data is being collected. When the gate is closed no data is collected.
- **Continuous Gating:** Continuous gating describes a situation where the gate never really closes. Think of a register that is continually collecting data and periodically its contents are sampled for the time or the events that have occurred since the last sampling.
- **Non-continuous Gating:** Non-continuous gating is conventional gating. The measurement gate opens on a trigger event. The gate stays open a set amount of time, collecting data. The gate closes on a trigger event after the set time elapses. The measurement processing then derives an answer from this isolated data.

- **Sample**: A sample is a data point.
- **Measurement:** A measurement consists of two successive samples.
- **Block:** A block is a group of measurements.
- **Measurement Size:** Measurement size is the number of measurements within a block. If the number of blocks is one, the number of measurements to be acquired is the same as the measurement size. The measurement size multiplied by the number of blocks gives you the total number of measurements for any measurement setup.
- **Block Size:** Block size is the number of blocks of measurements that will be collected.
- **Trigger Event:** The trigger event is a point on a Channel A or B signal edge that triggers the HP 5371A to start a measurement, take a sample, or end a measurement. The event is defined by setting a slope, a trigger level, and a trigger mode on the INPUT menu screen.
- **Block Holdoff:** Block Holdoff specifies the conditions that must be satisfied before a trigger event can initiate a block of measurements. (For continuous gating measurements.)
- **Sample Arm:** Sample Arm specifies the conditions that must be satisfied before each of the samples within a block can be acquired. (For continuous gating measurements.)
- **Start Arm:** Start Arm specifies the conditions that must be satisfied before a trigger event can initiate a measurement. (For non-continuous gating measurements.)
- **Stop Arm:** Stop Arm specifies the conditions that must be satisfied before a trigger event can end a measurement. (For non-continuous gating measurements.)

TOTALIZE

The Totalize function counts the number of events on the input signal received during a specified period of time, between a pair of designated signal edges, or between key pressings of the MANUAL ARM key.

TOTALIZE allows counting of events from 0 to 4,000,000,000 for Channel A and B.

Totalize Measurements

Totalize measurements are sampled differently from Frequency/Period measurements. For Totalize measurements, the sampling is synchronous with the interval, edge, or manual key-press, depending on the arming mode. The sampling point is not the trigger event, as it is for Frequency/Period measurements.

A totalize measurement is made up of two samples. The totalize result is the number of events counted between the two sample points.

TOTALIZE CHANNEL OPTIONS

The HP 5371A offers the same input channel combinations for Totalize as for Frequency and Period measurements. The channel options can be selected by first moving the menu cursor to the "Channel" field on the FUNCTION menu.

The measurement size can be 1000 for all channel options except "A & B." Option "A & B" is limited to a measurement size of 500. The measurement size is also limited to 500 for the Externally Gated arming mode, no matter what the channel option is. The total measurements (Block Size × Measurement Size) can equal 2,000,000,000 for all Totalize channel options and arming modes.

Channel A

A Totalize measurement can be made on Channel A by selecting the "A" softkey.

Channel B

A Totalize measurement can be made on Channel B by selecting the "B" softkey.

Channels A & B

A Totalize measurement can be made on two channels simultaneously by selecting the "A & B" softkey.

Simultaneous Measurement Features:

- Full accuracy is provided for each of the measurement channels.
- Measurement and Gate Time data can be displayed for both channels on the NUMERIC screen.
- Histogram and Time Variation graphs can be displayed for both measurement channels on the GRAPHIC screen, but only one channel at a time. Select Channel A or B under the Display options of the GRAPHIC key.
- Statistics are available for both measurement channels.

NOTE For Simultaneous Measurements:

1. The measurement size cannot exceed 500. The total number of measurements can equal 2,000,000,000.
2. When using the Externally Gated arming mode, an EXT ARM signal must be used to cause a totalize count on both Channel A and B.

Ratio A / B

The ratio of Totalize measurements can be made by selecting the "A / B" softkey. The measurement result will be the ratio of the signal at Channel A to the signal at Channel B. The HP 5371A can display ratios of less than 1.

Ratio B / A

The only difference here as compared to "A / B" is the measurement result will be the ratio of the signal at Channel B to the signal at Channel A.

Sum A + B

The HP 5371A will display the sum of two Totalize measurements if you select the "A + B" softkey. The totalize count at Channel A will be added to the one at Channel B.

Difference A – B

The HP 5371A will display the difference of two Totalize measurements if you select the "A – B" softkey. The totalize count at Channel B will be subtracted from the one at Channel A.

Difference B – A

The HP 5371A will display the difference of two Totalize measurements if you select the "B – A" softkey. The totalize count at Channel A will be subtracted from the one at Channel B.

TOTALIZE MEASUREMENT SUGGESTIONS

Before you connect your signal to the HP 5371A, think about the measurement you want to make.

For example, the HP 5371A has very sensitive input circuitry. Too much noise on your signal can cause false triggering.

Other considerations for Totalize measurements might be:

1. Do you want to make a totalize measurement without having to specify any setup parameters?

   If so, do the following:

   PRESS: FUNCTION key

   MOVE: Menu cursor to the "Measurement" field

   PRESS: **More** softkey until TOTALIZE is displayed as one of the softkey options

   PRESS: **TOTALIZE** softkey

   PRESS: SHIFT key and then PRESET key

   The HP 5371A will automatically be configured to measure the totalize count of the signal at Channel A. The display will show a combination of results and statistics for the 50 measurements being taken. Histogram or Time Variation graphs can be displayed after pressing the GRAPHIC key.

2. Are you sure the signal conditioning controls and the trigger event settings are correct for the measurement you want to make?

   Check these settings on the INPUT menu screen.

   For more information on general measurement recommendations, refer to Appendix D, MEASUREMENT SUGGESTIONS.

MEASUREMENT SETUP SEQUENCE

Listed below is a summary of the front panel menu screens and the instrument parameters that can be specified on each screen. After reviewing this information, you will see the relationship between the different HP 5371A screens. For example, statistics are viewed on the NUMERIC screen, but enabled on the MATH screen.

The FUNCTION, INPUT, MATH, AND GRAPHIC screen settings all help determine what you will see on the NUMERIC and GRAPHIC screens. Use the STATUS key to see a summary of HP 5371A settings.

FOR YOUR MEASUREMENT SETUP:

On this menu screen	You can specify
FUNCTION	Measurement type Measurement channel Number of blocks Number of measurements per block Arming mode
INPUT	Separate or common inputs Trigger slope, trigger event External arm level Bias level Attenuation
MATH	Statistics on/off Math values Reference set/clear Limit values
GRAPHIC	Histogram graph parameters Time variation graph parameters Event timing graph parameters

FOR YOUR MEASUREMENT REVIEW:

On this result screen	You can specify
NUMERIC	Measurement results only Statistics results only Measurements and statistics Measurements and.gate time Summary of limit results Enlarged numeric result display
GRAPHIC	Histogram graph Time variation graph Event timing graph Marker features Zoom features Display features Scaling Features

TOTALIZE ARMING MODES

Shown below are the measurement channels and arming modes for Totalize.

TOTALIZE

A
B

INTERVAL SAMPLING
EDGE SAMPLING

EDGE/INTERVAL
EDGE/EDGE
EXTERNALLY GATED
TIME/INTERVAL
MANUAL

A&B
A/B
B/A
A+B
A–B
B–A

INTERVAL SAMPLING
EDGE SAMPLING

EDGE/INTERVAL
EDGE/EDGE
EXTERNALLY GATED
MANUAL

TOTALIZE ARMING MODE EXAMPLES

Shown below are the arming modes available for totalize measurements along with a timing diagram to illustrate each arming mode.

TOTALIZE | INTERVAL SAMPLING

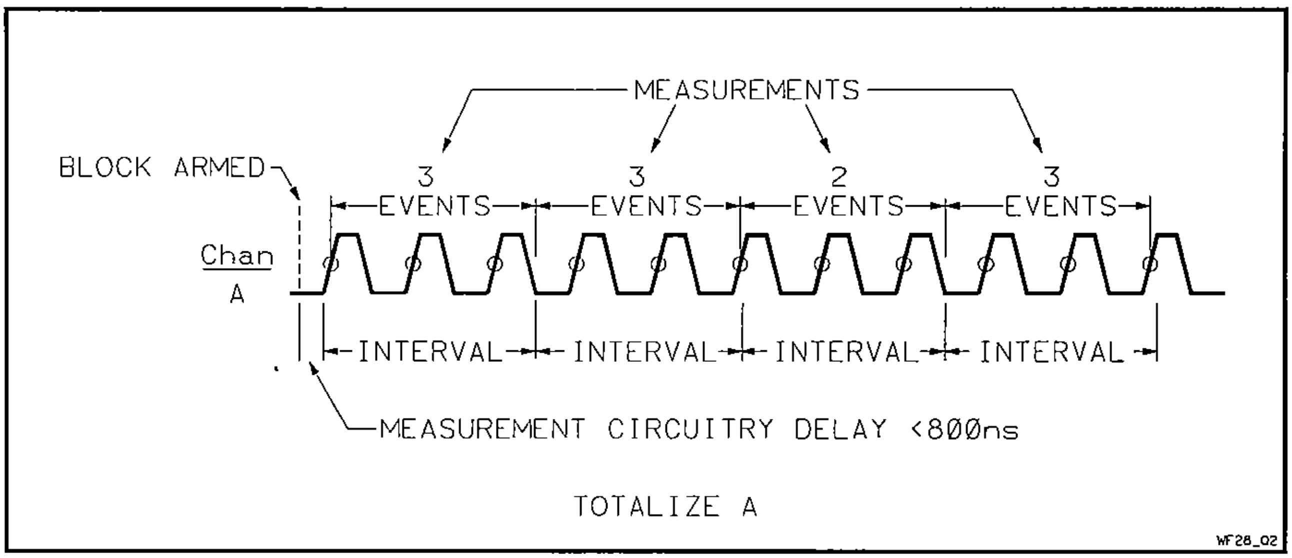


Figure 4-1. Totalize | Interval Sampling

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- 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.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 4-1. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

TOTALIZE | EDGE SAMPLING

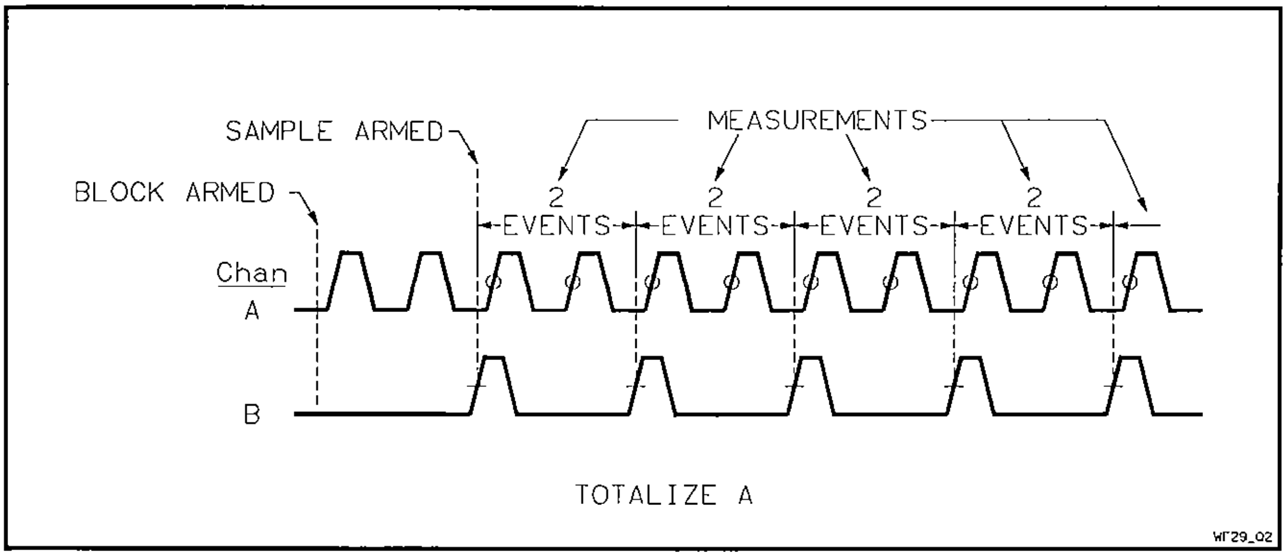


Figure 4-2. Totalize | Edge Sampling

DESCRIPTION:

- Block of measurements is armed as soon as the Analyzer is ready.
- Samples are taken on a POS edge of Channel B. One sample is taken per edge, at each edge. An edge is required for each sample. Four measurements are shown.

NOTE

Period of Sample Arm signal should not exceed 8.0 s.

TOTALIZE | EDGE/INTERVAL

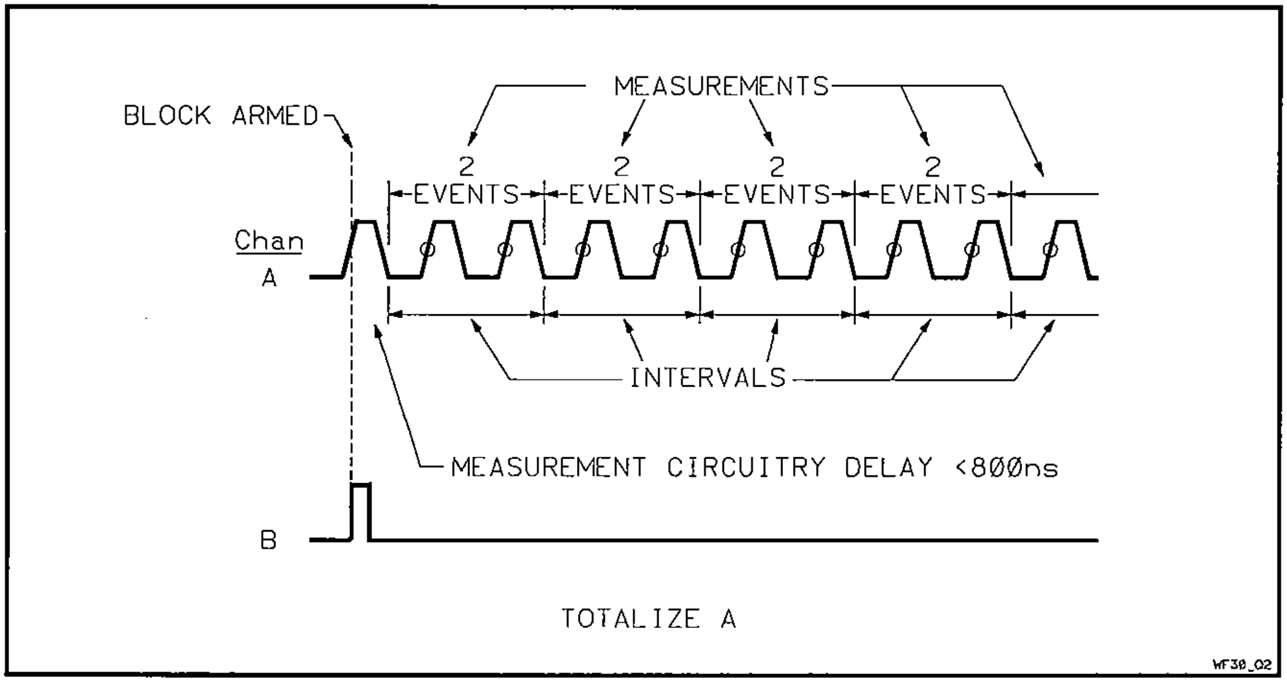


Figure 4-3. Totalize | Edge/Interval

DESCRIPTION:

- Block of measurements is armed after a POS edge on Channel B.
- 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.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 4-2. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

TOTALIZE | EDGE/EDGE

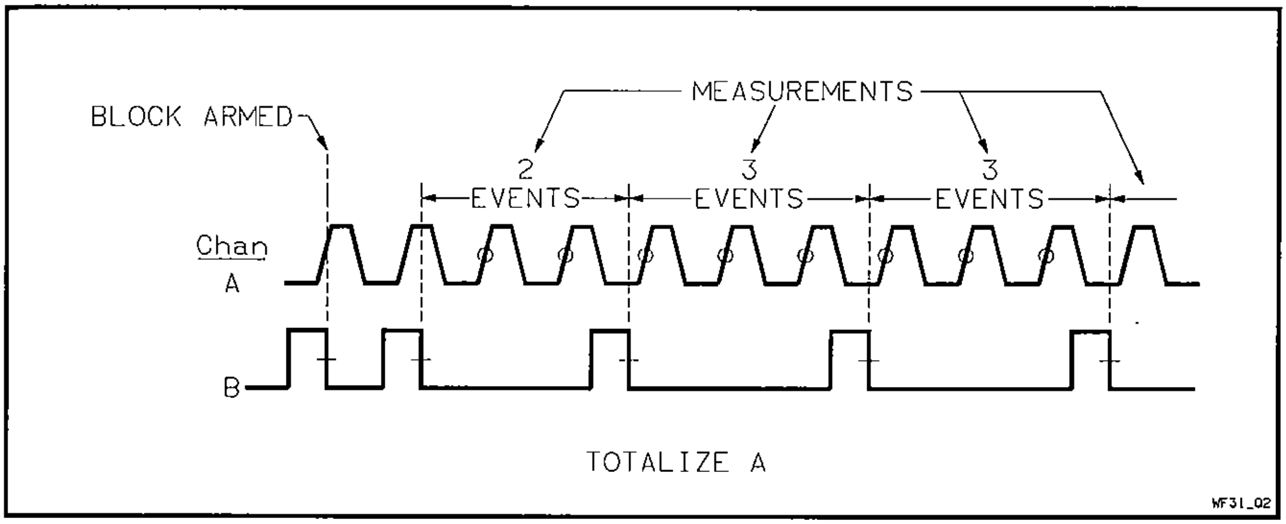


Figure 4-4. Totalize | Edge/Edge

DESCRIPTION:

- Block of measurements is armed after a NEG edge on Channel B.
- Samples are taken on a NEG edge on Channel B. One sample is taken per edge. An edge is required for each sample. Three measurements are shown.

NOTE

Period of Sample Arm signal should not exceed 8.0 s.

TOTALIZE | EXTERNALLY GATED

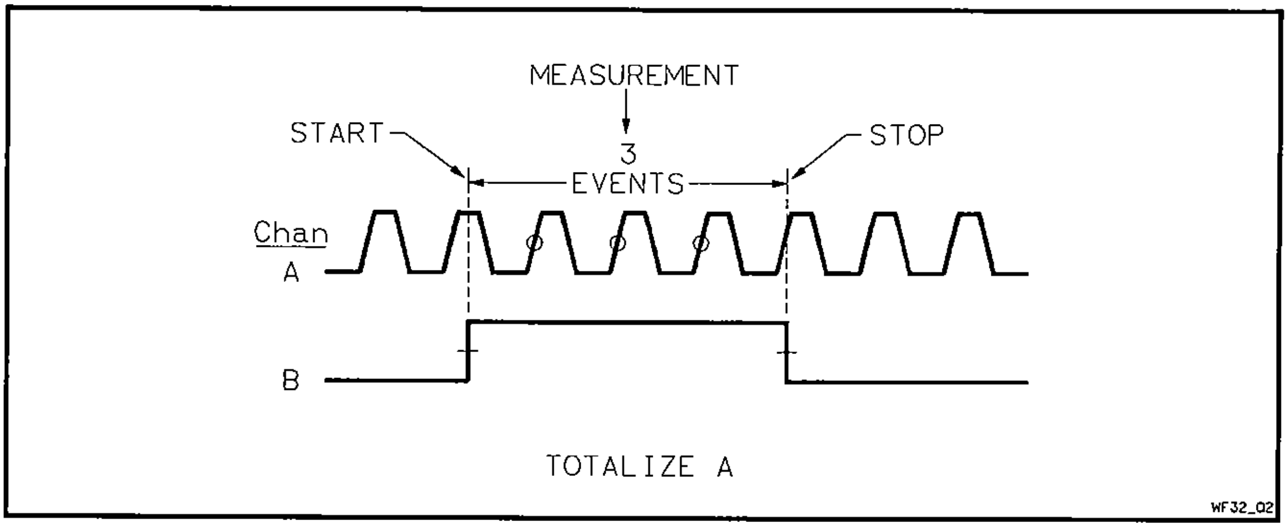


Figure 4-5. Totalize | Externally Gated

DESCRIPTION:

- Measurement starts on a POS edge on Channel B.
- Measurement ends on the opposite edge of the measurement start signal.

TOTALIZE | TIME/INTERVAL

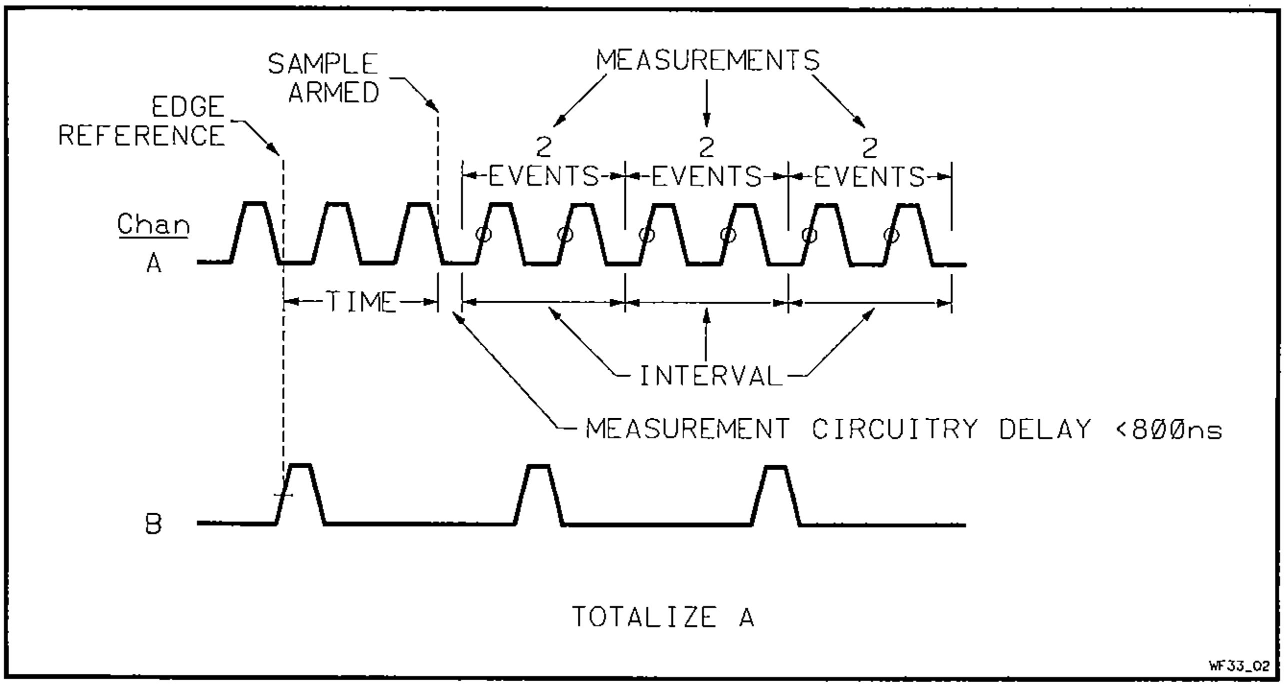


Figure 4-6. Totalize | Time/Interval

DESCRIPTION:

- Block of measurements is armed after a time delay. The start of the time delay is referenced to a POS edge on Channel B.

  TIME = 2 ns to 8.0 s with 2 ns resolution

- Samples are then taken on each specified 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.

  INTERVAL = 600 ns to 8.0 s (Resolution based on length of interval. See table below.)

Table 4-3. Interval Resolution

600 ns to 10 msec: 200 ns
10 msec to 100 msec: 2 μsec
100 msec to 1 second: 20 μsec
1 second to 8.0 seconds: 200 μsec

TOTALIZE | MANUAL

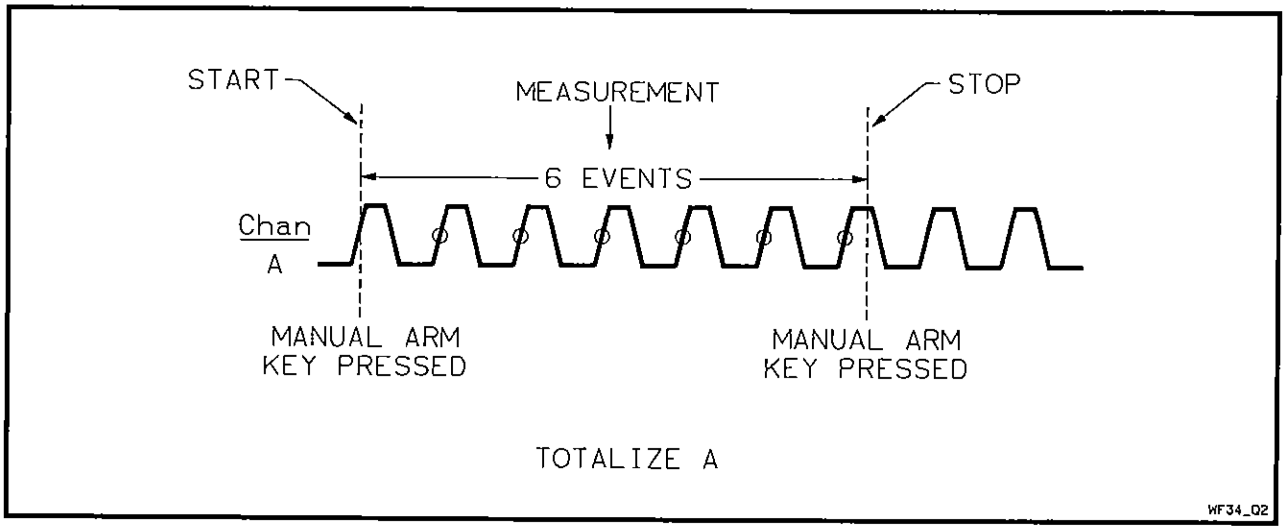


Figure 4-7. Totalize | Manual

DESCRIPTION:

- Measurement starts when MANUAL ARM key is pressed. The GATE LED comes on, and the CRT status line displays, "Gate open."
- Measurement ends when MANUAL ARM key is pressed. The GATE LED goes off, and the CRT status line displays, "Gate closed."
- When in SINGLE mode, the RESTART key must be pressed before another measurement can be made.
- When in REPETITIVE mode, the totalize count will accumulate if the MANUAL ARM key is pressed again. Pressing the RESTART key will clear the totalize count.

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."

RISE TIME

Description:

The Rise Time function automatically configures the HP 5371A 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

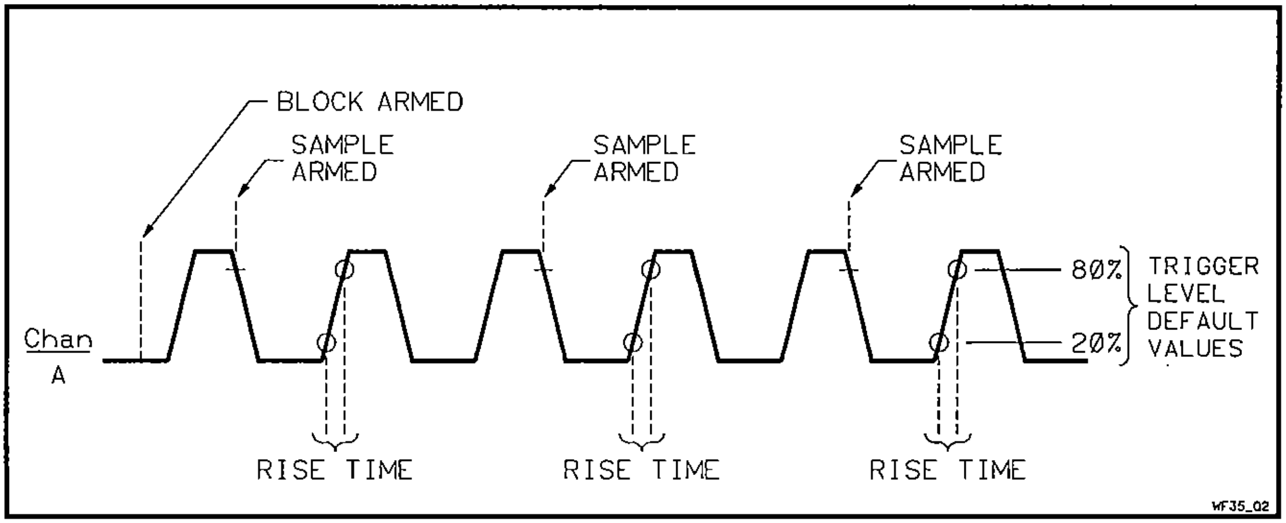


Figure 4-8. Rise Time A

Defaults:

- Measurement Channel – A
- Arming Mode – AUTOMATIC
- Input Channels – COMMON

- Channel A Trigger Event:
  Slope – POS
  Mode – REPETITIVE AUTO
  Level – 20%

- Channel B Trigger Event:
  Slope – POS
  Mode – REPETITIVE AUTO
  Level – 80%

Parameters that can be modified:

- INPUT screen:
  Trigger Event Mode
  Trigger Event Level

FALL TIME

Description:

The Fall Time function automatically configures the HP 5371A 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

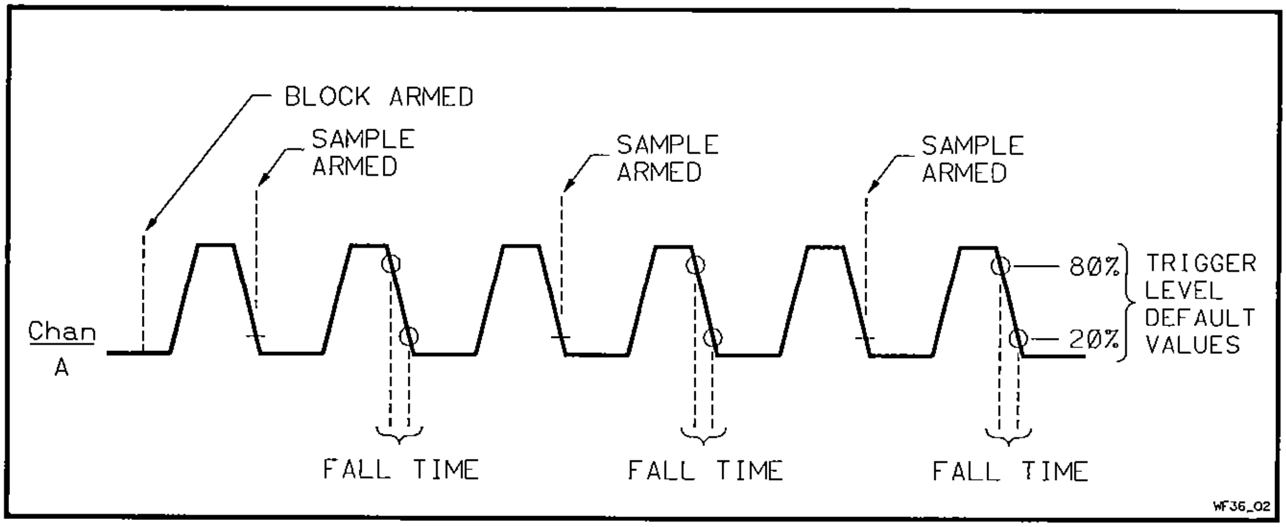


Figure 4-9. Fall Time A

Defaults:

- Measurement Channel – A
- Arming Mode – AUTOMATIC
- Input Channels – COMMON

- Channel A Trigger Event:
  Slope – NEG
  Mode – REPETITIVE AUTO
  Level – 80%

- Channel B Trigger Event:
  Slope – NEG
  Mode – REPETITIVE AUTO
  Level – 20%

Parameters that can be modified:

- INPUT screen:
  Trigger Event Mode
  Trigger Event Level

POSITIVE PULSE WIDTH

Description:

The Positive Pulse Width function automatically configures the HP 5371A to perform a positive 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: 1 ns to 1 ms pulse widths

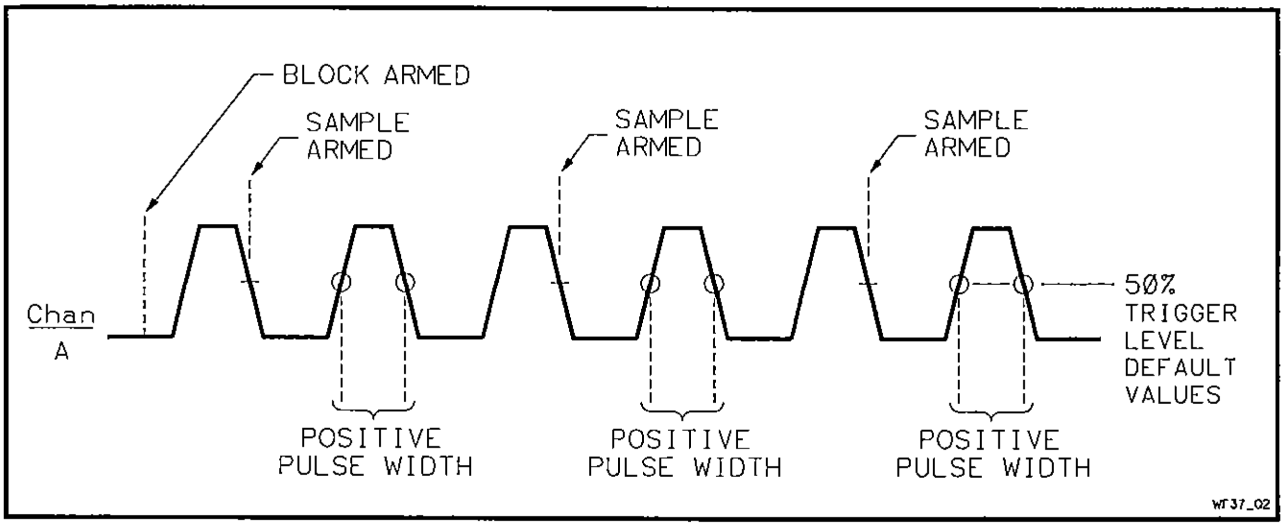


Figure 4-10. Positive Pulse Width A

Defaults:

- Measurement Channel – A
- Arming Mode – AUTOMATIC
- Input Channels – COMMON

- Channel A Trigger Event:
  Slope – POS
  Mode – REPETITIVE AUTO
  Level – 50%

- Channel B Trigger Event:
  Slope – NEG
  Mode – REPETITIVE AUTO
  Level – 50%

Parameters that can be modified:

- INPUT screen:
  Trigger Event Mode
  Trigger Event Level

NEGATIVE PULSE WIDTH

Description:

The Negative Pulse Width function automatically configures the HP 5371A to perform a negative pulse width 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: 1 ns to 1 ms pulse widths

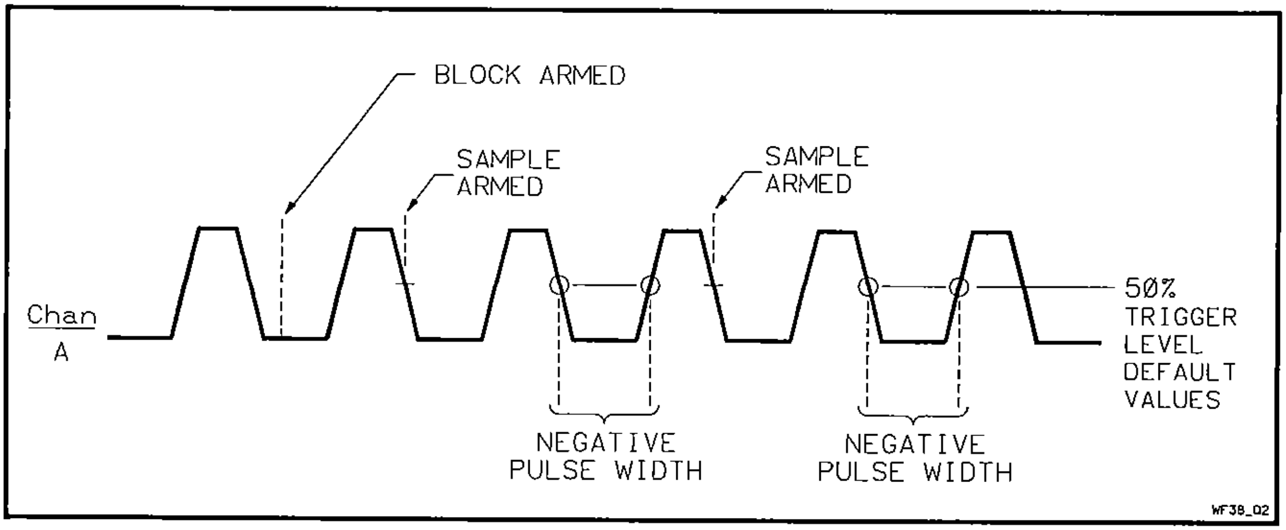


Figure 4-11. Negative Pulse Width A

Defaults:

- Measurement Channel – A
- Arming Mode – AUTOMATIC
- Input Channels – COMMON

- Channel A Trigger Event:
  Slope – NEG
  Mode – REPETITIVE AUTO
  Level – 50%

- Channel B Trigger Event:
  Slope – POS
  Mode – REPETITIVE AUTO
  Level 50%

Parameters that can be modified:
- INPUT screen:
  Trigger Event Mode
  Trigger Event Level

DUTY CYCLE

Description:

The Duty Cycle function automatically configures the HP 5371A 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 positive pulse width measurement expressed as a percentage of the period of the input signal.

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

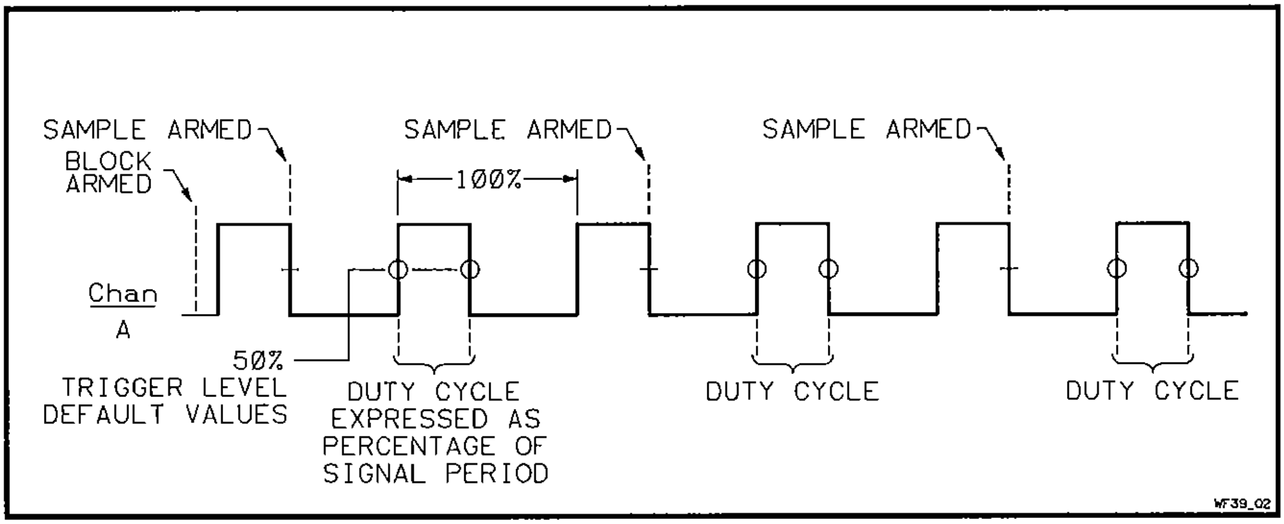


Figure 4-12. Duty Cycle A

Defaults:

- Measurement Channel — A
- Arming Mode — AUTOMATIC
- Input Channels — COMMON

- Channel A Trigger Event:
  Slope — POS
  Mode — REPETITIVE AUTO
  Level — 50%

- Channel B Trigger Event:
  Slope — NEG
  Mode — REPETITIVE AUTO
  Level — 50%

Parameters that can be modified:

- INPUT screen:
  Trigger Event Mode
  Trigger Event Level

PHASE

Description:

The Phase function automatically configures the HP 5371A 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 test signal's edge, the phase is positive. If the measurement size is set greater than 1, the phase changes are referenced to the first measurement in the block. The results will show the cumulative phase shift between the two signals.

Range: > ±360°

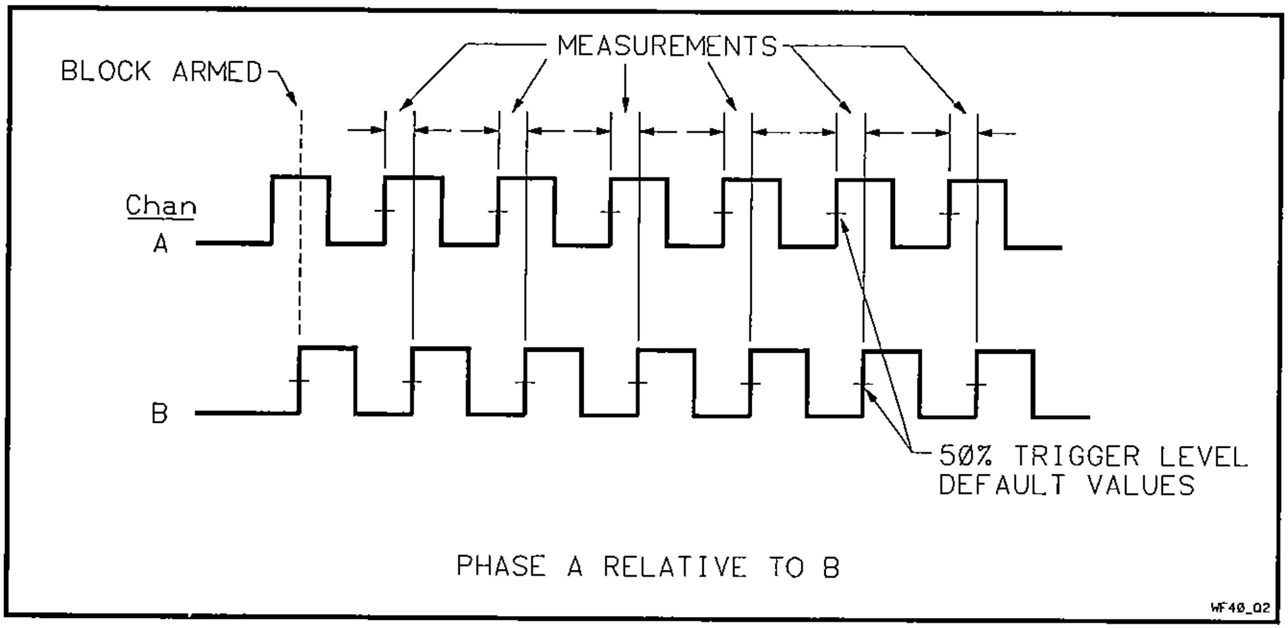


Figure 4-13. Phase A Relative to B

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

PEAK AMPLITUDE

Description:

The Peak Amplitude function automatically configures the HP 5371A to measure the peak voltages of the signal at Channel A.

Frequency Range: 1 kHz to 200 MHz

Amplitude Range: 200 mV pk-pk to 2 V pk-pk

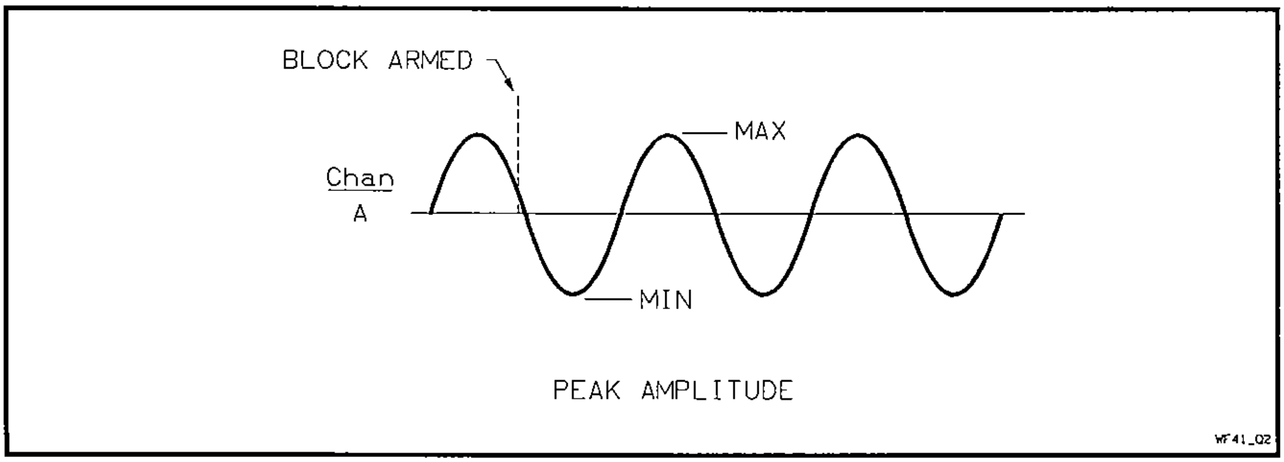


Figure 4-14. Peak Amplitude A

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
  Trigger Event Slope
  Trigger Event Mode
  Trigger Event Level

5 ARMING

5 ARMING

SUMMARY

This section describes the following:

- Overview of arming and gating characteristics
- Continuous vs. Non-continuous gating
- The arming modes
- A timing diagram for each of the arming modes

TERMS USED HERE

- **Gating:** Gating describes opening and closing of a measurement gate. When the gate is open, data is being collected. When the gate is closed no data is collected.
- **Continuous Gating:** Continuous gating describes a situation where the gate never really closes. Think of counting registers that are continually collecting data, and periodically their contents are sampled for the time or the events that have occurred since the last sampling.
- **Non-continuous Gating**: Non-continuous gating is traditional gating. The measurement gate opens on a trigger event. The gate stays open a set amount of time, collecting data. The gate closes on a trigger event after the set time elapses. The measurement processing then derives an answer from this isolated data.
- **Sample:** A sample is a data point.
- **Measurement**: A measurement consists of two successive samples.
- **Block:** A block is a group of measurements.
- **Block Size**: Block Size is the number of blocks of measurements that will be collected.
- **Measurement Size**: Measurement size is the number of measurements within a block. If the number of blocks is one, the number of measurements to be acquired is the same as the measurement size. The measurement size multiplied by the number of blocks gives you the total number of measurements for any measurement setup.
- **Trigger Event:** The trigger event is a point on a Channel A or B signal edge that triggers the HP 5371A to start a measurement, take a sample, or end a measurement. The event is defined by setting a slope, a trigger level, and a trigger mode on the INPUT menu screen.

- **Block Holdoff**: Block Holdoff specifies the conditions that must be satisfied before a trigger event can initiate a block of measurements. (For continuous gating measurements.)

- **Sample Arm**: Sample Arm specifies the conditions that must be satisfied before each of the samples within a block can be acquired. (For continuous gating measurements.)

- **Start Arm:** Start Arm specifies the conditions that must be satisfied before a trigger event can initiate a measurement. (For non-continuous gating measurements.)

- **Stop Arm:** Stop Arm specifies the conditions that must be satisfied before a trigger event can end a measurement. (For non-continuous gating measurements.)

ARMING OVERVIEW

The arming mode field lets you start your measurement, or block of measurements, automatically, or you can:

holdoff or delay the start of your measurement, or block of measurements, until:

- after an edge
- after some time
- after a number of events

AND

specify when samples are acquired within the block of measurements:

- automatically,
- repetitively, after a time interval (traditional gate time)
- repetitively, after a number of events
- repetitively, after an edge
- repetitively, after a pair of edges

OR

for non-continuous measurements, specify when the measurement ends:

- after some time
- after a number of events

ARMING/GATING/ SAMPLING

The HP 5371A offers a wide choice of methods for arming and acquiring measurements.

Gating Characteristics

The HP 5371A uses two methods for acquiring measurement samples, continuous or non-continuous gating. The arming mode determines if a measurement will be made with a continuous or non-continuous gating technique. The difference is illustrated below:

1. Continuous Gating:

```
|–|–|–|–|–|       |–|–|–|–|–|       |–|–|–|–|–|       |
|M|M|M|M|M| Process |M|M|M|M|M| Process |M|M|M|M|M| Process |
```

M = Measurement

The measurements in each block are collected in a continuous stream before they are processed and displayed. There can be up to 1000 measurements in each block for single-result measurements and 500 for dual-result measurements. Dual-result measurements produce two results for each measurement. These are frequency, period, and totalize functions with the "A & B" channel option selected.

A Block Holdoff precedes the start of each block of measurements. A Sample Arm precedes each measurement in the block.

NOTE

When using the binary HP-IB output mode, the available memory is increased to 4095 measurements per block (2047 for dual-result measurements).

2. Non-continuous Gating:

```
|–| |–| |–| |       |–| |–| |–| |       |
|M| I |M| I |M| I |Process |M| I |M| I |M| I |Process |
```

M = Measurement
I = Intermediate Processing

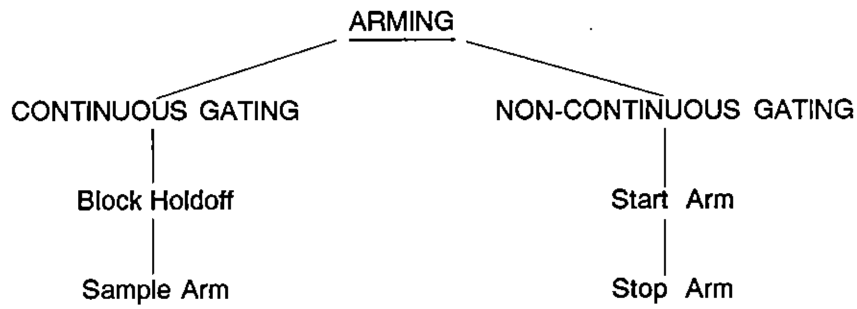
There is some processing time between each measurement, followed by the final processing at the end of each block of measurements. A Start Arm precedes the beginning of each measurement. A Stop Arm precedes the end of each measurement.

Arming Terms

The arming screens use two different pairs of words to describe arming depending on the type of gating used. The terms are:

- Block Holdoff/Sample Arm: for continuous gating measurements.
- Start Arm/Stop Arm: for non-continuous gating measurements.

  Block/Sample indicates that continuous measurements are acquired, while Start/Stop indicates non-continuous measurements. Measurements are acquired individually.



Non-continuous gating makes measurements as a traditional counting instrument does. One measurement is taken at a time. Some result processing takes place before another measurement begins.

Continuous gating is a feature that allows measurements to be collected in groups. As a result, the continuous measurements are "related" to one another (can be referenced to one another.) The graphics and statistical features of the HP 5371A can extract more meaningful data from these continuous measurements.

Holdoff and Sampling

Two of the concerns when preparing to make measurements are:

1. The point where the measurement will start.
2. The point where measurement samples will be taken or measurements will be stopped.

The HP 5371A introduces increased flexibility in how these two actions can be easily specified. The start point can be automatic, or it can be delayed (a holdoff of the measurement start) until user-defined conditions are satisfied. The sampling points (the individual measurement end points) can also be automatic or determined by user-defined conditions.

The following table summarizes the four ways to hold off and sample measurements.

Table 5-1. Arming Mode Options

MODE	Holdoff (or Start)	Sampling (or Stop)
AUTOMATIC	None	Automatic
HOLDOFF	User-Defined	Automatic
SAMPLING	None	User-Defined
HOLDOFF/SAMPLING	User-Defined	User-Defined

Ways to Arm and Sample a Measurement

Any conditions that must be satisfied before starting or sampling measurements are called arming conditions. The HP 5371A supports four types of arming modes. They are introduced here, and then described in more detail with timing diagrams and explanations.

1. AUTOMATIC

   Start measuring immediately (no holdoff); then sample as fast as possible.
   Arming Mode: AUTOMATIC

2. HOLDOFF

   Holdoff of measurement determined by user; then sample as fast as possible.
   Holdoff Arming Modes:
   EDGE HOLDOFF
   TIME HOLDOFF
   EVENT HOLDOFF

3. SAMPLING

   Start measuring immediately (no holdoff); sampling determined by user.
   Sampling Arming Modes:
   INTERVAL SAMPLING
   TIME SAMPLING
   CYCLE SAMPLING
   EDGE SAMPLING
   PARITY SAMPLING
   REPETITIVE EDGE
   REPETITIVE EDGE/PARITY

4. HOLDOFF/SAMPLING

   Holdoff of measurement determined by user; sampling determined by user.
   Holdoff/Sampling Arming Modes:
   EDGE/INTERVAL
   EDGE/TIME
   EDGE/EDGE
   EXTERNALLY GATED
   EDGE/CYCLE
   EDGE/EVENT
   EDGE/PARITY
   TIME/INTERVAL
   TIME/TIME
   EVENT/INTERVAL
   EVENT/EVENT
   MANUAL

AUTOMATIC MODE

DESCRIPTION:

This arming mode allows measurements to be started as soon as the HP 5371A 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. (The Rise/Fall, Positive/Negative Pulse Width, and Duty Cycle require some time to do the peak-to-peak measurements necessary before each measurement.)

