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Agilent no longer sells or supports this product. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available. You will find any other available product information on the Agilent Test & Measurement website, www.tm.agilent.com.

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. In other documentation, to reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product number/name was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

User's Guide

HP 70703A

Digitizing Oscilloscope

HP Part No. 70703-90028
Printed in United Kingdom December 1993

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Safety Symbols

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

CAUTION

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

WARNING

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

DANGER

The *DANGER* sign denotes an imminent hazard to people. It warns the reader of a procedure that, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a *DANGER* sign until the indicated conditions are fully understood and met.

General Safety Considerations

WARNING

- **Before this instrument is switched on, make sure it has been properly grounded through the protective conductor of the AC power cable to a socket outlet provided with protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.**
- **There are many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.**

CAUTION

Before this instrument is switched on, make sure its primary power circuitry has been adapted to the voltage of the AC power source. Failure to set the AC power input to the correct voltage could cause damage to the instrument when the AC power cable is plugged in.

HP 70703A Digitizing Oscilloscope

The HP 70703A digitizing oscilloscope provides 500 MHz of bandwidth inrepetitive measurements, 20 mega-sample-per-second sampling rate, and four-input, two-channel operation.

Features include:

- Dual time-base windowing (allows for closer inspection of pulse edges)
- Automatic measurements, autoscale, and waveform math (allows for fast test development and execution)
- Vertical sensitivity (1 mV/div to 5 V/div)
- Full function attenuator
- 8-bit vertical resolution
- Switchable inputs between 1 MΩ and 50Ω
- AC or DC coupling
- Simultaneous sampling by any two channels
- Four non-volatile waveform memories (to store digitized channel data or data from a controller)
- Electronic calibration (no manual adjustment or need for external test equipment)
- Diagnostic self test

Declaration of Conformity

DECLARATION OF CONFORMITY
according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Ltd.
Manufacturer's Address:	South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom

declares that the product

Product Name :	Digitizing Oscilloscope
Model Numbers:	HP 70703A
Product Options:	This declaration covers all options of the above product.

Conforms to the following Product Specifications:

Safety:	IEC 348 (1978) CSA - C22.2 No. 231 Series - M89
EMC:	CISPR 11:1990 / EN 55011 :1991, Group 1, Class A IEC 801-2:1991 / EN 50082-1:1992, 8kV AD IEC 801-3:1990 / EN 50082-1:1992, 3V/m, 27-500 MHz IEC 801-4:1988 / EN 50082-1:1992, 500V Signal lines, 1kV Mains

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.
The product meets the listed specifications when installed in a HP70001A mainframe along with a HP70205A Graphics Display.

South Queensferry, Scotland	9th Dec. 1993	P.A. Rigby
Location	**Date**	**Peter Rigby / Quality Manager**

European Contact:
Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department ZQ/Standards Europe, Herrenberger Strasse 130, D-7030 Boblingen (FAX: +49-7031-143143)

Figure 0-1.

In This Book . . .

Chapter 1	Get to know your HP 70703A digitizing oscilloscope with a few quick exercises that demonstrate essential functions and basic measurements.
Chapter 2	Use the verification of operation software to confirm that your digitizing oscilloscope is working correctly.
Chapter 3	Explore the functions and features of the digitizing oscilloscope through detailed descriptions of each softkey, setting, measurement, and calibration.
Chapter 4	Review the specifications and characteristics of your digitizing oscilloscope.
Chapter 5	Locate a function or softkey on maps to all softkey menus and submenus.
Chapter 6	Find out how to set up your digitizing oscilloscope, how to change its switch settings, how to calibrate it, how to mount it in an HP 70000 mainframe, how to troubleshoot it, and how to return it for service.

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1

Getting Started with the HP 70703A Digitizing Oscilloscope

This chapter introduces you to the HP 70703A digitizing oscilloscope, and gives you a quick overview of the instrument, its features and functions. You'll view and adjust a waveform, make automatic and manual measurements, examine a segment of a waveform in the expanded time base window, and store a waveform and an instrument state.

You'll need about 20 minutes to complete the ten steps. Before you start, make sure your oscilloscope is installed properly (see Chapter 6). After you've finished, refer to Chapter 3 for detailed information about each of the digitizing oscilloscope's softkeys and features.

Note

Keycaps and Softkeys

- (Boxed) words refer to keys on the front panel of the display module.
- Shaded words refer to softkeys that appear on the screen of the display module. The left-hand softkeys select menus of related functions. The right-hand softkeys select and perform functions.

For more about the types of softkeys, and how they're represented in this book, see "A Few Notes on the Softkey Symbols" in Chapter 3.

Take a Look at the Front Panel

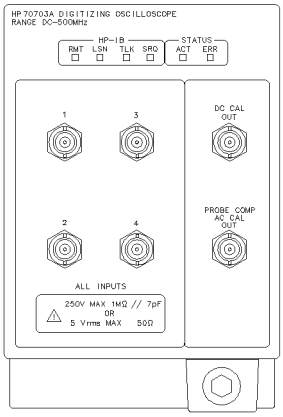


Figure 1-1. The HP 70703A Digitizing Oscilloscope Front Panel

Inputs

The HP 70703A digitizing oscilloscope has four BNC connectors which can be individually configured as 1 MΩ impedance shunted by nominal 7 pF (±250 V max), or as 50 Ω impedance (5 VDC rms max).

All four channels are fully functional. In addition, channel 1 or 2 can be used with channel 3 or 4 for dual-channel acquisition.

Outputs

DC CAL OUT: This is a DC output used during calibration. **PROBE COMP AC CAL OUT:** The AC calibration output provides either a 1.5 kHz nominal 800 mV nominal (into 1 MΩ impedance) square wave, or a trigger output. See "The Channel Menu" and "The Calibration Menu" in Chapter 3 for more information about using and calibrating probes with the HP 70703A digitizing oscilloscope.

Status LEDs

During a self-test and power-on, these LEDs will flash momentarily. If all the LEDs, including the HP-IB LEDs, continue to blink or remain lit, it indicates a problem.

ACT: This green LED lights when the digitizing oscilloscope can be controlled by the keyboard, or when it is being controlled over MSIB. It turns off, for example, when you press the (DISPLAY) key.

ERR: This red LED lights when an error condition occurs. If the **ERR** LED flashes at a rate of 1 Hz, it indicates an HP-MSIB connection error. However, a module may disrupt all HP-MSIB communication but not have a flashing error indicator.

- The HP 70703A digitizing oscilloscope has *no* operator adjustments or repairs; all repairs must be done only by qualified service persons. When the **ERR** LED flashes or remains on after the errors have been displayed, contact your service department, or an HP sales and service office.

HP-IB LEDs The four yellow HP-IB LEDs report the status of the digitizing oscilloscope when it is controlled by a computer over the HP-IB. See the programming manual for more information about these HP-IB LEDs.

Step 1. Find, Scale, and Display a Waveform Automatically

1. Connect the AC calibrator output (AC CAL OUT) to the channel 1 input. You can use a BNC cable, or a probe and probe-to-BNC adapter.
2. Press the green instrument preset key on the front of the display.
3. Press `AUTOSCALE`. The digitizing oscilloscope identifies the active channel, and automatically adjusts vertical and horizontal settings for that waveform.
4. Press (MENU) `Screen` `JOIN DOTS`. The waveform now is a solid line. Compare your results to Figure 1-2.

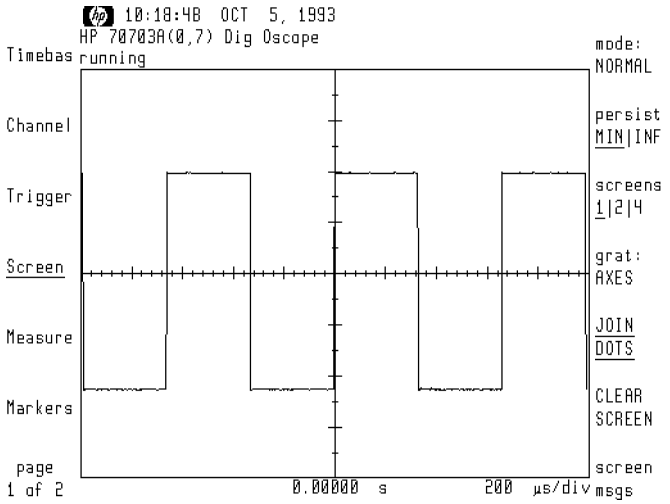


Figure 1-2. The Display in `JOIN DOTS` Mode

Step 2. Adjust the Time Base

1. Press Timebas . The time base menu is displayed along the right-hand edge of the screen. Time-per-division is the active function.
2. Use the step keys to set the time base. The step keys (▲ and ▼) increase and decrease the time base setting in a 1-2-5 sequence. Press ▼ to change the main time base to 100 μs/div.

Step 3. Adjust the Vertical Sensitivity

1. Press Channel . The channel menu is displayed along the right-hand edge of the screen. Volts-per-division is the active function.
2. Use the numerical keypad to change vertical sensitivity to 250 mV/div. Press 2 5 0 mV/div . Press the unit key (mV/div) to complete the entry and return to the previous menu.

Step 4. Set the Trigger

1. Press Trigger . The trigger menu is displayed along the right-hand edge of the screen. Trigger level is the active function.
2. Turn the control knob; as the knob is turned, the trigger level marker (a horizontal dotted line) moves up and down in increments proportional to the vertical sensitivity setting.
3. Use the numerical keypad to set the trigger level to −600 mV. Press (−) 6 0 0 mV . Press the unit key (mV) to complete the entry and return to the previous menu.

Step 5. Make Automatic Measurements

Automatic measurements can be made with standard preset measurement definitions or with user-defined measurement thresholds. This step uses the standard measurement definitions. For more information about user-defined measurements, see "The Measurements Menu" in Chapter 3.

You can display up to eight measurements at a time. If you make a measurement after the screen is full, the top measurements are erased, and the new measurement appears at the bottom.

1. Press `Measure`. The measurements menu is displayed along the right-hand edge of the screen. The 17 pulse parameter measurements in this menu are on pages two, three, and four of this menu. A message in the bottom right-hand corner of the screen shows the current page.

Measure frequency.

2. Press `more 1 of 4`. The second measurements menu page is displayed.
3. Press `FREQ`. The frequency measurement of the waveform on channel 1 is displayed.

Measure peak-to-peak voltage.

4. Press `more 2 of 4`. The third measurements menu page is displayed.
5. Press `V P-P`. The peak-to-peak voltage of the waveform on channel 1 is displayed.

Measure average voltage.

6. Press `V AVG`. The average voltage of the waveform on channel 1 is displayed in the left column at the bottom of the screen. Compare your results to Figure 1-3.

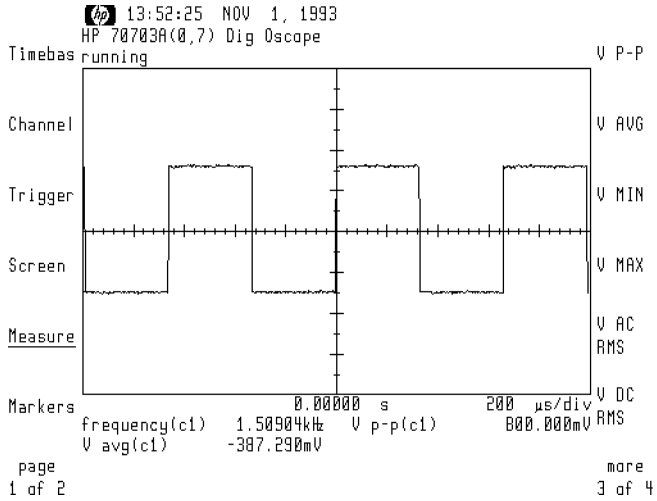


Figure 1-3. After Making the Three Automatic Measurements

7. Press `more 3 of 4`. The fourth measurements menu page is displayed.

Clear the measurements.

8. Press `more 4 of 4`. The first measurements menu page is displayed again.
9. Press `CLEAR MEAS`. All measurement readings are erased, and the screen returns to its default size.

Note

Screen only changes size if `screen msgs MEASURE ON|AUTO` is set to `AUTO`. The factory default is ON.

Step 6. Use Markers to Make Manual Measurements

The HP 70703A digitizing oscilloscope has two pairs of markers: horizontal markers for voltage measurements and vertical markers for time measurements.

These measurements remain onscreen until you make automatic measurements, which will replace the marker measurements temporarily. To restore the marker readings, press `Markers` again. To turn off the markers, press `marker: xxx` `OFF`.

1. Press `Markers`. The markers menu is displayed along the right-hand edge of the screen.

Measure the difference in voltage between two markers.

2. Press `volt 2: CHAN x` `CHAN 1` to select channel 1 as the source to be measured with the upper marker.
3. Press `VOLT 2 LEVEL`. Use the control knob to place the upper marker at the top of the waveform. The voltage 2 (upper marker) measurement appears at the bottom of the screen.
4. Press `volt 1: CHAN x` `CHAN 1` to select channel 1 as the source to be measured with the lower marker.
5. Press `VOLT 1 LEVEL`. Use the control knob to place the lower marker at the bottom of the waveform. The voltage 1 (lower marker) measurement and the difference (peak-to-peak) in voltage (ΔV) appear. Read the peak-to-peak difference in voltage between the two markers. Compare your results to Figure 1-4.

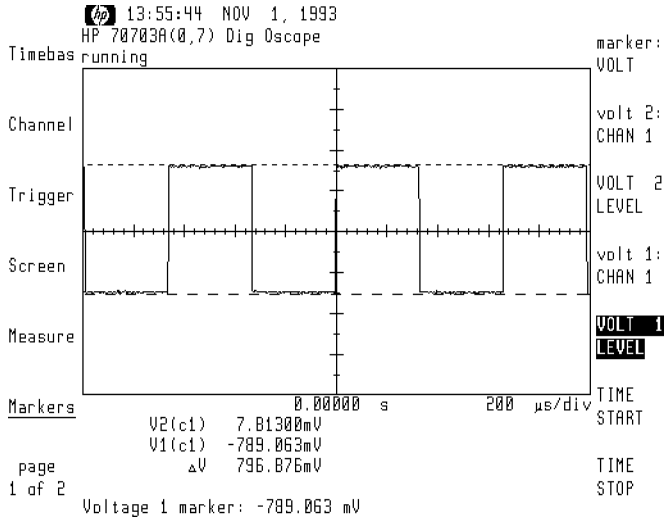


Figure 1-4. The Difference in Voltage Measured with Markers

Measure a complete cycle of the calibrator signal.

6. Press `markers: VOLT TIME`
7. Press `TIME START`. Use the control knob to place that marker on the first displayed falling edge of the waveform.
8. Press `TIME STOP`. Use the control knob to place that marker on the second displayed falling edge.
9. Read the stop time, the start time, the difference in time (Δt), and the frequency of the selected period (1/Δt).

Step 7: Open Multiple Windows

1. Press (USER) `AUTOSCALE` to reset the digitizing oscilloscope.
2. Press (MENU) `Screen`. The screen menu appears along the right-hand side of the screen.
3. Press `screens 1|2|4` until `2` is underlined. The screen divides into two windows. The waveform from channel 1 appears in the upper window, and the lower window is empty.
   - The upper window displays channels 1 and 2, the lower window displays channels 3 and 4. When both channels in a window are active, the waveforms are superimposed.
4. Press `screens 1|2|4` again to underline `4`. The screen now has four windows. The waveform from channel 1 appears in the top window; the three lower windows are empty. Compare your results to Figure 1-5.

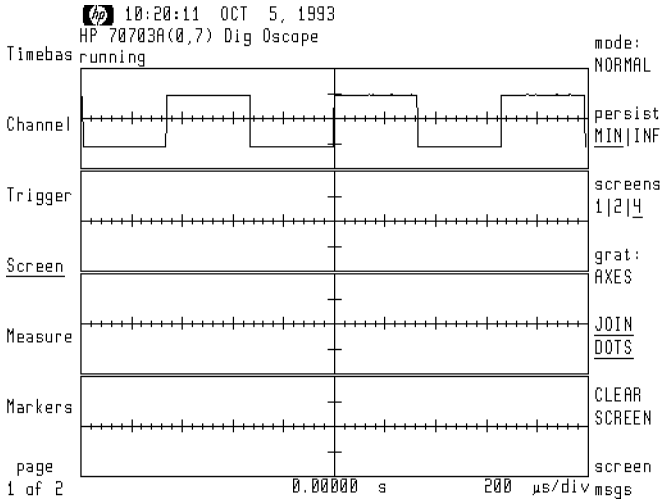


Figure 1-5. The Display with Four Windows

Step 8: View a Waveform Segment in the Expanded Time Base Window

1. Press (USER) `AUTOSCALE` to reset the digitizing oscilloscope.
2. Press (MENU) `Timebas` `expand ON|OFF`. The screen divides into two windows: an active waveform (upper) window and an expanded time base (lower) window. The display can have up to four active waveform windows and four expanded time base windows.

   Expanded time-per-division is the active function. The markers are set to display the expanded time base equal to the full displayed waveform.

   - `ref pos L|C|R` determines the reference position of the markers.
3. Turn the control knob until the markers define a complete pulse.
4. Press `EXPAND POS`.
5. Turn the control knob to center the pulse in the expanded time base window. Compare your results to Figure 1-6.

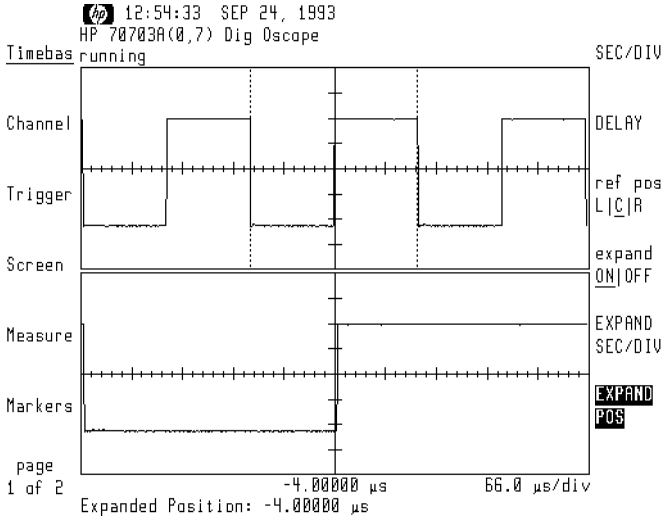


Figure 1-6. The Expanded Time Base Markers Define a Waveform Segment

Step 9: Store a Waveform

1. Press (USER) `autoscale` to reset the digitizing oscilloscope.
2. Press (MENU) `page 1 of 2` `Wavemem`. The waveform memory menu is displayed along the right-hand side of the screen.
3. Press `store: CHAN x` `CHAN 1` to select channel 1 as the waveform to be stored.
4. Press `dest: WMEM x` `WMEM 4` to select register 4 as the location where the waveform will be stored.
5. Press `STORE TO WMEM`. This erases any data stored in register 4, and replaces it with the waveform on channel 1.
6. If you want to compare the stored waveform to the active signal:
   a. Press `wmem ON|OFF` (to select ON); this will display the stored waveform.
   b. Press `page 2 of 2` `Screen`. Make sure channel 1 is the active channel.
   c. Press `Screens 1|2|4` to select 2. Channel 1 appears in the upper screen and the stored waveform appears in the lower screen. Compare your results to Figure 1-7.

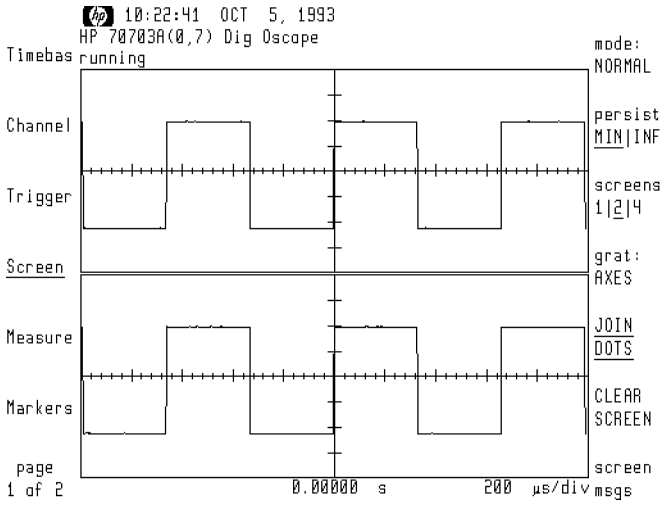


Figure 1-7. The Stored Waveform Compared to the Active Waveform

Step 10: Store an Instrument State

1. Press (USER) `autoscale` to reset the digitizing oscilloscope.
2. Press (MENU) `page 1 of 2` `State`. The instrument state menu is displayed along the right-hand side of the screen.
3. Press `save state` `SAVE STATE 1` to save the current instrument state in register 1.
4. Press `prev menu` to return to the state menu.

2

Verification of Operation

Operation verification tests are a convenient way to check your digitizing oscilloscope. They are designed to be done quickly, to use minimal test equipment, and to give you confidence that the instrument is working properly.

These tests are automated and computer-controlled; the test software takes you through each step of the process, and tells you how and when to connect the necessary equipment. It takes about an hour to perform all seven operation verification tests.

Note

The Self Test Feature

The HP 70703A digitizing oscilloscope also has a built-in self test, to perform internal diagnostics. See "The Selftest Menu" in Chapter 3.

What You'll Find in This Chapter

- How to install and use the operation verification software.
- How to perform each of the seven operation verification tests.

Required Test Equipment

To perform all of the operation verification tests, you must have *all* the test equipment listed in Table 2-1—either the default model or a supported alternate—and all the accessories listed in Table 2-2. The operation verification software supports only the recommended test equipment.

Table 2-1. Required Test Equipment

Test Setup Options	Required Equipment	Default Model	Supported Alternates
Test 1: DC Calibrator			
A) Default setup:	Digital multimeter	HP 3458A	HP 3455A, HP 3456A, HP 3478A, HP 70110A
Test 2: Input Resistance			
A) Default setup:	Digital multimeter	HP 3458A	HP 3455A, HP 3456A, HP 3478A, HP 70110A
Test 3: Voltage Accuracy			
A) Default setup:	Digital multimeter	HP 3458A	HP 3455A, HP 3456A, HP 3478A, HP 70110A
	High-voltage DC source	HP 6633A	
	Low-voltage DC source	HP 3325B	
B) Alternate setup:	DC calibrator	Datron 4708	Datron 4700, Datron 4707, Datron 4000A, Datron 4000, Fluke 5700A
Test 4: Offset Accuracy			
A) Default setup:	Digital multimeter	HP 3458A	HP 3455A, HP 3456A, HP 3478A, HP 70110A
	High-voltage DC source	HP 6633A	
B) Alternate setup:	DC calibrator	Datron 4708	Datron 4700, Datron 4707, Datron 4000A, Datron 4000, Fluke 5700A

Table 2-1. Required Test Equipment (continued)

Test Setup Options	Required Equipment	Default Model	Supported Alternates
Test 5: Bandwidth			
A) Default setup:	Signal generator	HP 8663A	HP 8656B, HP 8642B
	Power meter	HP 436A	HP 70100A
	Power sensor	HP 8482A	
B) Alternate setup:	High-frequency signal generator	HP 83640A	HP 8340A, HP 8341B, HP 8341A, HP 83640A, HP 83650A
	Low-frequency signal generator	HP 3325B	HP 3325A, HP 3335A
	Power meter	HP 436A	HP 70100A
	Power sensor	HP 8482A	
C) Alternate setup:	Signal generator	HP 8656B	HP 8663A, HP 8642B
	Power meter	HP 8902A	
	Power sensor	HP 8482A	HP 11722A
D) Alternate setup:	High frequency signal generator	HP 83640A	HP 8340A, HP 8341B, HP 8341A HP 83640A, HP 83650A
	Low-frequency signal generator	HP 3325B	HP 3325A, HP 3335A
	Power meter	HP 8902A	
	Power sensor	HP 8482A	HP 11722A
Test 6: Time Accuracy			
A) Default setup:	Signal generator	HP 8656B	HP 8663A, HP 8642B
B) Alternate setup:	High-frequency signal generator	HP 83640A	HP 8340A, HP 8341B, HP 8341A HP 83640A, HP 83650A
	Low-frequency signal generator	HP 3325B	HP 3325A, HP 3335A
Test 7: Trigger Sensitivity			
A) Default setup:	High frequency generator	HP 83640A	HP 8340A, HP 8341A/B, HP 83640A, HP 83650A

Table 2-2. Required Test Accessories

Required Accessories	Quantity	Part Number
BNC cable	2	HP 10503A
BNC (f) to dual banana plug (m), adapter	2	1251-2277
BNC tee (m-f-f)	1	1250-0781
BNC shorting cap	1	1250-0774
Power splitter	1	HP 11667A or HP 11667B
Type N 3 foot cable	1	HP 11500B
Type N (m) to BNC (m), adapter	1	1250-0082
Type N (f) to BNC (m), adapter	1	1250-0077

Computer Keyboard Compatibility and Mouse Operation

These instructions are based on an HP 9000 Series 200 or 300 controller with an HP 46021A keyboard. The operation verification program supports several input devices; it will detect the keyboard you are using and will display the appropriate key commands. However, keystrokes and text differences may appear in the softkeys and menus displayed onscreen. If you are using an HP 98203C keyboard, see "Using an HP 98203C Keyboard with a Series 200 or 300 Computer" below.

Using an HP 46021A Keyboard with a Series 300 Computer

If you use an HP 46021A keyboard (ITF keyboard) with a Series 300 computer, the operation verification program will assume you have a mouse or a trackball. See "Using a Mouse with a Series 300 Computer".

- To highlight your preference, press the ▲ or ▼ keys.
- To choose the highlighted item, press Select. To save your choice and return to the menu, press Return.
- To exit the menu, press ▶.

Using an HP 98203C Keyboard with a Series 200 or 300 Computer

If you use an HP 98203C (Nimitz) keyboard, the equivalent keys are:

HP 46021A Keyboard	HP 98203C Keyboard*
▶ (home)	Enter or Continue
Delete line	DEL LN
Return	Enter
Select	Enter
Stop	Pause
Menu `Continue`	Continue

* Keystrokes are identical on the Series 200 keyboard.

- To highlight an item in the menu, use ▲ and ▼, or turn the keyboard knob.
- To choose the highlighted item, press ENTER.
- To exit the menu, highlight `QUIT` or `EXIT`, and press Return. If neither `QUIT` nor `EXIT` is displayed, press Continue to exit.

Using a Mouse with a Series 300 Computer

The operation verification test software displays the choices available in each menu screen.

- Slide the mouse up or down to highlight your preference.
- To choose the highlighted item, press the left-hand button on the mouse or slide the mouse to the right.
- To exit the menu, press `QUIT` or `EXIT` if they are displayed in a menu. If neither `QUIT` nor `EXIT` is displayed, slide the mouse to the left to exit.

Step 1. Set up the Hardware for Operation Verification Testing

To run the operation verification software, you'll need an HP 9000 Series 200 or 300 computer, with:

- at least 2.5 to 4 megabytes of RAM (depending on the display configuration)
- an HP-IB interface
- a 3.5 inch double-sided flexible disk drive
- a hard disk drive with 4 megabytes available space *(optional)*

1. Connect the digitizing oscilloscope to the computer port.
   - If the computer has an HP 98624A HP-IB interface:
     a. Connect your digitizing oscilloscope to the port labeled HP-IB SELECT CODE 8.
     b. Check that the address switch on the HP 98624A HP-IB interface matches the HP-IB controller device address.
     c. If necessary, refer to the *HP 9000 Series 200/300 Peripheral Installation Guide, Volume I.*
   - If the computer has an HP-IB interface other than an HP 98624A:
     a. Connect the digitizing oscilloscope to the port labeled HP-IB SELECT CODE 7.
2. Connect the HP-IB cables from the test equipment to the computer's HP-IB SELECT CODE 7 port.
3. If you're using an external disk drive, connect its HP-IB to the HP-IB SELECT CODE 7 port on the computer, using a 0.5 meter HP-IB cable (HP 10833D, or a similar cable).

   Occasionally disk drives exhibit unpredictable behavior when sharing the HP-IB with instruments. If this happens, connect the disk drive to a separate HP-IB interface.
4. Set the external test equipment and the digitizing oscilloscope line switches to ON. Allow the equipment to warm up as specified for the operation verification tests.
5. Turn on the computer (and the external disk drive).

Loading BASIC and BIN Files

To load and run the operation verification test software, you must have a BASIC programming language and the appropriate binary files loaded in the computer.

1. Load BASIC 5.13 or later, with the BIN files listed below, into the HP 9000 Series 200 or 300 computer. If necessary, refer to an HP BASIC reference manual.

CLOCK	EDIT	KBD
CRTA	ERR	MAT
CRTB	GRAPH	MS
CRTX	GRAPHX	PDEV‡
CS80	HFS*	SRM†
DCOMM †	HPIB	XREF‡
DISC	IO	

*Optional: required only for HFS (hierarchical file system) environment.
†Optional: required only for SRM (shared resource management) environment.
‡Optional: required only for DEBUG.

Step 2. Install the Operation Verification Program on an SRM or HFS Hard Disk

Note

For Best Results

We recommend you install the operation verification software on, and run the tests from, a hard disk drive. If you want to run the tests from a flexible disk drive, see "Optional: Run the Operation Verification Tests from Flexible Disks".

This step is a general procedure for installing the operation verification software on an SRM (shared resource manager) or HFS (hierarchical file structure) hard disk system. For detailed information on creating directories and copying files, refer to the appropriate SRM or HFS hard disk manuals.

The operation verification program for the HP 70703A digitizing oscilloscope comprises these files:

Disk 1	CSUBS
	CSUBS6
	CSUBS6_UX
	CUSBS5_UX
	OPV
	INSTALL
Disk 2	C_TSCRIPT
	OPV_2
	TSCRIPT
	TESTINFO
	OPTIONS
	TEST_SEQS
	MUT_INFO
	ADDR_DEFS
	STE_INTFC
	UT_SUBSO

Note

Keeping Backup Copies of All Disks

If a disk is damaged or altered, it can't be ordered individually; you must order the entire set of disks to replace any one disk. If you will be running the operation verification program from an SRM or HFS hard disk (the recommended process), the files you install on the hard disk will be your backups. Keep the original disks in a safe place.

Assign the MSI

1. Insert disk 1 of the operation verification software in the disk drive.
2. Assign the MSI (mass storage is:) to the 3.5 inch double-sided flexible disk drive and press (Return).

   For example, to assign MSI to a hard disk drive with an address of 700, type:

   ```
   MSI ":,700,0"
   ```

Copy the Program Files onto the Hard Disk

3. Type `LOAD "INSTALL",1`
4. Press (Return).
5. The program will prompt you to enter the MSVS (mass storage volume specifier) of your flexible disk drive. Enter the address and press (Return).

   For example:

   ```
   : ,700,1
   ```

6. The program will prompt you to enter the MSVS of your hard disk. Enter the address and press (Return).
7. The program will prompt you for the directory path where you want to install the operation verification test program.

   `/OPV9000/ [***** ? *****]/` is the default; if you want the test program installed in another directory, substitute that path for the default path shown on the display. Press (Return).

Note **Include Slashes in Your Path**

The default shows leading and trailing slashes. Be sure your directory path contains these slashes.

8. When prompted, remove disk 1 and insert disk 2. Press `Continue`.

   If you have an HP 46021A keyboard, and the `Continue` softkey does not appear on the display, press (Menu). If you have an HP 98203C keyboard, refer to "Using an HP 98203C Keyboard with a Series 200 or 300 Computer".
9. Continue at "Step 3. Load the Test Software".

Optional: Run the Operation Verification Tests from Flexible Disks

Note **Keeping Backup Copies of All Disks**

If a disk is damaged or altered, it can't be ordered individually; you must order the entire set of disks to replace any one disk. If you will be running the program from flexible disks, the installation routine will prompt you to make backup copies of all the program disks.

Initialize New Disks

1. Before making backup copies of the operation verification program on new flexible disks, you must initialize the disks.

   For example:

   ```
   INITIALIZE  ":,700,0",2,3
   ```

   You must use format option 3, but the MSVS and interleave factor are specific to your system.

Assign the MSI

2. Insert disk 1 of the operation verification software in the disk drive.
3. Assign the MSI (mass storage is:) to the drive you will use as the default drive.

   For example:

   ```
   MSI ":,700,0"
   ```

Make Working Copies of the Operation Verification Disks

4. Type `LOAD "INSTALL",1` and press (Return).
5. The program will prompt you when to insert the initialized disks. When you have created the working disks, store the original operation verification disks in a safe place.

Load and Run the Operation Verification Program

6. Type `LOAD "OPV",1` and press (Return).
7. When prompted, remove disk 1 and insert disk 2. Press `Continue`.

   If you have an HP 46021A keyboard, and the `Continue` softkey does not appear on the display, press (Menu). If you have an HP 98203C keyboard, refer to "Using an HP 98203C Keyboard with a Series 200 or 300 Computer".

8. Continue at "Step 4. Enter Information about Your Digitizing Oscilloscope".
9. When the information about the UUT is correct, press (▷).

Step 3. Load the Test Software

1. Assign the MSI (mass storage is:) to the directory path where the program is installed.

   For example:

   ```
   MSI ":,700,0"
   ```

2. Type `LOAD "OPV",1` and press (Return).

3. When the program prompts you to insert disk 2, press `Continue`; you do not need to insert a disk.

Leaving the Operation Verification Program

To stop a test, to back up a menu screen, or to exit the operation verification program, press (↘).

Step 4. Enter Information about Your Digitizing Oscilloscope

To ensure that test records are accurate and that the correct tests are performed, you'll need to enter complete information about the digitizing oscilloscope you're testing—the unit under test (UUT).

```
=============== UUT: HP 70703A ===============
SERIAL NUMBER
ADDRESS TYPE     HP-IB
ADDRESS          707
CONTROLLER
OPTIONS
TEMPERATURE      23.0 DEG C
HUMIDITY         50.0 %
LINE FREQUENCY   60 Hz
```

1. Press (Select) to select SERIAL NUMBER.
2. Type the instrument's entire ten-digit serial number and press (Return).
3. Review the other items in the list to determine if any other information needs to be changed. Use (▲) or (▼) to highlight the item, then use the appropriate procedure in this section to enter the information.
4. When all the information is correct, press (▸) to continue to Step 5.

Note

Moving Around the Screen Using the Keyboard

Use the step up (▲) and step down (▼) keys to highlight an item, then press (Select) to move to the data line in the right-hand column. Press (Return) to save the selected data and to return to selection mode. Press (▸) to continue to the next menu screen.

Changing the Default HP-IB Address for the UUT

If your digitizing oscilloscope is set to an address other than the factory preset address of 707, you may modify the software to use the oscilloscope's actual address.

```
=============== UUT: HP 70703A ===============
SERIAL NUMBER  0000A00000
ADDRESS TYPE   HP-IB
ADDRESS        707
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY  60 Hz
```

1. Use ▲ or ▼ to highlight `ADDRESS`. Press Select to move the cursor to the right-hand column.
2. Use ◀ or ▶ to move the cursor to the digit you want to change, then use ▼ or ▲ to change the number.
3. Press Return.
4. Review the other items in the list to determine if any other information needs to be changed. Use ▲ or ▼ to highlight the item, then use the appropriate procedure in this section to enter the information. Otherwise, press ▼ to continue to Step 5.

Changing the Temperature Setting

If you are running the operation verification program from a hard disk, you may enter the ambient temperature of the area in which the digitizing oscilloscope is operating. This temperature data becomes part of the test record.

```
=============== UUT: HP 70703A ===============
SERIAL NUMBER  0000A00000
ADDRESS TYPE   HP-IB
ADDRESS        707
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY  60 Hz
```

1. Use ▲ or ▼ to highlight `TEMPERATURE`. Press Select to move the cursor to the right-hand column.

The default temperature is 23.0 degrees Celsius. Record the temperature only in degrees Celsius.

2. Use ◀ or ▶ to move the cursor to the digit you want to change, then use ▼ or ▲ to change the number.
3. Press Return.
4. Review the other items in the list to determine if any other information needs to be changed. Use ▲ or ▼ to highlight the item, then use the appropriate procedure in this section to enter the information. Otherwise, press ▶ to continue to Step 5.

Changing the Humidity Setting

If you are running the operation verification program from a hard disk, you may enter the humidity of the area in which the digitizing oscilloscope is operating. This humidity data becomes part of the test record.

```
=============== UUT: HP 70703A ===============
SERIAL NUMBER  0000A00000
ADDRESS TYPE   HP-IB
ADDRESS        707
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY  60 Hz
```

1. Use ▲ or ▼ to highlight HUMIDITY. Press Select to move the cursor to the right-hand column.

   The default humidity is 50 percent.

