Table of Contents

General Information

Manuals

Four manuals are included with the LeCroy 7200A Modular Oscilloscope System:

- *LeCroy 7200 Series Modular Oscilloscope System Operator's Manual* explains front-panel operation.
- *LeCroy 7200 Series Modular Oscilloscope System Programmer's Manual* explains programming protocol for controlling the 7200 Series from a host computer. Remote command descriptions for the 7200 Series and 7242/34 Series plug-ins are also included.
- *Getting Started with the LeCroy 7200 Modular Oscilloscope System and 7242/34 Series Plug-in Modules* helps a new user to quickly operate the instrument.

NEW ■ *LeCroy 7200 Series Technical Reference Manual, explaining the Pulse Parameters for the 7200 Series Oscilloscope.*

Note ***All Controls and Operation for the 7200 and 7200A Modular Oscilloscope Mainframes are the same except for the following:***

Time of Flight processing functions	p. 3-74
Persistence setup Screen	p. 3-99
1.44 MByte Floppy Format	p. 3-122
Trace Annotation Setup	p. 3-123
Display Options Setup	p. 3-125
Display Options	p 3-128

Using This Manual

This operator's manual contains installation and operating instructions for the 7200A Modular Oscilloscope System:

Section 1: Product Description	Overviews the 7200A's major features. It also contains a simple block diagram.
Section 2: Installation	Describes the proper operating environment, setup procedures, and plug-in installation.

Section 3:	**Operation**	Introduces concepts which are fundamental to operating the 7200A. Then, "Using Front Panel Controls" details manual operation. The remainder of the section explains how to use setup screens to configure controls.
Section 4:	**7200 Series Plug-in Operation**	Explains the Operation and Control of all 7200 Series Plug-in modules.

Warranty

LeCroy warrants operation under normal use for a period of two years from the date of shipment. Replacement parts and repairs are warranted for 90 days. Accessory products not manufactured by LeCroy are covered by the original equipment manufacturers' warranties. LeCroy provides software code error corrections at no charge.

USA

EAST

LeCroy Corporation
690 Chestnut Ridge Road
Chestnut Ridge, New York 10977-6449
TEL: (914) 578-6091
FAX: (914) 578-5999

FARWEST

LeCroy Corporation
5912 Stoneridge Mall Road, Suite 150
Pleasanton, California 94566
TEL: (415) 463-2600
FAX: (415) 463-9179

SOUTHWEST

LeCroy Corporation
14800 Central Avenue, S.E.
Albuquerque, New Mexico 87123
TEL: (505) 293-8100
FAX: (505) 293-9617

CANADA

LeCroy Canada Inc.
2751 Jacques Cartier est
Suite 200
Longueuil, PQ, J4N IL7
TEL: 514.928.4707
FAX: 514.928.0969

EUROPE

WEST GERMANY

LeCroy GmbH
Postfach 10-37-67
Manheimer Str. 177
D-6900 Heidelberg
West Germany
TEL: 011.49.6221.831001
FAX: 011.49.6221.834655

FRANCE

LeCroy SARL
B.P. 214
Avenue du Parana
F-91941 Les Ulis Cedex
France
TEL: 011.33.16.907.3897
FAX: 011.33.16.907.4042

SWITZERLAND

LeCroy SA
2, CheminPre-de-la-Fontaine
P.O. Box 341
CH-1217 Meyrin 1 Geneva,
Switzerland
TEL: 011.41.22.719.21.11

LeCroy SA
Bahnhofstrasse 18
CH - 5600 Lenzburg
Switzerland
TEL: 011.41.64.519.181
FAX: 011.41.64.519.192

ENGLAND

LeCroy LTD
28 Blacklands Way
Abingdon Business Park
Abingdon, Oxon OX14 1DY
Great Britain
TEL: 011.44.23.553.31.14
FAX: 011.44.23.552.87.96

ITALY

LeCroy S.r.l.
Via Roccaporena 58
I-00191 Roma
Italy
TEL: 011.39.6.33.13.146
FAX: 011.39.6.327.92.21

LeCroy S.r.l.
Via Pinturricchio, 9
I - 20133 Milano
Italy
TEL: 011.39.220.47.082
FAX: 011.39.220.47.026

JAPAN

LeCroy OS
Esaka Sansho Bldg - 3rd Floor
16-3, 3-Chome
Tarumicho, Suita City
Osaka 564 Japan
TEL: 011.816.330.0961
FAX: 011.816.330.8096

LeCroy TK
Zaiken Bldg 6th Floor
Sasazuka, Shibuya-ku
Tokyo 151 Japan
TEL: 011.813.3376-9400
FAX: 011.813.3376.9587

BENELUX

LeCroy BV
Waalreseweg 17
NL-5554 HA Valkenswaard
The Netherlands
TEL: 011.31.4902.8.9285
FAX: 011.31.4902.42628

In exercising this warranty, LeCroy will repair or, at its option, replace any product returned to the factory or an authorized service facility within the warranty period only if the warrantor's examination discloses that the product is defective due to workmanship or materials and the defect has not been caused by misuse, neglect, accident, or abnormal conditions or operations.

The purchaser is responsible for transportation and insurance charges. LeCroy will return all in-warranty products with transportation prepaid.

This warranty is in lieu of all other warranties, express or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. LeCroy Corporation shall not be liable for any special, incidental, or consequential damages, whether in contract, or otherwise.

Product Assistance

LeCroy Corporation will gladly answer your questions. Write or call your regional field service office (see next page) or Test & Measurement Division, 700 Chestnut Ridge Road, Chestnut Ridge, New York 10977-6499. TEL: (914) 425-2000, ext. 6011.

Maintenance Agreements

LeCroy offers a choice of customer support services to meet your individual needs. Annual software maintenance contracts, ensures your 7200A always features the latest processing enhancements and extensions. Extended warranty maintenance agreements let you budget maintenance costs after the initial warranty has expired. Other services such as installation, training, calibration, enhancements and on-site repair are available through specific Supplemental Support Agreements. Contact your regional field service office for details:

Service Procedure

Refer any servicing requiring removal of exterior enclosure panels to qualified LeCroy service personnel. Be prepared to describe the problem in detail.

> ***WARNING: Do not remove chassis panels. Removing the exterior covers exposes parts which could cause electric shock.***

If the product is under warranty, LeCroy will, at its option, repair or replace the 7200A at no charge. For repairs after the warranty period, the customer must provide a Purchase Order

Number before the service engineer can initiate repairs. The customer will be billed for the parts, labor, and shipping.

Shipping Guidelines

First, attach a tag to the instrument which indicates:

Purchase Order Number
Owner's name and complete address
The service required including detailed operational problems
Person to contact for confirmation (include phone number)

Ship the unit in its original packaging. If not possible, provide a 275 lb. strength double wall corrugated cardboard box with inside dimensions at least eight inches greater than the instrument dimensions. The extra space will provide adequate room for cushioning.

Protect the finish by carefully wrapping the unit in polyethylene sheeting.

Place adequate dunnage or urethane foam in the container (approximately 4 inch depth) and place the wrapped unit on it. Allow approximately four inches of space on all four sides and the top of the unit.

Fasten the container with packaging tape and/or industrial staples. Address the container to LeCroy's service location and include your return address.

Safety Precautions

This manual describes how to maintain the LeCroy 7200 Series Precision Digital Oscilloscope. For ease of reference, this equipment is referred to as the 7200 Mainframe throughout this manual.

The general Safety precautions listed below must be followed during all phases of operation and service of the LeCroy 7200 Series Precision Digital Oscolloscope. These warnings and other specific safety notices may be repeated elsewhere in this manual. LeCroy Corporation assumes no liability for the operator who fails to comply with these precautions.

AC POWER SOURCE

This product is designed to operate from an AC power source that will supply not more than 250 volts rms, between the two supply conductors (line and neutral), or between either supply conductor and ground.

PROPER GROUNDING

The 7200A is a Safety Class 1 instrument. This means that the instrument enclosure is connected to protective earth ground through the three-conductor power supply cord, and properly grounded AC power outlet. This protective grounding minimizes shock hazard and is essential for safe operation. Any interruption of the protective earth connection will cause a potential shock hazard, as all accessible conductive parts, (even knobs and controls which may appear to be non-conductive) may render an electric shock.

FUSES

To avoid fire hazard, use only fuses of the same type, current rating, and voltage rating, as specifically called out in this manual.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the 7200A in an atmosphere of explosive gases of flammable gases.

DO NOT REMOVE COVERS OR PANELS

To avoid personal injury, the operator should not remove the protective covers, or attempt internal servicing or adjustment of any kind. Refer this servicing to qualified LeCroy service personnel. Do not operate this instrument with any protective panels or covers removed.

DEFINITION OF TERMS

In Manuals: CAUTION statement, signifies conditions or practices which may result in damage to EQUIPMENT or PROPERTY. This differs from the

WARNING statement, which signifies a condition or pratice which could result in PERSONAL INJURY or LOSS OF LIFE.

When these terms are encountered in the text, the reader should not proceed further until the specific notice is fully understood.

On Equipment: CAUTION statement, indicates a personal injury hazard which is not immediately accessible to the person reading the marking. it may also signify a hazard to the equipment or property.

DANGER statement, signifies a personal injury hazard which is immediately accessible to the person reading the marking.

SAFETY SYMBOLS

As marked on equipment:

DANGER - Hazardous voltages

Protective ground (earth) terminal

ATTENTION - refer to the manual

Section 1: Product Description

The LeCroy 7200A Precision Digital Oscilloscope offers high accuracy waveform measurement and analysis with full IEEE-488 (GPIB) and RS-232-C support. Using different plug-ins, you can customize waveform acquisition parameters to match a specific application. These parameters include sample rate, resolution, bandwidth, triggering, waveform memory, and number of channels.

Key Features of the 7200A Precision Digital Oscilloscope

Modular Digitizing Plug-in

- 1 or 2 plug-ins per 7200A mainframe, with independent or slaved timebase and trigger.

Display

- High resolution color display.
- Up to 8 traces, simultaneously displayed.
- Vertical and horizontal expand and position for all traces.
- Hardcopy to plotters, dot matrix printers, laser printers and floppy disk (compatible with desktop publishing systems).

Manual, Remote, and Automatic Control

- Familiar analog controls for timebase, sensitivity, offset, etc.
- On-line HELP for all controls.
- Autosetup to set the trigger, gain, offset, and timebase to display a repetitive input signal.
- Full remote control from IEEE-488 (conforming to IEEE-488.2) and RS-232-C.
- Program mode for automated measurement sequences and test applications.

Waveform Measurements

- 14 basic waveform parameters on any trace.
- Up to 20 waveform parameters (choose from more than 70) on any combination of 8 traces.
- Any parameter on any trace available from remote control or Program mode.
- Simple vertical and horizontal measurements using cursors.

ESD Precaution

The 7200 Mainframe contains electrostatic discharge (ESD) sensitive devices. For this reason, it is necessary to work on the 7200 Mainframe in an environment that minimizes exposure of the circuit board assemblies and components to conditions that could be destructive. Servicing of the 7200 Mainframe and its ancillary devices requires an awareness of the potentially destructive effects of ESD. Depending upon the relative humidity of the maintenance shop, seemingly simple and unrealted acts such as walking across vinyl floor or picking up an ordinary polyethylene bag from a workbench can generate thousands of volts of electricity. If proper grounding practices are not used, accidental contact with one of the CMOS devices on a circuit can result in its destruction.

The maintenance shop must be free of sources of static electricity. This means that neither the 7200 mainframe nor any of its acillary devices should be disassembled on a work surface of melamine or finished wood unless a properly grounded electrostatic mat is underneath.

A work chair padded with urethane foan can generate 18 thousand volts of static electricity if humidity is low. Chairs of finished wood, vinyl, and fiberglass should not be used and metal work chairs may be used only if properly grounded.

Personell should not wear common clean room smocks, non-conductive shoes, or garments made of any material other than virgin cotton.

Common plastic bags, wraps, envelopes, bubble pack, foam, trays, tote boxes, vials, and parts bins should not be in the shop. All board assemblies should be placed in ESD-protective bags immediatley upon removal and all new boards should not be removed from their ESD-protective bags until immedialtely before installation.

In addition, common spray cleaners, solder suckers, and soldering irons should not be used. Brushes with synthetic bristles should not be used for solvent cleaning, e.g., removal of rosin residue from circuit board assemblies.

Heat guns and blowers are potential sources of static electricity and all cleaning and drying operations are potential sources as well.

Increased ESD awareness has four major effects:

- All electronic components are assumed to be ESD-sensitive
- Sensitive components are not touched unless a properly grounded wrist strap is worn
- Sensitive components are transported, stored, and handled only in ESD-free environments
- ESD-sensitive components are tested only in a static-free environment

As a general approach to servicing the 7200 Mainframe and its ancillary devices, do the following:

1. Disconnect power from the 7200 Mainframe except when required for voltage checks and adjustments.
2. Be sure the multimeter is properly grounded before checking power supply output levels.
3. Wear a properly grounded wrisy strap or touch the properly grounded 7200 Mainframe before removing any board, the hard disk drive, or the floppy drive.
4. Wear a properly grounded wrist strap to remove any board from a plug-in
5. Ground the ESD-protective package containing replacement devices before opening to dissipate its static charge.
6. Remove ESD-sensitive devices from their packaging immediately before installation. Avoid touching other parts, connections, and circuitry.
7. Use only anti-static spray for troubleshooting.

Plug-in Module Installation and Removal

Installation

CAUTION: *Plug-in modules should not be installed with 7200 Mainframe power on.*

To install a plug-in module, use the following procedure:

a.) Align groove on bottom of plug-in module (Figure 1) with guide on bottom of plug-in compartment of 7200 mainframe.

b.) Slide plug-in module into compartment until latched in place.

Removal

CAUTION: *Plug-in modules should not be removes with 7200 Mainframe power on.*

To remove a plug-in module, use the following procedure:

a.) At bottom front of plug-in module, pull latch to release, then slide out of compartment

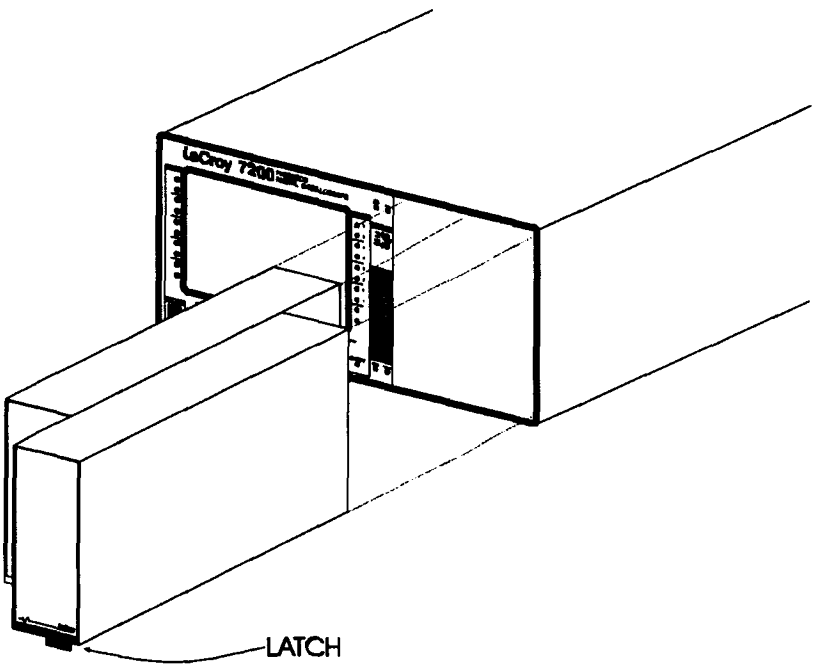


Figure 1

Waveform Processing

- Extensive processing possible for each of 8 traces including addition, subtraction, multiplication, division, differentiation, integration, smoothing, averaging, FFT, square, square-root, log, histograming, trending, etc.
- Engineering units used for all processing.

Data Storage and Portability

- MS-DOS® compatible 3.5" floppy for waveform storage and portability.
- 8 non-volatile memories available for individual waveform storage.
- Store and recall front-panel setups to internal or floppy disk.
- Optional external hard drive available for increased security

Software Support

- Updates via floppy disk.
- Future plug-in drivers supplied on floppy disk without firmware updates.

The LeCroy 7200A Precision Digital Oscilloscope provides high accuracy waveform measurement, analysis, and built-in mass storage with full IEEE-488 (GPIB) and RS-232-C support. Its modular architecture accepts plug-ins with integral digitizers and recording memories.
Different plug-ins allow you to customize acquisition parameters, such as sample rate, bandwidth, and number of channels, to match specific applications. Because each plug-in contains its own digitizing circuitry, you can add channels without losing performance. The system is truly integrated, permitting cable-free synchronization of timebases and triggers between plug-ins.

The 7200A can perform extensive waveform processing and measurements, either manually, automatically, or under remote control. Waveform processing includes addition, subtraction, multiplication, division, differentiation, integration, smoothing, averaging, FFT, square, square-root, log,histogram, trend, etc.

Using custom digital signal processing circuitry, the 7200A rapidly analyzes large waveforms to produce accurate waveform parameters based on the IEEE standard for pulse characterization. A comprehensive set of automatic waveform parameters is provided. Custom parameters can be added (contact LeCroy).

A built-in hard disk and 3.5" MS-DOS® floppy disk drive provide mass storage and data portability. Waveforms, front-panel setups, and user Programs can be stored on either disk. In Record Traces mode, thousands of waveforms can be stored at high speed to the hard disk for later recall, analysis, or processing. The hard disk also contains the operating system and the comprehensive on-line HELP manual. The MS-DOS® floppy disk provides convenient data portability and long-term storage. Software upgrades and new plug-in drivers are handled economically by using floppies rather than by changing firmware.

The 7200A supports a wide variety of hardcopy devices, using GPIB, RS-232-C, and parallel (Centronics®) communication standards. It also supports HPGL output to floppy for integrating graphic output with a desktop publishing system.

Another powerful feature of the 7200A is its ability to execute user programs, making it ideally suited for automated test applications. Programs are closely tied to the 7200A's remote control syntax with simple control-flow structures. The "Learn" mode records a sequence of front-panel keystrokes as a program, providing the basis for automating measurements. Offline editing on a PC can produce more powerful programs involving looping and decision making for sophisticated automatic tests.

The 7200A's extensive waveform processing and measurement capabilities, coupled with decision making, make it a complete stand-alone automatic test system for producing answers, not just data.

Block Diagram

The Central Processor co-ordinates the activities of the other units. Commands are received from the front-panel subsystem, which constantly monitors all the front-panel keys and knobs, or from a host computer. Alternately, the Central Processor can execute a previously saved sequence of commands, interpreting and directing them to the appropriate subsystem to perform tasks. All control settings are saved in non-volatile memory. The front panel control setup can also be saved on the internal disk or the floppy diskette.

The Central Processor also oversees data acquisition. The Master Timebase Reference synchronizes data acquisition between plug-ins. When acquisition completes, the Central Processor receives the data and performs any requested waveform processing and automatic measurements. Some processing can also be done in the plug-in itself. The results can be sent to the display, floppy diskette, and the I/O port. If Record Traces is enabled, the data can also be stored on the internal disk for later review.

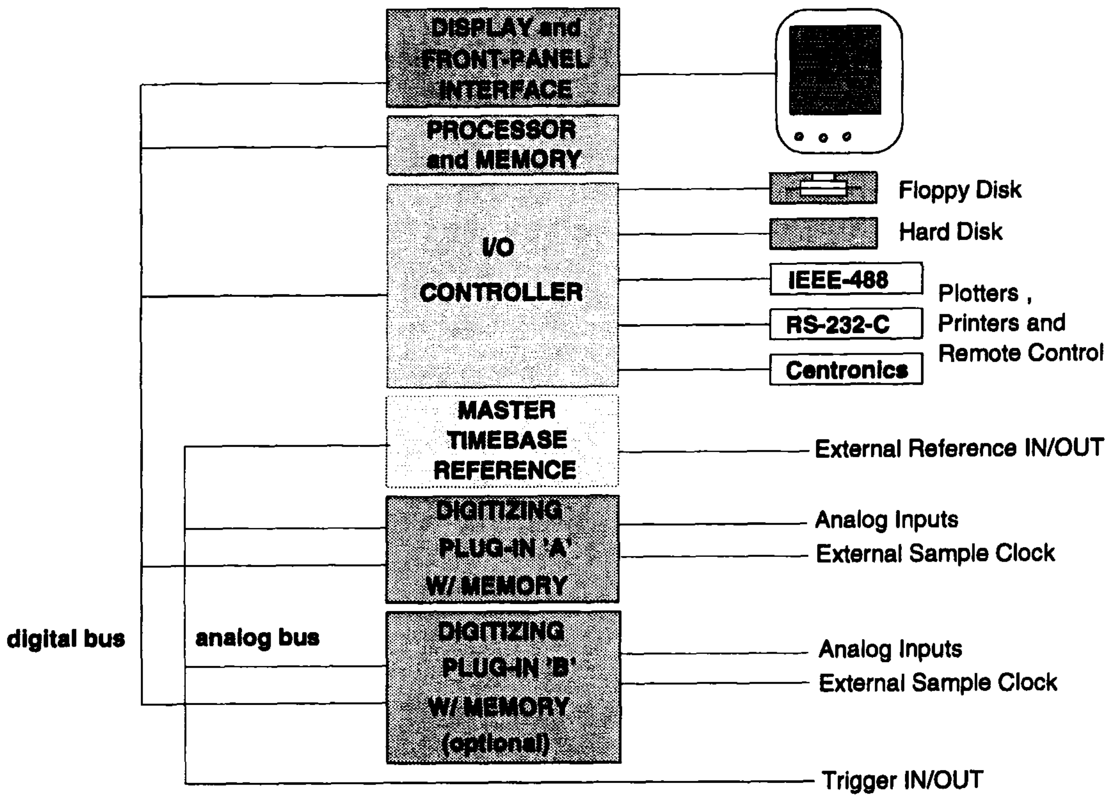


Figure 1.1: 7200A Block Diagram

Section 2: Installation

The 7200A runs over the full line voltage range of 90 Volt to 250 Volt AC rms and source frequencies of 47 to 63 Hertz.

The 7200A is shipped with the fuse drawer and fuses most common to its destination already installed in the line cord connector (rear panel).

Attach Line Cord

The AC input receptacle (CEE-22 style) located in the line cord connector (rear panel) has three recessed male pins which accept the detachable line cord. To obtain an AC line cord other than the one supplied, please contact the factory.

Operate in Proper Environment

WARNING: *To avoid explosion, do not operate the 7200A in an atmosphere of explosive gases.*

To ensure proper operation and long instrument life, the 7200A should be operated within the following environmental conditions:

Temperature

Ambient air temperatures between 0° to +40° C. Storage temperatures can range between –40 to +75 C.

Ventilation

The Model 7200A is cooled by air drawn from the bottom front and exhausted through the rear. Operate the instrument on a hard flat surface, or carpeting of very low pile. Allow at least one half inch clearance under the bottom and 2" behind the rear fans and along the side panels.

Grounding

Ensure a good ground. The Model 7200A is a Safety Class 1 instrument. Its exposed metal chassis is directly connected to earth via the power supply cord.

WARNING: *To avoid possible shock hazard, ground the 7200A chassis by connecting the power supply cord to an earth grounded AC power receptacle. Do not make any connections to the instrument's input or output terminals until the 7200A is properly grounded.*

Apply Power

CAUTION: *Use correct power source. The Model 7200A is designed to operate from a single-phase power source. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 250 Volts AC rms.*

To supply power to the 7200A, set its rear panel ON/OFF switch to the ON (I) position.

Selecting the Computer Port

CAUTION: *Before connecting external equipment to the 7200A, set its front panel power switch to the OFF (O) position.*

The 7200A provides three interfaces: the General Purpose Interface Bus (GPIB), an RS-232-C Serial Port, and a Centronics Port. The GPIB and RS-232-C ports can be used to connect the 7200A to a host computer or to connect to a printer or plotter for hardcopy output. The Centronics port is used for hardcopy output only. The advantage of GPIB is high transmission rates. The advantage of RS-232-C is that it is a lower cost interface which can generally be used over longer distances. If the 7200A will be used in conjunction with a host computer, set the "Remote Control from" field in the Communications screen to either GPIB or RS232.

CAUTION*: If the same port is selected for both Remote Control and Hardcopy, when the hardcopy key is pressed, no plot is produced and only the User Request (URQ) bit in the Standard Event Status register (*ESR) is set. This is so the Remote Controller can synchronously initiate the hardcopy remotely once all the connected devices are properly set up. If a Remote Controller is not used, then the "Remote Control from" field in the Communications Setup screen must be set to a port that is different from the Hardcopy Port in order to enable the hardcopy key.*

Setting the GPIB Address

The GPIB address is set in the Communications Setup screen. From the Main Screen, press the Configure System softkey to display the Configure System setup screen. Then press the Communication Setup softkey to display the Communications Setup screen. Move the box onto the "Remote Contol from" field and select GPIB. Then move the box onto the "GPIB Address" field and select an address from 0 to 30. Note that these controls are preserved in battery backed up memory and are NOT reset by pressing the Default Settings softkey.

GPIB Host and Hardcopy Operation

The 7200A can communicate across GPIB as a talker or a listener with a remote host controller to receive remote commands/queries and send responses. Alternately, it can operate over GPIB with a controller as a Talk Only device. The use of each of these modes is described below.

Remote Control Operation over GPIB

The 7200A enters Talk/Listen mode when the "Remote Control from" field in the Communications Setup screen is set to GPIB. In this mode, the 7200A can both receive commands and setups from the remote host computer and send data and measurement results.

Plotting/Printing over GPIB with a Controller

If the HARDCOPY command is sent to the 7200A when in this mode, the 7200A will wait to be addressed to talk before sending the hardcopy data. The host computer then has three options in generating the hardcopy:

1) The host computer may read the data into internal memory and then send the data to a printer/plotter. This is exactly the same as reading a query response.

2) The host computer may send the "HARDCOPY" remote command and then address the printer/plotter to listen and the 7200A to talk and read the data from the 7200A. As the data is read into the computer's internal memory, it is also printed/plotted to the printer/plotter which is a Listener.

3) The host computer may send the "HARDCOPY" remote command and then address the printer/plotter to listen, the 7200A to talk, and the controller to go into stand-by mode waiting for EOI. Alternatively, the Data Processing Status Register (DPR) could be programmed to issue an SRQ when hardcopy is complete so that the host computer can perform other tasks while the hardcopy is performed.

If the local HARDCOPY key is pressed when both the Remote Control port and the Hardcopy port are set to GPIB, then a hardcopy is not generated. This is so the hardcopy data does not disrupt controller activity on the GPIB bus. Instead, pressing the HARDCOPY key sets the User Request (URQ) bit in the Standard Event Status register (*ESR). The Remote Controller can monitor this bit and when it is set, it can initiate the hardcopy remotely in one of the three ways discussed previously.

Printing /Plotting over GPIB without a Controller

To output hardcopy data over GPIB, the "Hardcopy Port" field in the Hardcopy screen must be set to GPIB and the Remote Control port must be RS-232-C. Talk Only is a special GPIB mode where there is no controller allowed on the bus; the 7200A is the only talker and all connected devices must be listeners (ie., printers/plotters must be in Listen Only mode).

Note: *Since some printers/plotters do not properly enter Listen Only mode, the 7200A will address the device at address 30 to listen before sending the hardcopy data. If your GPIB printer/plotter does not work with the 7200A, set its GPIB address to 30 and the 7200A will force it to listen.*

GPIB Interconnection

The devices on the GPIB network can be connected in any combination of star or linear arrangements. Standard IEEE 488.2 cables must be used to connect all the devices and total length must not exceed 20 meters. Attach the 7200A's rear panel connector to the network using the cable provided with the 7200A.

The devices must conform to these rules:

- At least half of the devices on the network must be turned on.
- One network can connect no more than 15 devices (including the controller).
- One device must be connected for every two meters of cable, assuming one device represents one standard device load. The 7200A's GPIB connector is located on its rear panel.
- Each device must have a unique bus address.

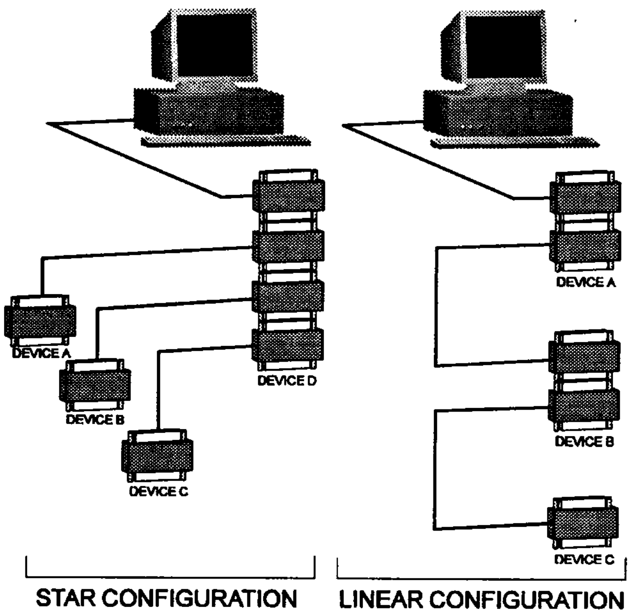


Figure 2.1: Examples of GPIB Network Arrangements

Connect the Printer / Plotter

When operating in Talker Only mode, set the GPIB printer/plotter to Listen Only, and the 7200A to Talk only.

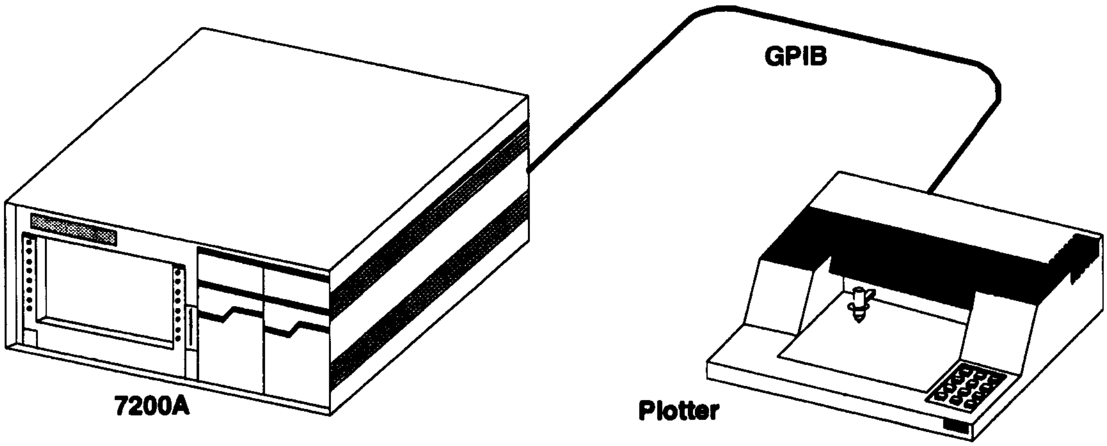


Figure 2.2: Talk Only mode GPIB output

When operating in Talk/Listen mode, a GPIB controller is required. The controller directs the 7200A to output data to the printer or plotter.