MEASUREMENTS:

Time Interval
Continuous Time Interval
±Time Interval (two-channel)
Frequency
Period
Rise/Fall Time
Positive/Negative Pulse Width
Duty Cycle
Phase
Peak Amplitude

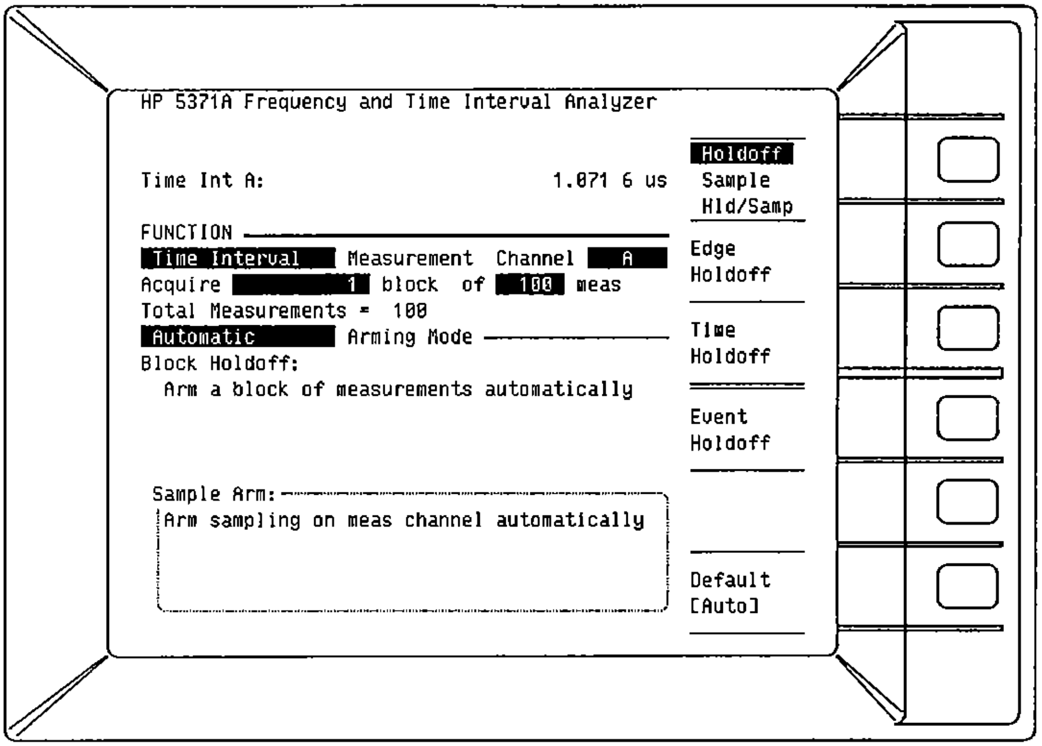


Figure 5-1. AUTOMATIC Menu Screen

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

GATING: Continuous

BLOCK ARM: Automatic

SAMPLE ARM: Automatic

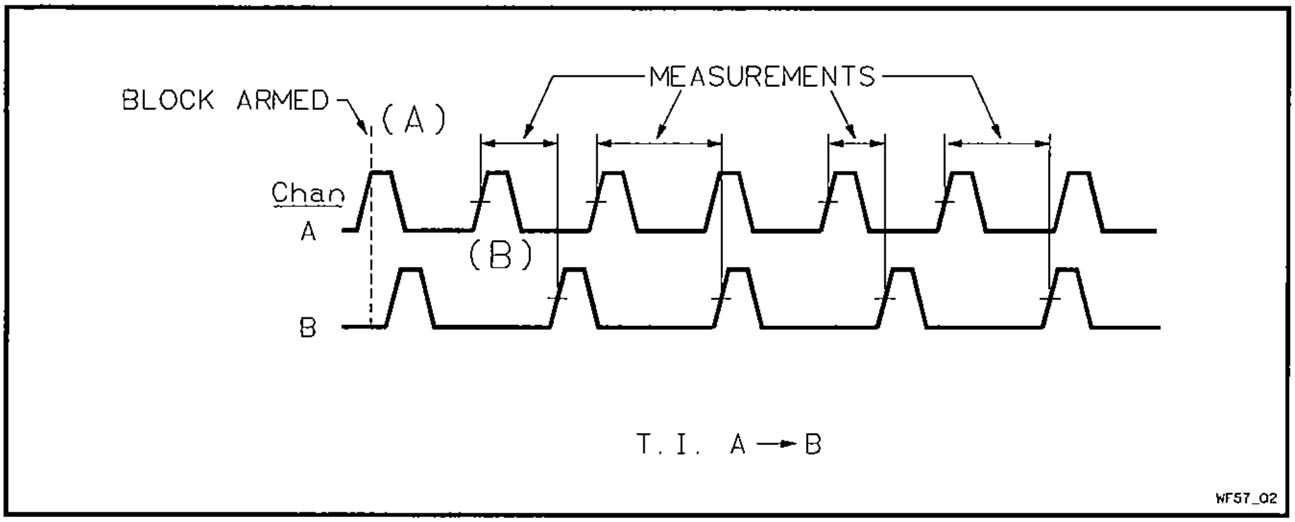


Figure 5-2. AUTOMATIC Timing Diagram

(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 MODE

DESCRIPTION:

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

- EDGE: A designated edge.
- TIME: A time period elapses.
- EVENT: A number of events are counted.

MEASUREMENTS:

Time Interval
Continuous Time Interval
±Time Interval

Edge Holdoff

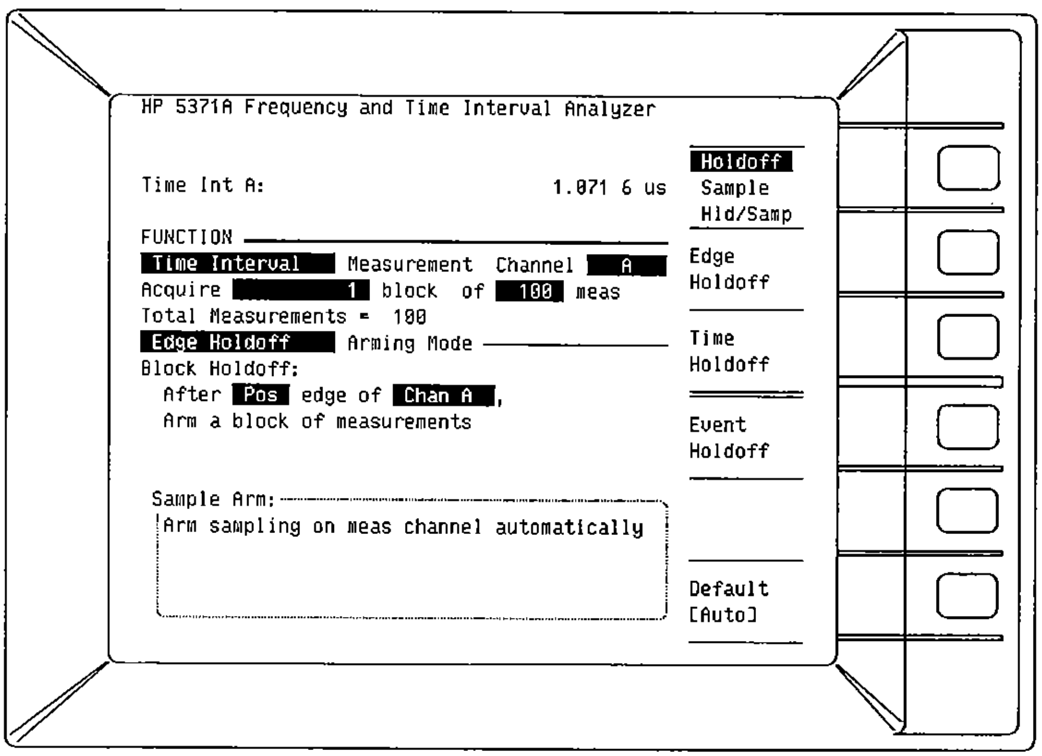


Figure 5-3. EDGE HOLDOFF Menu Screen

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

GATING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or EXT ARM

SAMPLE ARM: Automatic

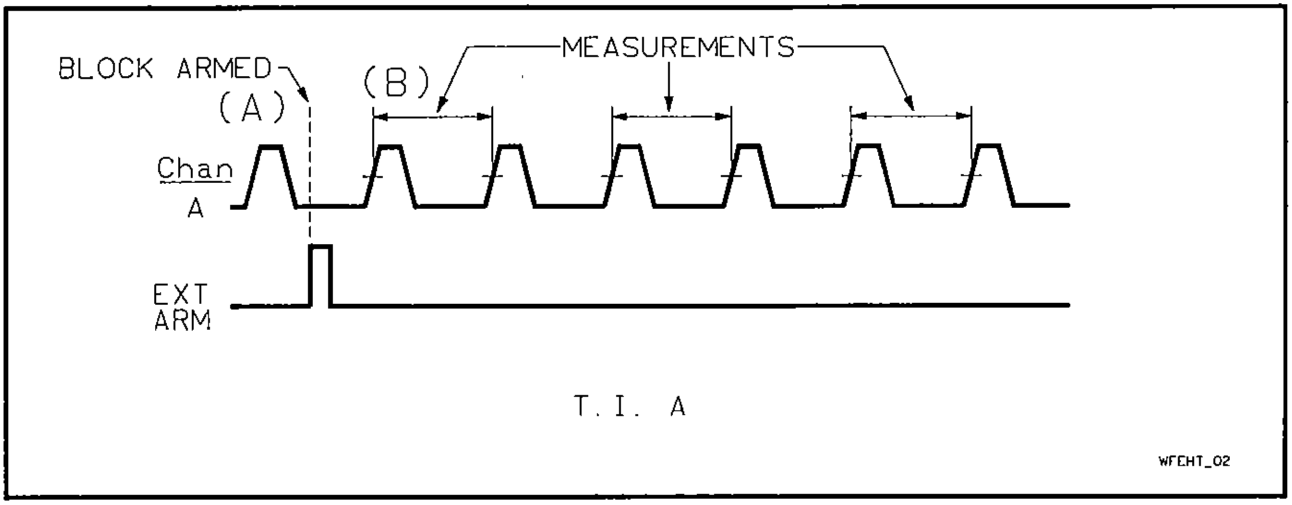


Figure 5-4. EDGE HOLDOFF Timing Diagram

(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

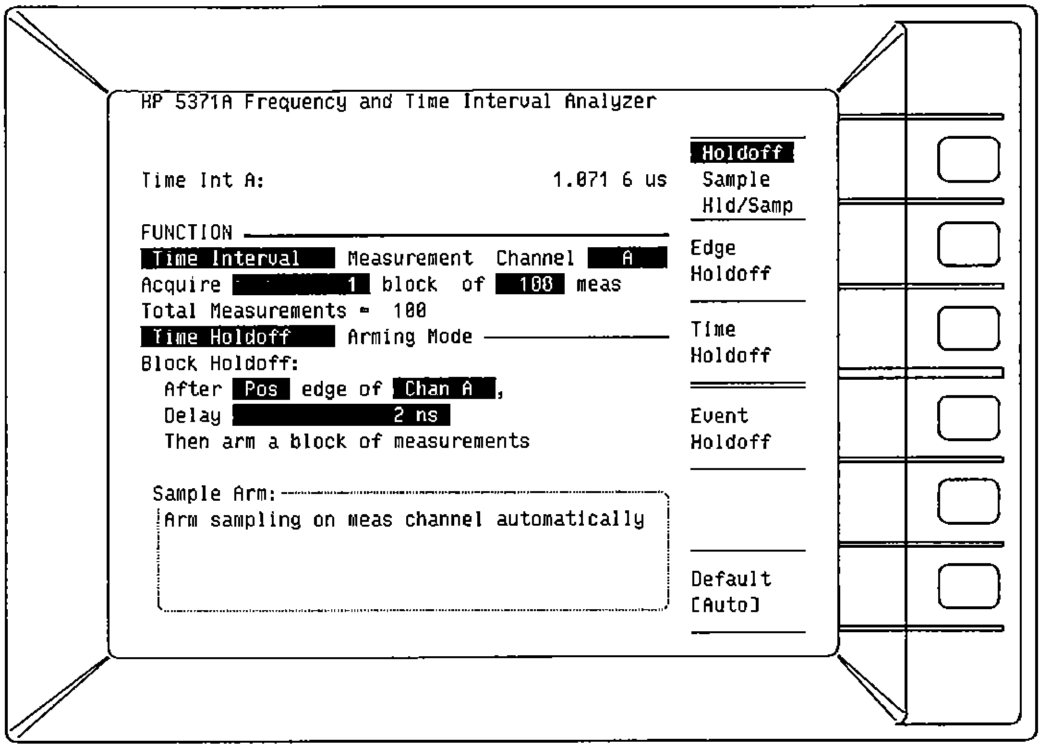


Figure 5-5. TIME HOLDOFF Menu Screen

MEASUREMENTS: Time Interval and Continuous Time Interval

GATING: Continuous

BLOCK HOLDOFF: Time (2 ns to 8.0 s with 2 ns resolution) referenced to an edge on Channel A, B, or EXT ARM.

SAMPLE ARM: Automatic

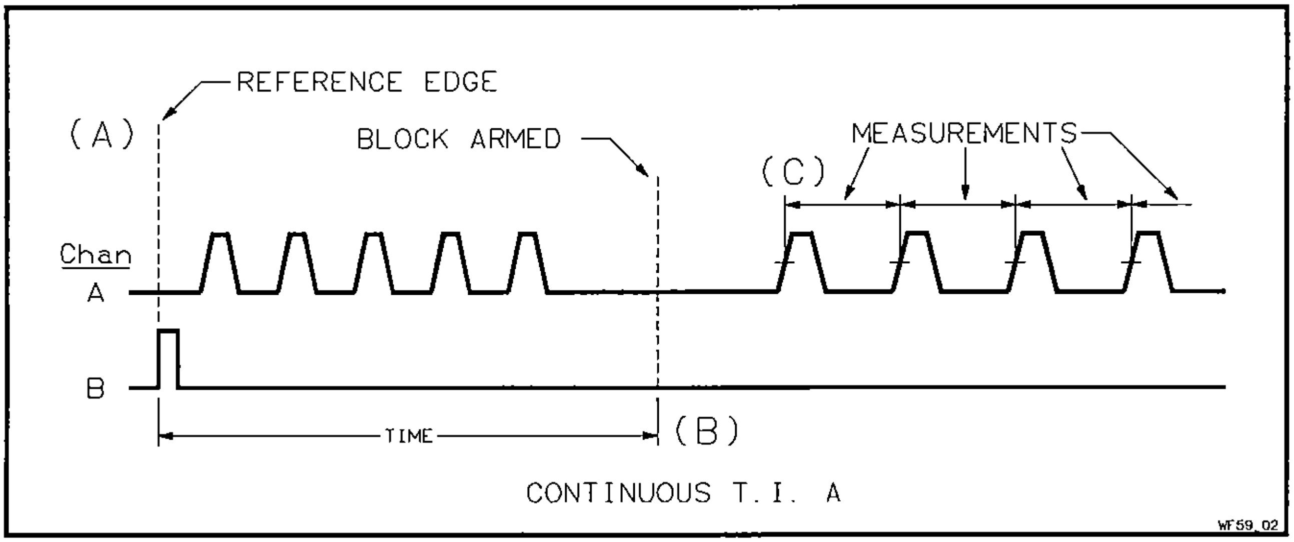


Figure 5-6. TIME HOLDOFF Timing Diagram

(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

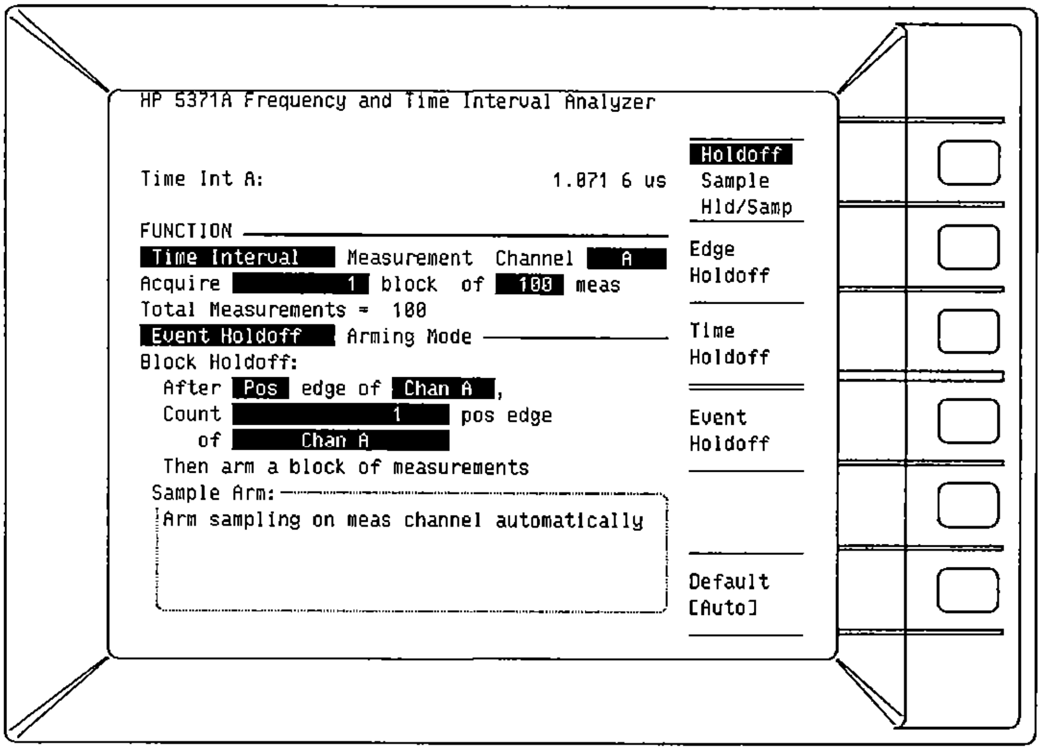


Figure 5-7. EVENT HOLDOFF Menu Screen

MEASUREMENTS: Time Interval and Continuous Time Interval

GATING: Continuous

BLOCK HOLDOFF: Events (0 to 4,000,000,000) on Channel A or B referenced to an edge on Channel A, B, or EXT ARM.

SAMPLE ARM: Automatic

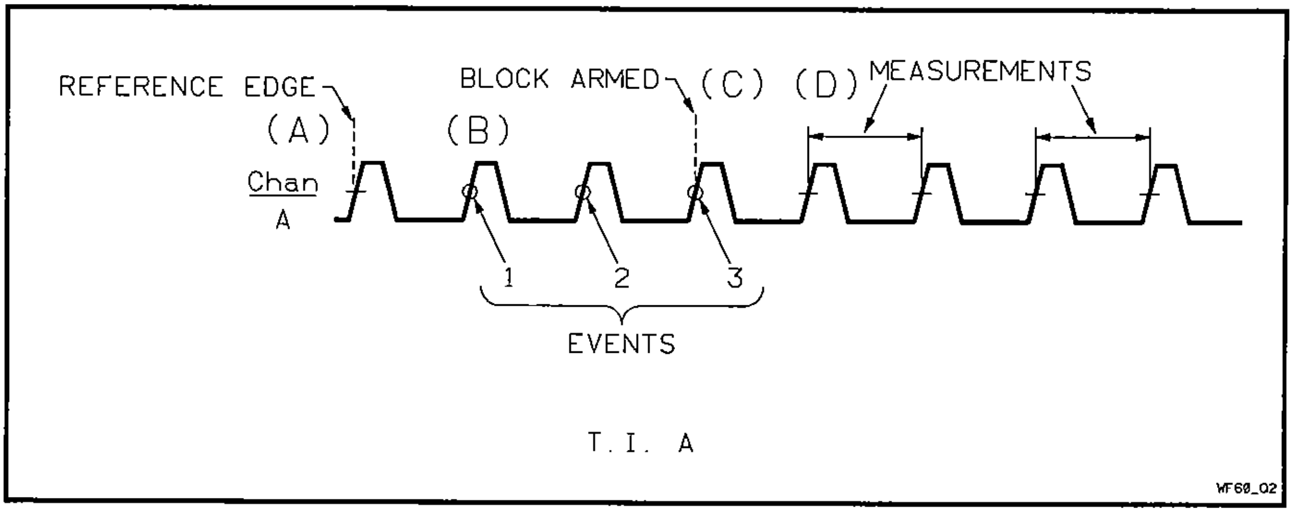


Figure 5-8. EVENT HOLDOFF Timing Diagram

(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 mode allows measurements to be started as soon as the HP 5371A 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-repetitive time period (2 ns resolution)
- **CYCLE:** A predetermined number of events (cycles).
- **EDGE:** A designated edge for frequency, 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)

MEASUREMENTS:

Time Interval
Continuous Time Interval
±Time Interval
Frequency
Period
Totalize

Interval Sampling

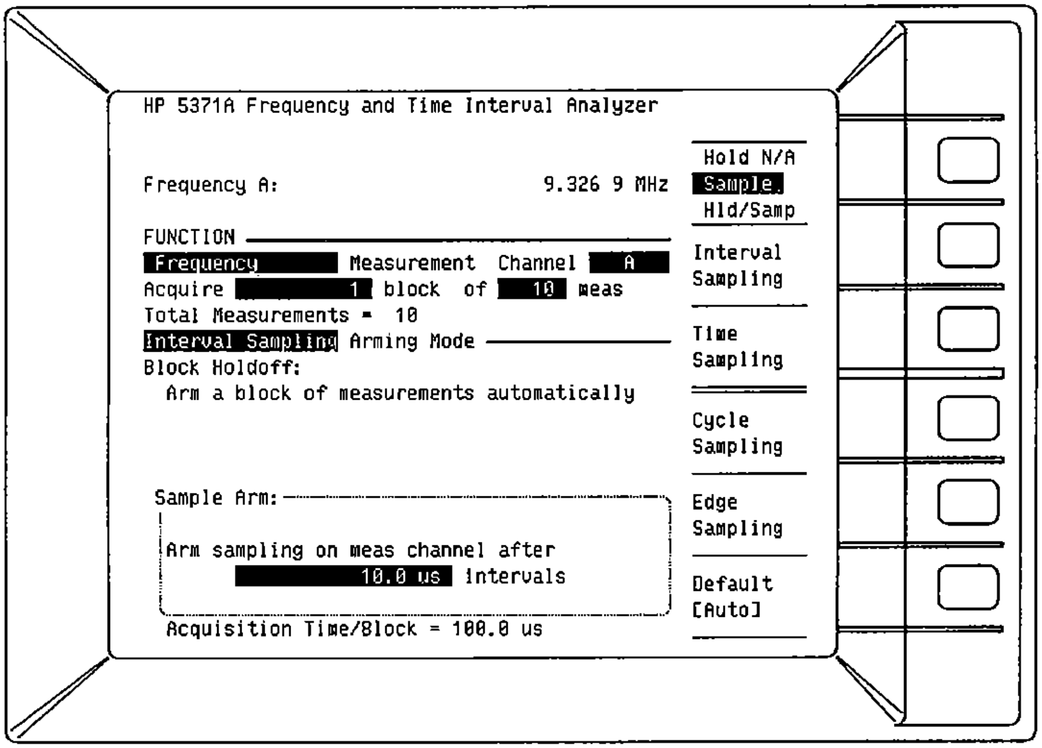


Figure 5-9. INTERVAL SAMPLING Menu Screen

MEASUREMENTS: Time Interval, Continuous Time Interval, ±Time Interval, Frequency, Period, and Totalize

GATING: Continuous

BLOCK ARM: Automatic

SAMPLE ARM: Interval (600 ns to 8.0 s)

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

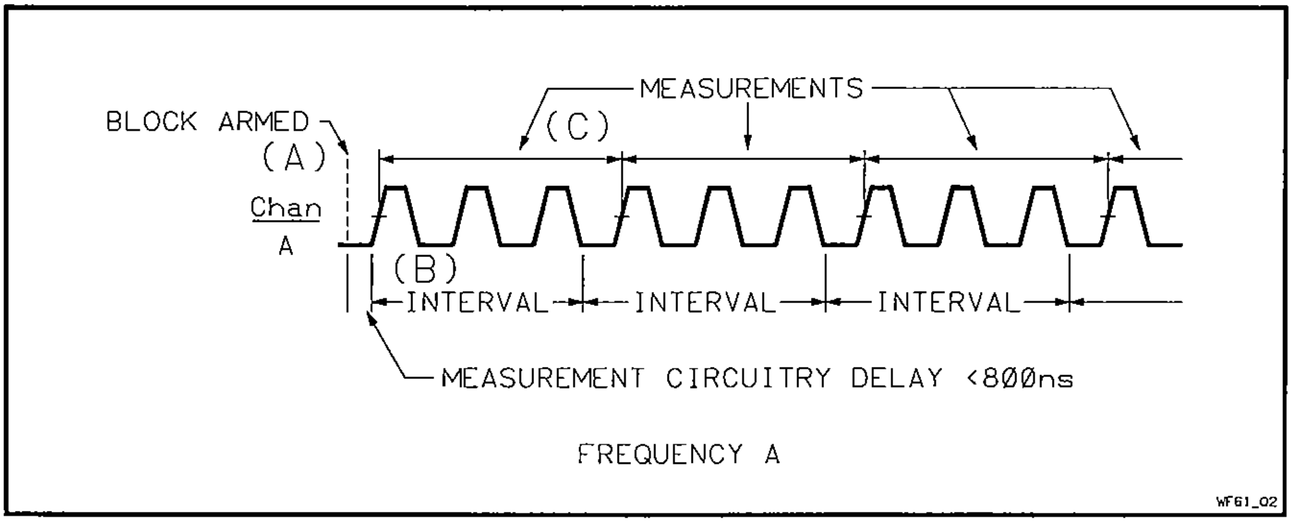


Figure 5-10. INTERVAL SAMPLING Timing Diagram

(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

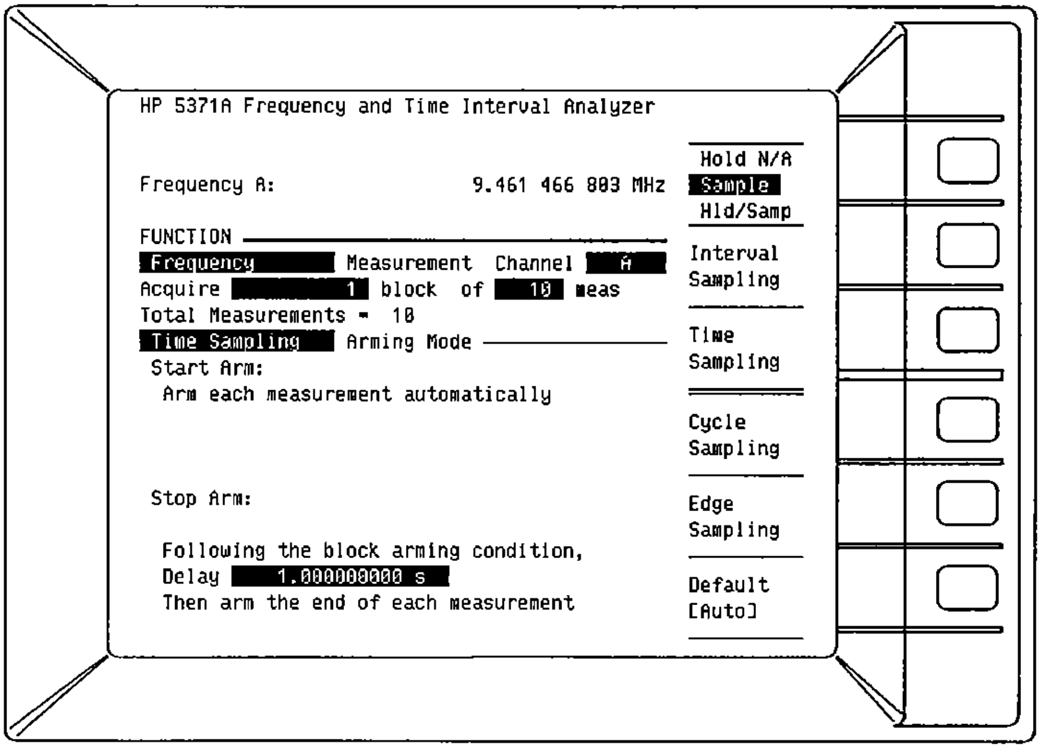


Figure 5-11. TIME SAMPLING Menu Screen

MEASUREMENTS: Frequency and Period

GATING: Non-continuous

START ARM: Automatic

STOP ARM: Time (2 ns to 8.0 s with 2 ns resolution) referenced to the automatic start arm signal.

COMMENTS: Each measurement ends on the trigger event following the set time.

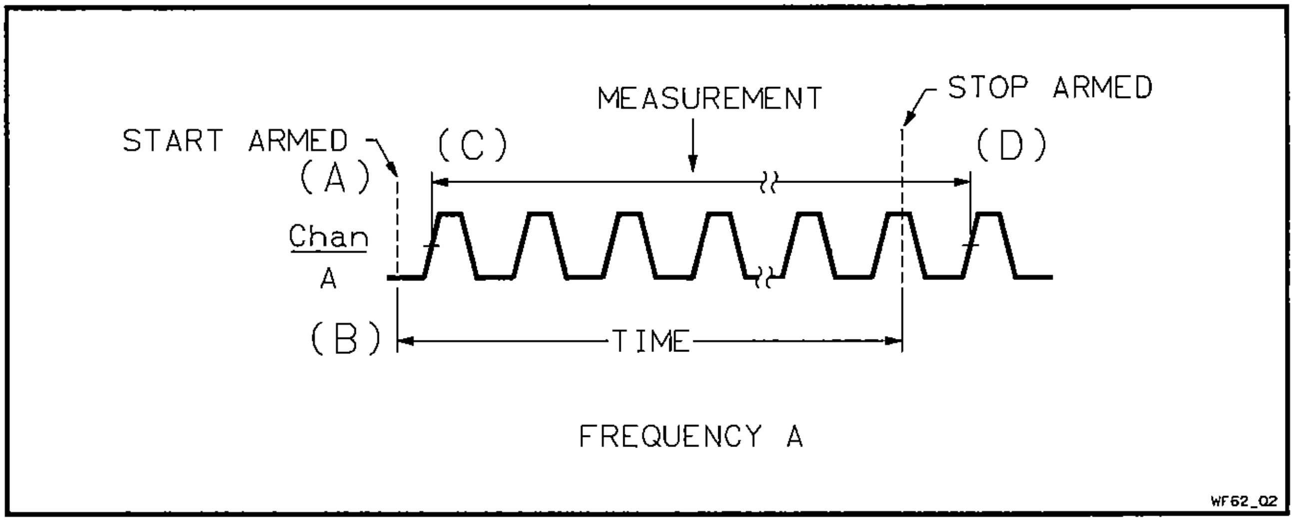


Figure 5-12. TIME SAMPLING Timing Diagram

(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

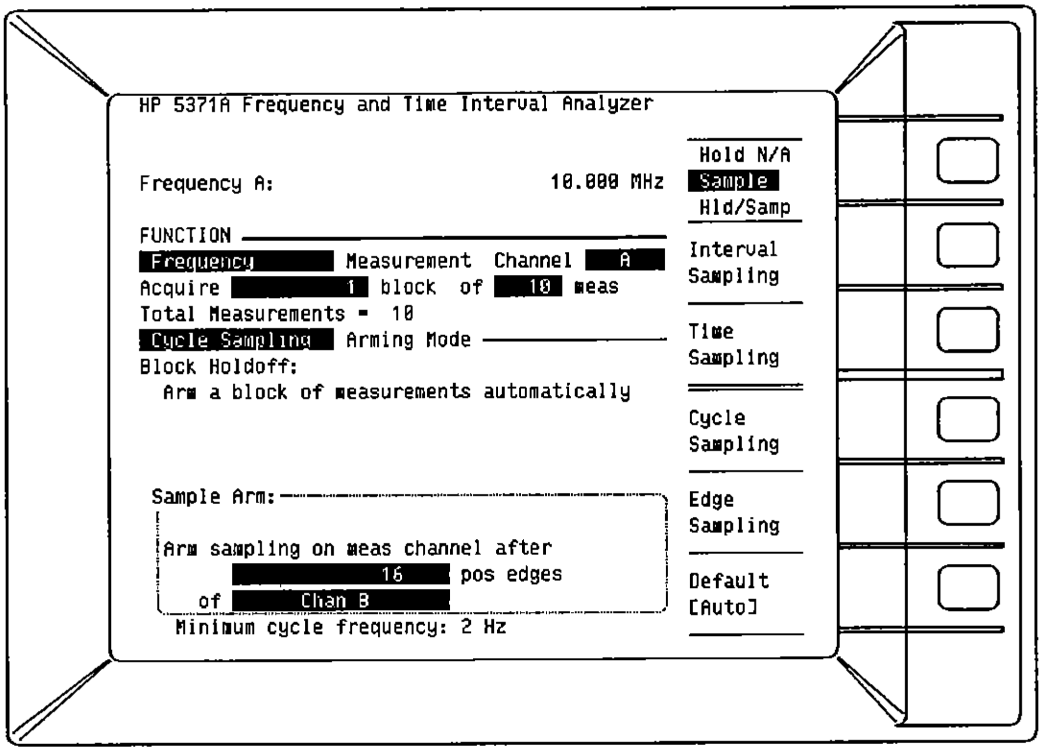


Figure 5-13. CYCLE SAMPLING Menu Screen

MEASUREMENTS: Frequency and Period

GATING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: Cycles (events) of Channel A, B, or internal timebase. Number of cycles restricted to 2^4, 2^8, 2^{12}, 2^{16}, 2^{20}, 2^{24}, 2^{28}

COMMENTS: Sampling takes place on the trigger event following the counting of the selected number of cycle events. If the input frequency is below the minimum cycle frequency, as shown on the CYCLE arming mode screen, frequency and gate times will be incorrect.

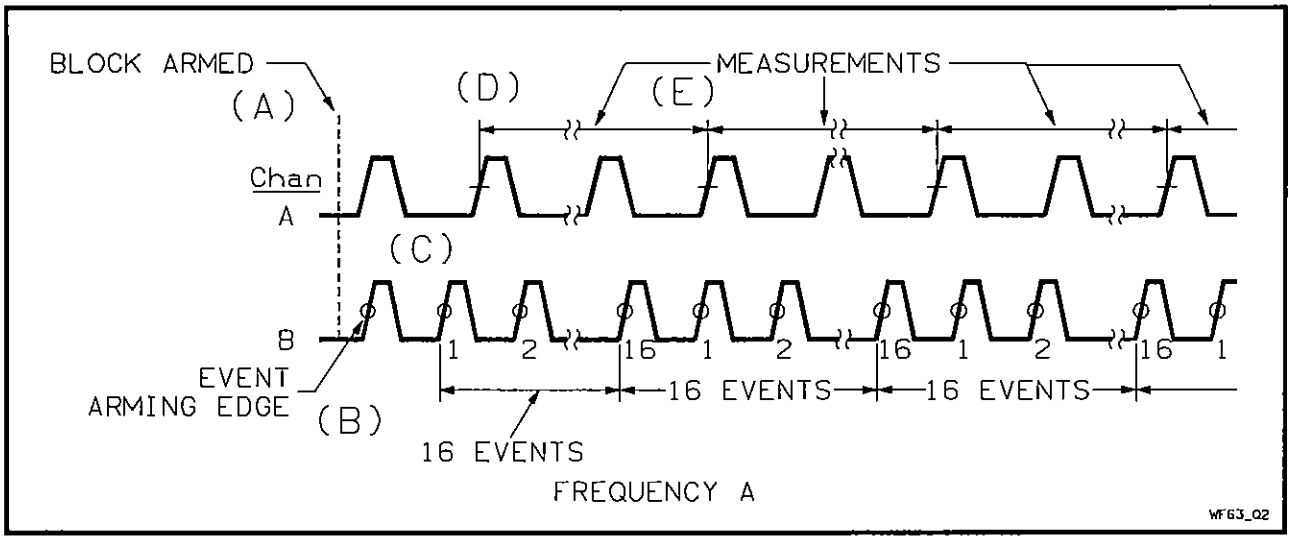


Figure 5-14. CYCLE SAMPLING Timing Diagram

(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

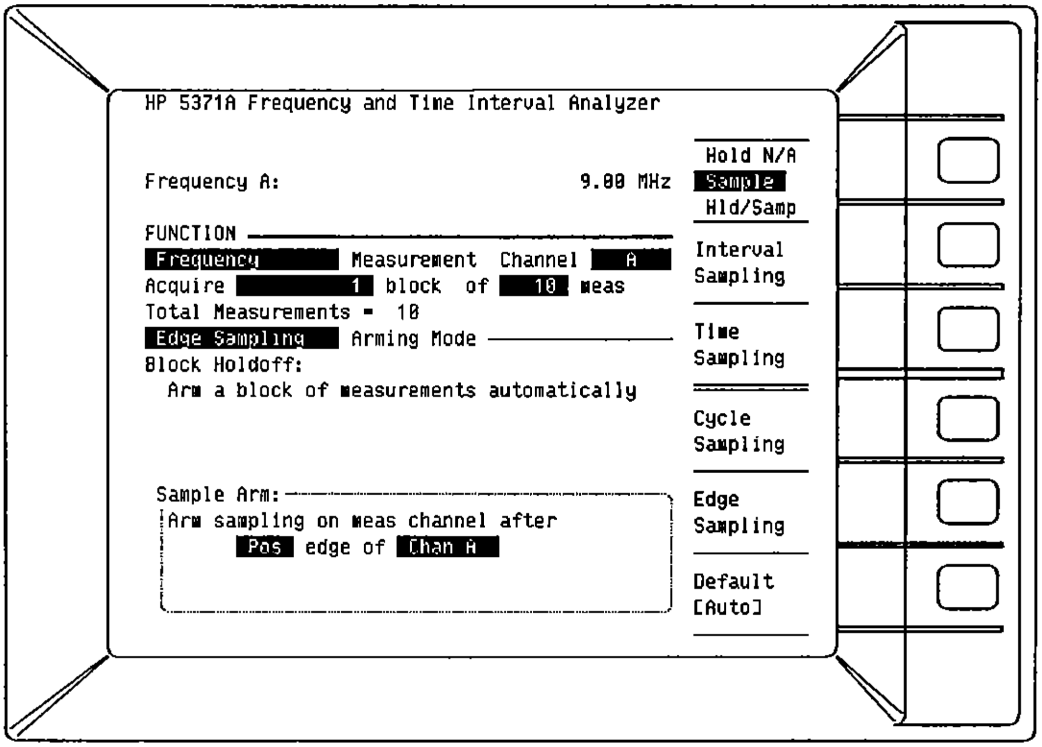


Figure 5-15. EDGE SAMPLING Menu Screen

MEASUREMENTS: Frequency, Period, and Totalize

GATING: 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.

NOTE

Period of Sample Arm signal should not exceed 8.0 s.

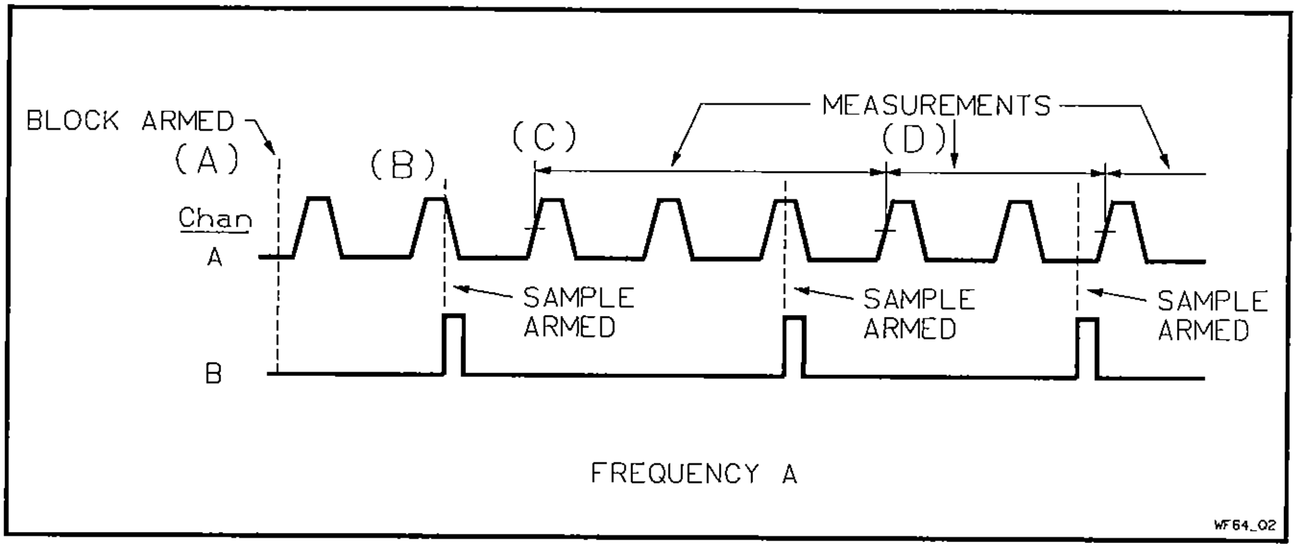


Figure 5-16. EDGE SAMPLING Timing Diagram

(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

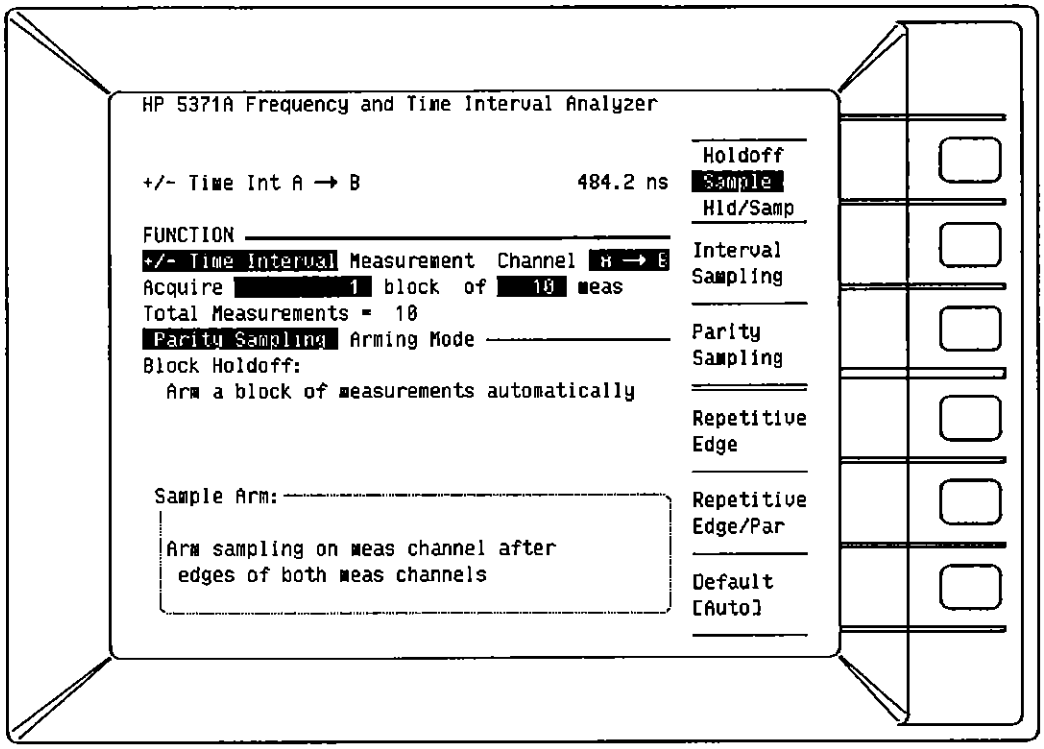


Figure 5-17. PARITY SAMPLING Menu Screen

MEASUREMENT: ±Time Interval (two-channel)

GATING: Continuous

BLOCK HOLDOFF: Automatic

SAMPLE ARM: Parity

COMMENTS: Sampling takes place on the two trigger events following the detection of an edge on each of two input 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 always want to measure the shorter time interval between A and B, instead of the longer interval of B to A.

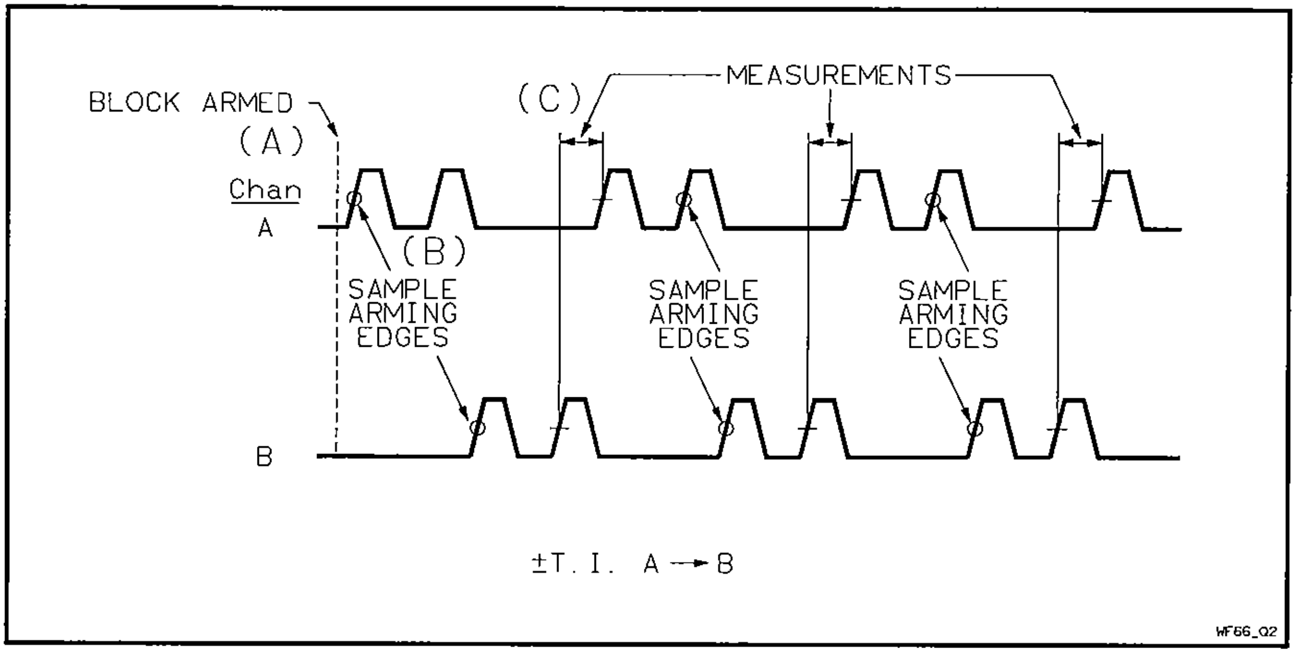


Figure 5-18. PARITY SAMPLING Timing Diagram

(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.

NOTE

For Parity Sampling ("Parity" = two Sample Arming Edges) —

During a 200 ns interval after every measurement, parity edge detection operates according to the following rules:

1. If an unequal number of edges occur on the two input channels, (for example, 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 these examples) 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 input 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 input channels is required after the 200 ns interval, to satisfy the parity condition for the next measurement.

Repetitive Edge

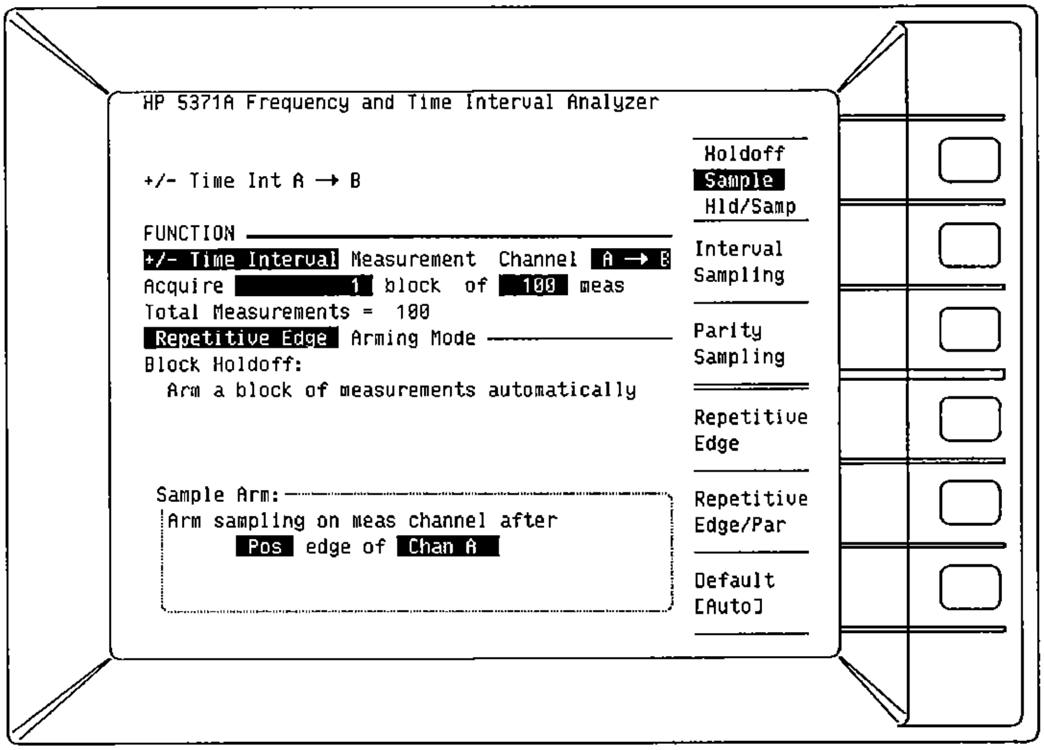


Figure 5-19. REPETITIVE EDGE Menu Screen

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

GATING: Continuous

BLOCK HOLDOFF: Automatic

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

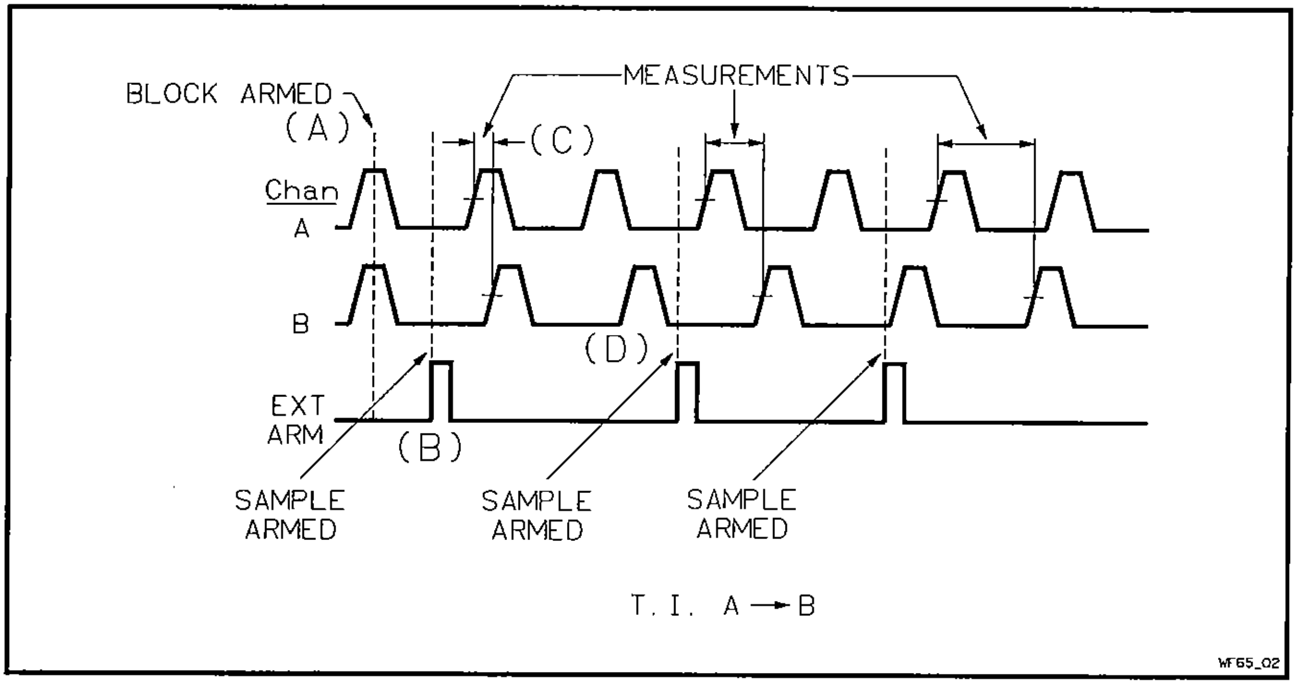


Figure 5-20. REPETITIVE EDGE Timing Diagram

(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

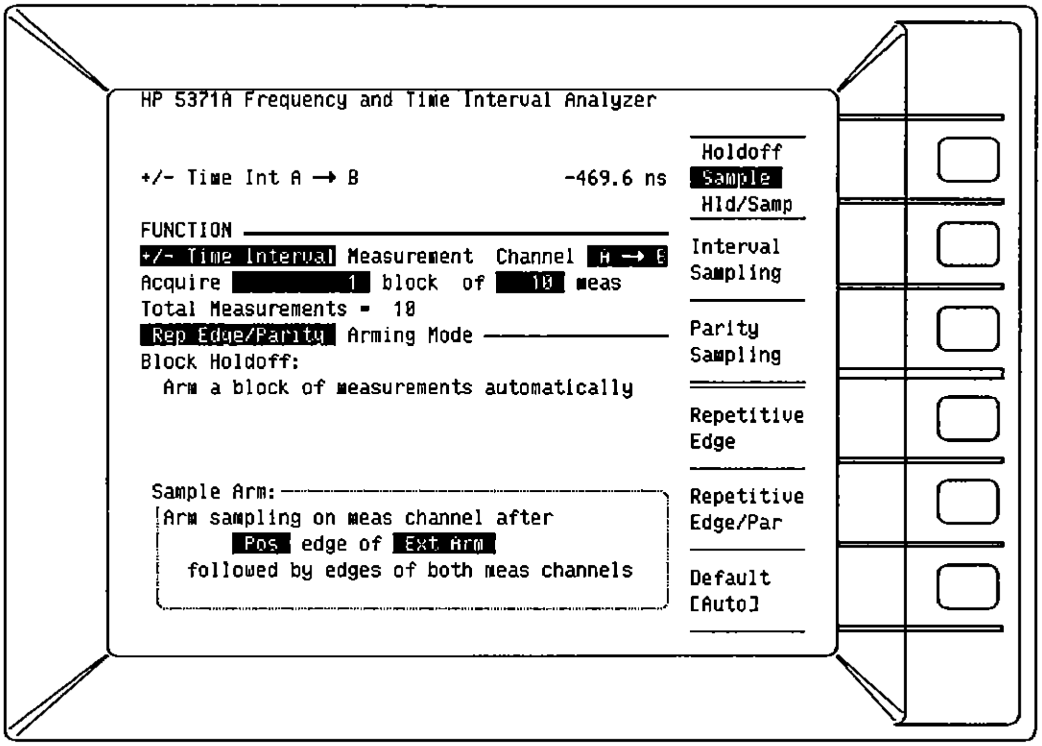


Figure 5-21. REPETITIVE EDGE/PARITY Menu Screen

MEASUREMENTS: ±Time Interval (two-channel)

GATING: Continuous

BLOCK HOLDOFF: Automatic

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

COMMENTS: The sample is armed after an edge on Channel A, B, or EXT ARM followed by the detection of an edge on each of the two input channels, A and B. 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 always want to measure the shorter time interval between A and B, instead of the longer interval of B to A.