2. Use ◀ or ▶ to move the cursor to the digit you want to change, then use ▼ or ▲ to change the number.
3. Press Return.
4. Review the other items in the list to determine if any other information needs to be changed. Use ▲ or ▼ to highlight the item, then use the appropriate procedure in this section to enter the information. Otherwise, press ▶ to continue to Step 5.

Selecting the Line Frequency

If you are running the operation verification program from a hard disk, you may enter the power line frequency the digitizing oscilloscope is using. This line frequency data is recorded with the test record.

```
=============== UUT: HP 70703A ===============
SERIAL NUMBER  0000A00000
ADDRESS TYPE   HP-IB
ADDRESS        707
CONTROLLER
OPTIONS
TEMPERATURE     23.0 DEG C
HUMIDITY        50.0 %
LINE FREQUENCY 60 Hz
  60 Hz
  50 Hz
  400 Hz
```

1. Use ▲ or ▼ to highlight `LINE FREQUENCY`. Press Select to display the selection list.

   The default line frequency is 60 Hz.

2. Use ▲ or ▼ to highlight the line frequency you are using, then press Return to select that frequency.

3. Review the other items in the list to determine if any other information needs to be changed. Use ▲ or ▼ to highlight the item, then use the appropriate procedure in this section to enter the information. Otherwise, press ▼ to continue to Step 5.

Step 5. Select Where You Want to Direct the Test Results

The test results may be printed on the computer's printer, displayed on the computer's CRT, or not displayed at all. You may choose how you want to output these test results. The default is `CRT`.

```
Where should test results be directed?    CRT
                                          PRINTER
                                          NO OUTPUT
```

1. Use ▼ and ▲ to direct test reports to the computer's display (the CRT) or to the printer, or to omit the report. You may choose only one output option.
2. Press Return.

The operation verification program will take a few moments to check equipment needed for the tests, then will display the default equipment and accessories required.

Step 6. Verify the Test Equipment

```
EQUIPMENT USED (MODEL/ADDRESS):
HP3458A      722
HP6633A      710
HP3325B      717
HP8663A      725
HP436A       713
HP8482A
HP83640A     719
                                    CONTINUE
                                    PRINT
```

- If the model numbers and addresses shown on your display match the model numbers and addresses of your test equipment, go on to "Step 7. Verify the Accessories". Highlight `CONTINUE` on the display, then press Return.

- If the model numbers and addresses in this display *do not* match the model numbers and addresses of your test equipment, either:

  Change your equipment and its addresses to conform to the list,

  or

  Modify the default equipment list by editing the `TSCRIPT` file.

Changing the Default Test Equipment and Addresses by Editing TSCRIPT

Table 2-3 lists the test equipment needed, the variable name by which it is listed in the `TSCRIPT` file, the default model, and models that may be substituted.

These instructions continue from substep 3 of "Step 6. Verify the Test Equipment". Use this procedure if your test equipment model numbers and addresses are different from the default test equipment. This operation verification software supports only the equipment shown in Table 2-3.

To perform this procedure, you must have BASIC 5.13 or above, with the binary language extensions, installed on your computer.

The **TSCRIPT** file contains the model numbers and HP-IB addresses of the test equipment and the test accessories required for each operation verification test. In this procedure, you will copy, edit, save, and run the TSCRIPT file.

Print the default equipment list.

1. If you have a printer connected to your computer, you can print the default test equipment list when you are in the test equipment menu screen. To print the list:

   a. Use (▼) to highlight `PRINT` on the display.

   b. Press (Return).

Exit the operation verification program.

2. Use (▲) to select `CONTINUE` on the display.
3. Press (Return). This displays the accessories required menu.
4. Press (Return) again. This displays the operation verification test menu.
5. Press (▶). You will be asked if you want to quit the Test Executive program. The default selection is `NO`. Press (▼) to highlight `YES`.
6. Press (Return) again. This will end the operation verification program.

Make a backup copy of the `TSCRIPT` file.

7. Using BASIC, make a copy of `TSCRIPT`. For example, type:

```
COPY  "TSCRIPT:,700,0" TO "TSCRIPT_BK:,700,0
```

Load the `TSCRIPT` file.

8. Type `GET "TSCRIPT"` and press (Return). Wait for the asterisk in the lower right-hand corner of the display to disappear.
9. Type `EDIT` and press (Return). Wait for the `TSCRIPT` file to appear on the display.

Edit the test equipment and HP-IB address lists.

10. Scroll to `CALIBRATION_STANDARDS(`. This section of the `TSCRIPT` file shows the default list of test equipment. The variable names with corresponding descriptions are shown in Table 2-3.

Note

Edit Carefully!

Be careful to edit only the suggested sections, and only in the method described. If the operation verification program doesn't run as expected after you have edited `TSCRIPT`, you may have deleted or modified a character accidentally (for example, the right parenthesis that separates test descriptions).

If you can't identify the cause of the problem, make a new copy of `TSCRIPT` from the backup copy you created in substep 7, and start again from substep 8.

Table 2-3. Test Equipment Variable Names

Variable Name	Description	Default Model	Alternate Models
PM	Power meter	HP 436A	HP 70100A
PM_PS	Power sensor	HP 8482A	
8902	Measuring receiver	HP 8902A	
8902_PS	Power sensor	HP 8482A	HP 11722A
DMM	Digital multimeter	HP 3458A	HP 3456A HP 3455A HP 3478A HP 70110A
SG	Signal generator	HP 8663A	HP 8656B HP 8642B
HFSG	High-frequency signal generator	HP 83640A	HP 8340B HP 8341B HP 8341A HP 83640A HP 83650A
LFSG	Low-frequency signal generator	HP 3325B	HP 3325A HP 3335A
RF	Radio-frequency signal generator	HP 8663A	HP 8656B HP 8642B
LDCS	Low-voltage DC source	HP 3325B	
HDCS	High-voltage DC source	HP 6633A	
DC_CAL	DC calibrator	Datron 4708	Datron 4700 Datron 4000A Datron 4000 Fluke 5700A
P_GEN	Pulse generator	HP 8161A	

11. Edit the default list of test equipment as needed. Press Return to save the change.

    The operation verification program uses `TSCRIPT` to identify the test equipment. The program designates the first model number following the variable name as the default instrument. The program ignores all but the first model number listed after the variable name; other model numbers are listed for reference only.

    Therefore, to select a different instrument as the default, you must change the variables line so the new model number follows the variable name. For example, to substitute an HP 8642B signal generator for the default HP 8656B signal generator:

    Scroll to the variable line for the signal generator:

    ```
    SG(HP8656B HP8663A HP8642B)
    ```

    You may make the change in either of two ways:

    Replace the model by typing the new model number over the old. The result is:

    ```
    SG(HP8642B HP8663A HP8642B)
    ```

    or

Move the selected model number to the position following the variable name, leaving the list of model numbers intact but changing its order. The result is:

```
SG(HP8642B HP8656B HP8663A
```

12. Scroll to the DEFAULT_ADDRESSES(section of the file and edit the equipment addresses using the same method.

    Valid addresses are 00 to 20, and 22 to 30; address 21 is reserved for the controlling computer. Valid select codes are 0 through 5, and 7 through 9; the default is 7. Do not set the equipment addresses to any addresses used by the unit under test.

Edit the test list to select setup configurations

Four of the operation verification tests give you a choice of test setup configurations: voltage accuracy, offset accuracy, bandwidth, and time accuracy. Depending on the equipment you have available, you may choose which setup configuration to use. Table 2-4 lists the options.

Table 2-4. Test Setup Alternatives

Test	Default Setup	Alternate Setup(s)
Test 3: Voltage Accuracy	"DC sources and DMM"	"Calibrator only"
Test 4: Offset Accuracy	"DC sources and DMM"	"Calibrator only"
Test 5: Bandwidth	"One source w/power meter"	Two sources w/power meter" One source w/8902 Two sources w/8902
Test 6: Time Accuracy	"One source"	"Two sources"

The operation verification program uses TSCRIPT to detect the test setup configuration. The program designates the first setup description following the test identification as the default setup. The program ignores all but the first setup; other setups are listed for reference only.

Therefore, to select a different test setup configuration as the default, you must change the order in which the test setup description appears, so your chosen setup configuration is the first setup following the test name.

For example, in the bandwidth test, to substitute "One source w/ 8902" for the default "One source w/ power meter":

13. Scroll to the test identification line for the bandwidth test:

    ```
    TEST(TN(Bandwidth) TP(Bandwidth_tp) TR(Bandwidth_tr)
    UTS(PM_LIB)
    ```

14. You may make the change in either of two ways:

    Use (Delete line) to remove any other test setup descriptions that precede your choice. In this example, you would delete the descriptions for "One source w/power meter" and "Two sources w/power meter."

    or

    Move *all lines* of the selected test setup description to the position following the test identification line, leaving the list of test setups intact but changing its order.

Note

Edit Carefully!

Be careful to edit only the suggested sections, and only in the method described. If the operation verification program doesn't run as expected after you have edited `TSCRIPT`, you may have deleted or modified a character accidentally (for example, the right parenthesis that separates test descriptions).

If you can't identify the cause of the problem, make a new copy of `TSCRIPT` from the backup copy you created in substep 7, and start again from substep 8.

Save the `TSCRIPT` file and restart the operation verification program.

15. To save the edited `TSCRIPT` file:
    a. Press (Stop).
    b. Type `RE-SAVE "TSCRIPT"` .
    c. Press (Return). Wait for the asterisk (*) in the lower right-hand corner of the display to disappear.
16. Type `LOAD "C_TSCRIPT"` and press (Return). Wait for the asterisk to disappear.
17. Type `RUN` and press (Return).

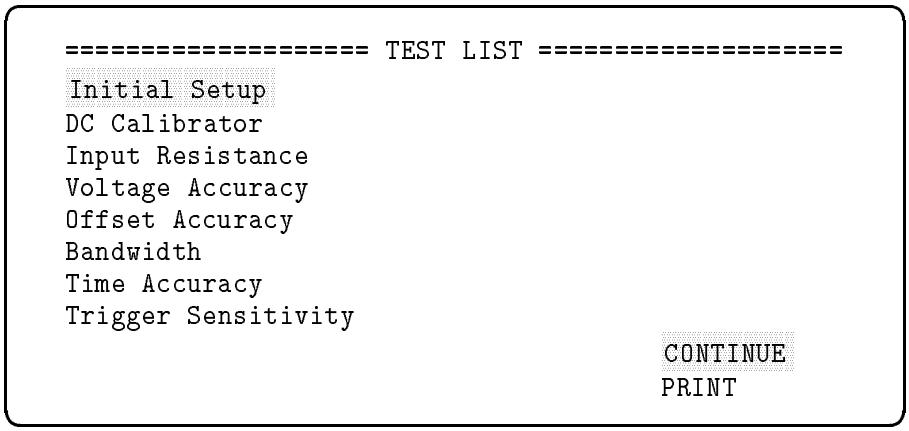
    When `Done.` appears on the computer display, you may load the operation verification program and run the operation verification tests.
18. Continue at beginning of the operation verification program. Refer to "Step 4. Enter Information about Your Digitizing Oscilloscope".

Step 7. Verify the Accessories

```
================= ACCESSORIES USED: =================
HP 10503A BNC cable
1251-1277 BNC (f) to dual banana plug (m) adapter
1250-0781 BNC tee (m-f-f)
1250-0774 BNC shorting cap
HP 11667A/HP 11667B power splitter
HP 11500B type N 3 foot cable
1250-0082 type N (m) to BNC (m) adapter
1250-0077 type N (f) to BNC (m) adapter
                                        CONTINUE
                                        PRINT
```

1. Make sure you have these accessories.
2. To print a copy of this list, highlight `PRINT` and press (Return).
3. Highlight `CONTINUE` and press (Return) to go on to "Step 8. Run the Operation Verification Tests".

Step 8. Run the Operation Verification Tests



1. Use (▼) and (▲) to highlight a test.

   The first item listed, "Initial Setup," is not a test; it runs automatically when you begin the operation verification program.

2. Press (Return). You will be asked if you want to check for HP-IB conflict of the UUT with the test equipment.

   a. If all test equipment is on the same HP-IB bus, press (Return) to continue to the next menu screen.

   b. If the UUT is on a separate HP-IB bus, press (▼) to select YES. The computer screen will prompt you through that process.

3. The next menu screen asks you to make sure the UUT is ready to be tested.

```
Please make sure that the UUT is plugged in,
turned on, and that an HP-IB cable is connected
between the UUT and the appropriate HP-IB interface.

                                                OK
                                                ABORT
```

4. When you are ready to begin the operation verification tests, press Return to select OK.
5. Follow the instructions on your display to set up the test equipment for each test.
6. Repeat steps 1, 4, and 5 until you have completed each operation verification test.

Note

Interrupting the Tests

You may select any test, in any order, from the test menu. You do not have to perform all the tests in one test session; you may quit at any time. However, the program *does NOT* save a record of completed tests. If you abort the test sequence, you must reload the program and repeat the initial setup process. If you want a record of the tests you have completed, be sure to direct test results to your printer.

If a Measurement Fails

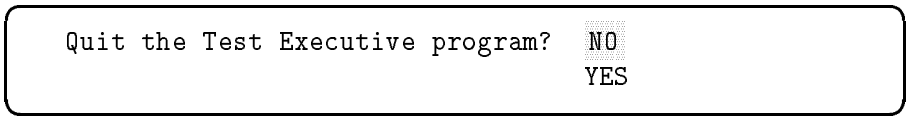
If the HP 70703A digitizing oscilloscope fails to pass any part of a test, you will be given the option to repeat the measurement, to continue to the next test, or to abort the test.

```
Measurement FAILED--do you want to repeat it?

                                        YES
                                        NO
                                        ABORT
```

Quitting the Operation Verification Program

When the tests are finished (or at any time during the test process), leave the operation verification test program by pressing (▶).



1. The default is NO ; use (▼) to highlight YES .
2. Press (Return).

Test 1: DC Calibrator

This test verifies that DC calibration output is switchable between 0 VDC and 5 VDC.

The program selects, measures (using a digital multimeter), and verifies calibration at 0 VDC, then at 5 VDC, for each of the four input channels. The computer screen will prompt you to change connections.

As the test is running, the computer screen displays the expected voltage, the measured voltage, and the tolerance for this measurement. The oscilloscope displays the voltage as it is measured. When the test is finished, the results will appear on your computer display or print out on your printer, depending on the option you selected at initial setup.

Equipment

Default configuration

- Digital multimeter
- BNC cable
- BNC (f) to dual banana plug (m) adapter

Test 2: Input Resistance

This test checks input resistance of all four channels and verifies that each is switchable between 1 MΩ and 50 Ω.

The program tests switching input resistance for the selected channel, to verify the load impedance is within tolerance. Each of the four channels is measured; the computer screen will prompt you to change connections.

As the test is running, the computer screen displays the expected resistance, the measured resistance, and the tolerance for this measurement. When the test is finished, the results will appear on your computer display or print out on your printer, depending on the option you selected at initial setup.

Equipment

Default configuration

- Digital multimeter
- Two BNC cables
- Two BNC (f) to dual banana plug (m) adapters
- BNC tee (m-f-f)

Test 3: Voltage Accuracy

This test verifies full-scale accuracy of each voltage range.

Full-scale voltage for each range is applied to the selected channel, then the voltage measured by the digitizing oscilloscope is compared to the same voltage measured by the multimeter (or the DC calibrator). Each of the four channels is measured; the computer screen will prompt you to change connections.

As the test is running, the computer screen displays the expected voltage, the measured voltage, and the tolerance for this measurement. The oscilloscope displays the voltage as it is measured. When the test is finished, the results will appear on your computer display or print out on your printer, depending on the option you selected at initial setup.

Equipment

Default configuration: DC sources and digital multimeter

- High-voltage DC source
- Low-voltage DC source
- Digital multimeter
- Two BNC cables
- Two BNC (f) to dual banana plug (m) adapters
- BNC tee (m-f-f)
- BNC shorting cap

Alternate configuration: DC calibrator

- DC calibrator
- BNC cable
- BNC (f) to dual banana plug (m) adapter
- BNC shorting cap

Test 4: Offset Accuracy

This test verifies DC offset for each channel at selected voltage ranges.

Maximum voltage is applied to the selected channel, with an offset to display the measured voltage, then the offset measured by the digitizing oscilloscope is compared to the same offset measured by the multimeter (or the DC calibrator). Each of the four channels is measured; the computer screen will prompt you to change connections.

As the test is running, the computer screen displays the expected voltage, the measured voltage, and the tolerance for this measurement. The oscilloscope displays the voltage as it is measured. When the test is finished, the results will appear on your computer display or print out on your printer, depending on the option you selected at initial setup.

Equipment

Default configuration: DC source and digital multimeter

- High-voltage DC source
- Digital multimeter
- Two BNC cables
- Two BNC (f) to dual banana plug (m) adapters
- BNC tee (m-f-f)

Alternate configuration: calibrator only

- DC calibrator
- BNC cable
- BNC (f) to dual banana plug (m) adapter

Test 5: Bandwidth

This test confirms that amplitude loss is less than 3 dB at 500 MHz.

Using a signal generator set first to 1 MHz, the program measures the amplitude of the signal with the digitizing oscilloscope, then with the power meter, and compares the readings. The signal generator is reset to 500 MHz and the sequence is repeated. Each of the four channels is measured.

At the beginning of this test, the screen will prompt you to enter information about your power sensor.

```
========== HP 8482A ==========
SERIAL NUMBER    0000A00000
ADDRESS TYPE     NONE
ADDRESS
CAL DUE DATE     15 Mar 1900
```

1. SERIAL NUMBER is highlighted. Press (Select) to move the cursor to the right-hand column.
2. Use the keyboard to enter the *full 10-digit serial number* of your power sensor.
3. Press (Return), then (▶). The screen will prompt you to make and change connections as needed.

As the test is running, the computer screen displays the expected amplitude, the measured amplitude, and the tolerance for this measurement. The oscilloscope displays the signal as it is measured. When the test is finished, the results will appear on your computer display or print out on your printer, depending on the option you selected at initial setup.

Equipment

Default configuration: One source with power meter

- Signal generator
- Power meter
- Power sensor
- Power splitter
- Type N cable, 3 ft
- Type N (m) to BNC (m) adapter

Alternate configuration: Two sources with power meter

- Signal generator
- Low-frequency signal source
- Power meter
- Power sensor
- Power splitter
- Type N cable, 3 ft
- BNC cable
- Type N (m) to BNC (m) adapter

- Type N (m) to BNC (f) adapter

Alternate configuration: One source with HP 8902A

- Signal generator
- HP 8902A power meter
- Power sensor
- Power splitter
- Type N cable, 3 ft
- Type N (m) to BNC (m) adapter

Alternate configuration: Two sources with HP 8902A

- High-frequency signal generator
- Low-frequency signal generator
- HP 8902A power meter
- Power sensor
- Power splitter
- Type N cable, 3 ft
- BNC cable
- Type N (m) to BNC (m) adapter
- Type N (m) to BNC (f) adapter

Test 6: Time Accuracy

This test verifies the ability of the digitizing oscilloscope to measure time between two events.

The program applies a signal of known frequency to the digitizing oscilloscope, measures the period of the signal, then compares that measurement to the expected value. This measurement is made for a range of time intervals. Each of the four channels is measured; the computer screen will prompt you to change connections.

As the test is running, the computer screen displays the expected period, the measured period, and the tolerance level for this measurement. The oscilloscope displays the signal as it is measured. When the test is finished, the results will appear on your computer display or print out on your printer, depending on the option you selected at initial setup.

Equipment

Default configuration: One source

- Signal generator
- Type N cable, 3 ft
- Type N (f) to BNC (m) adapter

Alternate configuration: Two sources

- High-frequency signal generator
- Low-frequency signal generator
- Type N cable, 3 ft
- Type N (f) to BNC (m) adapter

Test 7: Trigger Sensitivity

This test verifies the ability of the digitizing oscilloscope to trigger and measure a signal of a given amplitude.

Using a signal with a specific amplitude, the program reduces the signal level below the trigger threshold for the digitizing oscilloscope, then adjusts to the lowest signal where the trigger will occur. Each of the four channels is measured; the computer screen will prompt you to change connections.

As the test is running, the computer screen displays the channel sensitivity, the frequency, the amplitude, and confirms if the scope triggered as expected. The oscilloscope displays the signal. When the test is finished, the results will appear on your computer display or print out on your printer, depending on the option you selected at initial setup.

Equipment

Default configuration:

- Signal generator
- Type N cable, 3 ft
- Type N (f) to BNC (m) adapter

Quitting the Operation Verification Program

When the tests are finished, press (▶).

```
Quit the Test Executive program?  NO
                                  YES
```

1. The default is NO ; use (▼) to highlight YES .
2. Press (Return).

3

User's Guide

This chapter describes the functions and features of the digitizing oscilloscope. Detailed descriptions of each softkey, setting, measurement, and calibration are provided.

This chapter is divided into the following sections:

- Display conventions
- Instrument default settings
- USER key
- MENU key
- time base menu
- channel menu
- trigger menu
- screen menu
- measurements menu
- markers menu
- waveform memory menu
- functions menu
- instrument state menu
- selftest menu
- calibration menu

For complete diagrams of all the softkeys available on the HP 70703A digitizing oscilloscope, see Chapter 5.

Display Conventions

This section describes the display conventions that are used for the digitizing oscilloscope.

Screen Layout

The following figure and descriptions will familiarize you with the various screen elements.

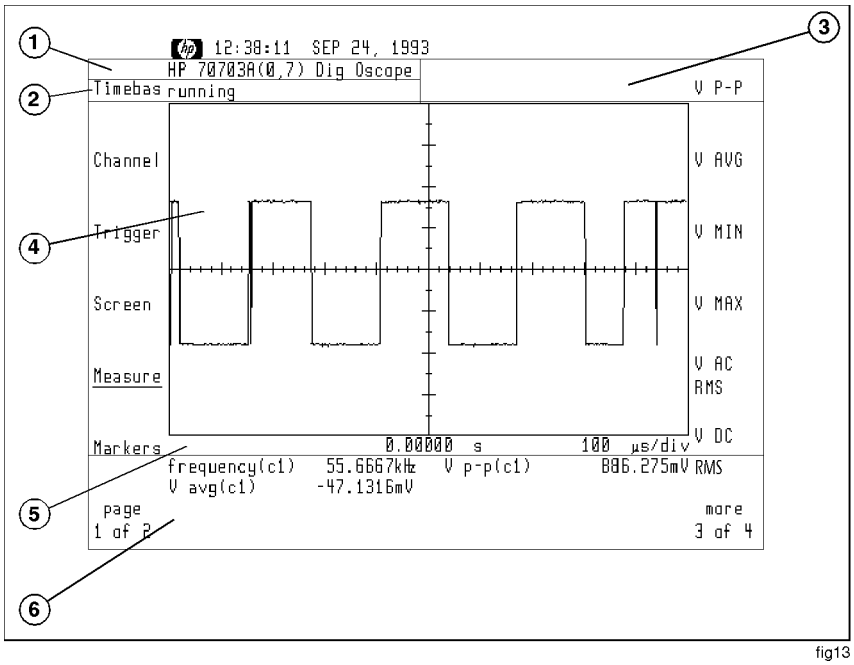


Figure 3-1. HP 70703A Screen Layout

1. The module identifier displays the module assigned to the graphics device. In addition, the MSIB address is listed in parenthesis (row, column).
2. The status message area displays the current acquisition status. For information about status messages, refer to “Status Messages” in this chapter.
3. The advisory message area displays error, warning, and general informational messages.
4. The main area of the screen displays the trace, graticules, and markers.
5. The timebase and scale are displayed in this area.
6. The measurement results and marker positions are displayed in this area.

Status Messages

Status messages provide you with real-time user feedback. By simply viewing the status area of the screen, you can determine the current action.

Note that only one message is displayed in the status area at any time.

all channels are off — All channels (1 through 4) are currently off. There is no data being acquired. Refer to the `Channel` menu.

stopped — The oscilloscope is not currently acquiring new data and the display will not be updated. Press (USER), `RUN|STOP` to restart the acquisition process.

awaiting trigger — The oscilloscope is in triggered mode and is waiting for the defined trigger event to occur.

auto triggering — The oscilloscope is in auto trigger mode and is generating triggers to acquire data. The defined trigger event is not occuring.

running — The oscilloscope is triggering on the defined trigger event (in both auto trigger and triggered mode), acquiring data, and displaying the data once it has been acquired.

triggered scroll — The timebase is set at 200 ms/div or slower and the oscilloscope is triggering on the defined trigger event. In this mode the display is updated with each data point as it is acquired. Pressing any keys will cause the oscilloscope to lose data and will invalidate the display.

auto triggered scroll — The timebase is set at 200 ms/div or slower and the oscilloscope is auto triggering. In this mode the display is updated with each data point as it is acquired. Pressing any keys will cause the oscilloscope to loose data and will invalidate the display.

n s to initialize — The oscilloscope is waiting n seconds to capture sufficient pre-trigger data before attempting to trigger.

n s until complete — The oscilloscope has triggered and still has n seconds of data to capture before the trace is complete and can be displayed.

digitizing — A controller has issued a "remote digitize" command to acquire data. If the oscilloscope is in remote, it will not respond to any key presses, except the (LOCAL) key which will abort the digitize action.

executing autoscale — An autoscale is currently in progress. The oscilloscope does not respond to key presses until the autoscale is complete.

limit test running A limit test is running. Refer to the `Measure` menu.

Softkey Conventions

On the HP 70703A digitizing oscilloscope, the softkey function menus appear on the left- and right-hand side of the screen.

Front-Panel Key

(BOXED). These keys are on the front panel of your display module (for example, (USER)).

Main Function Softkeys

`Shaded`. The label name is capitalized. These softkeys represent the main menus available on the HP 70703A digitizing oscilloscope, and are listed on two pages on the left-hand side of the screen. The active menu is underlined. These softkeys determine the array of softkeys that appears on the right-hand side of the screen (for example, `Channel`).

Navigation Softkeys

`shaded:`. The label name is *not* capitalized. These softkeys, on the right-hand side of the screen, represent top-level menus that access submenus.

Parameter Entry Softkeys

`SHADED`. The label name is *all* in capital letters. Use the step keys, the control knob, and/or the numerical keypad to enter a value. When you use the numerical keypad, a list of units of measure will appear in the right-hand softkey menu. Pressing one of these softkeys chooses the unit of measure, saves the value in memory, and returns you to the previous menu (for example, `OFFSET`). Note that the currently active parameter is highlighted.

Toggle Softkey

`shaded SHADED|SHADED`. The upper label name, which identifies the choice, usually is not in capital letters; the lower label name, which actually selects the choice, *is* in capital letters. The active selection is underlined. When you press the softkey, the selection steps through the two or three choices available (for example, `channel ON|OFF`).

Action Softkeys

`SHADED`. The label name is *all* in capital letters. These softkeys perform an action, or end a parameter entry, or make a selection; pressing one of these softkeys usually returns you to the previous menu.

Instrument Default Settings

The green instrument preset key on the display module resets the digitizing oscilloscope to these factory-default settings:

Time Base Menu

Time per division:	100 μs
Delay:	0 s
Reference position:	center
Expanded time base:	off

Channel Menu

Channel 1:	on
Channels 2, 3, 4:	off
Volts per division:	500 mV
Offset:	0.0 V
Channel coupling:	DC, 1 MΩ
Probe attenuation:	1:1

Trigger Menu

Mode:	edge
Source:	channel 1
Level:	0 V
Edge:	rising
Rejection filter:	off
Holdoff:	timed, 40 ns

Auto triggered, running

Screen Menu

Mode:	normal
Persistence:	minimum
Number of screens:	1
Graticule:	axes
Join dots:	off

Measurements Menu

Limit tests:	off
Measurements:	standard
Update method:	continuous, statistics off
Channel measured:	channel 1
Delay reference:	channel 1

Markers Menu

Time markers:	off
Voltage markers:	off

Waveform Save Menu

Channel to store:	1
Memory register:	1
Memory display:	off

Functions Menu

Function 1:	off
Function 2:	off
Source 1:	channel 1
Operator:	plus
Source 2:	channel 1
Function sensitivity:	1 V/div
Function offset:	0 V

State Menu

AC BNC output:	probe compensation signal

The USER Key

These are "shortcut" softkeys. Each of these softkeys appears elsewhere in the function menus, but for convenience can be accessed by pressing (USER). Most of the common setup functions can be directly accessed from this menu.

For a diagram of the softkeys and submenus available from the USER menu, see Chapter 5.

RUN | STOP

The RUN|STOP softkey toggles the acquisition status of the HP 70703A. If the oscilloscope is currently running (current status is displayed in the top left corner of the display in the message field) the instrument is placed in the stopped mode. In this mode, normal acquisistion is stopped and the last acquired data is displayed. If the oscilloscope is stopped, it is immediately changed to another mode (**running, awaiting trigger, auto-trigger,** and so on).

This softkey also appears in the second page of the Trigger menu.

SINGLE

The SINGLE softkey activates the acquisition system for one trigger event. One acquisition is made, displayed and then the data acquisition and display cycle is stopped. This single acquisition is superimposed on the current displayed data. If the display has been cleared before the SINGLE softkey is pressed, only one acquisition is displayed.

This softkey also appears in the second page of the Trigger menu.

CLEAR SCREEN

The CLEAR SCREEN softkey clears the display and resets all associated measurements. If the oscilloscope is in the stopped mode, all data that is currently displayed is erased. If the oscilloscope is **running**, all data is erased; however, new data is displayed on the next acquisition. The status of the RUN|STOP and SINGLE softkeys is not affected.

The RUN|STOP, SINGLE, and CLEAR SCREEN softkeys have a relationship that make it possible to manipulate data acquisitions and view one, two, or several acquisitions. It is possible to stop acquiring, clear the display, and capture one acquisition for evaluation. The display can be cleared while acquiring to capture new data. When acquisitions are manipulated with these three softkeys, other softkeys and settings are not affected.

This softkey also appears in the Screen menu.

AUTO | TRIG'D

Each trigger mode supports two conditions for acquisition and display.

AUTO — Automatic triggering: the oscilloscope generates a trigger if one is present.

TRIG'D — Conditional triggering: the oscilloscope does not acquire data until all trigger requirements are met.

This softkey also appears on the second page of the Trigger menu.

`trgsrc: CHAN x`

This softkey leads to a submenu where you select the trigger source channel. This softkey only appears when in edge trigger mode.

`LEVEL ADJ|CEN`

The trigger level can be centered automatically, or can be adjusted up to six divisions from the center. A horizontal marker shows the selected trigger level.

`ADJ` Use the step keys or the control knob to increase and decrease the trigger level in a fixed sequence proportional to the voltage of the active waveform. Use the numerical keypad to set an exact trigger point. The right-hand softkey menu displays a choice of units of measure for the setting; pressing a unit key completes the entry and returns you to the previous menu.

`CEN` The level and marker automatically are set at the center of the waveform. Notice that the `HOLDOFF` softkey is highlighted.

`edge ↑|↓`

The trigger can be set to occur either at the rising or the falling edge of the waveform.

`AUTO SCALE`

Autoscale identifies and evaluates all input signals, and sets the correct conditions to display the signals on all active channels. When you press the autoscale key (either in the user menu or in the state menu), the instrument sets:

- time base for approximately one full period of the input signal
- vertical sensitivity and offset for optimum display
- persistence to minimum
- auto-triggering, in edge mode, with a rising slope
- trigger level (to correctly display all active channels)

Autoscale also turns off:

- markers
- limit tests
- measurements
- expanded time base
- waveform memory display
- join dots
- math functions
- holdoff (sets to minimum value)

This softkey also appears in the `State` menu.

`recall state`

`RECALL PREV` The HP 70703A digitizing oscilloscope automatically saves the current configuration before executing an autoscale, a recall-state, or an automatic preset (ECL/TTL). Press this softkey to return the instrument to that previous configuration.

`RECALL STATE x` These four softkeys recall instrument configurations that you have stored in memory.

`RECALL PRESET` This returns the instrument to the factory-preset state (the same as pressing the green instrument preset key).

These softkeys also appears in the `State` menu.

SEC/DIV

The seconds-per-division softkey controls the sweep speed on the horizontal axis from 200 ps/div to 5 s/div. The main timebase is incremented and decremented in a 1-2-5 sequence.

During slow sweep speeds (200 ms/div to 5 s/div) the acquisition and write cycle changes. At these sweep speeds the oscilloscope needs up to 2.5 seconds to generate a trigger and acquisition; therefore, the displayed data is updated for each data sample. The HP 70703A must accommodate two trigger conditions for acquisition and display.

- In **auto** trigger mode, or **trig'd** mode with the delay at screen left being non-negative, the oscilloscope uses **scroll** mode. The oscilloscope acquires and immediately displays each data point rather than waiting until the end of the sweep. The status message is **auto triggered scroll** in **auto** trigger mode, and **triggered scroll** in **trig'd** mode. Pressing any softkey may cause the oscilloscope to miss data and will invalidate the display for that sweep.
- In **trig'd** mode when the delay at screen left is negative, the oscilloscope must acquire all the data before it can be displayed. As data is being sampled, the advisory **n s to initialize** is displayed while pre-trigger data is collected and **n s to initialize** is displayed while post-trigger data is collected. This message indicates the time needed to complete acquisition where **n** is the remaining time (in seconds, **s**) and countdown continues until the time has elapsed. The advisory **running** is displayed as the write cycle to the screen is executed and displayed data is updated.

  If the reference point is set to **left**, the only advisory displayed is **n s to complete** because all data is post-trigger. When right reference is set, all data is pre-trigger and the advisory is **n s to initialize**.

This softkey also appears in the `Timebas` menu.

DELAY

The delay function sets the time delay between the trigger event and the sweep. Maximum delay depends on the `SEC/DIV` setting. When the delay is set to zero, the trigger event is displayed at the delay reference point.

$$reference = trigger\ event + delay$$

Positive delay indicates time after trigger; negative delay indicates time before trigger. Therefore, a delay setting of −50 ns indicates the trigger event occurs 50 ns after the delay reference point.

`select: CHAN x`

This softkey leads to a submenu where you change the active channel. After you press a channel softkey, the main menu reappears; the channel selection softkey shows the active channel. This softkey also appears in the `Timebas` menu.

Note

Check Your Channel!

With the HP 70703A digitizing oscilloscope, you have several options for channel selection. Even in single-window mode, it is possible to view one channel while measuring or adjusting another. If you want to measure and view the same channel, make sure you have selected that channel both in the measure menu *and* in the channel menu, and that the channel is turned on.

`V/DIV`

The volts-per-division softkey controls vertical sensitivity, from 1 millivolt per division to 5 volts per division. While `V/DIV` is highlighted, the vertical sensitivity setting for the active channel appears at the bottom of the display.

- Use the step keys or the control knob to increase and decrease the vertical sensitivity in a 1-2-5 sequence,

  or

- Use the numerical keypad to enter a precise vertical sensitivity. When you press any numeral key, the right-hand softkey menu displays a choice of units of measure for the sensitivity setting; pressing a unit key completes the entry and returns you to the previous menu.

This softkey also appears in the `Channel` menu.

`OFFSET`

The offset softkey moves the displayed signal up or down. While `OFFSET` is highlighted, the offset setting for the active channel appears at the bottom of the display.

- Use the step keys or the control knob to increase and decrease the offset, in a fixed sequence proportional to the vertical sensitivity setting,

  or

- Use the numerical keypad to enter a precise offset. When you press any numeral key, the right-hand softkey menu displays a choice of units of measure for the offset setting; pressing a unit key completes the entry and returns you to the previous menu.

This softkey also appears in the `Channel` menu.

The MENU Key

When you press the (MENU) key, there are two pages of softkeys menus that appear on the left-hand side of the screen. These are the main function menus, and are shown as shaded words that have initial capitialization. For example, `Timebas` or `Trigger`, as shown in Figure 3-2 and Figure 3-3. See "Softkey Conventions" in this chapter.

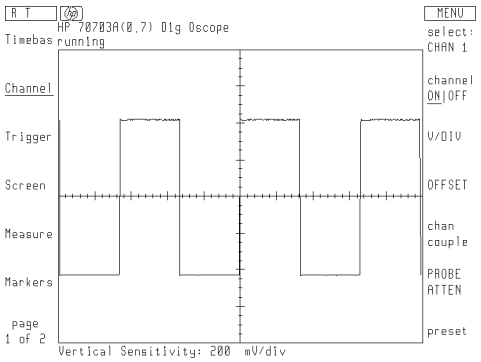


Figure 3-2. The (MENU) Key Softkeys—Page 1 of 2

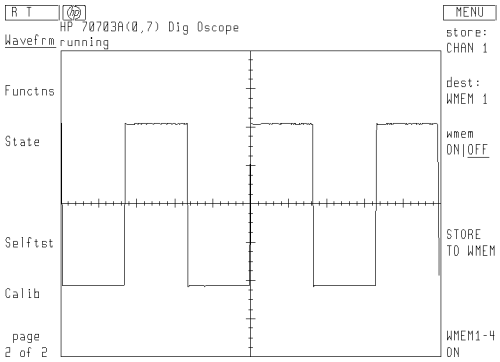


Figure 3-3. The (MENU) Key Softkeys—Page 2 of 2

The Time Base Menu

The time base menu (`Timebas`) controls the horizontal display and the expanded time base function.