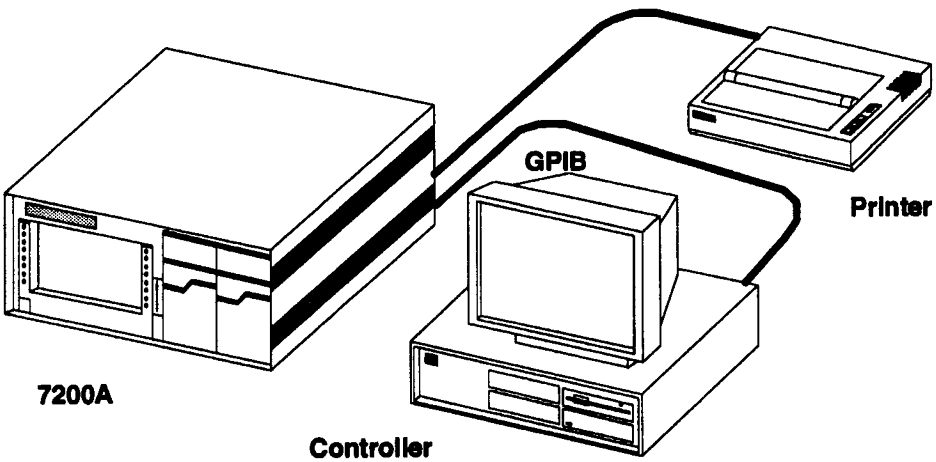


Figure 2.3: Talk/Listen mode GPIB output

RS-232-C Configuration

Setup the Serial Port

The 7200A contains a 9-pin, male RS-232-C connector for serial communication with a printer, terminal, or computer. To connect an RS-232-C line to the 7200A, use a female DB9-D connector. If the computer has a DB25-D connector, use a DB9-D to DB25-D cable adapter. It is recommended that you use CTS and RTS handshaking which guarantees that data passed between a remote computer and the 7200A will not overrun the 7200A or the computer's RS-232-C buffer.

Select the desired settings for the interface using the Communications Setup screen:

1. From the Main Screen, press the Configure System softkey to display the Configure System setup screen.
2. Then press the Communication Setup softkey to display the Communications Setup screen. (See Communications Setup, p. 3-131, for details.)

RS-232-C Host Interconnection

Although the RS-232-C standard defines signal lines and electrical characteristics, it does not define mechanical characteristics. The 7200A RS-232-C output port is configured as an RS-232-C "Data Terminal Equipment" so that data is sent from pin 2 and received on pin 3. For remote operation, the RS-232-C port must be connected to a computer terminal.
The following diagrams are used for various host drivers.

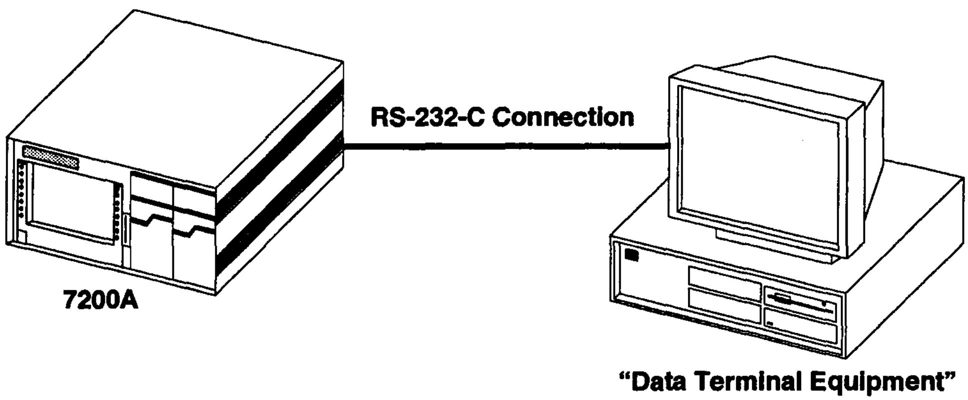
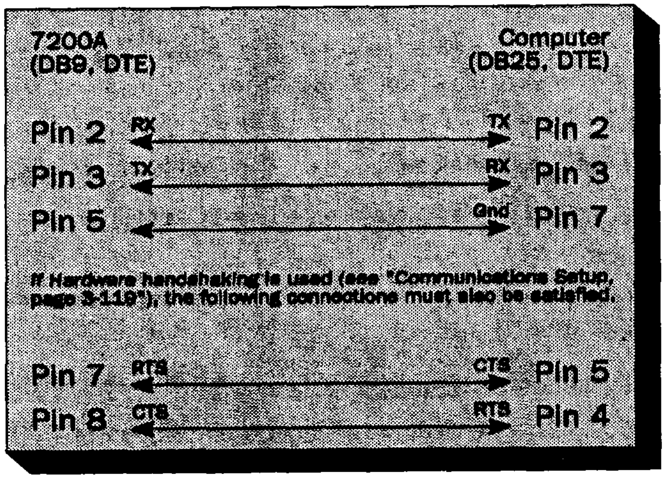


Figure 2.4: RS-232-C Connection to an IBM-PC Host

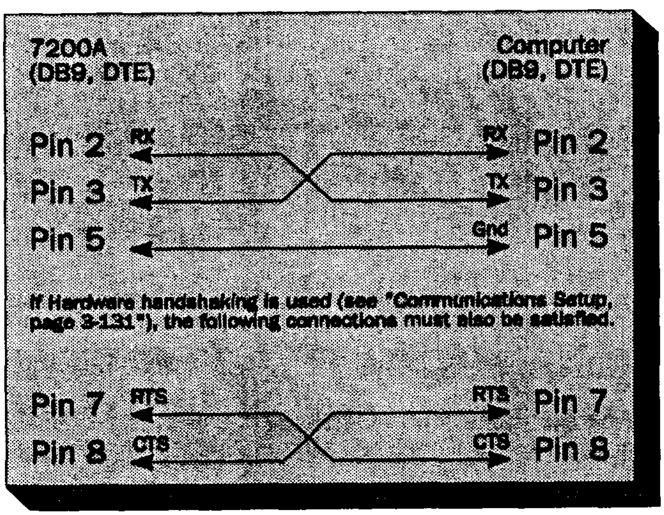
DB9 to DB25 Wiring

This wiring configuration is used for IBM-PCs and compatibles with DB25-D connectors configured as Data Terminal Equipment. Note that for XON-XOFF communication protocol, only pins 2, 3, and 5 on the DB9-D connector are needed. Also, commercially available DB9-to-DB25 adapter cables for the IBM-PC swap pins 2 and 3 and pins 7 and 8.



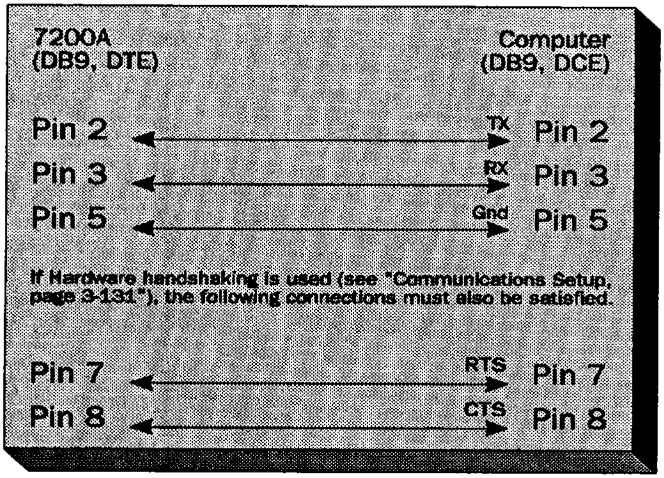
DB9 to DB9 Wiring

For IBM PC-AT types with DB9-D connectors configured as Data Terminal Equipment.



DTE to DCE Wiring

For non-IBM types with DB9-D connectors configured as Data Communications Equipment.



RS-232-C Interconnections for Hardcopy

When connecting an RS-232-C serial printer/plotter to the 7200A, the printer/plotter configuration must match the 7200A RS-232-C port settings. To modify the 7200A's settings, use the Communications Setup screen (see page 3-131).

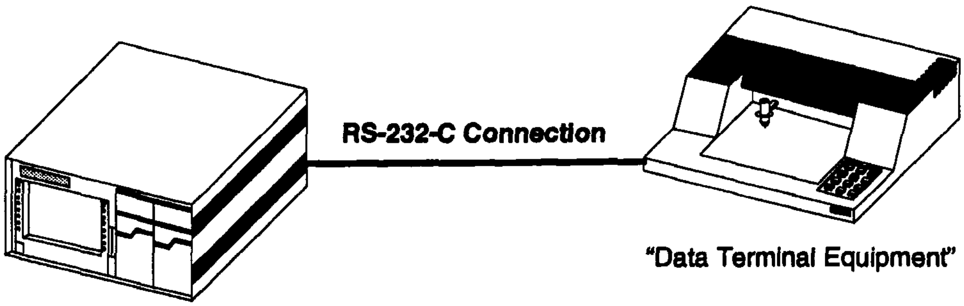
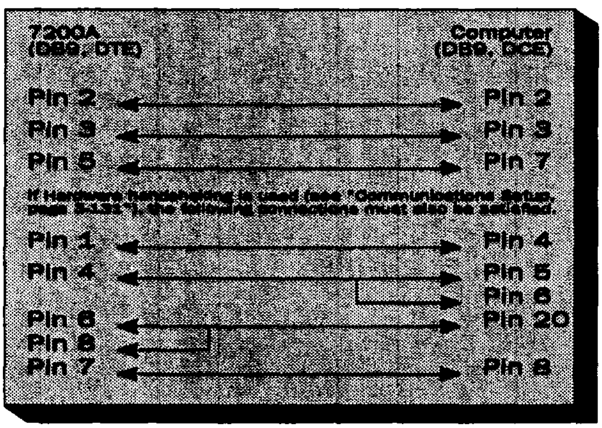


Figure 2.5: RS-232-C Connection to an RS-232-C Serial Plotter

DB9 to DB25 Wiring

NOTE: The 7200A RS-232-C interface is a DB9-D connector. Use an adapter cable to connect to an RS-232-C DB25-D connector.



Parallel-Centronics Wiring

The 7200A uses a standard DB25-D female connector as the Centronics parallel output port. An adaptor cable is required to adapt the 7200A DB25-D connector to the standard 36-pin bail lock connector used on most Centronics printers.

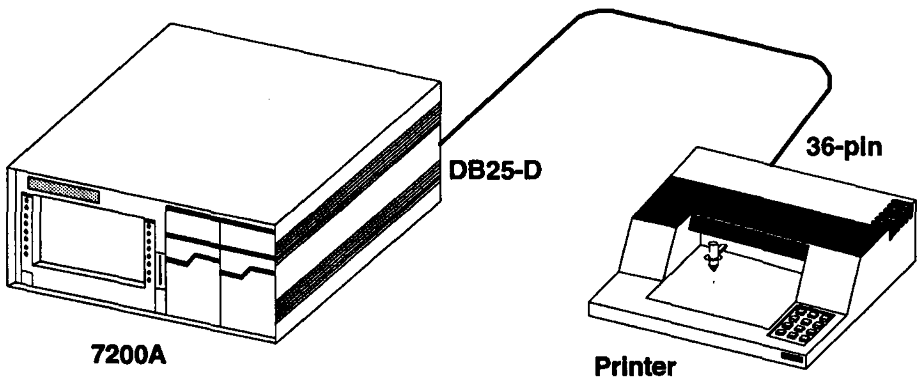


Figure 2.6: Output to Centronics type Printer/Plotter

Install the Plug-in(s)

The plug-in manual contains instructions for operating the front panel controls. Plug-in functions controlled by the 7200A mainframe front panel are detailed in Section 3 of this manual.

CAUTION: ***Do not install or remove a plug-in while the 7200A mainframe is powered on.***

To install, align the plug-in's bottom grooves with the guides at the bottom of the mainframe's plug-in compartment. Next, slide in the plug-in until it latches into place. Move the latch on the 7200 Series plug-in until it is flush with the plug-in body. Remove the plug-in by pulling out its latch and sliding it out.

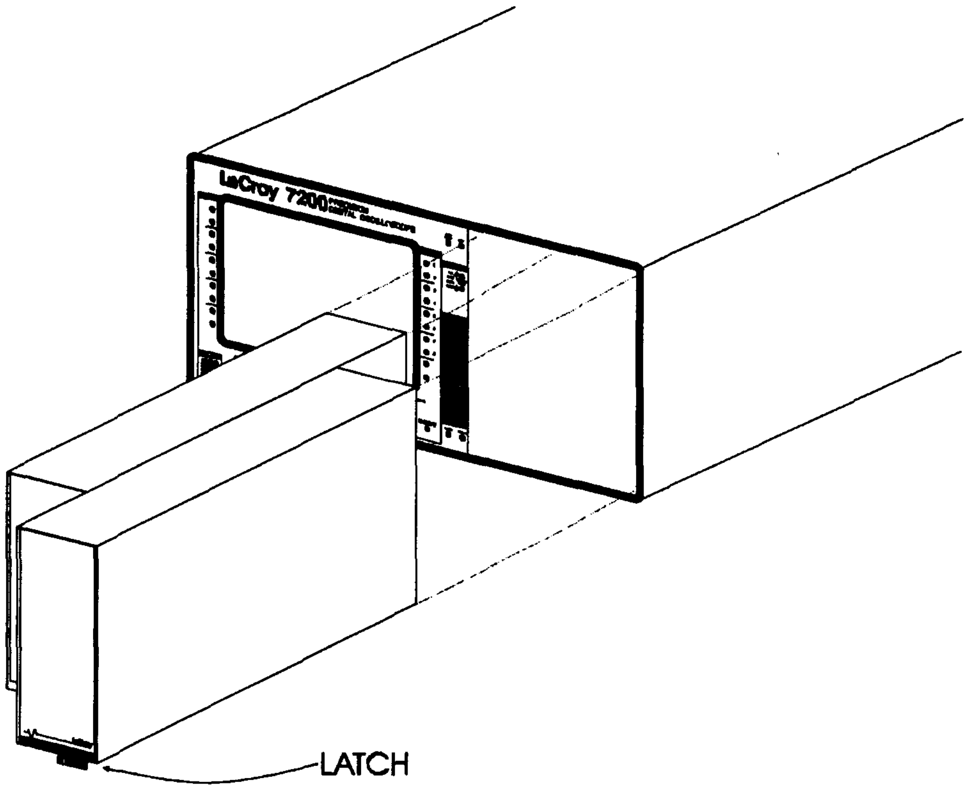


Figure 2.7: Plug-in Installation

Section 3: Operation

Section 3 first introduces concepts which are fundamental to operating the 7200A. Next, "Using Front Panel Controls" details manual operation. The remainder of the section explains how to use the setup screens to configure controls.

Overview

Controls

The 7200A's controls are keys, softkeys, and knobs.

Keys have front panel labels (upper case) which identify their functions.

Softkeys have screen labels (initial capitals) which identify their functions. The softkeys are arranged vertically to the left and right of the screen. Softkey labels change to suit specific operations.

All **knobs** have front panel labels (upper case) which identify their functions except the outer and inner knobs beneath the center of the screen. Labels on the screen indicate their current functions. See Figure 3.1:

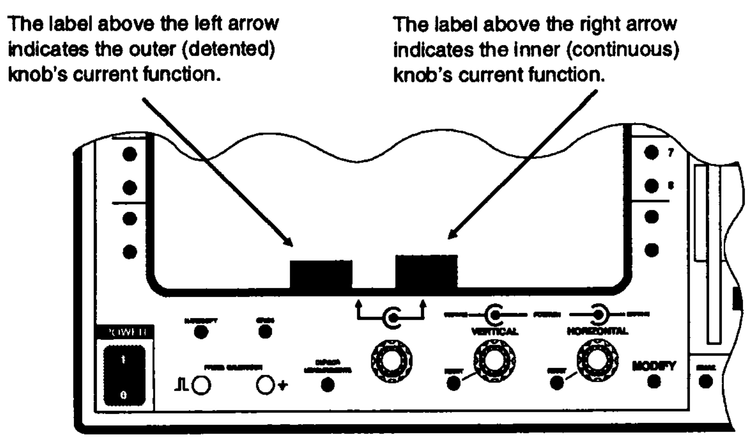


Figure 3.1: Outer and Inner knobs beneath center of screen

Plug-ins

7200 series plug-ins are complete waveform digitizers which install in the 7200A mainframe. The mainframe displays their waveforms. Each plug-in contains its own timebase, memory, and trigger capabilities. Alternatively, the 7200A allows you to lock the timebase and/or trigger sections of all the plug-ins.

Different plug-in types may have different numbers of channels. Data from each acquisition channel is labelled according to the position of the plug-in used to acquire the data, and the position of the input connector on the plug-in's front panel.

The plug-in slot in the mainframe closest to the screen is slot A. Slot B is located to the right of A. For any plug-in occupying slot A, the uppermost left connector is channel A1. The next lower connector is channel A2, and so on.

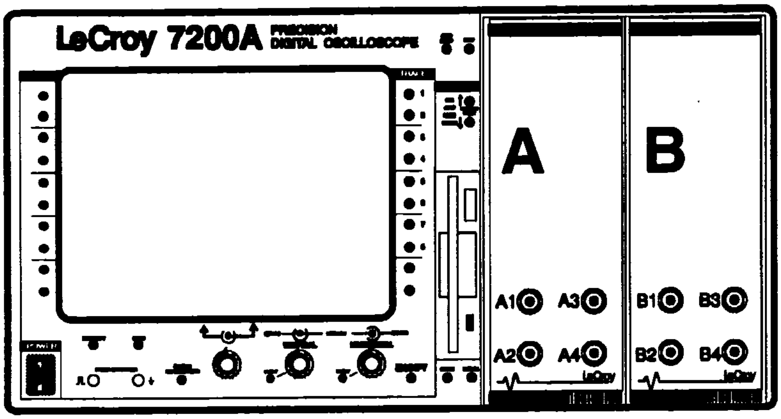


Figure 3.2: Plug-in slots and channel identification

The 7200A has 8 internal non-volatile memories, designated M1...M8, available for individual waveform storage.

Traces

Displayed waveforms are called traces. The 7200A has 8 traces, designated T1...T8. Each trace can represent unprocessed acquired data from any channel, or can be the result of processing channel data, other traces, or waveforms stored in memories. Each trace is defined by a mathematical equation called the trace equation which specifies the source(s) of data and the processing, if any, performed on the data. See page 3-56, "Setting Up Traces and Processing Functions," for more details.

Main Screen

The Main Screen is used for routine signal acquisition, display, and analysis. From 1 to 8 traces can be displayed at once on 1, 2, 4, or 8 grids. Each trace can be vertically and horizontally expanded and repositioned.

The Main Screen contains grid(s), text areas, and symbols. The text areas indicate prompts and responses, current acquisition parameters, measurement results, and status messages:

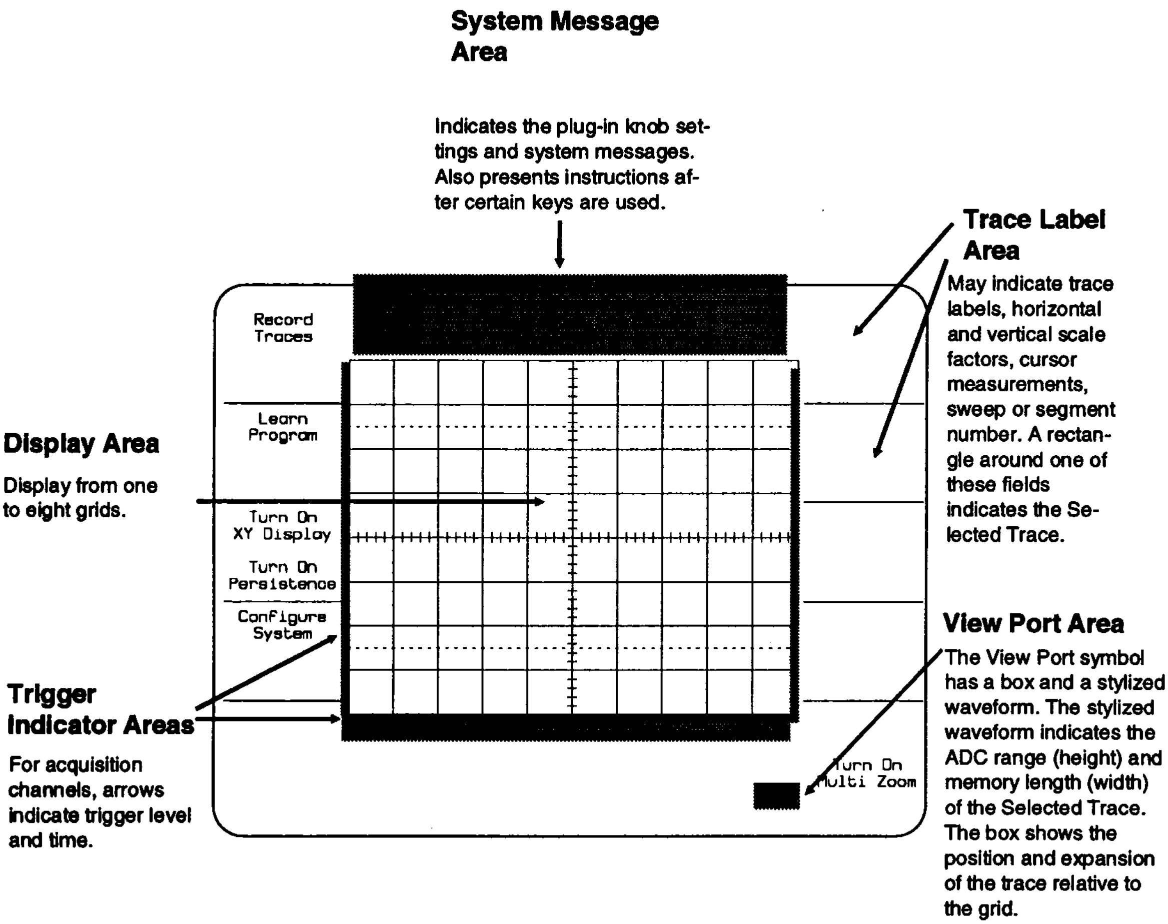


Figure 3.3: Main Screen Display Layout

Cursors

Cursors indicate either individual points or sections of the waveform being measured. The 7200A's cursor symbols are broken horizontal and vertical lines, arrows, and the crosshair. Cursors are used to make six types of measurements: Basic Parameters, Extended Parameters, Marker, Horizontal, Vertical Relative, and Vertical Absolute. Summary of Measurement Types, page 3-39, provides an overview of the measurement types and cursors. For more details, see CURSOR MEASUREMENTS, page 3-22.

When Cursor Measurements are being made, the label for the outer knob is Select Cursor. Rotating it will cycle through the different cursors, each click selecting a cursor(s) to be moved. The label for the inner knob is Move plus the cursor icon which was selected using the Select Cursor knob. The cursor icon matches the cursor(s) being displayed on the trace(s). Rotating the inner knob will move the cursor(s).

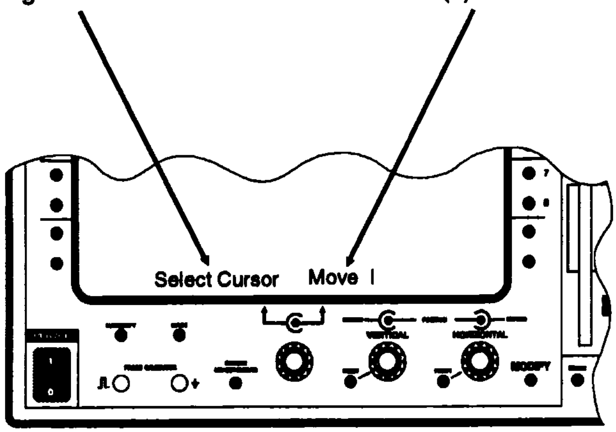


Figure 3.4: Select Cursor and Move (icon) knobs

Setup Screens

Setup Screens use softkeys and selection fields to adjust control actions. Softkeys are arranged vertically to the left and right of the screen. Their labels, appearing near them on the screen, change to match their current functions. Selection fields contain labels and their current configuration selections.The 7200A's Setup Screens are:

Trace Setup
Extended Parameter Setup
Hardcopy Setup
Acquisition Setup
Display Options Setup
Communications Setup

Waveform Storage Setup
Waveform Recall Setup
Disk Utilities
Multi Zoom Setup
Time & Date Setup
System Log

Configure System
Program Setup
Panel Settings
Persistence Setup
Display setup

To display the setup screen for a control, press the MODIFY key (beneath the lower right corner of the screen) and then press or turn the control.

> *NOTE: Adjusting a knob or pressing a key after pressing MODIFY will not affect its setting. If you press a key which does not have a setup screen, the System Message Area will display an appropriate message.*

For example, display the HARDCOPY SETUP screen by pressing MODIFY and then HARDCOPY. The major functional areas contained in the following example Hardcopy Setup screen are similar for all 7200A setup screens.

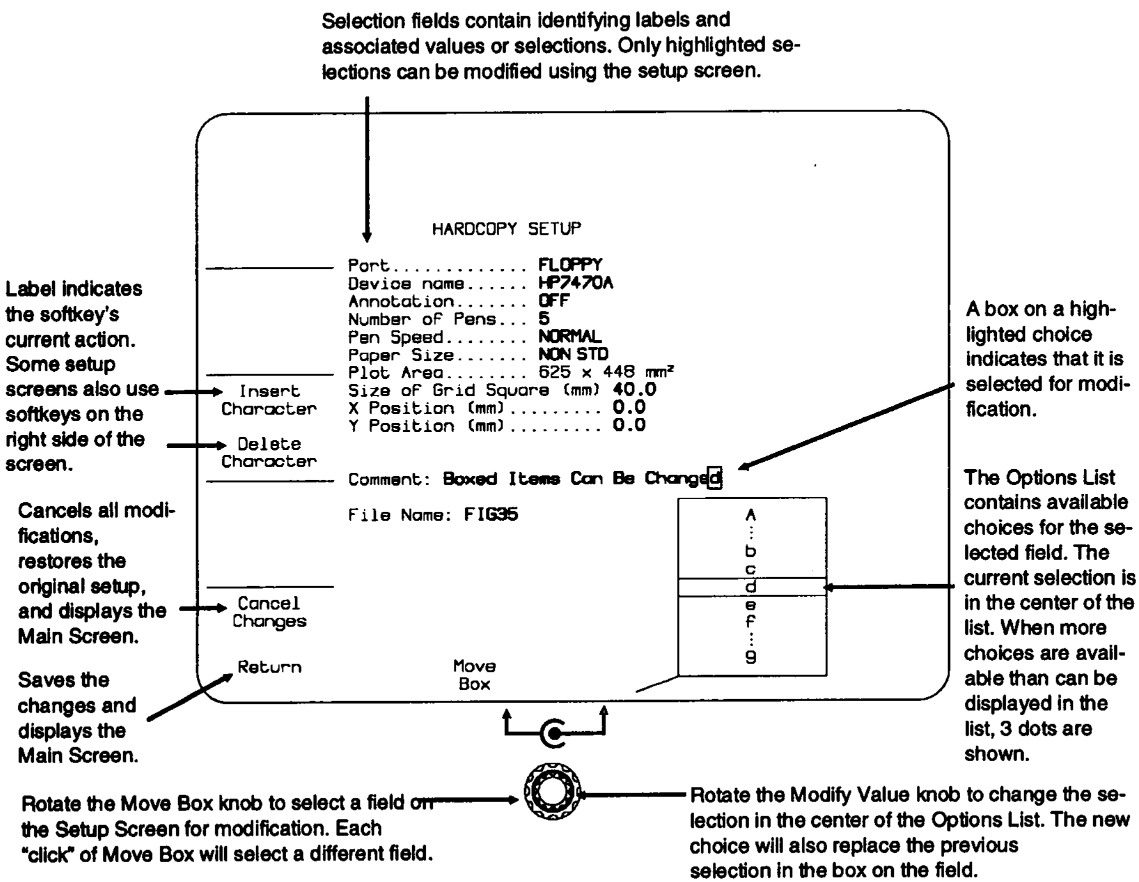


Figure 3.5: Example HARDCOPY SETUP screen

On-line HELP

On-line HELP contains information on the 7200A's keys, softkeys, knobs, and various other topics. Pressing the HELP key (above the floppy diskette drive at top of front panel) disables all control functions. The front panel keys and knobs can then be used to access the on-line HELP.

To display an explanation of any mainframe or plug-in control, press the HELP key and then press the key or turn the knob of interest.

For example, to obtain an explanation of HARDCOPY press HELP and then HARDCOPY. The screen will display the HARDCOPY section of the on-line manual. Once a section of the on-line manual is displayed, pressing another key or turning a different knob will retrieve its section of the on-line manual.

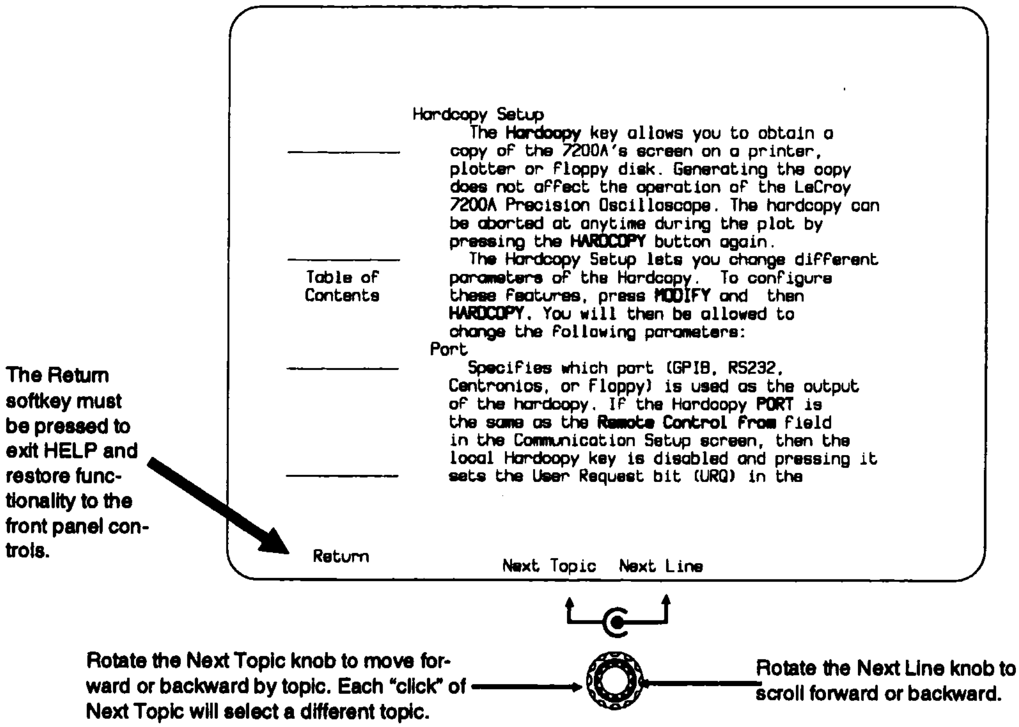


Figure 3.6: HARDCOPY HELP screen

Pressing the Table of Contents softkey will cause the 7200A to display the on-line HELP Table of Contents.

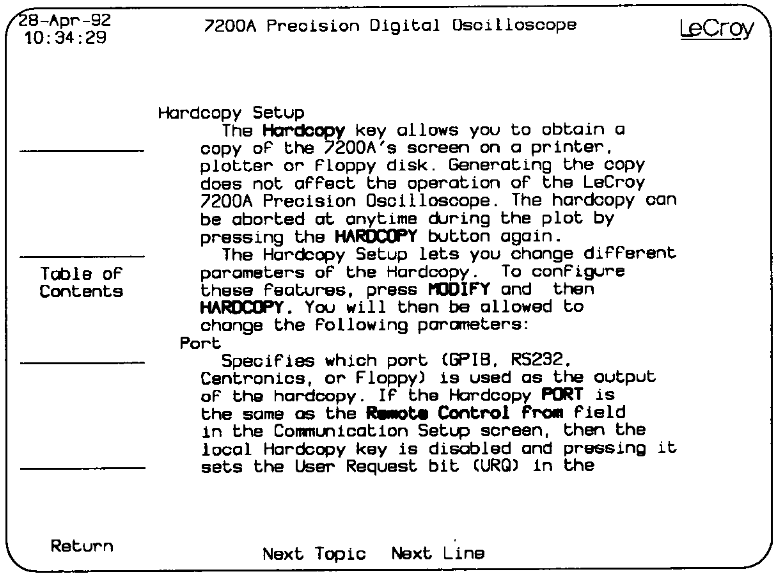


Figure 3.7: HELP Table of Contents Softkey

Once the Table of Contents is displayed, rotate the Next Line knob to select a topic by moving it into the box. In the example, General Control Philosophy is selected.