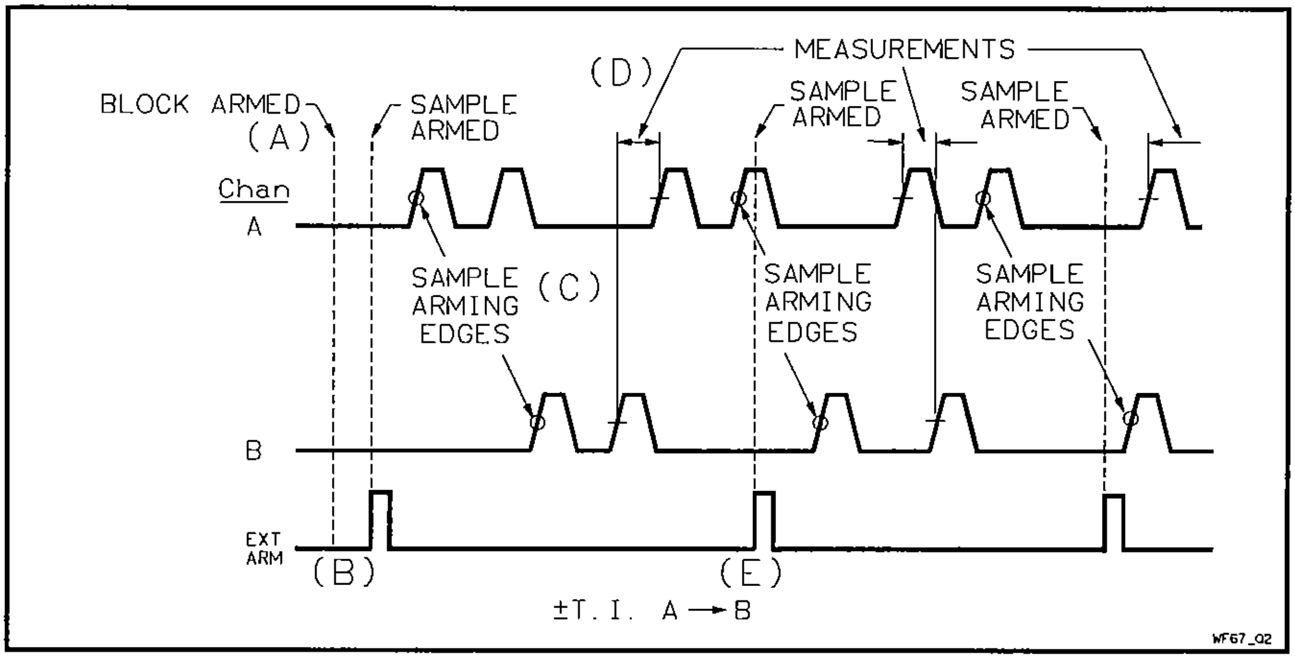


Figure 5-22. REPETITIVE EDGE/PARITY Timing Diagram

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

(B) A positive edge of EXT ARM 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.

NOTE

For Repetitive Edge/Parity ("Parity" = two Sample Arming Edges) —

Before every Sample Armed signal and during a 200 ns interval after every measurement, parity edge detection operates according to the following rules:

1. If an unequal number of edges occur on the two input channels, (for example, 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 these examples) is needed after the Sample Armed signal and 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 input 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 input channels is needed after the Sample Armed signal and after the 200 ns interval, to satisfy the parity condition required for the next measurement.

HOLDOFF/SAMPLING MODE

DESCRIPTION:

The Holdoff/Sampling arming modes allow the most flexibility in determining how measurements are armed. It is possible to specify when the measurements start and how they are sampled, or stopped.

MEASUREMENTS:

- Time Interval
- Continuous Time Interval
- ±Time Interval
- Frequency
- Period
- Totalize

Edge/Interval

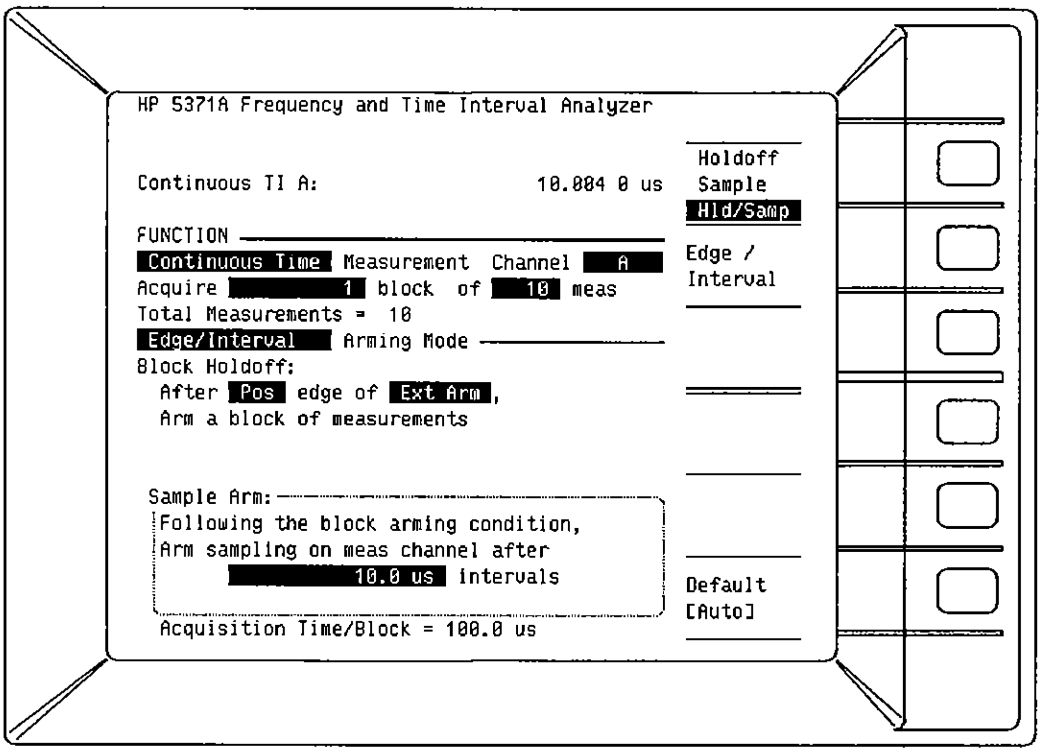


Figure 5-23. EDGE/INTERVAL Menu Screen

MEASUREMENTS: Time Interval, Continuous Time Interval, ±Time Interval, Frequency, Period, and Totalize

GATING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or EXT ARM

SAMPLE ARM: Interval (600 ns to 8.0 s)

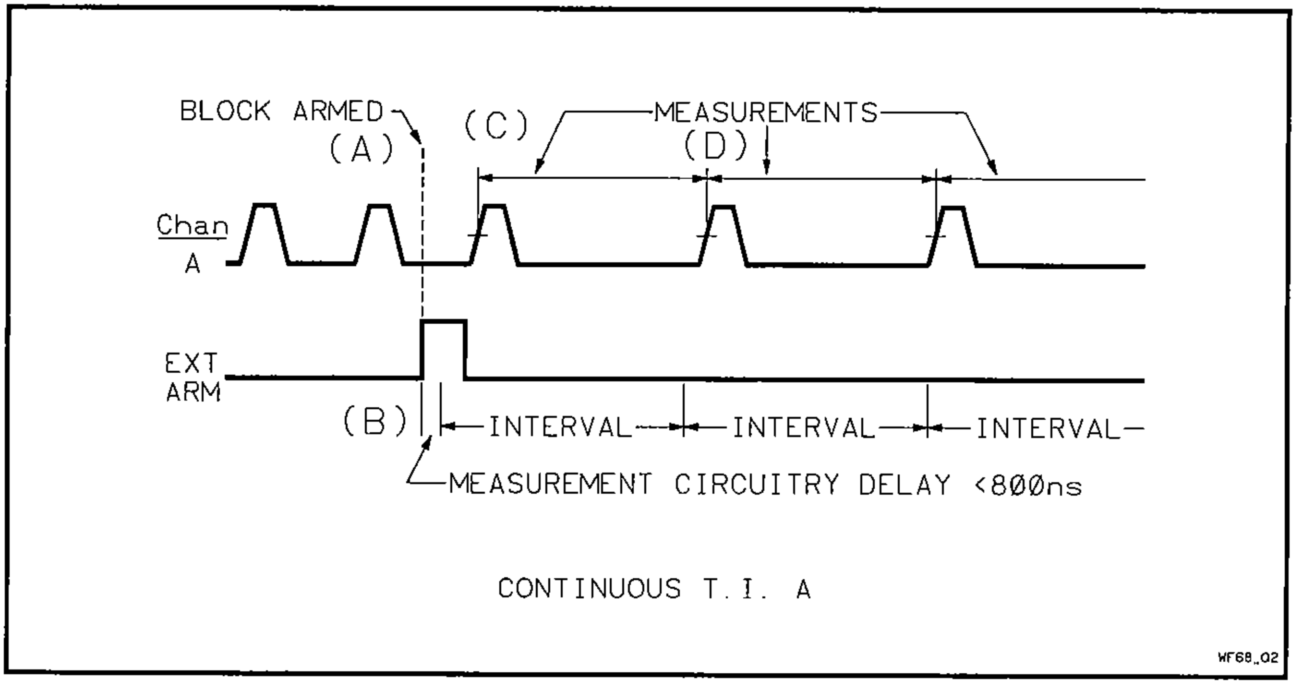


Figure 5-24. EDGE/INTERVAL Timing Diagram

(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 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

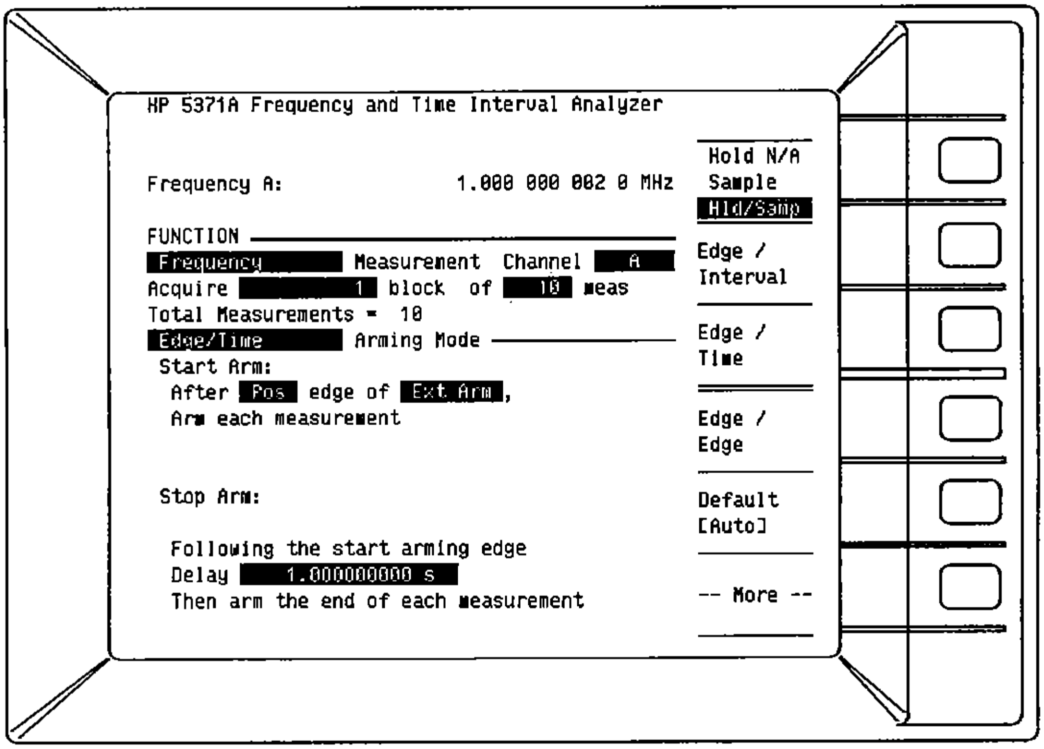


Figure 5-25. EDGE/TIME Menu Screen

MEASUREMENTS: Frequency and Period

GATING: Non-continuous

START ARM: Edge on Channel A, B, or EXT ARM

STOP ARM: Time (2 ns to 8.0 s with 2 ns resolution) referenced to the start arm edge.

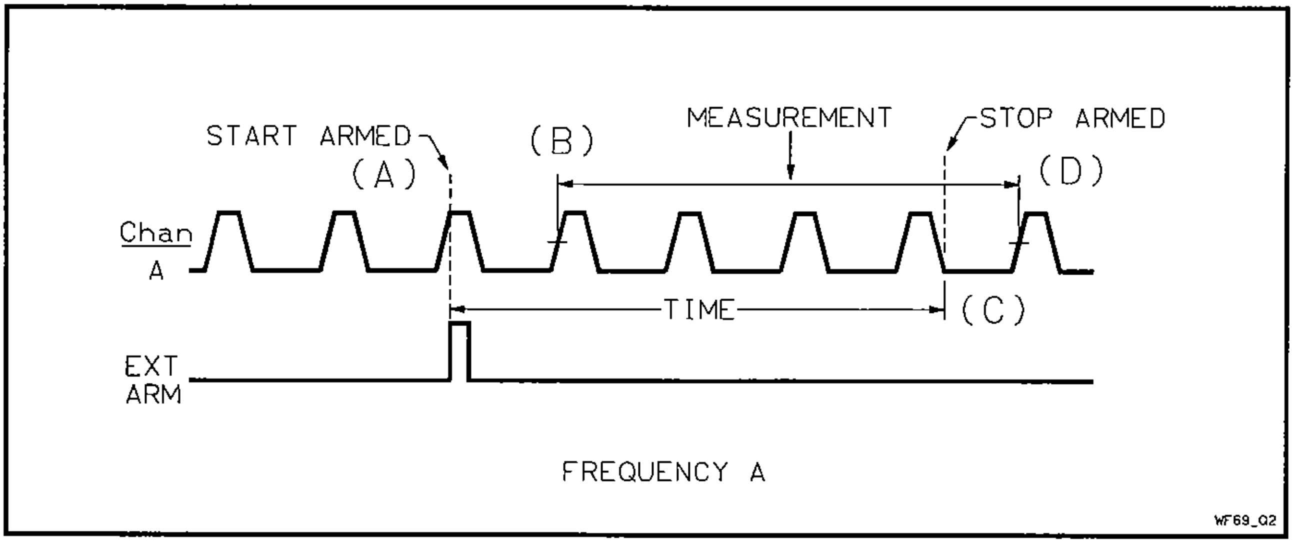


Figure 5-26. EDGE/TIME Timing Diagram

(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

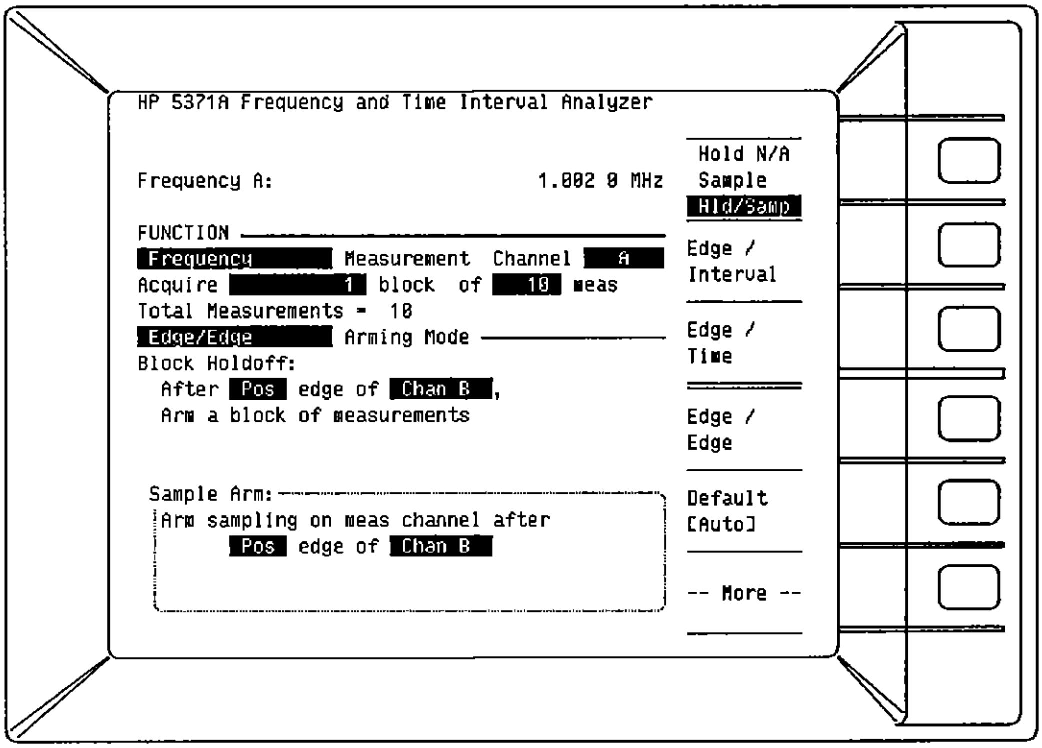


Figure 5-27. EDGE/EDGE Menu Screen

MEASUREMENTS: Frequency, Period, and Totalize

GATING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or EXT ARM

SAMPLE ARM: Edge on Channel A, B, or EXT ARM before every sample

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NOTE

Period of Sample Arm signal should not exceed 8.0 s.

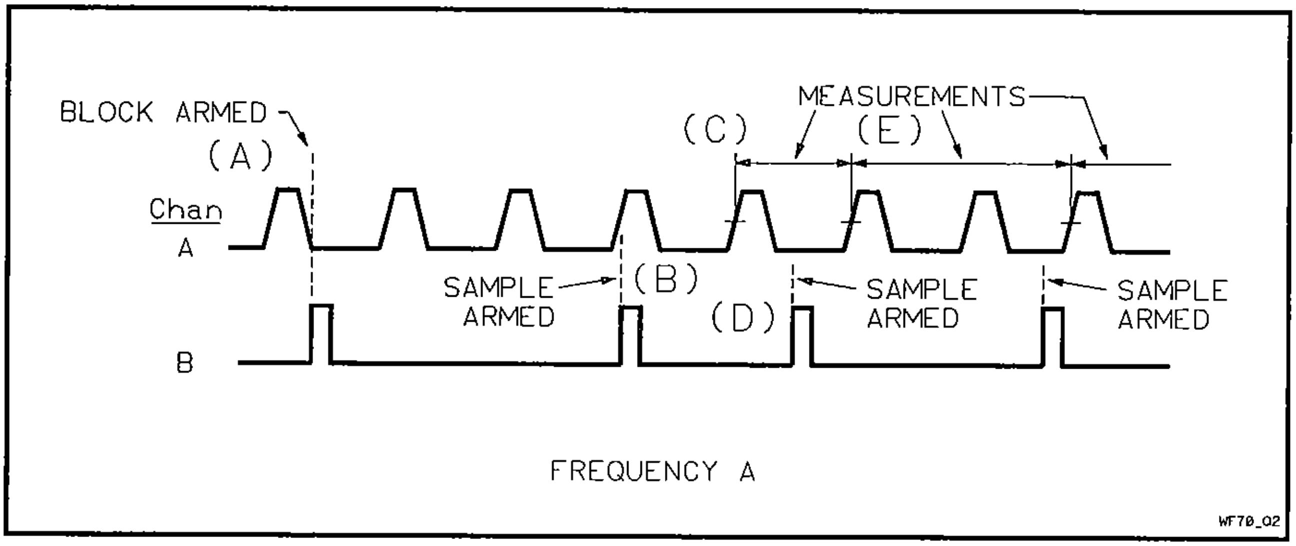

Figure 5-28. EDGE/EDGE Timing Diagram

(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.

Externally Gated

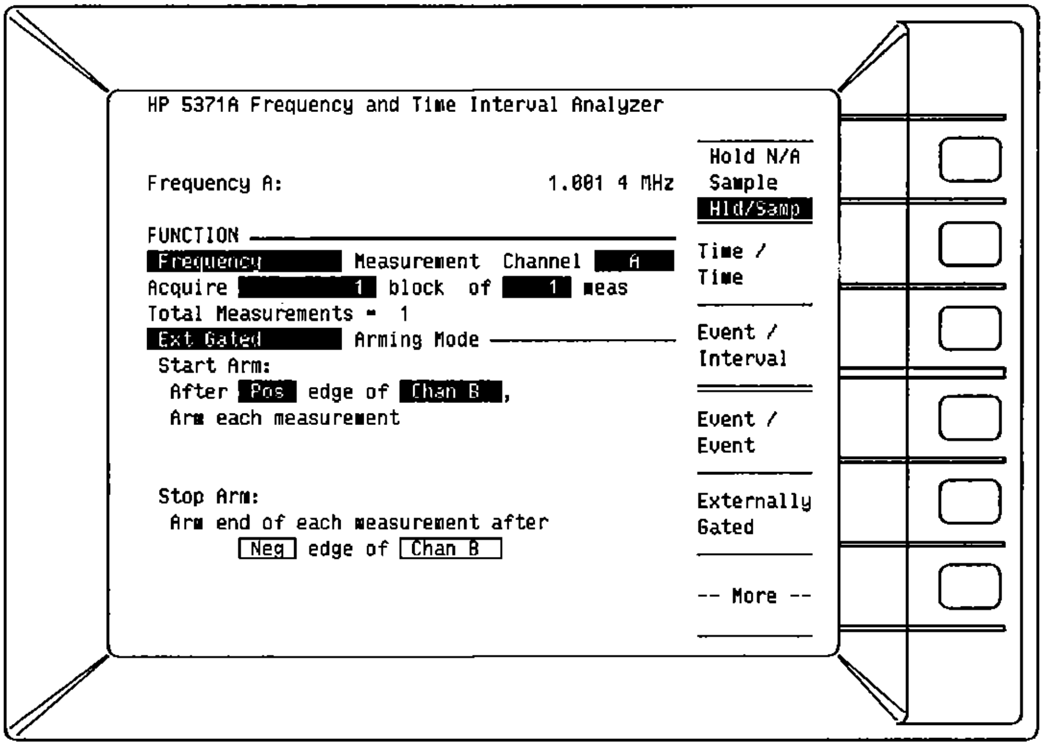

Figure 5-29. EXTERNALLY GATED Menu Screen

MEASUREMENTS: Frequency, Period, and Totalize

GATING: Non-continuous

START ARM: Edge on Channel A, B, or EXT ARM

STOP ARM: Opposite edge of start arm signal (not user-selected)

COMMENTS: The start and stop of the measurement is armed by successive edges (pos/neg or neg/pos) of the start arm pulse.

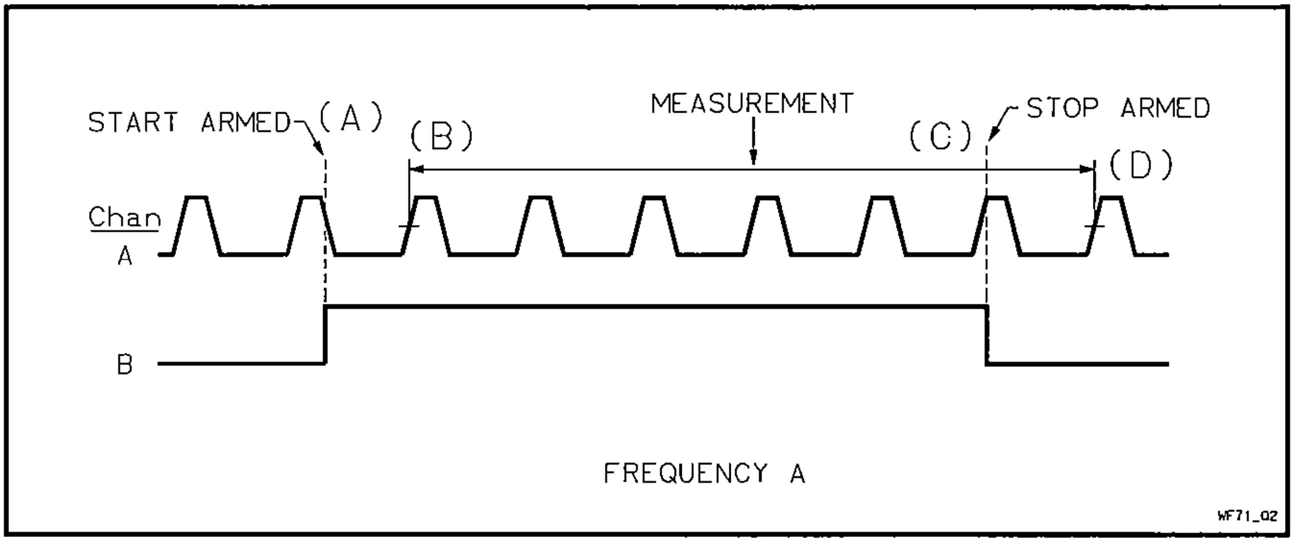

Figure 5-30. EXTERNALLY GATED Timing Diagram

(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.

Edge/Cycle

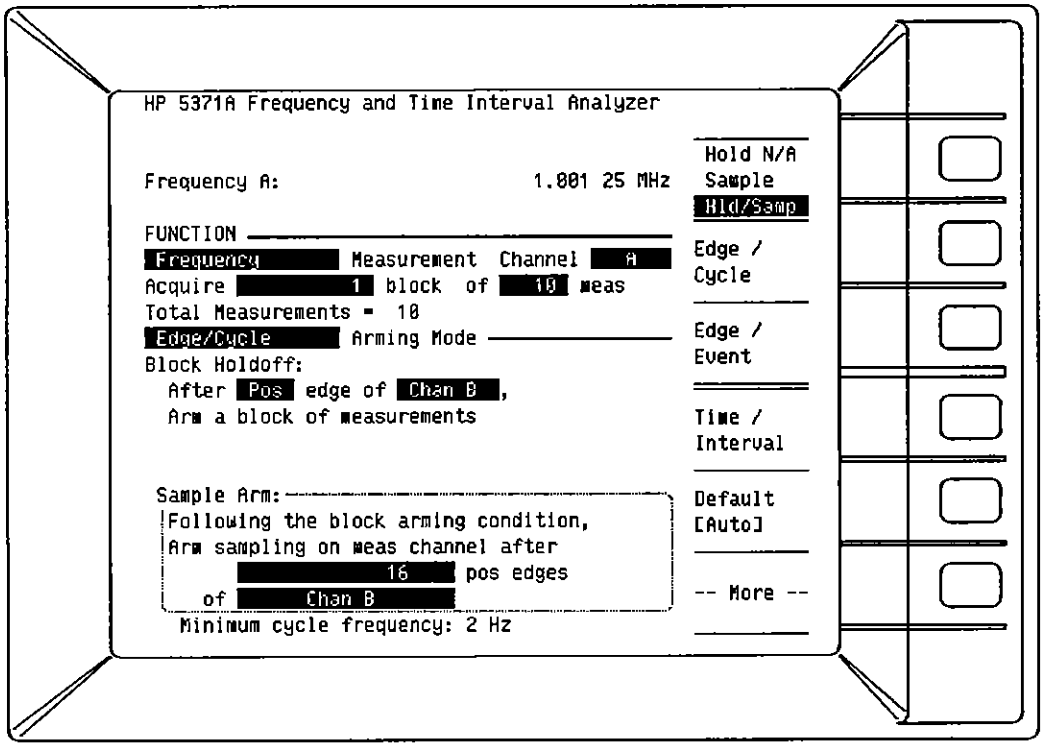

Figure 5-31. EDGE/CYCLE Menu Screen

MEASUREMENTS: Frequency and Period

GATING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or EXT ARM

SAMPLE ARM: Cycles (events) of Channel A, B, or internal timebase. Number of cycles restricted to 2^4, 2^8, 2^{12}, 2^{16}, 2^{20}, 2^{24}, 2^{28}

COMMENTS: Sampling takes place on the trigger event following the counting of the selected number of cycle events. If the input frequency is below the minimum cycle frequency, as shown on the CYCLE arming mode screen, frequency and gate times will be incorrect.

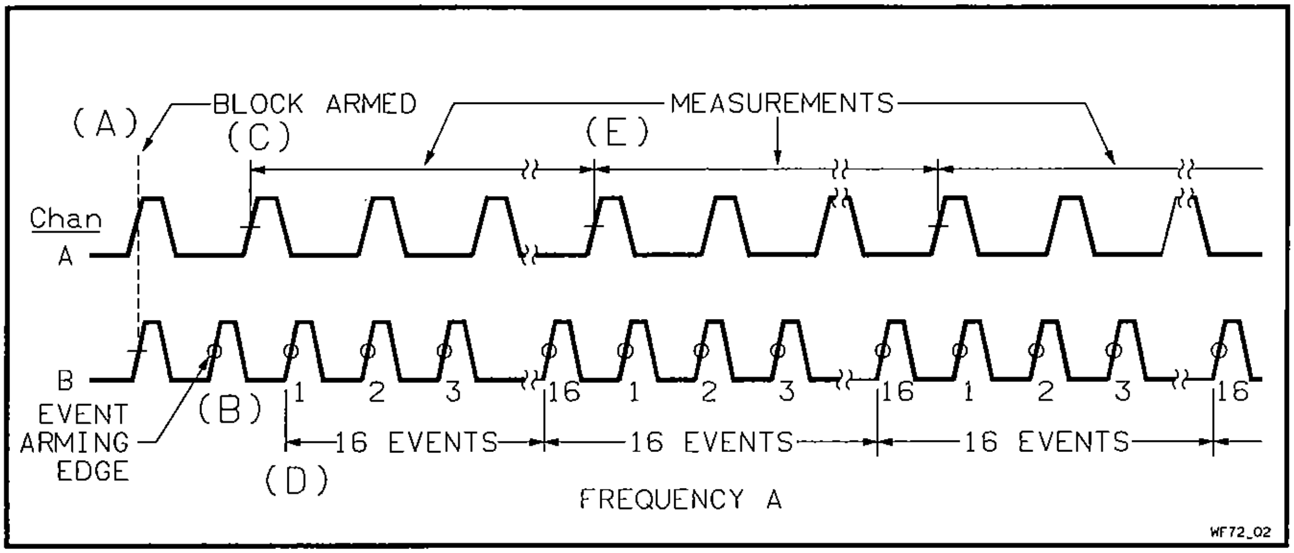

Figure 5-32. EDGE/CYCLE Timing Diagram

(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

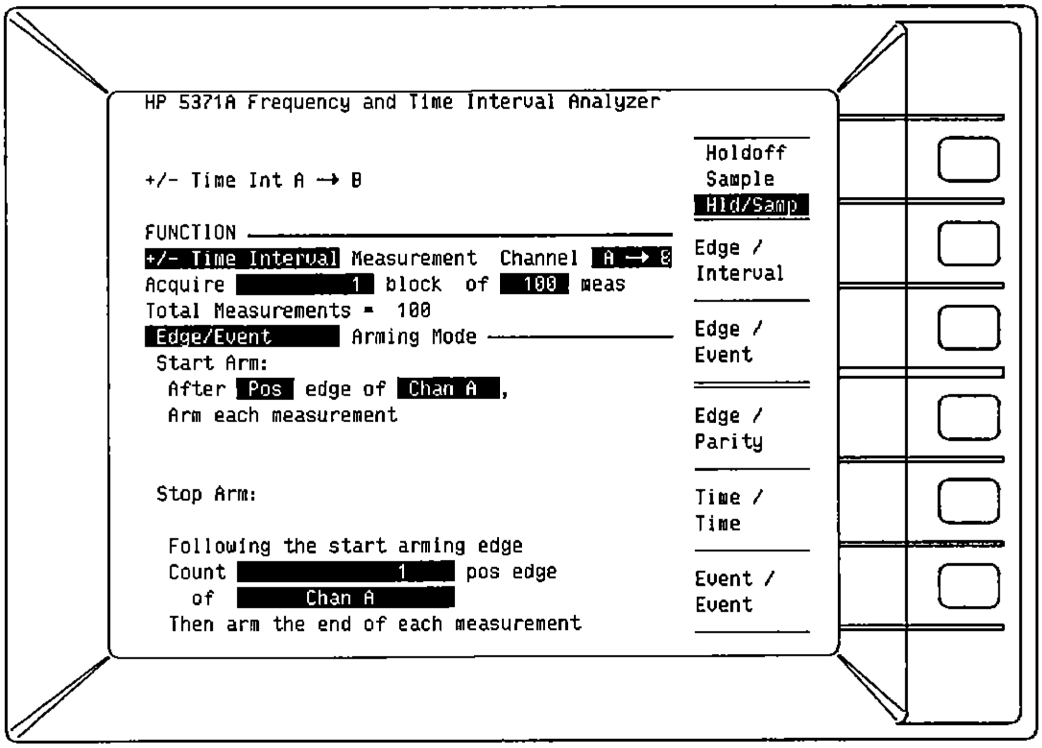

Figure 5-33. EDGE/EVENT Menu Screen

MEASUREMENTS: ±Time Interval, Frequency, and Period

GATING: Non-continuous

START ARM: Edge on Channel A, B, or EXT ARM

STOP ARM: Events (0 to 4,000,000,000) on Channel A or B referenced to the start arm edge

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NOTE

Total period of Stop Arm events should not exceed 8.0 s.

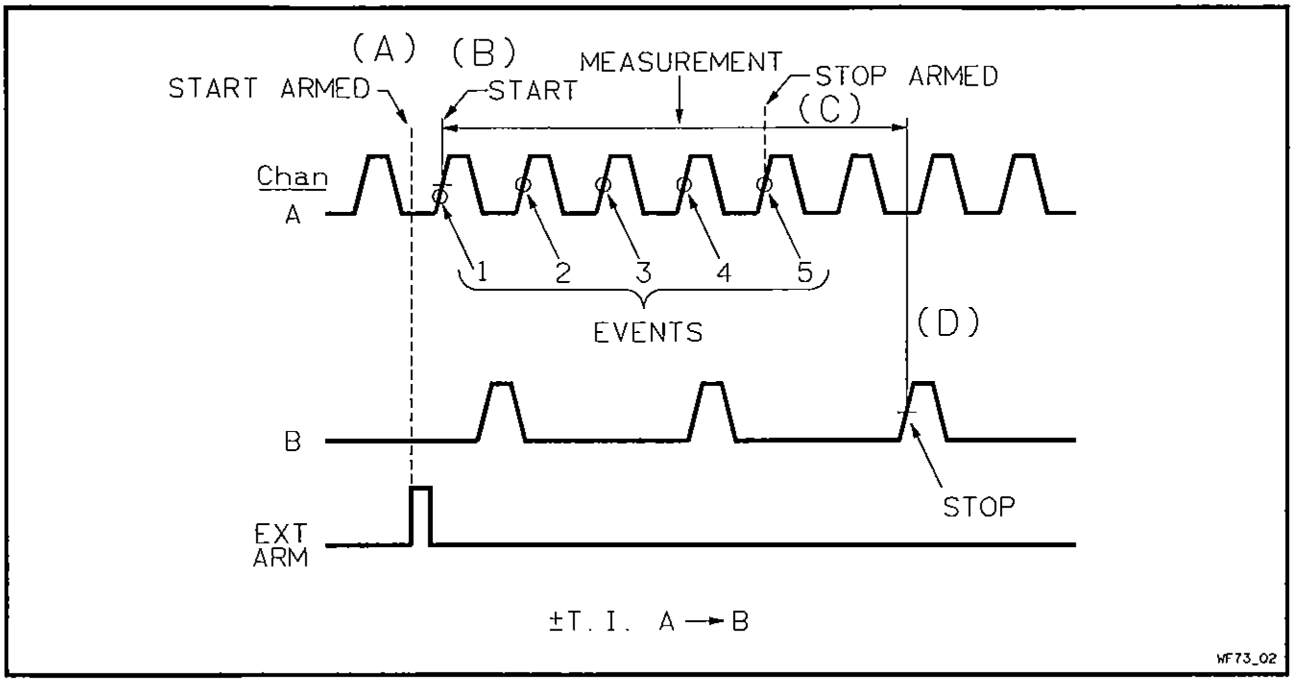


Figure 5-34. EDGE/EVENT Timing Diagram

(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

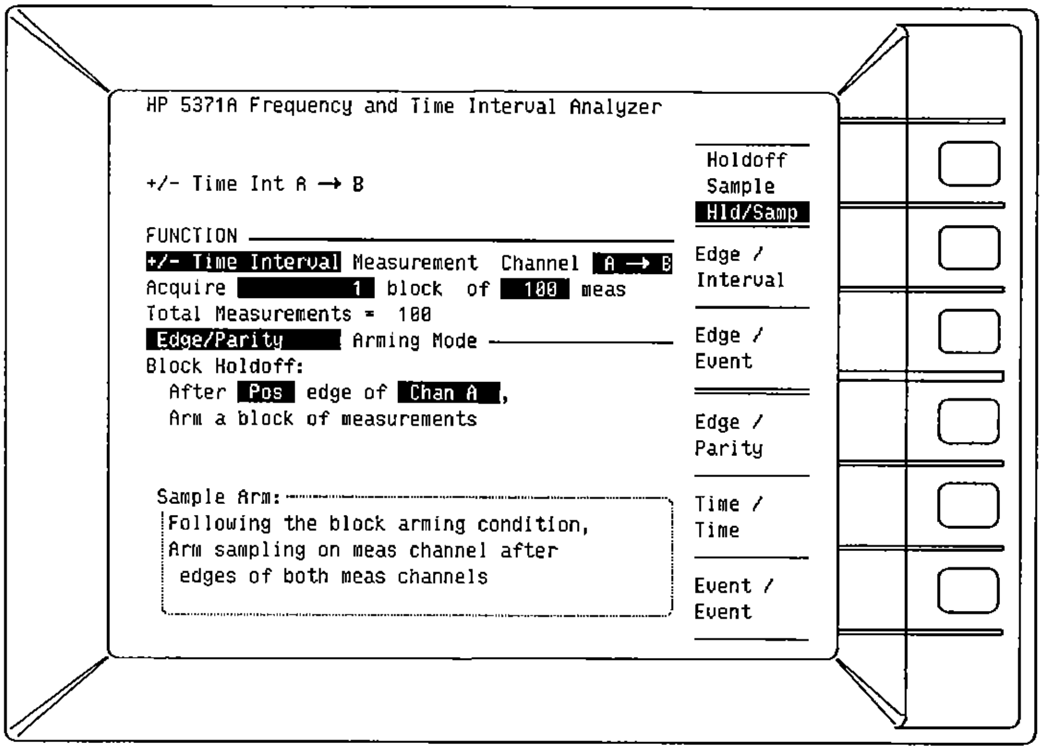


Figure 5-35. EDGE/PARITY Menu Screen

MEASUREMENT: ±Time Interval (two-channel)

GATING: Continuous

BLOCK HOLDOFF: Edge on Channel A, B, or EXT ARM

SAMPLE ARM: Parity

COMMENTS: Sampling takes place on the two trigger events following the detection of an edge on each of two input 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 always want to measure the shorter time interval between A and B, instead of the longer interval of B to A.

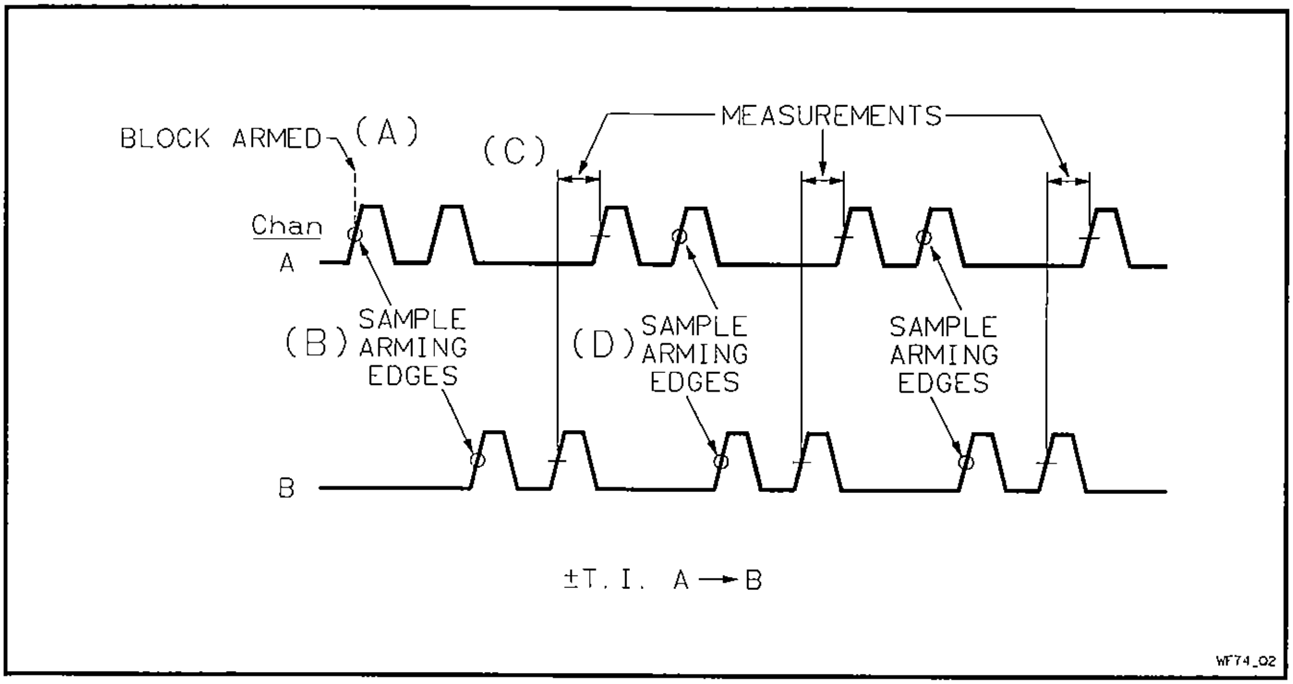


Figure 5-36. EDGE/PARITY Timing Diagram

(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.

NOTE

For Edge/Parity ("Parity" = two Sample Arming Edges) —

Before the Block Armed signal and during a 200 ns interval after every measurement, parity edge detection operates according to the following rules:

1. If an unequal number of edges occur on the two input channels, (for example, 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 these examples) is needed after the Block Armed signal or 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 input 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 input channels is needed after the Block Armed signal or after the 200 ns interval, to satisfy the parity condition required for the next measurement.

Time/Interval

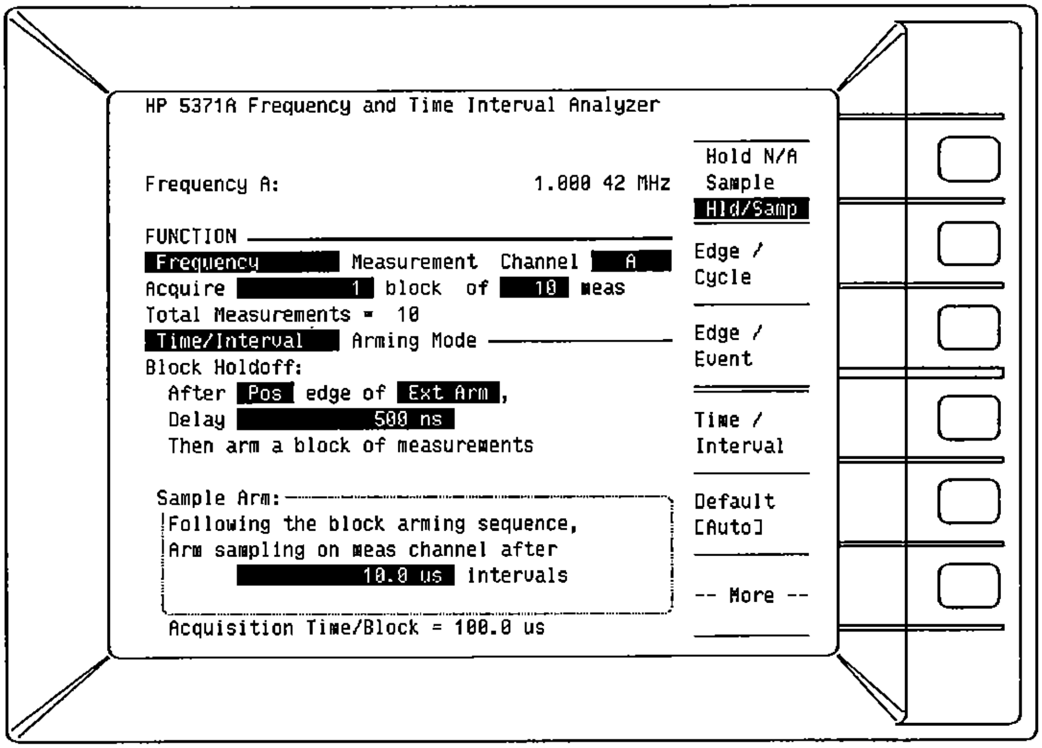


Figure 5-37. TIME/INTERVAL Menu Screen

MEASUREMENTS: Frequency, Period, and Totalize

GATING: Continuous

BLOCK HOLDOFF: Time (2 ns to 8.0 s with 2 ns resolution) referenced to an edge on Channel A, B, or EXT ARM.

SAMPLE ARM: Interval (600 ns to 8.0 s)

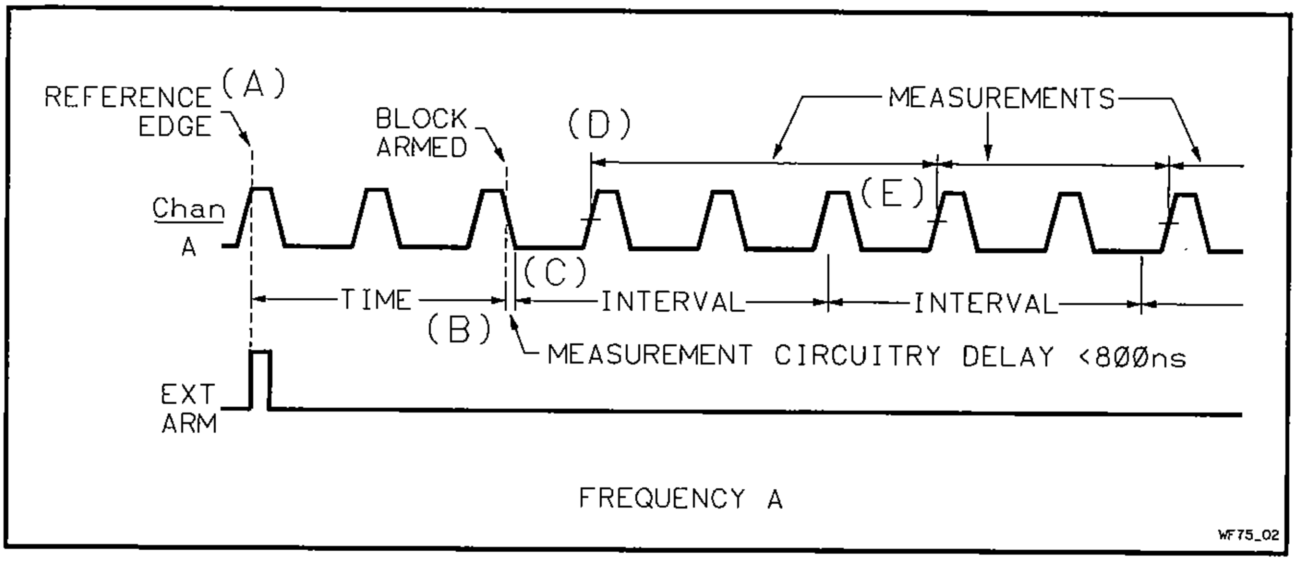


Figure 5-38. TIME/INTERVAL Timing Diagram

(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

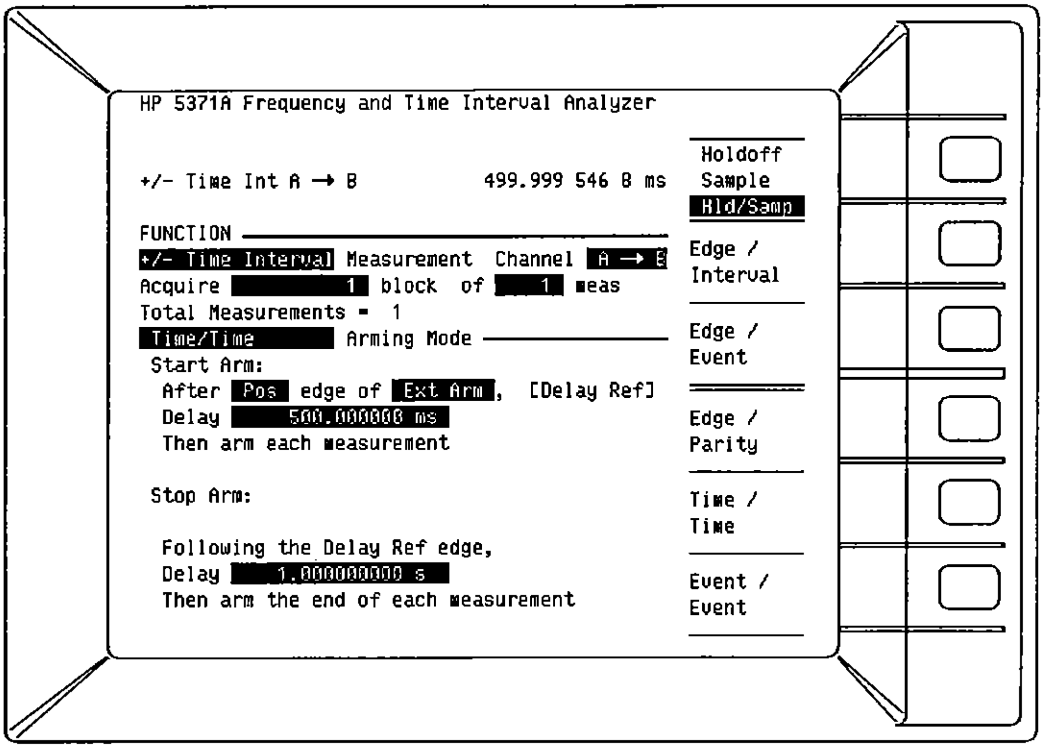


Figure 5-39. TIME/TIME Menu Screen

MEASUREMENTS: ±Time Interval, Frequency, and Period

GATING: Non-continuous

START ARM: Time (2 ns to 8.0 s with 2 ns resolution) referenced to an edge on Channel A, B, or EXT ARM.