For a diagram of the softkeys and submenus available from the time base menu, see Chapter 5.

Entering a Sweep Time

You may change the sweep time either with `SEC/DIV` or with `DELAY`.

- Use the step keys or the control knob to increase and decrease the main time base in a 1-2-5 sequence. When you press any numeral key, the right-hand softkey menu displays a choice of units of measure for the sweep setting; pressing a unit key completes the entry and returns you to the previous menu. You can use the numerical keypad to enter the sweep time, but the setting will be rounded up or down to the nearest number in the 1-2-5 sequence.

`SEC/DIV`

The seconds-per-division softkey controls the sweep speed on the horizontal axis from 200 ps/div to 5 s/div. The main timebase is incremented and decremented in a 1-2-5 sequence.

During slow sweep speeds (200 ms/div to 5 s/div) the acquisition and write cycle changes. At these sweep speeds the oscilloscope needs up to 2.5 seconds to generate a trigger and acquisition; therefore, the displayed data is updated for each data sample. The HP 70703A must accommodate two trigger conditions for acquisition and display.

- In **auto** trigger mode, or **trig'd** mode with the delay at screen left being non-negative, the oscilloscope uses scroll mode. The oscilloscope acquires and immediately displays each data point rather than waiting until the end of the sweep. The status message is **auto triggered scroll** in **auto** trigger mode, and **triggered scroll** in **trig'd** mode. Pressing any softkey may cause the oscilloscope to miss data and will invalidate the display for that sweep.
- In **trig'd** mode when the delay at screen left is negative, the oscilloscope must acquire all the data before it can be displayed. As data is being sampled, the advisory **n s to initialize** is displayed while pre-trigger data is collected and **n s to initialize** is displayed while post-trigger data is collected. This message indicates the time needed to complete acquisition where **n** is the remaining time (in seconds, **s**) and countdown continues until the time has elapsed. The advisory **running** is displayed as the write cycle to the screen is executed and displayed data is updated.

  If the reference point is set to **left**, the only advisory displayed is **n s to complete** because all data is post-trigger. When right reference is set, all data is pre-trigger and the advisory is **n s to initialize**.

This softkey also appears in the `Timebas` menu.

DELAY

The delay function sets the time delay between the trigger event and the sweep. Maximum delay depends on the SEC/DIV setting. When the delay is set to zero, the trigger event is displayed at the delay reference point.

reference = trigger event + delay

Positive delay indicates time after trigger; negative delay indicates time before trigger. Therefore, a delay setting of −50 ns indicates the trigger event occurs 50 ns after the delay reference point.

Setting the Reference Point

ref pos
L|C|R

The reference position softkey changes the reference point to one of three positions: left, center, or right. If delay is set to zero, the reference point consists of pre-trigger data to the left and post-trigger data to the right.

Viewing an Expanded Time Base

expand
ON|OFF

The expanded time base function places the digitizing oscilloscope in a paired-screen mode. The active waveform, with its original time base, appears in the upper screen. Two markers (vertical dotted lines) enclose a segment of the waveform. This segment appears expanded in the lower screen. All functions of the expanded time base are available during acquisition. If you press STOP or SINGLE (in the USER menu), the most recent display remains onscreen.

If the settings are changed while the oscilloscope is stopped, the expanded waveform in the lower screen is cleared. It will be redisplayed when the acquisition is restarted. When waveforms are stored in a register, it is the expanded waveform which is saved. However, the registers can only be recalled into the upper normal area; all information and measurement results for stored waveforms are established by the normal time base.

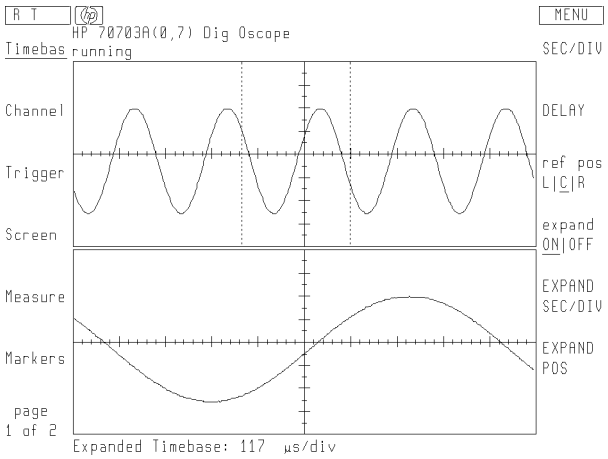


Figure 3-4. A Waveform Displayed with an Expanded Time Base

Multiple Windows. When more than one window is active, the two or four original waveforms are stacked at the top of the display, with the corresponding expanded waveforms stacked at the bottom of the display. Only one expansion setting and one position setting may be selected; these settings apply to all displayed windows.

Note

The displayed timebase information under the waveform display area is windowed timebase information. When the window is on, all measurement results and information are windowed information.

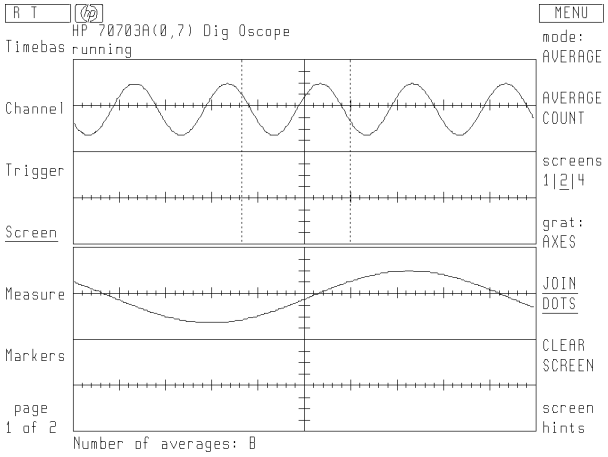


Figure 3-5.

Windowed Waveforms Displayed with an Expanded Time Base

Reference Position. When the reference position is set to L, only the right-hand marker moves as you change the expanded time base. When the reference position is set to R, only the left-hand marker moves. When C is selected, both markers move. This lets you adjust the reference point for better viewing, and maintains a specified time reference without changing any time base settings.

Adjusting the Time Base of the Selected Waveform Segment

EXPAND
SEC/DIV

Using the front-panel knob, the step keys, or the numerical keypad, you can adjust the time base of the waveform segment inside the markers from equal to the normal time base to 1/20 of the normal time base (1/2 of a major division). If you increase the time, the markers in the upper window move farther apart, and the time base of the waveform segment in the lower window increases (expands). When the markers in the upper window reach full screen, the main time base and the window time base become equal. Pressing EXPAND SEC/DIV automatically activates the expanded time base function.

EXPAND
POS

Using the front-panel knob, you can place the markers over any portion of the normal waveform. When the expanded time base is equal to the normal time base, there is only one possible setting for the markers; turning the knob will have no effect. Pressing EXPAND POS automatically activates the expanded time base function.

Example: Setting and Viewing an Expanded Time Base

Set the input signal.

1. Set a signal source to produce a 1 volt, 2 kHz square wave with adequate offset to display the signal at midscreen.
2. Using a BNC cable, connect the signal source to the channel 1 input on the digitizing oscilloscope and disconnect inputs to any other channel.
3. Press the green (INSTR PRESET) (or (I-P) key).

Set the digitizing oscilloscope.

4. Press AUTO SCALE.
5. Press (MENU) Timebas.
6. Press DELAY. Use the numerical keypad to set the delay to 500 μs.
7. Press expand ON|OFF to highlight ON. Use the numerical keypad to set the expanded time base to 40 μs/div.

Select the waveform segment to view in the expanded time base window.

8. Press EXPAND POS. Using the knob, move the markers to the left until the expanded position message (at the bottom of the screen) displays 200 μs.
9. Compare your results to Figure 3-6.

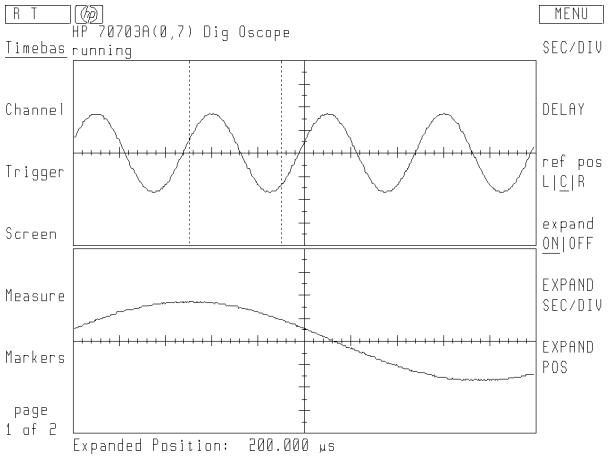


Figure 3-6.
Example: Setting and Viewing an Expanded Time Base

The Channel Menu

The channel menu (`Channel`) controls vertical sensitivity, offset, coupling, probe attenuation, and preset levels.

For a diagram of the softkeys and submenus available from the channel menu, see Chapter 5.

Selecting a Channel

`select:`
`CHAN x`

This softkey leads to a submenu where you change the active channel. After you press a channel softkey, the main channel menu reappears; the channel selection softkey shows the active channel.

`channel`
`ON|OFF`

Press this softkey to turn the selected channel on or off.

Note

Check Your Channel!

With the HP 70703A digitizing oscilloscope, you have several options for channel selection. Even in single-window mode, it is possible to view one channel while measuring or adjusting another. If you want to measure and view the same channel, make sure you have selected that channel both in the measure menu *and* in the channel menu, and that the channel is turned on.

Setting Vertical Sensitivity

`V/DIV`

The volts-per-division softkey controls vertical sensitivity, from 1 millivolt per division to 5 volts per division. While `V/DIV` is highlighted, the vertical sensitivity setting for the active channel appears at the bottom of the display.

- Use the step keys or the control knob to increase and decrease the vertical sensitivity in a 1-2-5 sequence,

  or

- Use the numerical keypad to enter a precise vertical sensitivity. When you press any numeral key, the right-hand softkey menu displays a choice of units of measure for the sensitivity setting; pressing a unit key completes the entry and returns you to the previous menu.

Setting the Offset

`OFFSET`

The offset softkey moves the displayed signal up or down with 0 V being midscreen. While `OFFSET` is highlighted, the offset setting for the active channel appears at the bottom of the display.

- Use the step keys or the control knob to increase and decrease the offset in a fixed sequence proportional to the vertical sensitivity setting,

  or

- Use the numerical keypad to enter a precise offset. When you press any numeral key, the right-hand softkey menu displays a choice of units of measure for the offset setting; pressing a unit key completes the entry and returns you to the previous menu.

Selecting Coupling Options

`chan`
`couple`

The channel coupling softkey leads to a submenu where you may choose various impedance, AC and DC, and filter options. These coupling options can be selected for each channel individually.

`select:`
`CHAN x` This softkey leads to a submenu where you can change the active channel. After you press a channel softkey, the channel coupling menu reappears; the channel selection softkey shows the active channel.

`1MΩ|50Ω` This softkey lets you set input impedance at 1 MΩ or 50 Ω for the active channel.

`DC|AC` AC coupling provides a 90 Hz high-pass filter, with a two-pole rolloff for triggering and for signal display. When AC is selected, the digitizing oscilloscope will ignore DC components and attenuate low-frequency (less than 90 Hz) AC components from the signal source.

`BW LIMIT` Bandwidth limitation (high-frequency rejection) provides 30 MHz low-pass filter. It reduces the noise in the display path as well as in the trigger path. When bandwidth limitation is active, the characters in the softkey are underlined.

`LF REJECT` Low-frequency rejection provides a 450 Hz high-pass filter, for triggering and for signal display. When low-frequency rejection is active, the characters in the softkey are underlined. To activate low-frequency rejections, you must be AC coupled; select AC with the softkey above.

`prev menu` Press this softkey to return to the channel menu.

Setting Probe Attenuation

PROBE
ATTEN

Probe attenuation controls scaling factors for the display, with a range of 0.9000:1 to 1000:1. Probe attenuation does not affect sensitivity at the input. Use save state in the State menu to save attenuation factors. While probe attenuation is highlighted, the attenuation setting appears at the bottom of the display.

- Use the step keys or the control knob to increase and decrease the probe attenuation in a 1-2-5 sequence,

  or

- Use the numerical keypad to enter a precise probe attenuation. After you have entered the attenuation ratio, press ENTER. Press CLEAR to cancel keypad entry and return to the previous probe attenuation setting.

Selecting ECL or TTL Presets

preset

This softkey leads to a submenu where you may activate presets for ECL or TTL circuits.

select:
CHAN x

This softkey leads to a submenu where you change the active channel. After you press a channel softkey, the main channel menu reappears; the channel selection softkey shows the active channel.

ECL

This softkey sets the digitizing oscilloscope to levels optimized for ECL (emitter-coupled logic) circuits:

V/Div:	200 mV/div
offset:	−1.3 V
coupling:	DC
trigger level:	−1.3 V

TTL

This softkey sets the digitizing oscilloscope to levels optimized for TTL (transistor-coupled logic) circuits:

V/Div:	1 V/div
offset:	2.5 V
coupling:	DC
trigger level:	1.4 V

Note

Cancelling ECL or TTL Presets

To cancel an ECL or TTL preset and restore instrument settings to a previous state:

1. Press (USER) `recall state`.
2. You can recall the setting that existed before you activated the preset (`RECALL PREV`), the factory preset state, or any one of four previously saved states.

The Trigger Menu

The trigger menu (`Trigger`) selects and defines triggering modes, thresholds, and channels. The five triggering modes are:

- edge
- pattern
- state
- delay
- tv

The selections available from the right-hand softkey menu and submenus are determined by the triggering mode selected. For a diagram of the softkeys and submenus available from the time base menu, see pages 5-6 through 5-10 in Chapter 5.

The trigger level (threshold) for each channel is set in the edge trigger mode and is independent for each channel. It is carried over to all other modes, except the tv trigger mode. These levels are important settings because the high and low levels in the pattern, state, and delay modes are greater than or less than the trigger level.

The tv trigger level is a special case and is set in the tv trigger menu.

If the oscilloscope is **auto triggered** and no trigger is present, the oscilloscope generates a trigger (as previously explained). However, if holdoff or delayed triggers are used in such a way as to make the trigger take a long time, the oscilloscope will auto trigger first, causing an unstable trace. The **trig'd** mode should be used in these instances. For example, if the oscilloscope is set to 1 MHz, auto trigger, edge trigger, 200 ns/div, and holdoff is set to 100,000, the trace is unstable. In this case, select **trig'd** for a stable trace.

Setting an Edge Trigger

When trigger mode is set to edge, the sweep begins at the defined edge of the triggering waveform.

```
source:
CHAN x
```

This softkey leads to a submenu where you select the trigger source channel.

```
LEVEL
ADJ|CEN
```

The trigger level can be centered automatically, or can be adjusted up to six divisions from the center. A horizontal marker shows the selected trigger level.

`ADJ` Use the step keys or the control knob to increase and decrease the trigger level in a fixed sequence proportional to the voltage of the active waveform. Use the numerical keypad to set an exact trigger point. The right-hand softkey menu displays a choice of units of measure for the setting; pressing a unit key completes the entry and returns you to the previous menu.

`CEN` The level and marker automatically are set at the center of the waveform. `HOLDOFF` becomes the active parameter.

`edge`
`↑|↓`

The trigger can be set to occur either at the rising or the falling edge of the waveform.

`rej fil`
`ON|OFF`

Select noise rejection to avoid false triggering in noisy signals.

`HOLDOFF`
`TIM|EDG`

This softkey disables the trigger circuit, for a specific period of time or number of events (edges) after the trigger event. You can select holdoff from 40 ns to 320 ms, or from 2 to 16,000,000 edges.

`more`
`1 of 2`

This softkey leads to the second page of the trigger menu. The options available depend on the trigger mode selected.

`AUTO |`
`TRIG'D`

Each trigger mode supports two conditions for acquisition and display.

`AUTO` Automatic triggering: the oscilloscope generates a trigger if one is present.

`TRIG'D`
Conditional triggering: the oscilloscope does not acquire data until all trigger requirements are met.

`RUN | STOP`

The `RUN|STOP` softkey toggles the acquisition status of the HP 70703A. If the oscilloscope is currently running (current status is displayed in the top left corner of the display in the message field) the instrument is placed in the stopped mode. In this mode, normal acquisition is stopped and the last acquired data is displayed. If the oscilloscope is stopped, it is immediately changed to another mode (**running, awaiting trigger, auto-trigger,** and so on).

This softkey also appears in the second page of the `Trigger` menu.

`SINGLE`

The `SINGLE` softkey activates the acquisition system for one trigger event. One acquisition is made, displayed and then the data acquisition and display cycle is stopped. This single acquisition is superimposed on the current displayed data. If the display has been cleared before the `SINGLE` softkey is pressed, only one acquisition is displayed.

Example: Using HOLDOFF in Edge Trigger Mode

Set up the equipment.

1. Set a pulse generator for a burst pattern with two positive cycles that repeat every 5 μs. For example, set an HP 8116A Option 001 pulse/function generator as follows:

   SIGNAL ..... square wave
   MODE: ..... I.BUR
   RPT: ..... 5.00 μs
   BUR: 2
   FRQ: ..... 1 MHz
   DTY: 50%
   HIL: ..... 1 V

2. Use a 1 meter BNC cable to connect the pulse generator to the channel 1 input on the digitizing oscilloscope; disconnect all other inputs.

Set the time base on the digitizing oscilloscope.

3. Press the green instrument preset key on the display.
4. Press (USER) AUTO SCALE.
5. Press (MENU) Timebas. Seconds-per-division is highlighted. Set the sweep to 500 ns per division. The digitizing oscilloscope sets up the display parameters, and attempts to trigger on the first rising edge of the two cycle burst.
6. Press Screen, then press JOIN DOTS.

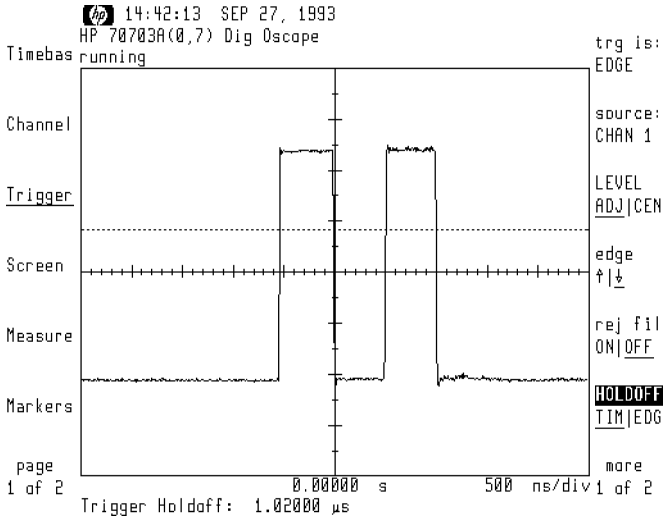


Figure 3-7. A Two-Burst Pulse

Set the trigger conditions.

7. Press Trigger, then press edge to select ↓. The instrument now is triggering on the first falling edge of the two cycle burst. Press edge again to select ↑, and trigger on the rising edge of the burst.

Note

Using HOLDOFF to correct an unstable trigger condition.

The digitizing oscilloscope has a minimum timed holdoff of 40 ns. A trigger occurs on the first rising edge and activates the 40 ns holdoff; when the holdoff time has elapsed, the oscilloscope triggers on the next rising edge, times a 40 ns holdoff and looks for another trigger. Then the oscilloscope triggers on the first rising edge of the second burst. Each trigger event occurs on a different pulse, creating an unstable trigger condition.

By adjusting the holdoff time until after the rising edge of the second pulse passes, the oscilloscope triggers only on the first rising edge and the signal is stable.

8. Press HOLDOFF TIM|EDG and set holdoff to 1.02 μs. The oscilloscope is not looking for a trigger until after the second rising edge, and therefore is now in a stable trigger condition.

Setting a Pattern Trigger

Pattern mode defines a four-bit pattern that will be recognized as a trigger event. When the inputs satisfy the trigger pattern and conditions, the oscilloscope triggers and displays the desired portion of the waveform. Pattern mode can trigger on noise as narrow as 1.5 ns.

trigger
pattern

This softkey leads to a submenu where you set a pattern (for each of the four channels) that will generate a trigger. Each channel must be identified as *high* (H), *don't care* (X), or *low* (L).

The voltage level of the active channel is compared to each channel as higher (H) or lower (L) then the reference trigger level defined in the edge trigger menu, or as "don't care" (X). Any channel not used in the qualifying pattern should be set as X, because if the channel is set as H or L, the oscilloscope will attempt to use the unused channel's trigger level to determine a trigger point, even if no signal is present on the channel.

For example, if channel 1 is active and the pattern is set as L X H X, a trigger will occur when the voltage on channel 1 is lower than the trigger level set for channel 1, and higher than the trigger level set for channel 3; the trigger levels for channels 2 and 4 are ignored.

when

This softkey leads to a submenu where you select which of five time conditions must be satisfied to generate a trigger.

ENTER PATTERN — generates a trigger on the first transition that makes a pattern true. The pattern must be false and become true to generate a trigger.

EXIT PATTERN — generates a trigger on the first transition that makes the pattern false. The pattern must be true and become false to generate a trigger.

`PATTERN > TIME` generates a trigger when a pattern has been true longer than a minimum time period (20 ns to 160 ms).

`PATTERN < TIME` generates a trigger at the end of a pattern, when the pattern has been true less than a maximum time period (also 20 ns to 160 ms).

`PATTERN RANGE` generates a trigger when a pattern has been true longer than the specified minimum, and less than the specified maximum time period. The first time setting must be less than the second time setting.

`HOLDOFF TIM|PAT`

This softkey disables the trigger circuit after the trigger event, for a specific period of time or number of patterns. You can select holdoff from 40 ns to 320 ms, or from 2 to 16,000,000 patterns.

`more 1 of 2`

This softkey leads to the second page of the trigger menu. The options available depend on the trigger mode selected.

`select: CHAN x`

This softkey leads to a submenu where you select the channel to change the trigger level. After you press a channel softkey, the second page of the trigger menu reappears; the channel selection softkey shows the selected channel.

`LEVEL ADJ|CEN`

The trigger level can be centered automatically, or can be adjusted up to six divisions from the center. A horizontal marker shows the selected trigger level.

`ADJ` Use the step keys or the control knob to increase and decrease the trigger level in a fixed sequence proportional to the voltage of the active waveform. Use the numerical keypad to set an exact trigger point. The right-hand softkey menu displays a choice of units of measure for the setting; pressing a unit key completes the entry and returns you to the previous menu.

`CEN` The level and marker automatically are set at the center of the waveform.

`AUTO | TRIG'D`

Each trigger mode supports two conditions for acquisition and display.

`AUTO` Automatic triggering: the oscilloscope generates a trigger if one is present.

`TRIG'D`
Conditional triggering: the oscilloscope does not acquire data until all trigger requirements are met.

`RUN | STOP`

The `RUN|STOP` softkey toggles the acquisition status of the HP 70703A. If the oscilloscope is currently running (current status is displayed in the top left corner of the display in the message field) the instrument is placed in the stopped mode. In this mode, normal acquisistion is stopped and the last acquired data is displayed. If the oscilloscope is stopped, it is immediately changed to another mode (**running, awaiting trigger, auto-trigger,** and so on).

This softkey also appears in the second page of the `Trigger` menu.

`SINGLE`

The `SINGLE` softkey activates the acquisition system for one trigger event. One acquisition is made, displayed and then the data acquisition and display cycle is stopped. This single acquisition is superimposed on the current displayed data. If the display has been cleared before the `SINGLE` softkey is pressed, only one acquisition is displayed.

`more 2 of 2`

This softkey returns you to the first page of the trigger menu.

Example: Defining the Pattern, and Using the Pattern to Change the Trigger Point.

Set up the equipment.

1. Set a function generator to produce a 1 MHz, 1 V peak-to-peak square wave signal.
2. Connect a BNC tee to the channel 1 input on the digitizing oscilloscope. Use a 1 meter BNC cable to connect one side of the BNC tee to the function generator output; use another 1 meter BNC cable to connect the other side of the BNC tee to the channel 4 input on the digitizing oscilloscope.

   The extra cable length between channel 1 and channel 4 provides a time delay between the two signals. The 6 to 7 ns propagation delay of that cable will be used to demonstrate the pattern trigger function.

Set the time base and display parameters on the digitizing oscilloscope.

3. Press the green instrument preset key on the display.
4. Press (USER) `AUTO SCALE`.
5. Press (MENU) `Timebas`. `SEC/DIV` is highlighted. Set the sweep to 10 ns per division. `ref pos L|C|R` is set to center, and `DELAY` is 0.0 seconds.
6. Press `Screen`, then press `JOIN DOTS`.

Set vertical sensitivity on channel 1 and channel 4.

7. Press `Channel`. `AUTO SCALE` has identified channels 1 and 4 as active, and has set channel 1 as the default channel. Press `V/DIV`. Set vertical sensitivity for channel 1 to 1 V per division.
8. Press `select: CHAN 1`. Select `CHAN 4`.
9. Press `V/DIV`. Set vertical sensitivity for channel 4 to 1 V per division.

Set the trigger level for channel 1.

10. Press `Trigger`, then press `trg is:`. Select `PATTERN`.
11. Press `more 1 of 2`, then press `select: CHAN x`. Select `CHAN 1`.
12. `LEVEL ADJ|CEN` will be highlighted. Set the trigger level for channel 1 to −200 mV.

Set the trigger level for channel 4.

13. Press `select: CHAN 1`. Select `CHAN 4`.

14. `LEVEL ADJ|CEN` will be highlighted. Set the trigger level for channel 4 to −200 mV.

Define the trigger pattern, and set it to trigger on entry.

15. Press `more 2 of 2` to return to the main trigger menu.

16. Press `trigger pattern`. Set the trigger pattern to `H X X L`. Press `CHAN 1 L|X|H` until `H` is selected. Press `CHAN 2 L|X|H` until `X` is selected; do the same for channel 3. For channel 4, select `L`. When you have finished selecting the pattern, press `prev menu`.

17. Press `when:` . Select `ENTER PATTERN`.

18. Press `HOLDOFF TIM|PAT` to select timed holdoff. Set the trigger holdoff to 500 ns.

19. Compare your results to Figure 3-8. Channel 1, in the upper window, is higher than the channel 1 trigger level (−200 mV), and channel 4, in the lower window, still is below the channel 4 trigger level (also −200 mV). The oscilloscope triggers on the first rising edge after these conditions are satisfied.

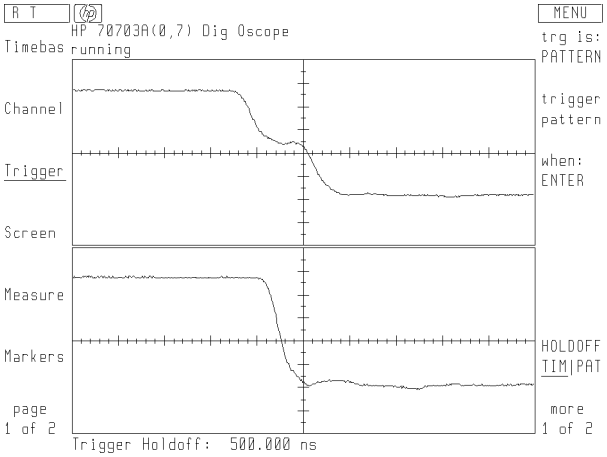


Figure 3-8.
A Trigger Occurs When the Signal Enters an `HXXL` Pattern

Setting a State Trigger

State trigger mode is similar to pattern trigger, because it also defines a pattern that recognizes and generates a trigger event. However, with state triggering, one channel is selected as a clock edge and the other three channels define the pattern. When pattern criteria are met, the digitizing oscilloscope triggers on the next clock edge if the pattern meets setup and hold criteria.

State triggering extends the logic triggering capability of the HP 70703A digitizing oscilloscope by selecting one of the inputs as a

clock and using the other inputs as qualifiers, such as when you need to synchronize the display with a system clock to detect a system state. For example, when testing a synchronous memory bus, the state trigger mode enables only those events that occur when reading from a block of memory to be captured and displayed.

`trigger state`

This softkey leads to a submenu where you select the clock channel, and define the pattern.

`clock: CHAN x` Select any channel to be used as the state clock.

`CHAN x ↑|↓` The pattern selection softkey for the state clock channel is used to pick a rising edge (positive slope) or a falling edge (negative slope) for the waveform.

x|CHAN x L X H key|

`CHAN x L|X|H` The pattern selection softkeys for the other three channels are used to define the pattern that will generate a trigger. Each of these channels must be identified as *high* (H), *don't care* (X), or *low* (L).

`state TRU|FAL` Specify whether the trigger will occur when the signal matches the pattern (TRUE) or when the signal *does not* match the pattern (FALSE).

`HOLDOFF TIM|STA`

This softkey disables the trigger circuit after the trigger event, for a specific period of time or number of states (patterns). You can select holdoff from 40 ns to 320 ms, or from 2 to 16,000,000 patterns.

This softkey leads to the second page of the trigger menu. The options available depend on the trigger mode selected.

`select: CHAN x`

This softkey leads to a submenu where you select the channel to change the trigger level. After you press a channel softkey, the second page of the trigger menu reappears; the channel selection softkey shows the selected channel.

`LEVEL ADJ|CEN`

The trigger level can be centered automatically, or can be adjusted up to six divisions from the center. A horizontal marker shows the selected trigger level.

`ADJ` Use the step keys or the control knob to increase and decrease the trigger level in a fixed sequence proportional to the voltage of the active waveform. Use the numerical keypad to set an exact trigger point. The right-hand softkey menu displays a choice of units of measure for the setting;

pressing a unit key completes the entry and returns you to the previous menu.

`CEN` The level and marker automatically are set at the center of the waveform.

`AUTO | TRIG'D`

Each trigger mode supports two conditions for acquisition and display.

`AUTO` Automatic triggering: the oscilloscope generates a trigger if one is present.

`TRIG'D`
Conditional triggering: the oscilloscope does not acquire data until all trigger requirements are met.

`RUN | STOP`

The `RUN|STOP` softkey toggles the acquisition status of the HP 70703A. If the oscilloscope is currently running (current status is displayed in the top left corner of the display in the message field) the instrument is placed in the stopped mode. In this mode, normal acquisistion is stopped and the last acquired data is displayed. If the oscilloscope is stopped, it is immediately changed to another mode (**running, awaiting trigger, auto-trigger,** and so on).

This softkey also appears in the second page of the `Trigger` menu.

`SINGLE`

The `SINGLE` softkey activates the acquisition system for one trigger event. One acquisition is made, displayed and then the data acquisition and display cycle is stopped. This single acquisition is superimposed on the current displayed data. If the display has been cleared before the `SINGLE` softkey is pressed, only one acquisition is displayed.

`more 2 of 2`

This softkey returns you to the first page of the trigger menu.

Example: Using an Input Pattern to Qualify a Clock Edge as a Trigger

Set up the Instrument.

1. Set a function generator to produce a 1 MHz, 1 V square wave signal.
2. Connect a BNC tee to the channel 1 input on the digitizing oscilloscope. Use a 1 meter BNC cable to connect one side of the BNC tee to the function generator output; use another 1 meter BNC cable to connect the other side of the BNC tee to the channel 4 input on the digitizing oscilloscope.

   The extra cable length between channel 1 and channel 4 provides a time delay between the two signals. The 6 to 7 ns propagation delay of that cable will be used to demonstrate the pattern trigger function.

Set the time base and display parameters on the digitizing oscilloscope.

3. Press the green instrument preset key on the display.
4. Press (USER) `AUTO SCALE`.
5. Press (MENU) `Timebas`. `SEC/DIV` is highlighted. Set the sweep to 10 ns per division. `ref pos L|C|R` is set to center, and `DELAY` is 0.0 seconds.
6. Press `Screen`, then press `JOIN DOTS`.

Set vertical sensitivity, offset, and channel coupling for channel 1 and channel 4.

7. Press `Channel`. `AUTO SCALE` has identified channels 1 and 4 as active, and has set channel 1 as the default channel. Press `V/DIV`. Set vertical sensitivity to 750 mV per division.
8. Press `select: CHAN 1`. Select `CHAN 4`.
9. Press `V/DIV`. Set vertical sensitivity to 750 mV per division.

Set the trigger level for channel 1.

10. Press `Trigger`, then press `trg is:`. Select `STATE`.
11. Press `more 1 of 2`.
12. Press `select: CHAN x`. Select `CHAN 1`.
13. Press `LEVEL ADJ|CEN`. Set the trigger level for channel 1 to 125 mV.

Set the trigger level for channel 4.

14. Press `select: CHAN 1`. Select `CHAN 4`.

15. Press `LEVEL ADJ|CEN`. Set the trigger level for channel 4 to −100 mV.

Define the state trigger pattern.

16. Press `more 2 of 2` to return to the main trigger menu.

17. Press `trigger state`. To set the trigger pattern to ↑ X X L, press `clock: CHAN x`. Select `CHAN 1`.

18. The pattern selection softkey for channel 1 will appear as `CHAN 1 ↑||`. Select ↑ (positive/rising edge).

19. Press `CHAN 2 L|X|H` until X is selected; do the same for channel 3. For channel 4, select L.

20. Press `state TRU|FAL` to select TRUE. When you have finished selecting the pattern, press `prev menu`.

21. `HOLDOFF TIM|STA` is highlighted. Use the numerical keypad to set the trigger holdoff to 500 ns.

22. Compare your results to Figure 3-9. Channel 1, in the upper window, is higher than the channel 1 trigger level (125 mV), and channel 4, in the lower window, still is below the channel 4 trigger level (−100 mV). The oscilloscope triggers on the first rising edge after these conditions are satisfied.

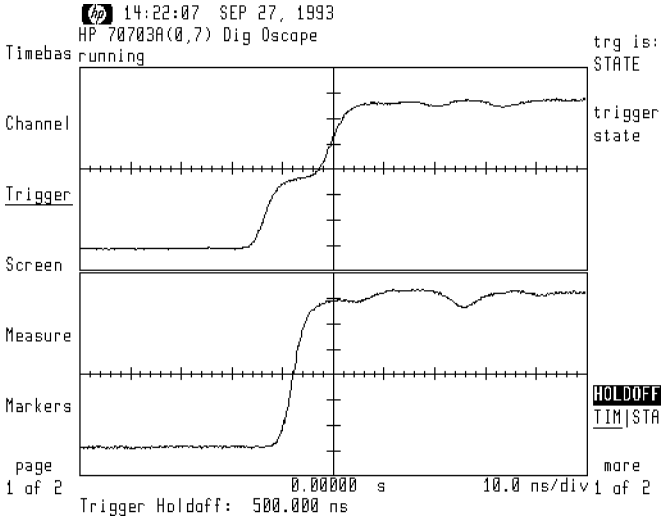


Figure 3-9. A Trigger in a Channel 1 Clock XXL State

Setting a Delay Trigger

Delay trigger mode qualifies on a signal edge, pattern, or state from any source, delays for a period of time (or occurrence of edges), and then triggers on a selected edge from any source. This versatile trigger mode lets you select different trigger sources, delay times, and delay counts, allows you to and display various points of the waveform.

There is a trigger holdoff of 40 ns after the delayed trigger.

`qualify`

This softkey selects which mode to qualify the trigger before a delay is defined.

`qual: x` This softkey leads to another submenu where you select how the trigger is qualified. The options are:

- `EDGE` With edge qualification, you select the source channel and the slope. See "Edge Trigger Mode" for more information.
- `PATTERN` With pattern qualification, you define a four-bit pattern (*low*, *don't care*, or *high*) for each of the four channels and select a time condition (*enter pattern*, *exit pattern*, *pattern* > *time*, *pattern* < *time*, or *pattern range*). See "Pattern Trigger Mode," above, for more information on defining the pattern.
- `STATE` With state qualification, you select a clock channel, define a pattern for the remaining three channels, and specify whether the trigger will occur when the signal matches the pattern (TRUE) or when the signal *does not* match the pattern (FALSE). See "State Trigger Mode," above, for more information on selecting the clock channel and defining the state pattern.

`delay`

This softkey leads to a submenu where you choose the delay method, select the delay source channel, and define the delay edge for the trigger.

`DELAY TIM|CNT`

DELAY BY TIME disables the trigger circuit for a selected period of time. Use the step keys, the control knob, or the numerical keypad to set a delay time from 30 ns to 160 ms.