Press the Read Topic softkey to display the HELP information on the selected topic displayed.

Press the Return softkey to exit on-line HELP and display the Main Screen.

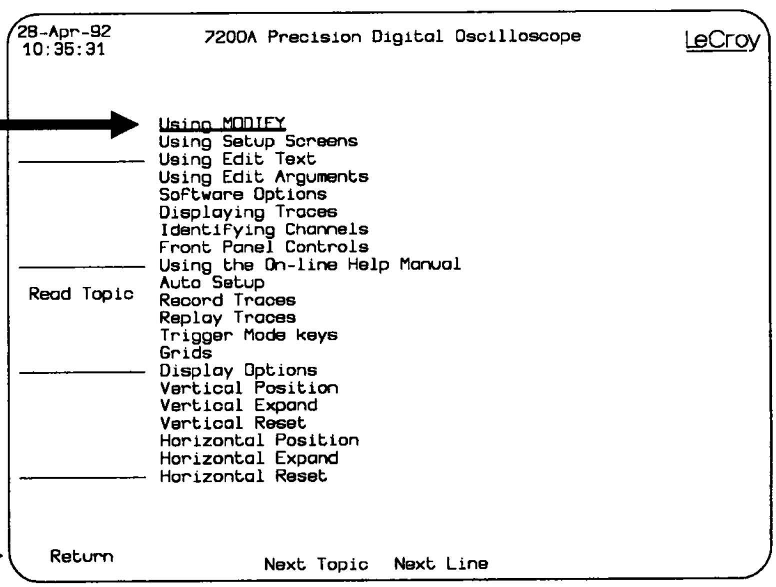


Figure 3.8: HELP Table of Contents screen

Using Front Panel Controls

The front panel controls capture the data and manipulate the display. The following summary precedes the details of manual operation:

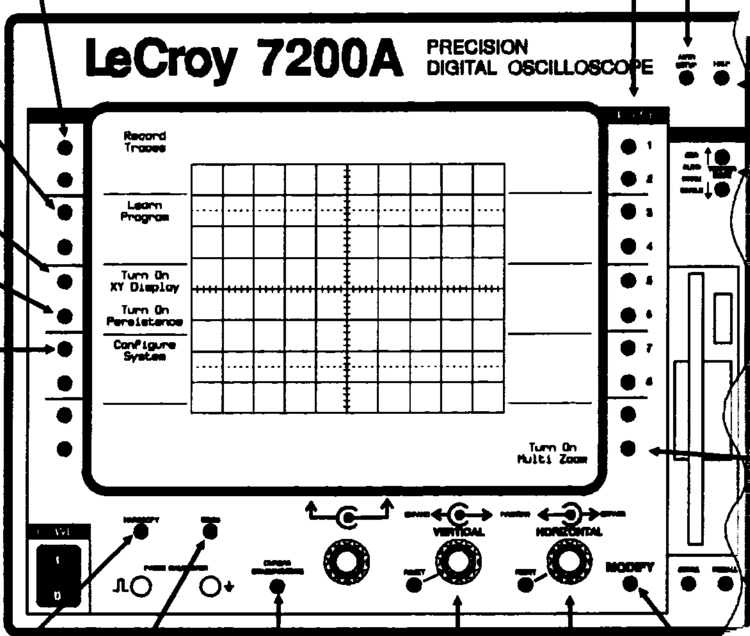


Figure 3.9: Mainframe Front Panel Control Summary

7200A Mainframe Front Panel Illustration

7200A Mainframe Front Panel

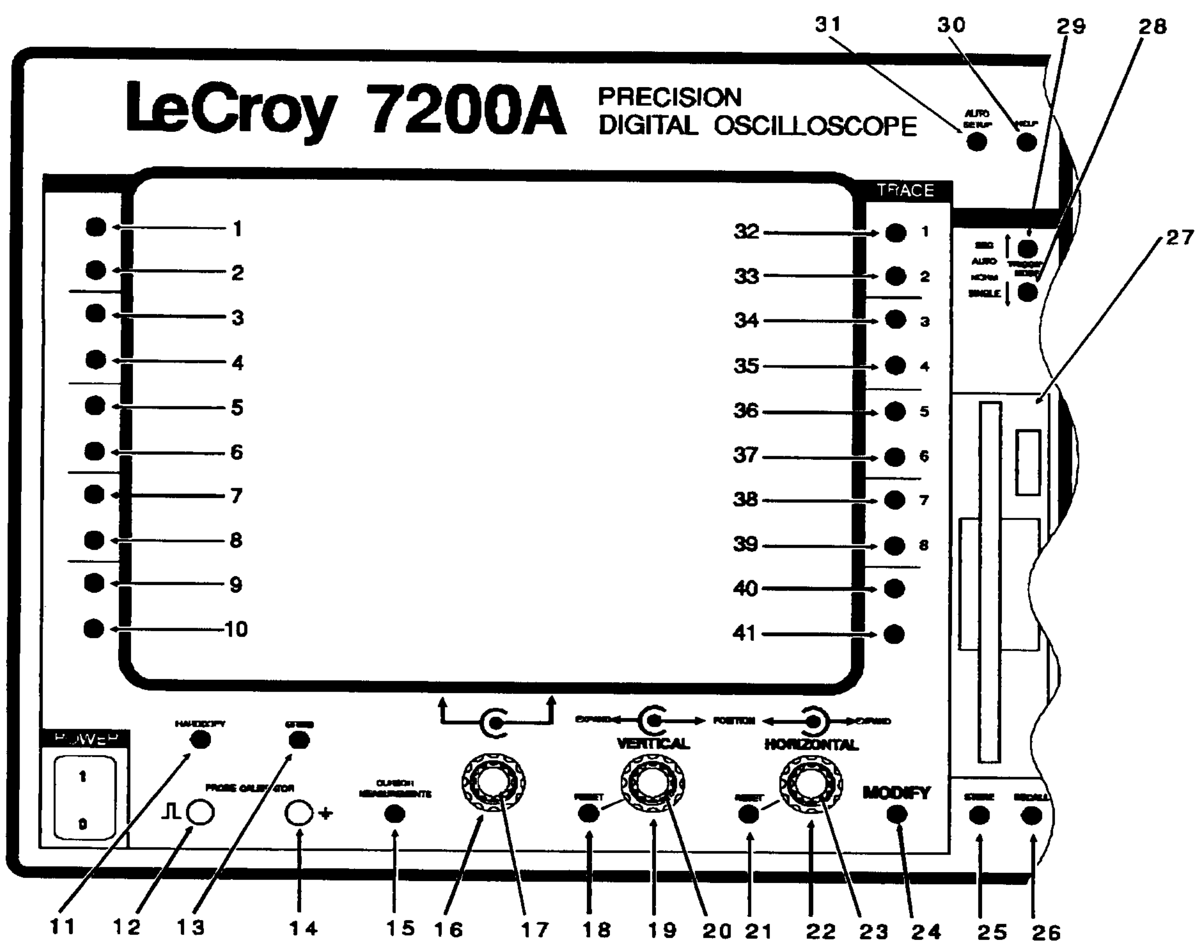


Figure 3.10: 7200A Front Panel Controls

Index to Controls

1 **Record Traces** softkey on the Main Screen, 3-46. Function will change. See Setup Screens.
2 **Softkey** function will change. See "Waveform Storage", 3-47, and setup screens.
3 **Learn Program** softkey on the Main Screen, 3-49. Function will change. See setup screens.
4 **Softkey** function will change. See "Waveform Storage", 3-49, and setup screens.
5 **Turn on XY Display** softkey on the Main Screen, 3-40. Function will change. See setup screens.
6 **Turn on Persistence** softkey on the Main Screen, 3-44. Function will change. See setup screens.
7 **Configure System** softkey on the Main Screen, 3-53. Function will change. See setup screens.
8 **Softkey** function will change. See setup screens.
9 **Softkey** function will change. See setup screens.
10 **Softkey** function will change. See setup screens.
11 **HARDCOPY** key, 3-51, 3-103
12 **PROBE CALIBRATOR** lug.
13 **GRIDS** key, 3-39
14 **GROUND LUG.**
15 **CURSOR MEASUREMENTS**
16 As **Select Cursor** knob, 3-4. As **Move Box** knob, 3-5. As **Next Topic** knob, 3-6. See setup screens.
17 As **Move Cursor** knob, 3-4. As **Modify Value** knob, 3-5. As **Next Line** knob, 3-6.See setup screens.
18 Vertical **RESET** key, 3-17.
19 Vertical **EXPAND** knob, 3-17.
20 Vertical **POSITION** knob, 3-16.
21 Horizontal **RESET** key, 3-20.
22 Horizontal **EXPAND** knob, 3-18.
23 Horizontal **POSITION** knob, 3-17.
24 **MODIFY** key, 3-11
25 **STORE** key, 3-50, 3-112.
26 **RECALL** key, 3-50, 3-115.
27 MS-DOS compatible **3.5" floppy diskette drive.**
28 Lower **TRIGGER MODE** key, 3-12.
29 Upper **TRIGGER MODE** key, 3-12.
30 **HELP** key, 3-6
31 **AUTO SETUP** key, 3-11.
32 - 39 **TRACE** keys, 3-15.
40 Clear Display softkey on the Main Screen, 3-22. Function will change. See setup screens.
41 Turn On Multi Zoom softkey on the Main Screen, 3-20. Function will change. See setup screens.

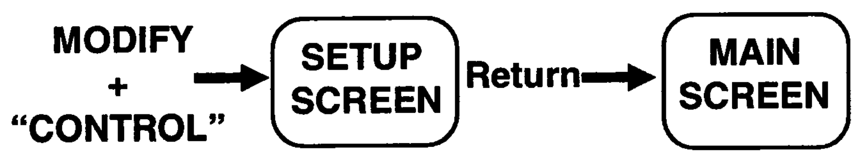
Following are descriptions of the mainframe front panel controls. The number in parentheses locates the control on the 7200A front panel drawing (Figure 3.10, page 3-10).

MODIFY (24)

The MODIFY key (beneath the lower right corner of the screen) provides access to the 7200A's setup screens. When MODIFY is pressed, PRESS KEY TO MODIFY ITS SETTINGS is displayed in the System Message Area. Pressing a key or turning a knob will then cause the control's setup screen to appear. Modifying the selection fields on the setup screen will change the control's actions.

For example, pressing MODIFY and then HARDCOPY will cause the 7200A to display the HARDCOPY SETUP screen. Modifying the HARDCOPY SETUP selection fields will change the HARDCOPY key's actions.

> ***NOTE:*** *If you press MODIFY and then select a control which does not have a setup screen, the System Message Area will display NO SETUP SCREEN FOR and the name of the control (e.g., NO SETUP SCREEN FOR GRIDS). Adjusting a control after pressing MODIFY does not change the control's setting.*



Acquisition Keys

AUTO (31) SETUP

Press this key to have the 7200A display a repetitive input signal by automatically adjusting the acquisition control settings of each plug-in for the "best" display. Pressing the key while in progress will abort AUTO SETUP. The acquisition controls may then be further adjusted if desired.

Input signals must have an amplitude between 2 mV and 8 V, frequency above 50 Hz, and a duty cycle greater than 0.1%. AUTO SETUP time depends on the signal frequency. It is generally under 20 seconds.

- The TRIGGER MODE (as described below) is set to AUTO, and timebase and trigger settings are automatically adjusted as follows:

  If AUTO SETUP is performed on a single channel that has a valid signal, the timebase and trigger controls adjust to best display the signal. If no signal or a DC signal is found, timebase for the channel is set to 10 µsec.

  If more than one channel is used by a trace(s) that is turned on, the lowest numbered channel with a valid signal is used to setup the timebase and trigger controls for all plug-in channels. If no signal or a DC signal is found, the timebase for all channels is set to 10 µsec.
- AUTO SETUP does not change the input's vertical coupling.
- Vertical settings for all channels are selected independently.

TRIGGER MODE ((28) and (29))

Selects from either Single, Normal, Auto, or Sequence trigger modes for all input channels. Trigger conditions can be independently selected on each plug-in. As these keys are pressed to step through each trigger mode, LEDs indicate the mode selected.

A READY LED on each plug-in indicates that the trigger circuit has been armed and the plug-in is currently acquiring input signals. The plug-in's TRIG'D LED is lit whenever a valid trigger has been received and waveform acquisition completed. In RIS or SEQuence mode, the TRIG'D LED is not lit until a complete waveform has been constructed after sufficient triggers have occurred.

If an acquisition key is changed while acquiring data, the acquisition stops and acquisition restarts using the new setting. If the key is changed between acquisitions, it affects the next acquisition.

NOTE: When the 7200A is in SINGLE or SEQuence mode and has finished acquiring data, changes to the plug-in acquisition settings will not affect the currently displayed trace, but will affect the acquisition of the next trace (initiated by pressing the TRIGGER MODE key to re-select the mode).

The Trigger modes operate as follows:

SINGLE

Arms the trigger circuit. When a valid trigger signal is detected, acquisition occurs and the waveform is displayed.

To arm the circuit again for another sweep, press the lower TRIGGER MODE key again to re-select SINGLE. (The READY LED is lit.) When a valid trigger is detected (TRIG'D LED lit), the acquisition completes and the new waveform then replaces the one previously displayed. This mode is useful for capturing transient events.

If TRIGGER MODE is pressed a second time prior to detecting a valid trigger, the 7200A will manually trigger all plug-ins.

When the 7200A is in the Random Interleaved Sampling (RIS) mode (as indicated by the LED on the plug-in front panel), the waveform is constructed and displayed after sufficient triggers have occurred. The 7200A must then be re-armed by pressing TRIGGER MODE again to re-select SINGLE before acquisition of the next RIS waveform begins.

NORMAL

The 7200A acquires data and updates the display for each valid trigger. The trigger circuit is automatically re-armed after each acquisition.

Select NORMAL mode by pressing either TRIGGER MODE key until the NORM LED is lit.

This mode is useful for capturing signals correlated in time with a repetitive trigger signal.

When the plug-in is in the RIS mode, as indicated by an LED on the plug-in front panel, each waveform is displayed after sufficient triggers have occurred to construct it.

AUTO

AUTO and NORMAL Trigger Modes are identical, except that in AUTO the 7200A automatically generates an internal trigger signal if a valid trigger is not detected within 100 msec during single shot mode and 200 msec in RIS mode.

This mode is useful for obtaining a trace on the screen for initial adjustment of acquisition settings. It is also used for capturing signals not having a reliable, detectable, or time-correlated trigger signal. Select AUTO mode by pressing either TRIGGER MODE key until the AUTO LED is lit.

SEQUENCE

In this trigger mode the acquisition memory is partitioned into segments as selected from within a Plug-in Status screen. Select SEQuence mode by pressing the upper TRIGGER MODE key until the SEQ LED is lit.

Each time a trigger occurs, the current segment is acquired and the trigger circuit is re-armed for acquisition of the next segment. When all segments are completed, the result is displayed. Some plug-ins will optionally average the successive segments, if desired, (see plug-in manuals for details).

There are 2 types of Sequence Triggers: Single and Normal. Sequence Trigger Types are selectable in the Acquisition Setup screen. This may be accessed either from the Configure System screen or by pressing the MODIFY key and then a TRIGGER MODE key.

Single Sequence acquires the requested number of segments and displays the sequence waveform. To arm the circuit again for another sweep, press TRIGGER MODE again to re-select Sequence.

If SEQuence Mode is selected again prior to acquiring all segments, acquisition halts and those segments which have been acquired so far are displayed. If SEQuence Mode is selected a third time, acquisition is restarted from the beginning.

Normal Sequence will keep acquiring and displaying sequence waveforms until the TRIGGER MODE key is pressed again to re-select Sequence.

In SEQuence mode the total duration of each segment is equal to the time/div x 10. Changing the number of required segments does not change the time per division; it only affects the number of data points (record length) per segment, and the time/point (sampling rate).

Waveform acquisition in this mode is particularly useful for short-lived or echoed signals, such as those in RADAR, SONAR, LIDAR and NMR.

Waveform Display and Measurement

TRACE
((32) through (39))

Turns the trace on, selects the trace, or turns the trace off. If a TRACE key is pressed while its corresponding trace is not displayed, the trace is turned on and becomes the Selected Trace. The Selected Trace is indicated by a rectangle around its trace label. If the trace is already on, pressing its TRACE key makes it the Selected Trace. If the TRACE key of the Selected Trace is pressed, the trace is turned off and the next trace becomes the Selected Trace.

While a trace is displayed, the area on the screen next to the TRACE key indicates the trace label and the horizontal and vertical scale factors for that trace (i.e., time per division and volts per division for unprocessed waveforms). The trace label indicates either: the source(s) and any processing of the trace data, or the user selected name for the trace. If cursor measurements are turned on, certain cursor values are displayed under the trace label. If the trace contains an average, extrema, histogram or trend function, the number of acquisition sweeps or parameter values accumulated is indicated. If the trace consists of a sequence waveform, the number of segments is indicated. If one segment of a sequence waveform is displayed, the segment number is indicated. When "Trace Colors" is set to 8 in the Display Setup Screen (see p. 3-128), this text is displayed in the same color that the trace is drawn for easy identification.

The following six controls affect the display of the Selected Trace, indicated by a rectangle around its trace label on the right side of the screen. These controls adjust the trace's position and magnification. As the trace is being altered, refer to the View Port which appears as a stylized waveform within a box below the lower right corner of the grid. The View Port graphically shows the trace location and expansion with respect to the display grid. The width of the stylized waveform represents the total record length of the trace; the height represents the full range of the Analog to Digital Converter (ADC). If the Selected Trace is positioned or expanded to accentuate some points and not display others, the View Port identifies the displayed section (boxed-in area) relative to the entire trace. That is, the section of the stylized waveform within the rectangle corresponds to the displayed section of the Selected Trace. Also, when a trace is expanded vertically or re-positioned, a two headed vertical arrow is positioned next to its' trace label. For horizontal expansion or position a two headed horizontal arrow is positioned next to its' trace label.

VERTICAL (20) POSITION

This knob moves the Selected Trace vertically anywhere on the screen. This allows traces to be overlaid for comparisons or separated for easy viewing. As the Selected Trace is positioned a two headed vertical arrow is positioned next to the trace label. The position knob does not affect the vertical offset of the acquisition channel(s).

The View Port shows the position of the trace relative to the grid. See Figure 3.11.

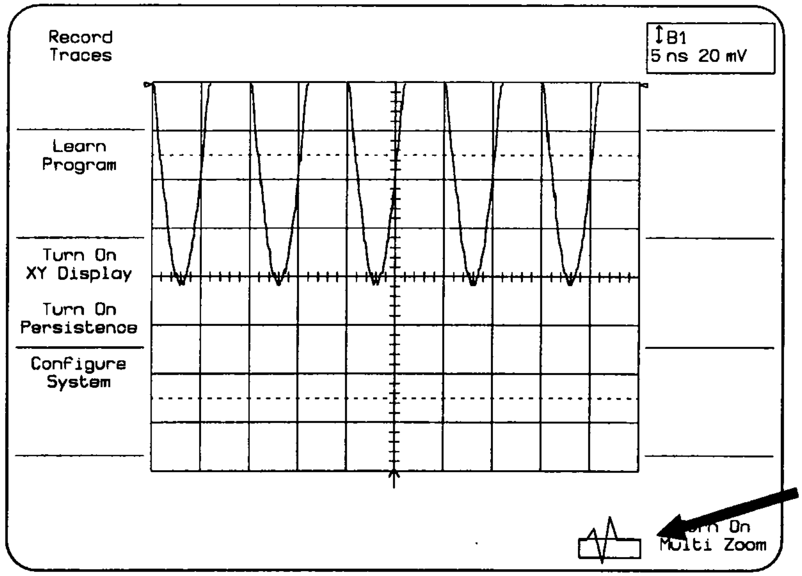


Figure 3.11: Trace Vertically repositioned. View Port indicates location of trace.

VERTICAL (19) EXPAND

This knob vertically expands the Selected Trace around the center of its home grid. As the Selected Trace is expanded, the View Port shows only a portion of the trace inside the View Port box to indicate that part of the data range is off the screen. The vertical scale factor indication under the trace label is automatically adjusted. The expansion knob does not affect the amplifier settings of the acquisition channel(s).

The waveform can be expanded or contracted vertically in steps that are multiples of one, two, and five.

VERTICAL (18) RESET

Toggles the vertical display of the Selected Trace between the selected expansion and position and the reset vertical state (unexpanded on the center of the home grid). When the Selected Trace is expanded or re-positioned, a two headed vertical arrow appears next to its' trace label.

HORIZONTAL (23) POSITION

This knob moves the Selected Trace horizontally anywhere on the screen. As the Selected Trace is positioned a two headed horizontal arrow is positioned next to the trace label. The position knob does not affect the trigger delay of the acquisition channel.

If part of the waveform is positioned off the display grid, the View Port and horizontal arrows can help determine the position of the displayed section relative to the entire trace.

If displaying one segment of a trace acquired with SEQuence Mode, rotate the knob to display other segments. When a segment boundary is reached, an extra turn of the knob is required to display the next segment. The segment number is indicated next to the trace label.

HORIZONTAL (22) EXPAND

This knob horizontally expands (i.e., magnifies) the Selected Trace around the center of the grid. As the Selected Trace is expanded, the View Port shows a shorter portion of the trace inside the View Port box to indicate that there is data which is not currently on the screen. The horizontal scale factor indication under the trace label is automatically adjusted. The expansion knob does not affect the timebase settings of the acquisition channel(s).

The waveform can be expanded or contracted horizontally in steps that are multiples of one, two, and five.

When a trace is horizontally expanded so that the number of data points is less than the number of display pixels across the screen, linear interpolation is used to connect the data points. The actual data points are displayed with greater intensity in order to distinguish them.

When displaying a trace acquired with SEQuence Mode, rotating the HORIZONTAL EXPANSION knob clockwise by one position displays a single segment of the trace. Additional rotations will expand that segment. Rotating the HORIZONTAL POSITION knob moves to the other segments. The displayed segment number is indicated next to the trace's label as shown on the next page:

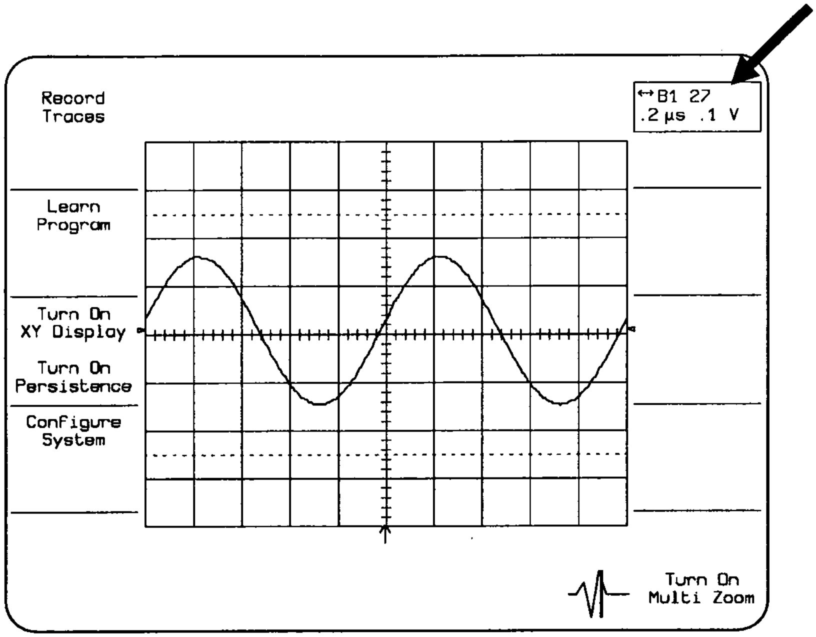


Figure 3.12: Horizontal Expansion of a segmented trace.
The twenty seventh segment is displayed.

Unlike the vertical controls, HORIZONTAL EXPANSION and POSITION actually change the number of points of the Selected Trace. Only the points displayed on the screen as selected by the HORIZONTAL EXPANSION and POSITION controls are used for processing in subsequent trace equations, for storing the trace to disk, or for remote read out. This means that if Trace 2 is defined to be Trace1 (i.e., T2=T1), horizontally expanding and repositioning Trace 1 will also horizontally expand and reposition Trace 2 the same amount. Selecting Trace 2 and changing its horizontal expansion and position (relative to Trace 1), will not affect

Trace 1. When Trace 2 is expanded, however, the corresponding area on Trace 1 is highlighted. In Figure 3.13, T2=T1. Trace 1 has a highlighted region corresponding to the expanded and repositioned Trace 2.

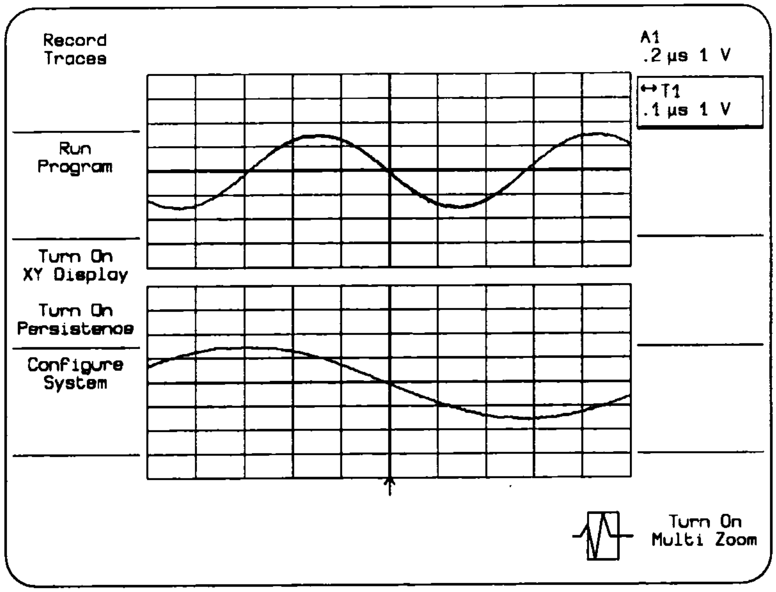


Figure 3.13: Highlighting indicates expansion

HORIZONTAL RESET **(21)**

Toggles the horizontal display of the Selected Trace between the selected expansion and position and the horizontal reset state (unexpanded in the center of the grid). When the Selected Trace is expanded or positioned, a two headed vertical arrow appears next to the trace label.

> *Note: When the trace is an expanded segment, pressing reset toggles between the unexpanded segment and its' expanded, re-positioned display. This allows easy comparison between segments. To display all of the segments, rotate the HORIZONTAL EXPAND knob.*

Turn On Multi Zoom **(41)**

Allows a group of traces to be simultaneously expanded and repositioned, horizontally and/or vertically using the six controls: HORIZONTAL EXPAND, HORIZONTAL POSITION, HORIZONTAL RESET, VERTICAL EXPAND, VERTICAL POSITION, VERTICAL RESET. See pages 3-16 to 3-20.

Use the Multi Zoom Setup Screen to assign traces to a group and to choose which axis (horizontal, vertical or both) affects the group. To display the Multi Zoom Setup Screen, press the MODIFY key and the Turn On Multi Zoom softkey or press the MODIFY key and rotate any of the expand or position keys (see Multi Zoom Setup, p 3-101).

When the selected trace is in the Multi Zoom group, all other traces in the group are indicated by a dotted box around its trace label.

Note: If a trace is added to a group and the new trace has a different expansion, the traces assigned to the group become unexpanded. Position is not affected.

When any of the traces in a group is the selected trace and a expansion or position control is changed, the control is applied to all of the traces in the group. Reset toggles the display of the group between the selected expansion and position and the reset state (unexpanded in the center of the grid). When the group is expanded or positioned, a two headed arrow appears next to the all trace labels.

Note: When a trace, which is not in the group of traces for Multi Zoom, is selected, changing an expansion control only affects that trace.

Clear Display (40)

Clears the accumulation memory used for History functions (averaging, extrema, histograms or trends) and the persistence display. Accumulation of data restarts with the next acquisition. The Clear Display softkey will appear only if a History function or persistence is used. See page 3-76 for a discussion of History Functions.

CURSOR MEASUREMENTS (15)

Turns on cursor measurements. Subsequent presses step through the measurement choices. Cursors, which are arrows, lines, or crosshairs, indicate a location or region(s) on a trace(s) to use for calculations. Six types of measurements are available:

Basic Parameters	A basic set of automatic waveform parameter calculations (frequency, peak-to-peak, mean, etc.) on the Selected Trace. The parameters are calculated for the section of the trace between two cursors.
Extended Parameters	A user-selected extended set of waveform parameters calculated on any combination of traces. The parameters are calculated for the sections of the traces between the cursors.
Horizontal Relative	The differences between the horizontal positions and corresponding vertical values of two cursors on a trace.
Vertical Relative	The difference between the vertical positions of two cursors.
Marker	The absolute horizontal position and absolute vertical value at a cursor on a trace.
Vertical Absolute	The absolute vertical value at the position of a single cursor.

To perform a measurement, first press the CURSOR MEASUREMENTS key to activate the cursors. When cursors are activated, a softkey (10) appears at the lower left corner of the screen. Its label indicates the currently selected cursor measurement. Each time the CURSOR MEASUREMENTS key is pressed, a different measurement is selected. Pressing the softkey in the lower left corner turns off cursor measurements.

There is one cursor for Marker and Vertical Absolute and two cursors for Vertical, Horizontal, and Parameter measurements. Knobs 16 and 17 under the center of the screen are used to move the cursor(s). When there is more than one cursor, rotate the outer knob (16) to select which cursor(s) to move. The icon above the inner knob (17) will change to indicate the selected cursor. Rotate the inner knob (17) to move the cursor whose icon has been selected with the outer knob. Rotating the outer knob cycles through the cursor selections: one cursor, the other cursor, both cursors together (track mode). In track mode the inner knob moves both cursors simultaneously while maintaining their separation constant.

NOTE: Horizontal Relative, Vertical Relative, Marker, and Vertical Absolute measurements cannot be made on sequence waveforms unless they are expanded to show individual segments. Basic and Extended waveform parameters on sequence waveforms are calculated on the first segment between the cursors.

Following are descriptions of the six measurement types.

Basic Parameters

In this measurement mode the 7200A calculates a set of basic waveform parameters for the Selected Trace. The Selected Trace is indicated by a rectangle around its trace label on the right side of the screen. To calculate the basic parameters on a different trace, select that trace by pressing its associated TRACE key.

A different set of basic parameters is calculated for time domain, frequency domain, and histogram traces. The parameters and their definitions are listed on the following pages.

All parameters are calculated only on the section of the trace between two cursors. If the trace is a sequence waveform, the parameters are calculated only on the first segment between the cursors (i.e., the segment in which the leftmost cursor is located). The cursors may be moved with the outer and inner knobs under the center of the screen, as described on p.3-22.