STOP ARM: Time (2 ns to 8.0 s with 2 ns resolution) referenced to the start arm edge.

COMMENTS: For ±Time Interval measurements, if the stop arm comes before the start arm, the result will always be negative.

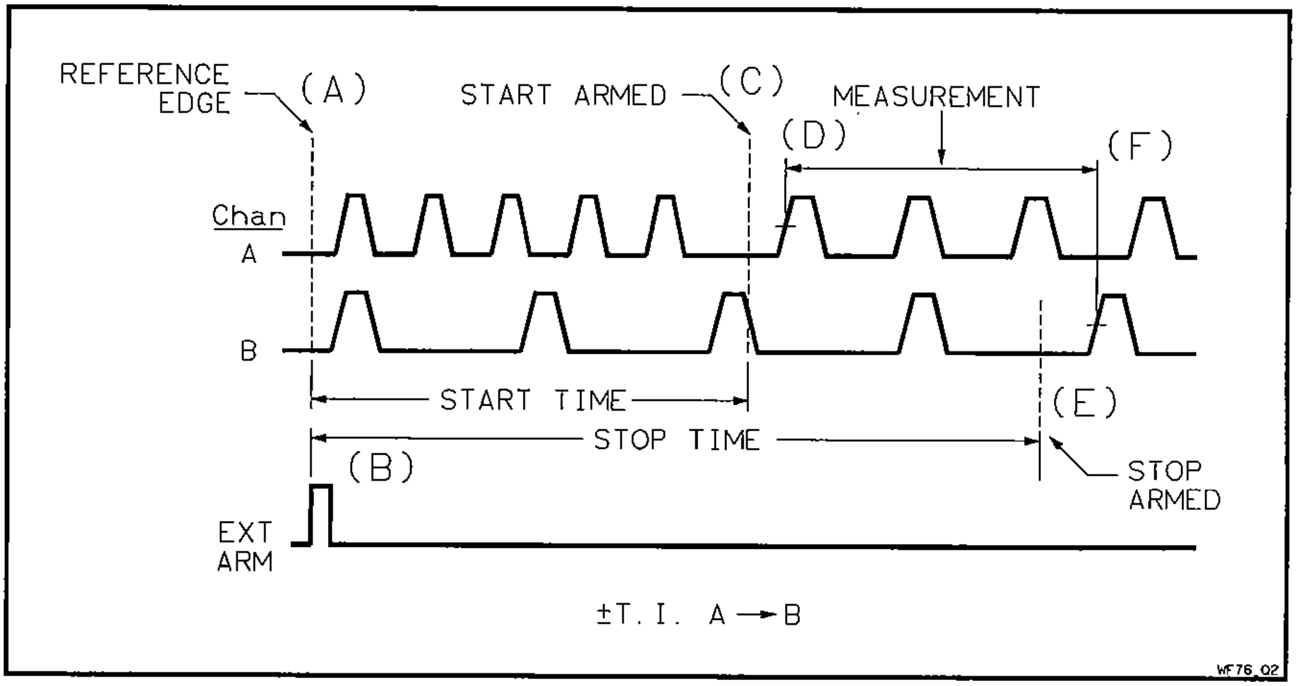


Figure 5-40. TIME/TIME Timing Diagram

(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

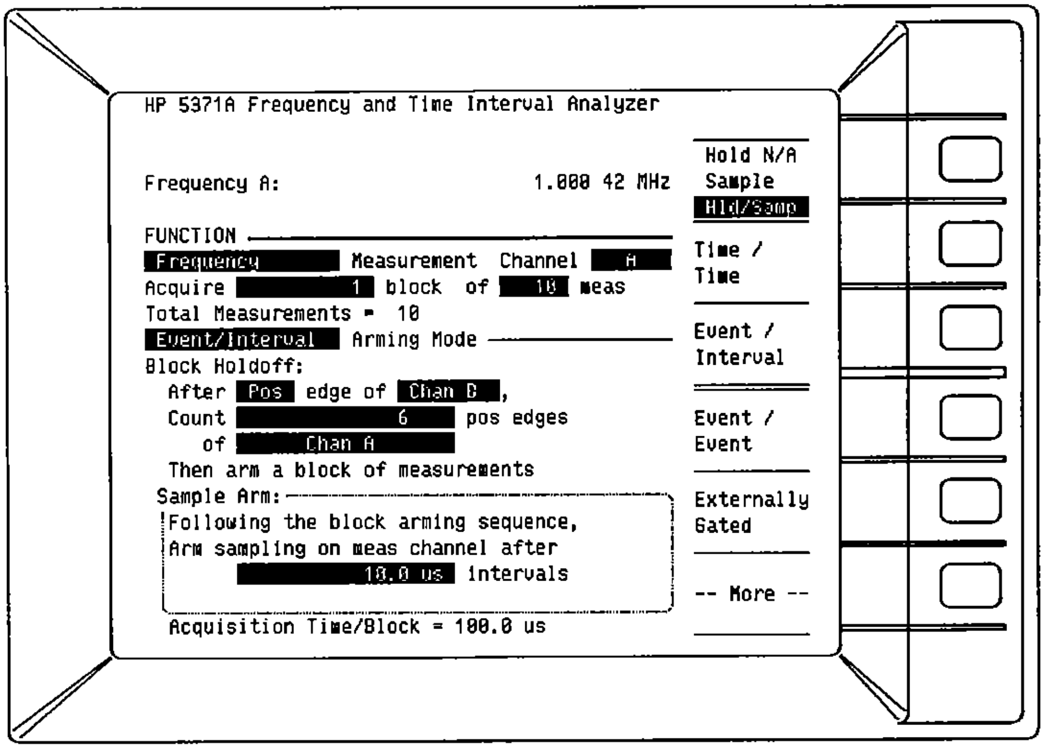


Figure 5-41. EVENT/INTERVAL Menu Screen

MEASUREMENTS: Frequency and Period

GATING: Continuous

BLOCK HOLDOFF: Events (0 to 4,000,000,000) on Channel A or B referenced to an edge on Channel A, B, or EXT ARM.

SAMPLE ARM: Interval (600 ns to 8.0 s)

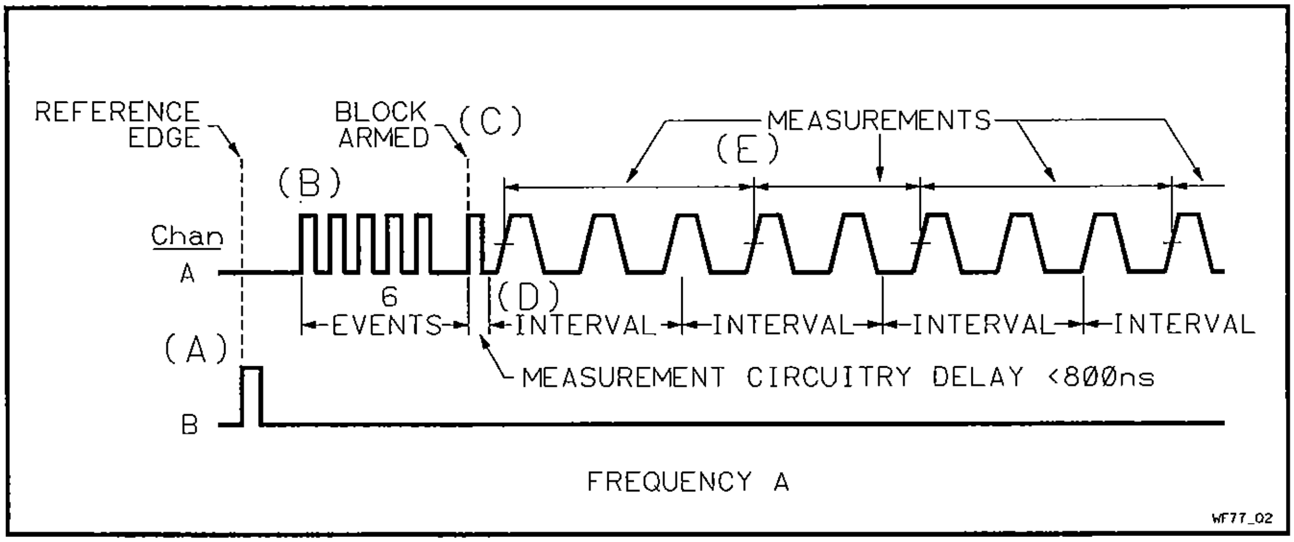


Figure 5-42. EVENT/INTERVAL Timing Diagram

(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

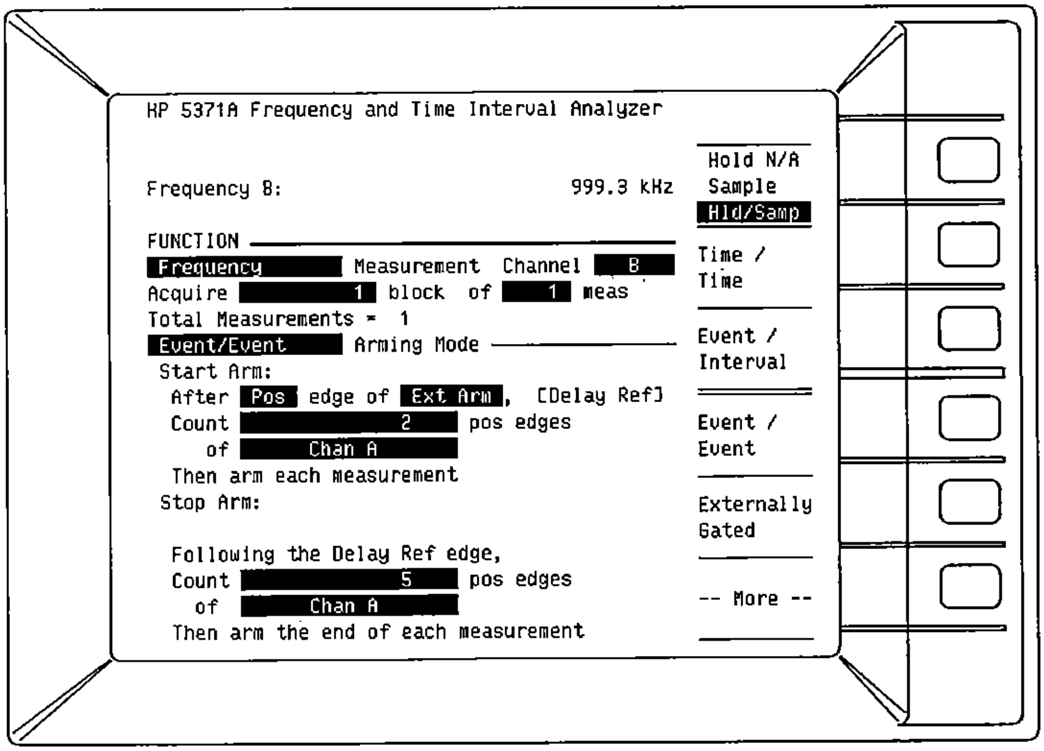


Figure 5-43. EVENT/EVENT Menu Screen

MEASUREMENTS: ±Time Interval, Frequency, and Period

GATING: Non-continuous

START ARM: Events (0 to 4,000,000,000) on Channel A or B referenced to an edge on Channel A, B, or EXT ARM.

STOP ARM: Events (0 to 4,000,000,000) on Channel A or B referenced to the start arm edge

COMMENTS: For Frequency and Period measurements, the start arm must be completed before the stop arm. Invalid results will be displayed should the stop events be completed before the start arm events. For ±Time Interval measurements, a stop arm coming before a start arm will give a negative result.

NOTE

Total period of Stop Arm events should not exceed 8.0 s.

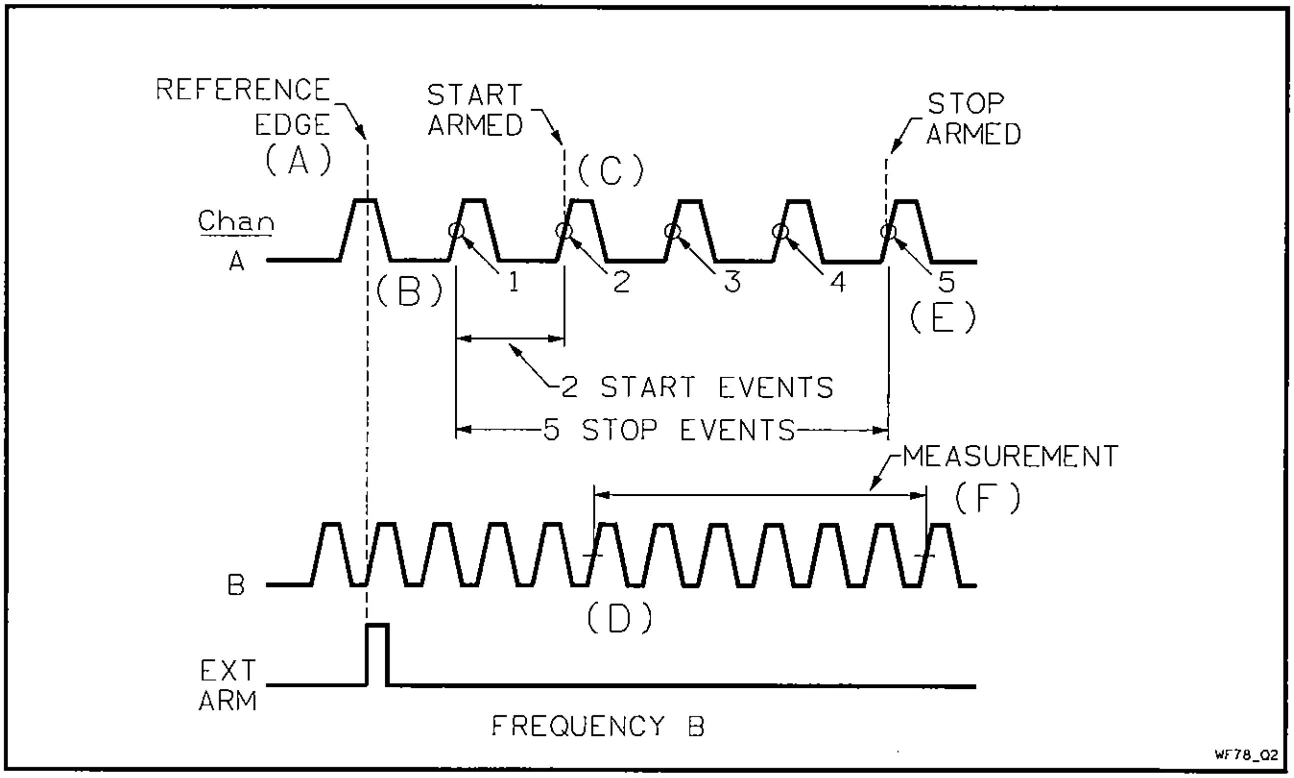


Figure 5-44. EVENT/EVENT Timing Diagram

(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.

Manual

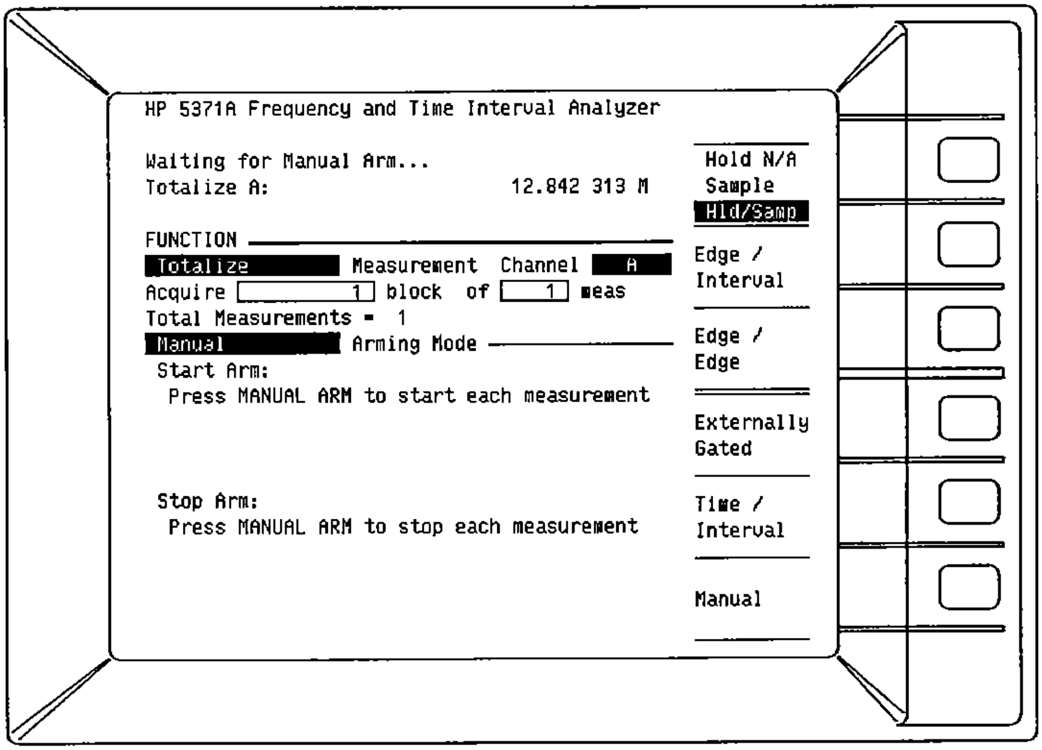


Figure 5-45. MANUAL Menu Screen

MEASUREMENT: Totalize

GATING: 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.

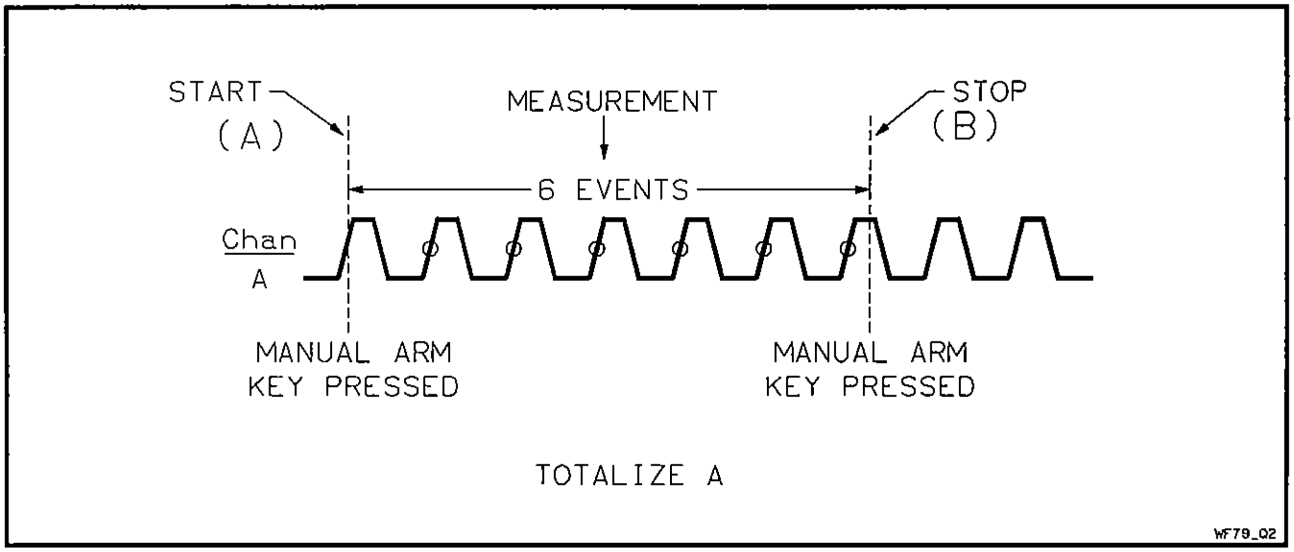


Figure 5-46. MANUAL Timing Diagram

(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 a total of the number of trigger events that occurred on Channel A between the key presses.

HOW TO CHOOSE AN ARMING MODE

In most cases, the "AUTOMATIC" or default modes will provide the fastest and most straightforward measurement. Otherwise, your choice of arming mode can depend on a number of items:

1. One-channel or two-channel measurement?

2. Need a continuous measurement?

3. How to arm the measurement to start?

4. How to sample the measurement?

It is important to note that the FUNCTION and INPUT menu parameters are interrelated. The implementation of these menus is such that only the supported arming choices are displayed as softkey options for a selected measurement and channel combination. For a selected arming mode, only the supported measurements and channel choices are available as softkey options. If entry of a non-supported parameter combination is attempted on the front panel, the parameters will automatically default to a supported setup.

Here is an example how this works:

> Say the current menu setup is a frequency measurement on Channel A. The arming mode is EVENT/EVENT, the block size is 1, the measurement size is 1000. (1000 total measurements.)
>
> If you then wanted to measure the frequency of both Channel A and B simultaneously, selecting the A&B softkey option automatically causes the arming mode to default to AUTOMATIC, an arming mode that supports two-channel measurements. The block size defaults to 2, the measurement size to 500. (500 is the measurement size limit for two-channel measurements, still 1000 total measurements.)
>
> Good Technique: Select Measurement first, then Channel, and then Arming Mode.

ARMING MODE SUMMARY

Table 5-2. HP 5371A Arming Mode Summary

Arming Mode	Measurement Function										
	Time Interval	Continuous Time	±Time Interval		Frequency, Period		Totalize		Pos Width, Neg Width, Rise Time, Fall Time, Duty Cycle	Phase	Peak Amplitude
	A B A-B B-A	A B	A B	A→B B→A	A B	A&B A/B A+B A-B B-A	A B	A&B A/B A+B A-B B-A	A	A rel B B rel A	A B
Automatic											
Automatic	C*	C*		C*	C*	C*			C*	C*	N*
Holdoff											
Edge Holdoff	C	C		C							
Time Holdoff	C	C									
Event Holdoff	C	C									
Sampling											
Interval Sampling	C	C		C	C	C	C*	C*			
Time Sampling					N						
Cycle Sampling					C						
Edge Sampling					C	C	C	C			
Parity Sampling				C							
Repetitive Edge	C	C		C							
Repetitive Edge/Parity				C							
Holdoff/Sampling											
Edge /Interval	C	C		C	C	C	C	C			
Edge/Time					N						
Edge/Edge					C		C	C			
Externally Gated					N		N	N			
Edge/Cycle					C						
Edge/Event			N	N	N						
Edge/Parity				C							
Time/Interval					C		C				
Time/Time			N	N	N						
Event/Interval					C						
Event/Event			N*	N	N						
Manual							N	N			

C = Continuous Measurements (Block/Measurement Arming)
N = Non-continuous Measurement (Start/Stop Arming
* = Default Arming

Arming Categories

Category	Holdoff	Sampling
Automatic	None (Automatic)	Automatic
Holdoff	User-defined	Automatic
Sampling	None (Automatic)	User-defined
Holdoff/Sampling	User-defined	User-defined

6
FRONT PANEL
OVERVIEW

6 FRONT PANEL OVERVIEW

SUMMARY

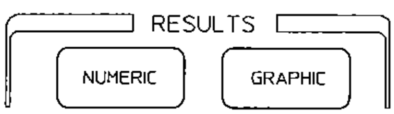
Description of the front panel's functional areas and the use of all the single function and shifted function keys.

FRONT PANEL ORGANIZATION

The HP 5371A 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:

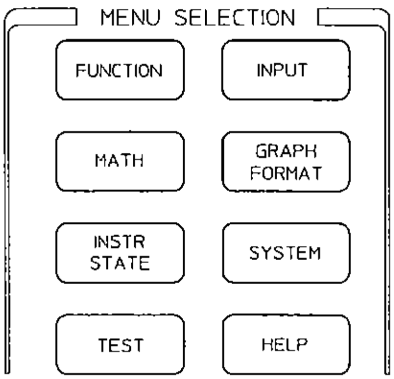
- Results
- Menu Selection
- Data Entry
- HP-IB Status
- Instrument Control
- Cursor/Scroll — Entry/Marker
- Display Screen and Softkeys
- Additional Keys

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 section of the manual.

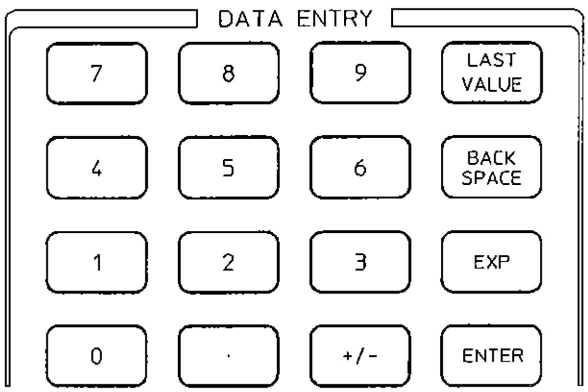
MENU SELECTION AREA



The MENU SELECTION keys are located below the RESULTS keys. The function of each key is discussed in detail in its own section of the manual. A short description of the purpose of each menu selection key is:

- FUNCTION — to select a measurement type and how that measurement will be armed/gated.
- INPUT — to define the trigger event and select input signal conditioning.
- MATH — to select post-processing math, statistics, and limit testing.
- GRAPH FORMAT — Not Used. ALL GRAPH controls are now accessed via the GRAPHIC key. (Earlier firmware versions required use of GRAPH FORMAT for scaling Histogram, Time Variation, and Event Timing graphics.)
- INSTRUMENT STATE — to display the contents of each SAVE/RECALL register and set overwrite protection.
- SYSTEM — to set HP-IB configuration, display concealment, and system clock.
- TEST — to provide diagnostic tests for a service technician when a failure of the instrument is suspected.
- HELP — to provide summarized instrument operating information.

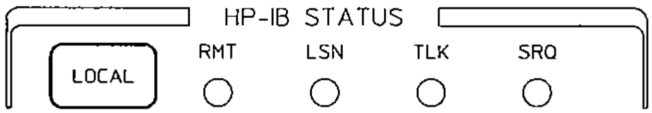
DATA ENTRY AREA



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 sign of number being entered. The change sign key will only apply to the exponent value if "E+00" is displayed.
- Pressing the EXP (exponent) key adds "E+00" to the mantissa 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 LED annunciators make up the HP-IB status area.

LOCAL key

Pressing this key returns the HP 5371A to front panel control when in remote operation. This key is ignored when the Local Lockout mode is enabled.

RMT LED

The RMT annunciator indicates that the HP 5371A is in the remote operating state.

LSN LED

The LSN annunciator indicates that the HP 5371A is addressed to listen or is an active listener.

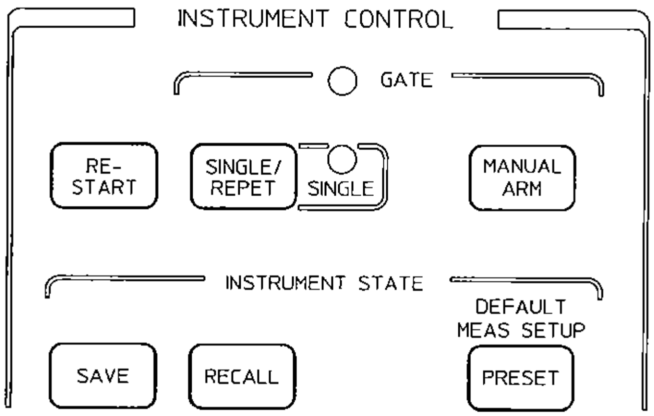
TLK LED

The TLK annunciator indicates that the HP 5371A is addressed to talk or is an active talker.

SRQ LED

The SRQ annunciator indicates that the HP 5371A is requesting service from the interface controller.

INSTRUMENT CONTROL AREA



The Instrument Control keys provide control of data acquisition, the SAVE/RECALL registers, and default setup of the HP 5371A.

GATE LED

The Gate LED comes on when the measurement gate is open, and when the HP 5371A is trying to make a measurement while no input signal is connected to the instrument.

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 selects either the single or repetitive acquisition mode. When the single mode is selected, the SINGLE LED is on. The HP 5371A will execute one measurement sequence as defined on the FUNCTION screen and then stop. Each time the RESTART key is pressed, one measurement sequence will be executed. When in the repetitive mode, the measurement sequence will restart as soon as possible after the previous one ends.

The SINGLE mode is very useful when first configuring the HP 5371A to make a measurement or using the NUMERIC or GRAPHIC screens to view and analyze collected data. Otherwise, when in REPETITIVE mode, the instrument is trying to make a another measurement as soon as the processing for the previous one is completed.

MANUAL ARM key

The MANUAL ARM key has two functions:

1. Provides manual control of the measurement gate for only one measurement and arming mode: Totalize / MANUAL arming mode.

2. Aborts a measurement in progress:

   - if in SINGLE acquisition mode

     AND

   - if the GATE LED is on when the MANUAL ARM key is pressed

     AND

   - if making any measurement other than Peak Amplitude

   In the measurement abort mode, the MANUAL ARM key is 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 measurement sequence requirements. The partial data, collected for the most recent block of measurements, can be viewed on the NUMERIC and GRAPHIC screens. The Histogram graph will display the cumulative data from the start of the measurement sequence to the time of the abort, if the Histogram graph Update option was set to "While" on the GRAPHIC screen. The Update option is only available if the Block Size is set to a value greater than 1.

   A new measurement sequence will begin when the RESTART key is pressed or the instrument is put into REPETITIVE mode. A measurement sequence cannot be aborted between measurement blocks.

Instrument State

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 the PRESET or DEFAULT MEAS SETUP functions are 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 basic 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 instrument conditions.

Table 6-1. HP 5371A Preset State

Function, Mode or Value	Preset State
Measurement Function Measurement Channel	Time Interval Channel A
Arming Mode Block Size Measurement Size	Automatic 1 100
Input Mode	Separate Inputs
Channel A Trigger Slope Channel B Trigger Slope Channel A Bias Level Channel B Bias Level	Positive Positive GND GND
Channel A Attenuation Channel B Attenuation	1:1 (0 dB) 1:1 (0 dB)
Channel A Trigger Mode Channel B Trigger Mode Channel A Manual Trigger Level Channel B Manual Trigger Level Channel A Auto Trigger Level Channel B Auto Trigger Level External Arm Trigger Level	Single Auto Trigger Single Auto Trigger 0 V 0 V 50% of peak-to-peak amplitude 50% of peak-to-peak amplitude 0 V
Math Functions (Chan. A) Math Functions (Chan. B) Statistics (Chan. A) Statistics (Chan. B) Limit testing (Chan. A) Limit testing (Chan. B) Offset Value (Chan. A) Offset Value (Chan. B) Normalize Value (Chan. A) Normalize Value (Chan. B) Scale Value (Chan. A) Scale Value (Chan. B) Reference Value (Chan. A) Reference Value (Chan. B) Upper Limit Value (Chan. A) Lower Limit Value (Chan. A) Upper Limit Value (Chan. B) Lower Limit Value (Chan. B)	Off Off Off Off Off Off 0 0 1 1 1 1 0 0 0 0 0 0
Measurement Memory	Cleared
Acquisition Mode	Repetitive

DEFAULT MEAS SETUP function

This is a shifted function. It involves a two-key sequence. First press the SHIFT key and then press the PRESET key.

When selected, a default instrument setup will be invoked for the current measurement function. This feature is designed to provide the most straightforward setup for any selected measurement function.

The following instrument conditions are invoked by the Default Measurement Setup for all measurement functions:

- The previous instrument setup is saved in SAVE/RECALL register "0".
- Block Size is set to 1.
- Measurement Size is set to 50 (except for Peak Amplitude measurement where the measurement size is 1).
- Channel A Trigger Mode is set to Repetitive Auto Trigger.
- Channel B Trigger Mode is set to Repetitive Auto Trigger.
- Channel A Attenuation is set to 1:1.
- Channel B Attenuation is set to 1:1.
- 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 set to Separate.

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.

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.

Positive Pulse Width:
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.

Negative 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.

Risetime:
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.

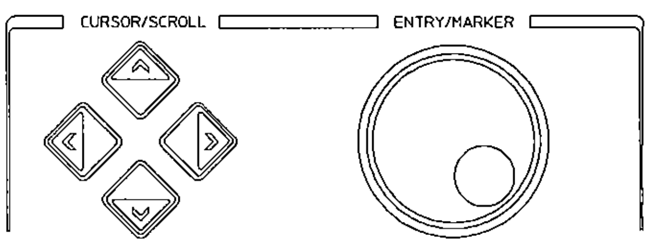
Falltime:
Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 80% (negative slope).
Channel B Trigger Level set to 20% (negative slope).
Input Mode set to Common.

Duty Cycle:
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.

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.

Peak Amplitude
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.

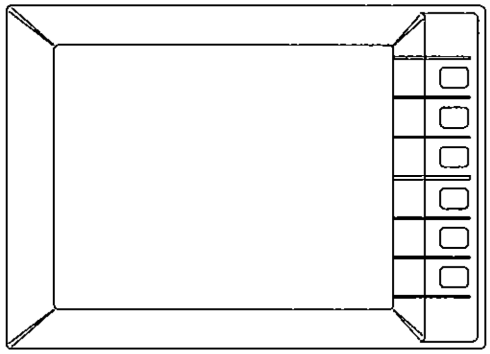
CURSOR/SCROLL – ENTRY/MARKER SECTION



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 displayed graphs on the GRAPHIC screen.

ENTRY/MARKER knob is used to modify numeric field entries by the smallest increment available. The knob is also used to control markers on the GRAPHIC screens and to scroll displayed graphs.

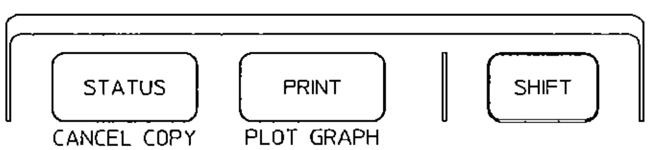
DISPLAY SCREEN AND SOFTKEY AREA



The display and softkey section contains the CRT (cathode ray tube) and 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 200 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 instrument settings. Along with the date and time, the current conditions for the FUNCTION, INPUT, and MATH menu screens are shown on this one screen.

PRINT key

Pressing this key causes the currently displayed screen on the CRT to be sent to an attached HP-IB graphics printer. The following conditions must first be set on the HP 5371A SYSTEM screen:

- Addressing Mode: TALK ONLY
- Print option: DISPLAY

The printer must be set to "LISTEN ONLY". For more information, refer to Section 12, SYSTEM MENU.

SHIFT key

The blue SHIFT key is used along with three other front panel keys to perform additional functions. The three keys are:

- STATUS
- PRINT
- PRESET

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. 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 5371A SYSTEM screen:

- 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 5371A.

POWER-UP CONDITION:

The instrument configuration when the HP 5371A was powered-down will be restored. Three statements describe the condition of the HP 5371A 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 front panel inputs are the Channel A, B, and External Arm.

Channel A and Channel B

The 5371A accepts three types of interchangeable input pods. These pods are the point of entry for signals into the A and B channels of the instrument, unless Option 060 Rear Panel Inputs are installed. The pod used dictates the termination impedance for the channel. All settings related to the Channel A and B inputs are on the FUNCTION and INPUT menu screens.

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.

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 5371A 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.

External Arm

All settings related to the External Arm input are included on the FUNCTION and INPUT menu screens.

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.

A full description of the External Arm input characteristics can be found in Appendix E, SPECIFICATIONS.

7 FUNCTION MENU

7 FUNCTION MENU

SUMMARY

While the FUNCTION screen is selected, the following parameters can be set:

- Measurement type (Time Interval, Frequency, etc.)
- Measurement channel(s)
- Block size (number of times to repeat measurement size)
- Measurement size (number of measurements per block)
- Arming mode

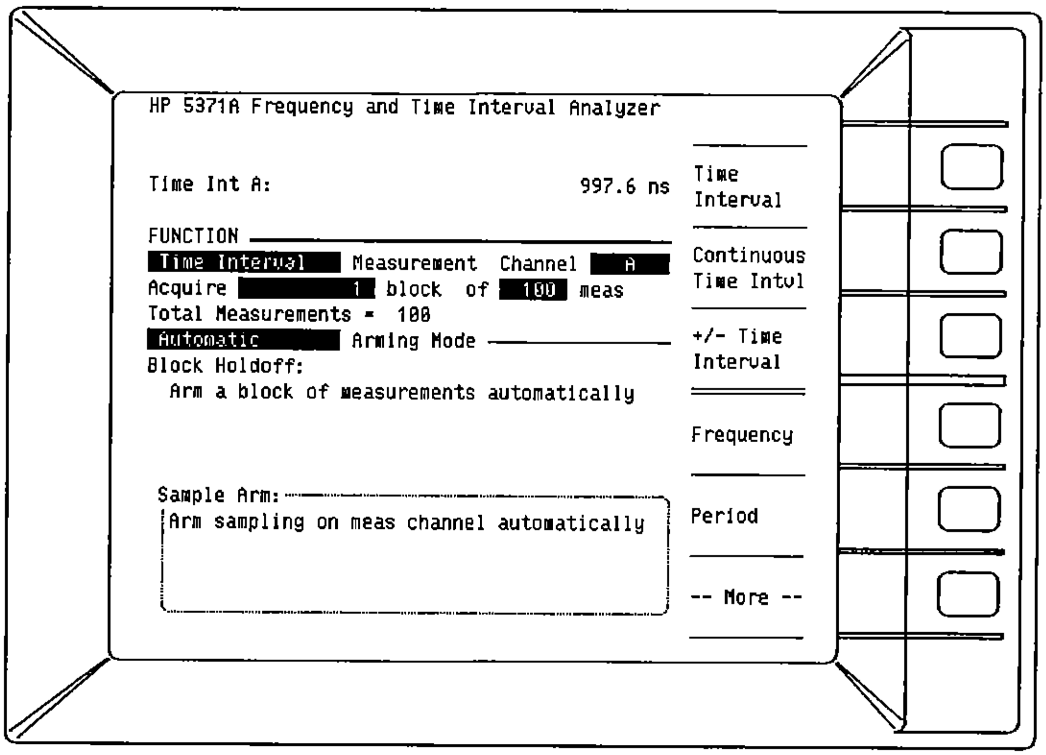


Figure 7-1. FUNCTION Menu Screen

MEASUREMENT FIELD

Description:

Use the measurement field to select the type of measurement the instrument will make.

The HP 5371A can make the following measurements:

- Time Interval
- Continuous Time Interval
- ±Time Interval
- Frequency
- Period
- Totalize
- Rise Time A
- Fall Time A
- Positive Pulse Width A
- Negative Pulse Width A
- Duty Cycle A
- Phase A Relative B
- Phase B Relative A
- Peak Amplitude

Softkey Options:

a) TIME INTERVAL | CONTINUOUS TIME INTVL | ±TIME INTERVAL

b) FREQUENCY | PERIOD | TOTALIZE | RISE TIME | FALL TIME

c) POS PULSE WIDTH | NEG PULSE WIDTH | DUTY CYCLE

d) PHASE | PEAK AMPLITUDE

HP-IB Parameters:

a) TINT|CTIN|PMT

b) FREQ|PER|TOT|RTIME|FTIME

c) PWID|NWID|DUTY

d) PHAS|PEAK

Comments:

Not all measurement channels and arming mode combinations are available for all measurements. Consult Section 2, 3, or 4 for a listing of the channel/arming combinations available for the measurement you want to make.

There is interaction between the different fields of this menu. The measurement selection determines the available softkey options for Channel(s) and Arming Mode.

CHANNEL FIELD

Description:

The Channel field is used to select the input channel, or channels, upon which to make the measurement.

Softkey Options:

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:

A|B|(A&B)|(A/B)|(B/A)|(A+B)|(A–B)|(B–A)|(A>B)|(B>A)|(A<B)|(B<A)

Comments:

Available channel options are determined by the selection of measurement and arming mode. Not all channel options are available for all measurements. Only the available options for the selected measurement and arming mode will appear in the softkey area.

BLOCK FIELD

Description:

The block field is used to set the number of blocks of measurements to be collected for any measurement setup. The number of measurements per block is set in the "meas" field. The total number of measurements = number of blocks × number of measurements per block.

Options:

The "block" field is a numeric field. Only numbers can be entered in this field. Use the DATA ENTRY keypad to enter numbers or modify the existing number using the ENTRY/MARKER knob.

Range=1 to 2,000,000,000 (Total measurements cannot exceed 2,000,000,000)

HP-IB Command:

BLOC <n>

where<n>= 1 to 2,000,000,000 (Total measurements cannot exceed 2,000,000,000)

MEAS FIELD

Description:

The "meas" field is used to set the number of measurements in a block. The total number of measurements = number of blocks x the number of measurements per block.

Options:

The "meas" field is a numeric field. Only numbers can be entered in this field. Use the DATA ENTRY keypad to enter numbers or modify the existing number using the ENTRY/MARKER knob.

Range=1 to 1000 (Total measurements cannot exceed 2,000,000,000)

The "meas" field sets the number of measurements to be collected per block.

HP-IB Command:

MSIZ <n> or SSIZ <n>

where<n>=1 to 1000 (Total measurements cannot exceed 2,000,000,000)

ARMING MODE FIELD

Description:

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 Section 5, ARMING.

Softkey Options:

a) AUTOMATIC

Holdoff modes—

b) EDGE HOLDOFF | TIME HOLDOFF | EVENT HOLDOFF

Sampling Modes—

c) INTERVAL SAMPLING | TIME SAMPLING | CYCLE SAMPLING

d) EDGE SAMPLING | PARITY SAMPLING | REPETITIVE EDGE

e) REPETITIVE EDGE/PARITY

Holdoff/Sampling modes—

f) EDGE/INTERVAL | EDGE/TIME | EDGE/EDGE | EXTERNALLY GATED

g) EDGE/CYCLE | EDGE/EVENT | EDGE/PARITY | TIME INTERVAL

h) TIME/TIME | EVENT/INTERVAL | EVENT/EVENT | MANUAL

HP-IB Parameters:

a) AUTO

Holdoff modes—

b) EDH | THOL | EVH

Sampling Modes—

c) ISAM | TSAM | CSAM

d) ESAM | PSAM | REDG

e) RPAR

Holdoff/Sampling modes—

f) EDIN | EDT | EDED | EGAT

g) EDCY | EDEV | EDP | TINT

h) TTIM | EVIN | EVEV | MAN

8 INPUT MENU

8 INPUT MENU

SUMMARY

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

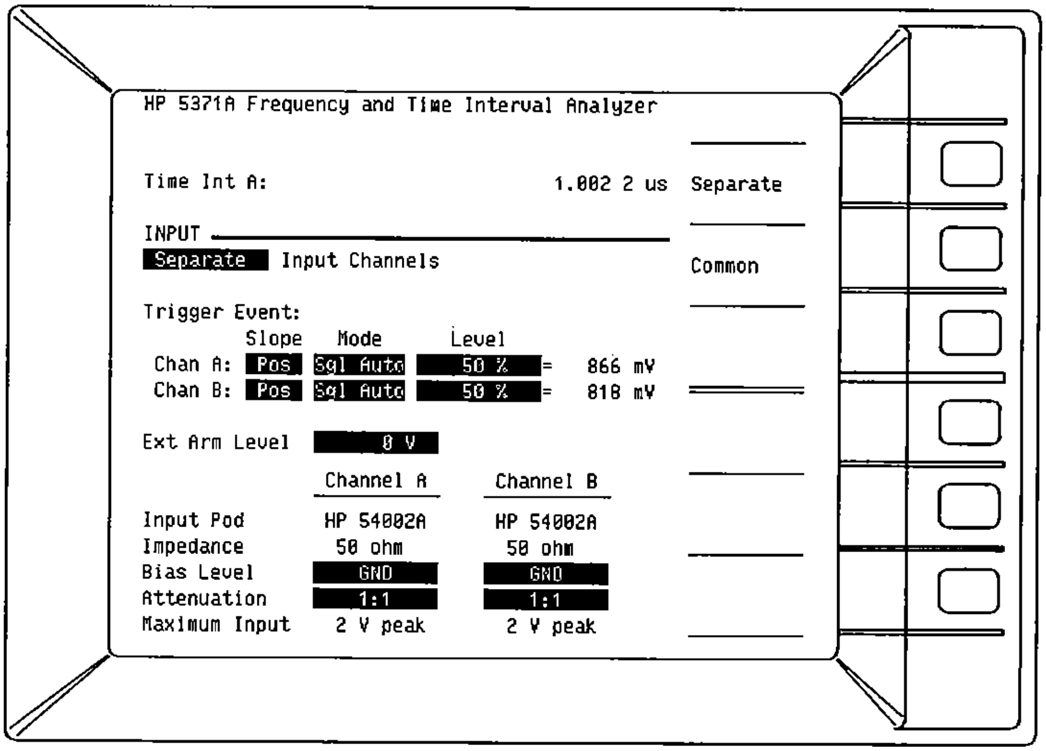


Figure 8-1. INPUT Menu Screen

INPUT CHANNELS FIELD

Description:

The Input Channels are Channel A and Channel B. They can be set to SEPARATE or COMMON.

SEPARATE: The Channel A and B input signals are connected to their respective input circuitry.

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.

NOTE

When the Input Channels are set to COMMON, the limits for the Channel B Trigger Event parameters (slope, mode, and level settings) are determined by the 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}

Comment:

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/Fall Time, Positive/Negative Pulse Width, 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

Description:

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 "POS" setting indicates that the trigger point will be on a rising voltage. Likewise, the "NEG" setting indicates that the trigger point will be on a falling voltage.

Softkey Options:

POS, NEG

HP-IB Command:

SLOP {POS | NEG}

Trigger Mode

Description:

Trigger Mode is the method the HP 5371A 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. For input frequencies greater than 200 MHz, auto triggering modes are functional, but accuracy specifications are not guaranteed.

MANUAL TRIGGER

If 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 Vdc. Values can be entered using the DATA ENTRY keypad or the ENTRY/MARKER knob.

1:1 Attenuation Range = –2.0 Vdc to +2.0 Vdc in 2 mV steps NOMINAL

2.5:1 Attenuation Range = –5.0 Vdc to +5.0 Vdc in 5 mV steps NOMINAL

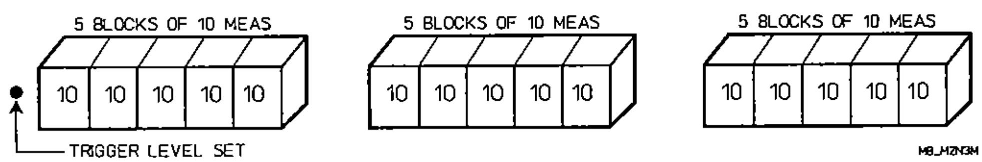
SINGLE AUTO TRIGGER

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:

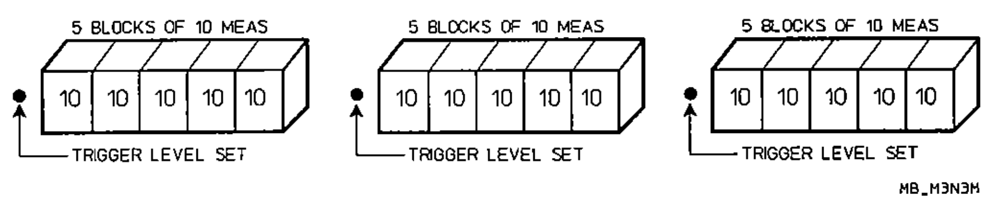
- whenever the Single Auto Trigger function is selected
- any time a measurement sequence restarts as a result of changing any parameter on the Function or Input menus
- whenever the **Restart** key is pressed
- prior to the start of every measurement sequence, when the Single/Repetitive acquisition 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

Description:

Trigger Level is the voltage at which the input signal will trigger the HP 5371A.

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 voltage on the INPUT menu screen. The default percentage is 50%.

Select the Manual trigger mode and a specific voltage value can be entered into the Level field using 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 Vdc to +2.0 Vdc (in 2 mV steps) for 1:1 Attenuation

–5.0 Vdc to +5.0 Vdc (in 5 mV steps) for 2.5:1 Attenuation

Default is 0 Vdc.

HP-IB Command:

RLEV <number> (specify an auto trigger level as a percentage)

LEV <number> (specify a manual trigger level)

EXT ARM LEVEL FIELD

Description:

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 to is 0 Vdc.

Range = dc coupled, 0 to 100 MHz

Softkey Options:

0 V | TTL Preset [1.4 V] | ECL Preset [–1.3 V]

HP-IB Command:

LEV <number>

INPUT POD and INPUT POD IMPEDANCE

The HP 5371A uses removable input pods that can be chosen according to the type of measurement application. This instrument recognizes which model pod is installed and displays the pod model number and impedance. The termination impedance for the Channel A and B inputs is dictated by the specific input pod used. See the input pod information below.

CAUTION

Do not remove an input pod while the HP 5371A 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

- HP 54002A 50Ω BNC Input Pod

  This pod will terminate a 50Ω coaxial cable. Two of these pods come standard with the HP 5371A. 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

Description:

For the 50Ω standard input pod, either a 0 volt (GND) or a –2 volt (ECL) termination voltage may be specified. The BNC input connector remains connected to ground. The –2 volt termination preserves the characteristics of high-speed ECL circuits. When any other pod is installed, the GND termination is automatically selected.

Softkey Options:

GND [0 V] | ECL [–2 V]

HP-IB Command:

BIAS {GND | ECL}

ATTENUATION FIELD

Description:

Increased attenuation allows the HP 5371A to measure a signal that would otherwise exceed the operating range of the instrument. It may also be used in some circumstances to improve the noise immunity of the measurement. (Refer to Appendix D, MEASUREMENT SUGGESTIONS.) Two attenuation values are available:

- 1:1 (0 dB), which is effectively 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.

Softkey Options:

1:1 | 2.5:1

HP-IB Command:

ATT {X1 | X2}

CAUTION

Be careful when connecting signals to the HP 5371A. 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 V with attenuation set to 1:1, or ±5 V with attenuation set to 2.5:1.

9 MATH MENU

9 MATH MENU

SUMMARY

While the MATH screen is selected, the following features can be set:

- Reference setting
- Statistics
- Math processing
- Limit testing

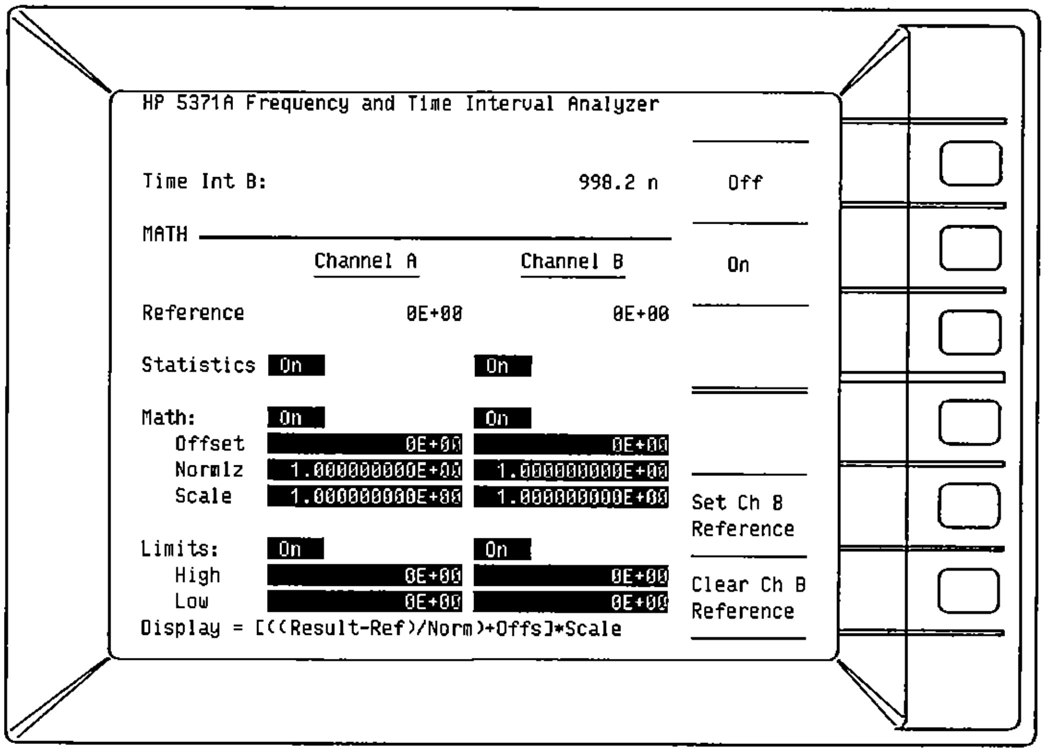


Figure 9-1. MATH Menu Screen

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 A+B	A
Period B/A	A
Phase B rel A	A

REFERENCE

Description:

A reference value is a value subtracted from measurements before any math processing or display of results.