Delay by time is not available with pattern-qualified delay when the time condition for the pattern is set to `PATTERN > TIME`, `PATTERN < TIME`, or `PATTERN RANGE`. If you have selected one of these conditions, `DELAY TIM|CNT` will default to delay by count. If you override this default and select delay by

time, the setting for pattern condition will change to `ENTER PATTERN`. **DELAY BY COUNT** disables the trigger circuit for a selected number of edges or events after the trigger has been qualified. Use the step keys, the control knob, or the numerical keypad to set the number of edges from 1 to 16,000,000.

`delsrc: CHAN x` When **DELAY BY COUNT** is selected, this softkey leads to another submenu where you select the channel to delay on.

`del edg |||` When **DELAY BY COUNT** is selected, this softkey specifies which edge (rising or falling) to delay on.

`trigger`

This softkey leads to a submenu where you define the specific edge to cause a trigger, after the qualification and delay conditions have been met.

`trgsrc: CHAN x` This softkey leads to another submenu where you select the channel to trigger.

`TRIGGER COUNT` This sets how many trigger events will be counted before the trigger will occur. Use the step keys, the control knob, or the numerical keypad to enter a number between 1 and 16,000,000.

`trg edg: |||` The trigger can be set to occur either at the rising or the falling edge of the waveform.

`more 1 of 2`

This softkey leads to the second page of the trigger menu. The options available depend on the trigger mode selected.

`select: CHAN x`

This softkey leads to a submenu where you select the channel to change the trigger level. After you press a channel softkey, the second page of the trigger menu reappears; the channel selection softkey shows the selected channel.

`LEVEL ADJ|CEN`

The trigger level can be centered automatically, or can be adjusted up to six divisions from the center. A horizontal marker shows the selected trigger level.

`ADJ` Use the step keys or the control knob to increase and decrease the trigger level in a fixed sequence proportional to the voltage of the active waveform. Use the numerical keypad to set an exact trigger point. The right-hand softkey menu displays a choice of units of measure for the setting;

pressing a unit key completes the entry and returns you to the previous menu.

`CEN` The level and marker automatically are set at the center of the waveform.

`AUTO | TRIG'D`

Each trigger mode supports two conditions for acquisition and display.

`AUTO` Automatic triggering: the oscilloscope generates a trigger if one is present.

`TRIG'D`
Conditional triggering: the oscilloscope does not acquire data until all trigger requirements are met.

`RUN | STOP`

The `RUN|STOP` softkey toggles the acquisition status of the HP 70703A. If the oscilloscope is currently running (current status is displayed in the top left corner of the display in the message field) the instrument is placed in the stopped mode. In this mode, normal acquisistion is stopped and the last acquired data is displayed. If the oscilloscope is stopped, it is immediately changed to another mode (**running, awaiting trigger, auto-trigger,** and so on).

This softkey also appears in the second page of the `Trigger` menu.

`SINGLE`

The `SINGLE` softkey activates the acquisition system for one trigger event. One acquisition is made, displayed and then the data acquisition and display cycle is stopped. This single acquisition is superimposed on the current displayed data. If the display has been cleared before the `SINGLE` softkey is pressed, only one acquisition is displayed.

`more 2 of 2`

This softkey returns you to the first page of the trigger menu.

Example: Using Delay Mode to Select the Exact Point for the Trigger

Set up the equipment.

1. Set a pulse generator for a burst of ten pulses at a 5 MHz rate, repeating every 50 μs. For example, set an HP 8116A (Option 001) pulse/function generator as follows:

   SIGNAL ..... square wave
   MODE: ..... I.BUR
   RPT: ..... 50 μs
   BUR: 10
   FRQ: ..... 5 MHz
   DTY: 50%
   AMP: ..... 1 V

2. Use a 1 meter BNC cable to connect the pulse generator to the channel 1 input on the digitizing oscilloscope; disconnect all other inputs.

Reset the instrument, autoscale the signal and set the triggering parameters.

Set the digitizing oscilloscope for a 2.5 μs conditional delay, edge-qualified and triggered on the rising edge of the signal on channel 1.

3. Press the green instrument preset key.
4. Press (USER) `AUTO SCALE`.
5. Press (MENU) `Timebas`. `SEC/DIV` is highlighted. Set the time per division to 250 ns.
6. Press `Screen`, the press `JOIN DOTS`.
7. Press `Trigger`, then press `trg is:`. Select `DELAY`.
8. Press `qualify`, then press `qual:`. Select `EDGE`.
9. Press `source: CHAN x`. Select `CHAN 1` as the source of the edge-qualified signal.
10. Press `edge ↑|↓` to select ↑ (the rising edge of the waveform).
    Press `prev menu`.
11. Press `delay`, then press `DELAY TIM|CNT` to select TIM (timed delay). Set the delay time to 2.5 μs; this stabilizes the trigger.
    Press `prev menu`.
12. Press `trigger`, then press `trgsrc: CHAN x`. Select `CHAN 1` as the trigger source.
13. Press `TRIGGER COUNT`. Use the numerical keypad to enter 5. This sets the trigger to occur on the fifth edge.
14. Press `trg edg ↑|↓` to select ↑ (the rising edge of the waveform).
    Press `prev menu`.

15. Press `more 1 of 2`, then press `AUTO|TRIG'D` to select TRIG'D (conditional triggering).
16. Compare your results to Figure 3-10. The oscilloscope qualifies on the fifth rising edge of the burst, delays through the remainder of the burst, then triggers on the rising edge of the next burst.

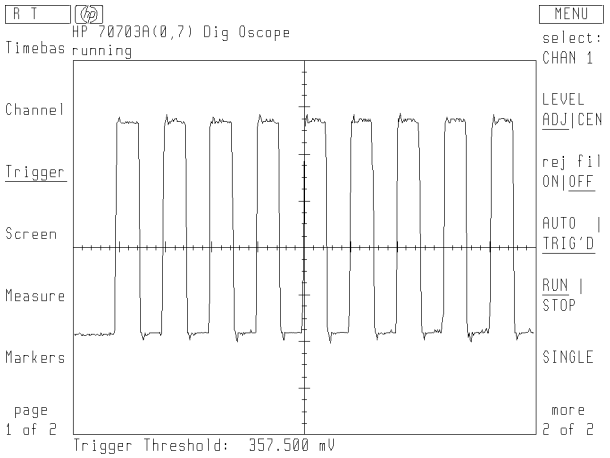


Figure 3-10. The Ten-Burst Pulse with a Stable Trigger

Setting a TV Trigger

TV trigger mode triggers on clamped television signals. You can choose one of two preset standards, or define your own television signal.

`std: x`

This softkey leads to a submenu where you select or define the television signal.

`60 Hz 525 LIN` This selects the 60 Hz/525 lines-per-frame NTSC standard used in the United States.

`50 Hz 625 LIN` This selects the 50 Hz/625 lines-per-frame standard used in most European countries.

When you select either preset signal definition, the softkey menu will offer these additional parameters:

`source: CHAN x` This softkey leads to another submenu where you select the source for the television signal.

`LEVEL POS|NEG` Press this softkey to select the polarity of sync pulses for the television trigger source, and use the step keys, the control knob, or the numerical keypad to enter a value for the trigger level. A horizontal marker tracks the trigger level on the display.

`FIELD 1|2` Select field 1 or field 2. This selection determines the range of choices for the `LINE` softkey.

`LINE` The line selection depends on the signal and field settings.

Signal	Field	Line Range	Broadcast Standard
60 Hz/525 line	1	1 to 263	M
	2	1 to 262	M
50 Hz/625 line	1	1 to 313	B, C, D, G, H, I, K, K1, L, N
	2	314 to 625	B, C, D, G, H, I, K, K1, L, N

`USER DEFINED` This allows you to set the parameters for a non-standard television signal.

When you define your own television signal, the softkey menu will offer these additional parameters:

`source: CHAN x` This softkey leads to another submenu where you select the source for the television signal.

`LEVEL HI|LOW` Press this softkey to select the polarity of sync pulses for the television trigger source, and use the step keys, the control knob, or the numerical keypad to enter a value for the trigger level. A horizontal marker tracks the trigger level on the display.

`> TIME` and `< TIME`
Use the step keys, the control knob, or the numerical keypad to set the time conditions for which the pulses defined by `LEVEL HI|LOW` must be present.

`more 1 of 2`

This softkey leads to the second page of the trigger menu. The options available depend on the trigger mode selected.

`TRIGGER ↑|↓`

(only in USER DEF) Select the number of pulses to count and which edge to use before triggering.

`HOLDOFF TIM|STA`

This softkey disables the trigger circuit after the trigger event, for a specific period of time or number of states (patterns). You can select holdoff from 40 ns to 320 ms, or from 2 to 16,000,000 patterns.

`rej fil ON|OFF`

Select noise rejection, to avoid false triggering in noisy signals.

AUTO |
TRIG'D

Each trigger mode supports two conditions for acquisition and display.

AUTO Automatic triggering: the oscilloscope generates a trigger if one is present.

TRIG'D
Conditional triggering: the oscilloscope does not acquire data until all trigger requirements are met.

RUN |
STOP

The RUN|STOP softkey toggles the acquisition status of the HP 70703A. If the oscilloscope is currently running (current status is displayed in the top left corner of the display in the message field) the instrument is placed in the stopped mode. In this mode, normal acquisistion is stopped and the last acquired data is displayed. If the oscilloscope is stopped, it is immediately changed to another mode (**running, awaiting trigger, auto-trigger,** and so on).

SINGLE

The SINGLE softkey activates the acquisition system for one trigger event. One acquisition is made, displayed and then the data acquisition and display cycle is stopped. This single acquisition is superimposed on the current displayed data. If the display has been cleared before the SINGLE softkey is pressed, only one acquisition is displayed.

more
2 of 2

This softkey returns you to the first page of the trigger menu.

Example: Displaying and Triggering on a Video Signal

Set up the equipment.

1. Set a standard NTSC signal generator (with clamped video output) to display the color bars.
2. Connect the NTSC video signal to the channel 1 input of the digitizing oscilloscope.

Set the trigger mode and identify the television signal and source.

3. Press the green instrument preset key.
4. Press (USER) `AUTO SCALE`.
5. Press (MENU) `Timebas` and set `SEC/DIV` to 1 μs/div.
6. Press `Trigger`, then press `trg is:`. Select `TV`.
7. Press `std:`. Select `60 Hz 525 LIN`.
8. Press `source: CHAN x`. Select `CHAN 1`.

Determine the polarity of the signal.

9. `LEVEL POS|NEG` is highlighted. Turn the control knob until display is stable. When you see a synchronized pulse, observe its polarity. Press the `LEVEL POS|NEG` softkey to set the polarity of the sync pulse to match the actual pulse.
10. Use the control knob to set the trigger level marker at the midpoint of the sync pulse. This established the trigger level just below the middle of the sync pulse, and sets the digitizing oscilloscope to trigger on the leading edge of the waveform.

Select the field and the line.

11. Press `FIELD 1|2` to select field 1.
12. Press `LINE`. Use the numerical keypad to select line 1.

Select conditional triggering, to eliminate a premature trigger event.

13. Press `more 1 of 2`, then press `AUTO|TRIG'D` to select TRIG'D (conditional triggering).

Set the time base.

14. Press `Timebas`. Use the numerical keypad to set the time per division to 100 μs.

    The digitizing oscilloscope is triggering on the first equalizing pulse of field 1 (the first pulse in the vertical interval). The pretrigger data at the left of the screen is field 2, lines 256 to 262. Compare your results to Figure 3-11.

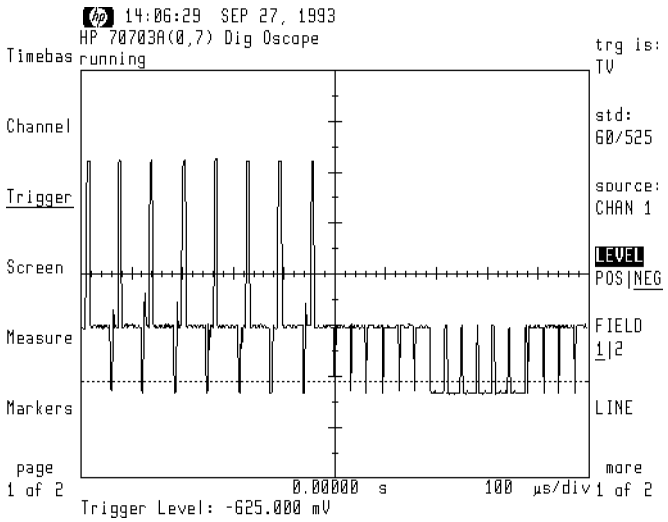


Figure 3-11. The TV Trigger at Field 1, Line 1.

The Screen Menu

The screen menu (`Screen`) controls display mode (normal, average, and envelope), display backgrounds (graticules), waveform persistence, windows, and screen message displays.

For a diagram of the softkeys and submenus available from the screen menu, see Chapter 5.

Selecting the Display Mode

```
mode
NORMAL
```

The display mode softkey leads to a submenu where you select one of the three display modes: normal, averaged, or envelope.

`NORM` Normal mode is the default. When in normal mode, you may select either minimum or infinite persistence.

```
persist
MIN|INF
```

Minimum Persistence rewrites each waveform on the display as it is acquired. The current display is always the most recent acquisition. **Infinite Persistence** retains acquired waveforms on the display indefinitely. Infinite persistence can be used to display worst-case characterizations of signal noise, jitter, or drift.

This is a graphical feature. Measurements will use the last acquired waveform, not the infinte series. Use envelope mode if you want to make min or max measurements.

`AVERAGE` In averaged mode, you select the number of waveform acquisitions averaged to generate the displayed waveform.

```
AVERAGE
COUNT
```

Use the step keys or the control knob to increase and decrease the number of averages. This value increases in powers of 2 from 1 to 2048. You may use the numerical keypad to enter the number, but if you select a non-power of 2 number, it will be rounded up or down to the nearest number in the sequence. Averaging the acquired waveforms significantly reduces displayed signal noise and improves resolution; however, as the number of averages increases, the display becomes less responsive to changes in the input signal(s).

`ENVELOP` In envelope mode, the screen retains the image of the minimum and maximum voltages in each horizontal position. This is useful for viewing jitter in voltage or time.

Selecting Multiple Windows

`screens`
`1|2|4`

This softkey selects the number of windows that appear on the screen.

`1` The entire display area is one screen; any displayed waveforms are superimposed.

`2` The display area is divided into two equal windows. The upper window displays channels 1 or 2, and the lower window displays channels 3 or 4. See Figure 3-12. If channels 1 *and* 2, or 3 *and* 4 are displayed at the same time, they will be superimposed.

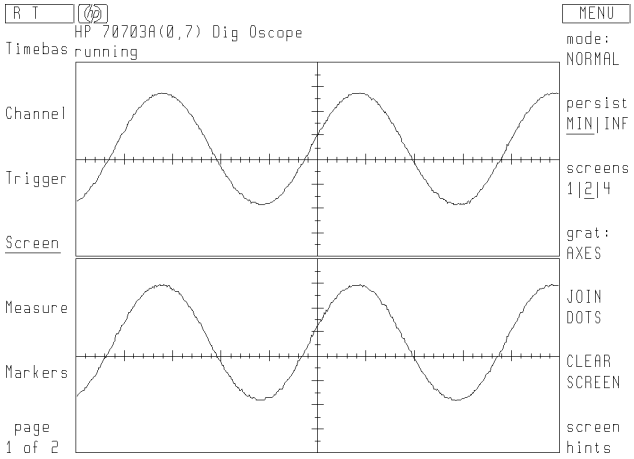


Figure 3-12. Two Windows

`4` The display is divided into four equal windows with one waveform displayed in each. See Figure 3-13.

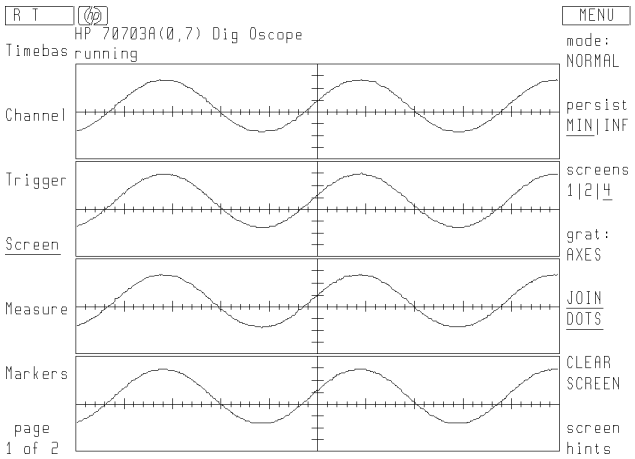


Figure 3-13. Four Windows

When waveform math functions or dual time base windows are active, they appear in the lower half of the screen, and the channel windows appear in the upper half of the screen.

Selecting a Display Background

`grat`

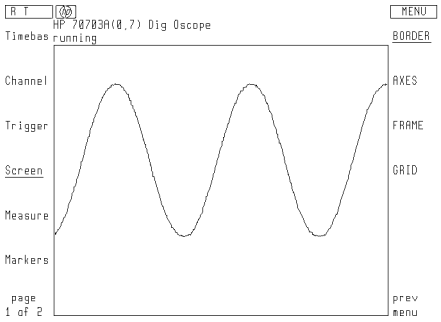
This softkey leads to a submenu where you select one of three graticules or an unmarked border.

`BORDER` This softkey turns off the background graticule. The displayed waveform appears in a plain border with no reference points.

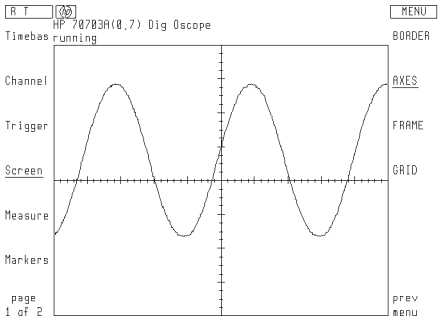
`AXES` This softkey displays vertical and horizontal scales (with major and minor divisions) crossing at mid-screen.

`FRAME` This softkey displays the outside border with a measurement scale marked with major and minor divisions.

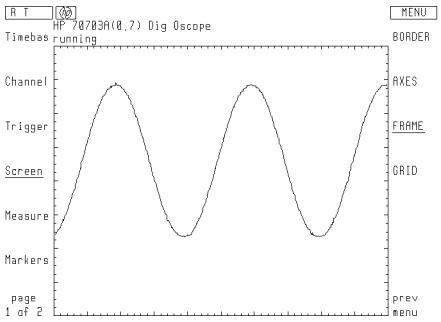
`GRID` This softkey displays a complete graticule with horizontal and vertical major divisions. Vertical and horizontal axes, with minor divisions, are superimposed.



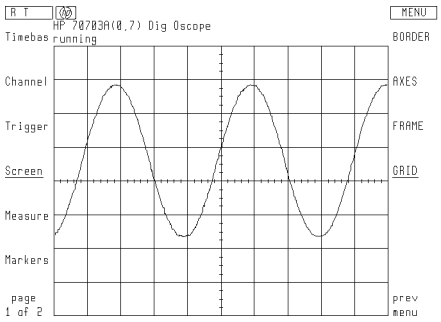
`BORDER`



`AXES`



`FRAME`



`GRID`

Displaying the Waveform as an Unbroken Line

JOIN
DOTS

This softkey displays the waveform with all data points connected. The signal is complete, with no breaks. When this function is active, the digitizing oscilloscope connects data points linearly; it does not interpolate data and generate data points. Figure 3-14 shows an example of a square wave displayed in join-the-dots mode.

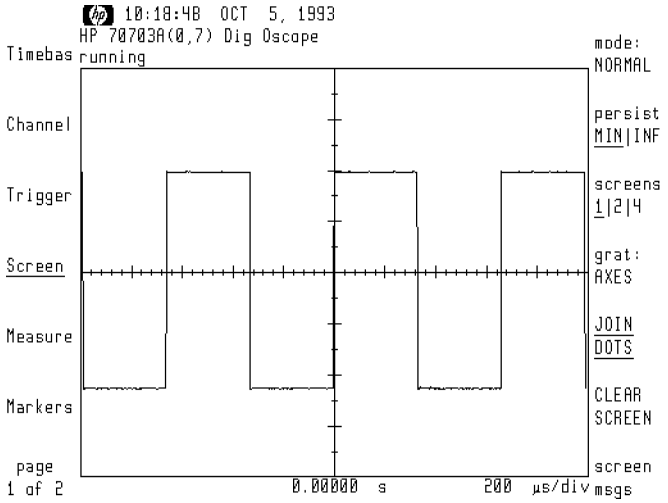


Figure 3-14. Join-the-Dots Mode

Clearing the Screen

`CLEAR SCREEN`

The `CLEAR SCREEN` softkey clears the display and resets all associated measurements. If the oscilloscope is in the stopped mode, all data that is currently displayed is erased. If the oscilloscope is **running**, all data is erased; however, new data is displayed on the next acquisition. The status of the `RUN|STOP` and `SINGLE` softkeys is not affected.

The `RUN|STOP`, `SINGLE`, and `CLEAR SCREEN` softkeys have a relationship that make it possible to manipulate data acquisitions and view one, two, or several acquisitions. It is possible to stop acquiring, clear the display, and capture one acquisition for evaluation. The display can be cleared while acquiring to capture new data. When acquisitions are manipulated with these three softkeys, other softkeys and settings are not affected.

Displaying Status Information

`screen msgs`

This softkey leads to a submenu that controls status displays. The settings in this menu are not affected by instrument preset.

`MOD ID ON|OFF`

This softkey turns on a message that shows the HP 70703A digitizing oscilloscope's model number, and the row and column of the HP-MSIB address (row, column), for example 0, 7; the HP-IB address defaults to the column number of the HP-MSIB address. This information appears in the upper left-hand corner of the display; it remains on until you press `MOD ID ON|OFF` again.

`STATUS ON|OFF`

This softkey turns on a message that shows the operating status of the digitizing oscilloscope. This information appears in the upper left-hand corner of the display; it remains on until you press `STATUS ON|OFF` again. For example, this line might read: `running`, `executing autoscale`, or `auto triggering`, depending on the acquisition.

`ADVISE ON|OFF`

The softkey activates or disables onscreen display of messages regarding internal errors, warnings, or advisory messages that occur.

`TIMEBAS ON|OFF`

This softkey turns on a message that shows the time per division and the position of the expanded timebase marker. This information appears under the waveform window(s); it remains on until you press `TIMEBASE ON|OFF` again.

`MEASURE ON|AUTO`

This softkey sets the number of measurements that will appear under the waveform window(s). When you select

`ON`, you can choose to show one to eight measurements.

When you select `AUTO`, the digitizing oscilloscope will only reserve the space when any measurements or markers require the space.

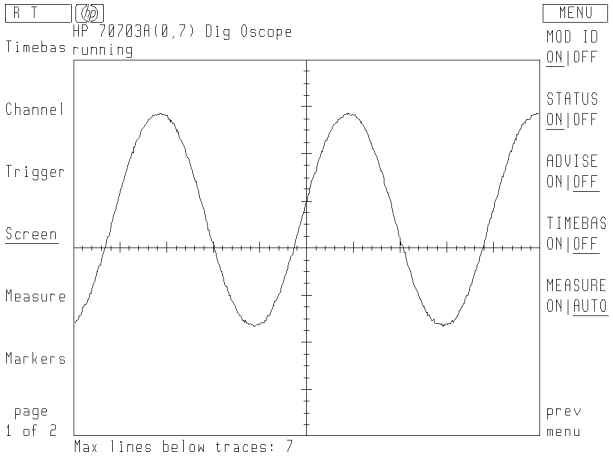


Figure 3-15. Status Information Messages

The Measurements Menu

The measurements menu defines and executes the 17 automatic measurements made by the HP 70703A digitizing oscilloscope which are:

- Frequency
- Period
- Rise time
- Fall time
- Pulse interval +
- Pulse interval –
- Volts peak-to-peak
- Volts average
- Volts minimum
- Volts maximum
- Volts AC_{rms}
- Volts DC_{rms}
- Volts base
- Volts top
- Volts amplitude
- Duty cycle
- Delay

This menu consists of four pages. The first page has softkeys for defining limit test, measurement, and display update parameters; pages two, three, and four contain the selection softkeys for the measurements themselves.

For diagrams of the softkeys and submenus available from the measurements menu, see Chapter 5.

Defining Limit Tests and Storing Failure Data

AUTO
SCALE

Autoscale identifies and evaluates all input signals, and sets the correct conditions to display the signals on all active channels. When you press the autoscale key (either in the user menu or in the state menu), the instrument sets:

- time base for approximately one full period of the input signal
- vertical sensitivity and offset for optimum display
- persistence to minimum
- auto-triggering, in edge mode, with a rising slope
- trigger level (to correctly display all active channels)

Autoscale also turns off:

- markers
- limit tests
- measurements
- expanded time base
- waveform memory display
- join dots

- math functions
- holdoff (sets to minimum value)

`limit meas`

This softkey leads to a submenu where you define minimum and maximum values for limit tests, select how the tests will be run, identify the channel to be tested, and choose a memory register where the failure data will be stored.

When limit tests are active, the screen displays statistics about the measurement:

- the measurement being tested
- the current value
- the minimum value
- the maximum value
- the percentage of traces passing the test

At least one measurement and up to three measurements must be selected from the main `Measure` menu.

`limtst` This softkey leads to a submenu where you turn off the limit tests, or set whether the display will stop or continue the test after a failure. If the status line is active, the message `limit test running` will appear at the top left-hand edge of the screen.

- `OFF` Turns off limit tests.
- `SINGLE` Stops the test after a failure occurs. If the status line is active, the message `STOPPED` will appear when a failure occurs.
- `CONT` Continues the test after a failure occurs.

Note

To Restart the Display When A Limit Test Has Failed

If you choose `limtst SINGLE`, you must restart the display manually after the test fails.

- Press (USER) `RUN|STOP`. Press (MENU) to return to the measurements menu.

  or

- Press `Trigger more 1 of 2 RUN|STOP`. Press `Measure` to return to the measurements menu.

  or

- Press `page 1 of 2` (in the left-hand softkey menu list) `State`, then press `recall state`. Select an instrument state to recall. Press `page 2 of 2 Measure` to return to the measurements menu.

`set limits` This softkey leads to a four-page submenu listing the automatic measurements made by the HP 70703A digitizing oscilloscope. Although you may set limit test values for all 17 automatic measurements (and save these values in a memory register as part of an instrument state), only three limit tests maximum can be used in a limit test. Each test has a lower and upper failure threshold. The threshold range is dependent on the measurement being made.

`store: x` This softkey leads to a submenu where you select the channel or function to store in the `dest` (below), if the limit test fails. After you select a source, the previous menu reappears; the store softkey shows the active channel or function.

`dest: x` This softkey leads to a submenu where you select the waveform memory register where failure data will be stored. If you select `OFF`, the failure data will not be saved.

Setting User-Defined Measurement Standards

`meas:`

This softkey leads to a submenu where you select standard or user-defined measurements.

`STD` Measurements are made based on IEEE standard parameters. When you select standard measurements, the other options in the `meas stds` menu are not active.

`USERDEF` You can define vertical thresholds, delay, and width parameters as described below.

- To define vertical measurements, you must set both the upper *and* the lower threshold.
- Set the upper and the lower threshold so each falls on the displayed waveform; if either threshold is not on the waveform, the message `not found` will appear.
- If upper and lower thresholds are set too close together, the instrument may not be able to determine the mid-point; the message `not found` will appear.
- A user-defined measurement is made on the selected edge count, slope, and transition point. The digitizing oscilloscope starts counting edges from the left of the screen, *not* from the preset reference point.
- The selected edge must be displayed. If the edge is not visible, the measurement cannot be made; the message `not found` will appear on the screen.

`set threshold`

This softkey leads to a submenu where you set the vertical measurement points on a waveform. Set a percentage between –25% and +125%, or between –250 kV and +250 kV. Use this feature to measure excessive overshoot or ringing.

`thresh %|VOLTS` Select percentage or voltage.

`UPPER THRESH` Set an upper threshold to +125%, or +250 kV.

`LOWER THRESH` Set a lower threshold to –25% or –250 kV

Measurement delay. Measurement delay is not the same as time base delay. Use measurement delay when measuring source-to-source delay or time separation. Delay can be defined by edge count, slope, and specific transition point.

`delay from`

`edge ↑|↓` Define the edge (number and slope) from which the delay will be measured. You may choose any edge between 1 and 100.

`thresh:` Set the threshold as upper, middle, or lower.

`delay to`

`edge ↑|↓` Define the edge (number and slope) to which the delay will be measured. You may choose any edge between 1 and 100.

`thresh:` Set the measurement point to an upper, middle, or lower position on the waveform.

Width. Set the measurement transition point to an upper, middle, or lower position on the displayed waveform.

`+ width:`

Set the measurement point used when measuring positive width.

`– width`

Set the measurement point used when measuring negative width.

Setting up a Measurement

`update:`

`SINGLE` One trace is measured; the result of the measurement appears in the test report area at the bottom of the display. In single update mode, the results of up to eight measurements can be shown.

The appropriate markers will be placed on the waveform, to show where the measurement was made.

`CONT` The trace is measured continuously and the results are updated periodically; the most recent reading appears in the test report area at the bottom of the display. In continuous update mode, the results of up to eight measurements can be shown. The markers are not changed.

`STATS` The trace is measured continuously and the results are updated periodically; the current, minimum, maximum, and average value of the measurement appears in the test report area at the bottom of the screen. In statistics update mode, the results of up to three measurements can be shown.

`CLEAR MEAS`

Clear the test report area, and restore the active window to full size if `Screen`, `screen msgs`, `MEASURE ON|AUTO` is AUTO.

`meas: x`

This softkey leads to a submenu where you select the channel, memory register, or function to be measured.

`del ref: x`

This softkey sets the source to use as the reference source when measuring delay.

Making a Measurement

The 17 automatic measurements are on pages two, three, and four of the measurements menu.

- For the most accurate results, measurements usually should be made at the fastest possible sweep speed.
- The entire portion of the waveform to be measured must be displayed on the oscilloscope:

  For period or frequency measurements: one complete cycle
  For width measurements: the entire pulse
  For risetime measurements: the leading (rising) edge of the waveform

For falltime measurements: the trailing (falling) edge of the waveform

- If more than one waveform, edge, or pulse is displayed, the measurements are made on the first (leftmost) portion of first usable waveform. If there are not enough data points for an accurate measurement, the message `not found` will replace measurement results.

Thresholds

- When any of the standard measurements are requested, the digitizing oscilloscope first determines the top-base voltage levels at 0% and at 100%. From this information, it can determine the 10%, 50%, and 90% thresholds needed to make the measurements. The 10% and 90% thresholds are used in the risetime and falltime measurements; the 50% mid-point is used for measuring frequency, period, pulse width, and duty cycle.
- Voltage thresholds are precise settings, for specific locations on the waveform. If the thresholds are not placed on the displayed waveform, the digitizing oscilloscope cannot make a measurement.
- When a user-defined measurement is requested, the digitizing oscilloscope still must determine the top-base voltage thresholds. From this information, it can determine user-defined upper and lower thresholds.

The Edge

Rising and falling edges are transitional edges that must cross three thresholds. Most time measurements are made based on the position of the first crossing of the middle threshold.

- A rising edge must cross the lower threshold in a positive direction, cross the mid-threshold (any number of crossings, both positive and negative are permissible), then cross the upper threshold without ever crossing the lower threshold.
- A falling edge must cross the upper threshold in a negative direction, cross the mid threshold (any number of times), then cross the lower threshold without ever crossing the upper threshold.

Automatic Top/Base

The top and base measurements determine V_{top} and V_{base} (the 0% and 100% voltage levels at the top and the bottom of the waveform). From this information, the digitizing oscilloscope can determine the 10%, 50%, and 90% points used in most measurements. The top or base of the waveform is not necessarily the maximum or minimum voltage present on the waveform.

For example, in a pulse with a slight overshoot, the waveform normally rests below the perturbation, so it would be inaccurate to select the highest point of the waveform as the top. Top/Base performs a histogram on the waveform and finds the most prevalent point above and below the waveform midpoint—the point that represents more than 5% of the 501 display points, and that is considered to be either the top or the base. If no point accounts

for more than 5% of the total, the top is selected as the absolute maximum and the base is selected as the absolute minimum.

The Markers Menu

The markers menu (`Markers`) controls pairs of horizontal voltage markers and vertical time markers. Using these markers, you can make manual measurements on displayed waveforms. The markers are controlled individually. Although you may use any marker with any channel, you may use a marker with only one channel at a time.

Marker measurements appear below the waveform window. These measurements remain onscreen until you make automatic measurements, which will replace the marker measurements temporarily. To restore the marker readings, press `Marker` again.

For a diagram of the softkeys and submenus available from the markers menu, see Chapter 5.

Setting Markers

This softkey leads to a submenu where you can turn markers on and off. The softkey displays the active marker function.

```
volt 2:
CHAN x
```

This softkey lead to a submenu where you can assign voltage marker 2 (usually the upper marker) to a channel, a stored waveform, or a math function.

Pressing this softkey automatically activates voltage markers.

```
VOLT 2:
LEVEL
```

Press this softkey, then use the step keys, the control knob, or the numerical keypad to position voltage marker 2. When you press any numeral key, the right-hand softkey menu displays a choice of units of measure for the marker position; pressing a unit key completes the entry and returns you to the previous menu. Pressing this softkey automatically activates voltage markers.

```
volt 1:
CHAN x
```

This softkey lead to a submenu where you can assign voltage marker 1 (usually the lower marker) to a channel, a stored waveform, or a math function.

Pressing this softkey automatically activates voltage markers.

```
VOLT 1:
LEVEL
```

Press this softkey, then use the step keys, the control knob, or the numerical keypad to position voltage marker 1. When you press any numeral key, the right-hand softkey menu displays a choice of units of measure for the marker position; pressing a unit key completes the entry and returns you to the previous menu.

Pressing this softkey automatically activates voltage markers.

TIME
START

Press this softkey, then use the step keys, the control knob, or the numerical keypad to position the start time marker (usually the left marker). When you press any numeral key, the right-hand softkey menu displays a choice of units of time for the marker position; pressing a unit key completes the entry and returns you to the previous menu.

Pressing this softkey automatically activates time markers.

TIME
STOP

Press this softkey, then use the step keys, the control knob, or the numerical keypad to position the stop time marker (usually the right marker). When you press any numeral key, the right-hand softkey menu displays a choice of units of time for the marker position; pressing a unit key completes the entry and returns you to the previous menu.

Pressing this softkey automatically activates time markers.

Note

Reading Marker Values

- When voltage markers are on, the location and the difference in voltage (ΔV) of the two markers appear at the bottom of the display, in the left-hand column:

  $$V2 - V1 = \Delta V$$

  If ΔV is negative, voltage marker 1 is located at a more positive voltage level than voltage marker 2.

- When time markers are on, the location, difference in time (Δt), and inverse difference in time (1/Δt, expressed as frequency) of the two markers appear at the bottom of the display, in the right-hand column:

  $$stop\ time\ marker - start\ time\ marker = \Delta t$$

  If Δt is negative, it means the stop time marker is incorrectly placed before the start time marker.

Time interval measurements are made with one or both time markers, to determine the relationship of specific points on a waveform. The digitizing oscilloscope automatically calculates the time difference between the two markers. After an autoscale, the trigger point is positioned at the center of the screen. When a time marker is placed to the left of the trigger point, the time for that marker is negative, indicating it occurs before the trigger. Any point to the right of the trigger occurs after the trigger and its time marker reading is positive.

- Use `ref pos L|C|R` (in the time base menu) to change the reference for the display (trigger point) to left, center, or right of the display.

- 1/Δt, as the inverse of Δt, is expressed as a frequency. If the time markers are positioned across segments of a waveform with changing time intervals, the 1/Δt reading may not be valid for the entire waveform.

  You can determine the frequency of a burst by placing the time markers across the burst at comparable points on the waveform.

The Waveform Memory Menu

The waveform memory menu (`Wavemem`) controls non-volatile memory registers, where you can store waveforms. You may store one waveform in each of the four memory registers. Waveforms with more than 500 points are compressed to fit by decimation. This only occurs if the data has been acquired via a remote digitize command. These memory registers retain the stored information when power is off, when you `AUTO SCALE` a waveform, or when you execute `CLEAR SCREEN`.

For a diagram of the softkeys and submenus available from the waveform memory menu, see Chapter 5.

What Kinds of Waveforms You Can Store

You can store an active waveform from any of the four input channels. You also can store the results of any math function calculation (except `VERSUS`).

What You Can Do with a Stored Waveform

When you recall a waveform stored in a memory register, you can make automatic measurements, use math functions, and set markers; however, you cannot use an expanded time base with a stored waveform.