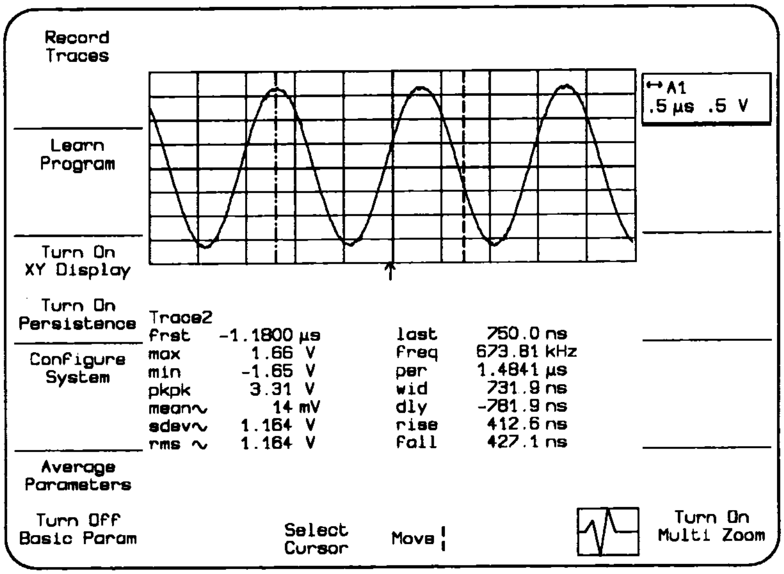


Figure 3.14: "Basic" Time Domain Waveform Parameter measurements on Trace 1

The parameters are recalculated each time the trace is updated or the cursors are moved.

The positions of the cursors can be locked together for all traces or independent on each trace. When the cursors are locked all traces use the same cursor positions. Locked cursors are represented by vertical lines extending the full height of the trace grid area. Selecting a different trace causes the basic set of parameters to be computed for the new trace but the cursors do not move.

When the cursors are unlocked each trace has its own independent cursor positions. Unlocked cursors are represented by short vertical marks which are displayed only on the Selected Trace. Selecting a different trace causes the cursors for the new trace to be displayed and the basic set of parameters to be computed for the new trace.

The cursors may be locked or unlocked by pressing the Lock/Unlock Cursors softkey in the Extended Parameter Setup screen (accessed by pressing MODIFY and then CURSOR MEASUREMENTS). See Extended Parameter Setup, p.3-89.

When Basic Parameters are enabled, the Average Parameters softkey appears. The parameter averaging feature transforms the parameter display from instantaneous values to average values.

When parameter averaging is off, the parameter values displayed are the instantaneous values for the currently displayed waveform sweep.

When parameter averaging is on, the parameter values computed for each waveform sweep are averaged with the parameter values from the previous sweep according to the following formula:

$$AVGPARAM_{sweep\ i} = [19 \cdot AVGPARAM_{i-1} + NEWPARAM_i] / 20$$

The displayed values are thus a continuous or running average of the values of successive acquisition sweeps.

To turn on parameter averaging, press the Average Parameters softkey. Its label will change to Stop Average Parameters. To turn off parameter averaging, press the Stop Average Parameters softkey.

For time domain waveforms, the 7200A computes and displays the following 14 parameters for the section of the Selected Trace between the cursors:

Parameter	Symbol	Explanation
first	**frst**	Time from trigger to first (leftmost) cursor.
maximum	**max**	Maximum value of the trace between the cursors.
minimum	**min**	Minimum value of the trace between the cursors.
peak-to peak	**pkpk**	Difference between the maximum and the minimum values.
mean	**mean**	Average or DC offset of the waveform. If the waveform is periodic, it is computed over an integral number of periods.
standard deviation	**sdev**	Square-root of sum of squares of difference from mean, divided by number of points-1. If the waveform is periodic, it is computed over an integral number of periods.
root mean square	**rms**	Square-root of sum of squares divided by number of points. If the waveform is periodic, it is computed over an integral number of periods.
last	**last**	Time from trigger to last (rightmost) cursor.
frequency	**freq**	Reciprocal of Period.
period	**per**	Time of a full cycle, averaged for all full cycles between the cursors.
width	**wid**	Width of the first pulse (either positive or negative), averaged for all similar pulses between the cursors.
delay	**dly**	Time from trigger to the midpoint of the first transition.
rise time	**rise**	Duration of the pulse waveform's rising transition from 10% to 90%, averaged for all rising transitions between the cursors.
fall time	**fall**	Duration of the pulse waveform's falling transition from 90% to 10%, averaged for all falling transitions between the cursors.

For frequency domain waveforms, the 7200A computes and displays the following 6 parameters for the section of the Selected Trace between the cursors:

first	**frst**	Frequency of the first (leftmost) vertical cursor
maximum	**max**	Maximum value of the trace between the cursors.
frequency at maximum	**xamx**	Frequency at maximum amplitude
last	**last**	Frequency of the last (rightmost) vertical cursor.
total power	**tpwr**	Area under the power density spectrum. This parameter only applies to waveforms produced by the FFTPWD function. See p.3-68.
frequency at minimum	**xamn**	Frequency at minimum amplitude

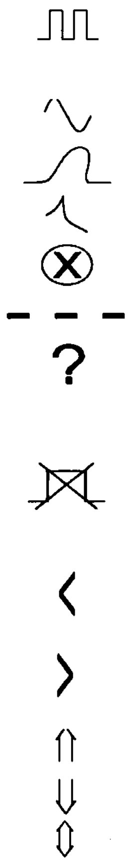
For histogram waveforms, the 7200A computes and displays the following 13 parameters for the section of the Selected Trace between the cursors:

first	**frst**	Horizontal position of first (leftmost) cursor
maximum	**max**	Horizontal coordinate of rightmost non-zero bin.
minimum	**min**	Horizontal coordinate of leftmost non-zero bin.
peak-to-peak	**pkpk**	Horizontal difference between the maximum and minimum values.
histogram standard deviation	**sdev**	Square-root of sum of squares of difference from mean, divided by number of values - 1, computed on the distribution.
histogram root mean square	**rms**	Square-root of sum of squares divided by number of values, computed on the distribution.
full width at half max	**fwhm**	The width of the distribution surrounding the mode including values which are at least 1/2 of the maximum bin population
last	**last**	Horizontal position of last (rightmost) cursor

mean	**mean**	Horizontal centroid of the distribution.
median	**medi**	Horizontal median. Horizontal value of the midpoint of the distribution.
mode	**mode**	Horizontal coordinate of the bin with maximum population.
total population	**totp**	Total population in the histogram.
maximum population	**(maxp)**	Maximum population in any histogram bin (i.e.vertical value at the mode).

A graphic symbol may appear between the parameter name and its value to indicate additional information. The symbols and their meanings appear on the next page:

To obtain basic waveform parameter measurements:



INFORMATION

Parameter has been determined for several periods (up to 10000), and the average of those values is displayed.

Parameter has been determined over an integral number of periods.

Parameter calculated on histogram

Parameter calculated on FFT waveform

Parameter does not apply to this waveform

Insufficient data to determine a parameter.

Waveform contains undefined points, displayed value is suspect

WARNINGS

Waveform cannot be classified as "pulse waveform", i.e., amplitude histogram is flat within statistical fluctuations. Minimum and maximum are used to assign base and top.

Only an upper limit could be estimated (actual value of parameter may be smaller than displayed value).

Only an lower limit could be estimated (actual value of parameter may be larger than displayed value).

Signal is partially in overflow.

Signal is partially in underflow.

Signal is partially in overflow and partially in underflow.

Figure 3.15: Waveform Parameter Interpretation

- Designate the trace to be measured as the Selected Trace by pressing its TRACE key.
- Turn on Cursor Measurements by pressing the CURSOR MEASUREMENTS key.
- Select Basic Param measurements by repeatedly pressing the CURSOR MEASUREMENTS key until Basic Param appears in the softkey label in the lower left screen.

- Use the outer and inner knobs (16 and 17) to position the cursors around the trace's section of interest.

Extended Parameters

In this measurement mode the 7200A calculates up to 20 user-selected waveform parameters on a user-selected combination of traces. This allows the same set of parameters to be calculated for several traces. Alternately, a different set of parameters may be computed for each trace.

The trace used for calculation for each parameter is indicated to the left of the parameter name. For example, as shown in Figure 3.16, "T1:rise" indicates that the rise time is computed on Trace 1.

Use the Extended Parameter Setup Screen to select parameters and to choose which trace(s) to measure. To display the Extended Parameter Setup screen, press the MODIFY key and then the CURSOR MEASUREMENTS key (see Extended Parameter Setup, p. 3-89). The Basic Parameter measurements are a subset of those available for Extended Parameters.

All parameters are calculated only on the section of the trace between two cursors. If the trace is a sequence waveform, the parameters are calculated only on the first segment between the cursors (i.e., the segment in which the leftmost cursor is located). The cursors may be moved with the outer and inner knobs under the center of the screen, as described on p.3-22.

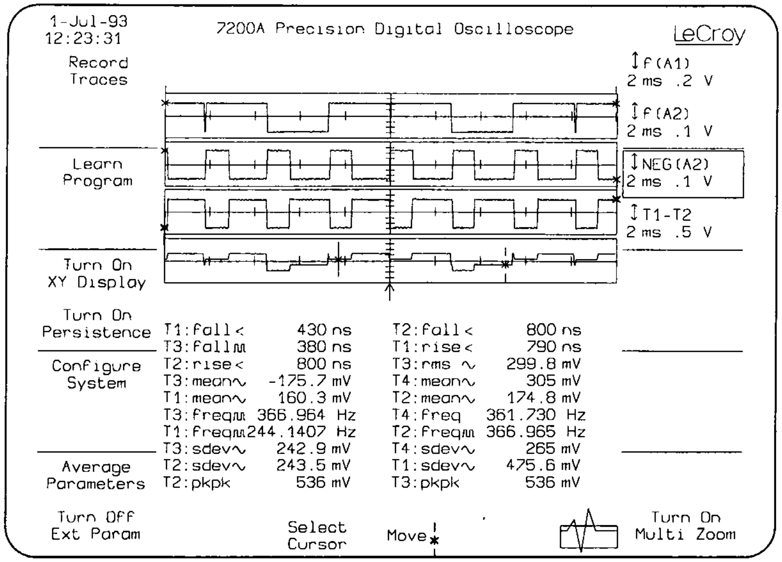


Figure 3.16: "Extended" Waveform Parameter measurements being made on multiple traces

The parameters for each trace are recalculated each time the trace is updated or the cursors are moved.

The positions of the cursors can be locked together for all traces or independent on each trace. When the cursors are locked all traces use the same cursor positions. Locked cursors are represented by vertical lines extending the full height of the trace grid area.

When the cursors are unlocked each trace has its own independent cursor positions. Unlocked cursors are represented by short vertical marks which are displayed only on the Selected Trace. Selecting a different trace causes the cursors for the new trace to be displayed.

The cursors may be locked or unlocked by pressing the Lock/Unlock Cursors softkey in the Extended Parameter Setup screen (accessed by pressing MODIFY and then CURSOR MEASUREMENTS). See Extended Parameter Setup, p.3-89.

When Extended Parameters are enabled, the Average Parameters softkey appears. The parameter averaging feature transforms the parameter display from instantaneous values to average values.

When parameter averaging is off, the parameter values displayed are the instantaneous values for the currently displayed waveform sweep.

When parameter averaging is on, the parameter values computed for each waveform sweep are averaged with the parameter values from the previous sweep according to the following formula:

$$AVGPARAM_{sweep\ i} = [19 \cdot AVGPARAM_{i-1} + NEWPARAM_i] / 20$$

The displayed values are thus a continuous or running average of the values of successive acquisition sweeps.

To turn on parameter averaging, press the Average Parameters softkey. Its label will change to Stop Average Parameters. To turn off parameter averaging, press the Stop Average Parameters softkey.

To obtain extended waveform parameter measurements:

- Turn on Cursor Measurements by pressing the CURSOR MEASUREMENTS key.
- Select Extended Parameter measurements by repeatedly pressing the CURSOR MEASUREMENTS key until Ext Param appears in the softkey label in the lower left screen. Use the Extended Parameter Setup screen to select parameters and traces. See Extended Parameter Setup p. 3-89.
- Use the outer and inner knobs (16 and 17) to position the cursors around the sections of interest of the traces being measured.

Horizontal Relative

Measures the horizontal difference between two points on a trace. It also gives the vertical difference between those points. The points are indicated by the upward and downward pointing arrows which are the Horizontal cursors. The horizontal difference is displayed under the lower left corner of the grid. For time domain waveforms, the difference in time and its reciprocal are displayed. For FFT, the difference is expressed as frequency. The vertical difference is displayed under the trace label for each trace on which the cursors are present.

> *NOTE: The sign of the measurements depends on which cursor is to the left of the other. If the upward arrow is to the right of the downward arrow, the resulting time difference is indicated as a positive value.*

More than one trace can be measured simultaneously if they have the *same* horizontal units. The cursors are shown at the same horizontal position relative to the trigger on each trace with the same units. See Figure 3.17.

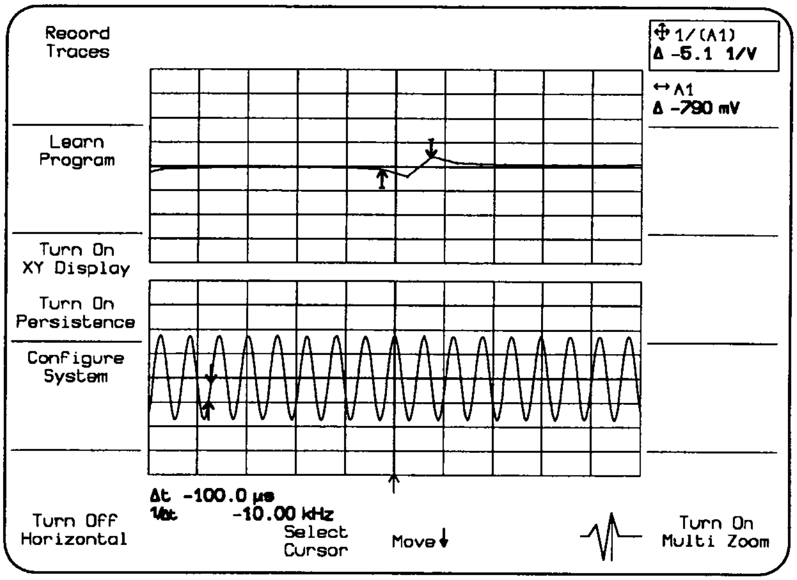


Figure 3.17: Horizontal measurement on multiple traces

If all traces on the screen have the same horizontal units, when the cursor(s) is moved to the edge of the screen it remains there. Otherwise, the cursor(s) moves off the edge of one trace (or group of traces) and onto the trace(s) with different units.

To use the Horizontal cursors:

- Turn on Cursor Measurements by pressing the CURSOR MEASUREMENTS key.
- Select Horizontal cursors by repeatedly pressing the CURSOR MEASUREMENTS key until Horizontal appears in the softkey label in the lower left screen. Upward and the downward arrows appear, similar to those shown in Figure 3.17.
- Use the outer and inner knobs (16 and 17) to position the cursors on the trace(s).

Note: When a trace is expanded so that individual data points are highlighted and the cursor is positioned on an acquired data point a serif will be attached to the cursor perpendicular to the ends of the arrow shaft. If a cursor is positioned between acquired data points, on interpolated data, there will be no serif on the end of the cursors arrow shaft. See Figure 3.17.

Vertical Relative

In this mode the 7200A measures the vertical difference between two horizontal cursor lines on one grid. The vertical difference is displayed under the trace label for each trace on the grid. See Figure 3.18.

NOTE: The sign of the measurements depends on which cursor is above the other. If the "– – –" cursor is on top, the resulting difference is indicated as a positive value.

If a measurement is *not* being made on a trace, its vertical and horizontal scale factors are shown under its trace label.

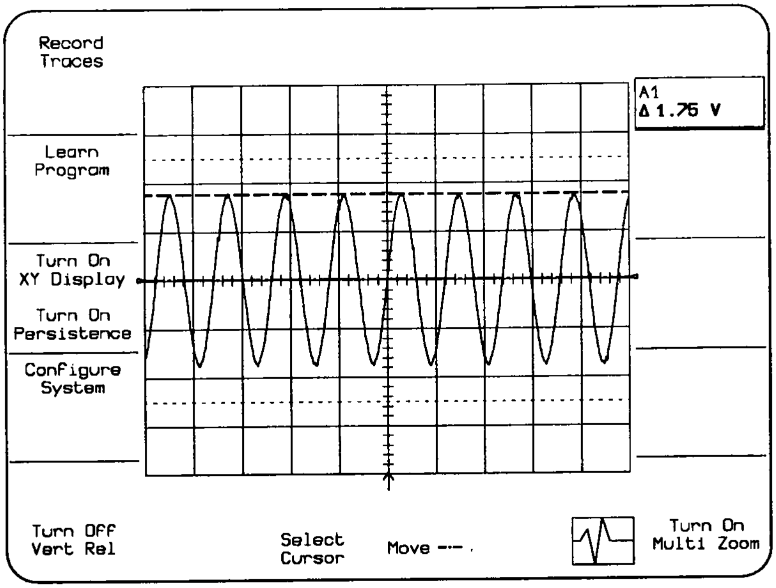


Figure 3.18: Vertical Relative measurement on Trace 1

To make a measurement with the vertical cursors:

- Turn on cursor measurements by pressing the CURSOR MEASUREMENTS key.
- Select Vertical Relative cursors by repeatedly pressing the CURSOR MEASUREMENTS key until Vert Rel appears in the softkey label in the lower left screen. Two horizontal lines, the cursors, appear similar to that shown in Figure 3.18.
- Use the outer and inner knobs (16 and 17) to position the cursors.

Marker

In this mode the 7200A measures the absolute vertical value and the horizontal position of a point on a trace(s). The vertical measurement indicates the absolute amplitude of the trace at the Marker (crosshair "+"), and is displayed under the trace label for each trace on which the marker is present.

The Marker's horizontal position is expressed as the time between the trigger and the Marker. For FFT, the horizontal position is expressed as a frequency. It is shown under the lower left corner of the grid. Both the vertical and horizontal measurements are correct regardless of trace expansion or position.

More than one trace can be measured simultaneously if they have the *same* horizontal units. A Marker cursor appears at the same horizontal position relative to the trigger on all traces. The cursors will move simultaneously when the knob is rotated. See Figure 3.19 on the next page.

If all traces on the screen have the same horizontal units, when the cursor(s) is moved to the edge of the screen it remains there.

To move the cursor(s) to a trace with different horizontal units, continue to rotate the Move cursor knob until the cursor(s) moves off the edge of one trace (or group of traces) and onto the trace(s) with different units.

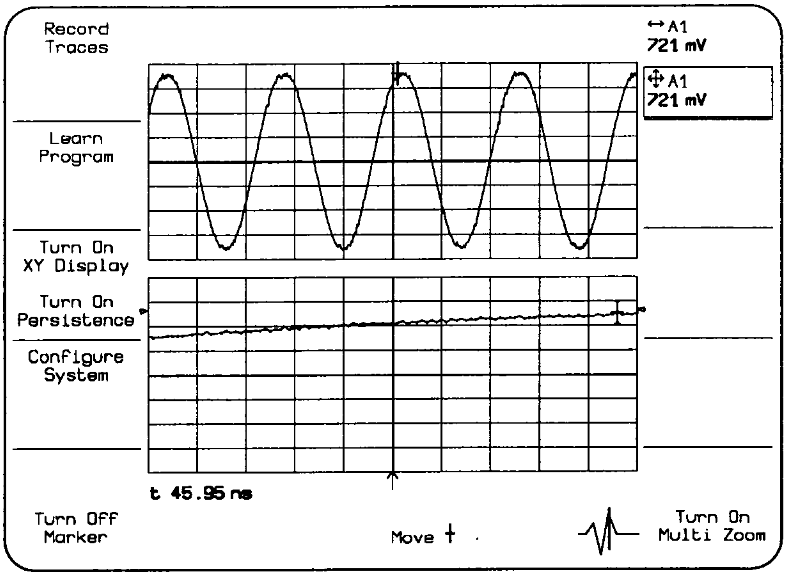


Figure 3.19: Marker cursor measurement on multiple traces

To make a measurement using the Marker cursor:

Turn on Cursor Measurements by pressing the CURSOR MEASUREMENTS key.

- Select the Marker cursor by repeatedly pressing the CURSOR MEASUREMENTS key until Marker appears in the softkey label in the lower left screen.
- Rotate the inner knob (17) until the cross-hair ("+") moves to the point on the waveform of interest.

Note: When a trace is expanded so that individual data points are highlighted and the cursor is positioned on an acquired data point a serif will be attached to the cursor perpendicular to the ends of the vertical crosshair member. If a cursor is positioned between acquired data points, on interpolated data, there will be no serif on the end of the cursors vertical crosshair member. See Figure 3.19.

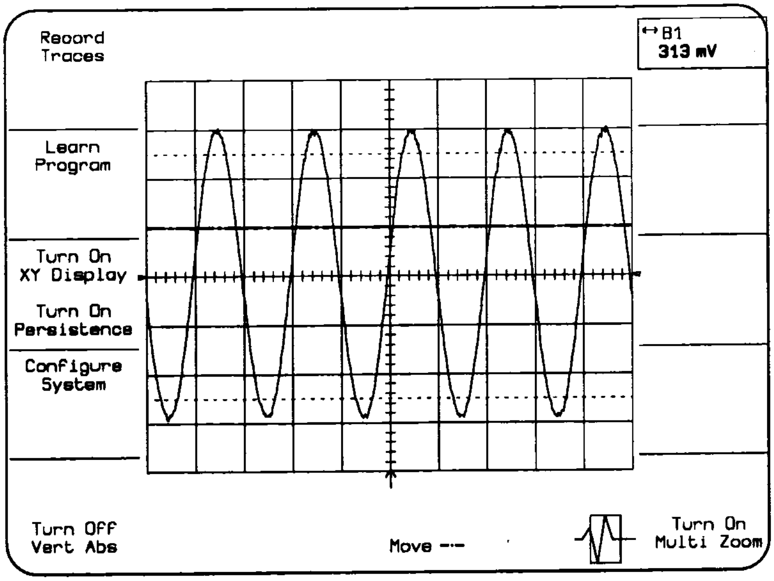


Figure 3.20: Vertical Absolute measurement on Trace 1

Vertical Absolute

In this mode the 7200A measures the absolute vertical value of the single cursor and displays it under the trace label for each trace on the grid. See Figure 3.20.

If a measurement is not being made on a trace, its vertical and horizontal scale factors are shown under its trace label.

To make a vertical absolute measurement:

- Turn on cursor measurements by pressing the CURSOR MEASUREMENTS key.
- Select the Vertical Absolute cursor by repeatedly pressing the CURSOR MEASUREMENTS key until Vert Abs appears in the softkey label in the lower left screen. One horizontal line, the cursor, appears similar to that shown in Figure 3.20.
- Rotate the inner knob (17) to position the cursor.

Summary of Measurement Types

TYPE	DEFINITION	CURSOR USED Locked	CURSOR USED Unlocked	MEASURE TRACE(S) THAT
BASIC PARAMETERS	Fourteen wavefrom parameters on the Selected Trace			is the Selected Trace: one trace is measures at a time
EXTENDED PARAMETERS	up to twenty wavefrom parameters on any combination of traces			were selected from the Extended Parameter Setup screen
HORIZONTAL RELATIVE	difference between horizontal positions of the cursors and their corresponding vertical values			contain both cursors and have the same horizontal units and relative trigger time
VERTICAL RELATIVE	vertical difference between two cursors			are on the same grid as both cursors
MARKER	horizontal position and its absolute vertical value			have the same horizontal units and relative trigger time
VERTICAL ABSOLUTE	absolute vertical value at the position of a single cursor			are on the same grid as the cursor

Table 3.1: Summary of Cursor Types

Table 3.1 provides an overview of all the measurements and their characteristics.

GRIDS (13)

Selects the number of grids to be displayed. Repeated presses of the GRIDS key cycle through all the options.

If a single grid is selected, all traces turned on are displayed on the grid, simplifying trace interpretation.

If multiple traces have different vertical magnitudes, displaying them on different grids simplifies trace interpretation.

For full screen displays the choices are Single, Dual, Quad, and Octal grids.

For half screen displays such as when a setup screen or waveform parameters are displayed, the choices are Single, Dual, Quad grids.

The 7200A automatically maps the traces to the grids, placing the lowest numbered trace which is displayed on the upper most grid, the next trace on the next highest grid, until all selected traces are allocated. When all grids are allocated the two traces are mapped to each grid starting at the upper most grid. This procedure repeats until all traces are mapped to grids.

Although traces are initially allocated to grids, they can be moved onto other grids for comparisons using the Vertical Position continuous knob.

Turn On XY Display (5)

Softkey(5) enables the X versus Y (XY) display mode which allows the user to display one trace against another. The technique is normally used to compare the amplitude information of two waveforms and can reveal phase and frequency information through the analysis of patterns called Lissajous figures. The softkey label will change to TURN OFF XY DISPLAY. Pressing softkey(5) after its label has changed will cause the standard display to appear.

If Persistence is on when XY mode is enabled or if TURN ON PERSISTENCE is pressed while the XY display is active, the X vs Y plot is not cleared after each sweep to allow comparison of successive acquisitions. The number of sweeps remembered may be selected by pressing the MODIFY key followed by the Turn On Persistence softkey to display the Persistence Setup Screen (see p. 3-99)

With persistence enabled, the X vs Y display is only cleared when a control, mainframe or plugin, which affects the display is changed or when the CLEAR DISPLAY key is pressed.

The layout of the XY screen is shown in Figure 3.21. The square grid in the top half of the screen is used for the XY display while the rectangular grid underneath simultaneously shows the original source waveforms. The rectangular grid can be either a single or dual grid and may be selected by the GRIDS key.

To select the two waveforms for display in the XY mode, simply use the TRACE ON/OFF buttons. If both traces are off, the first trace selected is automatically assigned to the X (horizontal axis of the XY display). The second trace selected is assigned to the Y (vertical) axis. Both selections are indicated to the left of the square grid. Selecting another trace key assigns the newly selected trace to the Y axis and turns off the previous Y trace.

For the XY display to be correctly generated, the traces selected must be of the same time or frequency interval/point and have the same horizontal unit (seconds or hertz). As soon as two compatible traces have been selected, the XY display is automatically generated. If incompatible traces are selected. a warning message is displayed at the top of the screen. If two compatible traces are selected that have different trigger points (horizontal Position), then only the common part of each trace is displayed.

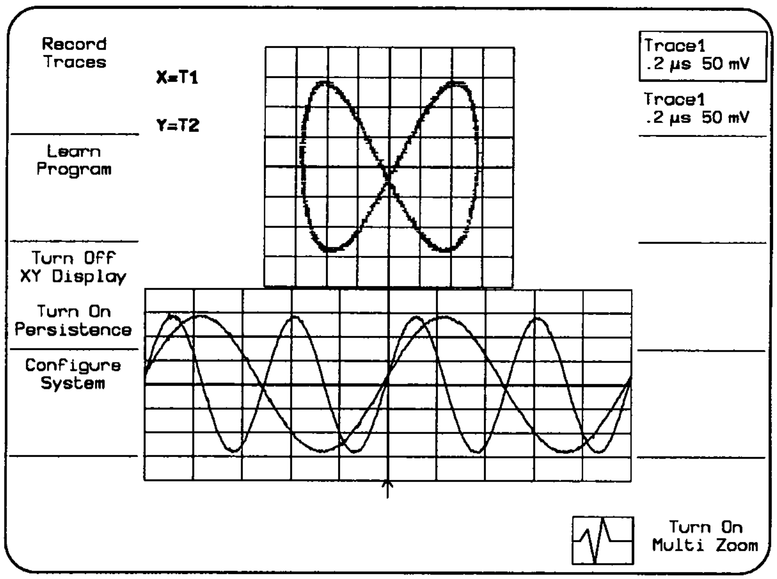


Figure 3.21: XY Display

As with the standard waveform display, time (Marker and Horizontal Relative) and voltage (Vertical Relative and Vertical Absolute) cursors can be used with the XY display. The time cursors are similar to those of the standard waveform display, with additional cursors at the corresponding XY position in the square XY display.

To make a measurement, press the CURSOR MEASUREMENTS key to activate the cursors. When cursors are on, a softkey (10) appears at the lower left of the screen. Softkey(10) indicates the currently selected cursor measurement each time the CURSOR MEASUREMENTS key is selected. Pressing the softkey in the lower left corner turns off cursor measurements. The time cursors move on the traces following the associated sampling interval and on the XY display on paths given by the acquisition time.

The voltage cursors appear on the square grid but do not appear on the rectangular grid which shows the normal time-domain waveforms. In absolute voltage mode a vertical and a horizontal bar appear on the XY display. While in relative voltage mode a pair of vertical and pair of horizontal bars appear on the xy display.

The voltage value of each cursor is shown below the trace label in the fields on the right hand side of the screen. The time cursor value which is common to all traces is shown at the lower left of the screen.

Combinations of the vertical values (voltages) are shown at the right side of the square grid (see Figure 3.21)

- The ratio $\frac{\Delta Y}{\Delta X}$
- The ratio in dB units $20 * log10(ratio)$
- The product $\Delta Y * \Delta X$
- The radius $r = \sqrt{(\Delta X^2 + \Delta Y^2)}$
- The angle (polar) $\Theta = \arctan\left(\frac{\Delta X}{\Delta Y}\right)$ range [-180 ° to +180 °]

The definition of ΔX an dΔY is dependent on the type of cursors used. Table 3.2 shows how ΔX and ΔY are defined for each type of measurement .

Cursors					
	V_{Abs}	V_{Rel}	T_{abs}		T_{Rel}
			Org =(0,0)	Org=$V_{XOffset}$ $V_{YOffset}$	
ΔX	V_{XRef} - 0	V_{XDif} - V_{XRef}	V_{XRef} - 0	V_{XRef} - $V_{XOffset}$	V_{XDif} - V_{XRel}
ΔY	V_{YRef} - 0	V_{YDif} - V_{YRef}	V_{YRef} - 0	V_{YRef} - $V_{YOffset}$	V_{YDif} - V_{YRel}

Table 3.2

Where:

VAbs = Absolute Voltage cursors
VRel = Relative Voltage cursors
TAbs = Absolute Time cursors
TRel = Relative Time cursors
Org = Origin
V XRef = Voltage of the reference cursor on the X trace
VYRef = Voltage of the reference cursor on the Y trace
VXDif = Voltage of the difference cursor on the x trace
VYDif = Voltage of the difference cursor on the Y trace

In order to make the polar readout of the absolute time cursor more useful, there is the possibility of choosing between two reference points. The reference is either located at point (0, 0), i.e. at X = 0 Volt and Y = 0 Volt, or at the center of the square grid. When the Marker cursor is on, pressing softkey (8) toggles between these two reference points.

The values of the origin are displayed on the left-hand side of the square grid. By changing the offsets of the source traces a figure can be centered on the screen and then angles and distances can be measured with respect to the center of the figure.