The reference value remains in effect until it is cleared by the Clear Channel Reference softkey. The reference value is the statistical mean of a group of measurements or the last measured value. For example, if Statistics are on, pressing the Set Ch A Reference function will enter the statistical mean of the last group of Channel A measurements as the reference value. If Statistics are off, pressing Set Ch A Reference after a measurement will enter the last measured value on Channel A as the reference value. Until the reference value is cleared, it will be subtracted from every measurement result before display. If a particular value needs to be subtracted from the measured value, use the Offset function in Math processing. One use for Reference is for canceling 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

HP-IB Command:

SREF

CREF

Comment:

When Set Reference is selected, with Math processing and Statistics already enabled, the statistical mean used as the reference value is the mean of the measurement results before any math processing.

The Reference values do not affect the Event Timing graph results.

STATISTICS FIELD

Description:

The HP 5371A can compute statistics for all measurement functions. The parameters computed include:

- Minimum of sample
- Maximum of sample
- Mean of sample
- Variance of sample
- Standard Deviation of sample
- Allan Variance of sample
- Root Allan Variance of sample
- Root Mean Square of sample

These functions are enabled as a group when Statistics is set to ON. When using HP-IB remote control, selected values can be retrieved.

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.

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

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

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. 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 —

$$\text{Allan Variance} = \frac{\sum_{i=2}^{N} (X_i - X_{i-1})^2}{2(N-1)}$$

ROOT ALLAN VARIANCE —

$$\text{Root Allan Variance} = \sqrt{\text{Allan Variance}}$$

RMS —

$$\text{RMS} = \sqrt{\frac{\sum_{i=1}^{N} X_i^2}{N}}$$

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:

- Xi = 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:

MIN? | MAX? | MEAN? | VAR? | SDEV? | AVAR? | RAV? | RMS?

Comment:

If math processing is enabled, (i.e., offset, normalize, scale), statistical calculations are performed on the measurement data after the math processing has completed.

Individual statistical values can be retrieved only via HP-IB commands. Otherwise, all values are available. Higher data transfer rates are possible when only a single statistical value is requested.

MATH FIELD

Description:

The HP 5371A normally displays the result of time interval, frequency, and period 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 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 instrument measurement modes. The math operators act on the measured results after any Reference Value is subtracted, but before other post-processing operations such as statistics, limit checking, and graphics displays.

Math processing is enabled or disabled separately for Channels A and B. Specific math operations are also set separately for the two 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:

Displayed Result = [((Result - Reference)/Normalize) + Offset] x Scale

Offset Field

OFFSET — The offset function is used to add (or subtract) a specified constant to the measurement.

Default Value = 0

Negative Range: $-1E+12 \leq n \leq -1E-12$

Positive Range: $+1E-12 \leq n \leq +1E+12$ and 0

Resolution = 1E-12

Normalize Field

NORMALIZE — The normalize function divides the measured value by a specified constant.

Default Value = 1

Negative Range: $-1E+12 \leq n \leq -1E-12$

Positive Range: $+1E-12 \leq n \leq +1E+12$

Resolution = 1E-12

Scale Field

SCALE — The scale function multiplies a measurement by a specified scaling factor.

Default Value = 1

Negative Range: $-1E+12 \leq n \leq -1E-12$

Positive Range: $+1E-12 \leq n \leq +1E+12$ and 0

Resolution = 1 E-12

HP-IB Command:

NORM <number>

OFF <number>

SCAL <number>

Comment:

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:

  Value = [(Result / Normalize) + Offset] x Scale

  Value = [(4.0 / 1) + 5.0] x 1.5 = 13.5

  The scale factor multiplies the result after the offset is added.

- Multiplication by 1.5 before the offset:

  Value = [(Result / Normalize) + Offset] x Scale

  Value = [(4.0 / .6666667) + 5.0] x 1 = 11

  The reciprocal of the number (1 / 1.5) used as the normalization constant will effectively multiply the result by that number 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.

The Math operations do not affect the Event Timing graph results.

Limits Field

Description:

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 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.

Negative Range: $-1E+12 \le n \le -1E-12$

Positive Range: $+1E-12 \le n \le +1E+12$, and 0.

Resolution: 1E–12

Softkey Options:

On | Off

M | k | m | u | n

HP-IB Command:

LIM {ON | OFF}

HLIM <number>

LLIM <number>

10 GRAPH FORMAT MENU

10 GRAPH FORMAT MENU

SUMMARY

If pressing the GRAPH FORMAT key causes the HP 5371A display to resemble that shown in *Figure 10-1,* all graph controls are accessed via the GRAPHIC key. GRAPHIC key functions are described in Section 16 of this manual. Update, View Channel are Display Options. Manual Scaling features are part of the Scaling Options.

Earlier firmware versions did not produce the message shown in *Figure 10-1* and required the use of GRAPH FORMAT key for scaling Histogram, Time Variation, and Event Timing graphics.

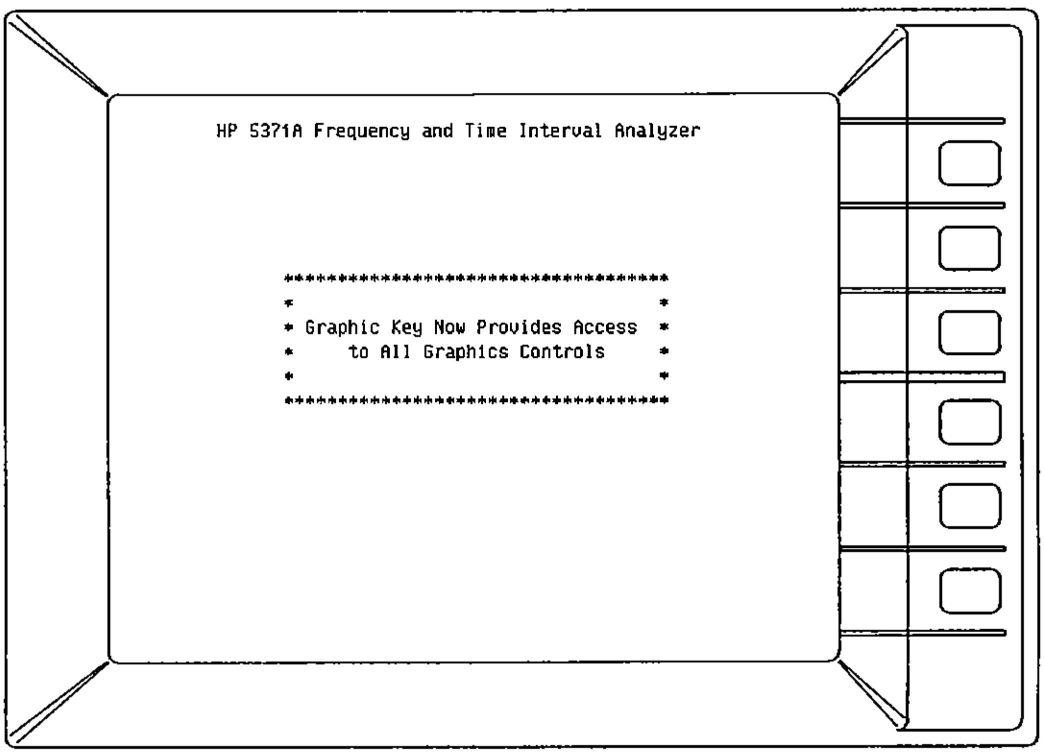


Figure 10-1. GRAPH FORMAT Display

11 INSTRUMENT STATE MENU

11 INSTRUMENT STATE MENU

SUMMARY

While the INSTRUMENT STATE screen 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.)
- Arming description for each of the stored front panel measurement setups.
- The date and time that each front panel setup was saved.

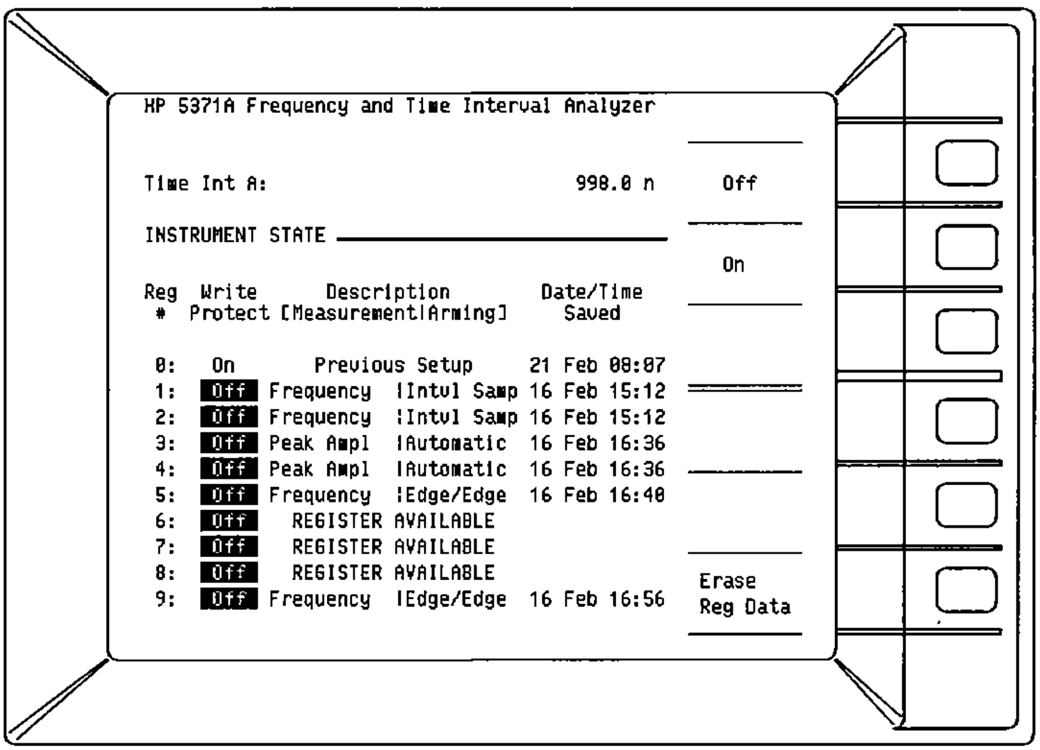


Figure 11-1. INSTRUMENT STATE Menu Screen

INSTRUMENT STATE SCREEN

The Instrument State menu is a listing of all currently stored instrument 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 functions are 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.

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 measurement and the arming mode for the stored instrument setup.

Date/Time Saved

The date and time a front panel setup was saved.

Erase Register Data softkey

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 zero 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 state:

- Measurement Setup Parameters
  - Measurement function
  - Measurement source channel
  - Measurement size
  - Block size
  - Arming mode (including all channels, slopes, and delays)

- Input Setup Parameters
  - Input mode (Separate/Common)
  - Slope (for each channel)
  - Trigger mode (for each channel)
  - Trigger level (for each channel)
  - Bias level (for each channel)
  - Attenuation (for each channel)
- Math Setup Parameters
  - Reference value (for each channel)
  - Statistics on/off status (for each channel)
  - Math on/off status (for each channel)
  - Offset value (for each channel)
  - Normalize value (for each channel)
  - Scale value (for each channel)
  - Limits on/off status (for each channel)
  - High Limit value (for each channel)
  - Low Limit value (for each channel)
- Numeric Results
  - Display mode (Numeric Results screen)
  - Expand Data on/off status
- System Menu Parameters
  - Result format
  - Measurement timeout status
  - Measurement timeout value
- Graphic Results
  - 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

12 SYSTEM MENU

12 SYSTEM MENU

SUMMARY

While the SYSTEM screen is selected, the following features can be set:

- HP-IB configuration for computer control of the HP 5371A
- HP-IB configuration for screen prints and plots without the need for an HP-IB controller
- Timeout limit
- System clock
- Display concealment

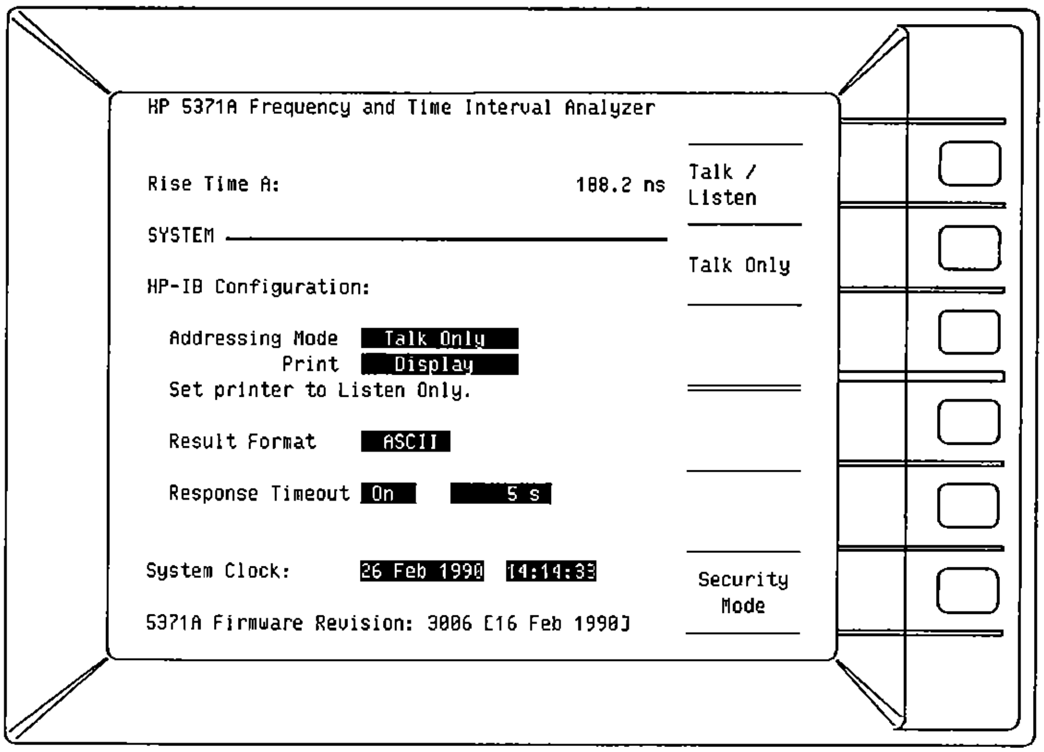


Figure 12-1. SYSTEM Menu Screen

HP-IB CONFIGURATION

The HP-IB Configuration consists of setting the conditions that allow external control of the HP 5371A, or the copying of instrument display screens to a printer or plotter. Only GRAPHIC screens can be plotted and the printer or plotter should be set to Listen Only.

Addressing Mode Field

Description:

The Talk/Listen mode sets the HP 5371A to respond to interface messages and programming commands. Interface messages consist of routine communications between the instrument and controller necessary for bus management. Programming commands are instructions to the instrument to perform some function particular to that instrument.

The Talk Only mode allows the HP 5371A 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

Device Address/Print Field

Description:

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 5371A. 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 5371A send measurement results to the attached printer whenever measurements are acquired. The type of measurement result information that is sent to the printer is determined by the NUMERIC display screen selected at the time of the measurement. For example, if you want strictly measurement results, select the Result display screen on the NUMERIC menu before starting the measurement sequence. All screens can be printed, but only GRAPHIC screens can be plotted.

Softkey Options:

For Device Address field: INCREMENT | DECREMENT

For Print Source field: DISPLAY | MEAS RESULT

HP-IB Command:

Device address cannot be programmed.

For Print Source field: PSO {DISP | MEAS}

Result Format Field

Description:

There are three result formats for the output of measurement data from the HP 5371A. The formats are summarized here. For a full explanation of these output formats and how to use them, see Programming Manual, Section 1, HP-IB.

a) **ASCII**

The ASCII measurement format sends processed measurement data. This is the most complete and general format, but the slowest.

b) **Floating Point**

The Floating Point measurement format sends processed data but in a more efficient format than ASCII mode. As a result, the transfer rate is faster than ASCII mode, but slower than Binary mode.

c) **Binary**

The Binary measurement format sends unprocessed measurement data to an HP-IB controller. This is the fastest output mode. The data is made up of the raw numbers from the counting hardware.

NOTE

With Result Format set to "BINARY," the HP 5371A 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

Description:

The Response Timeout field is used to set a time limit on how long the HP 5371A 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 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 = 1 to 36000 seconds, the default value is 5 seconds.

HP-IB Command:

MTST {ON | OFF}

MTV <number>

SYSTEM CLOCK FIELD

Description:

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>

Comment:

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

Description:

The display screen shows the firmware revision resident in your HP 5371A. 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 5371A, and the date code of the installed firmware revision)

SECURITY MODE SOFTKEY

The Security Mode softkey is used to disable the front panel and blank the display for classified applications. Press Security Mode softkey, then press Lock Panel/Blank Dsp softkey. This key sequence enables the Front Panel Security Mode.

When in this security mode, the front panel display is blanked, except for the instructions for enabling the keyboard and display. 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. The security mode is retained during instrument power-down, and can be exited only by entering the access code, 1 7 3 5.

13 TEST MENU

13 TEST MENU

SUMMARY

While the TEST screen is displayed, the following features are available:

- Instrument Self-Test
- Hardware diagnostic tests
- Memory diagnostic tests
- CRT diagnostic tests and adjustments
- Calibration routine

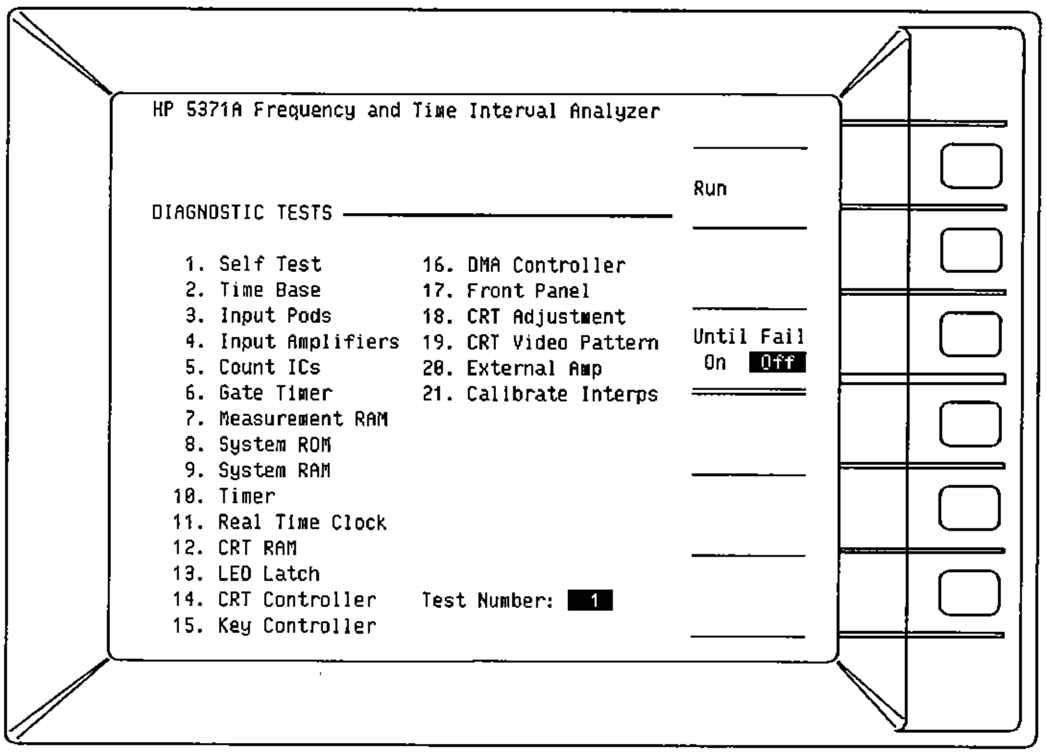


Figure 13-1. TEST Menu Screen

DIAGNOSTIC TESTS

Description:

The HP 5371A 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 5371A Service Manual for complete information on these diagnostic tests.

Softkey Options:

RUN | PAUSE | UNTIL FAIL | STOP

HP-IB Command:

TEST <number> (1 to 21) — Run Test

PAUS — Pause Test

CONT — Continue Test

UFA {ON | OFF} — Run Until Fail

Comment:

RUN starts the selected test, or continues 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 screen.

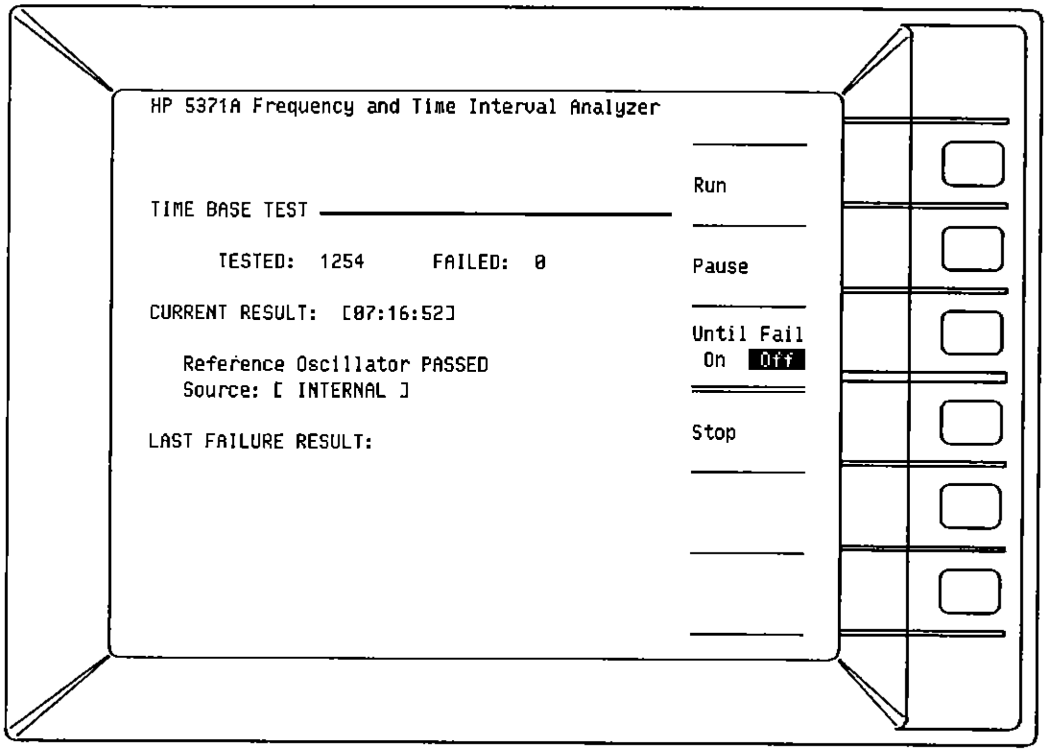


Figure 13-2. Diagnostic Test Screen

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, if UNTIL FAIL set to "Off." 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

a) When the TEST screen is called up, you will notice that one of the tests is highlighted by the menu cursor. This test will execute if the RUN softkey is pressed.

b) If you want to run a different test, move the menu cursor to that new test, or enter the test number in the Test Number field using the numeric keys.

c) 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.

d) The test can be temporarily halted by pressing the PAUSE softkey. This will suspend the test and freeze messages on the CRT display.

e) Press the RUN softkey to resume the test.

f) 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 the power-up initialization. If any failures are detected, messages will be displayed on the CRT screen. The following tests are executed during power-up:

- System RAM Test
- Backup RAM Test
- CRT RAM Test
- Front Panel Controller Initialization Test
- System ROM Test
- Timer Test
- Real-time Clock Test
- CRT Controller Test
- DMA Test
- LED Latch Test
- Time Base Test
- Count ICs Test
- Measurement RAM Test
- Gate Timer Test
- Input Amplifier Test
- Input Pod Test

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 find out some 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?

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 #17: 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.

14 HELP MENU

14 HELP MENU

SUMMARY

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

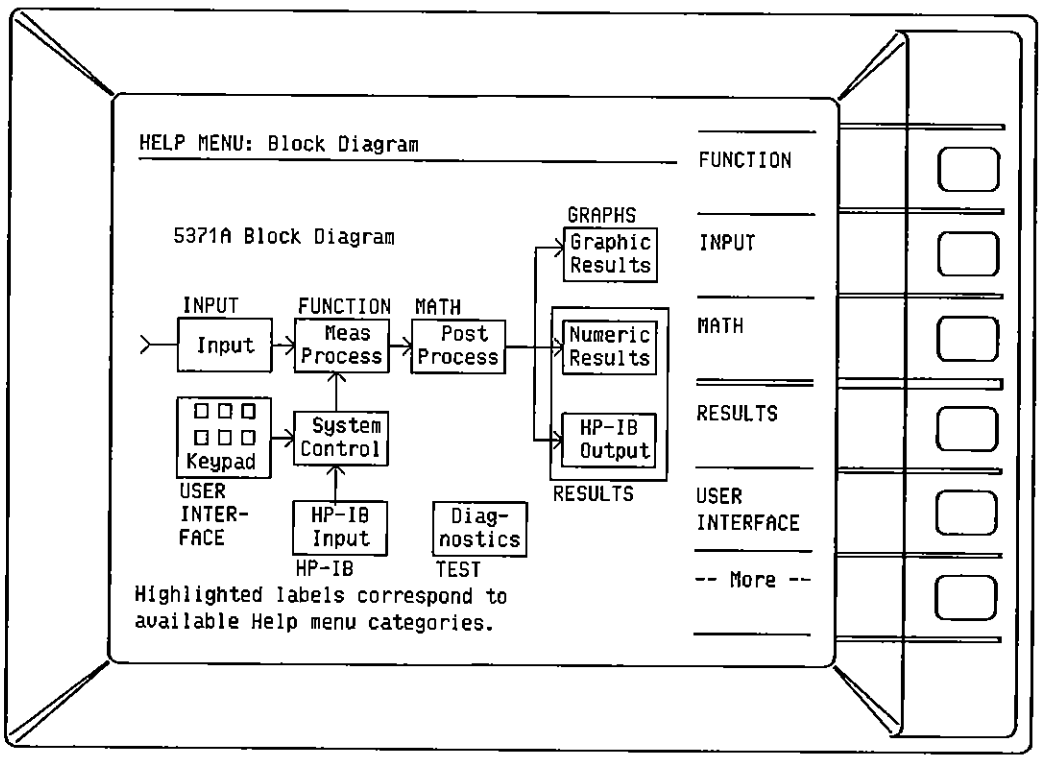


Figure 14-1. HELP Menu Screen

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

- Arming Overview
- Valid Arm Options
- Meas Size/Block Size
- Automatic Arming
- Sampling Arming
- Holdoff Arming
- Holdoff/Sampling Arming

For more information: Operating Manual, Section 5, ARMING

INPUT

- Input Channels
- Input Trigger
- Input Characterization
- Input Separate/Common

For more information: Operating Manual, Section 8, INPUT MENU

MATH

- Math modifiers/Statistics
- Limits/Reference

For more information: Operating Manual, Section 9, MATH MENU

RESULTS

- Numeric Screens

For more information: Operating Manual, Section 15, NUMERIC RESULTS

- ASCII Output
- Floating Point Output
- Binary Output

For more information: Programming Manual, Section 1, HP-IB

USER INTERFACE

- User Interface

For more information: Operating Manual, Section 1, GETTING STARTED

- Numeric Entry
- Other Keys

  For more information: Operating Manual, Section 6, FRONT PANEL OVERVIEW

- Errors

  For more information: Operating Manual, Appendix C, STATUS AND ERROR MESSAGES

Instrument State

For more information: Operating Manual, Section 11, INSTRUMENT STATE MENU

GRAPHS

- Graphics Overview
- Marker Features
- Zoom Features
- Display Features

  For more information: Operating Manual, Section 16, GRAPHIC RESULTS

HP-IB

- Command Structure

  For more information: Programming Manual, Section 2, HP-IB PROGRAMMING COMMANDS

- Status Byte
- Event Status Register
- Hardware Status Register

  For more information: Programming Manual, Section 1, HP-IB

TEST

- Test

  For more information: Operating Manual, Section 13, TEST MENU

15 NUMERIC RESULTS

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 (BLOCK SIZE)
- 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 or Math menu screen.

RESULT DISPLAY

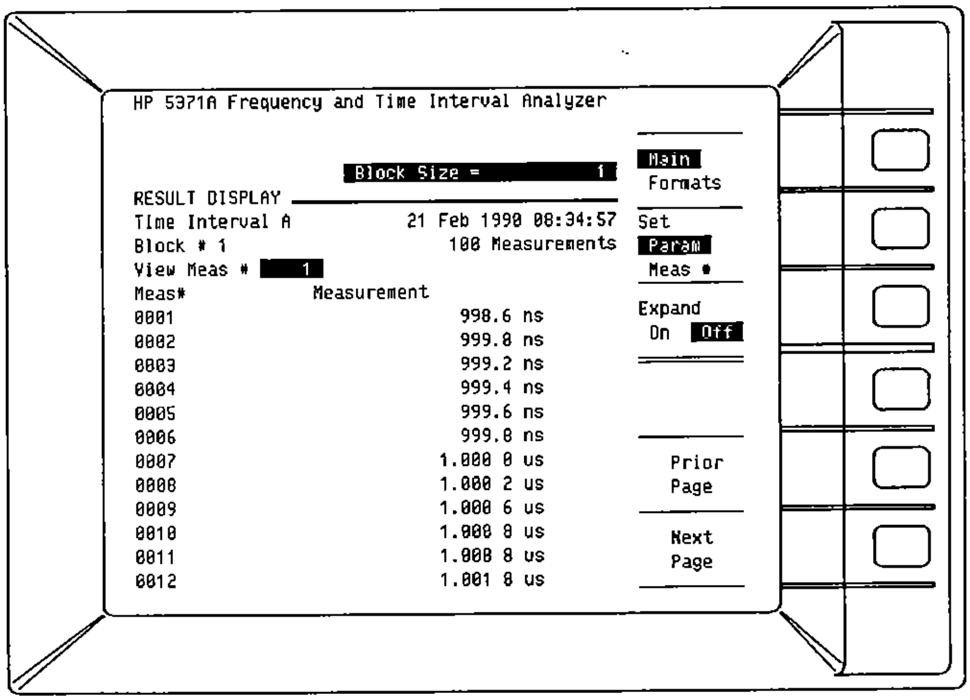


Figure 15-1. Result Display

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, period, or totalize measurements, the time over which the measurement was acquired is displayed. Since the HP 5371A 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 3.)

- 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 2.)

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.

When "View Meas #" is highlighted, you can use the ENTRY/MARKER knob to scroll through measurement numbers and data.

STATISTICS DISPLAY

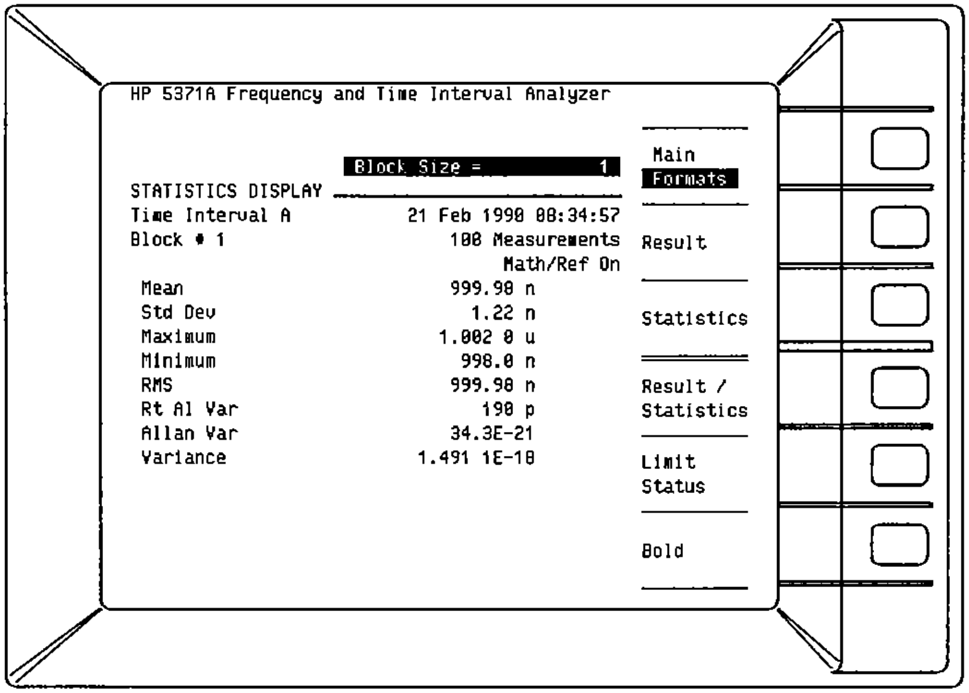


Figure 15-2. Statistics Display

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

RESULT/STATISTICS DISPLAY

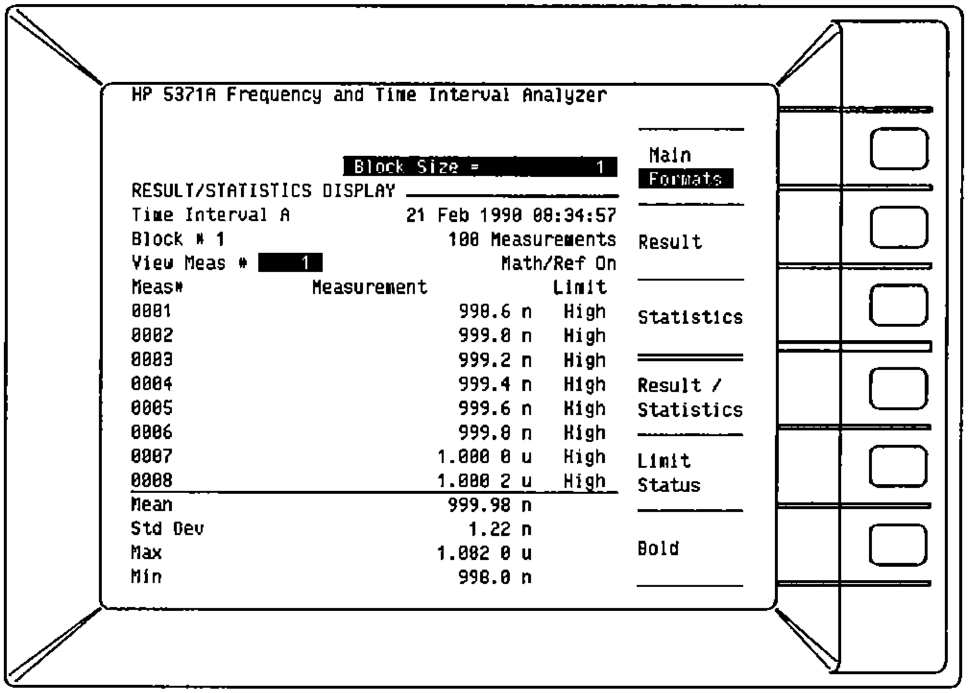


Figure 15-3. Result/Statistics Display

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

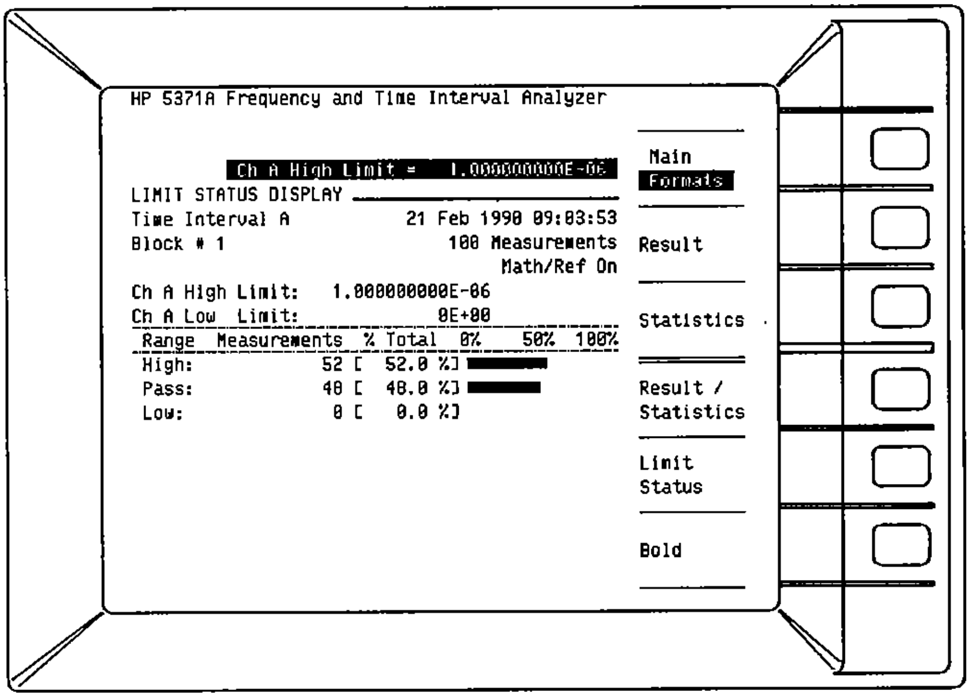


Figure 15-4. Limit Status Display

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

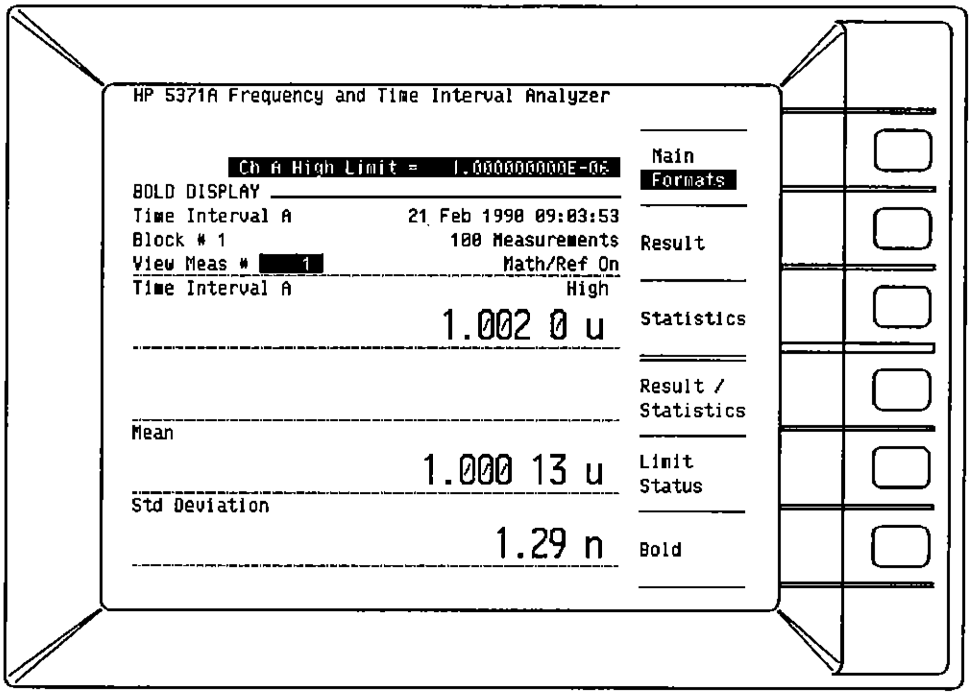


Figure 15-5. Bold Display

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.

16 GRAPHIC RESULTS

16 GRAPHIC RESULTS

CHAPTER OVERVIEW

This chapter describes the graphics features for analyzing the data collected by the HP 5371A. 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.
- 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.

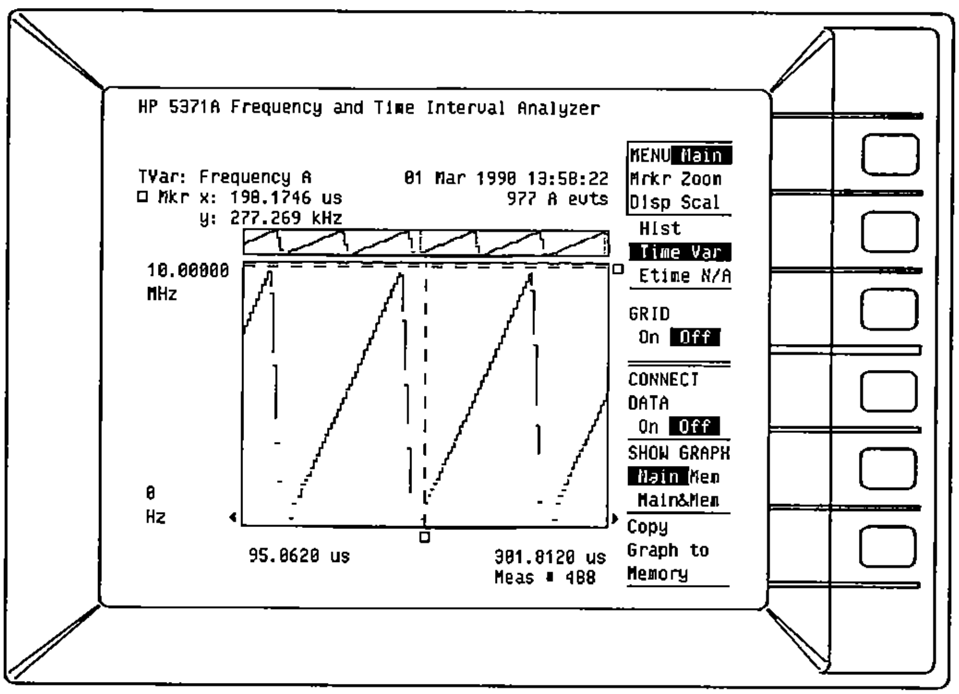


Figure 16-1. Main Menu for a Time Variation Graph

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.

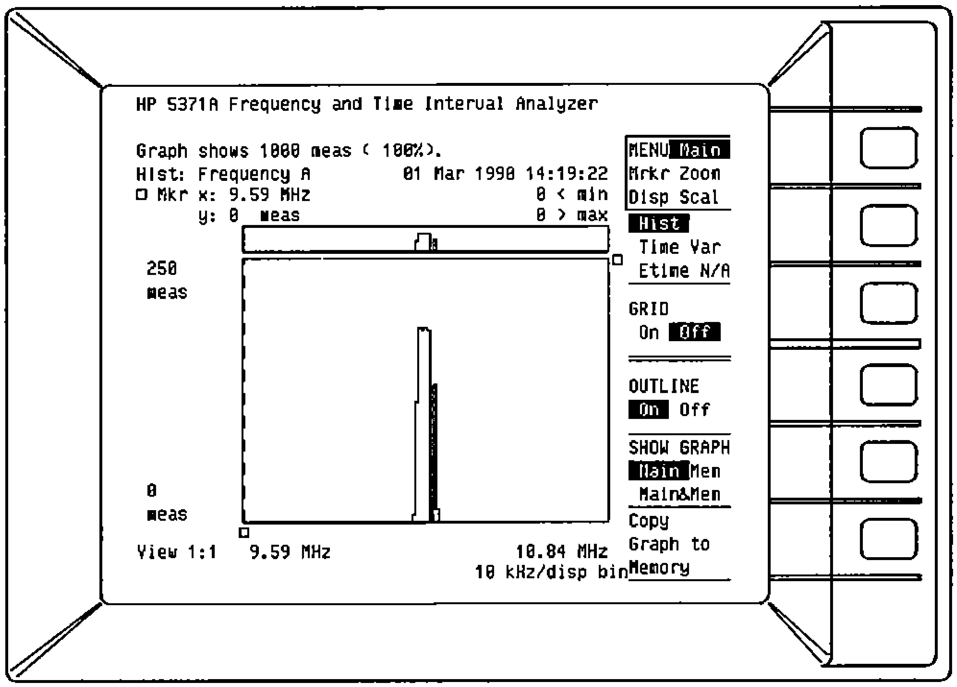


Figure 16-2. Main Menu Options

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 Frequency, Period, Totalize, and Phase measurement functions.

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 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 case is:

> There is no connecting line between measurements on either side of an invalid measurement result (1E+38).

- 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.

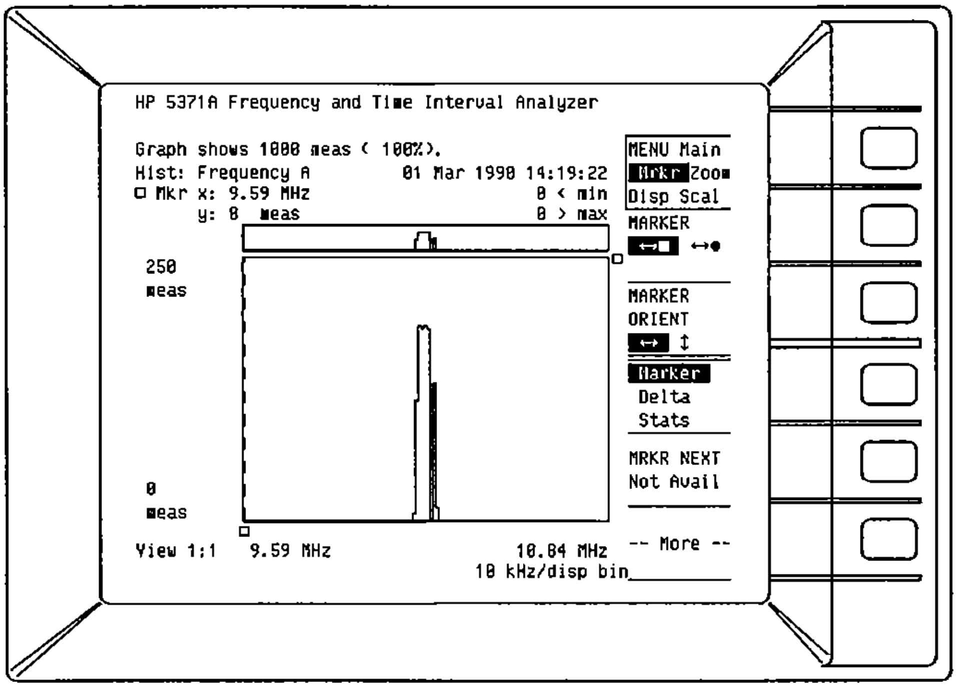


Figure 16-3. Marker Options Menu

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 below.

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 5371A 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, 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 5371A 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.

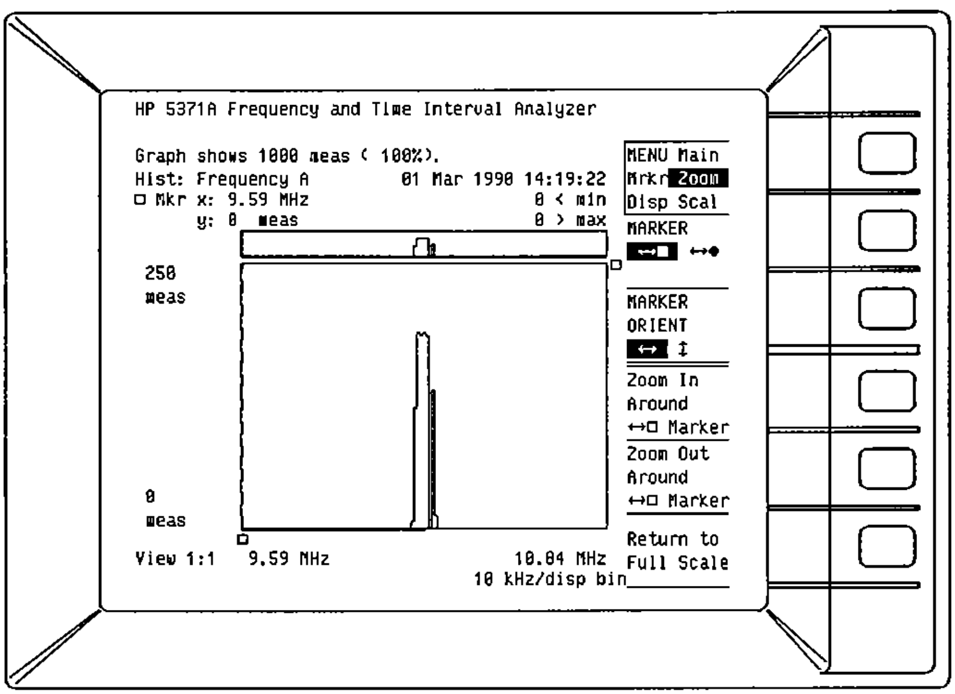


Figure 16-4. Zoom Options Menu

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.

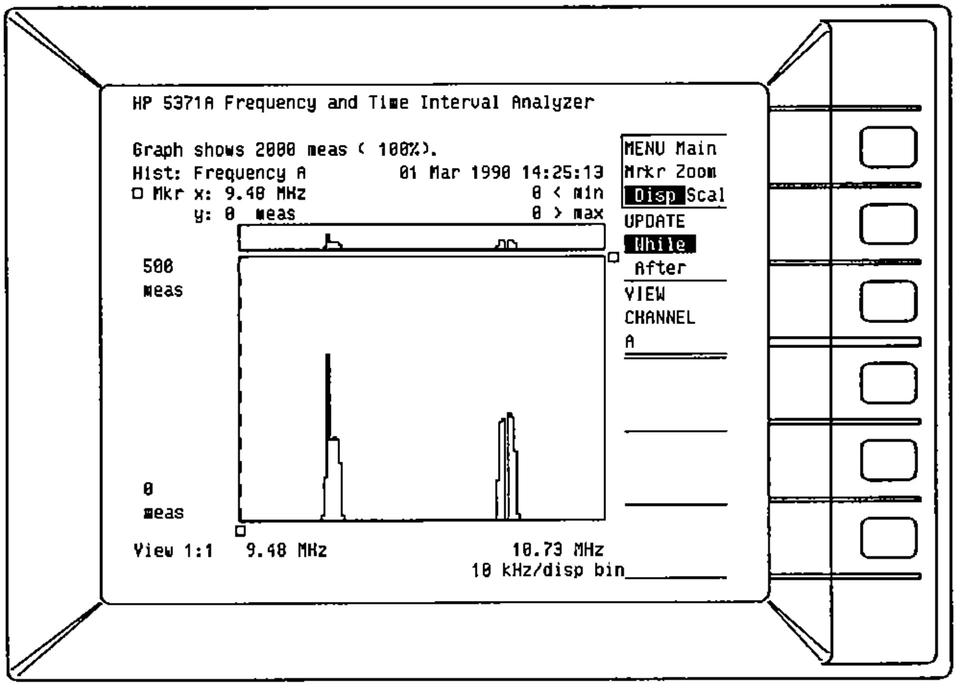


Figure 16-5. Display Options Menu

Update

UPDATE
While
After

This feature is available in the following instances:

- for Histogram graphs when the measurement sequence is multi-block. 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.
  1. UPDATE While will cause each block of data to be displayed as it is acquired. There is no accumulation of data across blocks.
  2. UPDATE After will cause only the last block of the measurement sequence to be displayed.

View Channel

VIEW
CHANNEL
A B

Use this softkey to select the channel to graph when making dual-channel, dual-result measurements. These are:

- Frequency A&B,
- Period A&B,
- 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.