A waveform memory consists of a single waveform record, including the horizontal and vertical scaling factors. Measurements can be performed on previously stored waveform and function data. Voltage and time markers can be set on waveforms when they are displayed; however, the time markers correspond to the `Timebas` menu `SEC/DIV` and not the memory waveform.

Storing a Waveform or Function in a Memory Register

```
store
CHAN x
```

This softkey leads to a submenu where you choose the active waveform, or the results of a math function, that you want to store. After you press a source softkey, the main memory menu reappears; the source selection softkey shows the active channel or function.

```
dest
WMEM x
```

This softkey leads to a submenu where you select the memory register where you want to store the selected waveform. This softkey also selects the memory register(s) to be displayed.

```
STORE
TO WMEM
```

This softkey stores the active channel or the results of active function in the selected memory register. When you press this key, you erase any data stored in the selected register, and overwrite it with data from the selected source.

Note **Storing a Waveform in Envelope Mode**

When the screen is in envelope mode, each stored waveform uses *two* memory registers. The minimum and maximum values of the waveform are stored separately, in preselected paired registers.

When you select memory register:	The minimum value is stored in register:	The maximum value is stored in register:
1	1	3
2	2	4
3	1	3
4	2	4

For example, when you select memory register 3, the minimum value of the envelope waveform is stored in register 1 and the maximum value is stored in register 3.

Viewing a Stored Waveform or Function

```
dest
WMEM x
```

This softkey leads to a submenu where you select the memory register(s) to be displayed.

```
wmem
ON|OFF
```

This softkey displays the selected memory register.

```
WMEM1-4
ON
```

This softkey allows all four memory registers to be simultaneously turned on or off.

Example: Saving and Viewing a Waveform

Set the input signal.

1. Set a signal source to produce a 1 volt, 60 kHz square wave with adequate offset to display the signal at midscreen.
2. Using a BNC cable, connect the signal generator to the channel 1 input on the digitizing oscilloscope and disconnect inputs to any other channel.
3. Press the green (INSTR PRESET) key.

Set up the source channel on the digitizing oscilloscope.

4. Press (USER) `AUTO SCALE`.
5. Press (MENU) `Screen` `JOIN DOTS`.

Select the memory register where you want to store the waveform.

6. Press `page 1 of 2` `Wavemem`.

Store the waveform in the memory register.

7. Press `STORE TO WMEM`.

Change the input signal.

8. Change the signal source to a 50 kHz sine wave; leave the source connected to the channel 1 input on the digitizing oscilloscope.
9. Press `State` `AUTO SCALE`.

View the stored waveform with the current waveform.

10. Press `Wavemem`.
11. Press `wmem ON|OFF` until ON is underlined.
12. Compare your results to Figure 3-16.

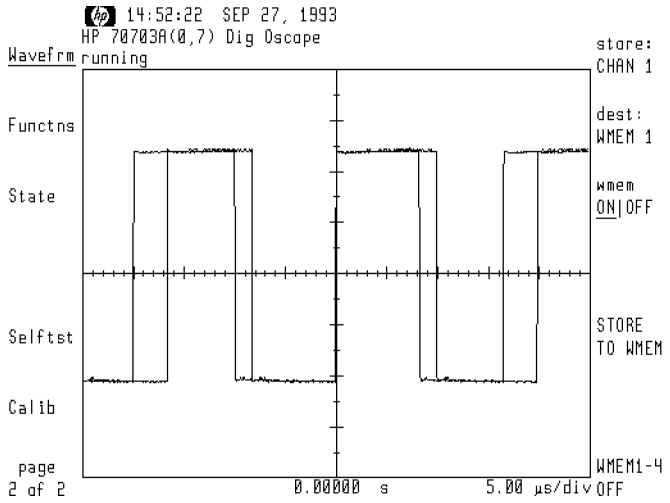


Figure 3-16. Example: Saving and Viewing a Waveform

The Functions Menu

The functions menu (`Functns`) defines one or two mathematical operations that may be performed on any of the four channels, or on a waveform stored in memory.

These operations are:

PLUS

MINUS

TIMES

VERSUS

ONLY

INVERT

The resulting calculation can be:

- displayed (the vertical display position and offset can be adjusted)
- evaluated with the measurement features (except `VERSUS`)
- stored in memory (except `VERSUS`)
- directed to an output device over the HP-IB (except `VERSUS`)

For a diagram of the softkeys and submenus available from the functions menu, see Chapter 5.

Note

Units of Measurement

The digitizing oscilloscope measures the vertical axis in volts per division, and the horizontal axis in time per division for all combinations of operands and operations. You must take this into account when using the result of waveform math function calculations.

For example, if you apply a +2 V signal to channel 1, and a −3 V signal to channel 2, the product is −6 V^2. However, the HP 70703A digitizing oscilloscope will display the product as −6 V.

Defining a Function

```
select:
FUNC x
```

This softkey leads to a submenu where you choose function 1 or function 2. After you press a function softkey, the functions menu reappears; the function selection softkey indicates the active function.

```
func
ON|OFF
```

Press this softkey to activate or deactivate the selected function. When on, the function is displayed in the lower portion of the display.

`src 1:`
`CHAN x`

This softkey leads to a submenu where you choose the source for the first operand; you may select either a channel or a stored waveform. After you make your selection, the functions menu reappears; the source 1 softkey indicates the active selection.

Note

Be sure the selected channel is turned ON in the channel menu, or that the selected memory register contains a stored waveform.

`oper:`
`PLUS`

This softkey leads to a submenu where you choose one of six mathematical operations.

`PLUS`	Add the first operand to the second; addition is calculated point by point.
`MINUS`	Subtracts the second operand from the first; subtraction is calculated point by point.
`TIMES`	Multiplies each data point in the first operand by its corresponding data point in the second operand, and displays the product (usually scaled to a different size).
`VERSUS`	draws a volts-versus-volts display of the first and second operand. Note: this is the only mathematical function that cannot be stored in waveform memory.
`ONLY`	displays and scales the first operand.
`INVERT`	inverts the data of the first operand.

`src 2:`
`CHAN x`

This softkey leads to a submenu where you choose the source for the second operand; you may select either a channel or a stored waveform. After you make your selection, the functions menu reappears; the source 2 softkey indicates the active selection.

Note

This softkey does not appear when you have selected `ONLY` or `INVERT`.

`V/DIV`

This softkey sets vertical sensitivity of the function display window.

`OFFSET`

This softkey sets offset of the function display window.

Display Options

When you activate either math function, the display splits into an upper (waveform) section and a lower (function) section. Depending on the number of waveform windows selected, the upper section will have one, two, or four subdivisions. Both math functions may be on at the same time, separately displayed in the two lower subdivisions if two or four waveform windows are active, or superimposed in the single lower section if only one waveform window is selected.

The expanded timebase function and the waveform math function may not be active at the same time. When you select a math function, the expanded timebase is turned off; conversely, math function is turned off when expanded timebase is active.

Example:
Subtracting One Waveform from Another

Connecting a 1 meter cable between channel 1 and channel 4 provides a time delay between the signals. The minus function will calculate and display the propagation of that 1 meter cable.

Set the input signal.

1. Set a signal source to produce a 1 volt, 2 kHz square wave with adequate offset to display the signal at midscreen.
2. Connect a BNC tee to the channel 1 input on the digitizing oscilloscope.
3. Connect a 1 meter BNC cable to the BNC tee and to the signal source.
4. Connect another 1 meter BNC cable to the BNC tee and to the channel 4 input on the digitizing oscilloscope.
5. Preset the instrument by pressing the green (INSTR PRESET) key.

Optimize the signal.

6. Optimize the signal. Press (USER) `AUTO SCALE`.
7. Press (MENU) `Timebas SEC/DIV`. Use the numerical keypad to set the main timebase to 50 ns/div.

Set the display mode.

8. Press `Screen mode: AVERAGE`.
9. Press `AVERAGE COUNT`. Set the number of averages to 16.
10. Press `screens 1|2|4` to display two screens.
11. Press `JOIN DOTS` to display the waveform with all data points connected.

Define the math function.

12. Press `page 1 of 2 Functns`.
13. Press `select FUNC 1`.
14. Press `func ON|OFF` to turn on function 1.
15. Press `src 1: CHAN x CHAN CHAN 1`.
16. Press `oper: MINUS`.
17. Press `src 2: CHAN x CHAN CHAN 4`.
18. Press `V/DIV`. Set the function sensitivity to 1 V/div.

The waveform math function subtracts channel 4 from channel 1, and displays the spike. See Figure 3-17.

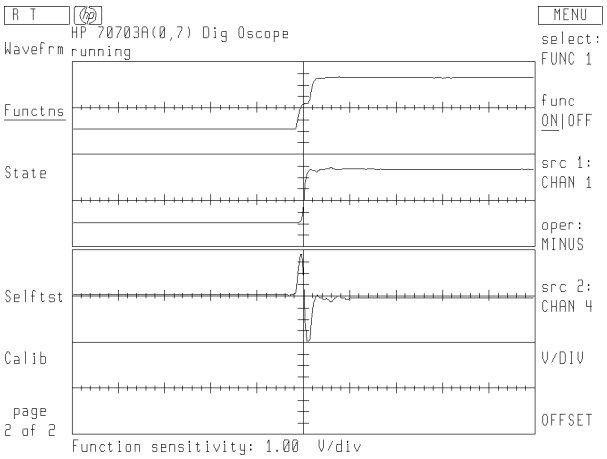


Figure 3-17. Example 2: Subtracting One Waveform from Another

The Instrument State Menu

The instrument state menu (`State`) has the autoscale key, and options for saving and recalling instrument configurations.

Optimizing Display of an Input Signal

`AUTO SCALE`

Autoscale identifies and evaluates all input signals, and sets the correct conditions to display the signals on all active channels. When you press the autoscale key (either in the user menu or in the state menu), the instrument sets:

- time base for approximately one full period of the input signal
- vertical sensitivity and offset for optimum display
- persistence to minimum
- auto-triggering, in edge mode, with a rising slope
- trigger level (to correctly display all active channels)

Autoscale also turns off:

- markers
- limit tests
- measurements
- expanded time base
- waveform memory display
- join dots
- math functions
- holdoff (sets to minimum value)

Saving or Recalling an Instrument Configuration

`save`
`state`

`SAVE STATE x`

Save the current state in one of four non-volatile memory registers.

`recall`
`state`

`RECALL PREV`

The HP 70703A digitizing oscilloscope automatically saves the current configuration before executing an autoscale, a recall-state, or an automatic preset (ECL/TTL). Press this softkey to return the instrument to that previous configuration.

`RECALL STATE x`

These four softkeys recall instrument configurations that you have stored in memory.

`RECALL PRESET`

This returns the instrument to the factory-preset state (the same as pressing the green instrument preset key).

`more`
`1 of 2`

This softkey displays the second page of the instrument state menu.

`ac bnc:x`

This softkey allows the AC CAL output on the front panel to be a probe compensation signal (`PROBE COMP`) or trigger output (`TRIGGER`).

`rpg NRM |`
`FIN`

This softkey sets the granularity of RPG steps to normal (`NRM`), or fine (`FIN`). This is not affected by an instrument preset.

`beep`
`ON|OFF`

This softkey enables or disables the beep sound. The beep sounds when error messages are displayed in the advisory area. This is not affected by an instrument preset.

`hp-ib`
`ON|OFF`

This softkey enables or disables the HP-IB remote control port. This is not affected by an instrument preset.

Note

When the HP-IB is turned off, the HP 70703A will not be able to respond to any HP-IB commands sent over HP-IB by a remote controller.

`ROM`
`VERSION`

This softkey displays the copyright message and current firmware revision number.

`more`
`2 of 2`

This softkey displays the first page of the instrument state menu.

The Selftest Menu

The selftest menu (`Selftst`) controls the self-diagnostic routines for the HP 70703A digitizing oscilloscope. When this menu is selected, the oscilloscope enters test mode, and another menu (or instrument preset) must be selected to exit.

Performing Self-Diagnostics on the Digitizing Oscilloscope

All inputs should be disconnected before running any of the tests below.

`TEST ALL`

Automatically perform all memory and acquisition tests. The results will appear on the display. If the HP 70703A fails any selftest, preset the HP 70703A and calibrate the oscilloscope. If this fails, refer to the service manual.

`memory tests`

`SYSTEM ROM`
: Tests and reports on all system read-only memory.

`SYSTEM RAM`
: Tests and reports on system random-access memory.

`STATE NV RAM`
: Tests and reports on unprotected non-volatile random-access memory for instrument state storage.

`CAL NV RAM`
: Tests and reports on protected non-volatile random-access memory for calibrations.

`ACQ RAM` Tests and reports on unprotected non-volatile random-access memory for data acquisition.

`acq tests`

`LOGIC TRIGGER`
: Tests and reports on acquisition using the logic trigger.

`ANALOG TRIGGER`
: Tests and reports on acquisition using the analog trigger.

`TIMEBAS` Tests and reports on the time base.

`D/A` Tests and reports on the digital-to-analog converter.

`A/D` Tests and reports on the analog-to-digital converter.

Note

The Service Tests

The HP 70703A digitizing oscilloscope has no user-serviceable components. All service and maintenance must be performed by qualified service personnel. The `service tests` submenus contain loop tests used by those technicians during various calibration routines.

The Calibration Menu

The calibration menu (`Calib`) controls probe compensation, channel null settings, and routines for periodic calibration of the HP 70703A digitizing oscilloscope.

Calibrating Probe Attenuation

`probe atten`

Using the DC calibration output, the digitizing oscilloscope determines and stores the probe attenuation value for a selected channel.

The probe attenuation submenu calibrates channel gain at the probe tip. Channel gain can be corrected through probe attenuation down to 0.9 attenuation.

- Below 0.9 the error message **Attenuation less than 1, see manual for action** is displayed. The corrective action is to recalibrate the HP 70703A.

If the probe is not connected to the DC CALIBRATOR OUTPUT or the probe attenuation exceeds approximately 250, the error message **Attenuation too high or bad connection** is displayed. The corrective action is to check the connections and recalibrate. If recalibration is unsuccessful, refer to the HP 70703A service manual.

- If the probe attenuation calibration is successful the displayed message is **Probe Attenuation = n.nnnnn This value has been entered into your channel probe setting**.

`chan: CHAN x`
: This softkey leads to another submenu where you select the channel you want to calibrate.

`START CAL`
: The instrument will prompt you to connect the DC CAL output to the selected channel.

`CONT CAL`
: The instrument will prompt you to press this softkey to continue the calibration routine.

`ABORT CAL`
: Press this softkey to interrupt the calibration routine. The calibration process is terminated with the previous calibration factors intact.

`prev menu`
: Press this softkey to return to the calibration menu.

Setting Channel Time-Compensation

`channel`
`cmpnsat`

Eliminate time discrepancies between channels. Use this feature to manually compensate for propagation delay introduced by differences in cable length.

`CHANNEL 1 TO 2`
Set time skew between channels 1 and 2, from −50 ns to +70 ns.

`CHANNEL 1 TO 3`
Set time skew between channels 1 and 3, from −50 ns to +70 ns.

`CHANNEL 1 TO 4`
Set time skew between channels 1 and 4, from −50 ns to +70 ns.

`prev menu`
Return to the main calibration menu.

Performing Periodic Self-Calibration

Perform the self-calibration routine:

- After 1000 hours of use, or at six month intervals.
- If ambient temperature changes more than 10 °C from the temperature at the last full calibration.
- As a confidence check of measurement accuracy.

The self-calibration routine needs only BNC cables and connectors; no additional equipment is necessary.

`protect`
`cal`

This softkey leads to a submenu where you remove calibration protection and select the calibrations you want to perform. When you press `START CAL`, each routine will prompt you to make the necessary connections, and lead you through the process. The results of the calibration will appear in the calibration table on the screen.

`protect ON|OFF`
Before performing any self-calibration routine, use this softkey to turn calibration protection OFF.

`default cal`
Leads to a submenu where you can reload the default calibration factors.

`verticl cal`
Leads to a submenu where you identify the vertical parameter to calibrate, select the channel, and control the vertical calibration routine.

`vert: x` Select ALL, A/D, GAIN, OFFSET, HYSTER, or TRIGGER.

`chan: x` Calibrate all channels at once, or select an individual channel.

`delay cal`

Leads to a submenu where you identify the channel to calibrate and calibrate the channel delay.

`tnull cal`

Leads to a submenu where you identify which pair of channels to calibrate, and calibrate the channel-to-channel time null.

`logic trigcal`

Leads to a submenu where you calibrate the logic trigger delay.

Note

The `service cal` softkey is a service function. All service and maintenance must be performed by qualified service personnel. Refer to the service manual.

4

Specifications, Characteristics, Features, and Definitions

This chapter contains warranted specifications, nonwarranted characteristics, major feature descriptions, and measurement definitions.

Performance Specifications

Specifications are valid for a temperature range ±10 °C from the software calibration temperature (nominally 25 °C), with eight or more averages selected.

Specifications apply after system temperatures have stabilized and calibration routines have run.

Vertical

Bandwidth (−3 dB, DC coupled)	
Repetitive*	DC to 500 MHz
Single-shot	DC to 2 MHz (based on 10 points per period of input signal)
* On ranges <10 mV/div, at 500 MHz the signal amplitude decreases <3.5 dB. Upper bandwidth decreases 2.5 MHz for each °C above 35 °C.	

Rise Time*	700 ps
* Rise time is calculated as: tr = 0.35/bandwidth.	

Input R (selectable)	1 MΩ ±1%, or 50 Ω ±1%

Maximum Input Voltage*	
1 MΩ	±250 V [DC + peak AC (<10 kHz)]
50 Ω	5 V_{rms}
* On ranges ≤50 mV/div, the maximum overdrive of the input must not exceed the V/div setting × 10^3.	

Offset Accuracy*	±(0.5% of channel offset + 2% of full scale)
* Expansion is used below 7 mV/div range so vertical resolution and accuracies are correspondingly reduced.	

Voltage Measurement Accuracy (DC)*	
Dual Cursor	±(1.25% of full scale + 0.032 x V/div)
Single Cursor	±(1.25% of full scale + offset accuracy + 0.016 x V/div)
* Expansion is used below 7 mV/div range so vertical resolution and accuracies are correspondingly reduced. Accuracy decreases 0.08% per °C from software calibration temperature.	

Horizontal Time Base

Time Base Reference Accuracy	0.005%
Delta-t Accuracy, Real Time	±(2% x s/div + 0.005% x delta-t + 100 ps)

Trigger

Trigger Sensitivity	
≥5 mV/div	
dc to 100 MHz	0.063 x full scale
100 MHz to 500 MHz	0.156 x full scale
<5 mV/div	
DC to 100 MHz	2.5 mV
100 MHz to 500 MHz	6 mV

Performance Characteristics

Characteristics provide useful, but *nonwarranted*, performance information.

Vertical

Switchable Bandwidth Limits	
AC-coupled (lower −3 dB frequency)	90 Hz
LF reject (lower −3 dB frequency)	450 Hz
Bandwidth limit (upper −3 dB frequency)	30 MHz

Number of channels*	4
* Data is acquired simultaneously on two channels: Two channels: data acquired on channels 1 and 4, 2 and 4, 1 and 3, or 2 and 3 Four channels: data acquired on channels 1 and 4, then on channels 2 and 3	

Vertical Sensitivity Range (all channels)	1 mV/div to 5 V/div

Vertical Gain Accuracy (DC)*	±1.25%
* Expansion is used below 7 mV/div range so vertical resolution and accuracies are correspondingly reduced. Accuracy decreases 0.08% per °C from software calibration temperature.	

Vertical Resolution*	±0.4% (8-bit A/D) ±0.1% (10 bits via HP-IB or MSIB with averaging)
* Expansion is used below 7 mV/div range so vertical resolution and accuracies are correspondingly reduced.	

Maximum Sample Rate	20 MSa/s

Waveform Record Length	501 points (display) 1024 points (via HP-IB or MSIB)
Mode via HP-IB or MSIB	**Waveform Record Length**
Single-shot	500 points
Repetitive	
200 ps/div time base range	100 points
500 ps/div time base range	250 points
1 ns/div time base range	500 points
≥2 ns/div time base range	1,000 points

Input C	7 pF nominal

Input Coupling	AC or DC

Offset Range	
Vertical Sensitivity	**Available Offset**
1 mV/div to 50 mV/div	±2 V
>50 mV/div to 250 mV/div	±10 V
>250 mV/div to 1.25 V/div	±50 V
>1.25 V to 5 V/div	±250 V

Dynamic Range (DC + peak AC)	±1.5 x full scale from center of screen

Channel-to-Channel Isolation	
(with channels at equal sensitivity)	
DC to 100 MHz	40 dB
100 MHz to 500 MHz	30 dB

Horizontal Time Base

Time Base Range	200 ps/div to 5 s/div

Time Base Resolution	20 ps

Delay Range	**Time/div Setting**	**Available Delay**
Post Trigger (reference position left)	50 ms to 5 s	40 x (s/div)
	100 μs to 20 ms	1 s
	200 ps to 50 μs	10,000 x (s/div)
Pretrigger (reference position right)	5 μs to 5 s	−39.96 x (s/div)
	2 μs	−99.9 μs
	1 μs	−89.9 μs
	500 ns	−84.9 μs
	200 ns	−81.9 μs
	100 ns	−80.9 μs
	50 ns	−80.4 μs
	20 ns	−80.1 μs
	10 ns	−80.0 μs
	200 ps to 5 ns	−10,000 x (s/div)

Trigger

Trigger Pulse Width (minimum)	1.5 ns

Trigger Level Range	±1.5 x full scale from center of screen

Features

Vertical Settings

Deflection Factors (All Channels)

Deflection varies depending upon how many windows are displayed. When a single window is active, you can adjust attenuation from 1 mV per division to 5 V per division, in a sequence proportional to the time base. When two windows are active, you can adjust attenuation from 2 mV per division to 10 V per division, and when all four windows are active, from 4 mV per division to 20 V per division.

Probe Attenuation Factors

You can scale the oscilloscope for external probes or attenuators attached to the channel inputs, from 0.9 to 1,000. If you have

executed a probe-tip calibration, the digitizing oscilloscope calculates this value automatically.

Input Impedance

You can select 1 MΩ or 50 Ω for each input.

Bandwidth Limit (High Frequency Rejection)

High frequency rejection provides a low pass filter (−3 dB at approximately 30 MHz), for triggering and for signal display. This bandwidth limit can be selected for each input individually.

Bandwidth Limit (Low Frequency Rejection)

Low frequency rejection provides a high pass filter (−3 dB at approximately 450 Hz) for triggering and for signal display. This bandwidth limit can be selected for each input individually.

AC Coupling

AC coupling provides a high pass filter (−3 dB at approximately 90 Hz), with a two-pole rolloff for triggering and for signal display. This setting can be selected for each input individually.

ECL/TTL Presets

Vertical deflection factor, offset, and trigger level can be preset for ECL and TTL level, on each channel independently.

Horizontal Settings

Expanded Time Base Window

Using markers displayed on the upper half of the screen, you can zoom in on portions of the waveform. The lower half of the screen displays an expanded time base; this time base can be set for an expansion ratio up to 20:1.

When multiple windows are active, selecting the expanded time base uniformly affects the waveforms in all windows.

Measurements are performed on the expanded time base channels.

Delay between Channels

The difference in delay between channels can be adjusted to compensate for differences in probe lengths or input cables.

Reference Location

The reference point can be placed at the left edge, the center, or the right edge of the display. The reference point is equal to the trigger point plus the delay time.

Trigger Modes

Edge Trigger

You can select a rising (positive) or falling (negative) edge for the trigger on any of the four channel inputs.

Pattern Trigger

You can specify a pattern using all four inputs. Each input can be designated as *high* (H), *low* (L), or *don't care* (X), relative to the level setting in the edge trigger menu. You can specify that the trigger occur on the last edge to enter or the first edge to exit the specified pattern.

Time-Qualified Pattern Trigger

A trigger will occur on the first edge to exit a pattern only if the edge meets time criteria. The available time-qualified modes are:

- `pattern present < time`
- `pattern present > time`
- `pattern range: pattern present > [time1] and < [time2]`

The time settings are adjustable from 20 ns to 160 ms (±3% ±2 ns). The time filter recovery time is less than or equal to 12 ns. In the `pattern present < time` mode, the pattern must be present more than 1.5 ns for the trigger to respond.

Glitch Trigger

Use `pattern present < time` with a time slightly less than the pulse width of the signal of the signal you are analyzing. The minimum glitch width is 1.5 ns.

State Trigger

A pattern is specified on any three of the four inputs, with the fourth input used as a clock. You may select a trigger to occur on the rising or on the falling edge of the input specified as the clock, and you may select the trigger to occur when the pattern is present or not present. Setup time for the pattern relative to the clock is less than or equal to 10 ns. The hold time is zero.

Delayed Trigger

Event-Delayed Mode

The trigger can be qualified by an edge, a pattern, a time-qualified pattern, or a state. The delay can be specified as a number of occurrences of a rising or falling edge on any one of the four inputs. After the delay, a rising or falling edge will generate the trigger. The occurrence value of "edge to trigger on" is selectable from 1 to 16,000,000; the maximum edge counting rate is 70 MHz.

Time-Delayed Mode

The trigger can be qualified by an edge, a pattern, or a state. The delay is selectable from 30 ns to 160 ms. After the delay, an occurrence of a rising or a falling edge on any one of the four inputs will generate the trigger. The occurrence value of "edge to trigger on"

is selectable from 1 to 16,000,000; the maximum edge counting rate is 70 MHz.

TV Trigger

60 Hz/525 Lines

You can select the source as any one of the four inputs, and adjust the trigger level for the selected source. Polarity is selected for positive or negative synchronizing pulses. A trigger occurs on the selected line and field of a 2/1 interlaced composite video signal. Line numbering is 1 to 263 for field 1, and 1 to 262 for field 2. This TV trigger mode is compatible with broadcast standard M.

50 Hz/625 Lines

You can select the source as any one of the four inputs, and adjust the trigger level for the selected source. Polarity is selected for positive or negative synchronizing pulses. A trigger occurs on the selected line and field of a 2/1 interlaced composite video signal. Line numbering is 1 to 313 for field 1, and 314 to 625 for field 2. This TV trigger mode is compatible with broadcast standards B, C, D, G, H, I, K1, L, and N.

User-Defined Mode

You can select the source as any one of the four inputs, and adjust the trigger level for the selected source. The trigger is qualified with a high or low pulse that meets a selectable time range. The trigger is an occurrence of a rising or falling edge of the source after the qualifying pulse. The time settings for the qualifier are selectable from 20 ns to 160 ms (±3% ±2 ns). The trigger occurrence value is selectable from 1 to 16,000,000.

Note

Use a Clamped Video Signal

All TV trigger modes require a clamped video signal for stable triggering. Use the HP 1133A TV pod to provide clamped video output that can be used in conjunction with the digitizing oscilloscope's TV triggering capabilities.

Trigger Holdoff

The trigger can be held off either by time (from 40 ns to 320 ns), or by events (from 2 to 16,000,000). An event is defined as the specified trigger condition. A separate holdoff setting (time or events) is available for each trigger mode except delayed trigger, which is set to 40 ns.

Noise Rejection Trigger

This feature improves triggering on noisy signals by increasing hysteresis.

Display

Data Display Resolution

Resolution depends on the size of the window allocated to the module by the MMS graphics device.

Number of Screens

You can select one, two, or four screens. This lets you display and compare up to four active channels or stored waveforms.

Display Modes

Normal: Minimum Persistence

One waveform data value appears in each horizontal position of the display. The waveform is updated as new data is acquired for a particular horizontal position.

Normal: Infinite Persistence

Each data point is displayed for an infinite time, until the screen is cleared, or a marker line is drawn over the data point.

Averaged

The number of averages (n) can be specified in powers of 2, up to 2048. On each acquisition, $1/n$ time the new data is added to $(n-1)/n$ of the previous value at each time coordinate. Averaging operates continuously, except for the HP-IB or MSIB `digitize` command, for which averaging terminates at the specified number of averages.

Enveloped

This feature lets you display running maximum and minimum voltage levels at each horizontal position for a repetitive waveform.

Graticules

You may choose full grid, axes, frame, or border graticule.

Join Dots

This mode gives a continuous display, connecting sample points with straight lines. Join dots operates in modes where a single-valued waveform can be connected: average, envelope, minimum, and infinite persistence.

Scroll Mode

In auto triggered mode at settings from 200 ns/div to 5 s/div, the oscilloscope automatically selects scroll mode display. Scroll mode will also be selected in triggered mode with delay reference left and delay ≥ 0. Scroll mode updates each data point on the displayed waveform as the data is acquired. Join dots is disabled until data acquisition stops.

Voltage and Time Markers

Dual voltage markers and dual time markers are available. Voltage markers can be assigned independently to channels, memories, or functions.

Waveform Math

Two independent functions are provided for waveform math. The operators are +, −, ×, *vs*, *invert*, and *only*. The vertical channels and the waveform memories can be used as operands for the waveform math. Sensitivity and offset for these functions can be adjusted independently.

Waveform Save

The instrument has four non-volatile waveform memories, to store single-valued waveforms (such as averaged waveforms). If an envelope waveform is stored in a waveform memory, it will be stored automatically with the upper waveform in one waveform memory, and with the lower waveform in another.

Automatic Pulse Parameter Measurements

The HP 70703A digitizing oscilloscope has 17 automatic pulse parameter measurements available from the front panel. Additional measurements, such as *all*, *overshoot*, and *preshoot*, can be programmed via the HP-IB. The standard measurements are performed with 10%, 50%, and 90% voltage thresholds, as defined by IEEE standard 194-1977, "IEEE Standard Pulse Terms and Definitions."

Automatic Measurements Available from the Front Panel

- Frequency
- Period
- Rise time
- Fall time
- Pulse interval +
- Pulse interval −
- Volts peak-to-peak
- Volts average
- Volts minimum
- Volts maximum
- Volts AC_{rms}
- Volts DC_{rms}
- Volts base
- Volts top
- Volts amplitude
- Duty cycle
- Delay

User-Definable Measurement Thresholds

The digitizing oscilloscope lets you set your own thresholds for automatic measurements. The upper and lower thresholds both can be set, either in percent or in volts, as long as the upper threshold value always is greater than or equal to the lower threshold. The mid-threshold always is equal to the mid-value between the upper and lower threshold.

Continuous Measurements

Automatic measurements can be continuously updated, and the most recent measurement results displayed. With continuous measurements off, the voltage and time markers appear on the waveform to indicate the last measurement taken.

Measurement Statistics

The maximum, minimum, and average of continuously updated measurements are calculated and displayed. Any three measurements can be selected for simultaneous display.

Measurement Limit Test

Maximum and minimum limits can be set for three of the automatic measurements. These continuously updated measurements are compared to the maximum and minimum limits. If the measurements

are outside the defined limits, acquisition stops and the waveform can be stored in a memory register. In addition, a remote (HP-IB or MSIB) service request can be set to flag the controller. The measurement limit test can be set to stop after test limits have been exceeded, or to continue testing.

Setup Aids

Autoscale

Autoscale automatically adjusts the vertical and horizontal deflection factors and the trigger level for a display appropriate to the signals applied to the inputs. The autoscale feature requires a signal with a duty cycle greater than 0.5%, and a frequency greater than 50 Hz. Autoscale operates only with relatively stable input signals.

Save/Recall

Four front-panel setups may be saved in non-volatile memory.

Recall Preset

Resets the digitizing oscilloscope to its factory-default settings.

Recall Previous

If autoscale, ECL or TTL preset, or recall setup are selected by mistake, this feature lets you restore the instrument to its state prior to the last selection.

Full Remote Programmability

Instrument settings and operating modes, including automatic measurements, may be programmed remotely via HP-IB (IEEE-488) or MSIB. Refer to *Programming the HP 70703A Digitizing Oscilloscope.* Programming complies with IEEE 488.2-1988 "Standard Codes, Formats, Protocols, and Common Commands."

Calibration and Self-Testing

Probe Compensation
AC Calibrator Output

The oscilloscope provides a signal of approximately 1.5 kHz, for probe compensation. Connect the probe to the probe compensation AC calibration output (PROBE COMP AC CAL OUT) with a probe-to-BNC adapter. During calibration, this output is used for other calibration signals. This same BNC connector is used for trigger output. You can switch the BNC from probe compensation and calibration signals to a trigger output pulse. The leading (rising) edge, with amplitude from about −400 mV to 0 V with a 50 Ω termination, is synchronous with the system trigger. The trailing (falling) edge of this pulse occurs near the end of the holdoff. The leading edge should be used as the edge synchronous with the trigger.

DC Calibrator Output

This output is used for vertical calibration of the instrument.

Built-In Self-Test and Calibration Routines

The internal self-test feature provides a high level of confidence that the instrument is operating properly. Self-calibration routines require no external test equipment, and ensure that the instrument is operating with greatest accuracy. Also, use the software supplied with your HP 70703A digitizing oscilloscope to perform the operation verification test routine (see Chapter 2).

Making Measurements

If more than one waveform, edge, or pulse is present, the measurements are made on the first (leftmost) portion of the active waveform that can be used. If there are not enough data points the HP 70703A will return $\leq$ with the measurement results. This is to remind you that the results may not be as accurate as possible. It is recommended that you rescale the active waveform and make your measurement again.

Standard Measurements

When any of the standard measurements are requested, the HP 70703A first determines the top-base voltage levels at 100%-0%. From this information, it can determine the other important voltage values (10%, 90%, and 50%) needed to make the measurements. The 10% and 90% voltage values are used in the risetime and falltime measurements as well as in all other edge measurements. The 10% and 90% values are also used to determine the 50% value. The 50% voltage value is used for measuring frequency, period, pulse width, and duty cycle.

User-Defined Measurements

The voltage thresholds are precise settings and set specific locations of the waveforem. If the thresholds are not placed on the waveform (above or below) the HP 70703A cannot make a measurement.

When any of the user defined measurements are requested the HP 70703A still must determine the top-base voltage thresholds. From this information it can determine user defined upper and lower thresholds. The midpoint is then determined to be the 50% point between the upper and lower threshold.

Automatic Top-Base

Top-Base is the heart of most automatic measurements. It is used to determine Vtop and Vbase, the 0% and 100% voltage levels at the top and the bottom of the waveform. From this information the oscilloscope can determine the 10%, 50%, and 90% points, which are also used in most measurements. The top or base of the waveform is not necessarily the maximum or minimum voltage present on the waveform. Consider a pulse that has slight overshoot. It would be wrong to select the highest point of the waveform as the top since the waveform normally rests below the perturbation. Top-Base performs a histogram on the waveform and finds the most prevalent point above and below the waveform midpoint. The most prevalent point is one that represents greater than approximately 5% of the total display points (501) and is considered to be either the top or base. If no point accounts for more than 5% of the total, then the top is chosen as the absolute maximum and the base is chosen as the absolute minimum.

Edge Definition

Both rising and falling edges are defined as transitional edges that must cross three thresholds.

A rising edge must cross the lower threshold in a positive direction (defining it as a rising edge), cross the mid threshold (any number of crossings, both positive and negative are permissible) and then cross the upper threshold without any crossing of the lower threshold.

A falling edge must cross the upper threshold in a negative direction, cross the mid threshold (any number of times), and then cross the lower threshold without crossing the upper threshold.

Note

Most time measurements are made based on the position of the first crossing of the middle threshold.

Measurement Definitions

Delay Measurements

Jitter

Jitter occurs only when:

- The measurements standards parameter is set to standard (not user-defined).
- Two delay parameters are the same.
- Display mode is enveloped.

If

the first edge on the minimum waveform is rising,

then

delay = mid-threshold of the first rising edge of the maximum waveform − mid-threshold of the first rising edge on the minimum waveform,

else

delay = mid-threshold of the first falling edge on the minimum waveform − mid-threshold of the first falling edge on the maximum waveform.

Standard Delay

The standard delay measurement occurs when the measurement standard parameter is set to standard (not user-defined), and is not a jitter measurement. Negative delay is possible.

Standard delay = mid-threshold of the first edge of the second parameter − mid-threshold of the first edge of the first parameter.

User-Defined Delay

Use the measurement standard parameter to select user defined (`USERDEF`).

User-defined delay = the second channel edge − the first channel edge.

Width Measurements

+ Width

The + width algorithm has standard and user-defined considerations. User-defined is the algorithm shown below using user-defined threshold and edge:

If

the first edge is rising,

then

+ width = the mid-threshold crossing of the first falling edge – the mid-threshold crossing of the first rising edge,

else

+ width = the mid-threshold crossing of the second falling edge – the mid-threshold crossing of the first rising edge.

– Width

The – width algorithm has standard and user-defined considerations. User-defined is the algorithm shown below using user-defined threshold and edge:

If

the first edge is rising,

then

– width = the mid-threshold crossing of the second rising edge – the mid-threshold crossing of the first falling edge

else

– width = the mid-threshold crossing of the first rising edge – the mid-threshold crossing of the first falling edge

Period

If

the first edge is rising,

then

period = the second rising edge – the first rising edge.

else

period = the second falling edge – the first falling edge.