Persistence softkey (6)

In this mode, the 7200A displays prior sweeps on the grid to allow comparison of successive acquisitions. To set the number of sweeps remembered, display the Persistence Setup screen by pressing the MODIFY key followed by the Turn On Persistence softkey (see Persistence Setup screen p 3-99)

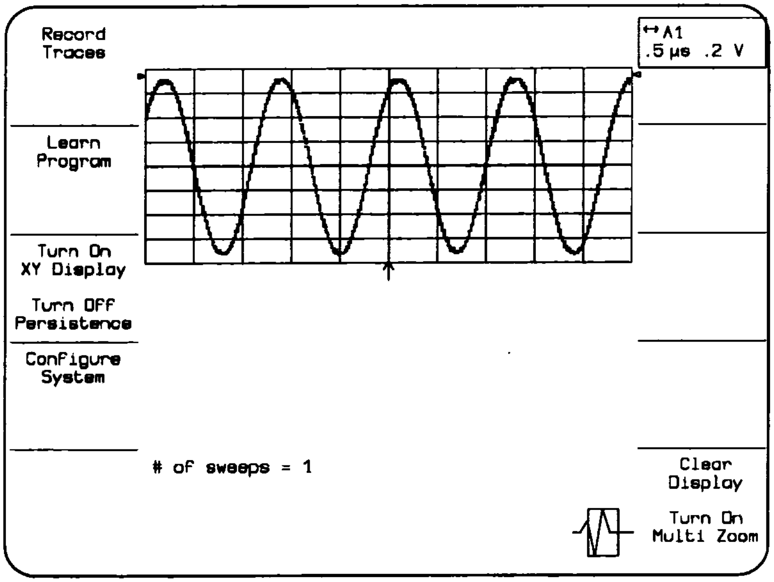


Figure 3.22: Persistence

While in Persistence mode the number of sweeps currently contained in the persistence array will be displayed under the grid. See Figure 3.22

The persistence display is cleared whenever a control, mainframe or plug-in which affects the display is changed or when the "Clear Display" key is pressed.

As with the standard waveform display, time (Marker and Horizontal Relative) and voltage (Vertical Relative and Vertical Absolute) cursors can be used with the persistence display grid.

To make a measurement, press the CURSOR MEASUREMENTS key to activate the cursors. When cursors are on, a softkey (10) appears at the lower left of the screen. Softkey(10) indicates the currently selected cursor measurement each time the CURSOR MEASUREMENTS key is selected. Pressing the softkey in the lower left corner turns off cursor measurements.

The voltage or time value of each cursor is shown below the trace label in the fields on the right hand side of the screen.

Waveform Storage

The 7200A has several options for storing trace waveforms:

- Trace waveforms can be stored on MS-DOS formatted 3.5" floppy diskettes. These diskettes can be read by any MS-DOS compatible machine. Conversely, waveform data previously stored on a diskette can be recalled, displayed, and processed. (Floppy diskettes can be formatted on the 7200A in the Disk Utilities screen. See page 3-118).
- The 7200A has 8 internal non-volatile memories, M1...M8, available for individual waveform storage.
- In Record Traces mode, all displayed traces are automatically recorded in an internal non-volatile variable size circular buffer each time they are updated with a new acquisition. The recorded traces may subsequently be replayed, examined, processed, or stored to floppy diskette. Note that the size of this buffer varies with memory option but is at least 8 Mbytes (4 million data points).
- Any waveform display with its annotation can be preserved on hard copy with a printer or color plotter. Alternatively, a tabular printout of the waveform data points and acquisition information can be produced.
- Trace waveforms can also be transferred remotely via GPIB or RS-232-C to an external mass storage device. Refer to "Section 3: Waveform Transfer" in the 7200A Remote Programming Manual.

The internal memories M1 ... M8 and the Record Traces buffer are non-volatile, i.e., they maintain their contents when the power is off. They may be cleared by pressing the Clear Memories softkey in the Configure System Setup screen.

Record Traces (1)

Automatically records all displayed traces each time they are updated with a new acquisition.The traces are saved in a circular buffer.

To start the automatic record process, press the Record Traces softkey in the 7200A's Main Screen. The softkey's label will change to "Stop Record Traces" and the REC icon will be displayed at the bottom of the screen.

All traces which display or process acquisition data and which are turned on are saved each time they are updated on the screen. The traces are saved in groups. If the plug-in triggers are locked together, all traces containing data from any plug-in are updated and recorded simultaneously for every acquisition. If the plug-in triggers are independent, traces which contain data from a plug-in are recorded as a group for each acquisition by that plug-in.

Each trace group is time stamped as it is recorded. The times are displayed when the traces are subsequently retrieved with the Replay Traces softkey.

The trace groups are recorded in a circular buffer. The number of trace groups which the buffer holds depends on the number of traces per group and the number of data points per trace. After the buffer is filled, the oldest traces are overwritten.

To stop the automatic record process, press the Stop Record Traces softkey.

Replay Traces (2)

Retrieves traces that Record Traces saved in the buffer. Replayed traces can be examined, processed, or stored to floppy diskette. The Replay Traces softkey is not present when the Record Traces buffer is empty.

To retrieve traces which have previously been recorded, press the Replay Traces softkey in the 7200A's Main Screen. The softkey's label will change to "Stop Replay Traces" and the PLAY icon will be displayed at the bottom of the screen.

If any history functions have been accumulating data (eg.: average, extrema [see History Functions, page 3-76]), the accumulated data will be lost when Replay Traces is enabled. If a history function has been defined and the Replay Traces softkey is pressed, the following warning prompt will appear in the System Message Area:

"HISTORY WILL BE LOST. CONTINUE? (PRESS YES OR NO)"

and the YES and NO softkeys will appear:

YES	Press YES to enter Replay Traces mode;
NO	Press NO to cancel the operation.

In Replay Traces mode, traces are retrieved in the same groups in which they were originally recorded. When the 7200A retrieves a trace group, it places the trace waveforms in the corresponding memories M1...M8. For example, if the 7200A retrieves a trace group containing traces 1 and 2, the trace 1 waveform is placed in memory M1 and the trace 2 waveform is placed in memory M2, overwriting the previous contents of the memories.

In Replay Traces mode, the 7200A stops acquiring data and switches from the acquisition set of trace equations to the replay set of trace equations. (Each trace is defined by a mathematical trace equation which specifies the source(s) of data and optional processing. See "Setting Up Traces and Processing Functions" on page 3-56.) The default values of the replay trace equations are T1=M1, T2=M2, ... T8=M8. *Thus, by default, all replayed trace waveforms will be displayed in the same traces they originally came from.* The replay trace equations may be modified in the Trace Setup screens to perform processing on the replayed waveforms in the memories. All operations which can be performed on the acquisition traces can be performed on the replay traces, including waveform processing, vertical and horizontal expansion and reposition, cursor measurements, waveform parameters, and storage to floppy diskette.

The 7200A provides sequential access to the trace groups which have been recorded. Softkeys are provided to step or scan backward and forward in the Record Traces buffer. On each step backward or forward the 7200A retrieves the group of traces recorded earlier or later and places the waveforms in the corresponding memories M1...M8. It automatically turns on all traces which display or process data from these memories and turns off all other traces.

The time at which the trace group was originally recorded is displayed in the upper left corner of the screen along with the index of the trace group in the Record Traces buffer. The most recently recorded group of traces has index 0, the next older group index -1, etc.

When Replay Traces mode is first turned on, the 7200A retrieves the most recently recorded trace group. The following softkeys provide sequential access to the other recorded trace groups:

Step Backward (3)
Retrieves the group of traces which was recorded previous to the current group. The Step Backward softkey is not present when there are no older trace groups.

Step Forward (4)
Retrieves the group of traces which was recorded after the current group. The Step Forward softkey is not present when there are no newer trace groups.

Switch To Scan Mode (5)
Switches from Step mode to Scan mode. The softkey's label will change to "Switch To Step Mode" and the Step Backward and Step Forward Softkeys will change to Scan Backward and Scan Forward.

Scan (3) Backward
Starts scanning backwards in the Record Traces buffer. The 7200A will automatically retrieve, display, and process (if configured in the replay trace equations) successively older trace groups. The softkey's label will change to "Stop Scanning". Press it to stop scanning.

Scan (4) Forward
Starts scanning forward in the Record Traces buffer. The 7200A will automatically retrieve, display, and process (if configured in the replay trace equations) successively newer trace groups. The softkey's label will change to "Stop Scanning". Press it to stop scanning.

Switch To (5) Step Mode
Switches from Scan mode to Step mode. The softkey's label will change to "Switch To Scan Mode" and the Scan Backward and Scan Forward softkeys will change to Step Backward and Step Forward.

The replay trace equations may be modified to perform history functions (eg.: average, extrema [see "History Functions" on p.3-76) on the replayed waveforms in the memories. For example, to average together all recorded sweeps of trace 3, enable Replay Traces and modify one of the trace equations to perform AVGS(M3). Then step or scan to retrieve and average together all recorded sweeps of trace 3. While stepping or scanning, if the next trace to be retrieved was originally acquired with different plug-in acquisition parameters (eg.: timebase, vertical gain), the following warning prompt will appear in the System Message Area:

"CONTINUE AND RESET HISTORY? (PRESS YES OR NO)"

and the YES and NO softkeys will appear:

YES Press YES to continue to retrieve the next trace. The accumulated history data (eg., average so far) will be reset.

NO Press NO to cancel the operation. If the 7200A was scanning, it will stop.

To exit Replay Traces mode and resume data acquisition, press the Stop Replay Traces softkey.

STORE (25) Stores trace waveforms to floppy diskette or memories M1...M8. The Waveform Storage Setup screen is used to configure the specific storage operation to be performed. To display the setup screen, press MODIFY and then STORE. See page 3-112 for a description of the Waveform Storage Setup screen.

RECALL (26) Recalls waveforms from floppy diskette to memories M1...M8. The Waveform Recall Setup screen is used to configure the specific recall operation to be performed. To display the setup screen, press MODIFY and then RECALL. See page 3-115 for a description of the Waveform Recall Setup screen.

Panel Settings Storage

All front panel settings can be stored on the 7200A's internal disk or on MS-DOS formatted 3.5" floppy diskettes. Users can store and recall their own front panel settings in a few key presses.

Panel settings are stored and recalled in the Panel Settings screen. To display the Panel Settings screen, first press the Configure System softkey in the Main Screen. This displays a screen which contains softkeys used to setup 7200A system operations. Then press the Panel Settings softkey. See page 3-136 for a description of the Panel Settings screen.

Hardcopy

HARDCOPY (11)

Outputs a screen image, waveform listing (description of acquisition parameters and actual data points), or Program listing to selected plotters and printers via the 7200A GPIB, Centronics, or RS-232-C ports. The 7200A can also save the screen image on floppy diskette.

Generating the copy does not affect scope operation. The screen copy can be aborted while in progress by pressing the HARDCOPY key again.

The Hardcopy Setup screen is used to specify the type of output, the hardcopy device, the port to which it is connected, and user specified annotations. To display Hardcopy Setup, press MODIFY and then HARDCOPY. The Hardcopy Setup screen will display its selections. See Hardcopy Setup, page 3-103.

Programming

Program (3) Softkey

Enables the 7200A to learn a sequence of key presses and knob changes. Once learned, the sequence, or program, can be executed repeatedly for automatic operation. The program can then be stored and recalled to and from disk for later use. Alternately, you can create programs with an editor, which can interact with the operator or make decisions based on wavefrom parameters, data values, control settings, etc. For more information refer to Section 7 of the Remote Programmer's Manual.

The program can be examined, stored, and recalled in the Program Setup screen, displayed by pressing MODIFY and then the Program softkey. See page 3-139 for a description of the Program Setup screen.

From the Main Screen, the Program learning process can be started and stopped. Also, execution of the learned program can be initiated and terminated.

The label appearing on the Main Screen for the Program softkey indicates the *next* possible Program action:

Learn Program	Initiates the learning process. All key presses and knob changes are remembered for later execution.
Stop Learn Program	Terminates the learning process.
Run Program	Initiates program execution. The program executes to completion unless it is suspended, or an error occurs.
Stop Run Program	Suspends execution. Pressing any other key or adjusting any knob during execution will also suspend the program. In either case, when the program is suspended, a message will appear in the upper screen:

"ABORT PROGRAM? (PRESS YES OR NO)" .

and the YES and NO softkeys will appear.

YES	Pressing the YES softkey terminates the program and re-displays the Run softkey label.
NO	Pressing the NO softkey resumes program execution.

Configure System

Configure System Softkey (7)

Displays a screen which contains softkeys used to setup 7200A system operations. Use the System Configure screen to store and recall panel settings, select trace and grid intensities, set time and date, set the GPIB address, set RS-232-C port parameters, and select plug-in interdependencies. System Configure also provides a default settings key, a system reset key, and a screen which displays a log of system messages. It also presents a summary of all trace equations and of the contents of the memories M1...M8.

Using Setup Screens

Setup screens use softkeys and selection fields to adjust control actions (see "Overview," pp. 3-1 and 3-7). The remainder of Section 3 explains how to use the 7200A's setup screens:

Setting up Traces and Processing Functions

Explains how to select which waveform data will be displayed in each trace and how to perform waveform processing. See page 3-56.

Extended Parameter Setup

Explains how to select and display up to twenty different waveform parameters (selected from over sixty) for any displayed trace(s). See page 3-89.

Persistence Setup

Explains how to set the number of sweeps remembered by the persistence display. See page 3-99.

Multi Zoom Setup

Explains how to select the traces to be locked together and how to select whether horizontal, vertical or both axis will be locked together. See page 3-101.

Hardcopy Setup

Explains how to output screen images, waveforms, and Program listings to plotters, graphics and laser printers, and 3.5" floppy disk. See page 3-103.

Waveform Storage Setup

Explains how to store traces to memories and 3.5" floppy diskette. See page 3-112.

Display Options Setup

Explains how the operator can include additional annotation on to the traces and how they are displayed. See page 3-125.

Waveform Recall Setup

Explains how to recall waveforms from 3.5" floppy diskette. See page 3-115.

Disk Utilities

(Accessed by pressing the Disk Utilities softkey from the Recall Setup, Store Setup, Panel Settings, or Program Setup screens.) Explains how Disk Utilities screen softkeys and fields are used to format floppy diskettes and to access and maintain files. See page 3-118.

Trace Annotation Setup

Explains how to annotate points of interest on traces. See page 3-123.

Configure System

Provides access to infrequently used screens. See page 3-127.

Panel Settings

Provides access to the Panel Settings screen which is used to store and recall panel settings. See page 3-136.

Acquisition Setup

Explains how to select various acquisition options. See page 3-133.

Display Setup

Explains how to select display intensities and colors. See page 3-128.

Program Setup

Explains how to configure the 7200A to learn a sequence of key presses and knob changes for repeated automatic operation and how to store and recall programs. See page 3-139.

Setting Up Traces and Processing Functions

A trace can represent unprocessed acquired data or can be the result of processing acquired channel data (A1, A2, B1, B2 ...), memories (M1...M8), and/or other traces. For the default setup, each trace represents acquired data from one channel. Using the Trace Setup screen, channel and/or memory data can be combined and processed to define trace data. Traces can also be combined to define still other traces.

The Trace Setup screen contains softkeys and highlighted fields which are used to specify a mathematical equation which combines and processes source data to generate the trace.

Display the Trace Setup screen by pressing the MODIFY key followed by the desired TRACE key. Only the trace being modified will be displayed. An example of the Trace Setup screen for Trace 3 is shown in Figure 3.23.

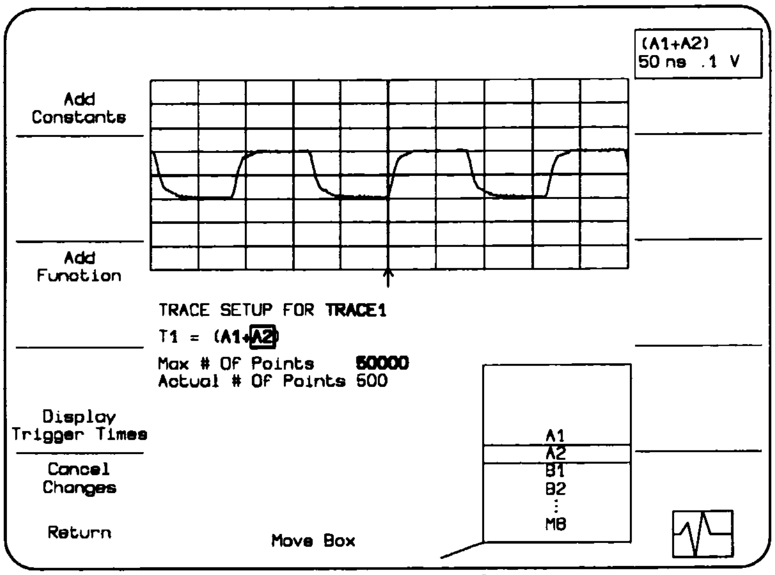


Figure 3.23: Example Trace Setup screen

In Figure 3.23, the trace is displayed in the upper screen. The trace equation is below the grid. It indicates the source(s) of data and how it is used to generate the trace. The trace being defined is T3.

The right side of the equation contains the sources, A1 and A2, and the processing function, "+" for sum. Corresponding points for each acquisition (A1 + A2) are added to create those in T3. The Max # Of Points field indicates an upper limit on the number of points that will be added to generate T3. The Actual # of Points field indicates the actual number of points in the waveform.

The softkeys to the left of the screen select processing functions, the trace label, constants, and units.

The Move Box outer knob (17) is used to select a field for modification. The options list in the lower right screen indicates available choices with the current choice in the center. To change the selection, rotate the Modify Value inner knob (16) to move the desired choice to the center of the list. The new choice will also replace the previous selection in the box.

As you modify the trace equation, the displayed trace will be continually updated to reflect the selected processing. Press the Return softkey to save the edited trace setup and return to the Main Screen. The Cancel Changes softkey cancels all changes, restores the original trace setup, and displays the Main Screen.

Changing the Trace Equation

The trace equation is a mathematical equation defining the trace. It contains sources and functions which operate on those sources. In addition, multiplicative constants, additive constants, and units may be associated with each source.

The source data for the trace comes from acquisition channels, memories, or other traces. Any channel present in the system and any memory (M1...M8) can be used as a source for any trace. To avoid circular definitions, a given trace can use only lower numbered traces as sources. The 7200A automatically determines which channels or traces can be used as sources and displays them in the options list for a source. In Figure 3.23, the options for sources for Trace 3 are A1, A2, T1, T2, M1, M2, M3, M4, M5, M6, M7, M8.

To change a source, move the box onto it and rotate the Modify Value inner knob to select a different source. The new source will appear in the trace equation and in the center of the options list.

The 7200A performs both unary waveform functions, which operate on one source, and binary functions which operate on two sources. An equation may contain up to two waveform functions. Only one of the following functions may be used per equation: AVGC, AVGS, EXTREMA, AVGMAG, AVGPWD, AVGPWS, FFTIM, FFTMAG, FFTPHA, FFTPWD, FFTPWS, FFTRE, FFTRI, HIST, TREND, TOFAN, TOFPC, WINHIST

To change a function, move the box onto it. The options list will display the available functions. Rotate the Modify Value knob to select the desired function. The new function will replace the previous one in the trace equation. See pages 3-67 to 3-70 for descriptions of the available waveform functions. The Add Function softkey, described below, adds a waveform function to the equation. The Delete Function softkey deletes the function in the box.

The default equation for each trace contains a single source, a channel. Further sources are added in conjunction with binary waveform functions. When a binary function is added, the 7200A automatically adds a second source, with an initial default value. The second source can be changed by moving the box onto it and rotating the Modify Value knob to select a different value. When a binary processing function is deleted or changed to a unary function, the 7200A deletes its righthand source.

Note: The 7200A has two distinct sets of trace equations. When in Replay Traces mode, the 7200A stops acquiring data and switches from the acquisition set to the replay set of trace equations. The only difference between the equations is that acquisition channels are not available to be sources in replay trace equations. See "Replay Traces," page 3-47.

Add Function

To add a mathematical operation to a trace equation, press the Add Function softkey while the box is on the equation. A new math symbol will appear in the equation, and the box will move onto the symbol. Use the Modify Value knob to select the desired function.

For example, in the trace equation:

$$T1 = \boxed{B2} \qquad \text{(Equation 1)}$$

Pressing Add Function with the box on the source B2 results in:

$$T1 = \boxed{ABS}(B2) \qquad \text{(Equation 2)}$$

with the box on ABS (the symbol indicating absolute value), which is the default chosen by the 7200A.

If you add a binary waveform function, a math symbol followed by a second source is added to the right of the box. For example, if you change ABS to "+" by rotating the Modify Value knob, Equation 2 becomes

$$T1 = (B2\boxed{+}A1) \qquad \text{(Equation 3)}$$

and the box moves to the binary waveform operator, "+". For Equation 3, A1 is the default chosen by the 7200A for the second source.

Rotating the Move Box knob and Modify Value knobs to change the rightmost A1 to another source, A2, results in

$$T1 = (B2 + \boxed{A2}) \qquad \text{(Equation 4)}$$

When you press the Add Function softkey, the 7200A adds a waveform function which operates on the element of the equation which is in the box. The element may be either a source or a previously added function. For example, in Equation 4, pressing Add Function with the box on A2 results in

T1 = (B2 + $\boxed{\text{ABS}}$(A2)) (Equation 5)

Changing the ABS to "–" would result in

T1 = (B2 + (A2 $\boxed{-}$ A1)) (Equation 6)

The 7200A added the binary operator "–" and a default source A1 to the right of A2.

Starting from Equation 4 again, moving the box onto "+" and then pressing Add Function results in

T1 = $\boxed{\text{ABS}}$(B2 + A2). (Equation 7)

The 7200A has added a function which operates on the result of the "+". Changing ABS to "–" would result in

T1 = ((B2 + A2) $\boxed{-}$ A1) (Equation 8)

Delete Function

To delete a waveform function, move the box onto the function to be deleted and press the Delete Function softkey.

Deleting a function is the reverse of adding a function. For binary waveform functions, the source to the right of the deleted function is also removed.

Although the deleted function (and righthand source) are removed from the trace equation, they are temporarily saved while the setup screen is displayed. The next time the Add Function softkey is pressed, they are the default function and source added by the 7200A.

This mechanism allows you to retrieve a function you may have accidentally deleted, or to move an operation and source from one part of the equation to another. For example, moving the box in Equation 8 to the rightmost "–" and pressing Delete Function causes "–A1" to be deleted:

T1 = (B2 $\boxed{+}$ A2) (Equation 9)

Moving the box left onto "B2" and pressing Add Function results in:

$$T1 = ((B2 \boxed{-} A1) + A2) \qquad \text{(Equation 10)}$$

Max # Of Points

Waveform processing may require appreciable execution time. To reduce this time, reduce the number of points to process for the trace by selecting a smaller value for this field.

NOTE: This is only an upper limit on the number of points to process. The actual number of points in the trace will be less than this value if the source(s) of the trace has fewer points. If the source(s) has more points,the 7200A will reduce the number of points used by decimating, or using every nth point.

Actual # Of Points

Indicates the actual number of points in the trace. This number will vary based on panel settings such as timebase, horizontal expansion, and processing function. It ranges from 20 points to the maximum record length, but no greater than the Max # Of Points.

Add Constants

Enables selection of multiplicative constants with units and additive constants. One multiplicative constant with units and one additive constant are associated with each source. Since a trace equation may include three sources, three pairs of constants may be specified. Different Greek letters are assigned to each of the six constants.

Both Multiplicative and Additive Constants are then divided into two independent fields. The fields, mantissa and exponent are independently set.

To change the constants for a source, move the box onto the source and press the Add Constants softkey. Additional fields appear as shown in Figure 3.24.

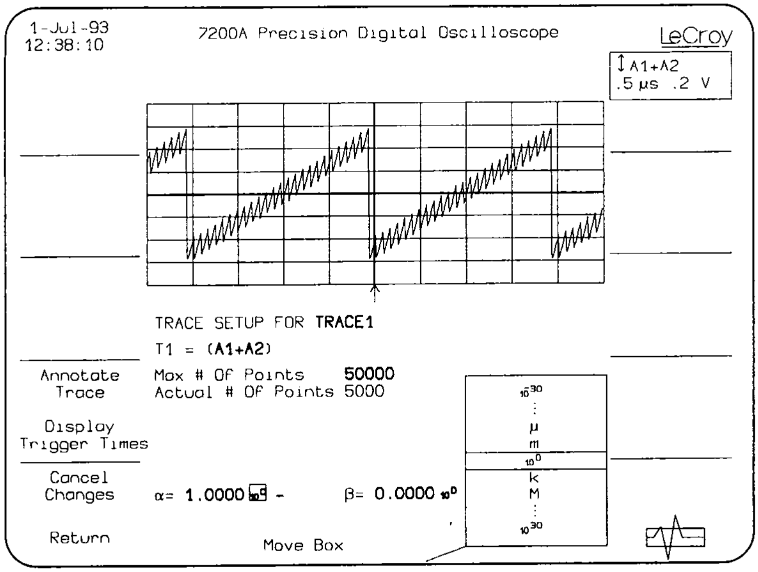


Figure 3.24: Additional fields appear for Add Constants

Move the box onto the mantissa of the multiplicative constant for the source. The options list in the lower right screen will display choices from 1.0000 to 999.99. Rotate the Modify Value knob to select a different value.

Move the box onto the exponent of the multiplicative constant for the source. Change its value using the Modify Value knob. The exponent field can range from 10^{-30} to 10^{30}.

Move the box onto the multiplicative constant units and use the Modify Value knob to select the desired units.

The units of a trace are calculated by the 7200A by combining the units of each source according to the trace equation. The 7200A reduces complex units to the simplest it can using its basis set. For example, cycles/sec is reduced to Hz.

The units of a source are modified by changing the units of the multiplicative constant for the source. The resulting units associated with the source in the trace equation are the product of the units of the trace, channel, or memory data and the units selected for the multiplicative constant. Dimensionless units, indicated by "–", may be selected for the multiplicative constant to

preserve the units of the source waveform data.
The units and their definitions are:

-	dimensionless
%	percentage
dB	decibels
dBM	decibel milliwatt
dBV	decibel Volts
decade	decade
octave	octave
ppm	part per million
#	events
m	meters
K	degree Kelvin
°	degree
A	amps
Hz	Hertz
s	seconds
C	Coulombs
F	Farads
MHO	1/ohms
Ω	ohm
V	Volts
W	Watts
H	Henrys
WB	Webers
N	Newtons
J	Joules
POISE	Poise
g	grams
1/s	1/seconds
1/H	1/Henrys
PAL	Pascal
L	liter
T	Tesla
DIV	Division

More complex combinations can be entered remotely or from ICL. For instance, the program "UNITS", which is distributed on the hard disk, lets the operator enter a unit string of up to 40 characters. The entered unit is automatically multiplied by the default units of Volts, thus, entering:

PAL/V	Converts acquired units to PALs (pressure)
S3*A/M2	Seconds^3 X Amps/meter^2 will display everything in g (grams)
(W/s)*V	Watts/seconds X Volts will display as V^3 A/s
W/sV	Watt/second Volt will appear as VA/s
g*m/s2/V	Grams X meters/seconds^2/Volt is converted to Newtons

NOTE: Channel data always has units of Volts. You can modify the units associated with an acquisition channel in a trace equation by selecting the appropriate multiplicative constant units.

Move the box onto the additive constant field and change its value with the Modify Value knob. The additive constant mantissa value can range from -999.99 to 999.99.

Move the box onto the additive constant exponent field. Change its value using the Modify Value knob. The exponent field can range from 10^{-30} to 10^{30}.

Reset Value

While constants are being edited, the Reset Value softkey is displayed. If the box is on the multiplicative constant mantissa, pressing Reset Value sets the value to 1. If the box is on the multiplicative constant exponent, pressing Reset Value sets the value to 10^0. When the box is on the additive constant mantissa, pressing Reset Value sets the value to 0. If the box is on additive constant exponent, pressing Reset Value sets the value to 10^0. If the box is on units, pressing Reset Value sets the units to "–" to indicate dimensionless units.

When any of the constants have changed from their reset values, the trace equation will change to display the current equation.

If any of the variable fields have changed, the trace equation will show the both the additive and multiplicative variables as greek letters.

Delete Constants

If the Add Constants softkey is pushed then it is re-labeled as Delete Constants. Pressing the Delete Constants softkey will remove the constants from that source and save it in memory.

After a constant is deleteted the softkey is again labeled Add Constants.

To transfer a constant from one source to another source, move the box over the source to be moved and press Delete Constants. Next move the box over the source to receive the constant. Press Add Constants. The constant is now transferred to the new source.

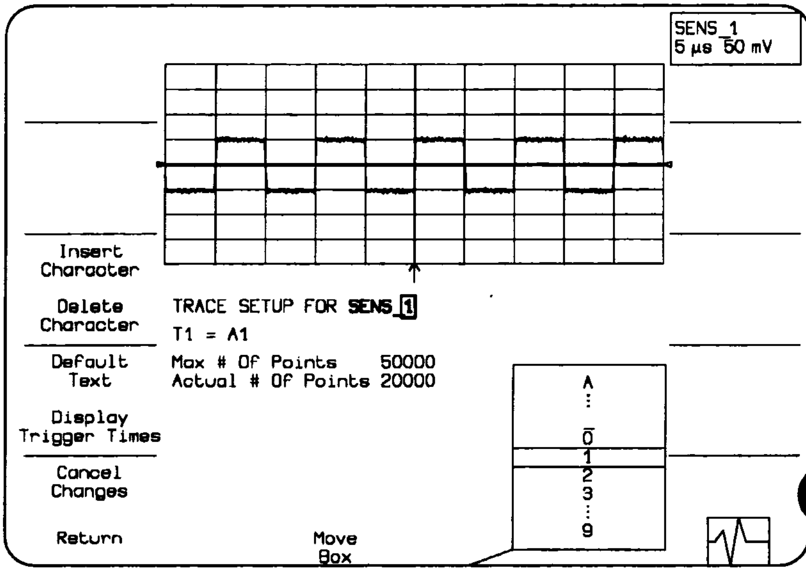


Figure 3.25: Editing the Trace Label

Once the desired changes are made, press the Return softkey to save the selections and continue editing other parts of the equation. If the changes are not desired, press the Cancel Changes softkey to restore the original selections and to continue editing the equation. To simplify the equation, the multiplicative constant, additive constant, and units will not be displayed if the values are 1.0, 0.0, and "–" respectively.

Trace Setup For

Associated with each trace is a label used for screen annotation and disk storage. The default labels are "TRACE1", "TRACE2", etc.

To edit the trace label, move the box onto the Trace Setup For field. The Edit Text softkey will appear in the upper left screen. When it is pressed the Insert Character, Delete Character, and

Default Label softkeys will appear, and the box will move on individual characters in the trace label. See Figure 3.25.

Insert Character	Press the Insert Character softkey once for each character to be inserted. Each new character will match the character displayed in the box and will be displayed to the right of the box. After adding a character(s), use the Modify Value continuous knob to change the character as desired.
Delete Character	Press the Delete Character softkey for each character to be deleted.
Default Text	Press the Default Text softkey to change the trace label back to the default ("TRACE1", "TRACE2", etc.).

Once the desired changes are made, press the Return softkey to save the edited trace label and continue editing other parts of the equation. If the changes are not desired, press the Cancel Changes softkey to retain the original trace label.

NOTE: If the trace label is equal to the default ("TRACE1", "TRACE2", etc.), an abbreviated form of the trace equation will be displayed next to the trace key. If the label has been changed so that it is not equal to the default, the label will be displayed next to the trace key.

Annotate Trace

This softkey displays the Trace Annotation Setup Screen which allows the operator to annotate up to 10 different points of interest on each trace. See page 3-123.

Display Trigger Times

The Display Trigger Times softkey will display the time(s) at which the trigger(s) occurred or the acquisition duration.

For Sequence trigger mode, the first and last trigger times (or Duration) are displayed along with the triggers time for each segment. When there are more segment trig times than can fit on the screen, the Next Line continuous knob will allow scrolling up and down the list of trig times.

The Show Absolute/Relative Times softkey will switch between the display of trig times from the time at which trigger occurred (Absolute) and the time from first trigger (Relative). The Return softkey when pressed will exit the trig times screen and return to the Trace Setup screen.