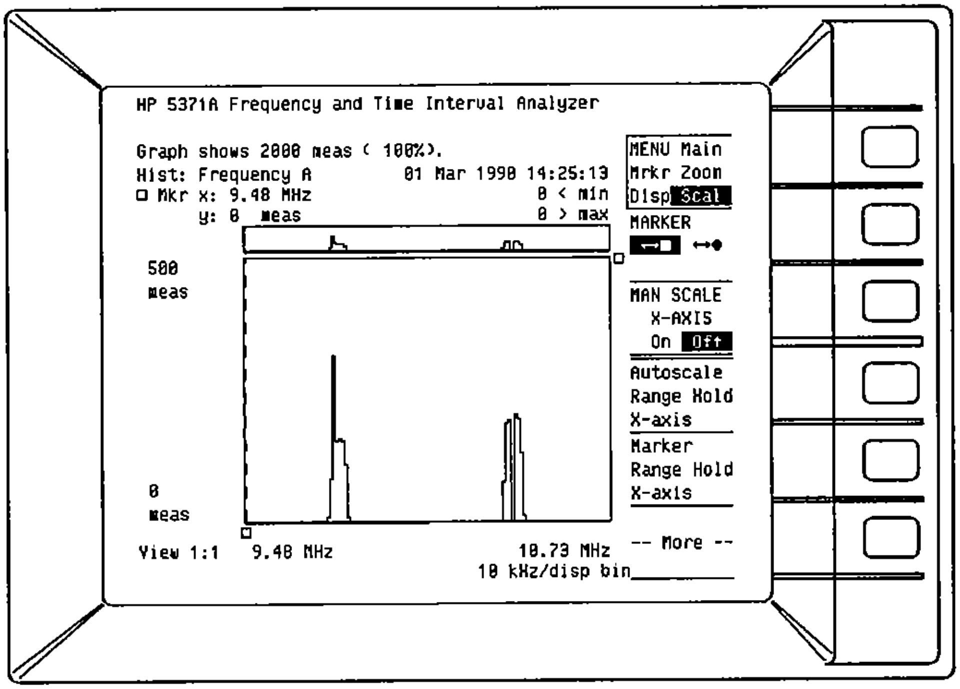


Figure 16-6. Scaling Options Menu

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 5371A 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.

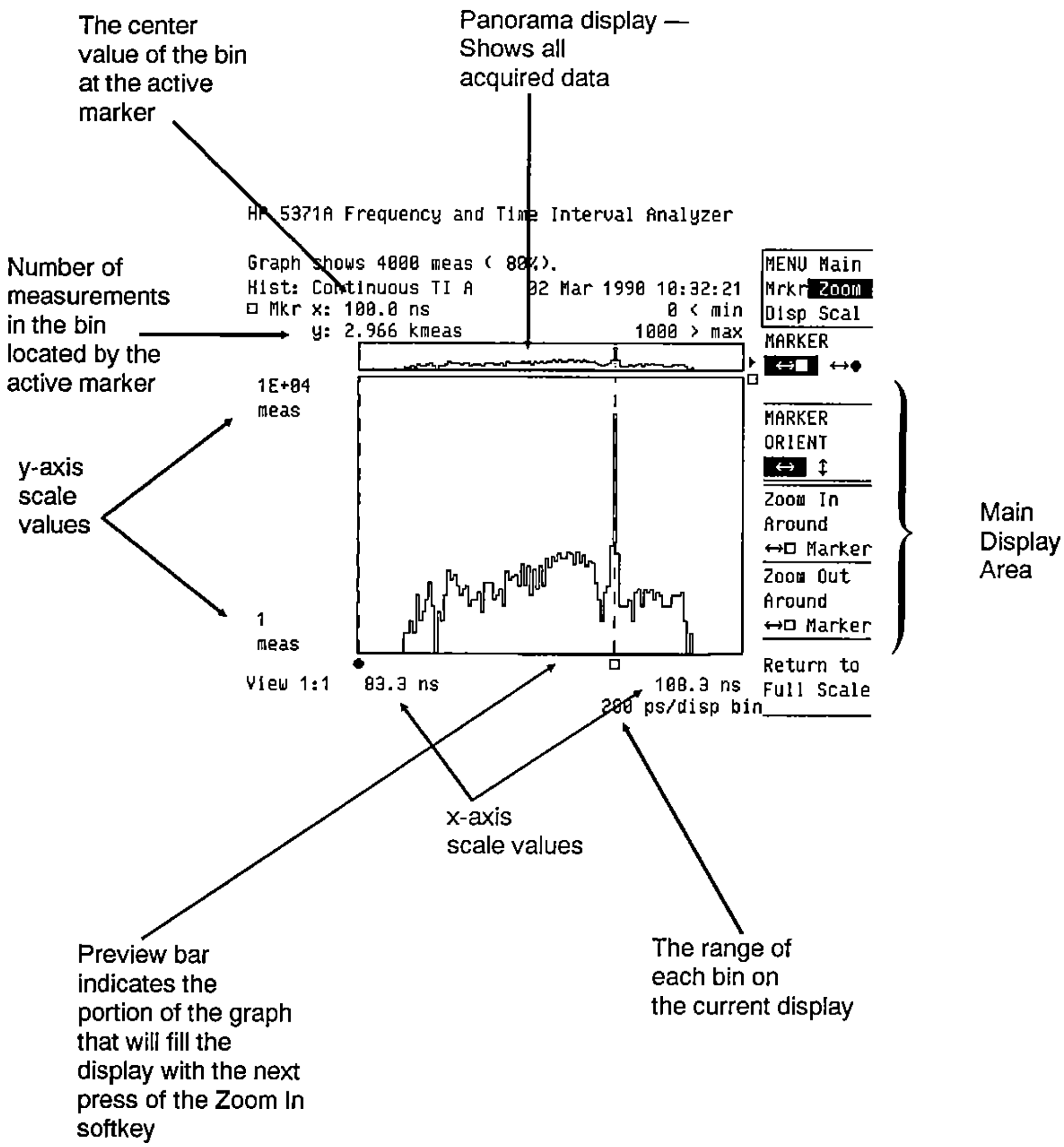


Figure 16-7. Histogram Graph Organization

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.

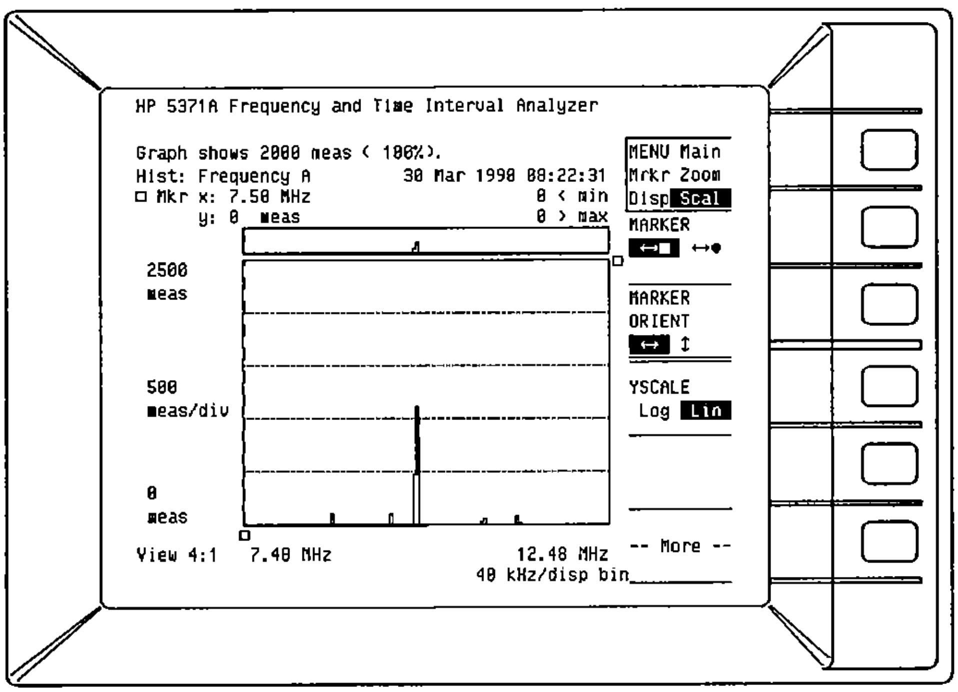


Figure 16-8. Histogram Linear Scale

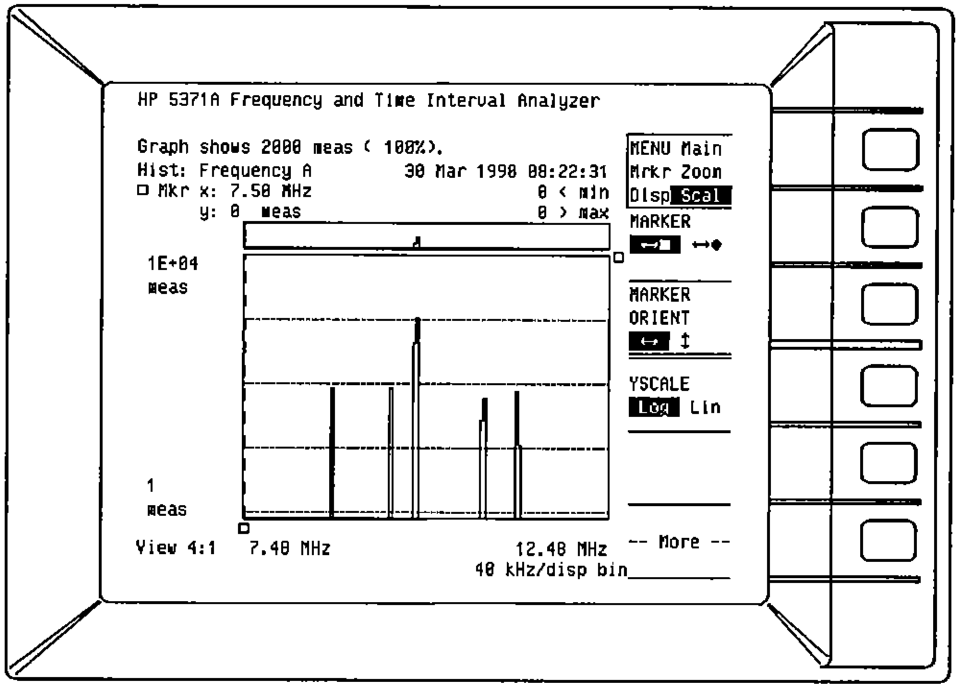


Figure 16-9. Histogram Log Scale (same data as Figure 16-8)

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.

Figure 16-10 shows a setup where UPDATE is not offered. *Figure 16-11* shows a setup where UPDATE While or After is available.

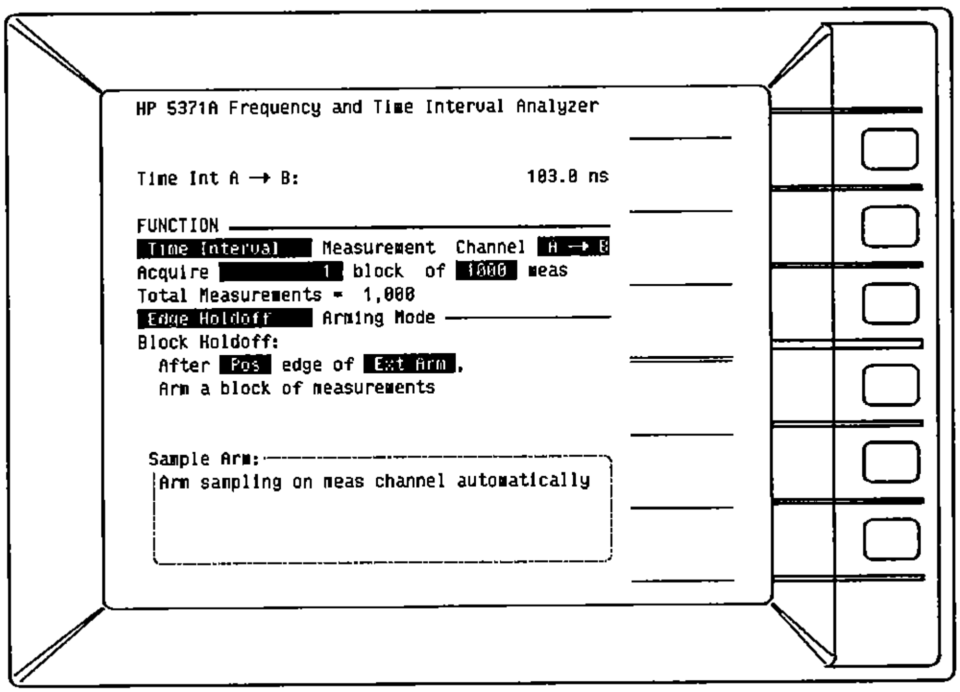


Figure 16-10. UPDATE is Not Available

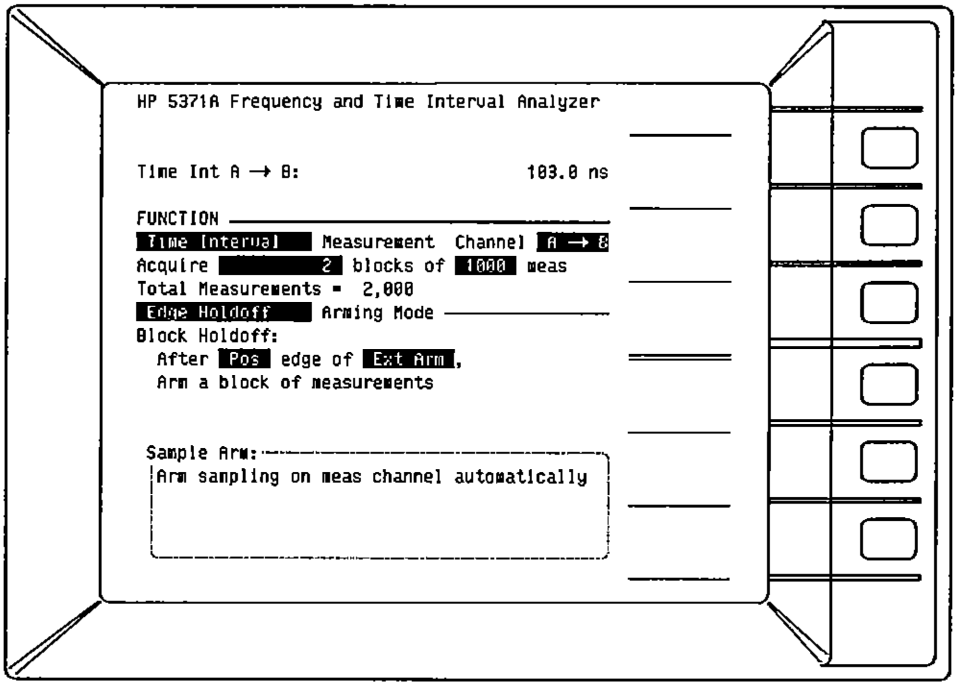


Figure 16-11. UPDATE While or After Selection is Available

- 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.

- 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 1,000 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.*

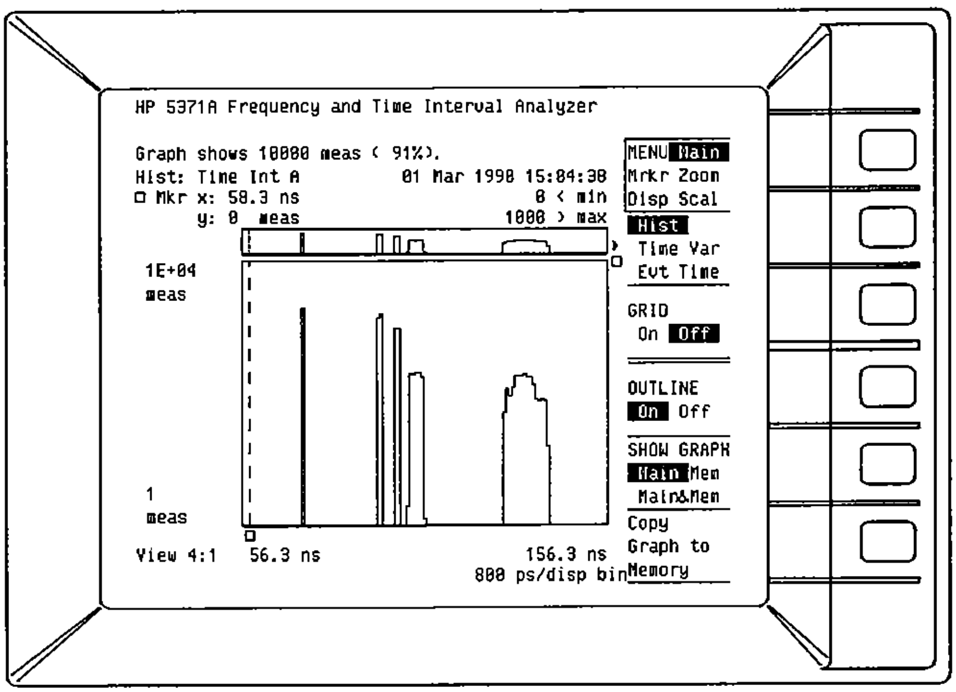


Figure 16-12. Not All Data Graphed

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.

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 1,000 data bins available for graph data, so the span of the graph will be:

  1,000 x bin width

  and the ending value will be

  minimum value + (1,000 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 1,000 data bins available for graph data, so the span of the graph will be:

  1,000 x bin width

  and the ending value will be

  minimum value + (1,000 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.

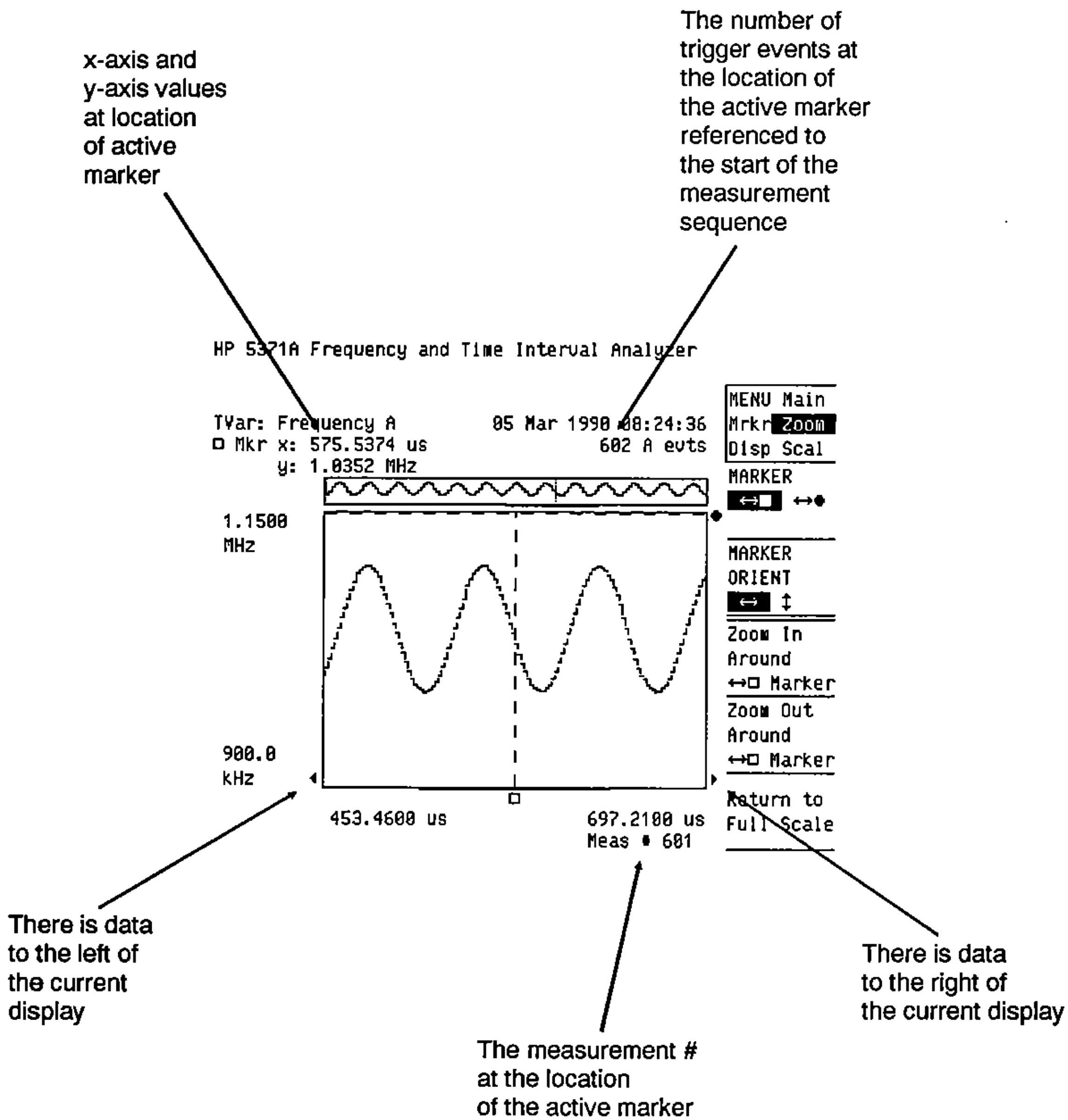


Figure 16-13. Time Variation Graph Organization

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*).

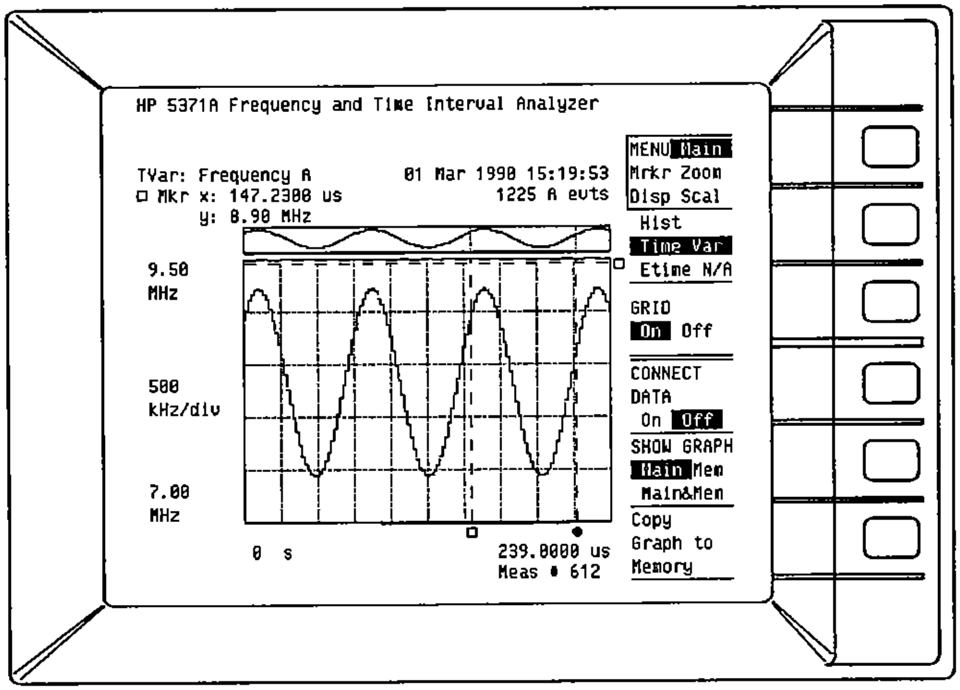


Figure 16-14. Time Variation Grid

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*).

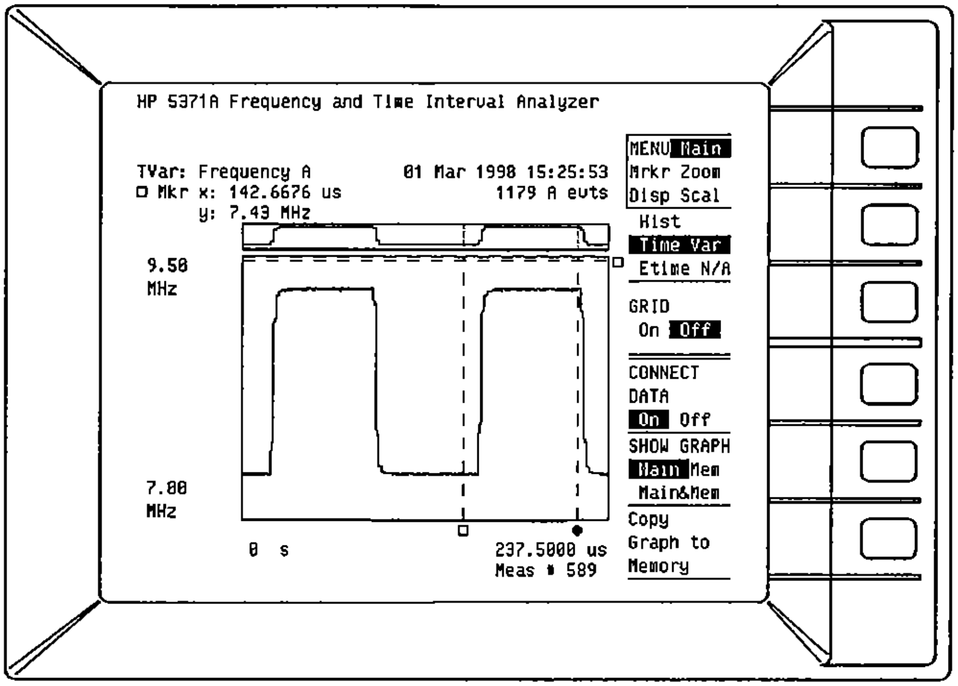


Figure 16-15. Connect Data On

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.

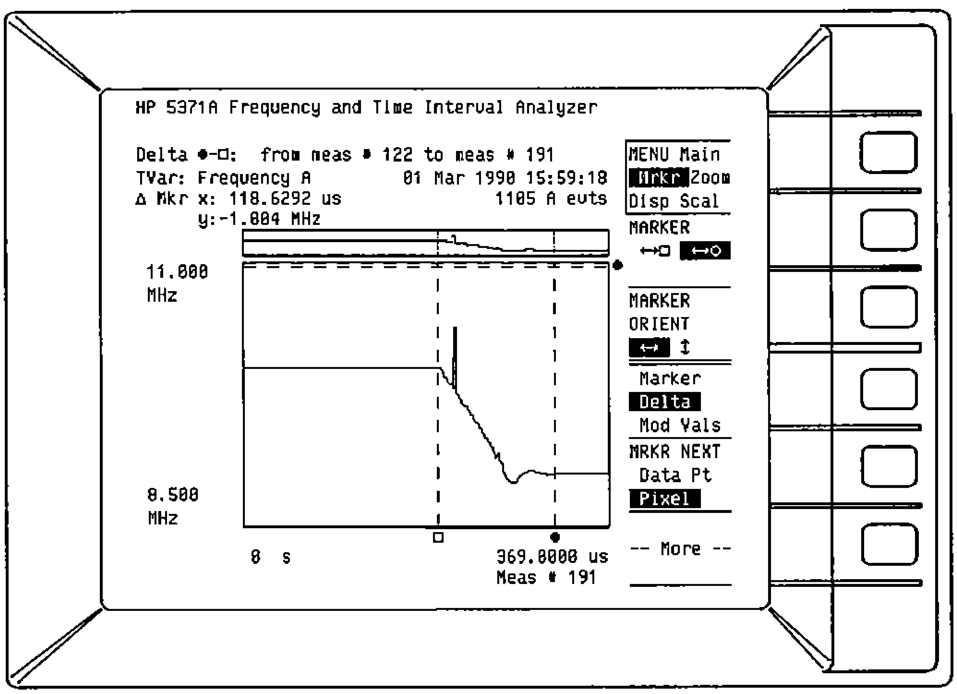


Figure 16-16. Time Variation X-axis Delta

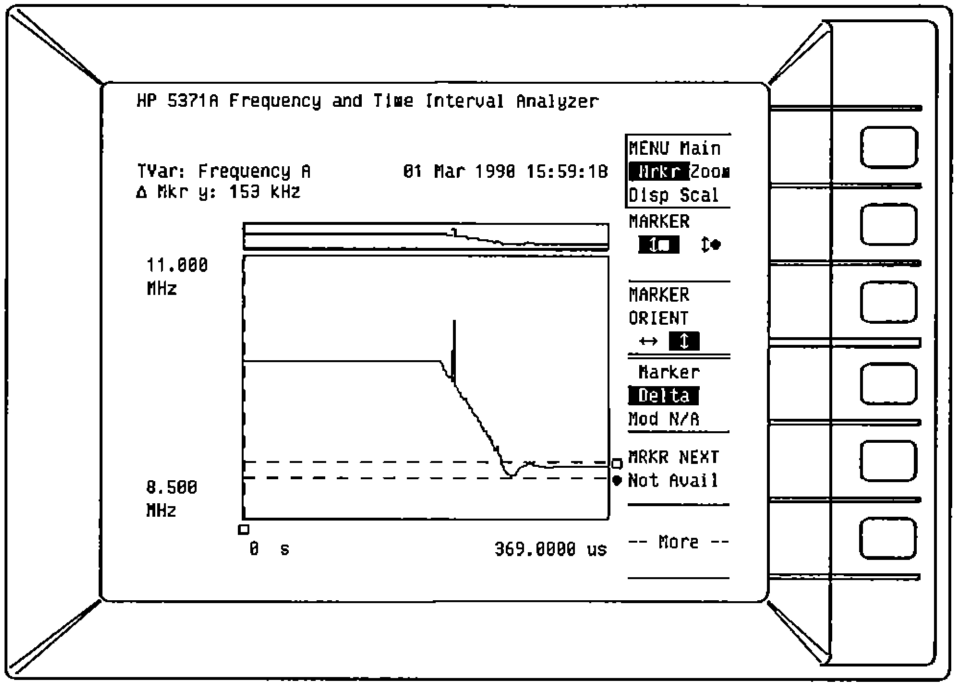


Figure 16-17. Time Variation Y-axis Delta

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 Note on the next page.

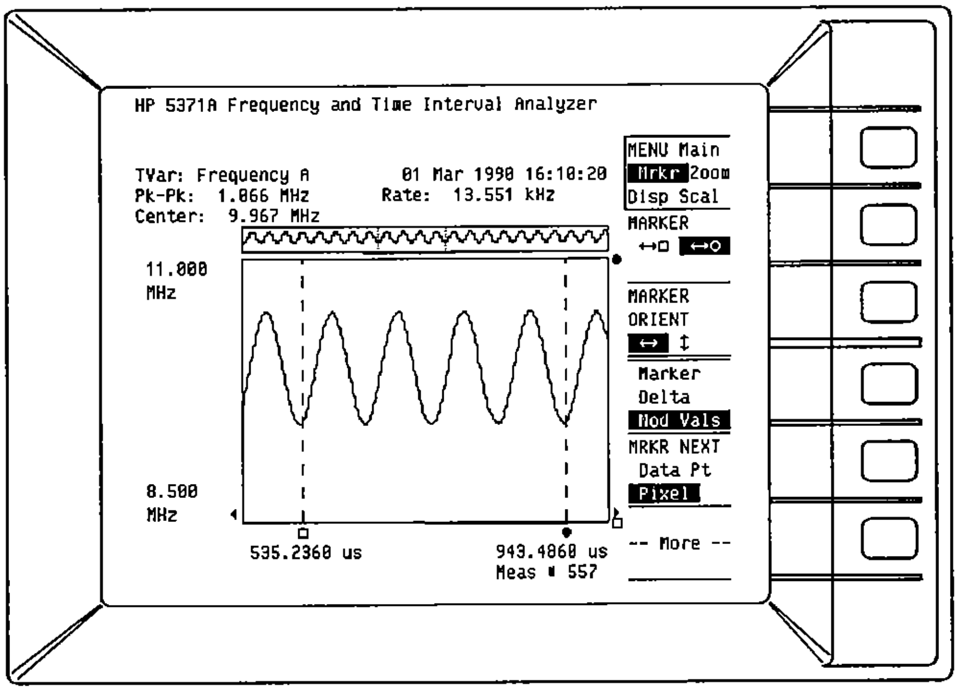


Figure 16-18. Modulation Analysis on a Sine Wave Modulated Signal

NOTE

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 5372A.

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, 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:

- 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.

Figure 16-19 shows a setup where UPDATE is not offered. *Figure 16-20* shows a setup where UPDATE While or After is available.

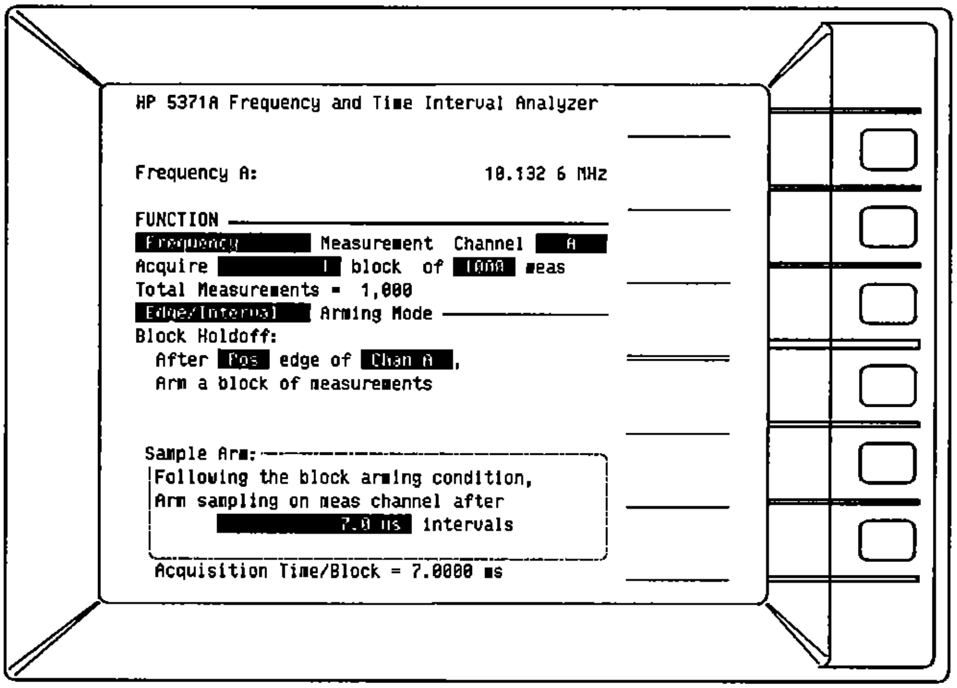


Figure 16-19. UPDATE is Not Available

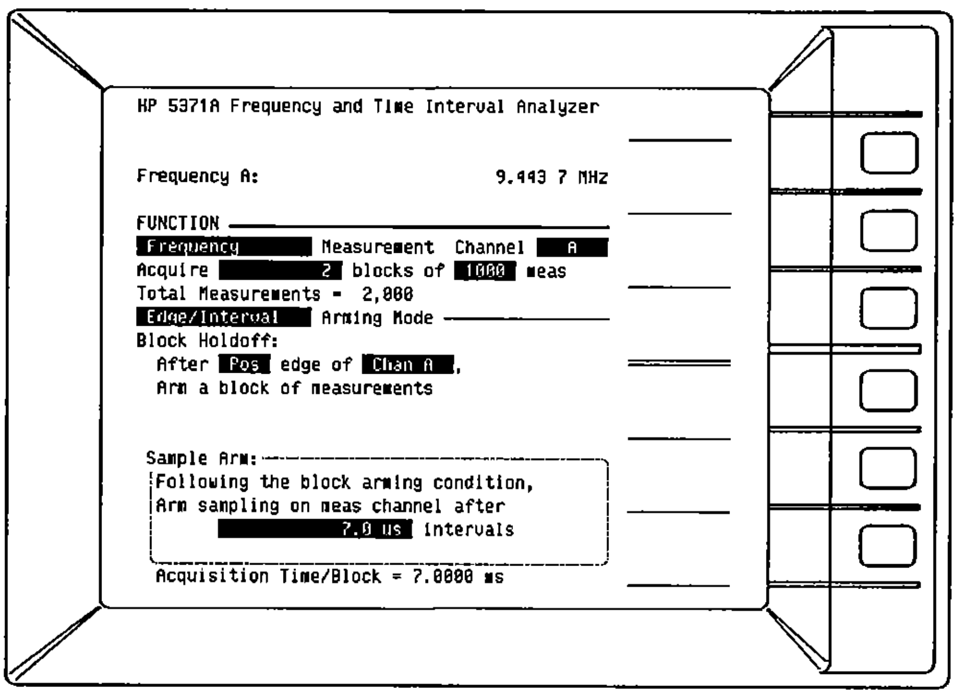


Figure 16-20. UPDATE While or After Selection is Available

- UPDATE While — will cause each block of data to be displayed as it is acquired. It is useful for observing trends after only a few blocks to help determine if the measurement is appropriate. There is no accumulation of data across blocks
- UPDATE After — will cause only the last block of the measurement sequence to be displayed.

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

- Autoscaling
- Manual Scaling

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, and Difference measurement results for Frequency, Period, and Totalize.

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.

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 Frequency, 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.

Figure 16-21 shows an Event Timing graph with information on the organization of the graph.

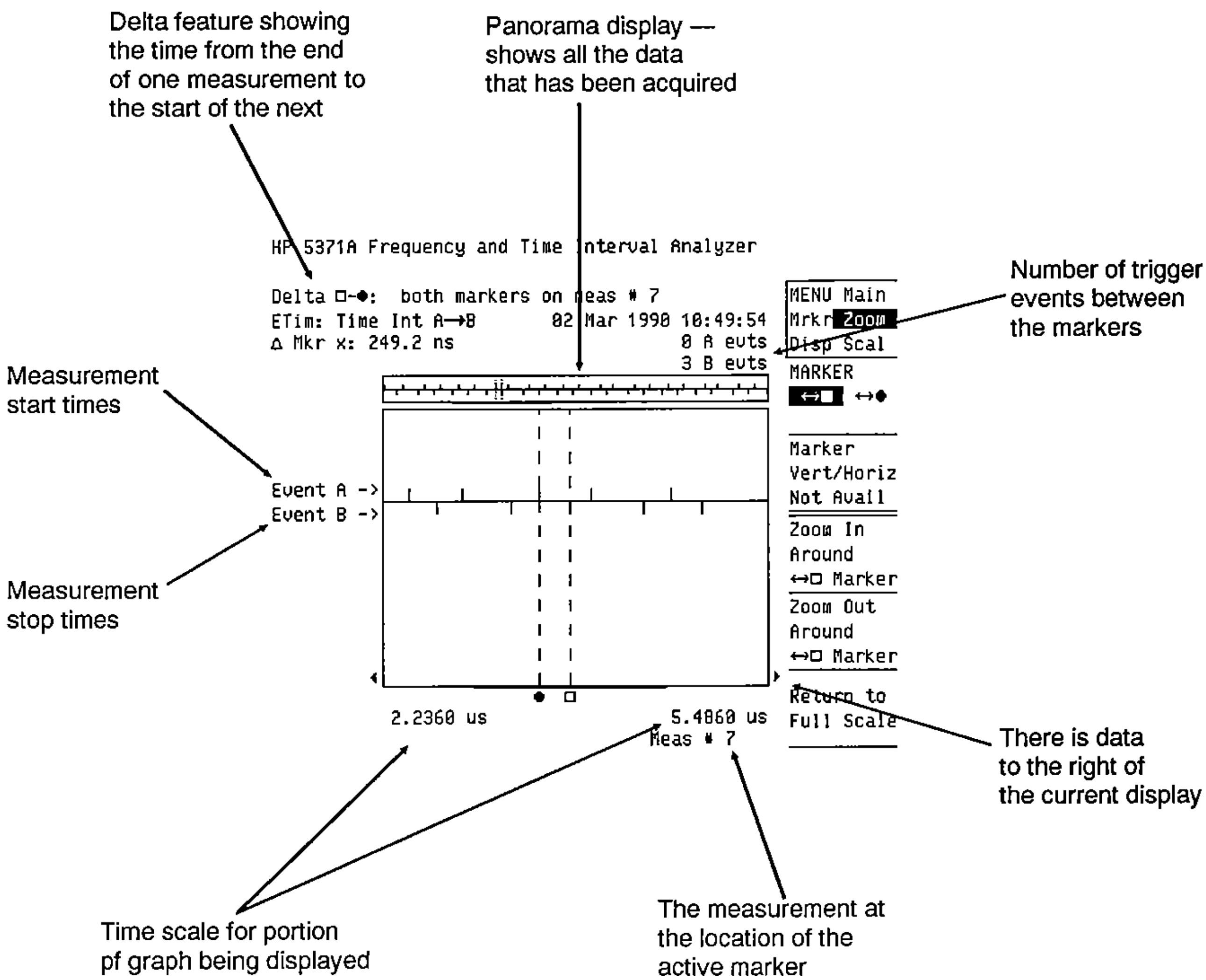


Figure 16-21. Event Timing Graph Organization

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

- Autoscaling
- 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 REAR PANEL

17 REAR PANEL

SUMMARY

The main features on the rear panel are:

- Power Module
- HP-IB Cable Connector
- Option 060, Rear Panel Inputs (if installed)
- Frequency Standard Input/Output
- Gate 1 and 2 Outputs
- Arm Delay 1 and 2 Outputs

⚠ Line Power Module

Line power for the HP 5371A 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 5371A. Refer to Appendix B, INSTALLATION, for more information.

HP-IB Connector

The HP-IB connector can be used for connecting the HP 5371A to a controller, or optionally, a listen-only printer, plotter, or other output device. Refer to Appendix B, INSTALLATION, for more information.

OPTION 060, REAR PANEL INPUTS

These are 50Ω BNC inputs for Channels A and B, and a 1 MΩ BNC input for External Arm available on the rear panel. Input pods cannot be used when Option 060 is installed. Channel A and B input performance is equivalent to front panel performance for this configuration. External Arm performance for the Option 060 configuration is listed in Rear Panel Specifications, Appendix E, SPECIFICATIONS.

FREQUENCY STANDARD

The HP 5371A can operate with an internal or external frequency standard. The internal timebase is a high-performance, ovenized crystal oscillator.

External Input

This is a BNC connector that provides for the connection of a house standard frequency. This input frequency is used in place of the internal 10 MHz ovenized oscillator. The acceptable input frequencies are: 1 MHz, 2 MHz, 5 MHz, and 10 MHz. The HP 5371A automatically switches to using this external frequency and turns off its internal oscillator. The user must press the RESTART key before the HP 5371A will continue operation whenever a frequency standard change is made.

Output

A BNC connector that provides a buffered 10 MHz output whether the HP 5371A is using an internal or external frequency source. This signal is provided for synchronizing another instrument to the timebase used by the HP 5371A. 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.

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.

Measurements and Gate Outputs

Listed below are the available Gate 1 and Gate 2 signals for the measurement/arming modes.

TIME INTERVAL

Refer to Section 2, 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 the time interval measured. The start of the interval at Gate 1 and the stop of the interval at Gate 2.

- AUTOMATIC
- EDGE HOLDOFF
- TIME HOLDOFF
- EVENT HOLDOFF
- INTERVAL SAMPLING
- REPETITIVE EDGE
- EDGE/INTERVAL

CONTINUOUS TIME INTERVAL

Refer to Section 2, TIME INTERVAL MEASUREMENTS, for a detailed timing diagram for each of the continuous time interval arming modes.

For the following arming modes, the falling edges at Gate 2 correspond to the time interval samples that 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 Section 2, 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 the time interval measured. The start of the interval at Gate 1 and the stop of the interval at Gate 2.

- AUTOMATIC
- EDGE HOLDOFF
- INTERVAL SAMPLING
- PARITY SAMPLING
- REPETITIVE EDGE
- EDGE/INTERVAL
- EDGE/EVENT
- EDGE/PARITY

FREQUENCY AND PERIOD

The gate outputs are identical for frequency and period measurements. Refer to Section 3, FREQUENCY/PERIOD MEASUREMENTS, for a detailed timing diagram for each of the frequency and period arming modes.

Two Channel Frequency/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, successive falling edges at the gate output corresponds to the gate time of the measurement being acquired.

- AUTOMATIC
- INTERVAL SAMPLING
- EDGE SAMPLING
- EDGE/INTERVAL

For the following arming modes, Gate 2 is active. The time between successive falling edges at Gate 2 corresponds to the gate time of the measurement being acquired.

- CYCLE SAMPLING
- EDGE/CYCLE
- EDGE/EDGE
- TIME/INTERVAL
- EVENT/INTERVAL

For the following arming modes, Gate 1 and 2 are active. The time between successive falling edges at Gate 1 and 2 corresponds to the gate time of the measurement being acquired.

- TIME SAMPLING
- EDGE/TIME
- EDGE/EVENT
- TIME/TIME
- EVENT/EVENT

TOTALIZE

Refer to Section 4, SPECIALIZED MEASUREMENTS, for a detailed timing diagram for each of the totalize arming modes.

For the following arming modes, Gate 2 is active. The time between successive falling edges at the Gate 2 output corresponds to the time over which the measurement is being acquired.

- INTERVAL SAMPLING
- EDGE SAMPLING
- EDGE/EDGE
- TIME/INTERVAL

For the following arming mode, Gate 1 and 2 are active. The time between successive falling edges at Gate 1 and 2 corresponds to the time over which the measurement is being acquired.

- MANUAL

RISE/FALL TIME, POS/NEG PULSE WIDTH, DUTY CYCLE, PHASE

Refer to Section 4, SPECIALIZED 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. The start of the interval at Gate 1 and the stop 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. Refer to Appendix E, SPECIFICATIONS, for the performance characteristics of these output signals.

Measurements and Arm Delay Ouputs

Listed below are the available Arm Delay 1 and Arm Delay 2 signals for the measurement/arming modes.

TIME INTERVAL

Refer to Section 2, 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 Section 2, 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 Section 2, 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

FREQUENCY AND PERIOD

Refer to Section 3, FREQUENCY/PERIOD MEASUREMENTS, for a detailed timing diagram for each of the frequency 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 (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

18 PERFORMANCE TESTS

18 PERFORMANCE TESTS

INTRODUCTION

This section contains procedures for testing the electrical performance of the HP 5371A Frequency and Time Interval Analyzer, using specifications listed in Section 1 of the HP 5371A Service Manual, as performance standards. Three types of testing are described: operation verification, complete performance testing, and HP-IB verification.

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 2-2.* 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 05371-13502 (5 1/4 inch LIF formatted disk) and HP Part Number 05371-13501 (3 1/2 inch LIF formatted disk).

EQUIPMENT REQUIRED

The equipment required for all test procedures in this section is listed in *Table 2-1.* Any equipment that satisfies the required characteristics given in the table may be substituted for the recommended models.

CALIBRATION CYCLE

The HP 5371A requires periodic verification of correct operation. Depending on use and environmental conditions, the HP 5371A 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 section.

Table 18-1. 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
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
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
Printer	ThinkJet	HP 2225A
Cable	HP-IB	HP 10833A

OPERATION VERIFICATION PROCEDURES

HP 5371A Setup

1. Insert 50 Ω BNC input pods (HP 54002A) into both Channel A and Channel B input pod slots in the front panel.
2. Attach a BNC T-connector to the HP 5371A rear-panel FREQUENCY STANDARD OUTPUT.
3. Connect a 4-foot BNC cable from the T-connector to the HP 5371A Channel A input pod.
4. Connect a 4-foot BNC cable from the T-connector to the HP 5371A Channel B input pod.

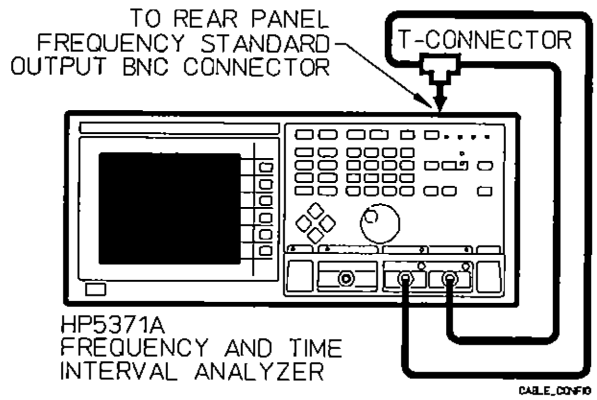


Figure 18-1. HP 5371A Operation Verification Setup

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 5371A 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 5371A displays an ERROR or FAILURE message, refer to the troubleshooting procedures in section 7 of the HP 5371A Service Manual. This section 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 "17" 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 "19" 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 "20" on the DATA ENTRY numeric keypad, and then press the Enter key.
14. Press the **Run** softkey.
15. Verify that the CRT displays the External Amp level as "LO".
16. Disconnect the BNC cable from the Channel A input pod and connect it to the External Arm input.
17. Verify that the CRT displays the External Amp level as "HI", and then press the **STOP** softkey.
18. Disconnect the BNC cable from the External Arm input and reconnect it to the Channel A input pod.

Instrument Control

PRESET AND SHIFT-PRESET

1. Press Preset key.

NOTE

Pressing the Preset key at any time resets the HP 5371A 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 = Time Interval
   "Channel" field = A
   "Arming Mode" field = Automatic

3. The GATE LED and both the Channel A and Channel B trigger LEDs should be blinking. (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 = 100.0 ns ±200 ps
Std Dev = 0 s up to 200 ps

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 5371A 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 5371A 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 **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, Positive Pulse Width, Negative Pulse Width, and Period measurements are also not tested directly since they are variations of the measurements tested below.

±TIME INTERVAL MEASUREMENT

1. Disconnect the BNC cable end from the Channel B input pod.
2. Press Preset key.
3. Press the **±Time Interval** softkey.
4. Press Input key.
5. Press the **Common** softkey.
6. Press the Single/Repet key. The SINGLE LED should now be illuminated.
7. The result displayed should be 0 s ± 200 ps.
8. Reconnect the BNC cable end to the Channel B input pod.

FREQUENCY MEASUREMENTS

1. Press Function key.
2. Press the **Frequency** softkey.
3. Move the cursor to the "Channel" field.
4. Press the **A&B** softkey.
5. The measurements shown at the top of the display should both be between 9.99 MHz and 10.01 MHz.

PEAK AMPLITUDE MEASUREMENTS

1. Move the cursor to the "Measurement" field.
2. Press the **More** softkey until **Peak Amplitude** is a menu selection option.
3. Press the **Peak Amplitude** softkey.
4. The maximum should be above 350 mV. The minimum should be below –400 mV.

5. Move the cursor to the "Channel" field.
6. Press the **B** softkey.
7. The maximum should be above 350 mV. The minimum should be below –400 mV.

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. Press the **Frequency** softkey.
3. Move the cursor to the "meas" field (the current value of this field is 100).
4. Press "1" 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 **Sample** is highlighted.
7. Press the following softkeys and verify that the values displayed at the top of the Function screen are approximately the same as those below:

Interval Sampling	10.000 0 MHz
Time Sampling	10.000 000 000 MHz
Cycle Sampling	10.000 MHz
Edge Sampling	10.00 MHz

8. 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	10.00 MHz

9. Press the **More** softkey and continue:

Edge/Cycle	10.000 MHz
Edge/Event	10.00 MHz
Time/Interval	10.000 0 MHz

10. 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. Disconnect the BNC cable end from the Channel B input pod.
2. Press Preset key.
3. Press Input key.
4. Press the **Common** softkey.
5. Press Function key.
6. Press the ± **Time Interval** softkey.
7. Move the cursor to the "Arming Mode" field.
8. Press the **Edge Holdoff** softkey and verify that the value displayed at the top of the Function Screen is approximately the same as the one below:

Edge Holdoff	0 s ±200 ps

9. Press the top softkey until **Sample** is highlighted.
10. 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
Repetitive Edge-Par	0 s ±200 ps

11. Press the top softkey until **Hld/Samp** is highlighted and continue:

Edge/Parity	0 s ±200 ps

12. Reconnect the BNC cable end to the Channel B input pod.

Input Menu

SEPARATE/COMMON INPUT

1. Press Preset key.
2. The result at the top of the display should be 100.0 ± 0.2 ns.
3. Move the cursor to the Channel field.
4. Press the **A→B** softkey.
5. The result displayed at the top right corner of the screen should be 100 ±2 ns.
6. Disconnect the BNC cable end from the Channel B input pod.

7. Press Input key.
8. Press the **Common** softkey. The value displayed should be 100.0 ±2 ns.
9. Reconnect the BNC cable end to the Channel B input pod.

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.

Rear Panel Outputs

GATE 1 OUTPUT

1. Connect a BNC cable from the rear panel Gate 1 output to the Channel B input pod.
2. Press Preset key.
3. Press the **Frequency** softkey.
4. Move the cursor to the "Channel" field.
5. Press the **A&B** softkey.
6. Move the cursor to the "Arming Mode" field.
7. Press the top softkey until **Sample** is highlighted.
8. Press the **Interval Sampling** softkey.
9. Press Input key.
10. Move the cursor to the Channel B "Mode" field.
11. Press the **Manual Trig** softkey.
12. Move the cursor to the Channel B "Level" field.
13. Press "500" on the DATA ENTRY numeric keypad, and then press the **mV** softkey.
14. The top of the CRT should display:

Frequency A:	10.000 0 MHz ± 200 Hz
Frequency B:	100.000 kHz ± 2 Hz

GATE 2 OUTPUT

1. Disconnect the BNC cable end from the rear panel Gate 1 output and connect it to the rear panel Gate 2 output.
2. Press Function key.
3. Move the cursor to the "Channel" field.

4. Press the **A** softkey.
5. Move the cursor to the Sample Arm "interval" field.
6. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key. The Channel B input trigger LED should flash once every second.