Frequency

frequency = 1/period

Duty Cycle

duty cycle = (+ width/period) × 100

Note: + width is always calculated using mid-threshold.

Risetime

risetime = the time at the upper threshold − the time at the lower threshold

Falltime

falltime = the time at the lower threshold − the time at the upper threshold

Overshoot

If

the first edge is rising,

then

$overshoot = (V_{max} - V_{top}) / V_{amp}$

else

$overshoot = (V_{base} - V_{min}) / V_{amp}$

Preshoot

If

the first edge is rising,

then

$preshoot = (V_{base} - V_{min}) / V_{amp}$

else

$preshoot = (V_{max} - V_{top}) / V_{amp}$

Maximum Voltage (V_{max}) Measurements

V_{max} = *the voltage of the maximum point on the screen*

Minimum Voltage (V_{min})

V_{min} = *the voltage of the minimum point on the screen*

Peak-to-Peak Voltage (V_{p-p})

$V_{p-p} = V_{max} - V_{min}$

Top Voltage (V_{top})

V_{top} = *most prevalent point above waveform midpoint*

Base Voltage (V_{base})

V_{base} = *most prevalent point below waveform midpoint*

Voltage Amplitude (V_{amp})

$V_{amp} = V_{top} - V_{base}$

Average Voltage (V_{avg})

The average voltage of the first cycle of the displayed signal is measured. If a complete cycle is not present, the oscilloscope will average all data points.

Root Mean Squared Voltage (V_{rms})

The rms voltage of the first cycle of the displayed signal is measured. If a complete cycle is not present, the measurement will compute rms on all data points:

$$V_{rms}\ (AC) = \{1/n\ \Sigma^{n}{}_{j=1}\ V_j{}^2 - (1/n\ \Sigma^{n}{}_{j=1}\ V_j)^2\}^{1/2}$$

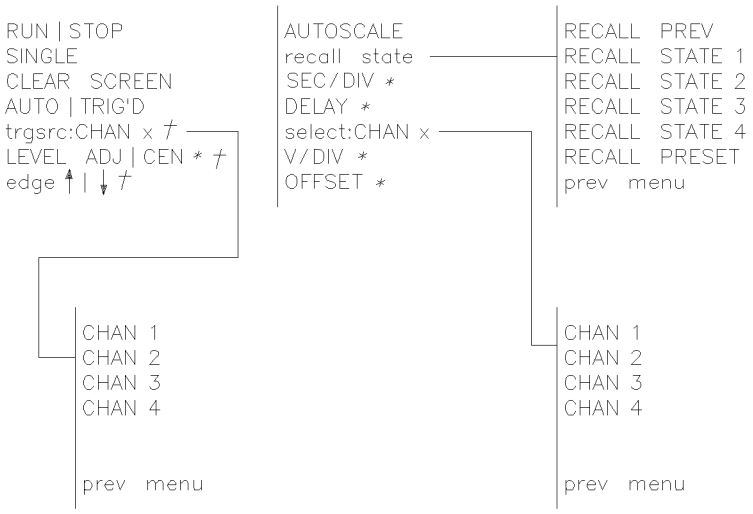
$$V_{rms}\ (DC) = \{1/n\ \Sigma^{n}{}_{j=1}\ V_j{}^2\}^{1/2}$$

5

Menu Maps

This chapter contains menu maps that show all softkey locations within the hierarchical structure.

USER Key Menu Map



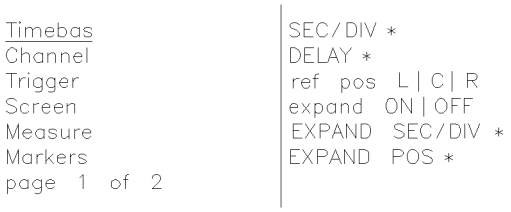
* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

† *Only appear when trigger mode is EDGE.*

user

Figure 5-1. (USER) Menu

Time Base Menu Map

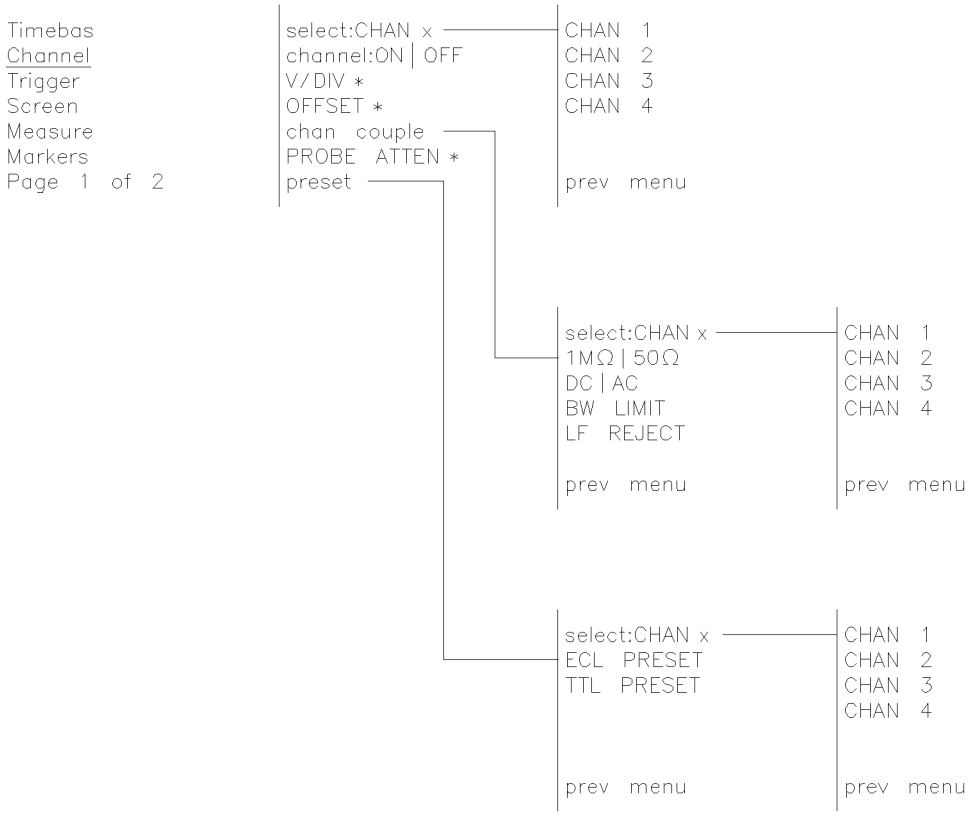


* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

timebase

Figure 5-2. Time Base Menu

Channel Menu Map

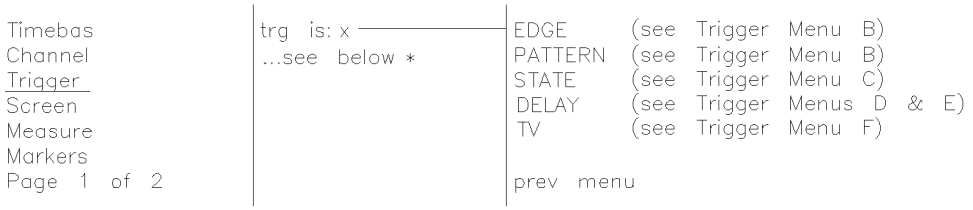


* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

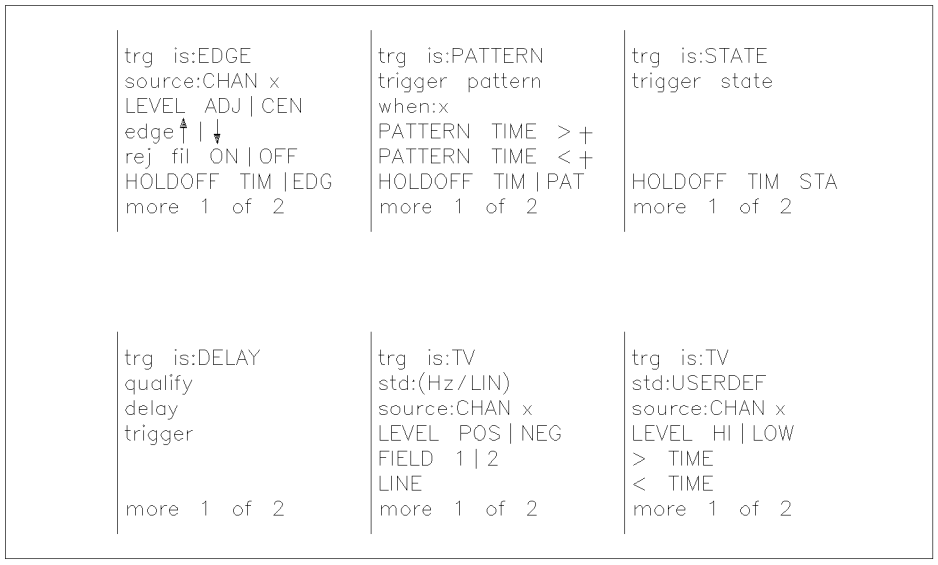
channel

Figure 5-3. Channel Menu

Trigger Menu Map



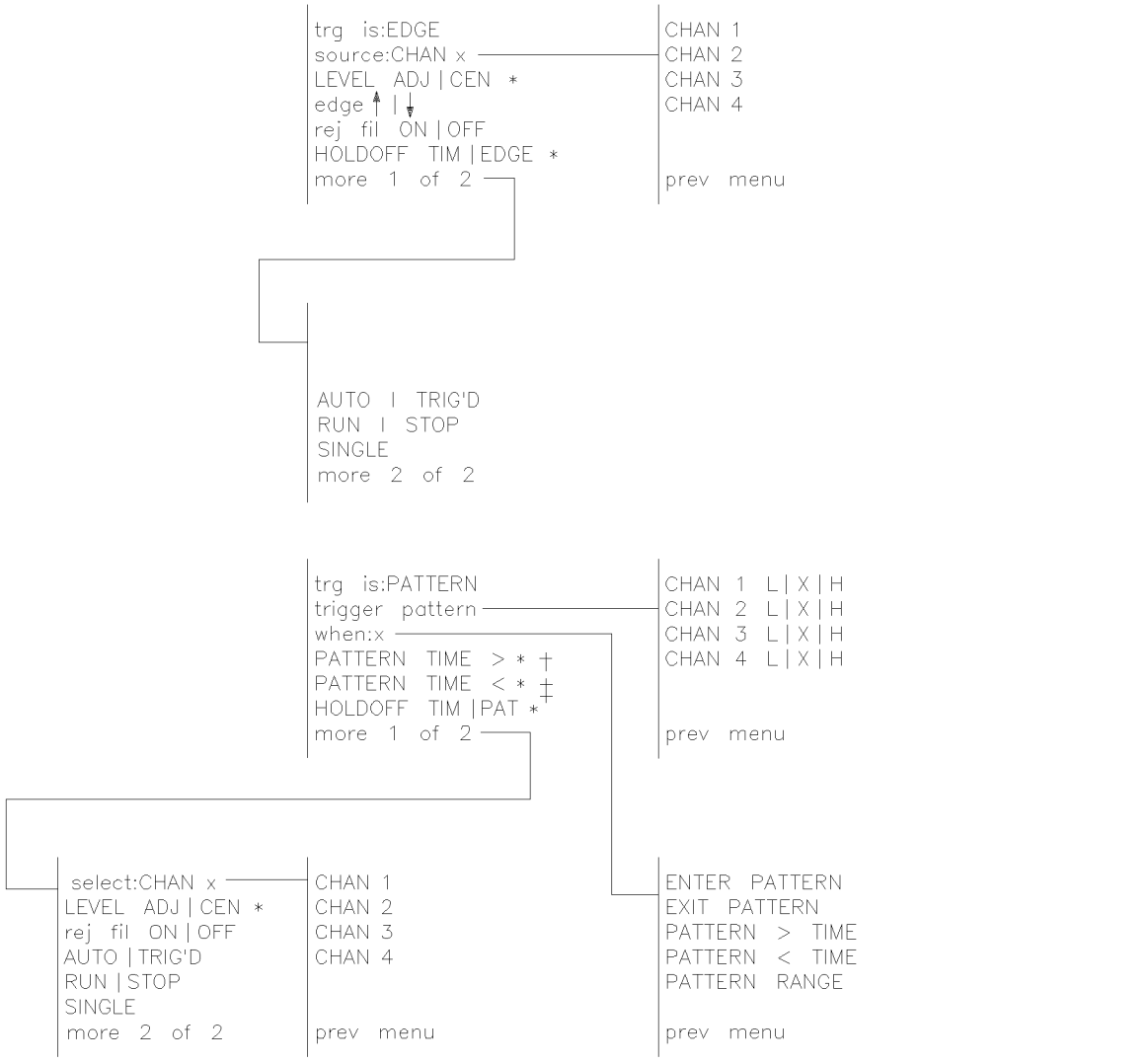
* *These are the softkey submenu selections available with each trigger mode.*



+ *Keys may not appear all the time. This depends on when:x*

triga

Figure 5-4. Trigger Menu (Map A)



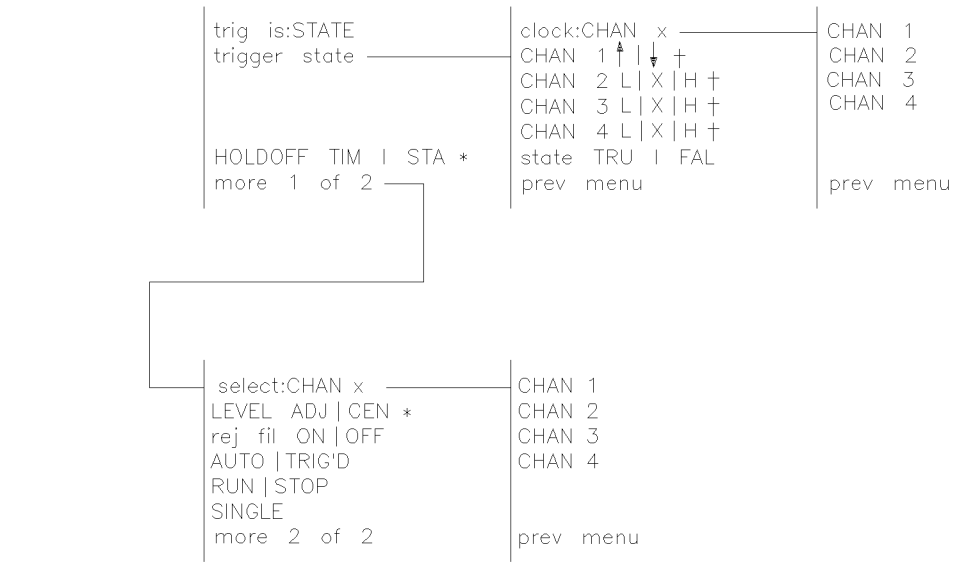
* *Settings for these softkeys are made with the step keys, the control knob and/or the numerical keypad.*

\+ *This softkey appears when TIME> or RANGE is selected for when:*

‡ *This softkey appears when TIME< or RANGE is selected for when:*

trigb

Figure 5-5. Trigger Menu (Map B)

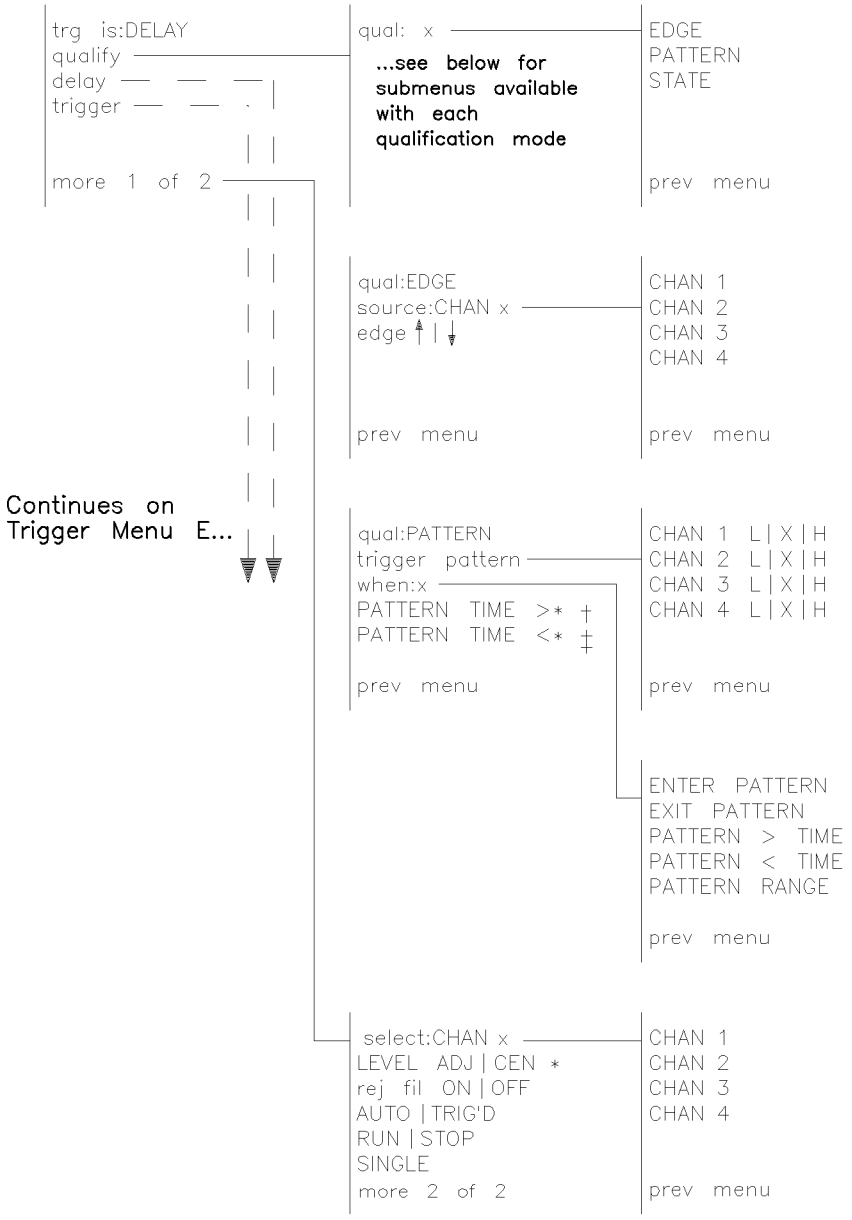


* *Settings for these softkeys are made with the step keys, the control knob, and/ or the numerical keypad.*

† ↑ | ↓ *appears for the active clock channel:* L | X | H *appears for the other channels.*

trigc

Figure 5-6. Trigger Menu (Map C)



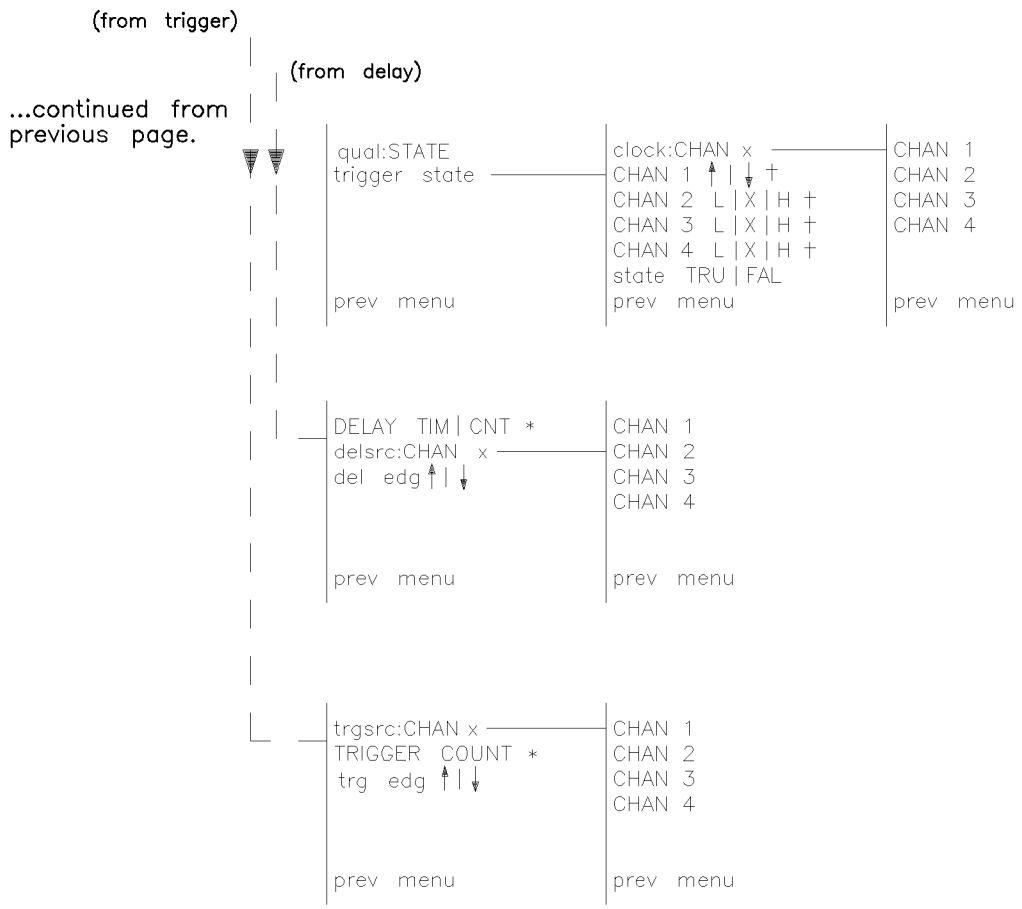
* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

† *This softkey appears when TIME> or RANGE is selected for when:*

‡ *This softkey appears when TIME< or RANGE is selected for when:*

trigd

Figure 5-7. Trigger Menu (Map D)

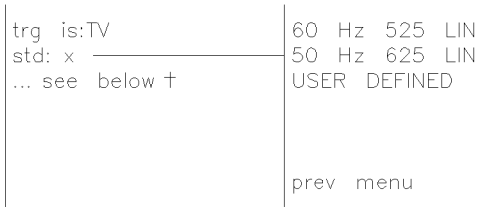


* *Settings for these softkeys are made with the step keys, the control keys, and/or the numerical keypad.*

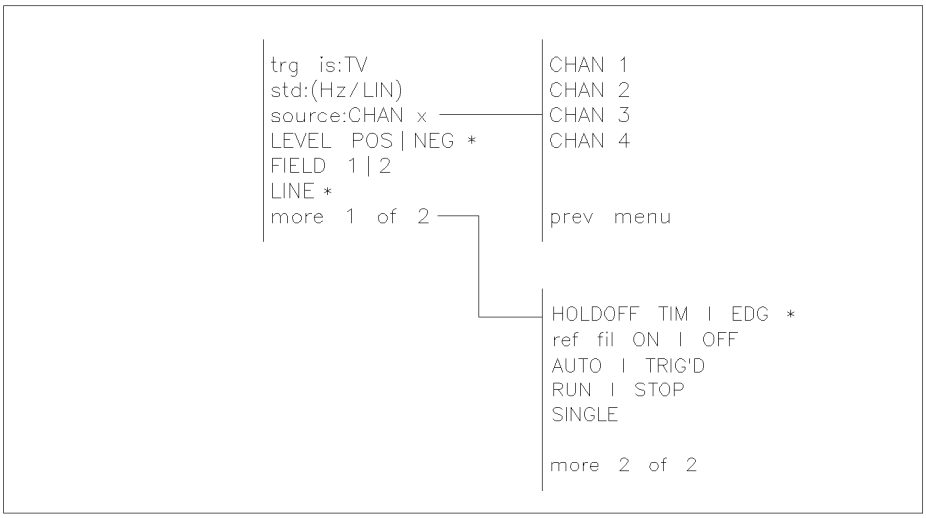
† ↑ | ↓ *appears for the active clock channel;* L | X | H *appears for the other channels.*

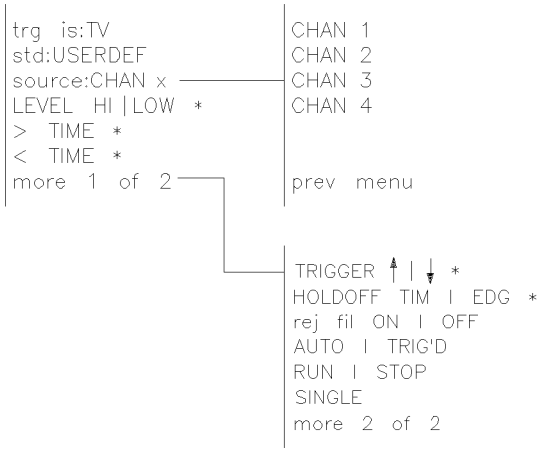
trige

Figure 5-8. Trigger Menu (Map E)



† *These are the softkey submenu selections for std: 60/525 and std: 50/625.*



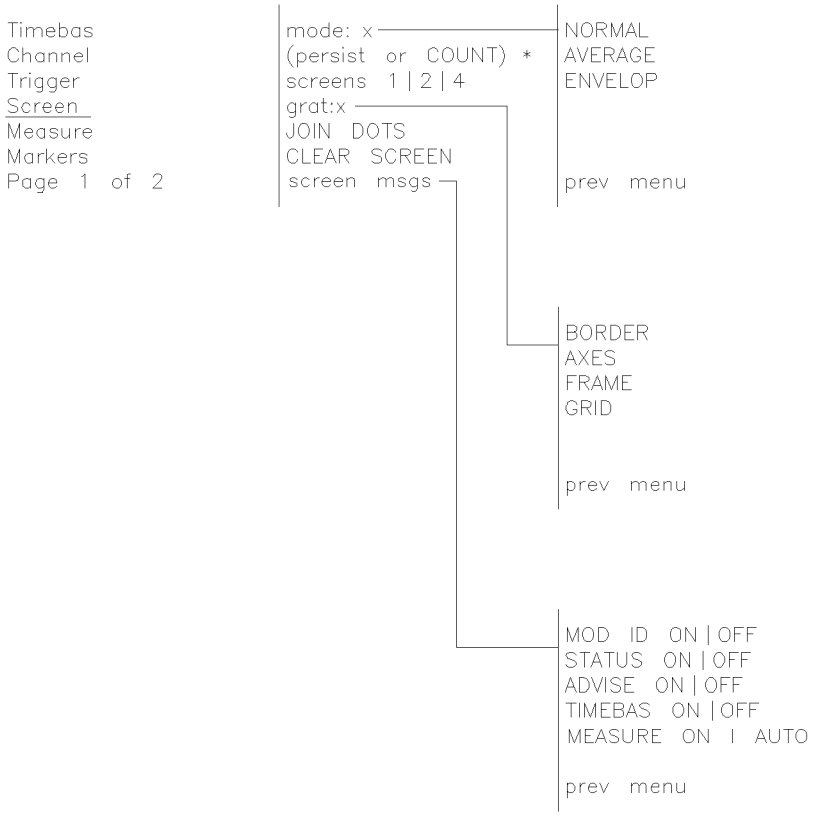


* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

trigf

Figure 5-9. Trigger Menu (Map F)

Screen Menu Map



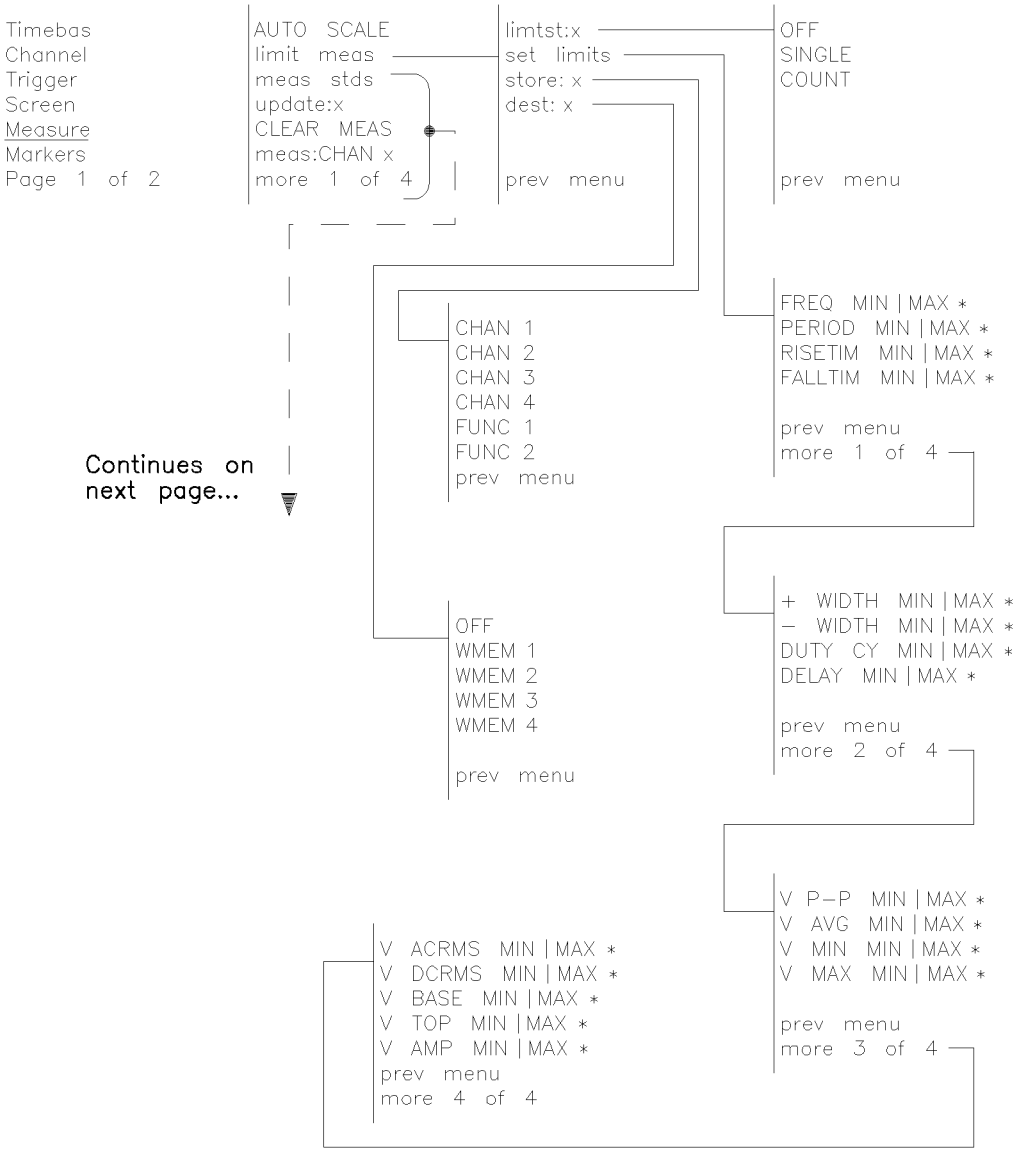
* *When NORMAL is selected, this softkey is persist MIN INF; when AVERAGE is selected, this softkey is AVERAGE COUNT.* †
When ENVELOPE is selected, this softkey is blank.

† *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

screen

Figure 5-10. Screen Menu

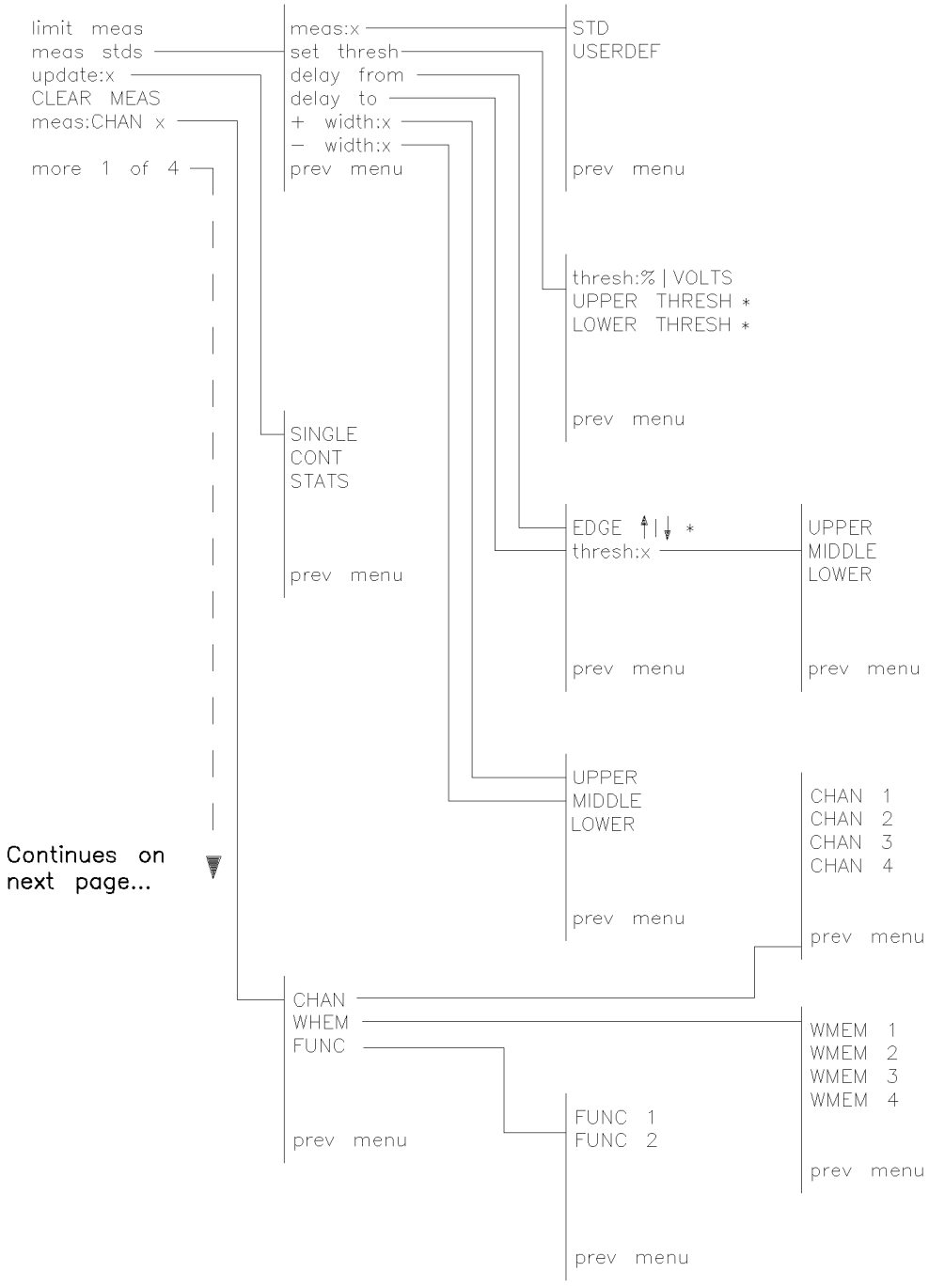
Measure Menu Map



* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

measure1

Figure 5-11. Measure Menu (Map A)



* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

measure2

Figure 5-12. Measure Menu (Map B)