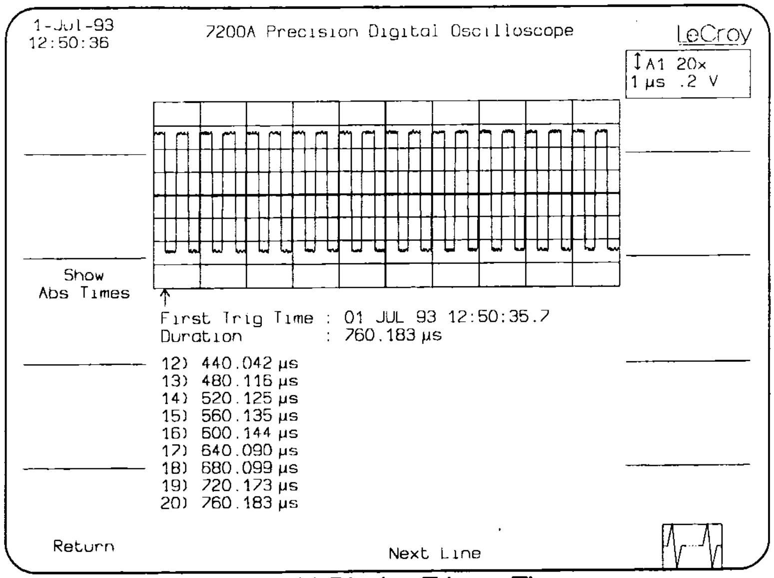


Figure 3.26 Display Trigger Times

Unary Waveform Functions

The Unary waveform functions operate on one source: trace, channel data, a memory, or the result of a previous function.

Not every function can be used as a source for every other function. Also, waveforms created by using SEQuence Trigger Mode cannot be processed by some waveform functions. If an
incorrect processing equation is selected, the 7200A displays an error message in the Message Field after each attempt at processing data.

The names of the single waveform functions and brief explanations follow:

NOTE: Unless otherwise stated, if the source is an Extrema waveform, these functions use the Roof information and ignore the Floor data.

Function	Symbol	Explanation
1-POINT SMOOTHING	**Sm 1**	Normally, if the maximum number of points specified for a function is less than the number of points in its source waveform, the source is decimated by skipping points. Rather than skipping points, and using only every n-th point, 1-POINT Smoothing averages n points together to produce each point in the result.
3-POINT SMOOTHING	**Sm 3**	Performs a 3-point moving average by adding adjacent data points to each other. Each data point of the source is recomputed according to the formula: $Y(i) = W(i-1)/4 + W(i)/2 + W(i+1)/4$
5-POINT SMOOTHING	**Sm 5**	Performs a 5-point moving average. The formula for 5-point smoothing is: $Y(i) = W(i-2)/16 + W(i-1)/4 + W(i)*6/16 + W(i+1)/4 + W(i+2)/16$
7-POINT SMOOTHING	**Sm 7**	Performs a 7- point moving average: $Y(i) = W(i-3)/64 + W(i-2)*6/64 + W(i-1)*15/64 + W(i)*20/64 + W(i+1)*15/16 + W(i+2)*6/64 + W(i+3)/64$

9-POINT SMOOTHING	**Sm 9**	Performs a 9-point moving average: Y(i) = W(i-4)/256 + W(i-3)*8/256 + W(i-2)*28/256 + W(i-1)*56/256 + W(i)*70/256 + W(i+1)*56/256 + W(i+2)*28/256 + W(i+3)*8/256 + W(i+4)/256
ABSOLUTE VALUE	**ABS**	Takes the absolute value of the source.
ANTILOG	**EXP**	The antilog to the base e of the source; that is, e raised to the power equal to the source. The vertical axis of the result is dimensionless.
AVGMAG	**AVGMAG**	Average Magnitude of Fast Fourier Transform.
AVGPWD	**AVGPWD**	Average Power Spectral Density.
AVGPWS	**AVGPWS**	Average Power Spectrum.
AVGSEQ	**AVGSEQ**	Averages the segments in a sequence waveform.
CONTINUOUS AVERAGE	**AVGC**	Uses an indefinite number of acquisitions and enables the user to see the effects of more recent changes to the signal. See page 3-77 for more details.
DERIVATIVE	**d/dt**	Differentiates the source.
ERES	**ERES**	Applies an enhanced resolution filter which increases the number of effective bits while decreasing the bandwidth.
EXP10	**EXT10**	Like EXP (ANTILOG), except the base is 10.
EXTREMA	**EXTREMA**	Generates a dual waveform which represents the minimum and maximum values of the source (i.e., the floor and roof functions displayed simultaneously). See page 3-79 for more details.
FFTIM	**FFTIM**	Imaginary Part of Fast Fourier Transform.
FFTMAG	**FFTMAG**	Magnitude of Fast Fourier Transform.
FFTPHA	**FFTPHA**	Phase of Fast Fourier Transform.
FFTPWD	**FFTPWD**	Power Spectral Density.
FFTPWS	**FFTPWS**	Power Spectrum.
FFTRE	**FFTRE**	Real Part of Fast Fourier Transform.

FFTRI	**FFTRI**	Real and imaginary parts of Fast Fourier Transform (dual waveform).
FLOOR	**FLOOR**	Generates a display of the floor function of the source; that is, the minima of the source from all acquisitions. If the source is an EXTREMA waveform, the lower part is selected. Otherwise, the EXTREMA is computed with MAX-SWEEPS=10000, and the lower part is selected.
HISTOGRAM	**HIST**	Produces continuously updating histograms of waveform parameter values.
INTEGRAL	∫	Integrates the source.
INVERSION	**1/**	Takes the reciprocal of the source.
LOG	**LOG**	Performs a log of a dimensionless source to the base e. Values less than or equal to zero are set to underflow.
LOG10	**LOG10**	Like LOG, except the base is 10.
NEGATION	**NEG**	Negates the values in the source.
ROOF	**ROOF**	Generates a display of the roof function of the source; that is, the maxima of the source from all acquisitions. If the source is an EXTREMA waveform, the upper part is selected. Otherwise, the EXTREMA is computed with MAX-SWEEPs=100000, and the upper part is selected.
SIGN	**SIGN**	Compares the source waveform with zero. Points which are less than zero are set to -1. Points which are equal to zero are set to zero. Points which are greater than zero are set to +1. The vertical axis of the result is dimensionless.
SINX	**SINX**	Performs 10-to-1 interpolation using a sin(x)/x filter.
SQUARE	**SQR**	Squares the source.
SQUARE ROOT	√	Takes the square root of the absolute value of the source.
SUMMED AVERAGE	**AVGS**	Provides a more accurate statistical measure than continuous averaging because the acquisitions are not weighted and artifacts may be rejected. See p 3-77 for more details.
TIME OF FLIGHT ANALOG	**TOFAN**	Produces a time of flight histogram to support measurements using a charge detector. See p.3-74 for more details

TIME OF FLIGHT PULSE COUNT	**TOFPC**	Produces a Time of Flight histogram to support measurements using a pulse detector. See p.3-74 for more details
TREND	**TREND**	The 7200A can produce rolling trends of the most recent waveform parameter values.
WINDOW HISTOGRAM	**WINHIST**	Takes a Time of Flight histogram as inputs and produces a new histogram using user defined windows, see p.3-75 for details.

Fast Fourier Transform Functions

The FFT functions compute spectra of single time-domain waveforms. Spectra are displayed with a linear frequency axis running from zero to the Nyquist frequency. The frequency scale factors (Hz/div) are in a 1, 2, 5 sequence.

FFT Functions

Function	Symbol	Explanation
Power Spectrum	**FFTPWS**	The Power Spectrum is the signal power (or magnitude) represented on a logarithmic vertical scale. For 50 Ω input coupling, 0 dBm corresponds to the voltage (0.315 V peak) which is equivalent to 1 mW into 50 Ω. For 1 MΩ input coupling, 0 dBV corresponds to 1 V peak. The power spectrum is suitable for characterizing spectra which contain isolated peaks.
Power Density	**FFTPWD**	The Power Density is the signal power normalized to the bandwidth of the equivalent filter associated with the FFT calculation. The units are dBm for 50 Ω input coupling, and dBV for 1 MΩ input coupling. The power density is suitable for characterizing broad-band noise
Magnitude	**FFTMAG**	The Magnitude has the same units as the input signal. It is the peak signal amplitude represented on a linear scale.
Phase (degrees)	**FFTPHA**	The Phase is measured with respect to a cosine whose maximum occurs at the left-hand edge of the screen, at which point it has 0°. Similarly, a positive-going sine starting at the left-hand edge of the screen has -90° phase.
Real	**FFTRE**	The Real part has the same units as the input, and represents the real part of the complex result of the FFT computation.

Imaginary	**FFTIM**	The Imaginary part has the same units as the input, and represents the imaginary part of the complex result of the FFT computation.
Real + Imaginary	**FFTRI**	The Real + Imaginary has the same units as the input. It is the entire complex result of the FFT computation.

FFT Parameters

Parameter	Explanation
Max # Of Points	FFT spectra are computed over all of the source time-domain waveform. This parameter limits the number of points used for FFT processing. If the input waveform contains more points than the selected maximum, these are decimated prior to FFT processing. If the input waveform has fewer points, all points are used.
Actual # Of Points	This is not a parameter which can be changed by the operator. Instead, it indicates the number of points actually generated in the output waveform. Since the FFT is computed on a real waveform, the result is symmetrical about zero frequency. The redundant information is not kept in the output waveform. Therefore, the Actual # Of Points is half of the number of points used to compute the FFT.
DC Suppression	When DC Suppression is turned ON, the DC component of the input signal is forced to zero prior to the FFT processing. This improves the amplitude resolution, especially when the input has a large DC component.
Window Type	The window type defines the bandwidth and shape of the equivalent filter associated with the FFT processing. See table 3.3 for window types.

Window type	resolution	amplitude	leakage
RECTANGULAR	high	**	**
VON_HANN (Hanning)	moderate	good	small
HAMMING	moderate	good	small
FLAT_TOP	moderate	excellent	small
BLKMN_HARRIS	moderate	excellent	minimum

Table 3.3 FFT Window Type

** The RECTANGULAR window is the best choice (maximum resolution and amplitude and minimum leakage) if one of the following conditions are met:
1. The signal is a transient which is completely contained in the time-domain window.
2. The signal is known to have a fundamental frequency component which is an integral multiple of the fundamental frequency of the window.
When these conditions are not met varying amounts of spectral leakage and scallop loss are developed.

Binary Waveform Functions

The 7200A performs binary waveform processing functions as follows:

1. Binary waveform functions operate on two sources. Each source may be a trace, channel data, a waveform stored in memory, or the result of a previous function.
2. The two source waveforms of a binary function must have the same horizontal scale factor, horizontal units, and vertical units.
3. The sources are combined on a point-by-point basis. For example, if the trace equation is "T3 = A1 * T2", the trace T3 is the product of data occurring at corresponding times in A1 and T2.
4. The 7200A automatically compensates for any differences in the vertical gains and offsets of the two sources.
5. Units are combined and simplified, if possible, for all operations. For example, if the trace equation is "T3 = T2/T1", the units of T2 is cycles, and T1 is seconds, the 7200A automatically assigns "Hz" to the units of T3.
6. The result's vertical range is corrected to fit onto the grid.

7. The source waveform's trigger points may be different, but this usually gives results that are difficult to interpret.

Not every function can be used as a source for every other function. Extrema data or waveforms created by using SEQuence Trigger Mode cannot be operated upon with binary functions. If an incorrect processing equation is selected, the 7200A displays an error message after each attempt at processing data.

The names of the binary waveform functions, their symbols as they appear in the options list, and brief explanations follow:

Function	Symbol	Explanation
SUM	+	Adds two source waveforms.
DIFFERENCE	-	Subtracts the second source from the first source.
PRODUCT	*	Multiplies two source waveforms.
RATIO	/	Divides the first source by the second source.

Time of Flight Fuctions

Function	Symbol	Explanation
TIME OF FLIGHT ANALOG	TOFAN	This processing function produces a time of flight histogram to support time of flight measurements using a charge detector.

This processing function also converts the horizontal axis from time to mass. Time in the input waveform is assumed to be a linear function of sqrt(mass) in the output. This assumes that the charge is the same for each ion. Note that the area of each peak is preserved by this function.

If the application requires averaging of the input data, it should be done prior to this function.

When this function is selected, the following parameters can be adjusted:

Max # Of Bins	specifies the maximum length of the output waveform. If the length of the output is less than that of the input, bins are summed rather than decimated.
Slope	specifies whether the peaks in the input waveform are positive or negative.
Gain	used to define the mass axis according to the following formula:

$$\sqrt{mass} = Gain * (time + Offset)$$

or

$$mass = [Gain * (time + Offset)]^2$$

Offset	used to define the mass axis according to the above formula.

Function	Symbol	Explanation
TIME OF FLIGHT PULSE COUNT	TOFPC	This processing function produces a time of flight histogram to support measurements using a pulse detector, such as a photomultiplier. Each input waveform is searched for peaks, and the time from trigger to each peak is computed. The corresponding bins in the histogram are incremented by one for each peak.

This processing function also converts the horizontal axis from time to mass. Time in the input is assumed to be a linear function of sqrt(mass) in the output This assumes that the charge is the same for each ion. Note that the area of each peak is preserved by this function.

When this function is selected, the following parameters can be adjusted:

Max # of Bins	specifies the maximum number of bins in the histogram. It can be as large as the number of points in the waveform.
Slope	specifies whether rising or falling edges are used to compute peak times. Choices are POS and NEG.
Coupling	indicates the method of applying the Threshold for locating edges. Choices are AC and DC.
Threshold	specifies the value for computing the time of an edge. The value is expresed in the vertical units of the input waveform. If Coupling is DC, the Threshold is an absolute value. If Coupling is AC, the Threshold is relative to the baseline of the input.
Max Events	indicates the maximum number of input waveforms which may contribute to the histogram.
Gain	used to define the mass axis according to the following formula:

$$\sqrt{mass} = Gain * (time + Offset)$$

or

$$mass = [Gain * (time + Offset)]^2$$

Offset	used to define the mass axis according to the above formula.

WINDOW HISTOGRAM **WINHIST** This processing function takes a time of flight histogram as input and generates another histogram from it. The user specifies a set of "windows" in the input histogram which are to be examined. This function sums the data in each window and stores the sum in the output histogram.

The output histogram is essentially a table of peak intensities, where the peaks are in pre-defined locations. It is up to the user to ensure that the windows are correctly located and sized.

When this function is selected, the following parameters can be adjusted:

Max # of	specifies the number of regions in the input to be examined. The actual size of the output histogram is the number of windows rounded up to the next cannonical histogram size. (i.e.the size is always on a 1, 2, 5 sequence.)
Center	the location of the center of the leftmost window. Expressed in horizontal units of the input waveform.
Width	is the width of each window, expressed in the horizontal units of the input waveform.
Spacing	is the distance from the center of one window to the center of the next one, expressed in the horizontal units of the input waveform. The window spacing may not be less than the window width.

History Functions

Most processing functions perform calculations that use only the most recently acquired set of waveforms. The square root function ("√"), for example, takes the square root of the most recent waveform for its source to generate the result. Previous waveform acquisitions are not used.

However, continuous average, summed average, extrema, histogram, trend, and the FFT averaging functions (AVGMAG, AVGPWD, AVGPWS) use the most recent waveform and one or more previously acquired sets of data. For example, the averaging functions use data from summing past acquisitions together. Because they depend on the history of past acquisitions, these functions are called History Functions.

When a trace includes a history function, the current sweep number is displayed next to the trace key for that trace. This number indicates the number of sets of data which have been accumulated so far to comprise the trace's history data. The sweep number is updated each time the trace display is updated with new acquisitions.

In order to increase the throughput of history functions, when one or more traces containing history functions are turned on, the 7200A automatically reduces the screen update rate to one per second. For each acquisition of data in between screen updates, only the history functions and functions which are used to produce their sources are computed, and the trace display remains unchanged. Once a second, all trace functions are computed and the display is updated.

The history data for each of the history functions is affected as follows:

- To suspend the operation of the history function to increase processing speed for other traces, turn off the applicable trace. The current state of the data will be saved and operation will be resumed from that state when the trace is subsequently turned on again.
- To reset all data back to zero, press the Clear Display softkey which appears in the Main Screen and the Trace Setup screens when history functions are enabled. The functions will start to accumulate history again with the next acquisition.

The following operations automatically reset the data to zero:

- Changing the plug-in acquisition parameters, such as timebase, for the source waveform(s) of a trace using a history function.
- Changing the parameters defining the operation of the function, except the maximum number of sweeps.
- Enabling Replay Traces.

Changing trigger mode to SINGLE suspends acquisition of data and accumulation of history functions.

The history functions require additional fields to define their operations. For example, to perform a summed average, the number of sweeps must be specified. The 7200A automatically displays the additional fields below the equation. Move the box on the desired fields in order to select their values.

Explanations of the history functions follow:

Function	Symbol	Explanation
CONTINUOUS AVERAGE	**AVGC**	The average function can be used to remove random noise from a signal and present a better picture of the actual waveform. Averaging more waveform acquisitions removes more noise. Also, an averaged waveform produces measurement results that have greater accuracy; that is, the dynamic range is increased. The Continuous average function uses an indefinite number of acquisitions to display the effects of more recent changes to the signal.

Weight — specifies the weighing factors, which determine the speed at which the continuous average follows changes in the source waveform. As the value of the weight decreases, the average follows changes in the signal more closely.

The continuous average (AVGC) is computed according to the following formula:

$AVGC_{sweep\ i} = [(Weight-1) * AVGC_{i-1} + Source_i]/Weight$

Averaging may not be applied to Extrema or segmented waveforms.

SUMMED AVERAGE — **AVGS** — Similar to Continuous Average, this function improves the signal to noise ratio and increases the dynamic range by several bits. Summed averaging provides a more accurate statistical measure than continuous averaging because the acquisitions are not weighted and artifacts may be rejected.

When this function is selected, the following parameters can be adjusted:

Max Sweeps — sets the number of sweeps to accumulate before pausing. The choices are 10 to 100000. Unlike other parameters, if the average is started and you want to change this parameter, the data is not reset. Changing this parameter during averaging has the following effects:

- If Max Sweeps is reduced to a number less than the number already averaged, the averaging immediately pauses.
- If Max Sweeps is set to a number that has not been reached, the averaging will continue until it reaches the new number.

Artifact Reject — If Artifact Reject is turned ON, the 7200A does not include in the average any waveforms with underflow or overflow. If waveforms consistently contain overflows, averaging will not proceed and the number of accumulated sweeps will stay at zero indefinitely.

If Artifact Reject is turned OFF, any overflows are set to the maximum possible value of the ADC and any underflows to the minimum value. The waveform is then included in the average. The average will be incorrect at the overflow positions.

Averaging may not be applied to Extrema or segmented waveforms.

When the source of AVGS is an acquisition channel, the averaging will be performed at a high rate (dependent on the plug-in) if the following conditions are true:

1. Record Traces is off.
2. The acquisition record length is ≤ 20K points. (This restriction is specific to the 7242 plug-in and may be different for other plug-ins.)
3. Acquisition type is not RIS or sequence.
4. Each enabled trace which uses a channel must use a unique channel, and must consist of either no processing (eg. T1= A1) or an AVGS function with no decimation (Max # of points ≥ record length).

For example, if T1=AVGS(A1) and T2=A2, averaging will be fast. However, if T1=AVGS(A1) and T2=A1, averaging will not be fast because the same channel is used for both an average and display.

When these conditions are met, the fast averaging icon will be displayed at the bottom of the screen.

EXTREMA

The EXTREMA function generates two waveforms which represent the minimum and maximum values of the source (i.e., the floor and roof functions displayed simultaneously). These waveforms are generated by repeated comparison of acquisitions of the source waveform with the already accumulated EXTREMA waveform. Whenever a point of the new waveform exceeds (either positively or negatively) the corresponding data point of the accumulated EXTREMA waveform, it replaces the former value in the EXTREMA waveform.

The single parameter for this function is Max Sweeps:

Max Sweeps — equals the maximum number of acquisitions used to create the envelopes. This number can be between 10 and 100000. When this maximum number is reached, the accumulation process stops.

- As in summed averaging, if Max Sweeps is increased while this function is in process, it will continue until it reaches the new value. If the new value selected is below the actual number, the process stops immediately.

The EXTREMA function cannot be applied to other Extrema or segmented waveforms.

HISTOGRAM **HIST**

The Histogram function produces a waveform consisting of one point for each histogram bin, where the value of each point is equal to the number of parameter values which fall into the corresponding bin. The number of points in the waveform, i.e. the number of bins in the histogram) is equal to the Max # Of Bins specified in Trace Setup.

Parameter values which fall outside of the histogram limits as specified by Center and Width are not included in any of the histogram bins, but do count as events for purposes of reaching Max Events. Also, if the Center and Width are changed these events may be included in the new histogram. Invalid parameter values (indicated on the parameter display by
("- - -") are not included in any of the histogram bins but do count as events.

The fields and softkeys are described below:

Max # Of Bins — The number of bins in the histogram (equals the number of points in the waveform).
If Max # Of Bins is changed, up to the last 20,000 accumulated parameter values are rehistogrammed to produce the new number of bins. The selections are 20, 50, 100, 200, 500, 1000, 2000.

Actual # Of Bins — The actual number of bins present in the histogram. This differs from Max # Of Bins only due to horizontal expansion or position.

Parameter — The parameter of the source waveform whose value is to be histogrammed. If the source waveform is a channel or memory, the parameter is computed on the entire waveform, for a sequence waveform, at least one parameter value is generated for each segment. If the source waveform is a trace, the parameter is computed only on the section of the trace delineated by the parameter cursors. The histogram is reset when the cursors are moved. If the trace is a sequence waveform, the parameter is computed for each segment between the cursors (including the segments in which the left and right cursors are located). The selections for Parameter are the same as in Extended Parameter Setup. Some parameters require 1 or 2 arguments. When a parameter requiring arguments is selected, the Parameter Argument fields appear as described below.

Max Events — The maximum number of parameter value events to maintain in the continuous histogram. Internally the HIST function maintains a record of the last 20000 parameter value events in a circular buffer, regardless of Max Events. However, only the specified Max Events most recent events are included in the histogram. If Max Events is changed, the available events in the buffer are used to immediately produce a new histogram containing the specified number of events. The new histogram is then maintained with the new Max Events. The selections are 10, 20, 50, 100, ... 2000000000. If the Max Events is greater than 20000, histogramming stops when the selected number of events is reached. If Max Events is less than or equal to 20000, the histogram will continually display the last Max Events values.

Center
The midpoint of the central bin of the histogram. The histogram is displayed with the Center located halfway across the screen. If Center is changed, the Max Events (up to 20,000)most recent accumulated events are rehistogrammed with the new Center. The softkeys "Center On Max" and "Find Center And Width", described below, can be used to automatically set the Center. The selections range from -1E30 to 1E30 with resolution of 1E-12.

Width
1/10 of the total width of the histogram. The histogram is displayed with the horizontal scale per division equal to the selected Width/div. If Width is changed, the Max Events (up to 20,000) most recent accumulated events are rehistogrammed with the new Width The softkey "Find Center And Width", described below, can be used to automatically set the Width.

The selections range from -500E30 to 500E30 in 1-2-5 steps. The value consists of two fields, mantissa and exponent, which may be selected individually to choose a number in engineering notation. Mantissa selections are -500, -200, -100, -50, -20, -10, -5, -2, -1, 1, 2, 5, 10, 20, 50, 100, 200, 500.

Exponent selections are E-30, E-27, E-24, E-21, E-18, E-15, pico, nano, micro, milli, " ", kilo, mega, giga, tera, E15, E18, E21, E24, E27, E30.

Vertical
The vertical scaling of the histogram, the options are LIN for linear, LOG for logarithmic, and MAX for autoscaling the histogram to fit the maximum limits of the display.

Events Per Waveform	For some parameters, e.g. delay, each source waveform sweep generates a single parameter value. For other parameters, e.g. rise, each source waveform sweep can contain multiple events, each of which generates a parameter value. The Events Per Waveform field is present only for the latter parameters. The selections are FIRST, ALL, and AVERAGE.

Note: For sequence waveforms, the Events per Waveform field determines the number of parameter values generated for **each** *segment. At least one parameter value* **per** *segment will always contribute to the histogram.*

FIRST	If FIRST is selected, the parameter value for the first event in the waveform sweep contributes to the histogram. All other events in the waveform sweep are ignored.
ALL	If ALL is selected, the parameter values for all events in the waveform sweep individually contribute to the histogram.
AVERAGE	If AVERAGE is selected, the parameter values for all events in the waveform sweep are averaged together to produce a single value which is accumulated in the histogram.

Parameter Argument 1 and 2	These fields appear only if the selected parameter requires arguments. The ranges of the parameter arguments are determined solely by the parameter and are independent of the source waveform. The menu field names and ranges of values will be dynamically provided for the selected parameter. See Extended Parameter Setup p. 3-89.

The following two softkeys automatically select the Center and/or Width to best display the accumulated parameter values:

Center On Max	When the "Center On Max" softkey is pressed the 7200A moves the histogram Center to the mode of the current histogram and keeps the Width the same. The last Max Events accumulated events (up to 20,00 events) are rehistogrammed about the new Center.
Find Center And Width	When "Find Center And Width" is pressed the 7200A automatically chooses the histogram Center and Width to encompass the Max Events most recent accumulated events (up to 20,000). The events are then rehistogrammed as specified by the new Center and Width.

TREND

The TREND function produces a waveform consisting of one point for each parameter value trended, where the value of each point is equal to the value of the parameter. At any time the number of points in the waveform is between zero and Max # of points, inclusive.

Parameter values which fall outside of the trend limits as specified by Center and Height and included in the trend as overflows or underflows, and count as events for purposes of reaching Max # of Points. Also, if the Center and Height are changed, these events may be included in the new trend. Invalid parameter values (indicated on the parameter display by "—") are recorded as invalid points in the TREND waveform and count as events. These invalid points show up as holes in the waveform.

The fields and softkeys are described below:

Max # Of Points	The maximum number of parameter values to maintain in the rolling trend (equals the maximum number of points in the trend waveform). The trend waveform is displayed with Max # Of Points across the screen when unexpanded. Internally the TREND function maintains a record of the last 20000

parameter value events in a circular buffer, regardless of Max # Of Points. However, only the specified Max # Of Points most recent events are included in the trend. If Max # Of Points is changed, the available events in the buffer are used to immediately produce a new trend containing the specified number of events. The new trend is then maintained at the new Max # Of Points. The selections are 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000.

Actual # Of Points	The actual number of parameter values included in the trend. Actual # Of Points is less than Max # Of Points if the trend has not yet accumulated Max # Of Points events or if the trend has been horizontally expanded or positioned off the screen.
Parameter	The parameter of the source waveform whose value is to be trended. If the source waveform is a channel or memory, the parameter is computed on the entire waveform. For a sequence waveform, at least one parameter value is generated for each segment. If the source waveform is a trace, the parameter is computed only on the section of the trace delineated by the parameter cursors. The trend is reset when the cursors are moved. If the trace is a sequence waveform, the parameter is computed for each segment between the cursors (including the segments in which the left and right cursors are located). The selections for Parameter are the same as in Extended Parameter Setup. Some parameters require 1 or 2 arguments. When a parameter requiring arguments is selected, the Parameter Argument fields appear as described below.
Center	The center of the range of parameter values to be included in the trend. The trend waveform is vertically scaled for display so that the Center value is at the center of the grid. If Center is changed, the trend of the

Max # Of Points most recent events is immediately redisplayed about the new Center. The softkey "Find Center And Height", described later, can be used to automatically set the center. The selections range from -1E30 to 1E30 with resolution of 1E-12.

Height — 1/8 of the total range of parameter values to be included in the trend. The trend waveform is vertically scaled for display so that the vertical scale per division is equal to the selected Height/div. If Height is changed, the trend of the Max # Of Points most recent events is immediately redisplayed with the new Height. The softkey "Find Center And Height", described below, can be used to automatically set the height. The selections range from -500E30 to 500E30 in 1-2-5 steps. The value consists of fields, mantissa and exponent, which may be selected individually to choose a number in engineering notation.

- Mantissa — selections are -500, -200, -100, -50,-20, -10, -5, -2, -1, 1, 2, 5, 10, 20, 50, 100, 200, 500.
- Exponent — selections are E-30, E-27, E-24, E-21,E-18, E-15, pico, nano, micro, milli, " ", kilo, mega, giga, tera, E15, E18, E21, E24, E27, E30.

Horizontal — The horizontal scaling of a trend. The options are 1,2,5,10,20,50,... 5000 s/div and Events. When EVENTS is selected, parameter values are used from each waveform, When a number of seconds per division is selected, waveforms are sampled at a rate determined by the Horizontal scaling and the Max # of Points. One value of the parameter, either the first or the average, is used from the sampled waveform, as determined by Events Per Waveform.

Events Per Waveform — For some parameters, e.g. delay, each source waveform sweep generates a single parameter value. For other parameters, e.g. rise, each source waveform sweep can contain multiple events each of which generates a parameter value. The Events Per Waveform field is present only for the latter parameters. The selections are FIRST, ALL, and AVERAGE.

FIRST	If FIRST is selected, the parameter value for the first event in the waveform sweep contributes to the trend. All other events in the waveform sweep are ignored
ALL	If ALL is selected, the parameter values for all events in the waveform sweep individually contribute to the trend.
AVERAGE	If AVERAGE is selected, the parameter values for all events in the waveform sweep are averaged together to produce a single value which is recorded in the trend

Note: For sequence waveforms, the Events per Waveform field determines the number of parameter values generated for **each** *segment. At least one parameter value* **per** *segment will always contribute to the trend.*

Parameter Argument 1 and 2	These fields appear only if the selected parameter requires arguments. The ranges of the parameter arguments are determined solely by the parameter and are independent of the source waveform. The menu field names and ranges of values will be dynamically provided for the selected parameter.
Find Center And Height	When the "Find Center And Height" softkey is pressed the 7200A automatically chooses the Center and Height to best display the trend of the Max # Of Points most recent events.

AVGMAG, AVGPWD, and AVGPWS

These functions are averages computed from any of the Fast Fourier Transform functions. As the names imply, they compute the average magnitude, power density, and power spectrum respectively.

The source of any of these functions should be a trace which is currently computing any Fast Fourier Transform. The average is computed directly from the complex intermediate result of the source FFT. For example,

T1 = FFTMAG(A1)
T2 = AVGMAG(T1)

is similar to

T1 = FFTMAG(A1)
T2 = AVGS(T1)

However, the former combination is computed with more accuracy. Note that the FFT type computed in T1 does not have to be the same as the type of the average computed in T2. Therefore, it is possible to have:

T1 = FFTPWS(A1)
T2 = AVGMAG(T1)

This example computes the power spectrum as well as the average magnitude.

The Max # Of Points and Max Sweeps parameters are supported by these functions. They have the same meaning as for the AVGS function.

Extended Parameter Setup

The 7200A can calculate up to twenty different waveform parameters for any combination of displayed traces. The Extended Parameter Setup screen is used to select from a large number of parameters and to choose which traces to measure.