ARM DELAY 1 OUTPUT

1. Disconnect the BNC cable end from the rear panel Gate 2 output and connect it to the rear panel Arm Delay 1 output.
2. Move the cursor to the "Arming Mode" field.
3. Press the top softkey until **Hld/Samp** is highlighted.
4. Press the **More** softkey until **Time/Time** is a menu selection option.
5. Press the **Time/Time** softkey. The Channel B input trigger LED should flash once every second.

ARM DELAY 2 OUTPUT

1. Disconnect the BNC cable end from the rear panel Arm Delay 1 output and connect it to the rear panel Arm Delay 2 output. The Channel B input trigger LED should flash once every second.

HP-IB and Print

NOTE

Disconnect HP-IB interface cables that may be connected between the HP 5371A 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 5371A 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 5371A Restart key.

11. Press Graphic key.

12. Press Print key. The printer should print a copy of the Graphic screen.

THE HP 5371A OPERATION VERIFICATION PROCEDURES ARE NOW COMPLETE.

PERFORMANCE TEST PROCEDURES

Table 18-2 lists a summary of the complete performance tests and the specifications tested.

Table 18-2. Specifications Tested by Performance Tests

PAGE NO.	TEST DESCRIPTION	SPECIFICATIONS TESTED
18-2	Operation Verification	Overall HP 5371A Operation
18-3	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
	Auto Trigger Tests	
	Frequency Range	1 kHz to 200 MHz
	Dynamic Range	200 mVp-p to 2 Vp-p
	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)
18-27	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
18-41	HP-IB Operation Verification Program	Overall HP-IB Operation

Equipment Preliminary Setup

HP 5371A PRELIMINARY SETUP

13. Disconnect any HP-IB cables from the rear panel.
14. Insert 50Ω input pods (HP 54002A) into both Channel A and Channel B input pod slots in the front panel.
15. 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.
16. Connect the HP 5371A 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:
17. After 3 seconds, the screen displays the words "Performing Self Test ..."
18. 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.
19. If the HP 5371A displays an ERROR or FAILURE message, refer to the troubleshooting procedures in Section 7 of the HP 5371A Service Manual. This chapter contains specific information about diagnostic failures.
20. 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

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 consists of four 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 auto trigger frequency range, dynamic range, accuracy, and signal operating range, and the fourth test (optional) verifies both the sensitivity and minimum pulse width.

HP 5371A Configuration Setup

NOTE

This procedure sets the HP 5371A 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. Press the **Frequency** softkey.
3. Move the cursor to the "meas" field.
4. Press "1" 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 **Sample** is highlighted.
7. Press the **Interval Sampling** softkey.

8. Move the cursor to the Sample Arm "intervals" field.
9. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.
10. Press Input key.
11. Move the cursor to the Channel A "Mode" field.
12. Press the **Manual Trig** softkey.
13. Move the cursor to the Channel B "Mode" field.
14. Press the **Manual Trig** softkey.
15. Press Single/Repet key. The SINGLE LED should now be illuminated.
16. Press Save key, and then enter "1" on the DATA ENTRY numeric keypad.
17. Press Function key.
18. Move the cursor to the "Channel" field.
19. Press the **B** softkey.
20. Press Save key, and then enter "2" on the DATA ENTRY numeric keypad.
21. Press the **A&B** softkey.
22. Press Input key.
23. Move the cursor to the "Input Channels" field.
24. Press the **Common** softkey.
25. Press Save key, and then enter "3" on the DATA ENTRY numeric keypad.
26. Move the cursor to the Channel A "Level" field.
27. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.
28. Move the cursor to the Channel B "Level" field.
29. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.
30. Press Save key, and then enter "4" on the DATA ENTRY numeric keypad.
31. Press "–1" on the DATA ENTRY numeric keypad, and then press the Enter key.
32. Move the cursor to the Channel A "Level" field.
33. Press "–1" on the DATA ENTRY numeric keypad, and then press the Enter key.
34. Press Save key, and then enter "5" on the DATA ENTRY numeric keypad.
35. Press Preset key.
36. Press the **More** softkey until **Peak Amplitude** is a menu selection option.
37. Press the **Peak Amplitude** softkey.
38. Move the cursor to the "block size" field.

39. Press "1" on the DATA ENTRY numeric keypad, and then press the Enter key.
40. Press Single/Repet key. The SINGLE LED should now be illuminated.
41. Press Save key, and then enter "6" on the DATA ENTRY numeric keypad.
42. Move the cursor to the "Channel" field.
43. Press the **B** softkey.
44. Press Save key, and then enter "7" 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).

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                          A

FUNCTION
Frequency  Measurement  Channel  A                    B
Acquire  1  block  of  1  meas
Total Measurements = 1
Interval Sampling  Arming Mode                        A & B
Block Holdoff:
  Arm a block of measurements automatically
                                                      A / B

 Sample Arm:
                                                      B / A
 Arm sampling on meas channel after
        1.0000 s  intervals
                                                      -- More --
  Acquisition Time/Block = 1.0000  s
```

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                          Separate

INPUT
Separate  Input Channels                              Common

Trigger Event:
         Slope   Mode      Level
 Chan A:  Pos    Manual     0 V
 Chan B:  Pos    Manual     0 V

Ext Arm Level    0 V
                 Channel A        Channel B

Input Pod        HP 54002A        HP 54002A
Impedance        50 ohm           50 ohm
Bias Level       GND              GND
Attenuation      1:1              1:1
Maximum Input    2 V peak         2 V peak
```

Figure 18-2. Channel A and B Configuration 1

```
HP 5371A Frequency and Time Interval Analyzer

Frequency B:                                          A

FUNCTION
Frequency  Measurement  Channel  B                    B
Acquire  1  block  of  1  meas
Total Measurements = 1
Interval Sampling  Arming Mode                        A & B
Block Holdoff:
  Arm a block of measurements automatically
                                                      A / B

 Sample Arm:
                                                      B / A
 Arm sampling on meas channel after
        1.0000 s  intervals
                                                      -- More --
  Acquisition Time/Block = 1.0000  s
```

```
HP 5371A Frequency and Time Interval Analyzer

Frequency B:                                          Separate

INPUT
Separate  Input Channels                              Common

Trigger Event:
         Slope   Mode      Level
 Chan A:  Pos    Manual     0 V
 Chan B:  Pos    Manual     0 V

Ext Arm Level    0 V
                 Channel A        Channel B

Input Pod        HP 54002A        HP 54002A
Impedance        50 ohm           50 ohm
Bias Level       GND              GND
Attenuation      1:1              1:1
Maximum Input    2 V peak         2 V peak
```

Figure 18-3. Channel A and B Configuration 2

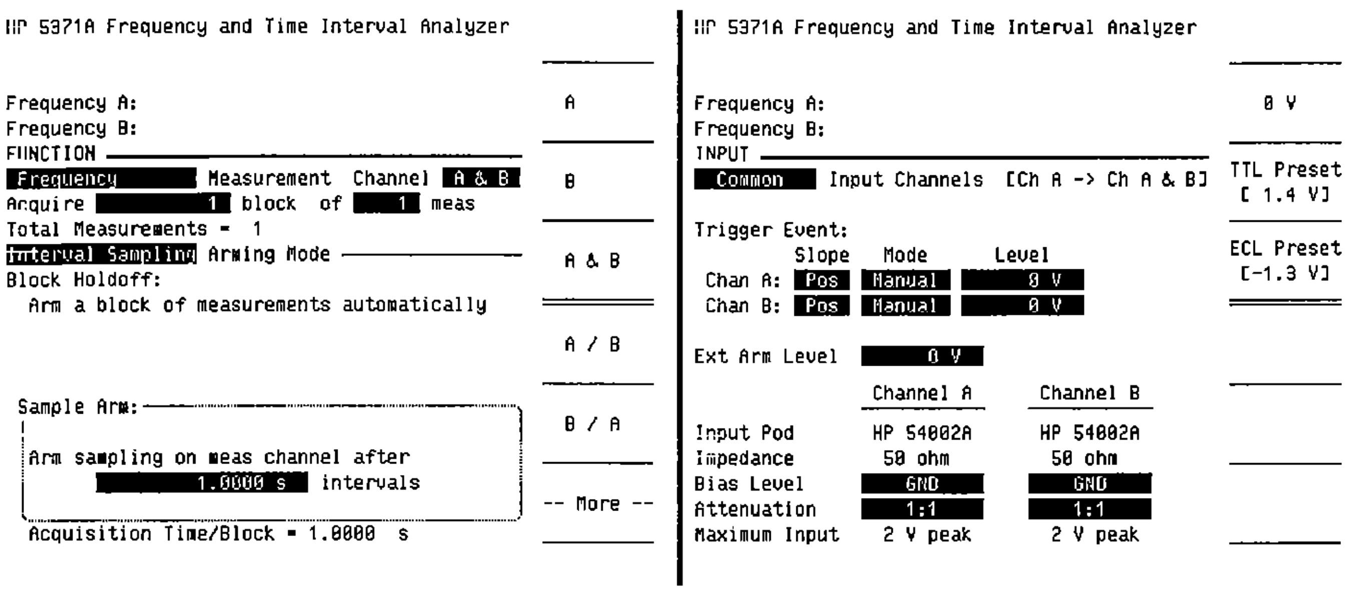


Figure 18-4. Channel A and B Configuration 3

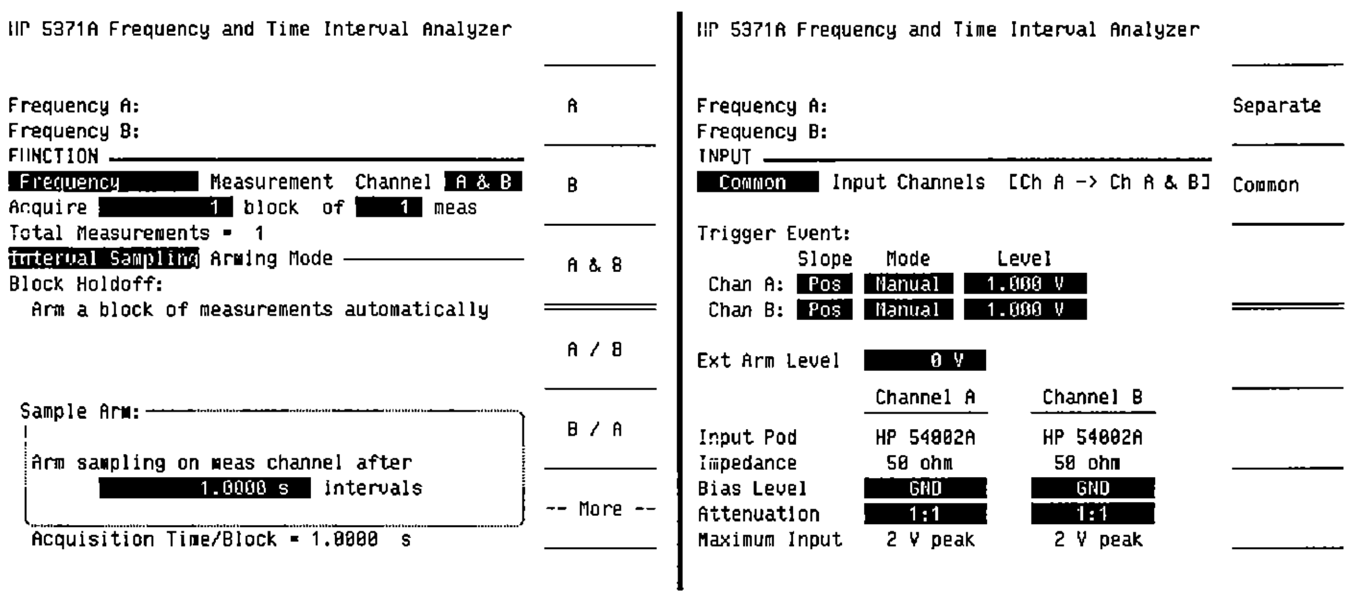


Figure 18-5. Channel A and B Configuration 4

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                          A
Frequency B:
FUNCTION ─────────────────────────────────
 Frequency     Measurement  Channel  A & B            B
Acquire          1  block  of    1  meas
Total Measurements = 1                                A & B
Interval Sampling Arming Mode ─────────────
Block Holdoff:
  Arm a block of measurements automatically
                                                      A / B
 Sample Arm: ────────────────────────────
 Arm sampling on meas channel after                   B / A
        1.0000 s  intervals
                                                      -- More --
  Acquisition Time/Block = 1.0000  s
```

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                          Separate
Frequency B:
INPUT ─────────────────────────────────────
 Common  Input Channels  [Ch A -> Ch A & B]           Common

Trigger Event:
          Slope   Mode     Level
 Chan A:  Pos    Manual   -1.000 V
 Chan B:  Pos    Manual   -1.000 V

Ext Arm Level      0 V
                 Channel A      Channel B
Input Pod        HP 54002A      HP 54002A
Impedance         50 ohm         50 ohm
Bias Level         GND            GND
Attenuation        1:1            1:1
Maximum Input    2 V peak       2 V peak
```

Figure 18-6. Channel A and B Configuration 5

```
HP 5371A Frequency and Time Interval Analyzer

Max Amplitude A:                              2 mV
Min Amplitude A:                              2 mV
FUNCTION ─────────────────────────────────
 Peak Amplitude  Measurement  Channel   A
Acquire          1  block  of    1  meas
Total Measurements = 1
 Automatic       Arming Mode ─────────────
Block Holdoff:
  Arm a block of measurements automatically

 Sample Arm: ────────────────────────────
 Arm sampling on meas channel automatically
```

```
HP 5371A Frequency and Time Interval Analyzer

Max Amplitude A:                              2 mV    Separate
Min Amplitude A:                              2 mV
INPUT ─────────────────────────────────────
 Separate  Input Channels                             Common

Trigger Event:
          Slope   Mode       Level
 Chan A:  Pos    Sgl Auto    50 %  =   2 mV
 Chan B:  Pos    Sgl Auto    50 %  =   2 mV

Ext Arm Level      0 V
                 Channel A      Channel B
Input Pod        HP 54002A      HP 54002A
Impedance         50 ohm         50 ohm
Bias Level         GND            GND
Attenuation        1:1            1:1
Maximum Input    2 V peak       2 V peak
```

Figure 18-7. Channel A and B Configuration 6

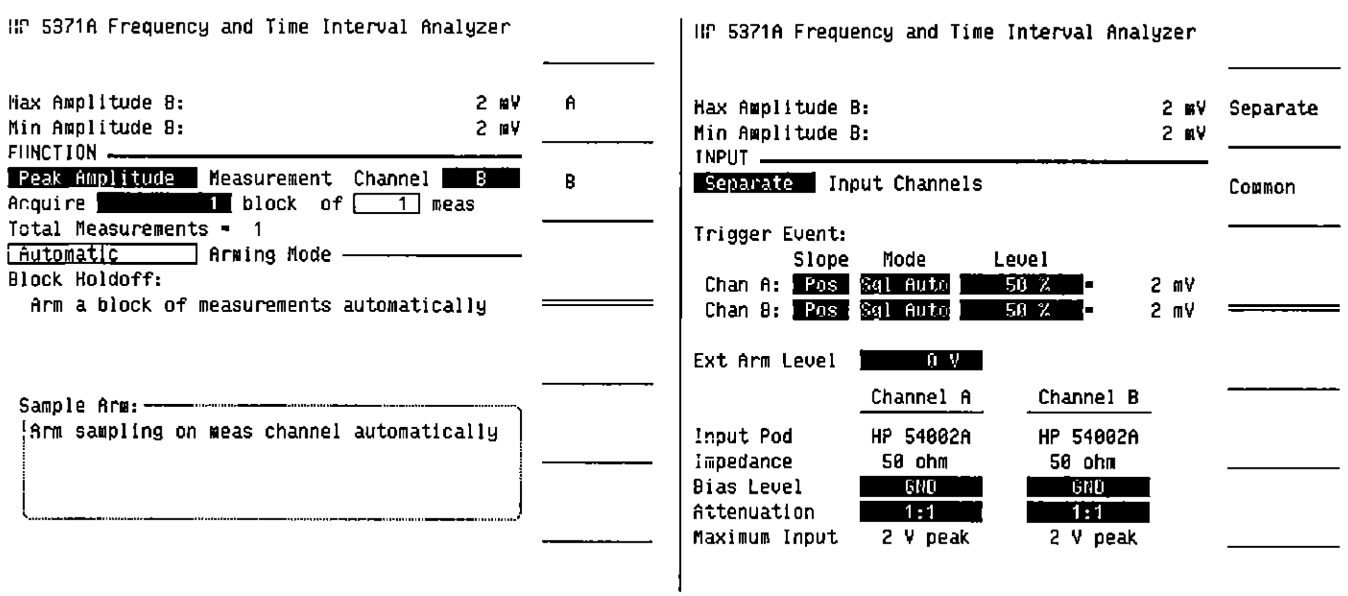


Figure 18-8. Channel A and B Configuration 7

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 5371A Channel A input pod.
6. Connect a BNC cable from the rear panel EXT REF IN to the HP 5371A 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 5371A requires 8 seconds to perform each .125 Hz test.

---

2. After 8 seconds, the top of the HP 5371A CRT should display a result for Channel A. Enter this value on the Performance Test Record.
3. Disconnect the BNC cable from the HP 5371A Channel A input pod and connect it to the HP 5371A Channel B input pod.
4. Press Recall key, and then enter "2" on the DATA ENTRY numeric keypad.
5. After 8 seconds, the top of the HP 5371A CRT should display a result for Channel B. Enter this value on the Performance Test Record.
6. Press the HP 3325A AMPTD key, enter "2", and press VOLT key.
7. Press the HP 3325A square wave (10 MHz) function key.
8. Press HP 5371A Restart key.
9. After 8 seconds, the top of the HP 5371A CRT should display a result for Channel B. Enter this value on the Performance Test Record.
10. Disconnect the BNC cable from the HP 5371A Channel B input pod and connect it to the HP 5371A Channel A input pod.
11. Press Recall key, and then enter "1" on the DATA ENTRY numeric keypad.
12. After 8 seconds, the top of the HP 5371A CRT should display a result for Channel A. Enter this value on the Performance Test Record.
13. Disconnect the BNC cable end from the HP 3325A SIGNAL output, and connect it to the HP 8663A RF OUTPUT.
14. 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.
15. Press Numeric key.

16. Press Recall key, and then enter "3" on the DATA ENTRY numeric keypad.
17. The HP 5371A CRT should display results for both Channel A and B. Enter these values on the Performance Test Record.
18. Press the HP 8663A AMPLITUDE key, enter "10", and press +dBm key (The +10 dBm amplitude is equivalent to 2 Vp-p).
19. Press HP 5371A Restart key.
20. The HP 5371A 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 5371A Channel A input pod.
6. Connect a BNC cable from the rear panel EXT REF IN to the HP 5371A 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 5371A 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 5371A CRT should display results for both Channel A and B. Enter these values on the Performance Test Record.

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

NOTE

The Peak Amplitude function specifications are tested in the Auto Trigger tests.

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 5371A Channel A input pod.
5. Connect a BNC cable from the rear panel EXT REF IN to the HP 5371A 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 "6" on the DATA ENTRY numeric keypad.
2. The HP 5371A CRT should display maximum and minimum results for Channel A. Enter these values on the Performance Test Record.
3. Disconnect the BNC cable from the HP 5371A Channel A input pod and connect it to the HP 5371A Channel B input pod.
4. Press Recall key, and then enter "7" on the DATA ENTRY numeric keypad.
5. The HP 5371A CRT should display maximum and minimum results for Channel B. Enter these values on the Performance Test Record.
6. Press the HP 3325A AMPTD key, enter "2", and press VOLT key.
7. Press the HP 3325A DC OFFSET key, enter "1", and press VOLT key.
8. Press HP 5371A Restart key.

9. The HP 5371A CRT should display results for Channel B. Enter these values on the Performance Test Record.
10. Press the HP 3325A DC OFFSET key, enter "-1", and press VOLT key.
11. Press HP 5371A Restart key.
12. The HP 5371A CRT should display results for Channel B. Enter these values on the Performance Test Record.
13. Disconnect the BNC cable from the HP 5371A Channel B input pod and connect it to the HP 5371A Channel A input pod.
14. Press Recall key, and then enter "6" on the DATA ENTRY numeric keypad.
15. The HP 5371A CRT should display results for Channel A. Enter these values on the Performance Test Record.
16. Press the HP 3325A DC OFFSET key, enter "1", and press VOLT key.
17. Press HP 5371A Restart key.
18. The HP 5371A CRT should display results for Channel A. 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 5371A Restart key.
22. The HP 5371A CRT should display results for Channel A. Enter these value on the Performance Test Record.
23. Disconnect the BNC cable from the HP 5371A Channel A input pod and connect it to the HP 5371A Channel B input pod.
24. Press Recall key, and then enter "7" on the DATA ENTRY numeric keypad.
25. The HP 5371A CRT should display results for Channel B. Enter these values on the Performance Test Record.
26. Press the HP 8663A AMPLITUDE key, enter "10", and press +dBm key (The +10 dBm amplitude is equivalent to 2 Vp-p).
27. Press HP 5371A Restart key.
28. The HP 5371A CRT should display results for Channel B. Enter these values on the Performance Test Record.
29. Disconnect the BNC cable from the HP 5371A Channel B input pod and connect it to the HP 5371A Channel A input pod.
30. Press Recall key, and then enter "6" on the DATA ENTRY numeric keypad.
31. The HP 5371A 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 equipment.

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 5371A 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 5371A 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 5371A 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 5371A Restart key.
3. The top of the HP 5371A 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 the HP 5371A 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 5371A 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 5371A Configuration Setup

NOTE

This procedure sets the HP 5371A 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 **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 **Edge/Edge** softkey.
7. Move the cursor to the Block Holdoff "Channel" field.
8. Press the **Ext Arm** softkey.
9. Move the cursor to the Sample Arm "Channel" field.
10. Press the **Ext Arm** softkey.
11. Press Numeric key.
12. Press the **Expand** softkey until **On** is highlighted.

13. Press Single/Repet key. The SINGLE LED should now be illuminated.
14. Press Save key, and then enter "1" on the DATA ENTRY numeric keypad.
15. Press Input key.
16. Move the cursor to the Ext Arm "Level" field.
17. Press "2.5" on the DATA ENTRY numeric keypad, and then press the Enter key.
18. Press Save key, and then enter "2" on the DATA ENTRY numeric keypad.
19. Press "–2.5" on the DATA ENTRY numeric keypad, and then press the Enter key.
20. Press Save key, and then enter "3" on the DATA ENTRY numeric keypad.
21. Press "100" on the DATA ENTRY numeric keypad, and then press the **mV** softkey.
22. Press Function key.
23. Move the cursor to the "Arming Mode" field.
24. Press the **More** softkey until Edge/Event is a menu selection option.
25. Press the **Edge/Event** softkey.
26. Move the cursor to the Stop Arm "Count" field.
27. Press "0" on the DATA ENTRY numeric keypad, and then press the Enter key.
28. Press Save key, and then enter "4" on the DATA ENTRY numeric keypad.
29. Move the cursor to the Block Holdoff "edge" field.
30. Press the **Neg** softkey.
31. 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).

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                              Pos

FUNCTION ------------------------------------
Frequency        Measurement  Channel    A                Neg
Acquire           1  block  of   2  meas
Total Measurements = 2
Edge/Edge        Arming Mode ----------------
Block Holdoff:
  After Pos  edge of  Ext Arm ,
  Arm a block of measurements


 Sample Arm: ---------------------------------
 Arm sampling on meas channel after
       Pos  edge of  Ext Arm


Maximum Input     2 V peak        2 V peak
```

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                               0 V

INPUT ----------------------------------------
Separate   Input Channels                                  TTL Preset
                                                           [ 1.4 V]
Trigger Event:
             Slope   Mode        Level                     ECL Preset
 Chan A:     Pos   Sgl Auto    50 % =          2 mV        [-1.3 V]
 Chan B:     Pos   Sgl Auto    50 % =          2 mV

Ext Arm Level       0 V
                  Channel A        Channel B
Input Pod         HP 54002A        HP 54002A
Impedance          50 ohm           50 ohm
Bias Level          GND              GND
Attenuation         1:1              1:1
Maximum Input     2 V peak         2 V peak
```

Figure 18-9. External Arm Input Configuration 1

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                              Pos

FUNCTION ------------------------------------
Frequency        Measurement  Channel    A                Neg
Acquire           1  block  of   2  meas
Total Measurements = 2
Edge/Edge        Arming Mode ----------------
Block Holdoff:
  After Pos  edge of  Ext Arm ,
  Arm a block of measurements


 Sample Arm: ---------------------------------
 Arm sampling on meas channel after
       Pos  edge of  Ext Arm


```

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                               0 V

INPUT ----------------------------------------
Separate   Input Channels                                  TTL Preset
                                                           [ 1.4 V]
Trigger Event:
             Slope   Mode        Level                     ECL Preset
 Chan A:     Pos   Sgl Auto    50 % =          2 mV        [-1.3 V]
 Chan B:     Pos   Sgl Auto    50 % =          2 mV

Ext Arm Level     2.50 V
                  Channel A        Channel B
Input Pod         HP 54002A        HP 54002A
Impedance          50 ohm           50 ohm
Bias Level          GND              GND
Attenuation         1:1              1:1
Maximum Input     2 V peak         2 V peak
```

Figure 18-10. External Arm Input Configuration 2

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                              Pos

FUNCTION
Frequency    Measurement  Channel  A                      Neg
Acquire          1 block  of   2 meas
Total Measurements = 2
Edge/Edge     Arming Mode
Block Holdoff:
  After Pos edge of Ext Arm,
  Arm a block of measurements


 Sample Arm:
 Arm sampling on meas channel after
       Pos edge of Ext Arm
```

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                              8 V

INPUT
Separate  Input Channels                                  TTL Preset
                                                          [ 1.4 V]
Trigger Event:
          Slope   Mode        Level                       ECL Preset
 Chan A:  Pos   Sgl Auto     50 % =        2 mV           [-1.3 V]
 Chan B:  Pos   Sgl Auto     50 % =        2 mV

Ext Arm Level    -2.50 V
                 Channel A       Channel B

Input Pod        HP 54002A       HP 54002A
Impedance        50 ohm          50 ohm
Bias Level       GND             GND
Attenuation      1:1             1:1
Maximum Input    2 V peak        2 V peak
```

Figure 18-11. External Arm Input Configuration 3

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:

FUNCTION
Frequency    Measurement  Channel  A
Acquire          1 block  of   2 meas
Total Measurements = 2
Edge/Event    Arming Mode
 Start Arm:
  After Pos edge of Ext Arm,
  Arm each measurement


 Stop Arm:

  Following the start arming edge
  Count             0    pos edges
    of        Chan A
  Then arm the end of each measurement
```

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                              8 V

INPUT
Separate  Input Channels                                  TTL Preset
                                                          [ 1.4 V]
Trigger Event:
          Slope   Mode        Level                       ECL Preset
 Chan A:  Pos   Sgl Auto     50 % =        2 mV           [-1.3 V]
 Chan B:  Pos   Sgl Auto     50 % =        2 mV

Ext Arm Level      100 mV
                 Channel A       Channel B

Input Pod        HP 54002A       HP 54002A
Impedance        50 ohm          50 ohm
Bias Level       GND             GND
Attenuation      1:1             1:1
Maximum Input    2 V peak        2 V peak
```

Figure 18-12. External Arm Input Configuration 4

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                              Pos

FUNCTION
 Frequency   Measurement  Channel   A                     Neg
Acquire          1  block  of   2  meas
Total Measurements = 2
 Edge/Event   Arming Mode
 Start Arm:
  After  Neg  edge of  Ext Arm ,
  Arm each measurement

 Stop Arm:

  Following the start arming edge
  Count            0   pos edges
   of         Chan A
  Then arm the end of each measurement
```

```
HP 5371A Frequency and Time Interval Analyzer

Frequency A:                                                     0 V

INPUT
 Separate  Input Channels                                 TTL Preset
                                                          [ 1.4 V]
Trigger Event:
         Slope   Mode        Level                        ECL Preset
 Chan A:  Pos   Sgl Auto     50 %  =        2 mV          [-1.3 V]
 Chan B:  Pos   Sgl Auto     50 %  =        2 mV