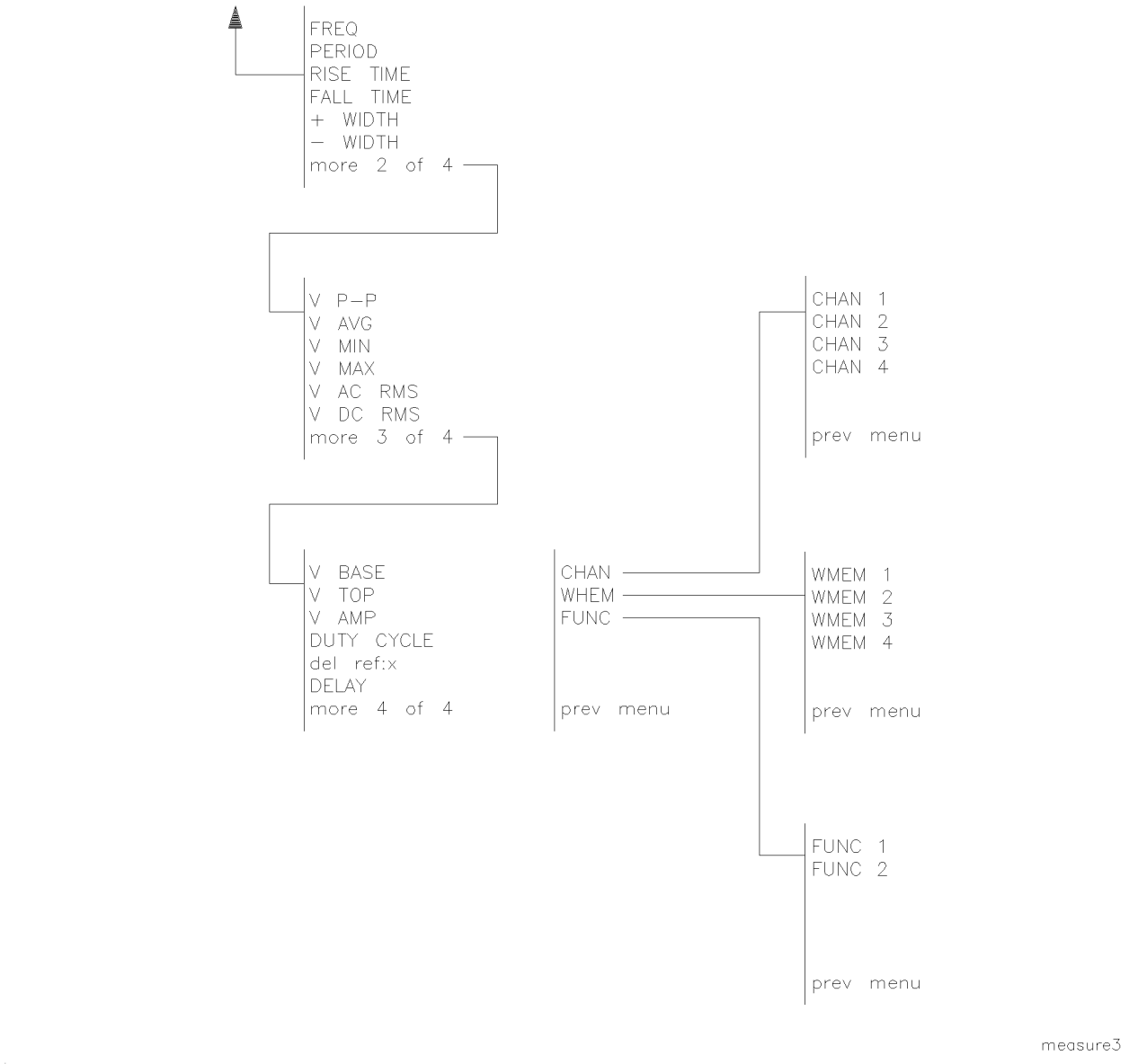
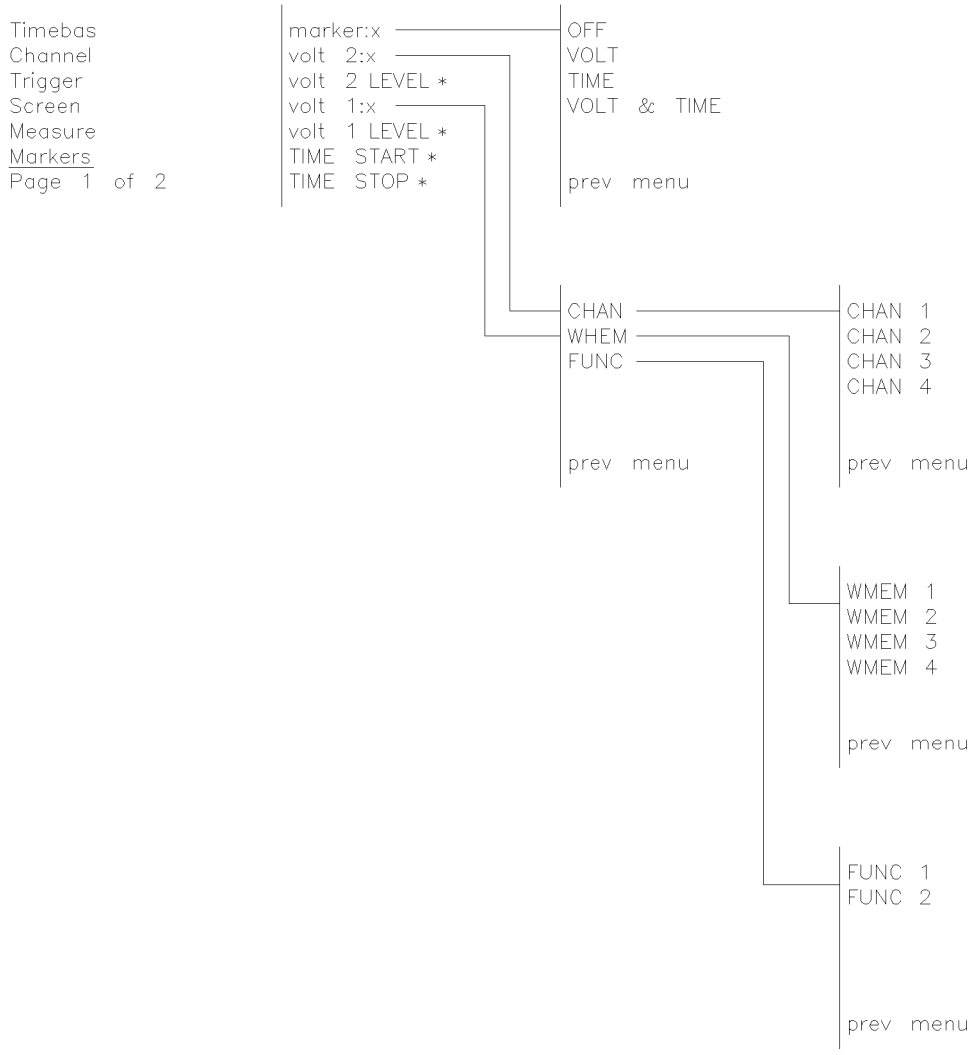


Figure 5-13. Measure Menu (Map C)

Markers Menu Map



* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

markers

Figure 5-14. Markers Menu

Waveform Save Menu Map

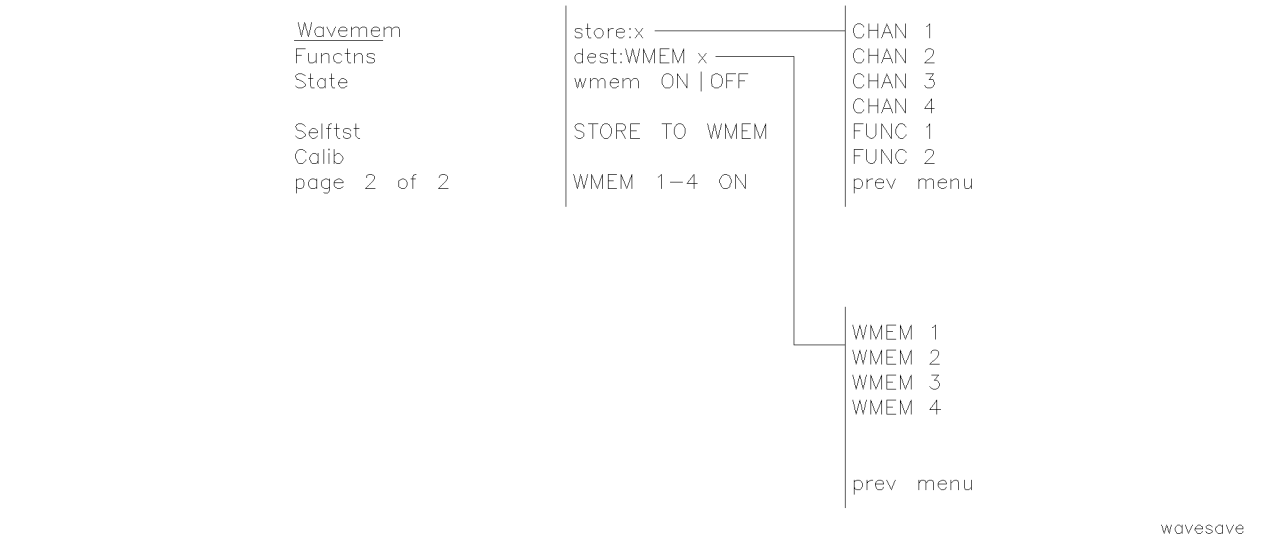
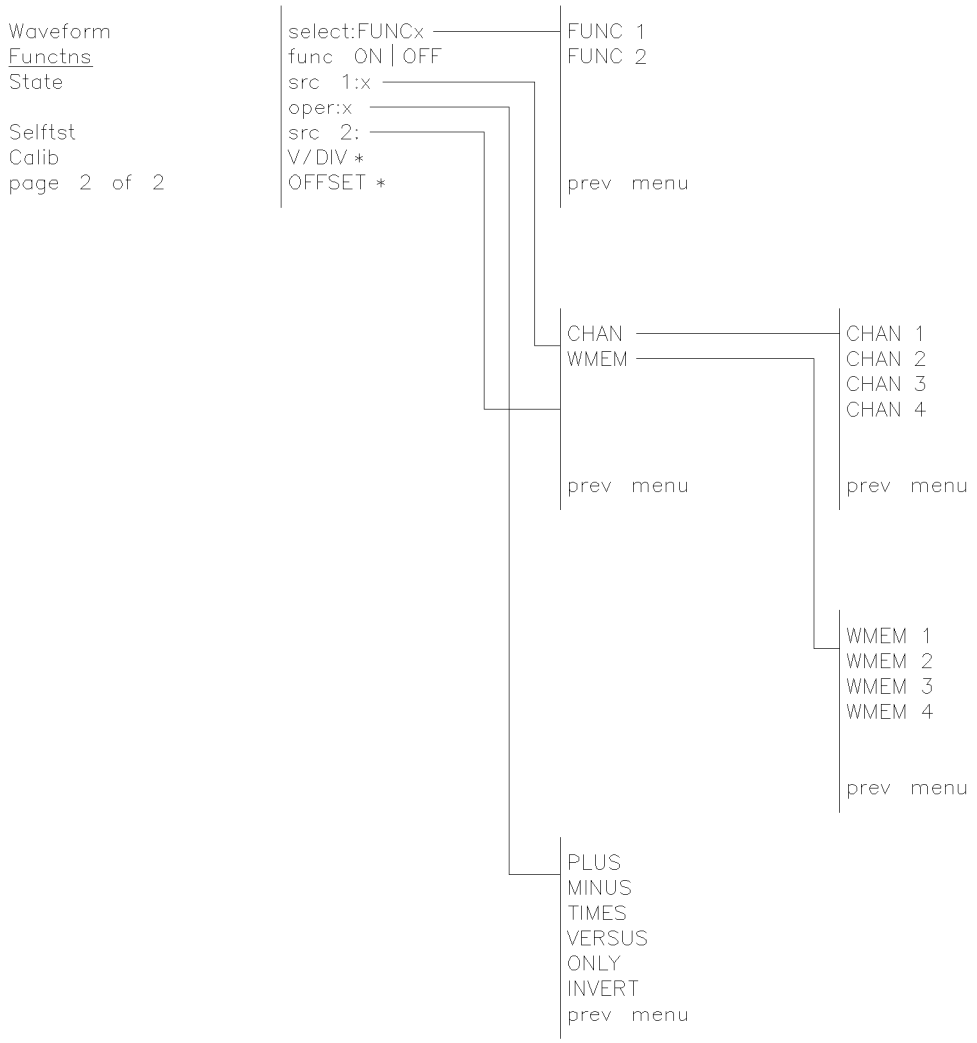


Figure 5-15. Waveform Save Menu

Functions Menu Map



* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

function

Figure 5-16. Functions Menu

State Menu Map

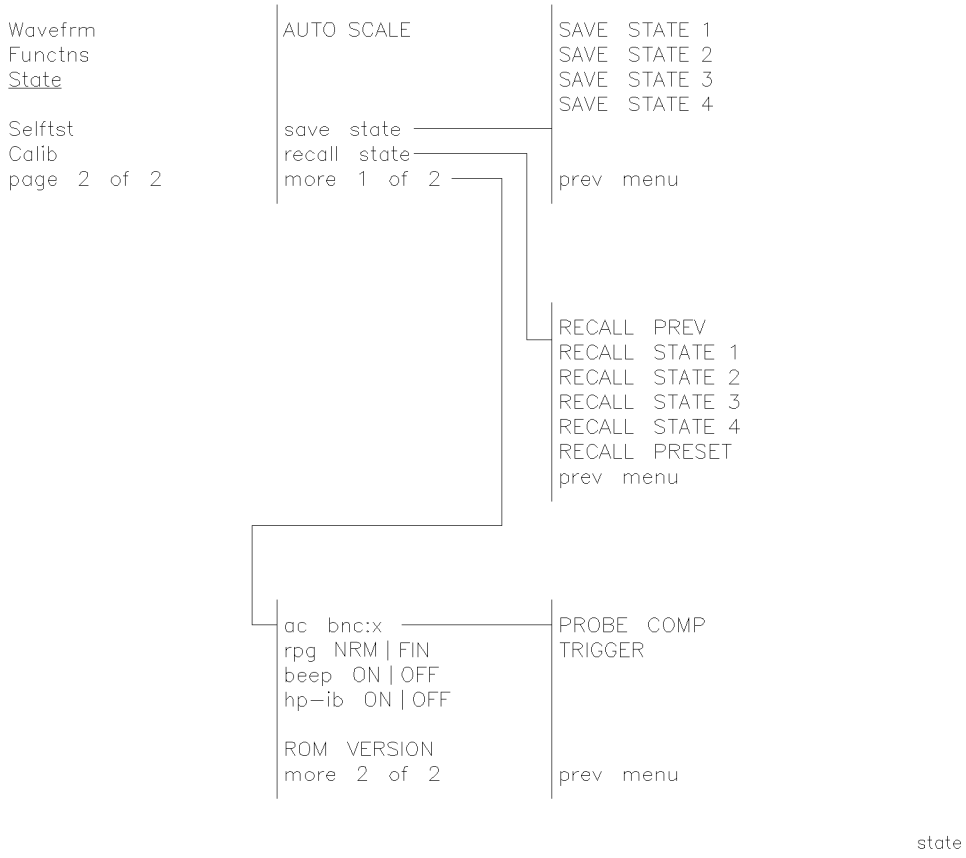
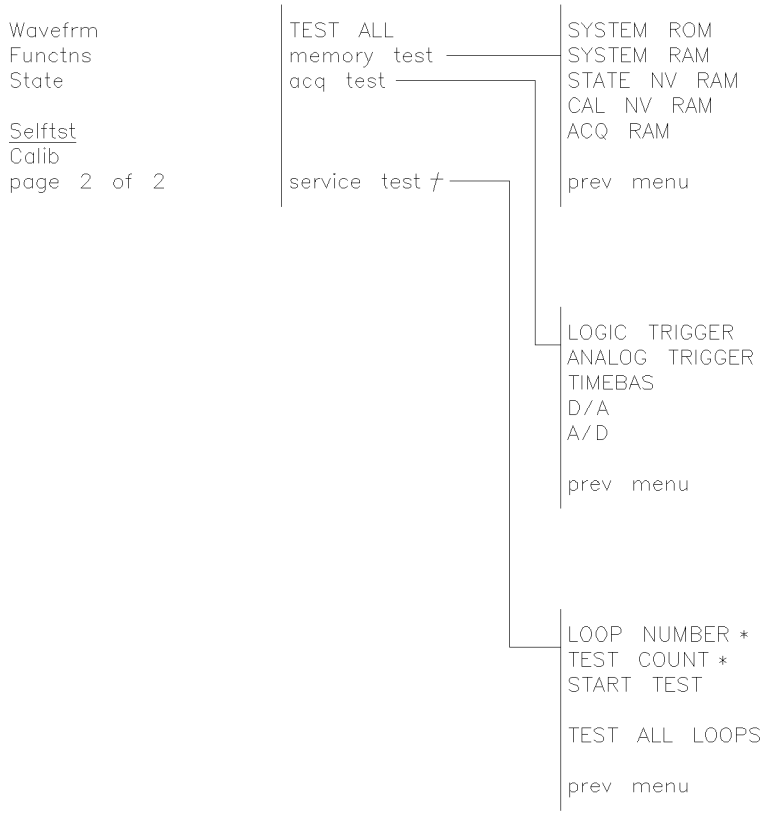


Figure 5-17. State Menu

Selftest Menu Map



* *Settings for these softkeys are made with the step keys, the control knob, and/or the numerical keypad.*

† *The HP 70703A has no user–serviceable components. All service and maintenance must be performed by qualified service personnel. The service test submenus contain loop tests used by those technicians during various calibration routines.*

selftest

Figure 5-18. Selftest Menu

Calibration Menu Map

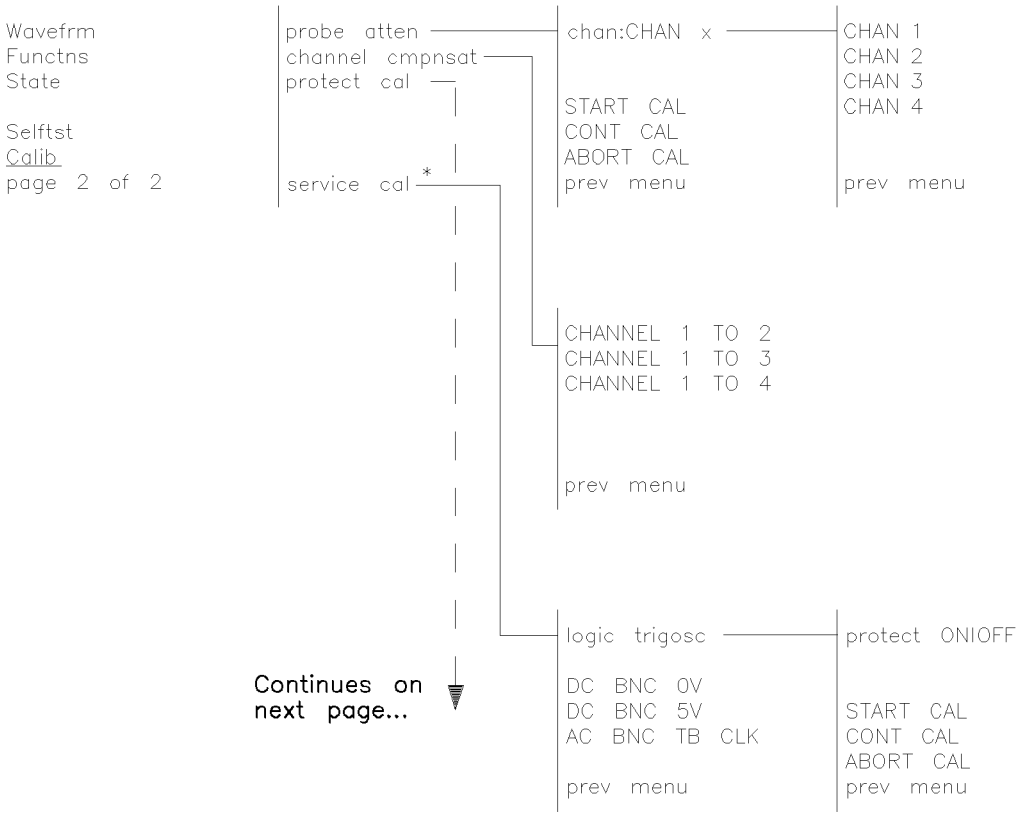


Figure 5-19. Calibration Menu (Map A)

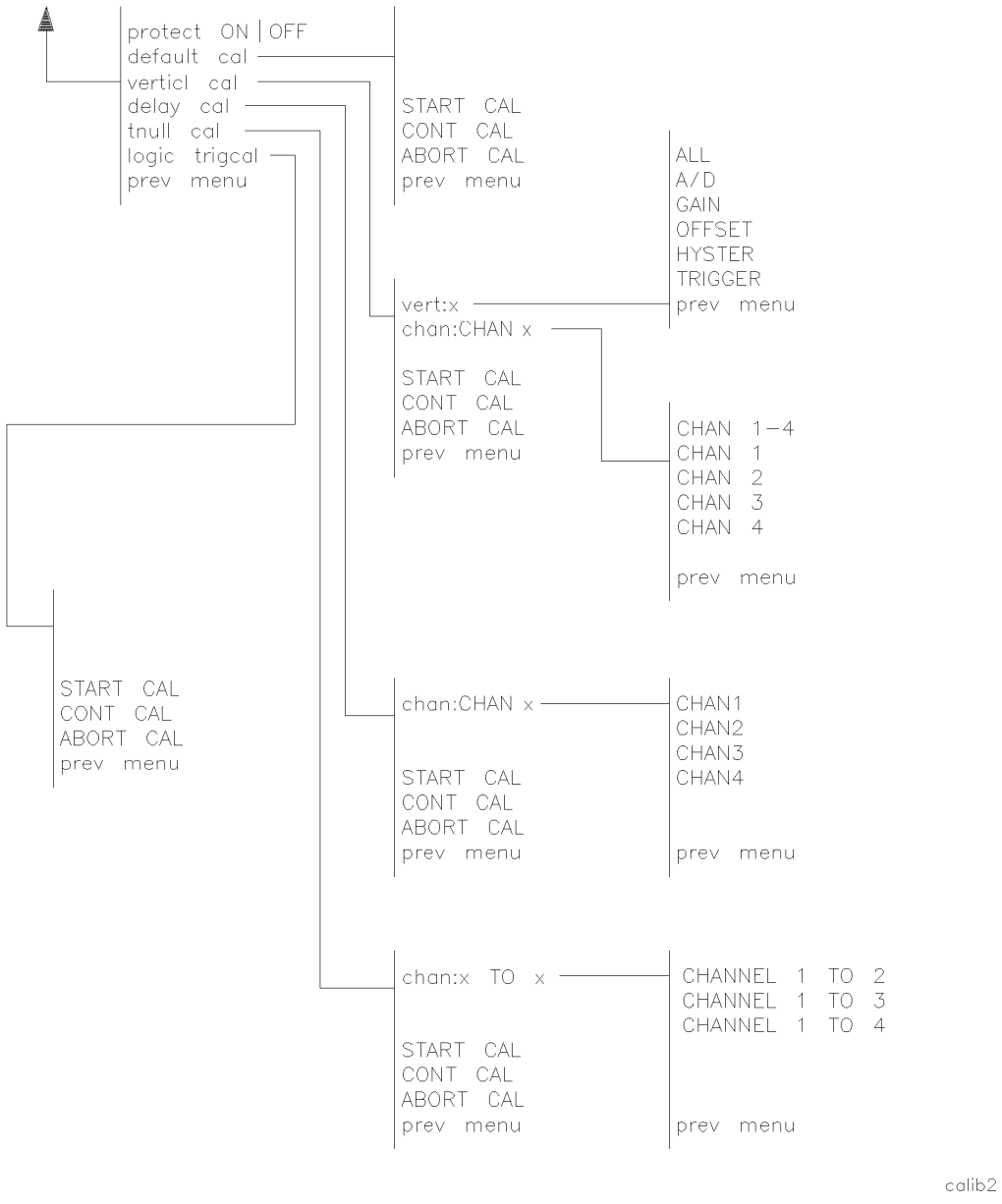


Figure 5-20. Calibration Menu (Map B)

6

Installation

This chapter contains information necessary for installing the HP 70703A digitizing oscilloscope into an HP 70000 Series mainframe.

The following information is included in this chapter.

- "HP-MSIB/HP-IB Addressing" provides information for setting the HP-MSIB address of each module, explains how HP-IB and HP-MSIB addresses interrelate, and illustrates examples of address switches.
- "HP 70703A Address Switches" describes how to set the address switches.
- "Calibration Memory Protection" describes how to set calibration memory protection using switches A and B located at the top of the module.
- "Self-Test and Self-Calibration" describes how to perform a self-test and first level calibration procedures.
- "Preparing a Static-Safe Work Station" discusses electrostatic discharge precautions that must be used when handling assemblies consisting of electronic components.
- "Module Removal and Installation" describes how to remove or install modules.
- "If You Have a Problem" provides troubleshooting information for problems related to installation.
- "System Replaceable Parts" lists model and part numbers for system-level replaceable parts, system cables, and service accessories.

HP-MSIB/HP-IB Addressing

An **element** in an HP 70000 modular measurement system is a **system component** able to communicate with other modules over HP-MSIB. Element addresses must adhere to the set of rules defined in this section.

HP-MSIB addressing is different from HP-IB addressing, and is explained in more detail in this section. The topics listed below include definitions and information about the HP-MSIB and HP-IB address of an element. Correct addressing requires an understanding of the following concepts:

- Modular Measurement System Terms
- Address Map (Matrix) Protocol
- Addressing Elements
- Addressing Order Requirements
- Address Switches

Modular Measurement System Terms

Understanding the following terms is essential to understanding HP-MSIB addressing and the structural relationship of modular measurement system devices.

Functional Terms

The devices of a modular system may be combined in such a way to allow them to communicate and operate as an instrument. The following terms identify the interrelationship among devices within a modular instrument.

Element — Any device that communicates over the HP-MSIB (for example, HP 70703A oscilloscope). In contrast, the HP 70001A mainframe controls all HP-MSIB communication, but does not communicate over the HP-MSIB and therefore is not an element.

Master — An element that controls other elements.

Sub-master — An element that simultaneously controls other elements and is controlled by another element.

Slave — An element that is controlled by another element.

Independent element — An element that is neither a master nor a slave (for example, HP 70703A oscilloscope).

Instrument — A module, or group of modules, that performs an independent function (for example, HP 70703A oscilloscope).

Structural Terms

Modular systems consist of hardware structures dedicated to specific functions. The structural terms used in reference to these functions are described below.

Mainframe — A housing for modules which also provides power, cooling, interconnection for HP-MSIB and HP-IB, and HP-MSIB communications control for up to eight 1/8-width modules. The HP 70004A color display also provides the same functions for up to four 1/8-width modules.

Module — Modules are devices that plug into an HP 70004A or HP 70001A. Modules cannot function without these independent elements.

Stand-Alone Instrument — An HP-MSIB element capable of performing its functions without a mainframe or HP 70004A display (for example, HP 70206A system graphics display).

Address Map Protocol

Protocol for master, sub-master, slave, and independent element addressing is explained in this section. The factors governing proper system communication and system function are based on adherence to the addressing protocol of modular spectrum analyzers.

By definition, a master is an element addressed to control another element, or is the controlling element of a system. Slave elements are addressed within the area a master controls, called the slave area. Independent elements are addressed so that they are neither masters nor slaves, though they may have functions that appear to control other elements. For example, the graphics display front-panel keys are used to select oscilloscope functions, but the oscilloscope is not a slave to the display.

Address Matrix

The address matrix is a graphic representation of assigned and available HP-MSIB addresses. The address assigned to each element appears on the matrix and indicates the relationship among master, sub-master, slave, and independent elements. Module function, access to HP-IB communication, and error reporting are all based on the location of the module address on the matrix. See Figure 6-1. The 8-row by 32-column matrix implies that 256 addresses are available; however, there are actually 255 legal addresses plus an illegal address at row 0, column 31.

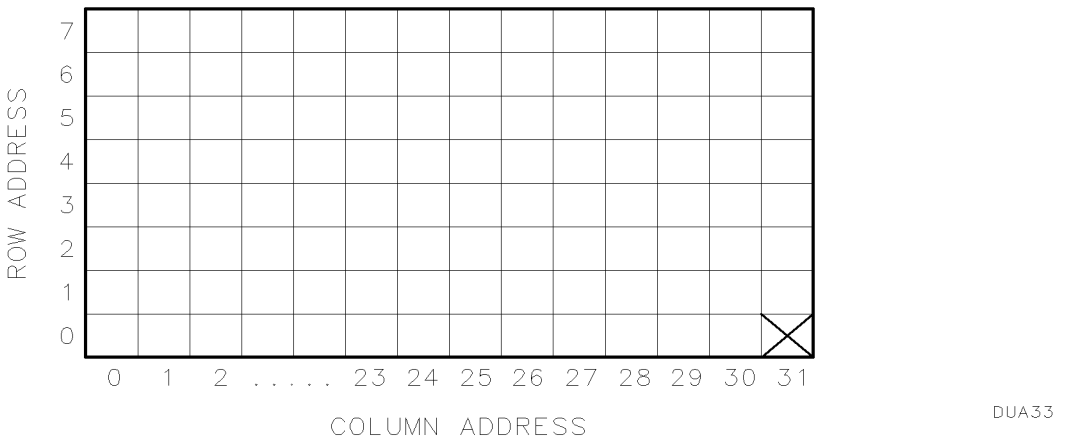


Figure 6-1. Address Matrix

Each element must have a unique 8-bit binary HP-MSIB address correctly placed on the address matrix. The three most significant bits (MSB) determine the row address; the five least significant bits (LSB), the column address. This manual refers to the decimal equivalent of a binary address.

Table 6-1. Decimal Equivalent of Binary Address

	Row MSB	Column LSB
Binary	010	11000
Decimal	2	24

Display-Response Area

A display-response area exists at row 0. The display's `REPORT ERRORS` menu key function can only access a module addressed at row 0. A display must be assigned to an instrument before communication between the two is initiated. This can be done automatically or manually. The automatic assignment function (`SELECT INSTRUMENT` menu key) searches the display-response area (row 0) when it assigns itself to an instrument. The display can be assigned to a module at any other row, but this assignment must be done manually using the `ASSIGN KEYBOARD` and `ASSIGN WINDOW` menu keys.

Note

To be addressed at row 0, a module must be designed to interface with the display and report errors. If a module that does not have these capabilities is addressed at row 0, the system will cease to communicate.

HP-IB Access

The HP-IB access area is at row 0 of the address matrix. Address row 0, column 31, however, is an illegal address location for any element. Modules that have been designed for HP-IB access are able to use HP-IB only if their addresses are in the HP-IB access area (row 0, columns 0 through 30).

Note Address row 0, column 31 is an illegal address for any element.

Addressing Elements

Master Elements

The address switches set an element's HP-MSIB address. If the element is a master or an independent element, the column switches also determine the "Default" HP-IB address. (Displays do not have row address switches, so they are always set to row address 0.) A master is typically placed at any legal row 0 address. This row address location allows error reporting and access to HP-IB. If neither error reporting nor HP-IB access are required, a master may be placed at any legal address.

Modules controlled by another module are called slaves. To be controlled by a master, slave modules must be addressed within the slave area defined by that master. Refer to Figure 6-2 for examples of modules in a slave area. For proper system function and communication, slaves must be addressed within the boundaries set by the defining elements.

A defining element is any element, residing to the right and in the same row or lower than a master.

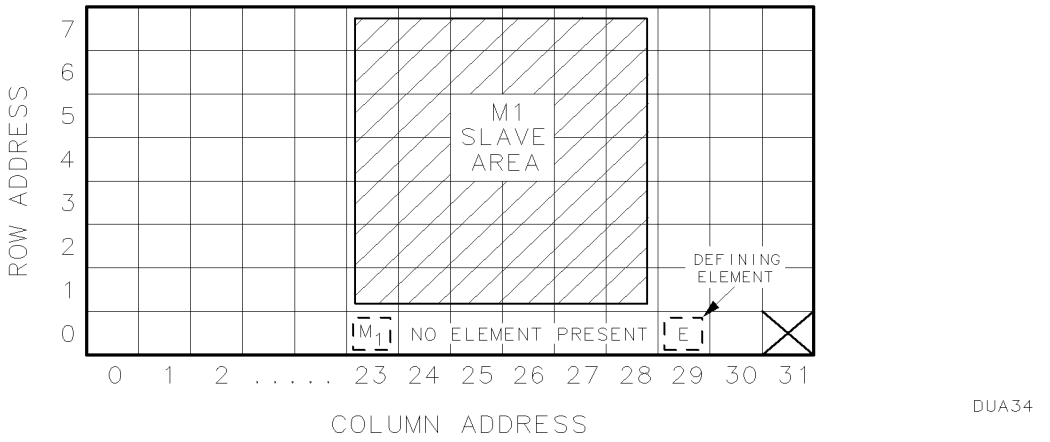


Figure 6-2. Master/Slave Address Matrix

Sub-Master Elements

A sub-master is an element that can function as both master and slave at the same time. Sub-masters are located at a row address other than 0, are controlled by another master, and control a slave area of their own. For example, Figure 6-3 illustrates sub-master M2 at address 3, 24. M2 is a slave to M1. M2 also has a slave area that lies within the

slave area of M1. M1 does not communicate directly with M2 slaves; it can only communicate with them through M2.

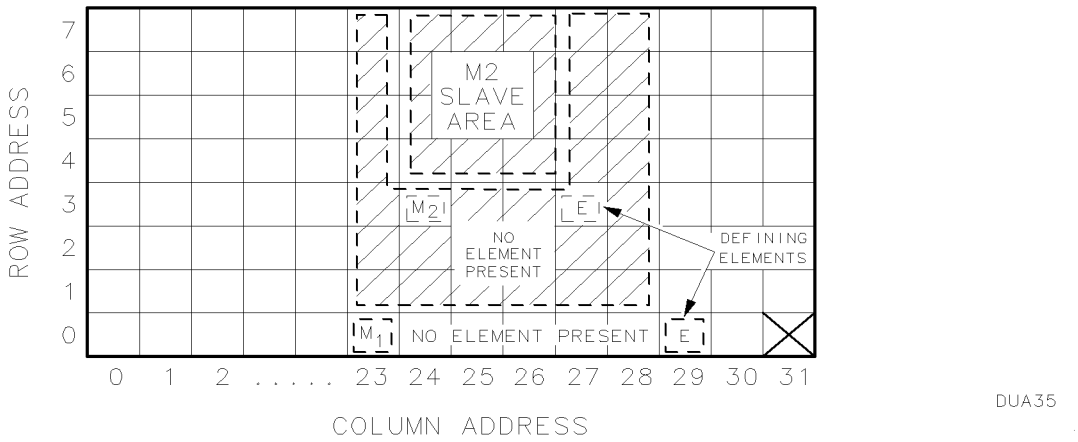


Figure 6-3. Sub-Master Address Matrix

Slave Elements

For an instrument to function properly, the master must determine the slave area it controls on the address matrix. Master modules establish their slave area by determining the location of the defining element on the address matrix. The defining element establishes the boundaries of the slave area. Any module located within this area is a slave to the master module.

The HP-MSIB address requirements of a defining element are as follows:

- The column address of a defining element must be greater than the column address of the master. In Figure 6-2, for the master addressed in column 23, the defining element must be addressed in column 24 or above. In Figure 6-3, for M2 addressed in column 24, the defining element must be addressed in column 25 or above.
- The row address of a defining element must be equal to or less than the row address of a master. In Figure 6-2 the address of the master at row 0 has a defining element addressed at row 0. Figure 6-3 shows two masters, M1 and M2. The defining element for M1 is located at row 0 and the defining element for M2 is located at row 3.

Slave Area Boundaries

The master determines its slave-area boundaries by first searching upward in its own column starting in the master's row, then in each higher column starting in the master's row. The search stops at the boundary column or, if there is no defining element, after searching column 31.

After a master locates the defining element of its slave area, the slave area boundaries are set by using the following criteria:

- The column address of the master is the left-hand boundary of the slave area. In Figure 6-2, the left-hand boundary is column 23.

- The right-hand boundary of the slave area is equal to one less than the column address of the defining element. For the master at column 23 in Figure 6-2, the right-hand boundary is at column 28. If there is no defining element, the right-hand boundary of the slave area extends through column 31.
- The lower boundary of the slave area is one row greater than the row address of the master. For the master in row 0 in Figure 6-2, the lower boundary is at row 1.
- The upper boundary of the slave area is the top row of the matrix (row 7).

If a new module is added to the area labeled "No Element Present" in Figure 6-2, this module becomes the new defining element and the right-hand boundary moves toward the master.

Independent Elements

An independent element, such as a display, is neither a master nor a slave. Displays are considered independent elements and separate instruments. Because they do not have row address switches, displays automatically are at row address 0. The typical address for a display is row 0, column 4.

HP 70703A Address Switches

Figure 6-4 is an illustration of the address switches found on the HP 70703A digitizing oscilloscope.

The **ROW** 1-3 switches set the HP-MSIB row address.

The **COLUMN** 1-5 switches set the HP-MSIB column address.