To display the Extended Parameter Setup screen, press the MODIFY key and then the CURSOR MEASUREMENTS key. The Extended Parameter Setup screen will display its current selections:

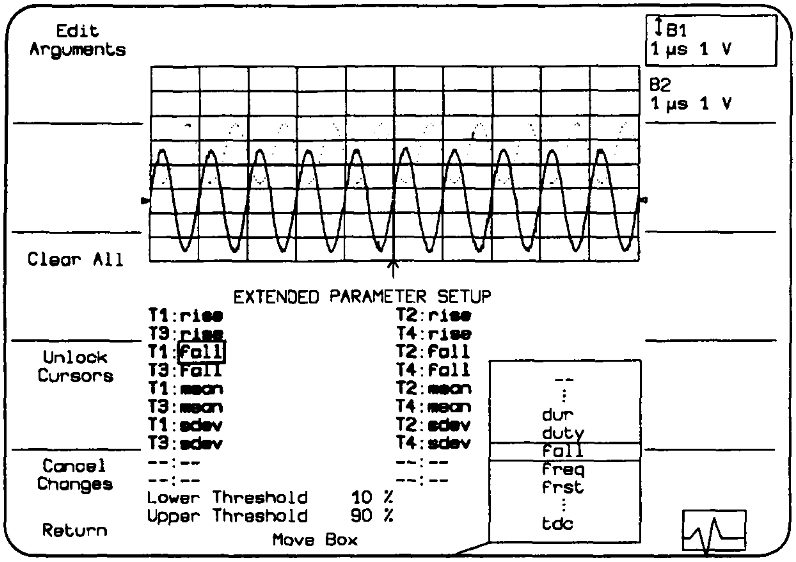


Figure 3.27: Example Extended Parameter Setup screen

The screen contains selection fields for choosing up to twenty trace-parameter combinations. Each selection has two fields separated by a colon (:). The left field indicates the trace to be measured; the right field indicates the parameter to be calculated. For example, Figure 3.27 indicates that the median and mode will be computed for trace 1, trace 2, and trace 3.

NOTE: The parameter values will be displayed on the Main Screen (when Cursor type EXT PARAM is enabled) in the same locations as selected on the setup screen.

The Move Box knob is used to select a field for modification. The options list in the lower right screen will indicate available choices with the current selection in the center. To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the previous selection in the box.

> *NOTE: When "– –" is selected from the Options List for either the trace or parameter field, no parameter will be calculated and the corresponding location in the Extended Parameter display on the Main Screen will be blank.*

Some parameters have arguments which specify how they will be computed by the 7200A. When the box is on a parameter with arguments, the arguments and their values are displayed at the bottom of the screen and the Edit Arguments softkey appears in the upper left hand corner of the Setup screen. Push the Edit Arguments softkey to move the box from the parameter field to the argument fields and change their values. Press the Return softkey to save the new argument values and return the box to the parameter field. Press the Cancel Changes softkey to restore the original values and return the box to the parameter field.

The Clear All softkey deselects all the traces and parameters and replaces them with "- -".

The Unlock/Lock Cursors softkey selects either independent cursors for each trace or locking all the cursors together in the same place on all traces. See Extended Parameters p.3-30.

After completing all changes, press the Return softkey to save the changes and display the Main screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The waveform parameters available are described below. The parameters are grouped according to the types of waveforms on which the operate: General (all types of waveforms), Time Domain, Frequency Domain, and Histogram parameters.

Parameters displayed in Extended Parameters are calculated only on the section of the trace delineated by the two cursors. If the trace is a sequence waveform, the parameters are calculated only on the first segment between the cursors (i.e., the segment in which the leftmost cursor is located).

General Parameters

Parameter	Symbol	Explanation
acquisition duration	**(dur)**	For a single sweep waveform, dur is 0. For a sequence waveform, dur is the time from the trigger of the first segment to the trigger of the last segment. For a single segment of a sequence waveform, dur is the time from the trigger of the previous segment to the trigger of the current segment. For a waveform produced by a history function (e.g. AVGS), dur is the time from the

		trigger of the first waveform accumulated to the trigger of the last waveform accumulated.
data	**(data)**	The data value at the left cursor. When this parameter is used for histograming, and EVENTS PER WAVEFORM is set to ALL, all of the data values between the cursors are histogrammed.
date	**(date)**	Date of acquisition of the waveform.
first	**(frst)**	Horizontal position of first (leftmost) cursor.
last	**(last)**	Horizontal position of last (rightmost) cursor.
points	**(pnts)**	Number of points between the cursors.
time	**(time)**	Time of acquisition of the waveform.

Time Domain Parameters

Parameter	Symbol	Explanation
amplitude	**(ampl)**	Top minus the base.
area	**(area)**	Sum of sampled values between the cursors times the duration of a sample.
base	**(base)**	Lower of two most probable states. This is characteristic of rectangular waveforms and represents the lower most probable state determined from the statistical distribution of data point values in the waveform.
cycles	**(cycl)**	Number of pairs of transitions in the same direction.
delay	**(dly)**	Time from trigger to the midpoint of the first transition.
differetial nonlinearity	**(dnl)**	Finds the maximum absolute difference between adjacent measured code levels and the ideal code level. The input is assumed to be a Digital to Analog Converter output. The results are measured in terms of LSB's. When differential nonlinearity is selected, the arguments "Steps" and "Dwell Time" are displayed at the bottom of the screen. The steps argument is the number of ideal quantization levels. The Dwell Time is the amount of time that should be spent at each

plateau. Pushing the Edit Arguments softkey allows selection of these values.

duty cycle	**(duty)**	Average duration above midpoint value as a percentage of period.
fall time	**(fall)**	Duration of the pulse waveform's falling transition between two user-specified thresholds, averaged for all falling transitions between the cursors. The thresholds are specified as a percentage of the amplitude. When fall time is selected, the arguments "Lower Threshold" and "Upper Threshold" are displayed at the bottom of the screen with their default values. The lower threshold ranges from 1 to 45 percent of amplitude, with a default value of 10%. The Upper Threshold ranges from 55 to 99 percent of amplitude, with a default value of 90%. Push the Edit Arguments softkey to gain access to the arguments.
frequency	**(freq)**	Reciprocal of period.
integral nonlinearity	**(inl)**	Finds the maximum absolute difference between each of the measured code levels and its ideal value. The input is assumed to be a Digital to Analog Converter output. The results are measured in terms of percentage. When integral nonlinearity is selected, the arguments "Steps" and Dwell Time" are displayed at the bottom of the screen. The steps argument is the number of ideal quantization levels. The Dwell Time is the amount of time that should be spent at each plateau. Pushing the Edit Arguments softkey allows selection of these values.
local maximum	**(lmax)**	Average of all local maxima between the cursors. When local maximum is selected, the argument "Hysteresis" is displayed at the bottom of the screen. Hysteresis controls feature finding; it is used by the 7200A to discriminate features from noise. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Pushing the Edit Argument softkey allows selection of hysteresis values from .001 to 100.0 v. The default is 1.0 v.
local minimum	**(lmin)**	Average of all local minima between the cursors. When local minimum is selected, the argument "Hysteresis" is

displayed at the bottom of the screen. Hysteresis controls feature finding; it is used by the 7200A to discriminate features from noise. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Pushing the Edit Argument softkey allows selection of hysteresis values from .001 to 100.0 v. The default is 1.0 v.

local pk to pk (lpp)

Average for all pairs of local maxima and minima between the cursors.

When local peak to peak is selected, the argument "Hysteresis" is displayed at the bottom of the screen. Hysteresis controls feature finding; it is used by the 7200A to discriminate features from noise. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Pushing the Edit Argument softkey allows selection of hysteresis values from .001 to 100.0 v. The default is 1.0 v.

local time between peaks (ltbp)

Average time between peaks for all pairs of adjacent features between the cursors.

When local time between peaks is selected, the argument "Hysteresis" is displayed at the bottom of the screen. Hysteresis controls feature finding; it is used by the 7200A to discriminate features from noise. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Pushing the Edit Argument softkey allows selection of hysteresis values from .001 to 100.0 v. The default is 1.0 v.

local time between troughs (ltbt)

Average time between troughs for all pairs of adjacent features between the cursors.

When local time between troughs is selected, the argument "Hysteresis" is displayed at the bottom of the screen. Hysteresis controls feature finding; it is used by the 7200A to discriminate features from noise. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Pushing the Edit Argument softkey allows selection of hysteresis values from .001 to 100.0 v. The default is 1.0 v.

local time at minimum (ltmn)

Time from trigger to first local minimum between the cursors.

When local time at minimum is selected, the argument "Hysteresis" is displayed at the bottom of the screen. Hysteresis controls feature finding; it is used by the 7200A to discriminate features from noise. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Pushing the Edit Argument softkey allows selection of hysteresis values from .001 to 100.0 v. The default is 1.0 v.

local time at maximum **(ltmx)**

Time from trigger to first local maximum between the cursors.

When local time at maximum is selected, the argument "Hysteresis" is displayed at the bottom of the screen. Hysteresis controls feature finding; it is used by the 7200A to discriminate features from noise. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Pushing the Edit Argument softkey allows selection of hysteresis values from .001 to 100.0 v. The default is 1.0 v.

local time over threshold **(ltot)**

Time over a user-specified percentage of the local peak to peak range, averaged for all features between the cursors.

When local time over threshold is selected, the arguments "Hysteresis" and "Threshold" are displayed at the bottom of the screen. Hysteresis is used to discriminate features from noise, and ranges from 0.001 to 100.0 V with a default value of 1.0 V. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Threshold is the threshold percentage of peak to peak and ranges from 0 to 100%, with a default value of 50%. Push the Edit Arguments softkey to gain access to the arguments.

local time between peak and trough **(ltpt)**

Time between the maximum and minimum value in a feature, averaged for all features between the cursors.

When local time between peak and trough is selected, the arguments "Hysteresis" and "Threshold" are displayed at the bottom of the screen. Hysteresis is used to discriminate features from noise, and ranges from 0.001 to 100.0 V with a default value of 1.0 V. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Threshold is the threshold percentage of peak to peak and ranges from 0 to 100%, with a default value of 50%. Push the Edit Arguments softkey to gain access to the arguments.

local time between trough and peak	**(lttp)**	Time between the minimum of one feature and the maximum of the next, averaged for all pairs of adjacent features between the cursors. When local time between trough and peak is selected, the arguments "Hysteresis" and "Threshold" are displayed at the bottom of the screen. Hysteresis is used to discriminate features from noise, and ranges from 0.001 to 100.0 V with a default value of 1.0 V. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Threshold is the threshold percentage of peak to peak and ranges from 0 to 100%, with a default value of 50%. Push the Edit Arguments softkey to gain access to the arguments.
local time under threshold	**(ltut)**	Time under a user-specified percentage of the local peak to peak range, averaged for all features between the cursors. When local time under threshold is selected, the arguments "Hysteresis" and "Threshold" are displayed at the bottom of the screen. Hysteresis is used to discriminate features from noise, and ranges from 0.001 to 100.0 V with a default value of 1.0 V. The local peak-to-peak value of a feature must exceed the hysteresis for the feature to be recognized. Threshold is the threshold percentage of peak to peak and ranges from 0 to 100%, with a default value of 50%. Push the Edit Arguments softkey to gain access to the arguments.
maximum	**(max)**	Maximum value of the trace between the cursors.
mean	**(mean)**	Average or DC level of the waveform. If the waveform is periodic, it is computed over an integral number of periods.
median	**(medi)**	The data value above and below which are an equal number of data points. The median value is computed over an integral number of periods if the waveform is periodic.
minimum	**(min)**	Minimum value of the trace between the cursors.
mode	**(mode)**	The most frequently occurring data value. The mode is computed over an integral number of periods if the waveform is periodic.
narrow -band phase	**(nbph)**	Narrow-band phase in degrees relative to the left cursor for a user-specified frequency.

		When Narrow-band phase is selected, the argument "frequency" is displayed at the bottom of the screen with the default value. Pushing the Edit Argument softkey allows selection of center frequency values from .001 to 1000000 KHz . The default is 1KHz.
narrow-band power	**(nbpw)**	Narrow-band power in dbV (relative to 1V rms) for a user-specified frequency. It is computed over an integral number of periods. When Narrow -band power is selected, the argument "frequency" is displayed at the bottom of the screen with the default value. Pushing the Edit Argument softkey allows selection of center frequency values from .001 to 1000000 Khz . The default is 1kHz.
overshoot negative	**(ovsn)**	Base value minus the minimum sample value, expressed as a percentage of the amplitude.
overshoot positive	**(ovsp)**	Maximum sample value minus the top value, expressed as a percentage of the amplitude.
peak-to-peak	**(pkpk)**	Difference between the maximum and the minimum values.
period	**(per)**	Time of a full cycle averaged for all full cycles between the cursors.
rise time	**(rise)**	Duration of the pulse waveform's rising transition between two user-specified thresholds, averaged for all rising transitions between the cursors. The thresholds are specified as a percentage of the amplitude. When rise time is selected, the arguments "Lower Threshold" and "Upper Threshold" are displayed at the bottom of the screen. The Lower Threshold ranges from 1 to 45 percent of amplitude, with a default value of 10%. The Upper Threshold ranges from 55 to 99 percent of amplitude, with a default value of 90%. Push the Edit Arguments softkey to gain access to the arguments.
root mean square	**(rms)**	Square-root of sum of squares divided by number of points-1. If the waveform is periodic, it is computed over an integral number of periods.
standard deviation	**(sdev)**	Square-root of sum of squares of difference from mean, divided by number of points-1. If the waveform is periodic, it is computed over an integral number of periods.

time at fall	**(tafl)**	Time relative to trigger of the first falling transition.
time at maximum	**(xamx)**	Time relative to trigger where the maximum sample occurred.
time at minumum	**(xamn)**	Time relative to trigger where the minimum sample occurred.
time at rise	**(tars)**	Time relative to trigger of the midpoint of the first rising transition.
top	**(top)**	Upper of two most probable states. This is characteristic of rectangular waveforms and represents the higher most probable state determined from the statistical distribution of data point values in the waveform.
width	**(wid)**	Width of the first pulse (either positive or negative), averaged for all similar pulses between the cursors.

Frequency Domain Parameters

maximum	**(max)**	Maximum value of the waveform between the cursors (i.e. amplitude of the largest frequency component).
total power	**(tpwr)**	Area under the power density spectrum. This parameter is only computed on waveforms produced by the FFTPWD function. See page 3-68.
frequency at maximum	**(xamx)**	Frequency at maximum amplitude.
frequency at minimum	**(xamn)**	Frequency at minimum amplitude.

Histogram Parameters

amplitude	**(ampl)**	Top minus base.
base	**(base)**	The centroid of the leftmost significant peak.
full width at half max	**(fwhm)**	The width of the distribution surrounding the mode including values which are at least 1/2 of the maximum value.
full width user-specified	**(fwxx)**	Full width at a user-specified percentage of the maximum value. When fwxx is selected, the argument "Threshold" is displayed at the bottom of the screen. Pushing the Edit Arguments softkey al-

		lows selection of threshold values from 0 to 100 percent of the maximum value. The default is 50%.
maximum	**(max)**	Horizontal coordinate of rightmost non-zero bin.
maximum population	**(maxp)**	Maximum population in any histogram bin (i.e.vertical value at the mode).
mean	**(mean)**	Horizontal centroid of the distribution.
median	**(medi)**	Horizontal median. Horizontal value of the midpoint of the distribution.
minimum	**(min)**	Horizontal coordinate of the leftmost non-zero bin.
mode	**(mode)**	Horizontal coordinate of the bin with maximum population.
percentile	**(pctl)**	The horizontal coordinate to the left of which lies a user-specified percentage of the distribution. When percentile is selected, the argument "Threshold" is displayed at the bottom of the screen. Pushing the Edit Arguments softkey allows selection of threshold values from 0 to 99 percent of the distribution. The default is 95%.
peak-to-peak	**(pkpk)**	Horizontal difference between the maximum and minimum values.
peaks	**(pks)**	The number of peaks in the distribution.
histogram root mean square	**(rms)**	Square-root of sum of squares divided by number of values, computed on the distribution.
histogram standard deviation	**(sdev)**	Square-root of sum of squares of difference from mean, divided by number of values - 1, computed on the distribution.
top	**(top)**	The centroid of the rightmost significant peak
population	**(totp)**	Total population in the histogram.
user-specified peak.	**(xapk)**	The horizontal mean of the user-specified peak. The peak is specified by number, where the peaks are sorted by decreasing area above the background. (i.e. the peak with the largest area is number 1, the next largest peak is number 2, etc.) When xapk is selected, the argument "peak" is displayed at the bottom of the screen. Pushing the Edit Arguments softkey allows selection of the peak number. The default is 1.

Persistence Setup Screen

Persistence mode of the 7200A keeps prior sweeps on the display to allow comparison of successive acquisitions. The Persistence Setup screen is used to select the number of sweeps remembered in persistence mode, and xy mode with persistence.

To display the Persistence Setup screen, press MODIFY and the Turn On Persistence soft-key. The Persistence Setup screen will display its current selections. Figure 3.28 shows an example Persistence Setup screen.

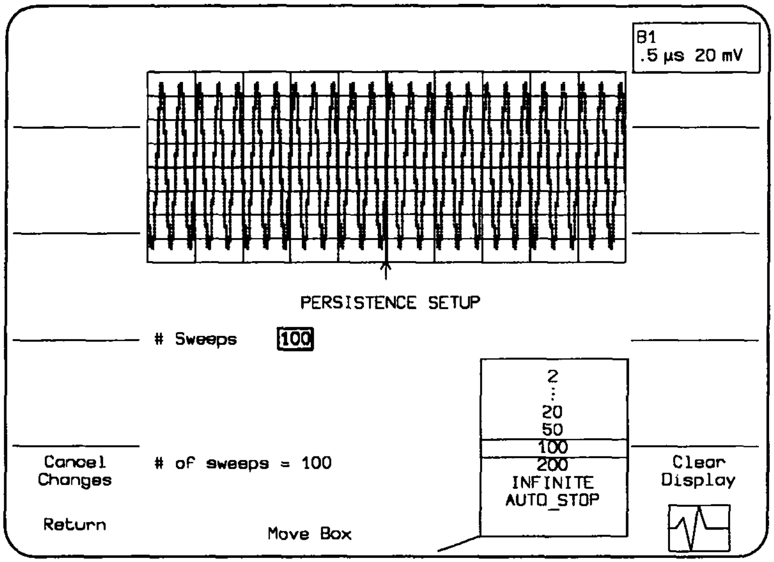


Figure 3.28: Example Persistance Setup screen

To set the number of Sweeps, rotate the Modify Value knob. The number of sweeps may be set to 2, 5, 10, 20, 50, 100, 200, INFINITE or AUTO_STOP. The selection will appear in the highlighted box in the # Sweeps field.

When INFINITE or AUTOSTOP is selected, the 7200A keeps a count of the number of times each pixel gets "hit" by a sample point. Each pixel can be hit upto 65535 times. (Note that, in AUTOSTOP, acquisitions will stop as soon as the first pixel reaches the maximum value). The number of counts of the pixel determines which color the pixel is drawn. The color bar shown in Persistence Setup Screen displays the colors as a function of count density;

100% represents the pixel with the highest number of counts. Displaying the data in this manor adds a qualitative view of the sample point density.

Upto 64 different colors can be used for this display. Refer to the Display Setup Screen for more details, Page. 3-128.

The # of sweeps field contains the number of sweeps currently contained in the persistence array.

Multi Zoom Setup Screen

The 7200A allows a group of traces to be locked together. Trace locking allows simultaneous expansion and repositioning of the traces. When any of the traces in the group is the selected trace and an expansion or position control is changed, the control is applied to all of the traces in the group. The Common Expand Setup Screen is used to select traces assigned to a group and to select whether the group applies to the horizontal and/or vertical controls.

To display the Expand Setup Screen press MODIFY followed by Turn On/Off Multi Zoom or any of the expand or position controls. Figure 3.29 shows an example of the Multi Zoom Setup Screen.The Multi Zoom Setup screen will display its current selections:

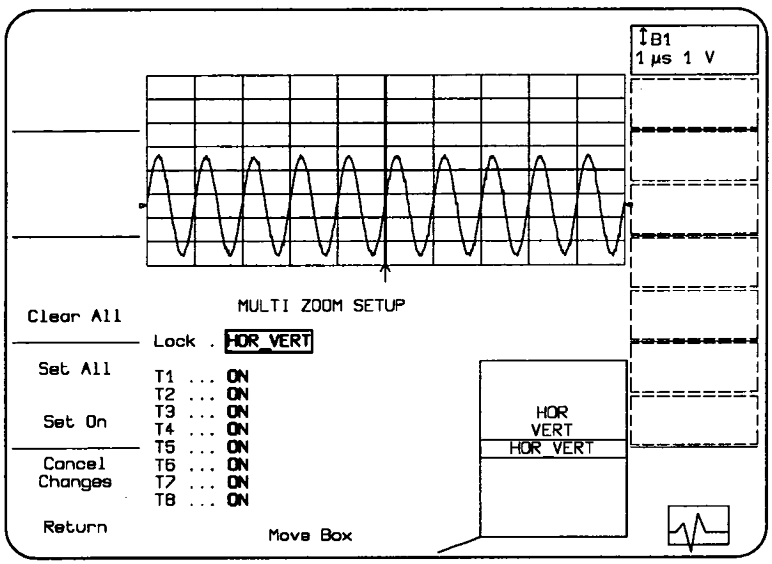


Figure 3.29 Example Multi Zoom Setup Screen

The move box knob is used to select a field for modification. The options list in the lower right screen will indicate available choices with the current selection in the center. To change the selection, rotate the modify value knob to move the desired choice to the center of the list. The new choice will also replace the previous one in the box.

After modifying fields, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original trace grouping and expansion setup, and displays the Main Screen.

The following fields and softkeys appear when the Multi Zoom Setup screen is displayed:

Lock — Selects whether the Horizontal and /or Vertical expansion controls are locked together for the selected group of traces.

T1 ... T8 — Eight fields to select any combination of traces to be locked together.

- ON — indicates that trace is part of the selected group.
- OFF — allows the trace to be expanded or positioned independently of all other traces.

Clear All — Softkey removes all of the traces currently selected in the group.

Set All — Softkey selects all of the traces.

Set On — Softkey select all the traces currently displayed to be in the trace group.

Hardcopy Setup

The 7200A can produce an image of the screen, a printout of a waveform, or a printout of a program. The plot or printout can be made on one of several different plotters and printers via the 7200A's GPIB, Centronics, and RS-232-C ports (or it can be saved on 3.5" floppy diskette). The plot or printout can also be annotated with user supplied text.

To select Hardcopy options, press MODIFY (24) and then HARDCOPY (11). The Hardcopy Setup screen will display its current selections. Figure 3.30 displays the Hardcopy fields when a HP7470A plotter is selected as the hardcopy device.

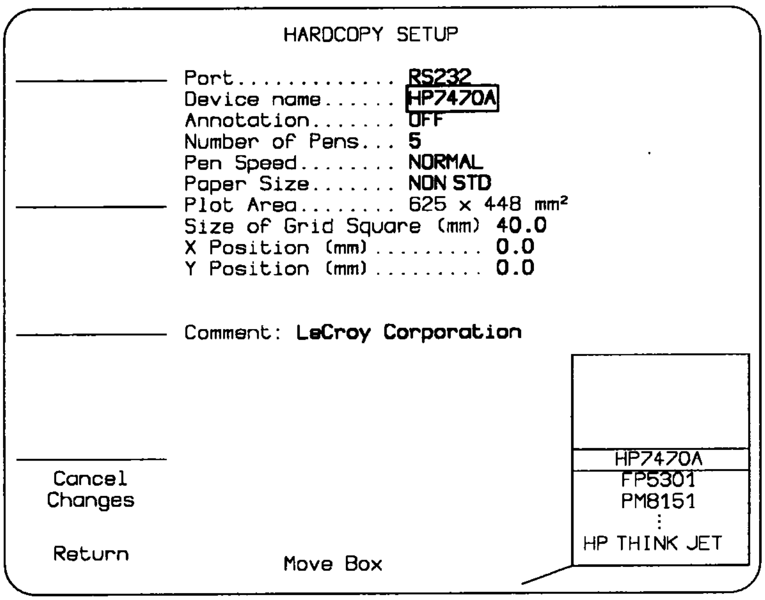


Figure 3.30 Hardcopy Setup for an HP7470A Plotter

To change Hardcopy settings, rotate the Move Box knob to select a field for modification. The options list in the lower right screen will indicate available choices. To change the selection, rotate the Modify Value knob to move the desired choice between the lines in the center of the options list. The new choice will also replace the previous one in the box.

Upon completing Hardcopy Setup modifications, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all modifications, restores the original setup, and displays the Main Screen.

The Hardcopy Setup screen is organized such that certain fields are present whether the hardcopy device is a plotter or a printer. However, some fields are device specific. Following are fields which always appear when the Hardcopy Setup screen is displayed.

Port

Specifies which port (GPIB, RS-232-C, Centronics, or Floppy drive) is used for the hardcopy device.

When the hardcopy port is selected to be the same as the Remote control port, the local hardcopy key is disabled from generating hardcopies. Instead, pressing the hardcopy key will set the User Request (URQ) bit in the Standard Event Status register (ESR). If a system controller is used, it may elect to detect this event and initiate a hardcopy remotely, after properly setting up all connected devices. If a controller is not used, then set the "Remote Control from" field in the Communication Setup screen so it does not conflict with the hardcopy port.

When Floppy is selected as the port, the Filename field will appear:

Filename specifies a filename for identifying data saved to floppy diskette. To change the filename, move the box onto the Filename field. The Edit Text softkey will appear in the upper left screen. When it is pressed, the Insert Character and Delete Character softkeys will appear, and the box will move on an individual character in the Filename field.

Insert Character — Press the Insert Character softkey once for each character to be inserted. Each new character will match the character in the box and will be displayed to the right of the box. After adding a character(s), use the Modify Value knob to change the character as desired.

Delete Character — Press the Delete Character softkey to delete the character in the box.

Default Text — Press the Default Text softkey to set the filename to its default value, "HARDCOPY".

When you are finished editing the Filename, press the Return softkey to continue modifying other fields on the Hardcopy Setup screen.

When Floppy is the selected port, pressing Hardcopy will direct the output to the selected filename on the floppy disk. If the filename already exists, the following warning prompt will appear in the message area:

OVERWRITE "filename"? (PRESS YES OR NO)

and the YES and NO softkeys will appear.

YES	Pressing YES will overwrite the file.
NO	Pressing NO cancels the Hardcopy operation.

Device Name

Specifies the name of the hardcopy device. The 7200A supports the following plotters and printers:

Plotters	
HP7470A	Hewlett Packard 7470A
FP5301	GRAPHTEC FP5301
PM8151	Philips PM 8151
HP7550A	Hewlett Packard 7550A

Printers	
CITIZEN 120D	Citizen 120D
HPQJ	Hewlett Packard Quiet Jet
EPSON	FX series or compatible
HP LASER JET	Hewlett Packard Laser Jet
HP THINK JET	Hewlett Packard Think Jet

All fields (except the Port) are device specific, allowing the user to set different parameters for different devices.

Annotation

Selects whether the 7200A will print/plot the logo, date, time, comment, and softkey labels with the grid and waveform display.

Plot Area

Displays the size of the resulting plot in length x width mm^2. The Plot Area field is read only.

Comment

The Comment field accepts a user comment of up to 40 characters to describe the print/plot. (The Comment appears at the top of the plot on the same line as the date and time when annotation is ON.) To change the Comment, move the box on the Comment field. The Edit Text softkey will appear in the upper left screen. When it is pressed, the Insert Character and Delete Character softkeys will appear, and the box will move on individual characters in the Comment field.

Insert	Press the Insert Character softkey once for each character to be inserted. Each new character will match the character in the box and will be displayed to the right of the box. After adding a character(s), use the Modify Value knob to change the character as desired.
Delete Character	Press the Delete Character softkey to delete the character in the box.
Default Text	Press the Default Text softkey to set the comment to its default value, "7200A Precision Digital Oscilloscope".

NOTE: The comment field must be at least 1 character long. If no comment is desired, the remaining character can be replaced by a space (selected from Options List).

Plotters

When the hardcopy device selected is a plotter, the Hardcopy Setup screen will also contain these fields:

Number Of Pens

Enables color plots if multiple pens are present and indicates the maximum number of pens being used. The 7200A can control up to eight pens. The number of pens selected should match the number of pens supported by the plotter.

Pen Speed

Selects the plotter's drawing rate: SLOW or NORMAL. Selecting SLOW is appropriate when using slow-drying ink pens so the plot does not smear on lines that cross.

Paper Size

Specifies the size of the paper. The choices are A5 (5.5" x 8.5"), A4 (8.5" x 11") , A3 (11" x 17"), and NON STD. If NON STD is selected, the following fields appear:

Size of Grid Square (mm)	can be selected from 0.1 to 99.9 mm
X Position (mm)	can be selected from -999.9 to 999.9 mm
Y Position (mm)	can be selected from -999.9 to 999.9 mm

In Non Standard, the user specifies the size (either length or width) of a single grid square to determine the proportions of the resulting plot. A grid square is the length or width (in millimeters) of a single square on the grid when single grid is selected on the Main Screen. The user can also position the plot anywhere on the paper by specifying the lower left corner (via the X and Y positions).

> *NOTE: The size selected should match the paper used or "OUT OF LIMIT" errors will occur which may ruin the plot.*

Printers

When the hardcopy device selected is a printer, the Hardcopy Setup screen will display certain fields which are specific to the printer configuration. These fields will change to match the selection in the Type of Output field. Figure 3.31 displays the Hardcopy fields when an EPSON printer is selected as the hardcopy device and the Type of Output is a Screen Dump.

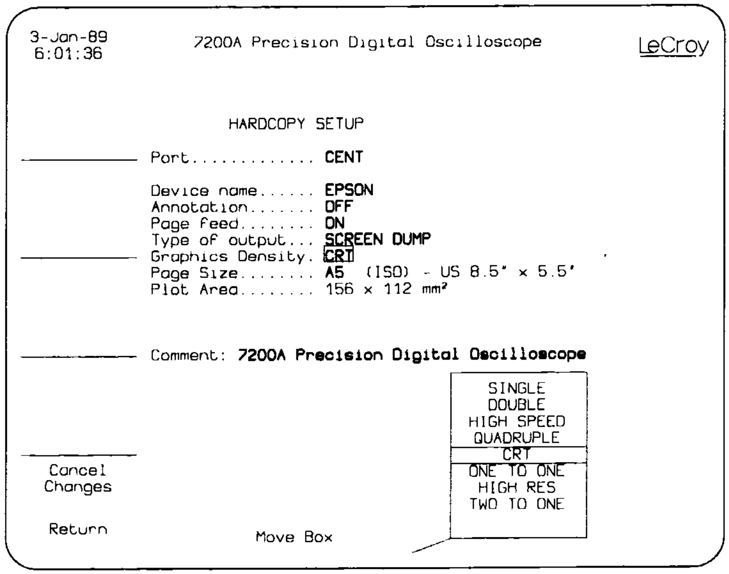


Figure 3.31 Hardcopy Setup for an EPSON Printer

The HARDCOPY fields specific to printers follow:

Type of Output

Specifies the type of output to the printer. The choices are Screen Dump, Waveform, and Program.

Page Feed

Page feed ON will cause the last page printed to be followed by a Form Feed. Page Feed OFF will not advance the paper when the printer has completed the hardcopy.

Screen Dump

Screen Dump causes the contents of the screen to be printed. All prints begin at the current paper position and at the left edge of the paper. When Screen Dump is selected as the type of output, the following fields are added to the Hardcopy Setup screen:

Graphics Density Specifies the resolution. Choices vary by type of printer. The higher the resolution, the finer the printer plots. Higher resolution plots take longer to generate.

Page Size Specifies the page size. The choices are A5 (5.5" x 8.5") and NON STD. If NON STD is selected the grid square field appears:

Size of Grid Square (mm) can be selected from 0.1 to 99.9 mm. (See p. 3-107 for details.)

NOTE: The size of the plot selected should be less than or equal to paper used or information will be lost.