Ext Arm Level    100 mV
                 Channel A       Channel B

Input Pod        HP 54002A       HP 54002A
Impedance        50 ohm          50 ohm
Bias Level        GND             GND
Attenuation       1:1             1:1
Maximum Input    2 V peak        2 V peak
```

Figure 18-13. External Arm Input Configuration 5

NOTE

The rear panel External Arm Input specifications (option 060) are different than the front panel specifications. The complete front-panel performance tests are listed first, followed by the complete rear-panel performance tests.

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

±20 mV 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 5371A 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 5371A External Arm input.
6. Connect a BNC cable from the rear panel EXT REF IN to the HP 5371A 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 5371A 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 5371A Restart key.
9. The HP 5371A 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 5371A 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 5371A External Arm input.
6. Connect a BNC cable from the rear panel EXT REF IN to the HP 5371A 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 5371A 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 5371A 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 5371A 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 5371A 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 steps 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 5371A 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 mininimum amplitude

HP 8161A SETUP

7. Press the PERIOD key, enter "200" on the CHANNEL/DATA keys, and then press ns key.
8. Press the DELAY key, press CHANNEL A key, enter "0" on the CHANNEL/DATA keys, and then press ns key.
9. Press the WIDTH key, press CHANNEL A key, enter "5" on the CHANNEL/DATA keys, and then press ns key.
10. Press the LEE key, press CHANNEL A key, enter "1.3" on the CHANNEL/DATA keys, and then press ns key.
11. Press the TRE key, press CHANNEL A key, enter "1.3" on the CHANNEL/DATA keys, and then press ns key.
12. Press the HIL key, press CHANNEL A key, enter ".07" on the CHANNEL/DATA keys, and then press V key.
13. Press the LOL key, press CHANNEL A key, enter "–.07" on the CHANNEL/DATA keys, and then press V key.
14. Enable the Channel A output by ensuring the DISABLE LED is off.
15. Connect a BNC cable from OUTPUT A to the HP 5371A External Arm Input.

SENSITIVITY AND MINIMUM PULSE WIDTH TEST PROCEDURE

1. Press Recall key, and then enter "1" on the DATA ENTRY numeric keypad.
2. The HP 5371A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.

Rear Panel External Arm Input Tests

Specifications Tested:

DC to 100 MHz Frequency Range
280 mV p-p to 5 Vp-p Dynamic Range
(DC to 20 MHz)
280 mV p-p to 2.5 Vp-p Dynamic Range
(20 MHz to 100 MHz)

–5 V to +5 V Signal Operating Range

±20 mV or 10% of setting Trigger Accuracy

280 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 Rear Panel 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 verifies the trigger accuracy, and the fourth test verifies both the sensitivity and minimum pulse width.

Rear Panel External Arm Input Frequency and Dynamic Ranges Test

Specifications Tested:

DC to 100 MHz
280 mVp-p to 5 Vp-p (DC to 20 MHz)
280 mVp-p to 2.5 Vp-p (20 MHz to 100 MHz)

NOTE

The low frequency range (DC) specification is tested in the trigger accuracy test.

HP 5371A SETUP

1. Connect a 50 ohm feedthrough termination to the External Arm input.
2. Connect a 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.

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 "280", and press mV key.
4. Select the sine wave (20 MHz) function.
5. Connect a BNC cable from the SIGNAL output to the HP 5371A External Arm input.
6. Connect a BNC cable from the rear panel EXT REF IN to the HP 5371A 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 "100", 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 "2" on the DATA ENTRY numeric keypad, and then press the Enter key.
5. The HP 5371A 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 5371A Restart key.
9. The HP 5371A 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 5371A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.

Rear Panel 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 5371A External Arm input.
6. Connect a BNC cable from the rear panel EXT REF IN to the HP 5371A 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 5371A 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 5371A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.

Rear Panel 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 5371A 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 5371A 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 steps 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 5371A Ext Arm trigger level) from the average. Record this result on the Performance Test Record.

Rear Panel External Arm Input Sensitivity and Minimum Pulse Width Test

Specifications Tested: 280 mVp-p at minimum amplitude
5 ns at mininimum 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 ".14" on the CHANNEL/DATA keys, and then press V key.
7. Press the LOL key, press CHANNEL A key, enter "–.14" 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 5371A External Arm Input.

SENSITIVITY AND MINIMUM PULSE WIDTH TEST PROCEDURE

1. Press Recall key, and then enter "1" on the DATA ENTRY numeric keypad.
2. The HP 5371A CRT should display both a frequency result and a gate time for Channel A. Record the gate time on the Performance Test Record.

THE HP 5371A PERFORMANCE TESTS ARE NOW COMPLETE.

HP-IB VERIFICATION PROGRAM

The HP-IB Operation Verification Program checks the HP 5371'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 5371A, 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 5371A operates correctly from the front panel. This can be verified by performing the "HP 5371A Operation Verification Tests" found earlier in this chapter.
- The controller being used can properly execute HP-IB commands.

The HP 5371A'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 are successful, the HP 5371A'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 5371A. 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, mark **"PASS"** or **"FAIL"** on the "HP 5371A Performance Test Record" located at the end of this chapter.

THE HP 5371A HP-IB OPERATION VERIFICATION IS NOW COMPLETE.

HP 5371A PERFORMANCE TEST RECORD (Page 1 of 5)

HEWLETT-PACKARD MODEL 5371A FREQUENCY AND TIME INTERVAL ANALYZER	Repair/Work Order No. ______
Serial Number: ______	Temperature: ______
Test Performed By: ______	Relative Humidity: ______
Date: ______	Post-Calibration Test: ☐
Notes: ______	Pre-Calibration Test: ☐

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 5371A PERFORMANCE TEST RECORD (Page 2 of 5)

HEWLETT-PACKARD MODEL 5371A FREQUENCY AND TIME INTERVAL ANALYZER					
Recommended Instrument	Test		Results		
			Minimum	Actual	Maximum
	CHANNEL A AND B TESTS (Continued)				
	Auto Trigger Frequency Range/Dynamic Range/ Accuracy/Signal Operating Range				
3325A	1 KHz	PkAmp Chan A			
	200 mVp-p	Max.	+60 mV	________	+140 mV
	0 V Offset	Min.	–140 mV	________	–60 mV
		PkAmp Chan B			
		Max.	+60 mV	________	+140 mV
		Min.	–140 mV	________	–60 mV
3325A	1 KHz	PkAmp Chan A			
	2 Vp-p	Max.	+1.6 V	________	+2.4 V
	1 V Offset	Min.	–400 mV	________	+400 mV
		PkAmp Chan B			
		Max.	+1.6 V	________	+2.4 V
		Min.	–400 mV	________	+400 mV
3325A	1 KHz	PkAmp Chan A			
	2 Vp-p	Max.	–400 mV	________	+400 mV
	–1 V Offset	Min.	–2.4 V	________	–1.6 V
		PkAmp Chan B			
		Max.	–400 mV	________	+400 mV
		Min.	–2.4 mV	________	–1.6 mV
8663A	200 MHz	PkAmp Chan A			
	71 mVrms (200 mVp-p)	Max.	+60 mV	________	+140 mV
	0 V Offset	Min.	–140 mV	________	–60 mV
		PkAmp Chan B			
		Max.	+60 mV	________	+140 mV
		Min.	–140 mV	________	–60 mV
8663A	200 MHz	PkAmp Chan A			
	10 dBm (2 Vp-p)	Max.	+600 mV	________	+1.4 V
	0 V Offset	Min.	–1.4 V	________	–600 mV
		PkAmp Chan B			
		Max.	+600 mV	________	+1.4 V
		Min.	–1.4 V	________	–600 mV

HP 5371A PERFORMANCE TEST RECORD (Page 3 of 5)

HEWLETT-PACKARD MODEL 5371A
FREQUENCY AND TIME INTERVAL ANALYZER

Recommended Instrument	Test		Results Minimum	Actual	Maximum
	CHANNEL A AND B TESTS (Continued)				
	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 5371A PERFORMANCE TEST RECORD (Page 4 of 5)

HEWLETT-PACKARD MODEL 5371A FREQUENCY AND TIME INTERVAL ANALYZER				
Recommended Instrument	**Test**	**Results**		
		Minimum	**Actual**	**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
	Sensitivity/Minimum Pulse Width			
8161A	5.0 ns Pulse 200.0 ns Period 140 mVp-p 0 V Offset (Square Wave) — Gate Time	199.8 ns	__________	200.2 ns

* A 50Ω feedthrough termination must be connected to the External Arm input.

† TRIGGER LEVEL ACCURACY = $\left[\frac{\text{MAX. TRIGGER LEVEL + MIN. TRIGGER LEVEL}}{2}\right]$ -100mV

HEWLETT-PACKARD MODEL 5371A FREQUENCY AND TIME INTERVAL ANALYZER					
Recommended Instrument	Test		Results		
			Minimum	Actual	Maximum
	OPTION 060 REAR PANEL EXTERNAL ARM TESTS*				
	Frequency Range/Dynamic Range				
3325A	1 Hz 280 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 100 mVrms (280 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
	Sensitivity/ Minimum Pulse Width				
8161A	5.0 ns Pulse 200.0 ns Period 280 mVp-p 0 V Offset (Square Wave)	Gate Time	199.8 ns	______	200.2 ns

* A 50Ω feedthrough termination must be connected to the External Arm input.

† TRIGGER LEVEL ACCURACY = $\left[\frac{\text{MAX. TRIGGER LEVEL + MIN. TRIGGER LEVEL}}{2}\right]$ –100mV

A

MENU REFERENCE GUIDE

APPENDIX A MENU REFERENCE GUIDE

This Appendix has been deleted.

B INSTALLATION

APPENDIX B INSTALLATION

INTRODUCTION

This section provides installation instructions including unpacking, initial inspection, storage, and shipment information for the HP 5371A Frequency and Time Interval 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. Procedures for checking electrical performance are given in Section 18, Performance Tests. 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.

HUMIDITY. The instrument may be operated in environments with humidity from 5% to 95% at 0°C to 40°C. However, the instrument should be protected from temperature extremes which might cause condensation within the instrument.

ALTITUDE. The instrument may be operated at altitudes up to 4,572 metres (15,000 feet).

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 5371A WEIGHS 23.2 KG (51 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 5371A can operate from power sources of 100-, 120-, 220-, or 240-volt ac, +10%, –10%, 50 to 60 Hertz. 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

⚠

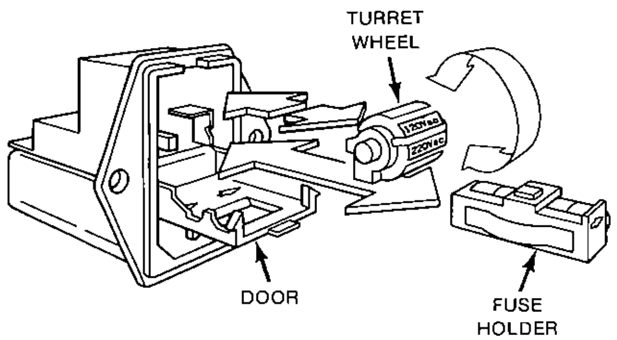
CAUTION

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 5371A to the power source as described in the following paragraph.

The HP 5371A 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 5371A, the turret wheel selector must be set to the correct position and the correct fuse must be installed as described in the following paragraph.

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

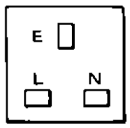
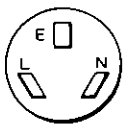
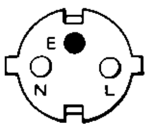
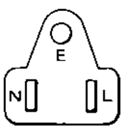
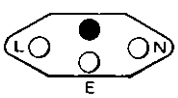
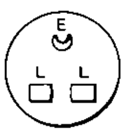
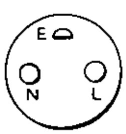
1. Using a small, flat-head screwdriver, snap open the power module door to access the fuse and turret wheel.
2. REMOVE the turret wheel before turning to desired voltage. DO NOT turn turret wheel while installed in module. Push wheel firmly into module slot.
3. To change or install fuse, pull fuse holder and re-insert fuse in holder, using caution to select correct fuse value. Re-insert iuse and holder.
4. Close the power module door. The selected operating voltage is shown 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.	*C D	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, Saudi Arabia, Egypt, So Africa, India (Unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight **NEMA5-15P 90° Straight **NEMA5-15P Straight **NEMA5-15P 90° Straight **NEMA5-15P	80 80 36 80 80 30	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
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

* 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

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 Operating Manual, Appendix B, INSTALLATION.

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.
⏊ OR ⊥	Indicates terminal is connected to chassis when such connection is not apparent.
∼	Alternating current.
⎓	Direct current.

The **WARNING** sign 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.

The **CAUTION** sign 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.**

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 instrument. 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 and 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 metres (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 metres (65 feet).

c. The total number of instruments connected to the bus must not exceed 15.

HP-IB Address Selection

The HP-IB device address of the HP 5371A is selected from the front panel through the SYSTEM Menu screen. 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 Section 12, SYSTEM MENU.

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 HP 5371A 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 5371A 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 5371A 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 and 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 5371A, which weighs 23.2 kg (51 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 metres (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.

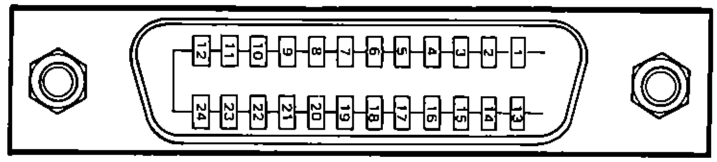
c. Use a layer of shock-absorbing material 70 to 100 mm (3- to 4-inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside container. Protect control panel with cardboard.

d. Seal shipping container securely.

e. Mark shipping container FRAGILE to ensure careful handling.

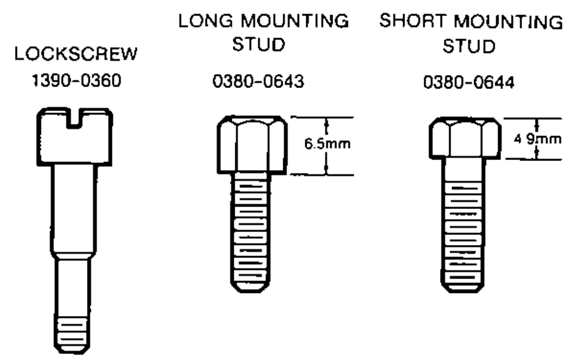
f. In any correspondence, refer to instrument by model number and full serial number.

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 5371A 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

C

STATUS AND
ERROR MESSAGES

APPENDIX C STATUS AND ERROR MESSAGES

INTRODUCTION

Five types of messages appear on the CRT Status Line of the HP 5371A 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.

In addition to the messages listed above, Graphics Subsystem messages appear in the Status Line, but these messages are not described in this manual.

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 5371A'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 5371A 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 5371A. 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 5371A is in the Repetitive Sample mode. The Abort command is valid only when the HP 5371A is in Single Sample mode, so no action takes place.

Alternate Timebase selected. Press RESTART.

Type:	Static Failure	*Associated With:*	Rear Panel External Reference Input
		Error Number:	105

The HP 5371A 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, 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.

Limits, Binary output may have been disabled.

Type: Momentary Status *Associated With:* Parameter Coupling

Limits testing and HP-IB binary output mode are turned off when the Peak Amplitude function is selected. If the HP-IB output mode was binary, it is changed to ASCII.

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+9. When this happens, the entered parameter is allowed, but the other is defaulted to keep the total acquisition size less than 2E+9 measurements. For example, if the Measurement Size is 100 measurements, the maximum Block Size enterable is 20,000,000 (to insure that the total does not exceed 2E+9). If the Measurement Size is increased (so that it is greater than 100), the corresponding Block Size is decreased to keep the total from exceeding 2E+9 measurements.

Calculating measurements.

Type: Static Status *Associated With:* System Operation

This message is displayed while the HP 5371A 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 5371A while it is in the Binary output mode. The HP 5371A 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 5371A 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 5371A 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 5371A while it is in Talk-Only mode. The instrument cannot accept commands via HP-IB while in this mode. To allow the HP 5371A 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 5371A is in Remote mode, but not in Local Lockout (LLO) 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 any HP 5371A front-panel key is pressed while the HP 5371A 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 eliminate the error-causing condition, you can do one or both of the following: 1) change the signal Bias or Attenuation on the Input menu; 2) decrease the input signal level. Restarting the measurement erases the error message.

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 eliminate the error-causing condition, you can do one or both of the following: 1) change the signal Bias or Attenuation on the Input menu; 2) decrease the input signal level. Restarting the measurement erases the error message.

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 eliminate the error-causing condition, you can do one or both of the following: 1) change the signal Bias or Attenuation on the Input menu; 2) decrease the input signal level. Restarting the measurement erases the error message.

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 5371A 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 5371A 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 or Erase

This message occurs when you try to save to or erase a register (0 through 9) whose Write Protect is On. Save to another register, or set Write Protect for the desired register to Off. Write Protect status is shown 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.

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 and Peak Amplitude Measurements

Graphics displays are not allowed when the HP 5371A is making Manually armed Totalize or Peak Amplitude measurements.

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.

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 5371A is in Single Sample mode.

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 5371A 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, see System Menu.

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 5371A to Talk-Only mode on the System menu screen.

Number must be positive.

Type: Momentary Status *Associated With:* Numeric Entry

This message 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 occurs if you do any one of the following after you have begun entering a number using the DATA ENTRY keys: 1) press the LAST VALUE key; 2) turn the ENTRY/MARKER knob; 3) press any of the RESULTS keys; 4) press any of the MENU SELECTION keys; 5) press any INSTRUMENT CONTROL key except PRESET. The parameter that was being entered is restored to its last previous value.

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).

Response timeout occurred, see System Menu.

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).

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 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 Manual Arm...

Type: Static Status *Associated With:* Measurement Status

This message appears when a Totalize measurement with Manual arming is started. The HP 5371A is waiting for the MANUAL ARM key to be pressed which will open the gate.

WARNING: Both freqs 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.

D

MEASUREMENT SUGGESTIONS

APPENDIX D

MEASUREMENT SUGGESTIONS

INTRODUCTION

This appendix provides some helpful information for the operation of the HP 5371A. The topics include:

- Before you start...
- Low frequency measurements
- Select SINGLE mode
- How to speed up measurements
- One use of Time Variation or Event Timing graphs
- Advantages of using Channel A or B input signals as arming signals
- Differences between Continuous Time Interval and Period measurements
- Calibration procedure for HP 54003A 10:1 probe

Before you start

Before you start, think about the signal you want to measure. The HP 5371A has a multitude of arming modes that will allow you to measure your signal. Refer to Section 5, ARMING if you want an explanation of how each arming mode works. Sections 2, 3, and 4 contain timing diagrams for each of the measurements and arming modes.

There are four classes of arming modes:

- Automatic: You don't have to specify anything.
- Holdoff: You specify a delay before the measurement begins.
- Sampling: You specify when the measurements will be sampled.
- Holdoff/Sampling: You specify a delay before the measurement begins; and you specify when the measurements will be sampled.

Low Frequency Measurements

The HP 5371A 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, low frequency signals can cause the HP 5371A to count noisy events, resulting in a miscount and erroneous measurement results. Many signal sources do not provide good frequency response at these low frequencies (in general, 10 MHz, although response varies from source to source). If the HP 5371A is miscounting a low frequency signal, it could be the result of a noisy source. Here are three 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 an 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 (see INPUT menu screen) 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.

Select SINGLE mode

It can be helpful when configuring the HP 5371A or reviewing measurement results to have the instrument in the single acquisition mode. When set to SINGLE, the instrument will execute one measurement sequence (the total number of of measurements as defined on the FUNCTION menu screen) and stop. Another measurement sequence will start only when a parameter is changed on the FUNCTION, INPUT, or MATH screens, or when the RESTART key is pressed.

How to Speed Up Measurements

Your measurements will go faster if you don't need the some of the post-processing features. To increase the measurement rate of the HP 5371A:

- Set Statistics to OFF (MATH screen)
- Set Math to OFF (MATH screen)
- Set Limits to OFF (MATH screen)
- Use Manual or Single Auto trigger mode (INPUT screen)
- If block size is greater than one, set Histogram Update to After on the Display Options screen (GRAPHIC key).

One Use of Time Variation and Event Timing Graphs

If you want to make a measurement that is held off for some number of events until the events of interest occur, and you don't know how many events to delay by, do the following:

- Make a measurement that includes all the events (measurement size can be set to 1000, maximum)
- Use Single acquisition mode (press the SINGLE/REPET key, the SINGLE LED will turn on) and make one measurement sequence (for this example, one block of 1000 measurements).
- Use the markers to display how many events occurred prior to the events of interest.
- Select an arming mode that delays the measurement by events (Event Holdoff, Event/Interval, Event/Event)
- Use the number of events displayed on the graphs as the start delay count.

Single-Shot Measurements

When making single-shot measurements, it is important to note the following:

The HP 5371A sets auto trigger levels before it begins a block of measurements. If a measurement event (for example, an external trigger edge) occurs while the auto trigger routine is setting trigger levels, the measurement event will not be detected by the HP 5371A. Use manual trigger mode to set trigger levels.

Advantages of Using Channel A and B as Arming Signals

Three advantages of using the A or B input for arming instead of the External Arm input are:

- Auto trigger capabilities on Channel A and B. Ext Arm can only be manually set.
- A choice of pod impedance vs. a fixed 1-MΩ for Ext Arm.
- 500 MHz bandwidth for Channel A or B compared to 100 MHz for Ext Arm.

Continuous Time Interval vs. Period Measurements

Electrically, there is no difference in the way continuous time interval measurements and period measurements are made. The difference lies in the arming selections available for these two functions and the post-processing of the data after a measurement has been made.

ARMING SELECTIONS

The arming selections for period measurements and continuous time interval measurements vary only slightly. For example, the period function offers no holdoff arming mode options, while the continuous time interval function does. On the other hand, the period function offers a wider variety of Sampling Arming modes and Holdoff/Sampling Arming modes.

POST-PROCESSING OF DATA

The displayed result for a period measurement is an averaged result:

Result = GATE TIME/NUMBER OF EVENTS

The displayed result for a continuous time interval measurement is:

Result = GATE TIME

Calibration Procedure for 10:1 Probe

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

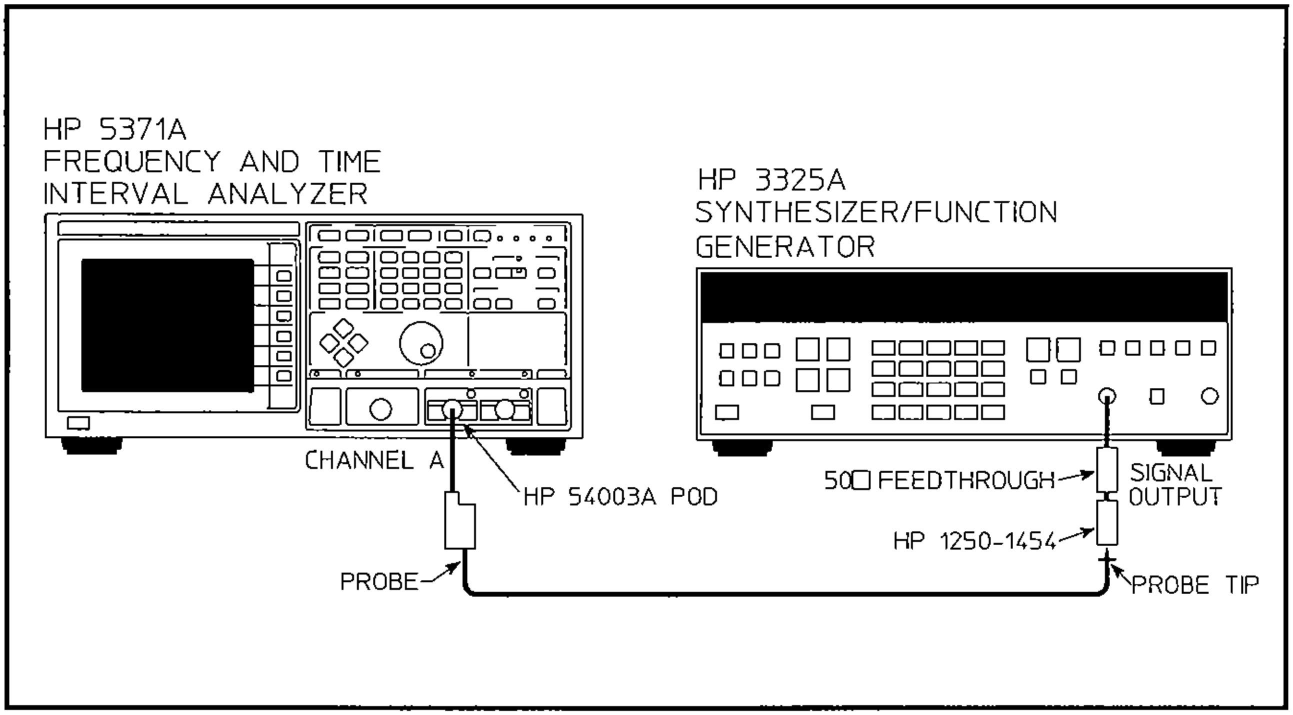


Figure D-1. HP 10017A 10:1 Probe Calibration Setup

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 5371A to Peak Amplitude 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 reach a minimum and stop decreasing.
6. Adjust probe capacitor in the opposite direction from step 5 until peak readings 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%.

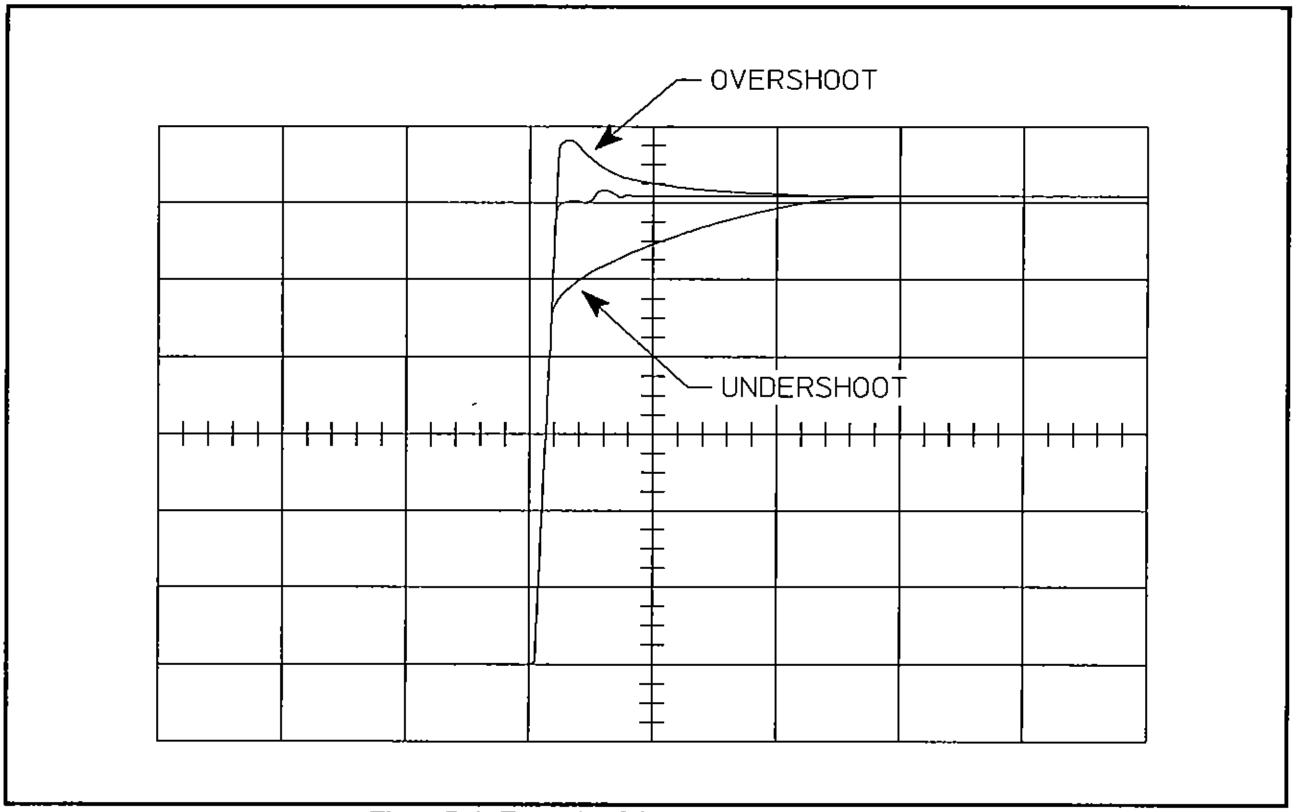


Figure D-2. Example of Overshoot and Undershoot

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 5371A to make erroneous measurements.

During the calibration procedure, the shape of the waveform being measured by the HP 5371A is changing. As the probe capacitor is adjusted, the waveform is similar to those 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.

E SPECIFICATIONS

APPENDIX E SPECIFICATIONS

Table of Contents

All data and specifications subject to change.

INPUT SPECIFICATIONS

Channel A and B:

All frequencies refer to sinusoidal signals, except where noted.

INPUT PODS

The following specifications refer to pods installed in an HP 5371A system.

	HP 54002A	HP 54001A	HP 54003A with 10:1 probe	HP 54003A without 10:1 probe
Coupling	dc	dc	dc	dc
Input Capacitance (NOMINAL)	N/A	2 pf	8 pf	10 pf
Input Resistance (NOMINAL)	50Ω	10 kΩ	1 MΩ	1 MΩ
Bandwidth (–3dB)	dc to 500 MHz	dc to 500 MHz	dc to 300 MHz	dc to 300 MHz
Maximum Input Voltage X 1: X 2.5:	 ±2V ±5V	 ±20V N/A	 ±20V N/A	 ±2V N/A

The following specifications refer to an HP 5371A with HP 54002A pods installed.

RANGE:

dc coupled to 500 MHz.

SENSITIVITY:

Independent of SEPARATE or COMMON Input Mode selection.

15 mV rms sine wave (45 $mV_{pk\text{-}pk}$).

45 $mV_{pk\text{-}pk}$ at a minimum pulse width of 1 ns.

MINIMUM PULSE WIDTH:

For all measurement modes except Holdoff Arming: 1 ns (at a minimum amplitude of 45 $mV_{pk\text{-}pk}$).

Holdoff Arming modes: 1.5 ns (at a minimum amplitude of 45 $mV_{pk\text{-}pk}$).

ATTENUATOR:

X1 or X2.5, selectable, for 50Ω termination to ground (HP 54002A Input pod only).

X1 only for 50Ω termination to –2 Vdc (NOMINAL), or for HP 54001A and HP 54003A Input pods.

ATTENUATOR ACCURACY:

X1: Direct connection.

X2.5: ± 5 %.

DYNAMIC RANGE:

X1: 45 $mV_{pk\text{-}pk}$ to 2 $V_{pk\text{-}pk}$.

X2.5: 115 $mV_{pk\text{-}pk}$ to 5 $V_{pk\text{-}pk}$ NOMINAL.

SIGNAL OPERATING RANGE:

X1: -2 Vdc < dc ± ac pk < $+2$ Vdc.

X2.5: -5 Vdc < dc ± ac pk < $+5$ Vdc NOMINAL.

⚠ **DAMAGE LEVEL:**

X1: ± 2.5 V (dc ± ac pk).

X2.5: ± 5.5 V (dc ± ac pk).

Input Triggering Characteristics

	Manual Triggering	Auto Triggering (Single or Repetitive)
Voltage Range:		
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:	dc to 500 MHz (HP 54001A, HP 54002A) dc to 300 MHz (HP 54003A)	1 kHz to 200 MHz*
Resolution:		
X1:	2 mV NOMINAL	1% steps (2 mV minimum)
X2.5:	5 mV NOMINAL	1% steps (5 mV minimum)
Accuracy:	20 mV ± 1% of setting	±20% of pk-pk amplitude (200 $mV_{pk\text{-}pk}$ minimum)

* For input frequencies greater than 200 MHz, auto triggering modes are functional, but accuracy specifications are not guaranteed.

Auto trigger modes require a repetitive input signal and are available for input channels A and B.

For input frequencies greater than 200 MHz, auto trigger modes are functional, but accuracy specifications are not guaranteed.

SINGLE AUTO TRIGGER MODE:

The HP 5371A determines voltage trigger levels automatically at the beginning of the first block of measurements. These trigger levels are maintained for subsequent blocks in the measurement.

REPETITIVE AUTO TRIGGER MODE:

The HP 5371A determines voltage trigger levels at the beginning of each measurement block.

AUTO TRIGGER ACQUISITION TIME:

100 msec (NOMINAL) per channel, 200 msec (NOMINAL) for two-channel measurements. Auto triggering will only be performed for channels which are currently selected as measurement sources on the FUNCTION menu.

TRIGGERING INDICATOR:

An LED for each respective input: A, B, and External Arm, will flash when a signal is triggering the input circuitry. The LED will not flash if the signal does not cross the trigger threshold.

TRIGGER LEVEL DRIFT:

Less than ± 10 mV (0 – 40°C).

INPUT MODE SELECTION:

Separate: User-selectable and programmable. Each input channel A and B is connected directly to its respective input circuitry.

Common A: User-selectable and programmable. Input channel A signals are also routed to the input channel B count circuitry. Input channel B is terminated per the INPUT menu selection. Termination characteristics are maintained to the device under test, while signal amplitude is maintained to both input channels.

External Arm Input:

In addition to the External Arm input, both input channels A and B may also be used as high performance arming inputs.

RANGE:

dc coupled to 100 MHz.

SENSITIVITY:

50 mV rms sine wave.

140 $mV_{pk\text{-}pk}$ at a minimum pulse width of 5 ns.

MINIMUM PULSE WIDTH:

5 ns (at a minimum amplitude of 140 $mV_{pk\text{-}pk}$).

IMPEDANCE:

1 MΩ NOMINAL, shunted by < 50 pf.

DYNAMIC RANGE:

50 $mV_{pk\text{-}pk}$ to 5 $V_{pk\text{-}pk}$.

SIGNAL OPERATING RANGE:

–5 Vdc < dc ± ac pk < + 5 Vdc.

DAMAGE LEVEL:

5 V rms (±15 $V_{pk\text{-}pk}$, dc ± peak ac).

TRIGGER LEVEL RANGE:

Adjustable from –5.00 Vdc to +5.00 Vdc in 20 mV steps.

TRIGGER LEVEL RESOLUTION:

20 mV NOMINAL.

TRIGGER LEVEL ACCURACY:

±20 mV or ± 10% of trigger level setting, whichever is greater.

MEASUREMENT MODE SPECIFICATIONS

Continuous Frequency Measurements:

The minimum continuous sample interval is 100 ns (10 MHz sample rate) for single-channel measurements, and 200 ns (5 MHz sample rate) for two-channel measurements. Sample intervals less than 100 ns are available, but measurements will not be contiguous.

The HP 5371A offers one- and two-channel measurement features for frequency. The following single-result and dual-result arithmetic combinations of frequency measurements are available for display and analysis:

- Frequency A (single-result).
- Frequency B (single-result).
- Frequency A&B (dual-result).
- Frequency A+B (single-result).
- Frequency A-B (single-result).
- Frequency B-A (single-result).
- Frequency A/B (single-result).
- Frequency B/A (single-result).

Accuracy and resolution equations apply to both input channels.

Frequency measurements are acquired simultaneously for all two-channel measurements. Measurement throughput is dictated by the lower frequency input signal.

RANGE:

Frequency A,B: 125 mHz to 500 MHz.

Frequency A&B, A+B, A–B, B–A: 250 mHz to 500 MHz.

FOR A SINGLE MEASUREMENT:

LEAST SIGNIFICANT DIGIT DISPLAYED:

$$\pm\frac{200\text{ps}}{\text{Sample Interval}} \times \text{Frequency}$$

RESOLUTION:

$$\pm\frac{150\text{ps rms} + (1.4 \times \text{Trigger Error})}{\text{Sample Interval}} \times \text{Frequency}^{\dagger}$$

ACCURACY:

$$\pm\text{Resolution} \pm (\text{Time Base Aging} \times \text{Frequency})^{\ddagger}$$

† Refer to graph 1
‡ Refer to graph 2

FOR CONTINUOUS FREQUENCY MEASUREMENTS (MEAN ESTIMATION):

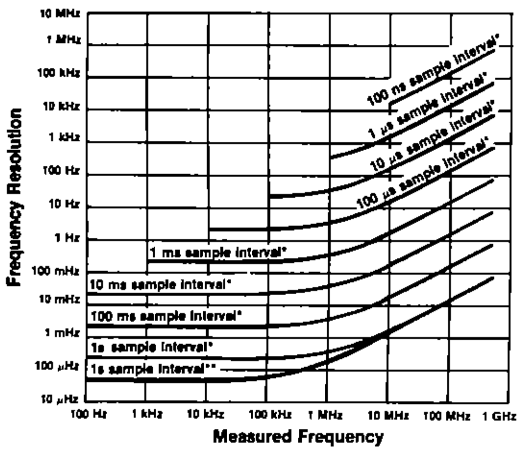
rms RESOLUTION: (for Number of Measurements per Block ≥ 3)

$$\frac{\sqrt{13.5} \times (150\text{ps rms} + 1.4 \times \text{Trigger Error})}{(\text{Number of Blocks})^{1/2} \times (\text{Number of Measurements per Block})^{3/2} \times \text{Sample Interval}} \times \text{Frequency}$$

ACCURACY:

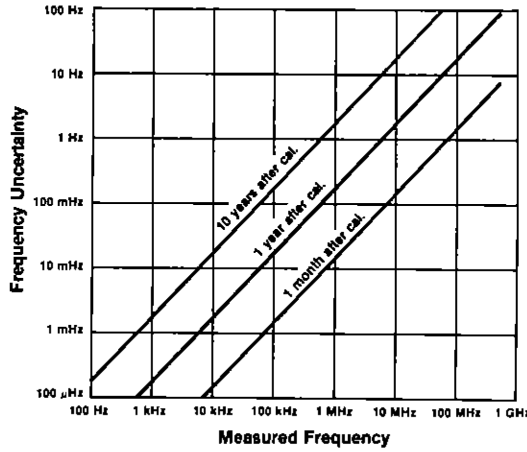
$$\pm\text{Resolution} \pm (\text{Time Base Aging} \times \text{Frequency})^{\ddagger}$$

† Refer to graph 1
‡ Refer to graph 2



*1 mV rms noise, 2 Vp-p sine wave
**100 μV rms noise, 2 Vp-p sine wave

Graph 1. Noise on the input signal will add uncertainty to Frequency or Period measurement resolution. Longer sample times and averaging will reduce the effects of random noise.



Graph 2. Timebase crystal aging affects Frequency and Period measurement accuracy. You can further reduce aging uncertainty by using an atomic standard.

Continuous Period Measurements:

The HP 5371A offers one- and two-channel period measurement features. The following single-result and dual-result arithmetic combinations of period measurements are available for display and analysis:

- Period A (single-result).
- Period B (single-result).
- Period A&B (dual-result).
- Period A+B (single-result).
- Period A-B (single-result).
- Period B-A (single-result).
- Period A/B (single-result).
- Period B/A (single-result).

Accuracy and resolution equations apply to both input channels.

Period measurements are acquired simultaneously for all two-channel measurements. Throughput is dictated by the lower frequency (larger period) input signal.

RANGE:

Period A,B: 2 ns to 8.0 seconds.

Period A&B, A+B, A–B, B–A: 2 ns to 4.0 seconds.

FOR A SINGLE MEASUREMENT:

LEAST SIGNIFICANT DIGIT DISPLAYED:

$$\pm\frac{200\text{ ps}}{\text{Sample Interval}} \times \text{Period}$$

RESOLUTION:

$$\pm\frac{150\text{ ps rms} + (1.4 \times \text{Trigger Error})}{\text{Sample Interval}} \times \text{Period}$$

ACCURACY:

$$\pm\,\text{Resolution} \pm (\text{Time Base Aging} \times \text{Period})$$

FOR CONTINUOUS PERIOD MEASUREMENTS (MEAN ESTIMATION):

rms RESOLUTION: (for Number of Measurements per Block ≥ 3)

$$\frac{\sqrt{13.5} \times (150\text{ps rms} + 1.4 \times \text{Trigger Error})}{(\text{Number of Blocks})^{1/2} \times (\text{Number of Measurements per Block})^{3/2} \times \text{Sample Interval}} \times \text{Period}$$

ACCURACY:

$$\pm\,\text{Resolution} \pm (\text{Time Base Aging} \times \text{Period})$$

Frequency or Period Ratio Measurements A/B or B/A:

The following equations apply for frequency or period A/B and B/A measurements:

RANGE:

250 mHz to 500 MHz (2 ns to 4.0 seconds).

LEAST SIGNIFICANT DIGIT DISPLAYED:

$$\pm\frac{200\text{ ps}}{\text{Sample Interval}}$$

RESOLUTION:

$$\pm\text{RATIO} \times \frac{150 \text{ ps rms} + (1.4 \times \text{Trigger Error})}{\text{Sample Interval}}$$

ACCURACY:

$$\pm\text{Resolution} \pm \frac{\text{Timebase Aging} \times \text{Frequency A}}{\text{Timebase Aging} \times \text{Frequency B}}$$

Totalize Measurements:

The HP 5371A offers one- and two-channel measurement features for totalize. The following single-result and dual-result arithmetic combinations of totalize measurements are available for display and analysis:

Totalize A (single-result).
Totalize B (single-result).
Totalize A&B (dual-result).
Totalize A + B (single-result).
Totalize A-B (single-result).
Totalize B-A (single-result).
Totalize A/B (single-result).
Totalize B/A (single-result).

Accuracy and resolution equations apply to both input channels.

Totalize measurements are acquired simultaneously for all two-channel measurements.

RANGE:

0 to 4×10^9 events per measurement sample, for each channel.

LEAST SIGNIFICANT DIGIT DISPLAYED:

1 count of input per measurement sample, for each channel.

RESOLUTION:

± 1 count of input per measurement sample, for each channel.

For A/B, B/A:

$$\pm\frac{(\text{Totalize Result A} \pm 1)}{(\text{Totalize Result B} \mp 1)}$$

ACCURACY:

± 1 count of input per measurement sample, for each channel.

For A/B, B/A:

$$\pm\frac{(\text{Totalize Result A} \pm 1)}{(\text{Totalize Result B} \mp 1)}$$

Time Interval Measurements:

The HP 5371A is capable of measuring consecutive time intervals up to a 10 MHz rate for period type interval measurements (Continuous Time Interval A or B), and 5 MHz for two channel measurements such as Time Interval A→B.

If data rates exceed these values, the number of events which do not have timing information are noted on the NUMERIC display in the EXPANDED results display.

The following Time Interval measurement configurations are available:

Time Interval, ±Time Interval, Continuous Time Interval A (single-result).

Time Interval, ±Time Interval, Continuous Time Interval B (single-result).

Time Interval and ± Time Interval A→B (single-result).

Time Interval and ± Time Interval B→A (single-result).

RANGE:

Time Interval: 10 ns to 8.0 seconds

Continuous Time Interval: 100 ns to 8.0 seconds

± Time Interval: – 4.0 seconds to + 4.0 seconds, including 0 seconds.

LEAST SIGNIFICANT DIGIT DISPLAYED:

N = number of measurements averaged.

$$\pm\frac{200 \text{ ps}}{\sqrt{N}}$$

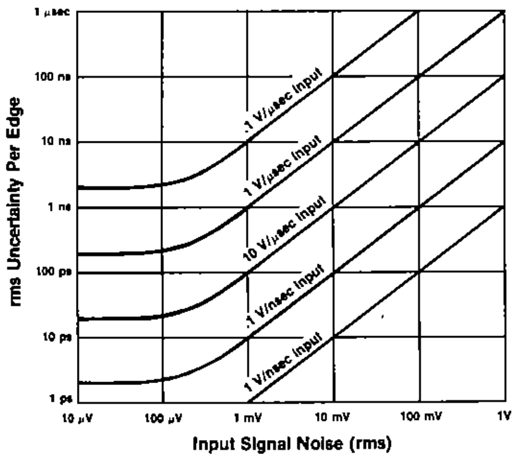
RESOLUTION:

$$\pm\frac{150 \text{ ps rms} \pm \text{Start Trigger Error}^{\dagger} \pm \text{Stop Trigger Error}^{\dagger}}{\sqrt{N}}$$

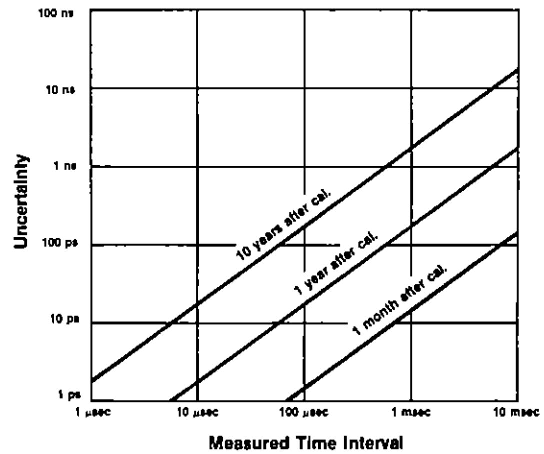
ACCURACY:

$$\pm\text{RESOLUTION} \pm (\text{Time Base Aging} \times \text{Time Interval}^{\dagger\dagger}) \pm \text{Trigger Level Timing Error}^{\ddagger} \pm 1 \text{ ns Systematic Error}^{*}$$

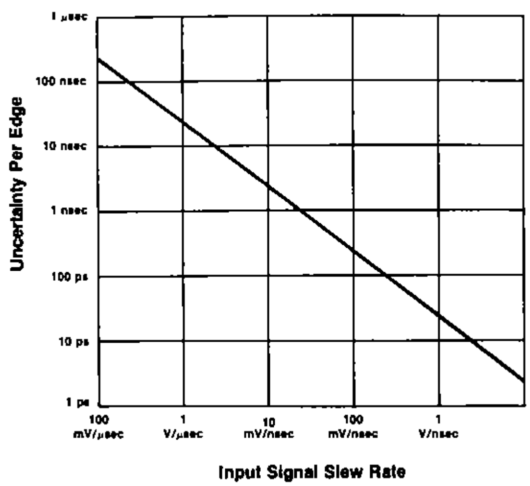
† Refer to Graph #3.
†† Refer to Graph #4.
‡ Refer to Graph #5.
* Systematic error can be reduced to less than 10 ps with the HP J06-59992A Time Interval Calibrator.



Graph 3. Noise on the input signal will add uncertainty to time interval measurements. Averaging will reduce the effects of random noise.



Graph 4. Timebase crystal aging affects time interval measurements.



Graph 5. Trigger level timing error varies with input signal slew rate. Uncertainty is associated with both start and stop edges.

Rise Time A and Fall Time A:

Common A and Repetitive Auto Trigger are automatically enabled for these measurements. Trigger points are defaulted to the 20% and 80% points of the peak-to-peak amplitude for rise time (or 80% and 20% for fall time). All trigger values are NOMINAL. Other trigger values may be selected from the INPUT menu.

Rise time and fall time measurements are two-channel, single-result measurements.

RANGE:

1 ns to 100 μs transitions (auto trigger).

4 s period slowest repetition rate (manual trigger).

MINIMUM PULSE HEIGHT (X1 Attenuation):

200 mV_{pk-pk} (auto trigger).

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:

$\pm$RESOLUTION $\pm$ (Time Base Aging $\times$ Rise Time) $\pm$ Trigger Level Timing Error $\pm$ 1 ns Systematic Error

Positive and Negative Pulse Width A:

Common A and Repetitive Auto Trigger are automatically enabled for these measurements. Trigger points are defaulted to the 50% (NOMINAL) point of the peak-to-peak amplitude. Trigger levels can then be varied on the INPUT menu if desired.

Positive and negative pulse width measurements are two-channel, single-result measurements.

RANGE:

1 ns to 1 ms pulse width (auto trigger).

4 s period slowest repetition rate (manual trigger).

MINIMUM PULSE HEIGHT (X1 Attenuation):

200 $mV_{pk\text{-}pk}$ (auto trigger).

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:

$\pm$RESOLUTION $\pm$ (Time Base Aging $\times$ Pulse Width) $\pm$ Trigger Level Timing error $\pm$ 1 ns Systematic Error

Duty Cycle A:

Common A and Repetitive Auto Trigger are automatically enabled for these measurements. Trigger points are defaulted to the 50% (NOMINAL) point of the peak-to-peak amplitude. Trigger levels can then be varied on the INPUT menu if desired.

Duty cycle A consists of simultaneous positive pulse width and period measurements on input channel A. Duty cycle A measurements are made continuously, or consecutively to a maximum rate of 5 MHz.

Duty cycle A is a two-channel, single-result measurement.

RANGE:

0% to 100% (provided pulse width is > 1 ns, and signal period is:
- < 1 ms (auto trigger)
- < 4 s (manual trigger)

MINIMUM PULSE HEIGHT (X1 Attenuation):

200 $mV_{pk\text{-}pk}$ (auto trigger).

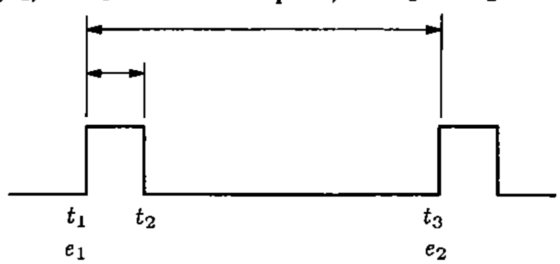
LEAST SIGNIFICANT DIGIT DISPLAYED:

$$\pm\frac{200\ \text{ps}}{\text{Period}} \times 100\%$$

RESOLUTION:

$$\pm\text{DUTY CYCLE} \times \left(150\ \text{ps rms} \pm (1.4 \times \text{Trigger Error})\right) \times \sqrt{\frac{1}{(t_2 - t_1)^2} + \frac{1}{(t_3 - t_1)^2}}$$

where t_1, t_2, and t_3 are time "samples", and e_1 and e_2 are event "samples".



$$\text{Duty Cycle} = \frac{(t_2 - t_1)}{(t_3 - t_1)} \times (e_2 - e_1) \times 100\%$$

ACCURACY:

$$\pm\text{Resolution} \pm \left(\frac{\text{TLTE} \pm 1\ \text{ns}}{\text{Period}}\right) \times 100\%$$

Note : TLTE ≡ Trigger Level Timing Error

Phase A-relative-to-B, Phase B-relative-to-A:

Repetitive Auto Trigger is automatically enabled for this measurement. Trigger points are defaulted to the 50% (NOMINAL) point of the peak-to-peak amplitude for both input channels A and B. Trigger levels can then be varied on the INPUT menu if desired.

Phase measurements are made continuously, or back-to-back, up to a rate of 5 MHz. Phase measurements are two-channel, single-result measurements.

RANGE:

Phase deviations can be measured in excess of ± 360°. Results are not adjusted modulo 360°, therefore phase shifts greater than 360° will be measured and displayed. The input signal's period must be less than 4 seconds (minimum frequency 250 mHz).

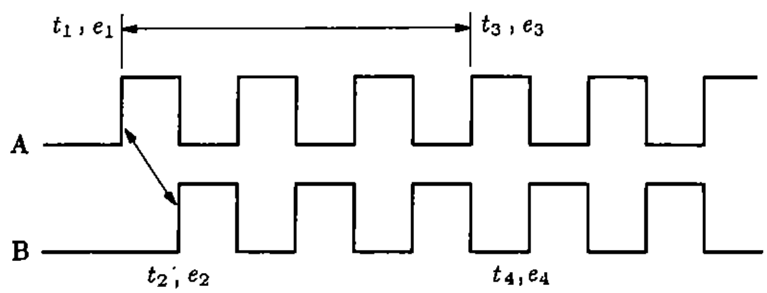
LEAST SIGNIFICANT DIGIT DISPLAYED:

$$\pm\frac{200\ \text{ps}}{\text{Period}} \times 360^\circ$$

RESOLUTION: A relative to B (B relative to A)

$$\pm\text{PHASE} \times \left(150\ \text{ps rms} \pm (1.4 \times \text{Trigger Error})\right) \times \sqrt{\frac{1}{(t_2 - t_1)^2} + \frac{1}{(t_3 - t_1)^2}}$$

where t_1, t_2, and t_3 are time "samples" and e_1, e_2, and e_3 are event "samples".



Phase B relative to A

$$\text{Phase} = \left[\frac{(t_2 - t_1)}{(t_3 - t_1)} \times (e_3 - e_1) + ((e_3 - e_1) - (e_4 - e_2))\right] \times 360^\circ$$

ACCURACY: (A relative to B) (B relative to A)

$$\pm\text{Resolution} \pm \left(\frac{\text{TLTE} \pm 1\ \text{ns}}{\text{Period}}\right) \times 360^\circ$$

Peak Amplitudes A,B:

FREQUENCY RANGE:

1 kHz to 200 MHz.

AMPLITUDE RANGE:

200 $mV_{pk\text{-}pk}$ to 2 $V_{pk\text{-}pk}$ (X1 Attenuation).

RESOLUTION:

X1: 2 mV NOMINAL.

X2.5: 5 mV NOMINAL.

ACCURACY:

± 20% of peak-to-peak amplitude, 1 kHz to 200 MHz.

Note: The peak amplitude measurement mode is operational for frequencies between 200 MHz and 500 MHz, but accuracy is not guaranteed.

ARMING, GATING AND "TRIGGERING" CHARACTERISTICS

The HP 5371A features extensive arming and triggering capabilities. These capabilities allow you to control measurements in the following ways:

- external edge
- specified time holdoff or gate
- specified event holdoff or gate
- specified number of cycles of the input or the internal time base
- parity
- manual

Input channels A, B or External Arm may be used to arm the HP 5371A. Input channels A and B offer higher performance (500 MHz bandwidth) versus the External Arm channel (100 MHz).

Time or event delays are relative to a specified edge on any of the three input channels.

For certain arming modes, a 2 ns resolution time holdoff or gate time is available. This high resolution time sampling mode is called "TIME". For other time sampling modes, a lower resolution mode is used. This type of time sampling is termed "INTERVAL". INTERVAL sampling can be used for continuous measurements, while the 2 ns resolution TIME sampling is only available for non-continuous measurements.

AUTOMATIC Arming and Sampling:

The particular hardware configuration for this arming mode is defaulted to the fastest mode possible for the particular function. Each measurement begins as soon as the HP 5371A internal processor has configured the measurement.

EDGE Holdoff and Sampling:

Holdoff and sampling can be armed or "triggered" with a signal edge on input channels A , B, or External Arm. The slope of this edge is specified on the FUNCTION menu, while the trigger voltage is specified on the INPUT menu.

EDGE ARMING SETUP TIME:

30 ns TYPICAL.

EVENT Arming and Gating

Event holdoffs and gating are counted on the Input A or Input B channel. All event holdoffs and gates are referenced to an input signal edge on Channel A, B, or External Arm.

RANGE:

0 to 4 $\times 10^9$. If 0 is specified, the arming defaults to the edge arming mode.

RESOLUTION:

± 1 count of input signal.

EVENT ARMING SETUP TIME:

Upon the completion of the event holdoff, a setup time of < 25 ns is required before the measurement is armed.

TIME Arming and Gating:

The Time holdoff is referenced to an input signal edge on input channels A, B, or External Arm.

RANGE:

2 ns to 8.0 seconds.

RESOLUTION:

2 ns.

ACCURACY:

± 2 ns + (systematic uncertainty <25 ns)

TIME ARMING SETUP TIME:

Upon the completion of the time holdoff, a setup time of < 25 ns is required before the measurement becomes armed.

INTERVAL Sampling:

RANGE:

600 ns to 8.0 seconds.

RESOLUTION:

600 ns to 10 ms : 200 ns

10 ms to 100 ms : 2 μs

100 ms to 1 second : 20 μs

1 second to 8.0 second : 200 μs

Note that this refers to the "settability" of the sample interval. Actual measurement intervals are displayed with 200 ps LSD. In addition, the HP 5371A uses a reciprocal counting technique which synchronizes measurements to the input signal. Therefore, actual measurement gates will vary depending on the relative synchronization of the input signal.

SETUP DELAY:

The first INTERVAL will begin < 800 ns after the HP 5371A is armed.

CYCLE Sampling:

The CYCLE sampling mode uses prescaled counts of an input signal on channel A or B, or the internal 500 MHz timebase to arm measurement samples. CYCLE sampling on an input channel offers essentially a continuous EVENT sampling mode, while using the CYCLE mode with the 500 MHz timebase offers a high precision continuous time sampling mode. Each prescale value has a minimum specified input frequency at which it can be used. The available prescale ratios and the associated minimum operating frequencies are listed below:

Cycles	*Minimum Cycle Input Frequency*
2^{28} (268,435,456)	33,554,432 Hz
2^{24} (16,777,216)	2,097,152 Hz
2^{20} (1,048,576)	131,072 Hz
2^{16} (65,536)	8,192 Hz
2^{12} (4,096)	512 Hz
2^{8} (256)	32 Hz
2^{4} (16)	2 Hz

The 2^4 prescale factor is not recommended for input frequencies above 160 MHz, as it results in non-continuous measurements.

RESOLUTION:

2ns, or 1 edge of input.

PARITY Sampling:

Parity is a sample arming condition that arms a measurement after a signal edge on both input channels A and B has been detected. This mode is useful when measuring time intervals between edges that lead and follow one another randomly.

The parity sampling mode is available for ± Time Interval A→B and B→A measurements only.

PARITY MODE FREQUENCY RANGE:

Parity sampling is available for input signal frequencies from 125 mHz to 100 MHz.

EXTERNALLY GATED Sampling:

The frequency, period, or totalize sampling interval can be controlled by the leading and trailing edges of an external pulse on input channels A, B, or External Arm.

GATE WIDTH RANGE:

10 ns to 8.0 seconds.

SETUP DELAY:

30 ns TYPICAL.

AMPLITUDE:

The gating signal must meet dynamic range specifications for the input channel.

When using the EXTERNAL GATE mode with the TOTALIZE function, the maximum repetition rate of the external gating signal is 2.5 MHz.

MANUAL Sampling:

For TOTALIZE measurements the sampling of the totalize count occurs when the front panel MANUAL ARM key is pressed, or when the HP-IB commands GET (Group Execute Trigger) or *TRG (Trigger) are received.

MATH, STATISTICS, AND ANALYSIS FEATURES

Math:

Computations can be automatically performed on each measurement result in order to scale results to appropriate values. Separate math values are available for input channels A and B. Other instrument functions such as statistics, limit checking, and graphics are performed on this processed data.

The math functions are applied in the following manner:

$$\text{Math Result} = \left[\frac{\text{MEASUREMENT RESULT} - \text{Reference}}{\text{Normalize}} + \text{Offset}\right] \times \text{Scale}$$

NORMALIZE:

Raw measurement results, less the reference value, are divided by the NORMALIZE value. This value may not be 0.

Negative Range: -1×10^{12} < NORMALIZE value < -1×10^{-12}.

Positive Range: 1×10^{-12} < NORMALIZE value < 1×10^{12}.

Resolution: 10 digits.

Default value: 1.

OFFSET:

The OFFSET value is added to the normalized result.

Negative Range: -1×10^{12} < OFFSET value < -1×10^{-12}.

Positive Range: 1×10^{-12} < OFFSET value < 1×10^{12}, and 0.

Resolution: 10 digits.

Default value: 0.

SCALE:

After normalize and offset processing, the result will be multiplied by the SCALE value.

Negative Range: -1×10^{12} < SCALE value < -1×10^{-12}.

Positive Range: 1×10^{-12} < SCALE value < 1×10^{12}, and 0.

Resolution: 10 digits.

Default value: 1.

SET REFERENCE:

Set Reference is a constant value subtracted from each measurement result. The subtraction operation is performed before other math operations. Set Reference differs from the Offset value in that it is entered as the mean of the last sample set if statistics are enabled, or the last measurement value if statistics are disabled. The Set Reference value cannot be entered directly from the numeric keypad. Separate reference values are available for input channels A and B. Clear Reference sets the reference value to 0.

Default value: 0

LIMIT TEST:

Upper and lower limit values may be specified for each input channel A and B. Limit comparison is performed after the measurement block has been acquired. Measurements falling outside of the user-defined limits will be indicated on a numeric display. In addition, a bit will be set in the HP-IB status register, indicating an out-of-limit occurrence. Limit values are also denoted on the Time Variation and Histogram displays.

Negative Range: -1×10^{12} < LIMIT value < -1×10^{-12}.

Positive Range: 1×10^{-12} < LIMIT value < 1×10^{12}, and 0.

Resolution: 1×10^{-12}.

Statistics:

The following statistical values are available on a HP 5371A numeric display:

Mean

Minimum Value

Maximum Value

Variance

Standard Deviation

rms (Root Mean Square)

Allan Variance

Root Allan Variance (square root of the Allan Variance calculation).

Measurement sample sizes to 2 billion measurements are available (2 million, 1000 measurement blocks).

In addition, statistics on subsets of measurement data can be computed on the Histogram display. These statistics are: Mean, Minimum, Maximum, and Standard Deviation.

Graphic Analysis:

HISTOGRAM

Histograms, or probability density distributions, can be displayed for all measurement types. The user can define minimum and maximum limits for the histogram, or an auto-scaling feature can be used to scale the bin values. Linear or logarithmic scaling may be selected for the vertical axis. Measurements are acquired in blocks of up to 1000 measurements. Larger sample sizes may be obtained by specifying multiple blocks of measurements. The histogram can then be made to "grow" (accumulate) with each new block of data. Specific measurements are retained for the most recent measurement block.

The minimum and maximum values, as well as the number of bins may be defined by the user. The following number of bins are available: 5, 25, 125, 250, 500, and 1000.

TIME VARIATION

The Time Variation plot displays measurement values versus their time of occurrence. Measurement sizes up to 1000 measurements may be acquired and displayed.

The time variation display shows up to 125 separate values. These data points are connected by a line. For displays greater than 125 measurements, each measurement is depicted by a dot, while a line shows an average value of these measurement values. The "zoom" feature can then be used to magnify the display until 125 measurements are displayed on the screen. The dot is placed at the time of the completion of the measurement.

EVENT TIMING

The Event Timing graph depicts the starting and ending time of each time interval measurement. Start values are denoted with an upward tick mark while stop values are denoted with a downward tick mark. Up to 250 start and 250 stop points can be displayed separately on this graph. Measurement sizes up to 1000 measurements can be analyzed with this graph.

MEMORY

The HP 5371A queues measurements in an internal memory. The memory size (block size) is as follows:

1000 MEASUREMENTS:
Frequency, Period, Totalize A B A+B A–B B–A A/B B/A
Time Interval A B A→B B→A
± Time Interval A B A→B B→A
Continuous Time Interval A B
Rise/Fall Time A
Positive/Negative Pulse Width A
Phase A rel B B rel A
Duty Cycle A

500 MEASUREMENTS
Frequency, Period, Totalize A&B

1 MEASUREMENT
Peak Amplitudes A,B

When using the binary HP-IB output mode, the available measurement memory is increased to 4095 measurements (2047 for dual result measurements). Processing of these samples can then be performed on the raw data to compute the appropriate measurement results, using an instrument controller.

REAR PANEL SPECIFICATIONS

Option 060 Rear Panel Inputs:

50Ω, BNC inputs for channel A and channel B and a 1 MΩ, BNC input for External Arm are available on the HP 5371A rear panel with Option 060. Input pods are not available with Option 060 installed (HP 54002A pods are deleted from the Option 060 configuration). Input channel A and B performance is equivalent to front panel performance for this configuration. External Arm performance for the Option 060 configuration is as follows:

Range: dc coupled to 100 MHz.

Sensitivity: 100 mV rms sine wave.

280 mV_{pk-pk} at a minimum pulse width of 5 ns.

Minimum Pulse Width: 5 ns (at a minimum amplitude of 280 mV_{pk-pk}).

Impedance: 1 MΩ NOMINAL, shunted by < 100 pf.

Dynamic Range: 280 mV_{pk-pk} to 5 V_{pk-pk}, dc to 20 MHz.

280 mV_{pk-pk} to 2.5 V_{pk-pk}, 20 MHz to 100 MHz.

Signal Operating Range: ± 5 Vdc.

⚠ **Damage Level:** 5 Vrms (± 15 V_{pk-pk}, dc ± peak ac).

All triggering specifications are the same as for the front panel configuration.

Frequency Standard External Input:

This BNC input will be automatically selected as the reference time base when a signal is present. The internal time base will be used when no signal is present at this BNC connector.

Impedance: 1 kΩ, ac coupled, NOMINAL.

Input Level Range: 1.0 V_{pk-pk} to 5.0 V_{pk-pk}.

Acceptable Frequencies: 1 MHz, 2 MHz, 5 MHz, or 10 MHz, ± 1%.

⚠ **Damage Level:** ± 10V (dc ± peak ac).

Frequency Standard Output:

When no external reference is present, the HP 5371A internal 10 MHz oscillator signal is provided at this output. When an external reference is applied, this output will always be 10 MHz.

Frequency: 10 MHz (see time base Specifications)

Level: > 2 V_{pk-pk} NOMINAL, ac coupled square wave into a high impedance.

>1 V_{pk-pk} NOMINAL, ac coupled square wave into 50Ω.

Gate Outputs 1 and 2:

A falling edge indicates when measurement samples occur.

Delay: 30 ns TYPICAL.

Output Level: Falling edge active, TTL levels into $\geq 10\ K\Omega$.

1 V (minimum) to 0 V into 50Ω.

Pulse Width: > 30 ns (TYPICAL) into 50Ω.

Arm Delay Outputs 1 and 2:

A falling edge occurs at these outputs with the completion of the arming condition. For example, if a time holdoff is specified, a falling edge will occur at the completion of the time holdoff.

Delay: 30 ns TYPICAL.

Output Level: Falling edge active, TTL levels into $\geq 10\ K\Omega$.

1 V (minimum) to 0 V into 50Ω.

HP-IB CHARACTERISTICS

Interface Capabilities:

Subset Identifier	Interface Function
SH1	Complete source handshake capability
AH1	Complete acceptor handshake capability
T5	Basic talker with serial poll and talk-only capabilities
TE0	No extended talker capability
L4	Basic listener
LE0	No extended listener capability
DT1	Device trigger capability
DC1	Complete device clear capability
RL1	Remote/local capability
SR1	Serial poll capability
PP0	No parallel poll capability
C0	No controller capability
E2	Three-state drivers

HP-IB Address:

The HP-IB address can be changed via the SYSTEM menu. This address is saved in non-volatile memory. The default HP-IB address is 03.

Characteristic Measurement Output Rates:

The HP 5371A sends measurements to an external HP-IB controller at the completion of each block of measurements. Characteristic output rates are listed accordingly. For example, the typical binary output rate for the Continuous Time Interval Mode is 20,000 measurements per second. This should be interpreted as "up to twenty, 1000 measurement blocks can be transferred in 1 second to an instrument controller."

The HP 5371A can transfer data to an HP-IB instrument controller in one of three formats:

ASCII

IEEE Double Precision Floating Point (matches HP 9000 Series 200/300 controller floating point format, no character conversion is required for these controllers)

Binary (raw binary results from the HP 5371A counting hardware. Results can then be processed accordingly in the external computer)

For these benchmarks:

The HP 5371A is configured to the PRESET condition before the appropriate function is selected. Statistical and math operations are not enabled. In addition, the MANUAL input triggering mode is used to set the input voltage trigger levels.

Except where noted, a sample size of 10 blocks of 1000 measurements (10,000 total measurements) was used to determine these values.

All values include the measurement time, as well as the transfer time, of the data using an input signal of
13 MHz (76.9 ns).

For BINARY output rates, the values represent the number of measurements sent to the computer and stored in a buffer without processing. See note 5.

For these benchmark rates, the header information at the beginning of each block was not processed.

Note that these are TYPICAL values; performance is also affected by other instrumentation on the bus, the performance of the external controller, and the particular measurement software.

Characteristic HP-IB Output Rate

MEASUREMENT MODE	(All values in "Readings per Second") ASCII	FLOATING POINT	BINARY
Time Interval A, B, A→B, B→A	150	350	12,500
Continuous Time Interval A , B	200	600	20,000
±Time Interval A, B, A→B, B→A	130	250	12,500
Frequency A, B	130	275	13,000
Frequency A&B (1)	50 per channel	110 per channel	5,300 per channel
Frequency A/B, B/A	90	140	5,500 per channel (3)
Frequency A − B, B − A, A + B	90	140	5,500 per channel (3)
Period A, B	130	275	13,000
Period A&B (1)	50 per channel	110 per channel	5,500 per channel
Period A/B, B/A	90	140	5,500 per channel (3)
Period A–B, B–A, A + B	90	150	5,500 per channel (3)
Totalize A, B	140	275	7,500
Totalize A&B (1)	80 per channel	175 per channel	5,200 per channel
Totalize A/B, B/A	90	175	5,200 per channel (3)
Totalize A-B, B-A, A + B	125	225	5,200 per channel (3)
Rise/Fall Time A	130	260	12,500 (4)
Pulse Width A	130	260	12,500 (4)
Phase A rel B, B rel A	90	150	12,500 (4)
Duty Cycle A	110	200	12,500 (4)
Peak Amplitudes A,B (2)	5	5	N/A

(1) 10 blocks of 500 measurements (5000 total) were used for this benchmark value.

(2) 10 measurements were used to characterize this value.

(3) These measurement rates are the same as the "A&B" mode. Appropriate math calculations must be performed in the controller when the results are processed.

(4) These measurement rates are essentially the same as the Time Interval A→B mode. Appropriate math operations must be included in the controller program to compute Phase A rel B, or B rel A and Duty Cycle A.

(5) Binary output mode rates do not include processing time in the controller. This processing time will vary with the controller, the program language, and the particular program. As an example: 10,000 conversions per second can be achieved using an HP 9000 Series 320 controller. This value excludes the transfer time of the data from the HP 5371A.

The user may also configure the HP 5371A to output BINARY data indefinitely to an external controller. This is achieved by configuring the HP 5371A for 1 block of 1 measurement, in the REPETITIVE acquisition mode. A single binary result will be transferred at a TYPICAL rate of 75 measurements per second. This rate will also depend on the particular controller as well as other instruments connected to the bus.

Direct Printer or Plotter Output

Any HP 5371A CRT display may be sent directly to an HP-IB graphics printer such as the HP 2225A ThinkJet Printer using the TALK ONLY mode. In addition, a list of measurement results can be printed directly from the front panel (up to 1000 values).

Any HP 5371A Time Variation graph, Histogram graph, or Event Timing graph may be sent directly to an HP-IB HP-GL plotter such as the HP 7440A ColorPro Plotter option 002.

Response Timeout

The response timeout feature enables the user to program the HP 5371A to generate a service request if the measurement is not completed within a specified time.

Timeout Range: 0 to 10 hours.

Resolution: 1 second.

Default Value: 5 seconds.

TIME BASE SPECIFICATIONS

HP 10811A Oven Oscillator

FREQUENCY:

10 MHz.

STABILITY:

Aging Rate:

$< 5 \times 10^{-10}$ per day after a 24 hour warm-up when:

1. oscillator off-time* was less than 24 hours.
2. oscillator aging rate was $< 5 \times 10^{-10}$ per day prior to turn-off*.

$< 5 \times 10^{-10}$ per day in less than 30 days of continuous operation for off-time* greater than 24 hours.

$< 1 \times 10^{-7}$ per year for continuous operation.

Short Term:

$< 1 \times 10^{-10}$ for a 1 second average.

Temperature:

$< 7 \times 10^{-9}$, 0 to 40°C ambient temperature.

Line Voltage:

$< 1 \times 10^{-10}$ for 10% change from the NOMINAL line voltage.

Warm-up:

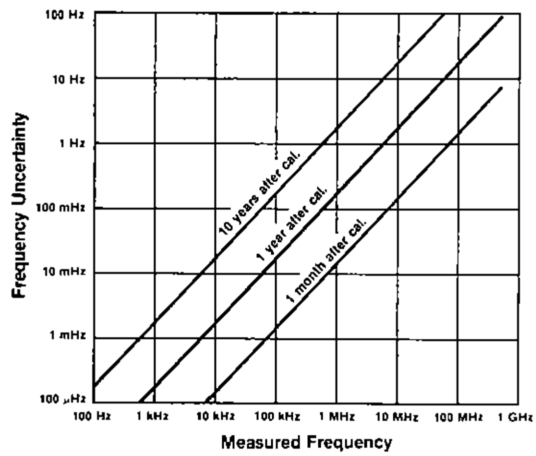
Within 5×10^{-9} of final value (see below), 10 minutes after turn-on* when:

1. HP 5371A is operated in a 25°C environment.
2. Oscillator off-time* was less than 24 hours.
3. Oscillator aging rate was $< 5 \times 10^{-10}$ per day prior to turn-off*.

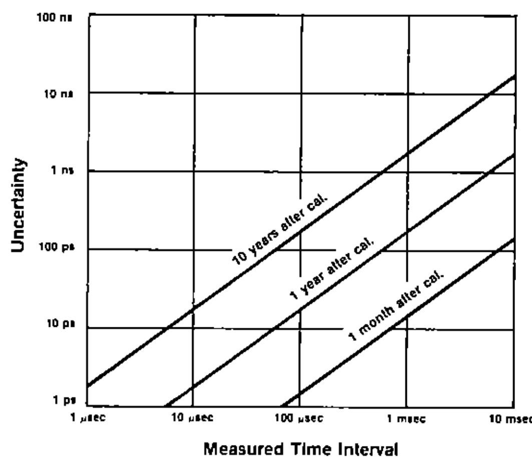
Final value is defined as oscillator frequency 24 hours after turn-on*.

Refer to the Rear Panel Specifications Section for information regarding signal levels.

*"Turn-off", "turn-on", and "off-time" apply to periods when power is disconnected from the HP 5371A rear panel. Stand-by operation provides power to the oscillator's oven.



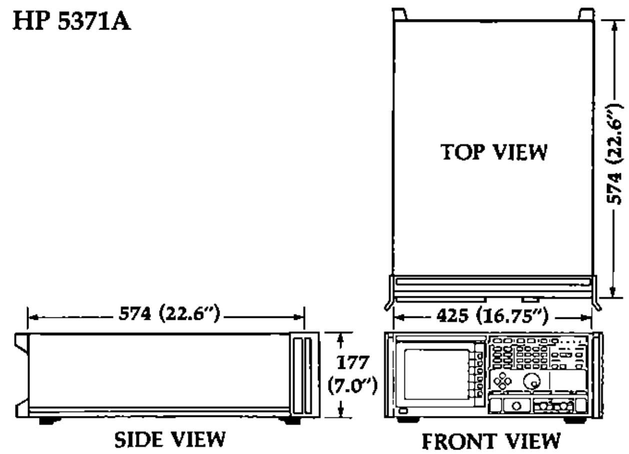
Timebase crystal aging affects Frequency and Period measurement accuracy. You can further reduce aging uncertainty by using an atomic standard.



Timebase crystal aging affects time interval measurements.

GENERAL SPECIFICATIONS

Dimensions:



WEIGHT:

Net, 23.2 kg (51 lbs); Shipping, 24.5 kg (54 lbs).

OPERATING TEMPERATURE:

0 to 40°C.

POWER REQUIREMENTS:

Voltages: 100, 120, 220, or 240 Vac; +10%, -10%.

Frequencies: 50 to 60 Hz.

Maximum Power: 500 VA maximum.

Display Characteristics:

The HP 5371A features a raster-scan, green phosphor CRT. Screen display resolution is 408 pixels horizontally by 304 pixels vertically. Graph display resolution is 250 pixels horizontally by 200 pixels vertically.

For numeric displays, a BOLD feature is available to display results in large characters for viewing from a distance. Up to 12 measurements (6 measurements with associated "gate" data) can be displayed in the standard numeric display. All results may be viewed using scrolling features.

Results on the numeric screen will be displayed with a maximum of 15 digits, depending on the measurement resolution.

MEASUREMENT UNCERTAINTIES

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 5371A 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 5371A 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 5371A: the SET REFERENCE feature for each input channel, or the HP J06-59992A Time Interval Calibrator.

Accuracy = Random Errors + Systematic Errors

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 5371A. The following equation is used to quantify trigger error.

$$\text{Trigger Error} = \frac{\sqrt{(\mathrm{E_{amp}})^2 + (E_n)^2}}{\text{Input Signal Slew Rate}}$$

Where:

E_{amp} is the typical rms input amplifier noise: (200 μV rms TYPICAL), and

E_n is the rms noise of the input signal over a 500 MHz bandwidth.

Trigger Level Timing Error is a systematic uncertainty due to the input hysteresis of the HP 5371A. 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.

$$\text{Trigger Level Timing Error} = \left(\frac{0.5 \times \text{hysteresis window}}{\text{Start Input Signal Slew Rate}} - \frac{0.5 \times \text{hysteresis window}}{\text{Stop Input Signal Slew Rate}}\right)$$

$$\pm \frac{\text{Trigger Level Accuracy}}{\text{Start Input Signal Slew Rate}} \pm \frac{\text{Trigger Level Accuracy}}{\text{Stop Input Signal Slew Rate}}$$

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