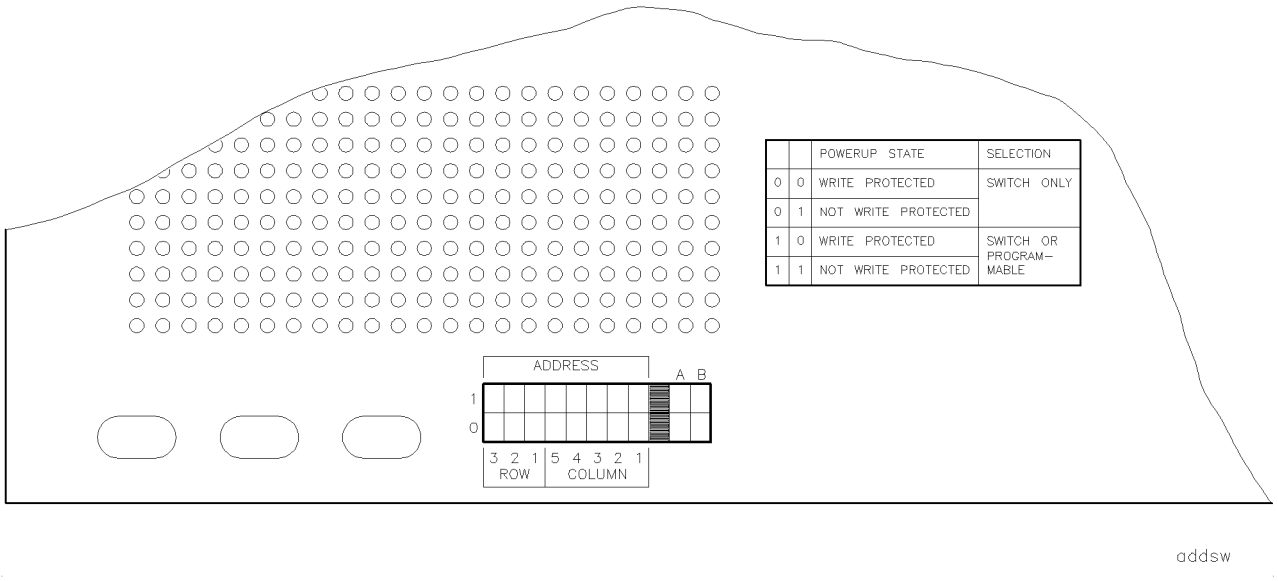


Figure 6-4. HP 70703A Address Switches

Setting the HP-MSIB Address Switches

A module-address change requires the following steps:

1. Locate the address switches on the top cover of the module. See Figure 6-5 for an example of the switches.
2. Set the three address switches labeled "ROW" to the binary value of the module's HP-MSIB row number. For example, if the row value is 6, set the switches to binary 110.
3. Set the five address switches labeled "COLUMN" to the binary value of the module's HP-MSIB column number. For example, if the column value is 18, set the switches to binary 10010.

Note

Changing HP-MSIB addresses requires an understanding of HP-MSIB addressing rules. If a custom addressing configuration is used, refer to the installation and verification manuals for the other modules in the system for information on determining and assigning HP-MSIB addresses.

Changing the HP-MSIB address will cause the HP-IB address to reset to the new value of the column address. This can be changed to a different value using the [SET HP-IB] key in the address map.

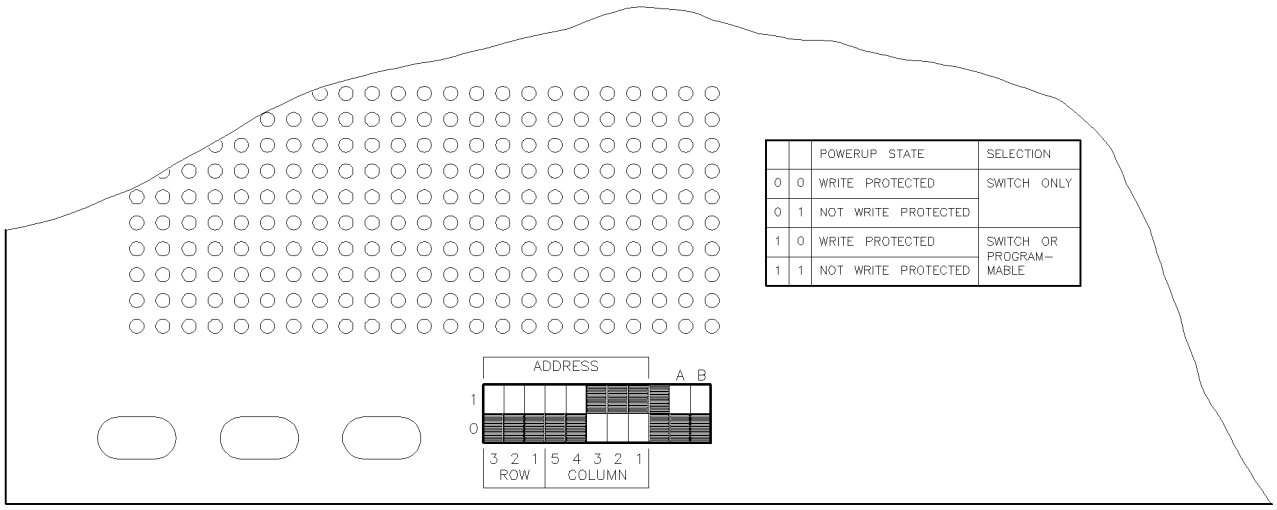


Figure 6-5. Module Address Switches

The address switches are a group of two position toggle switches. Each can be set to either 1 or 0. In Figure 6-5, black indicates the on position for each switch to set an HP-MSIB address of row 0, column 7.

Self-Calibration

The HP 70703A digitizing oscilloscope can be verified using the self-test routine (`Selftst`). The response will be either pass or fail indicated on the screen.

Calibration for the HP 70703A oscilloscope module consist of vertical, delay, time null, and logic trigger tests. Calibration tests can be performed by the operator.

The Calibration should be performed under the following conditions:

- at six month intervals or every 1000 hours of use
- if the ambient temperature changes more than 10°C from the temperature at full calibration
- to optimize measurement accuracy
- to provide improved hardware verification

CAUTION

Do not remove the module with power applied to the mainframe.

The firmware calibration procedures should only be performed after the instrument has run for one hour at ambient temperature installed in the mainframe.

Note

It is NOT necessary to perform first level calibration procedures prior to every operation.

When performing a first level calibration, all procedures should be done in the order given.

After calibrating, you MUST perform an `AUTO SCALE` or INSTR PRESET to return to normal operation.

It is assumed that the person performing the following procedures understands how to operate the mainframe and the HP 70703A digitizing oscilloscope. It is also assumed that the technician will select the cables, adapters, and probes required to complete the test setups described in this section.

Calibration Memory Protection

Calibration memory protection is controlled by switches A and B situated in the bank of switches at the top of the module. Refer to Figure 6-5.

Switch A determines whether the calibration memory protection is controlled by the switch settings or by programmable methods. With switch A set to the "0" position ("hard mode"), the calibration memory protection state is determined by the position of switch B. When B is set to "0," the calibration memory is write-protected. When B is set to "1," the calibration memory is not write protected.

Setting switch A to "1" ("soft mode") means that the calibration memory protection can be controlled by the programmable method. The position of switch B determines the power-up state of the calibration memory protection. With switch B set to "0," the power-up state is write-protected. When B is set to "1," the power-up

state is not write-protected. The initial power-up state can be altered using the `Calib`, `protect cal`, `protect ON|OFF` softkey. This is particularly useful when it is not practical to power down the system. Setting protection ON will set the calibration memory protection to write-protected mode. Setting protection OFF will set the calibration memory protection to not write-protected mode. Cycling the power will reset the calibration memory protection to the conditions determined by the positions of switches A and B.

It is recommended that the calibration memory protection switches (A/B) are set to the write-protected settings (A = 0 or 1, B = 0). This will ensure that at power-up the calibration memory protection mode will be set to write protected.

Self-Test Procedure

1. Press the following keys:

   (MENU)
   `page 1 of 2`
   `Selftst`

2. Disconnect all inputs.
3. Press `TEST ALL`.

   Onscreen messages indicate whether tests passed or failed.

Note

Test failures can be caused by improper cabling, or improper selection of the interface select code or address setting. Verify proper connection and address selection before troubleshooting.

If the calibration time exceeds 20 to 30 minutes, or if any of the calibration procedures fail, the calibration is invalid. Recycle the power then repeat the procedure, starting the self-test procedure. If the condition repeats, the instrument is malfunctioning. Return the instrument to the nearest Hewlett-Packard service office for repair.

Default Cal Procedure

4. Press the INSTR PRESET on the mainframe.
5. Set the calibration memory protection switches (A/B) to not write protected as described in "Calibration Memory Protection", above.

   or,

   if the calibration memory protection switches are set to "soft mode," press the following keys:

   (MENU)
   `page 1 of 2`
   `Calib`
   `protect cal`
   `protect ON|OFF` (OFF)

6. Press the following keys:

   `default cal`
   `START CAL`

CONT CAL

7. The message “Default calibration factors loaded” should be displayed.
8. Press prev menu .

Vertical Cal Procedure

9. Press the following keys:

   vertical cal

   chan: Chan1

   CHAN1

Note

This procedure can be accomplished by testing all four channels at the same time. Connect the DC Cal Out BNC through equal paths to the input of Channels 1 through 4. Press CHAN1-4 instead of CHAN1 .

10. Press START CAL .
11. Connect the DC CAL OUT according to the onscreen instructions.

    Calibration will take several minutes. During this time, onscreen messages indicate whether tests passed or failed.
12. Press the following keys to select another channel to calibrate.

    chan: CHAN x

    CHAN x
13. Repeat steps 10 through 12 until all channels have been calibrated, then press prev menu .

Delay Cal Procedure

14. Press delay cal .
15. Press START CAL .
16. Connect the AC CAL OUT according to the onscreen instructions.

    Onscreen messages indicate whether tests passed or failed.
17. Press the following keys to select another channel to calibrate.

    chan: CHAN x

    CHAN x
18. Repeat steps 15 through 17 until all channels have been calibrated, then press prev menu .

Time Null Cal Procedure

19. Press `tnull cal`.
20. Press `START CAL`.
21. Connect the AC CAL OUT according to the onscreen instructions.

    Onscreen messages indicate whether the tests passed or failed.
22. Press the following keys to select another pair of channels to calibrate.

    `chan: 1 TO x`

    `CHANNEL 1 TO x`
23. Repeat steps 20 through 22 until all channels have been calibrated, then press `prev menu`.

Logic Trigger Cal Procedure

24. Press the following keys:

    `logic trigcal`

    `START CAL`
25. Connect the AC CAL OUT according to the onscreen instructions.

    Onscreen messages will indicate whether the test passed or failed.
26. Press `prev menu`.
27. If the calibration memory protection switches are set to "soft mode," press `protect ON|OFF` (ON),

    otherwise,

    turn off power, remove the HP 70703A digitizing oscilloscope, then reset the memory protection switches to write-protected mode.

Preparing a Static-Safe Work Station

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all work performed on assemblies consisting of electronic components should be done at a static-safe work station.

Figure 6-6 shows an example of a static-safe work station. Two types of ESD protection are shown:

- a conductive table mat and wrist strap combination
- a conductive floor mat and heel strap combination

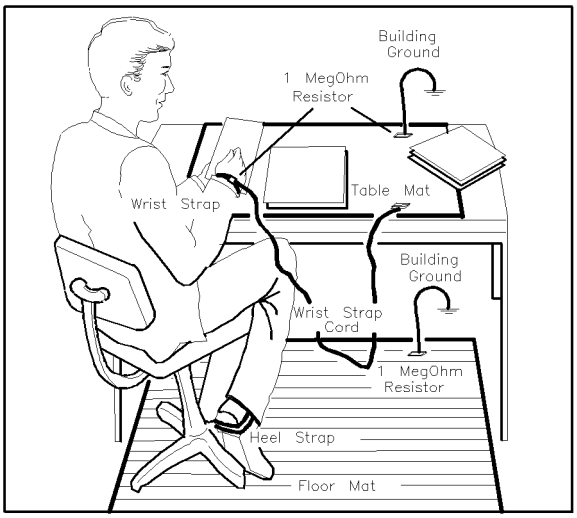


Figure 6-6. Static-Safe Work Station

These two types of ESD protection must be used together. Refer to Table 6-2 for a list of static-safe accessories and their HP part numbers.

CAUTION

- Do not touch the edge-connector contacts or trace surfaces with bare hands. Always handle board assemblies by the edges.
- Do not use erasers to clean the edge-connector contacts. Erasers generate static electricity and degrade the electrical quality of the contacts by removing the thin gold plating.
- Do not use paper of any kind to clean the edge-connector contacts. Paper or lint particles left on the contact surface can cause intermittent electrical connections.

Reducing ESD Damage

To help reduce the amount of ESD damage that occurs during testing and servicing, use the following guidelines:

- Be sure that all instruments are properly earth-grounded to prevent buildup of static charge.
- Personnel should be grounded with a resistor-isolated wrist strap before touching the center pin of any connector and before removing any assembly from a piece of equipment.

  Use a resistor-isolated wrist strap that is connected to the HP 70000 Series modular spectrum analyzer system mainframe's chassis. If you do not have a resistor-isolated wrist strap, touch the chassis frequently to equalize any static charge.
- Before connecting any coaxial cable to an instrument connector for the first time each day, *momentarily* short the center and outer conductors of the cable together.
- Handle all PC board assemblies and electronic components only at static-safe work stations
- Store or transport PC board assemblies and electronic components in static-shielding containers
- PC board assembly edge-connector contacts may be cleaned by using a lintfree cloth with a solution of 80% electronics-grade isopropyl alcohol and 20% deionized water. This procedure should be performed at a static-safe work station.

Static-Safe ESD Accessories

Table 6-2. Static-Safe ESD Accessories

HP Part Number	Description
9300-0797	Set includes: 3M static control mat 0.6 m × 1.2 m (2 ft × 4 ft) and 4.6 cm (15 ft) ground wire. (The wrist-strap and wrist-strap cord are not included. They must be ordered separately.)
9300-0980	Wrist-strap cord 1.5 m (5 ft)
9300-1383	Wrist-strap, color black, stainless steel, without cord, has four adjustable links and a 7 mm post-type connection.
9300-1169	ESD heel-strap (reusable 6 to 12 months).
Order the following by calling HP DIRECT at (800) 538-8787 or through any Hewlett-Packard Sales and Service Office.	

Module Removal and Installation

The following procedure defines the steps in removing or installing the HP 70703A digitizing oscilloscope.

Module Removal

1. Set the HP 70004A/70001A LINE switch to OFF. See Figure 6-7.
2. Open the HP 70004A/70001A front-panel door. With an 8 mm hex-ball driver, loosen the module hex-nut latch.
3. Press against the rear panel, and slide the module out.

Installation

1. Set the HP 70004A/70001A LINE switch to OFF.
2. Check the HP-MSIB address switch on the module for the correct address setting.
3. Open the HP 70004A/70001A front-panel door, and slide the module into the HP 70004A/70001A.
4. Press against the module front panel while tightening the hex-nut latch with an 8 mm hex-ball driver.
5. Turn the HP 70004A/70001A LINE switch on.

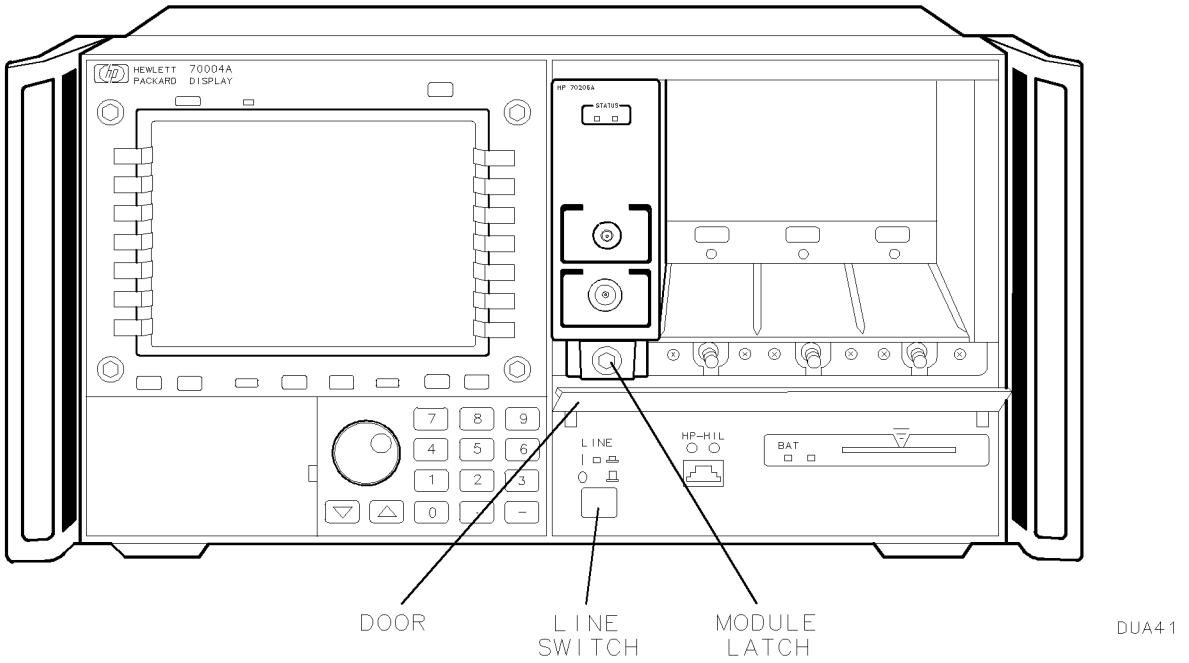


Figure 6-7. Module Removal/Replacement

WARNING **If an instrument handle is damaged it should be replaced immediately. Damaged handles can break while the instrument is being moved or lifted. This may cause damage to the instrument or personal injury.**

If You Have a Problem

This section provides information on the front-panel status LEDs, indicator LEDs, and the error messages produced by the HP 70703A digitizing oscilloscope.

If problems are encountered, review the previous sections of this chapter to ensure that the module addressing switches are properly set and the module is securely seated in the mainframe. If problems persist, refer to the installation and verification manual for the system master.

Status Indicators

All elements and the mainframe have status indicators. Status indicators that inform the operator of a problem are called error indicators. Status indicators that tell the operator which elements are being controlled or accessed are called active indicators.

The HP 70703A digitizing oscilloscope has several HP-IB related indicators: **RMT** (remote), **LSN** (listen), **TLK** (talk), and **SRQ** (service request). **RMT**, **LSN**, and **TLK** are status indicators and do **not** indicate an error condition when they are lit. **SRQ** can be set by the user to light in response to different conditions (for example, an error condition, or completion of an operation). Refer to the HP 70703A digitizing oscilloscope programming manual for information about setting **SRQ**.

The HP 70001A mainframe does not have an active indicator, but it does have three front-panel error indicators: **VOLT/TEMP**, **CURRENT**, and **I/O CHECK**.

The **VOLT/TEMP** light indicates that the line voltage or power supply temperature needs checked.

The **CURRENT** light indicates that the loading conditions on the mainframe power supply may be incorrect.

The **I/O CHECK** light indicates that there is a communication problem.

Exchanging the HP 70703A

CAUTION Module exchange should only be performed at a static-safe work station. Refer to the section "Preparing a Static-Safe Work Station" in this chapter.

Removing the Module from the Mainframe

1. Set the LINE switch to OFF.
2. Open the mainframe front access door. Note that the door may not be opened unless the LINE switch is OFF.
3. Loosen the module latch using an 8 mm hex-ball driver.
4. Slide the module forward out of the mainframe.

Reinserting the Module in the Mainframe

1. Ensure that the LINE switch is OFF.
2. Open the front access door.
3. Check the module HP-MSIB address switches for correct addressing.
4. Slide the module into the mainframe.
5. Tighten the module latch, using an 8 mm hex-ball driver while pressing against the module front.
6. Close the mainframe access door.
7. Turn the mainframe LINE switch on.

Troubleshooting Over HP-IB

The following remote commands can be used from an external HP-IB computer:

∗**TST?** begins the self-test routine of the HP 70703A digitizing oscilloscope. The response returns either "0" for a pass or "1" for a failure.

The **:SYSTEM: ERR? STR** query returns a text description of one error. If there is more than one error, repeat the query until the response is "0, NO ERROR."

Troubleshooting Using the Selftest Menu

The `TEST ALL` function in the selftest menu can be used to view results of performing all memory and acquisition tests.

1. Press `Selftst`.
2. Press `TEST ALL`.
3. View onscreen messages.

Troubleshooting Catastrophic Failures

Catastrophic failures prevent the system from running most troubleshooting routines. These failures usually result in flashing error lights. Where additional controllable elements exist, try selecting another one to verify the source of failure.

Note

Before troubleshooting a catastrophic failure, verify that the correct line power is applied to the mainframe (and stand-alone display, if used). The mainframe power-on indicator should light when the LINE switch is turned on. If the power-on indicator does not light, refer to the mainframe service manual for troubleshooting information.

The following sections contain troubleshooting information for the following symptoms: lit I/O CHECK, VOLT/TEMP or CURRENT.

Mainframe I/O CHECK Indicator is Lit

The I/O CHECK light should be off when both HP-MSIB cables are either connected to, or disconnected from, the mainframe. The I/O CHECK light should be lit when only one HP-MSIB cable is connected to the mainframe.

To isolate other causes of the I/O CHECK light being lit, use the following procedure.

1. Verify that all mainframes and stand-alone displays on the HP-MSIB have their power turned on.
2. Check for proper HP-MSIB cable connections, making sure that all cable connections are secure.
3. Disconnect the HP-MSIB cables from the mainframe.
   a. If the I/O CHECK light is still lit, the mainframe is faulty. Refer to the mainframe service manual for further troubleshooting information.
   b. If the I/O CHECK light is no longer lit, the problem is either in the cables or in the instrument that was connected by the cables to the mainframe. Reconnect the HP-MSIB cables, and refer to "Using the HP-MSIB Troubleshooting Utility" to further isolate the problem.

Note

If an element outside of the mainframe responds to the HP-MSIB troubleshooting utility with `COMMUNICATION COMPLETE`, the cables are not faulty.

Mainframe VOLT/TEMP Indicator is Lit

The VOLT/TEMP indicator usually lights if either the input voltage is too low, or the internal temperature on the mainframe power-supply board assembly exceeds the normal operating temperature.

1. Check the LINE VOLTAGE SELECTOR on the mainframe to make sure the selector setting matches the line voltage.
2. Allow the instrument to cool. If the temperature decreases to normal operating range, the mainframe will attempt to restart itself. After the instrument has restarted, verify that the cooling fans are operating by visually checking the airflow into the fan-intake openings in the rear panel of the mainframe.

If neither of the above steps result in correction of the problem, the mainframe is faulty. Refer to the mainframe service manual for further troubleshooting and repair information.

Mainframe CURRENT Indicator is Lit

The CURRENT indicator lights when a module in the mainframe is drawing too much current.

1. Remove one module from the mainframe.
2. Cycle the power.
   a. If the CURRENT indicator is no longer lit, the module is faulty. Verify this by replacing the module in the mainframe and seeing if the CURRENT indicator lights again. Refer to the appropriate service manual for repair information.
   b. If the CURRENT indicator is still lit, that particular module is not faulty. Repeat steps 1 and 2 until the faulty module is identified.
3. If the CURRENT indicator is still lit, when **all** of the modules have been removed from the mainframe, the mainframe is faulty.

Using the HP-MSIB Troubleshooting Utility

The HP-MSIB troubleshooting utility is a firmware routine of the display instrument. It allows you to verify that an element can communicate on the HP-MSIB. By determining which elements can communicate, you can isolate the HP-MSIB problem. However, if the problem is in the mainframe or the display, the utility cannot determine which is faulty.

Preparing to Use the Utility

To use the utility, you must know the HP-MSIB addresses of the elements. It is recommended that you keep a written list of all HP-MSIB addresses.

Note The address map may not function if there is an HP-MSIB problem. After an HP-MSIB problem occurs, the address map cannot be relied upon to determine the address of the elements.

If you do not know the HP-MSIB addresses, they can be identified by checking the switch settings on each module. The HP-MSIB addresses can also be deduced from the response of the troubleshooting utility, and the addressing rules given in the "HP-MSIB/HP-IB Addressing" section of this chapter.

Note The HP-MSIB troubleshooting utility inhibits normal operation of the system. Using the utility may put the system in a state from which you can only recover by cycling power.

Module Self-Test

During module self-test, which occurs each time the instrument is turned on, the LEDs will blink on momentarily as the instrument activates and checks the module. If the LEDs continue to blink, or remain lit, this is an indication of a problem.

Status ACT

The ACT LED turns on when:

1. The module is performing a function directed by manual control of the display keyboard.
2. The instrument is in self-test mode.

Status ERR

The module error indicator, the **ERR** LED, indicates when the module is in an error condition.

The **ERR** LED flashes at a 1 Hz rate when communication over HP-MSIB is not satisfactorily completed.

Note

It is possible that a module may disrupt all HP-MSIB communication without its own error indicator flashing.

Status indicator problems can be isolated by substituting master, mainframe, or modules. Since there are no operator adjustments or repairs, problems should be referred to qualified technical personnel.

Hardware Warning Errors

These error codes report the status of the HP 70703A hardware. An error indicates that some of the hardware is not functioning properly. Measurement accuracy may be impaired.

Hardware errors are listed for information only. The HP 70703A digitizing oscilloscope has no operator repairs or adjustment. Repairs should only be attempted by qualified technical personnel.

Power-Up Failure

If the HP 70703A digitizing oscilloscope fails its power-up self-check routines, a catastrophic failure has occurred.

A possible cause is the corruption of the calibration data stored in non-volatile memory. This is typically due to a damaged circuit or defective battery. If this is the case, perform the following procedure.

1. Turn the mainframe LINE switch to OFF, then remove the module from the mainframe.
2. Set the service switch to "1" (the hex-coded rotary switch which is on the right-hand side of the module when looking at it from the front).
3. Set the calibration data protection switches to NO WRITE PROTECTED (A and B both set to "1").
4. Reinsert the module into the mainframe, then turn the LINE switch to ON.

   The module should power up in its factory default setting. If it does not, the module requires service.

5. Once the module powers up, turn the mainframe LINE switch OFF, remove the module, set the service switch to "0" and the calibration data protection switches to the desired value (suggested A to "1" and B to "1" for the remainder of this procedure).
6. Reinsert the module into the mainframe, then turn the LINE switch to ON.

   If the module does not power up, or powers up with a `Cal menu checksum error` or `Default cal factors loaded` advisory message, the module requires service because the non-volatile memory is not retaining its contents.
7. If the power-up is successful, recalibrate the instrument.

System Replaceable Parts

Tables of system-level part numbers and ordering information are included in this section.

The replaceable parts table in this section lists system-level replacement parts, cable assemblies, and service accessories by part number.

Ordering Information

To order a part listed in the replaceable parts list, contact the nearest Hewlett-Packard Sales or Service Office and provide the following information:

- Hewlett-Packard part number and quantity required
- Check digit (CD) of each part, if available
- Name and address for delivery and billing

Parts that are not listed in the replaceable parts list may be ordered by contacting the nearest Hewlett-Packard sales or service office and providing the following information:

- Element or mainframe model number that needs the replacement part (such as HP 70703A oscilloscope)
- Element or mainframe serial number
- Description, function, and quantity of each part required
- Name and address for delivery and billing

Direct Mail-Order System

Hewlett-Packard can supply parts through direct mail order within the United States. Advantages of using this method are listed below:

- Direct ordering and shipments from the HP Parts Center in Mountain View, California
- No maximum or minimum requirements exist on any mail order
- Prepaid transportation fee (although there is a small handling charge for each order)
- No invoices—a check or money order must accompany each order

Mail order forms and specific ordering information are available through your local Hewlett-Packard Sales and Service Office.

Table 6-3. Replacement Parts

HP Part Number	CD	Description
		Miscellaneous System-Level Parts
2110-0703	7	Fuse, 6.3 A, 250 V
5061-9006	9	Panel-Mainframe Front Blank 1/8 module width
70001-40017	7	Filter-Mainframe Air
70001-60059	9	Cabinet Interconnecting Kit (Mainframe to Mainframe)
5061-9061	6	Cabinet Interconnecting Kit (Mainframe to HP 70206A)
1420-0315	3	Battery for HP 70205A and HP 70206A, 3.60V 1.7 AH
70001-60066	8	Isolation-Transformer Assembly for HP 70001A Mainframe and HP 70206A Graphics Display (400 Hz operation)
5061-9678	1	Rack Flange Kit (to mount HP 70001A/70206A without handles)
5062-3979	5	Rack Flange Kit (to mount HP 70004A without handles)
5062-4072	1	Rack Flange Kit (to mount HP 70001A/70206A with handles)
5062-4073	2	Rack Flange Kit (to mount HP 70004A with handles)
5062-0781	1	Rack Mount with Slides for HP 70001A Mainframe
5062-0782	2	Rack Mount with Slides for HP 70206A
5062-7086	3	Rack Mount with Slides for HP 70004A
		System Adapters
1494-0064	4	Adapter Kit for non-HP Racks (also included in 5062-0781)
1494-0061	1	Adapter Kit for non-HP Racks (also included in 5062-0782)
		System Interconnecting HP-MSIB Cables
		(two or more HP-MSIB cables are needed for each system)
HP 70800A	5	Cable—HP-MSIB 0.5 m
HP 70800B	6	Cable—HP-MSIB 1.0 m
HP 70800C	7	Cable—HP-MSIB 2.0 m
HP 70800D	8	Cable—HP-MSIB 6.0 m
HP 70800E	9	Cable—HP-MSIB 30 m
		System Service Accessories
70001-60013	5	Module Service Extender
8710-1307	7	8mm Hex Ball Driver—6-1/2 inch shaft
8710-1651	4	8mm Hex Ball Driver—1-3/4 inch shaft
8500-2163	0	Display Cleaner, thin-film cleaner
70206-60058	5	Display Service Kit
71000-60003	4	System Reconfiguration Cable Kit

If You Want Hewlett-Packard to Service Your Digitizing Oscilloscope

Before calling Hewlett-Packard or returning your digitizing oscilloscope for service, please read your warranty information.

In any correspondence or telephone conversations, refer to the digitizing oscilloscope by its full model number and full serial number. With this information, the Hewlett-Packard representative can determine whether your unit is still within its warranty period.

Determining Your Digitizing Oscilloscope's Serial Number

When a module is manufactured by Hewlett-Packard, it is given a unique serial number. This serial number is attached to a label on the front frame or front panel of the module. A serial number label is in two parts. (Refer to Figure 6-8.) The first part makes up the serial number prefix and consists of four digits and a letter. The second part makes up the serial number suffix and consists of the last five digits on the serial number label. The serial number prefix is the same for all identical modules; it only changes when a change in the electrical or physical functionality is made. The serial number suffix, however, changes sequentially and is different for each module.

Figure 6-8. Typical Serial Number Label

Table 6-4. Hewlett-Packard Sales and Service Offices

US FIELD OPERATIONS HEADQUARTERS
Hewlett-Packard Company
19320 Pruneridge Avenue
Cupertino, CA 95014, USA
(800) 752-0900

California
Hewlett-Packard Co.
1421 South Manhattan Ave.
Fullerton, CA 92631
(714) 999-6700

Hewlett-Packard Co.
301 E. Evelyn
Mountain View, CA 94041
(415) 694-2000

Colorado
Hewlett-Packard Co.
24 Inverness Place, East
Englewood, CO 80112
(303) 649-5000

Georgia
Hewlett-Packard Co.
2000 South Park Place
Atlanta, GA 30339
(404) 955-1500

Illinois
Hewlett-Packard Co.
5201 Tollview Drive
Rolling Meadows, IL 60008
(708) 342-2000

New Jersey
Hewlett-Packard Co.
West 120 Century Road
Paramus, NJ 07653
(201) 599-5000

Texas
Hewlett-Packard Co.
930 E. Campbell Rd.
Richardson, TX 75081
(214) 231-6101

EUROPEAN OPERATIONS HEADQUARTERS
Hewlett-Packard S.A.
150, Route du Nant-d'Avril
1217 Meyrin 2/Geneva
Switzerland
(41 22) 780.8111

France
Hewlett-Packard France
1 Avenue Du Canada
Zone D'Activite De Courtaboeuf
F-91947 Les Ulis Cedex
France
(33 1) 69 82 60 60

Germany
Hewlett-Packard GmbH
Hewlett-Packard-Strasse
61352 Bad Homburg
Germany
(+49 6172) 16-0

Great Britain
Hewlett-Packard Ltd.
Eskdale Road, Winnersh Triangle
Wokingham, Berkshire RG11 5DZ
England
(44 734) 696622

INTERCON OPERATIONS HEADQUARTERS
Hewlett-Packard Company
3495 Deer Creek Rd.
Palo Alto, California 94304-1316
(415) 857-5027

Australia
Hewlett-Packard Australia Ltd.
31-41 Joseph Street (P.O. Box 221)
Blackburn, Victoria 3130
(61 3) 895-2895

Canada
Hewlett-Packard (Canada) Ltd.
17500 South Service Road
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
Canada
(514) 697-4232

Japan
Yokogawa-Hewlett-Packard Ltd.
1-27-15 Yabe, Sagamihara
Kanagawa 229, Japan
(81 427) 59-1311

China
China Hewlett-Packard, Co.
38 Bei San Huan X1 Road
Shuang Yu Shu
Hai Dian District
Beijing, China
(86 1) 256-6888

Singapore
Hewlett-Packard Singapore
Pte. Ltd.
Alexandra P.O. Box 87
Singapore 9115
(65) 271-9444

Taiwan
Hewlett-Packard Taiwan
8th Floor, H-P Building
337 Fu Hsing North Road
Taipei, Taiwan
(886 2) 712-0404

Returning Your Digitizing Oscilloscope for Service

Hewlett-Packard has sales and service offices around the world to provide complete support for your digitizing oscilloscope. To obtain servicing information or to order replacement parts, contact the nearest Hewlett-Packard sales and service office listed in Table 6-4.

Use the following procedure to return your digitizing oscilloscope to Hewlett-Packard for service:

1. Fill out a service tag (available at the end of this chapter) and attach it to the instrument. Please be as specific as possible about the nature of the problem. Send a copy of any or all of the following information:
   - any error messages that appeared on the HP 70000 Series display
   - a completed Performance Test record
   - any other specific data on the performance of the digitizing oscilloscope

CAUTION

Damage can result if the original packaging materials are not used. Packaging materials should be anti-static and should cushion the digitizing oscilloscope on all sides.

Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the instrument or prevent it from moving in the shipping container. Styrene pellets can also cause equipment damage by generating static electricity or by lodging in fan motors.

2. Place the digitizing oscilloscope in its original packaging materials. (Refer to Figure 6-9.) If the original packaging materials are not available, you can contact a Hewlett-Packard sales and service office to obtain information on packaging materials or you may use an alternative packing material referred to as "bubble-pack". One of the companies that makes bubble-pack is Sealed Air Corportation of Commerce, California, 90001.
3. Surround the digitizing oscilloscope with at least 3 to 4 inches of its original packing material or bubble-pack to prevent the digitizing oscilloscope from moving in its shipping container.
4. Place the digitizing oscilloscope, after wrapping it with packing material, in its original shipping container or a strong shipping container that is made of double-walled corrugated cardboard with 159 kg (350 lb) bursting strength.

   The shipping container must be both large enough and strong enough to accommodate your digitizing oscilloscope and allow at least 3 to 4 inches on all sides for packing material.
5. Seal the shipping container securely with strong nylon adhesive tape.
6. Mark the shipping container "FRAGILE, HANDLE WITH CARE" to help ensure careful handling.
7. Retain copies of all shipping papers.

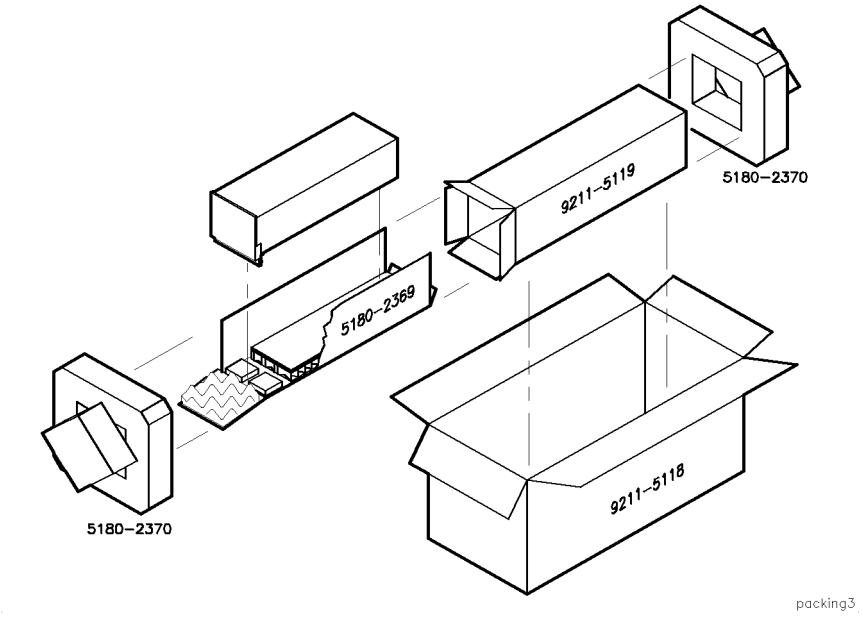


Figure 6-9.

Table 6-5. Packaging for a 2/8 Module

Item	Description	HP Part Number	Qty
1	Carton-outer	9211-5118	1
2	Carton-inner	9211-5119	1
3	Carton-sliders	5180-2369	1
4	Foam inserts	4208-0493	1
5	Foam pads	5180-2370	2

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