Waveform

Waveform enables you to print waveform data values and/or acquisition information in tabular form on a printer. The acquisition information is printed in rows and columns with a field description followed by its value. This makes it easy to determine all the parameters and values of the waveform in a readable fashion. When Waveform is selected as the type of output, the following fields are added to the Hardcopy Setup screen:

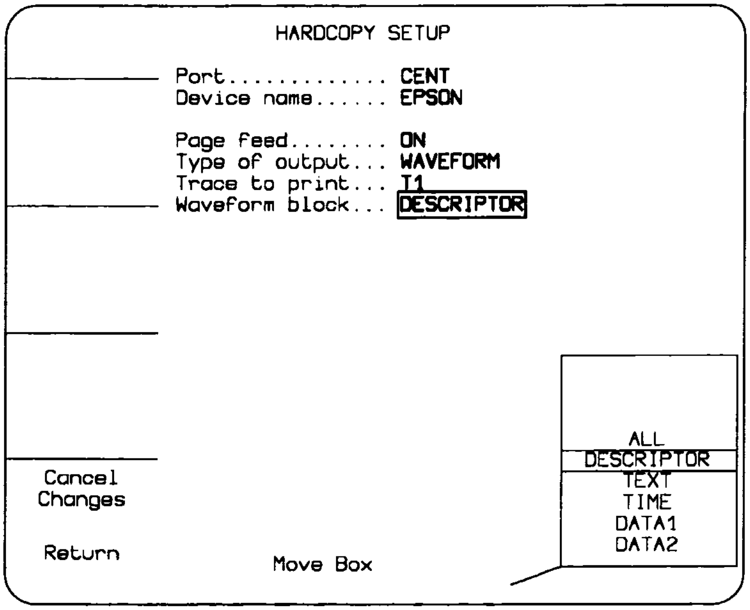


Figure 3.32 Hardcopy Setup to print the waveform Descriptor

Trace to Print — Specifies which trace to print. The choices are T1 to T8. A channel may be printed by setting a trace to be equal to a channel and acquiring the data prior to printing the trace (i.e., T1= A1).

Waveform Block — Specifies which part(s) of the waveform to print. The choices are:

ALL	Causes the DESCRIPTOR, TEXT, TIME, DATA 1, and DATA 2 to be printed as applicable (see below).
DESCRIPTOR	Causes the acquisition settings to be printed.
TEXT	Not implemented.

TIME	Causes sequence waveform time arrays to be printed.
DATA 1	Causes the actual waveform data samples to be printed.
DATA 2	For dual waveforms, such as extrema, causes the second set of waveform data samples to be printed.

Program

Selecting Program causes the current program to be printed (see Program Setup, page 3-139).

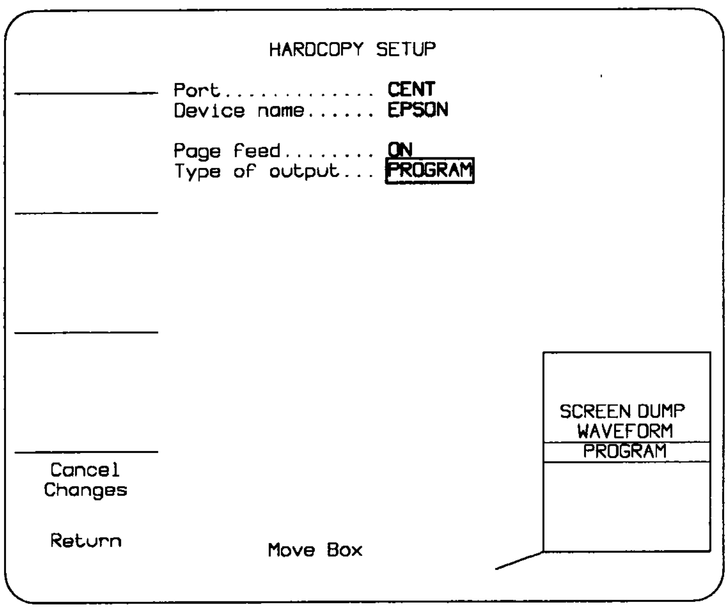


Figure 3.33 Sample Hardcopy Setup to print a Program

Waveform Storage Setup

The 7200A can store trace waveforms to MS-DOS formatted 3.5" floppy diskettes or to the non-volatile internal memories M1...M8. Use the Waveform Storage Setup screen to select which traces to store and to assign where to store them. The actual store operation does not occur until the STORE key is pressed.

NOTE: Only those traces which have been selected on the Waveform Storage Setup screen and which are displayed at the time the STORE key is pressed will be stored.

To display the Waveform Storage Setup screen, press MODIFY and then STORE. The Waveform Storage Setup screen will display its current selections. Figure 3.34, for example, indicates that when the STORE key is pressed, trace 1 (designated T1) will be stored to a file named PROBE.000, trace 2 will be stored to M1, trace 4 to M6, and trace 7 to a file named TRACE7.000

NOTE: The memories M1...M8 are non-volatile, i.e. they maintain their contents even when the power is off. The memories (as well as the Record Traces buffer) are cleared when the Clear Memories softkey in the Configure System Setup screen is pressed.

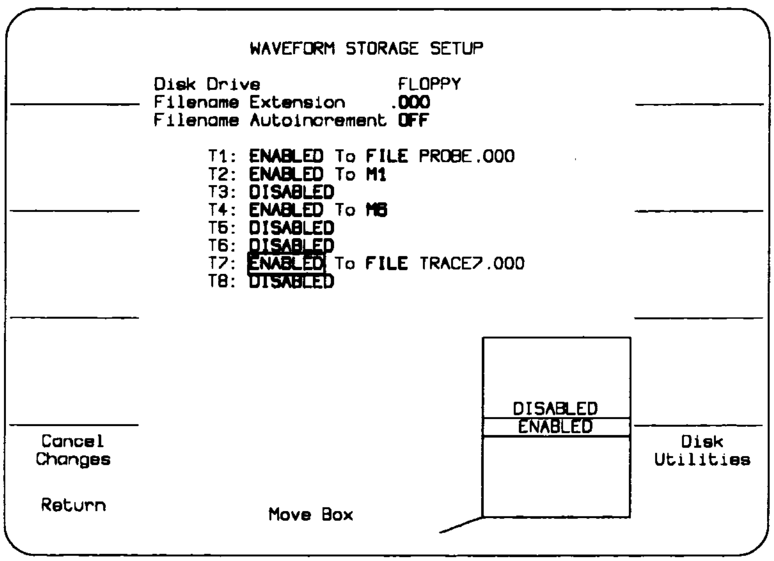


Figure 3.34: Example Waveform Storage Setup Screen

The Move Box knob is used to select a field for modification. The options list in the lower right screen will indicate available choices with the current selection in the center. To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the previous selection in the box.

After modifying fields, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The following fields and softkeys appear when the Waveform Storage Setup screen is displayed:

Disk Drive

This read-only field indicates that traces can be stored to the floppy diskette, but not the internal disk.

Filename Extension

Selects the numeric extensions for the filenames used for storing to floppy.

A filename has two parts which are separated by a period. For storing traces, the first part of the filename corresponds to the trace label. The trace label is selected in the Trace Setup screen (see p. 3-64). The default labels are TRACE1, TRACE2, etc.

The second part of the filename is called the extension. Traces are always stored to files with numeric extensions which range from .000 through .999.

Use the Filename Extension field to choose the numeric extensions of the filenames to which the selected traces will be stored. For example, if the trace label is TRACE1 and the selected filename extension is .017, the trace will be stored in a file called TRACE1.017.

Filename Autoincrement

Selects whether subsequent presses of the STORE key will store data in separate files or will overwrite the same file. This feature allows you to store a series of files without reconfiguring the Storage Setup in between each store operation.

The choices are OFF and ON:

OFF — Uses the same file for all presses of the STORE key, overwriting whatever was previously in the file.

ON — For each press of STORE, a new filename is generated by incrementing the extension of the previously used file. If the initial filename is TRACE1.000, for example, the second store would use TRACE1.001, and the 1000th store would use

TRACE1.999. The 1001st store would use file TRACE1.000, overwriting the first stored trace.

NOTE: If the filename already exists on the floppy, the warning prompt OVERWRITE "filename"? (Press YES or NO) *will appear when the STORE key is pressed. Press the* YES *softkey to overwrite the file,* NO *to abort the store operation.*

T1,...T8

Specifies whether the corresponding trace will be stored. The choices are ENABLED and DISABLED. DISABLED traces are not stored. When a trace is ENABLED, the "To" field appears:

To

Indicates where to store the trace waveform. The choices are FILE, M1, M2, M3, M4, M5, M6, M7, M8, T1= M1, T2= M2, T3= M3, T4= M4, T5= M5, T6= M6, T7= M7, T8= M8.

FILE — Stores the trace to floppy disk. When selected, the filename used for the next store appears to the right of FILE. As discussed above under Filename Extension, the trace label is used in the filename.

M1...M8 — Stores the trace to the specified internal memory.

T1= M1... T8= M8 — Stores the trace to the specified internal memory, changes the indicated trace equation to Tx= Mx, and turns on the indicated trace. (This is a shortcut for storing to memory Mx and then entering the Trace Setup screen for trace Tx and changing its equation to Tx= Mx in order to display the waveform in Mx.) See "Setting Up Traces and Processing Functions" on page 3-56.

For example, if the following fields are selected: T1: ENABLED To T3= M3, when the STORE key is pressed the trace 1 waveform will be stored to memory M3, the trace equation of trace 3 will automatically be changed to T3= M3 (so that trace 3 will display the contents of M3), and trace 3 will be turned on for display.

Disk Utilities

This softkey displays the Disk Utilities screen (see page 3-118). which can be used to format floppy diskettes or to examine or delete files on a disk.

Waveform Recall Setup

The 7200A can recall waveforms from MS-DOS formatted 3.5" floppy diskettes to the internal memories M1...M8. The waveforms in the memories can then be displayed and/or processed as traces. The Waveform Recall Setup screen is used to select waveform files to recall and to assign where they are placed. The actual recall operation does not occur until the RECALL key is pressed .

NOTE: The memories M1...M8 are non-volatile, i.e. they maintain their contents even when the power is off. The memories (as well as the Record Traces buffer) are cleared when the Clear Memories softkey in the Configure System Setup screen is pressed.

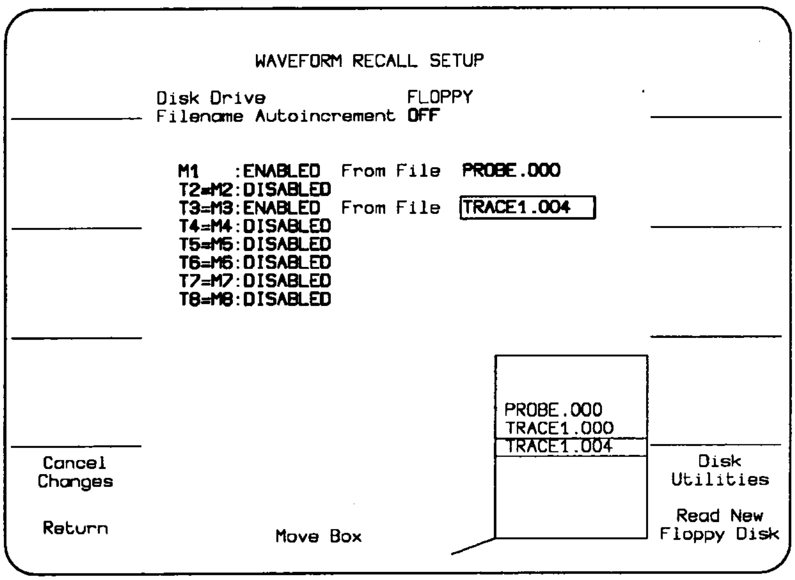


Figure 3.35: Example Disk Waveform Recall Setup Screen

To display the Waveform Recall Setup screen, press MODIFY and then RECALL. The Waveform Recall Setup screen will display its current selections. For example, Figure 3.35 indicates that pressing the RECALL key will cause the waveform in file PROBE.000 to be recalled to memory M1, and the waveform in file Trace1.004 to be recalled to M3 and displayed in T3.

The Move Box knob is used to select a field for modification. The options list in the lower right screen will indicate available choices with the current selection in the center. To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the previous one in the box.

After modifying fields, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The following fields and softkeys appear when the Waveform Recall Setup screen is displayed:

Disk Drive — This read-only field indicates that waveforms can be recalled from floppy diskette only.

Filename Autoincrement — Selects whether subsequent repeated presses of RECALL will recall a waveform from a series of files or from one file. The choices are OFF and ON:

OFF	Recalls waveform data from the same file for all presses of the RECALL key.
ON	Recalls waveforms from a sequence of files on disk. For each press of RECALL, the numeric extension of the previously used filename is incremented to the next file on disk before the recall occurs. The extensions on the disk do not have to be sequential; the filename with the next higher extension will be used.

M1 or T1= M1
.
.
.
M8 or T8= M8

Specifies whether a waveform will be recalled to the corresponding memory and whether or not the corresponding trace equation will automatically be changed. If Mx is chosen, the waveform is simply recalled to memory Mx. If Tx= Mx is chosen, the waveform is recalled to memory Mx, the trace equation of Tx is changed to be Tx= Mx, and trace Tx is turned on. (This is a shortcut for recalling to memory Mx, then entering the Trace Setup screen for trace Tx and changing its equation to Tx= Mx to display the waveform in Mx.) See "Setting Up Traces and Processing Functions" on page 3-56.

For each memory, the choices ENABLED and DISABLED are available. DISABLED memories are not recalled. When a memory is ENABLED, the "From File" field appears:

From File Indicates which file to recall. The available choices are all the files on the floppy disk with numeric extensions. (Waveforms are always stored to files with numeric extensions.). To recall from a different disk, change the disk and press the Read New Floppy Disk softkey. The new floppy's files will be displayed in the options list.

The 7200A will not test whether the selected file contains a valid waveform until the RECALL key is pressed later to initiate the actual recall operation.

For example, if the following fields are selected:

T3= M3: ENABLED From File LASER.000

when the RECALL key is pressed, the waveform in the file LASER.000 will be recalled and placed in memory M3, the trace equation of trace 3 will automatically be changed to T3= M3 (so that trace 3 will display the contents of M3), and trace 3 will be turned on for display.

Disk Utilities This softkey displays the Disk Utilities screen (see page 3-118), which can be used to format floppy diskettes or to examine or delete files from a disk.

Disk Utilities

The Disk Utilities screen contains softkeys and fields which are used to access and maintain disk files. To access the Disk Utilities screen, press the Disk Utilities softkey from the Waveform Recall Setup, Waveform Storage Setup, Panel Settings, or Program Setup screens:

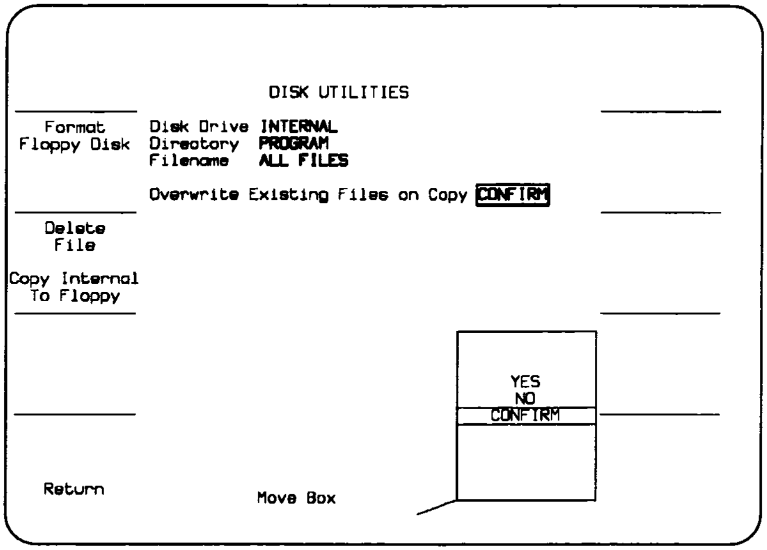


Figure 3.36: Example Disk Utilities Screen

Rotate the Move Box knob to select a field for modification. The options list in the lower right screen will indicate available choices with the current selection in the center. To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the previous one in the box.

Press the Return softkey to return to the previous screen.

The Disk Utilities screen contains softkeys and fields as follows:

Disk Drive

Specifies the current drive for disk utility operations. The choices are INTERNAL and FLOPPY.

INTERNAL When INTERNAL is selected, the Directory field appears beneath the Disk Drive field and softkey (6) is labeled Copy Internal to Floppy.

Directory Specifies the current directory (the group of related files) for disk utility operations on the internal drive. The choices are PANEL SETUPS and PROGRAM.

FLOPPY When FLOPPY is selected, the Read New Floppy Disk softkey appears and softkey (6) is labeled Copy Floppy to Internal.

Read New Floppy Disk To read the files on a new floppy disk, insert the desired disk and press the Read New Floppy Disk softkey. The floppy's files will appear in the Filename options list.

Filename

Specifies either ALL FILES or the individual file for disk utility operations. The filenames on the specified disk and directory are displayed in an options list in the lower screen. The selected file will appear in the center of the list and in the Filename field. Next to this field, the date and time of the file are shown. Use the Modify Value continuous knob to scroll through the list and select the desired filename. To specify all files, select the ALL FILES option at the beginning of the list. When ALL FILES is selected the Overwrite Existing Files on Copy field appears below the filename field.

Overwrite Existing Files on Copy

For a copy ALL FILES operation, specifies whether existing files should be overwritten. The choices are YES, NO, CONFIRM.

YES — When YES is selected all files will be copied. If a file to be copied has the same name as one that already exists, the file will overwrite the existing file.

NO — When NO is selected, only not already existing files will be copied. If a file to be copied has the same name as one that already exists, the file will not overwrite the existing file.

CONFIRM — When CONFIRM is selected, if a file to be copied has the same name as one that already exists, the following warning prompt will appear in the message area:

"OVERWRITE "(filename)"? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

- YES — Pressing YES overwrites the existing file.
- NO — Pressing NO skips the file and continues the copy operation with the next file.

Copy Internal to Floppy

Press the Copy Internal to Floppy softkey to copy the selected file(s) from the internal disk to a floppy disk.

If ALL FILES is selected for Filename, all files on the selected directory on the internal disk will be copied to the floppy. If one of the files to be copied has the same name as a file already existing on the floppy disk, the 7200A will either overwrite the existing file, not overwrite the existing file, or ask for confirmation, as specified by the Overwrite Existing Files on Copy field described above. When the Copy Internal to Floppy softkey is pressed, the following warning prompt will appear in the message area:

"COPY ALL FILES? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

- YES — Press YES to initiate the Copy operation.
- NO — Press NO to cancel the Copy operation.

If an individual file is selected for Filename, only the selected file will be copied from the internal disk to the floppy. If a file with the same name already exists on the floppy disk, the following warning prompt will appear in the message area:

"OVERWRITE "(filename)"? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

YES	Press YES to overwrite the existing file.
NO	Press NO to cancel the Copy operation.

Copy Floppy to Internal

Press the Copy Floppy to Internal softkey to copy the selected file(s) from a floppy disk to the internal disk. Panel settings files with the extension .PNL will be copied to the PANEL SETUPS directory on the internal disk. RCL program files with the extensions .SRC and .APD will be copied to the PROGRAM directory on the internal disk. Files with other extensions will not be copied.

If ALL FILES is selected for Filename, all panel settings and program files on the floppy will be copied to the appropriate directories on the internal disk. If one of the files to be copied has the same name as a file already existing on the internal disk, the 7200A will either overwrite the existing file, not overwrite the existing file, or ask for confirmation, as specified by the Overwrite Existing Files on Copy field described above. When the Copy Floppy to Internal softkey is pressed, the following warning prompt will appear in the message area:

"COPY ALL FILES? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

YES	Press YES to initiate the Copy operation.
NO	Press NO to cancel the Copy operation.

If an individual file is selected for Filename, only the selected file will be copied from the floppy disk to the internal disk. If the file is not a panel settings or program file, a warning message will be displayed and the copy will be aborted. If a file with the same name already exists on the internal disk, the following warning prompt will appear in the message area:

"OVERWRITE "(filename)"? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

YES Press YES to overwrite the existing file.

NO Press NO to cancel the Copy operation.

Delete File

Pressing the Delete File(s) softkey deletes the selected file. If the ALL FILES option is selected all files on the selected disk and directory will be deleted. After pressing the Delete File softkey, the following warning prompt will appear in the message area:

"DELETE FILE (filename)? (PRESS YES OR NO)"

or "DELETE ALL FILES? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

YES Pressing YES deletes the selected file(s).

NO Pressing NO cancels the Delete File operation.

Format Floppy Disk

Press the Format Floppy Disk softkey to format a 3 1/2" floppy disk. After inserting the floppy and pressing the Format Floppy Disk softkey, the following warning prompt will appear in the message area:

"FORMAT FLOPPY? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

YES Pressing YES begins the formatting process. All data on the disk will be destroyed during the formatting process. The 7200A will now display the prompt "FORMAT HIGH DENSITY? (PRESS YES OR NO)" and the YES or NO softkeys will reappear. Press YES if you want the floppy formatted for 1.44 Mbytes (High Density). Press NO if formatting the floppy for 720k byes is desired.

NO Pressing NO cancels the Format Floppy Disk operation.

TRACE ANNOTATION SETUP

This setup screen allows the user to annotate up to 10 different points of interest on a trace. The annotation is associated with a trace and moves along with the trace as it is repositioned on the screen. The text is saved with the trace if it is stored to disk or read out of the 7200A via a remote port. It is also useful for generating hardcopy reports.

To display the Trace Annotation Setup screen, press the Annotate Trace softkey in the Trace Setup screen. The current setting of each field on the Trace Annotation Setup screen is displayed as can be seen in Figure 3.37.

The Move Box knob is used to select a field for modification. The options list in the lower right screen indicates the available choices with the current selection in the center. To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the previous one in the box.

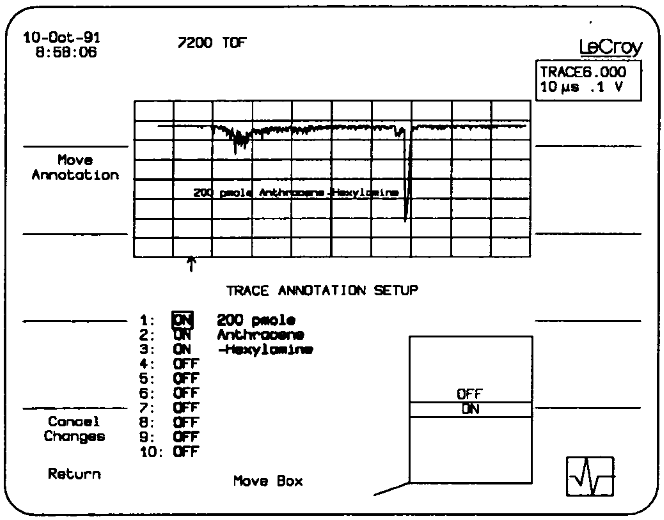


Figure 3.37. Example Trace Annotation Setup Screen

After modifying fields, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all changes made while in this screen and displays the Main screen.

The fields and softkeys are described below:

1 ... 10

There are two fields for each of the 10 strings you can associate with a trace. The first field selects whether or not the string should be displayed. The second field is the text for the string. When you move the box onto the text field, the Edit Text softkey will appear in the upper left of the screen. When it is pressed, the Insert Character, Delete Character, and Default Text softkeys will appear and the box will move on individual characters in the string.

Insert — Press the Insert Character softkey once for each character to be inserted. Each new character will match the character displayed in the box and will be displayed to the right of the box. After adding a character, use the Modify Value contiuous knob to change the letter as desired.

Delete — Press the Delete Character softkey for each character to be deleted.

Default — Press the Default Text softkey to change the text string back to it's default.

Once the desired changes are made, press the Return softkey to save the editted text string and continue modifying other fields of the Trace Annotation Setup screen. If the changes are not desired, press the Cancel Changes softkey to retain the original text.

Move Text

When this softkey is pressed, a horizontal and vertical cursor appear on the grid. The detented knob under the center of the screen is used to select which cursor to move. The center continuous knob is used to move the selected cursor around on the screen. The begining of the selected text will be placed at the intersection of the two cursors. If the text was not previously enabled for display, it is automatically turned on when this key is pressed. When you have positioned the text where you want it, press the Return key to save the changes and return to the Trace Annotation Setup screen or Cancel Changes to restore it to its previous position.

DISPLAY OPTIONS SETUP

The Display Options Setup screen allows the operator to select whether or not he wishes additional annotation on the display as well as how some waveforms are displayed.

To access the Display Options Setup screen, press MODIFY and then GRIDS. The Display Options Setup show its current selections as can be seen in Figure 3.38.

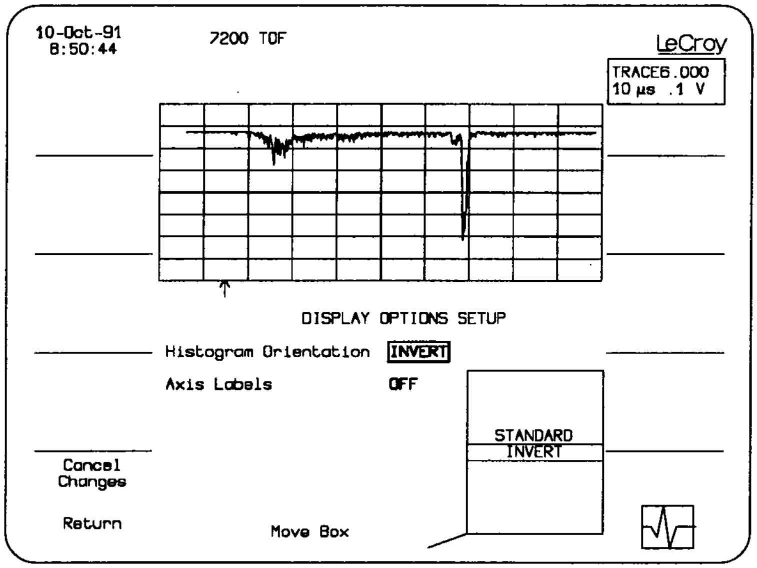


Figure 3.38. Example Display Options Setup Screen

The Move Box knob is used to select a field for modification. The options list in the lower right screen indicates the available choices with the current selection in the center.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the previous one in the box.

After modifying fields, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all changes made while in this screen and displays the Main screen.

The fields of the Display Setup screen are described below:

Axis Labels

When this field is set to ON and the grid is single or dual, the 7200A prints the value of the end points for the active trace on both the horizontal and vertical axes.

Histogram Orientation

Specifies how histograms will be displayed by the 7200A. The selections are STANDARD and INVERT.

STANDARD	In the standard orientation, the histogram is drawn with the zero baseline at one division up from the bottom of the grid and the peaks grow upward.
INVERT	When selected, the baseline is drawn one division down from the top of the screen and the peaks grow downward.

Configure System

The Configure System screen contains softkeys for setting up 7200A operations. It also contains a summary of how each trace is defined, the contents of the waveform memories, and version identification for the 7200A software.

To display the Configure System screen, press the Configure System softkey from the Main Screen:

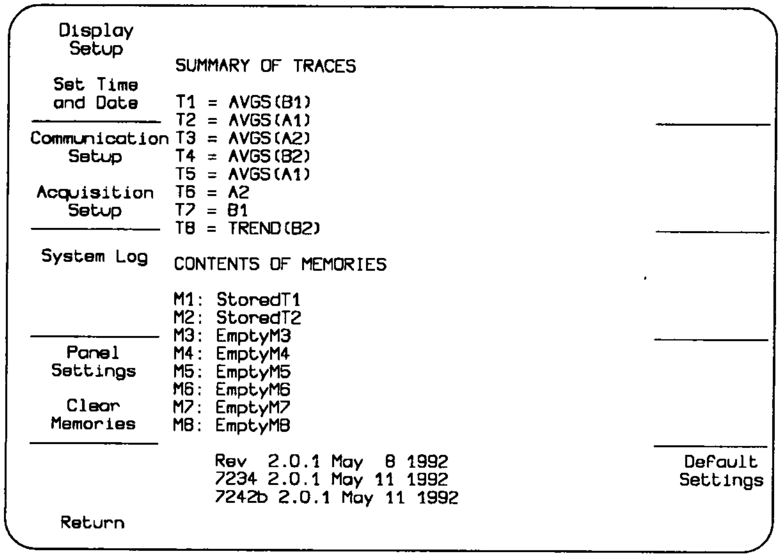


Figure 3.39: Configure System Screen

Pressing a softkey on the left side of screen will display another screen used to select a particular set of 7200A operating characteristics. When in these screens, the Move Box knob is used to select a field for modification. The options list in the lower right screen will indicate available choices with the current choice in the center. To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the previous selection in the box.

After modifying fields, press the Return softkey to save the changes and display the Configure System screen. The Cancel Changes softkey cancels all changes and restores the original setup.

The softkeys in the lower right of the Configure System screen are Default Settings and Reset System:

Default Settings Sets all system and plug-in control settings to their default values. Upon completion, the Main Screen is displayed.

CAUTION: *This softkey will erase all the control settings saved in the non-volatile memory. It will also clear the eight waveform memories, M1...M8, and the Record Traces buffer. Selections set on the Communication Setup screen are stored in non-volatile RAM but are not reset by the Default Settings softkey.*

Clear Memories Erases the 8 internal memories (M1 ... M8) and the Record Traces Buffer.

Pressing the Return softkey from the Configure System screen displays the Main Screen.

The Configure System softkeys and setup screens follow:

Display Options

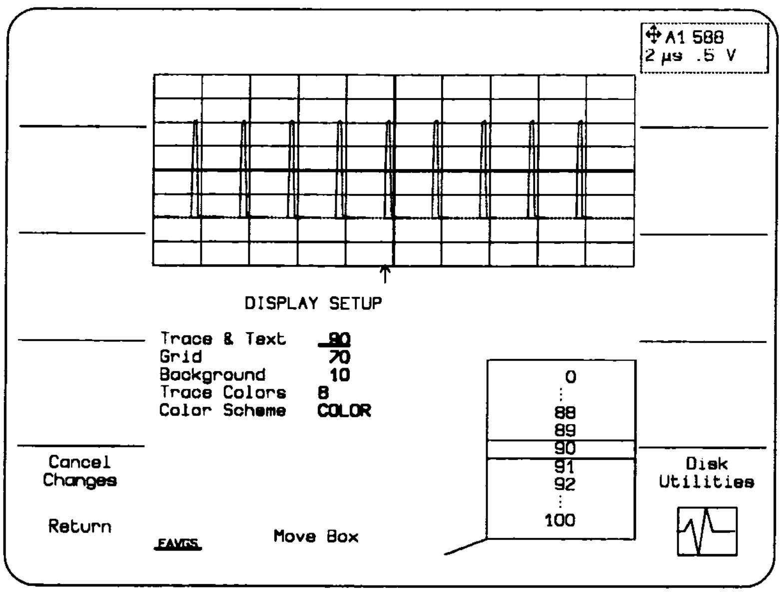


Figure 3.40: Display Setup Screen

Screen Intensity displays a screen which is used to select the brightness of the traces and grid. When Screen Intensity is selected, the following fields appear:

Trace & Text — Sets the intensity level for displaying traces and text on the screen. The choices are from 0 to 100 percent. The intensity of the displayed traces will change to show the effects of the selected level.

Grid — Sets the intensity level used for drawing the grid. The choices are from 0 to 100 percent. The intensity of the displayed grid will change to show the effects of the selected level.

Background — Sets the intensity level for the screen background. The choices are 0 to 100 percent.

Trace Colors — Selects how many different colors should be used to display the traces. Choices are 1 (all traces the same color), 2 (the active trace one color, all other traces a second color), and 8 (each trace is a different color).

Color Scheme — Selects the color scheme to use. The color scheme is a file (in the panel setup directory with a ".COL" extension for color systems and ".MON" for monochrome systems) that contains a list of the color assignments for each possible display entity. The file DEFAULT.COL contains a description of each of the fields.

For 7200A with the color option, the ICL program, COLOR, can be used to generate your own customized color scheme.

Set Time and Date

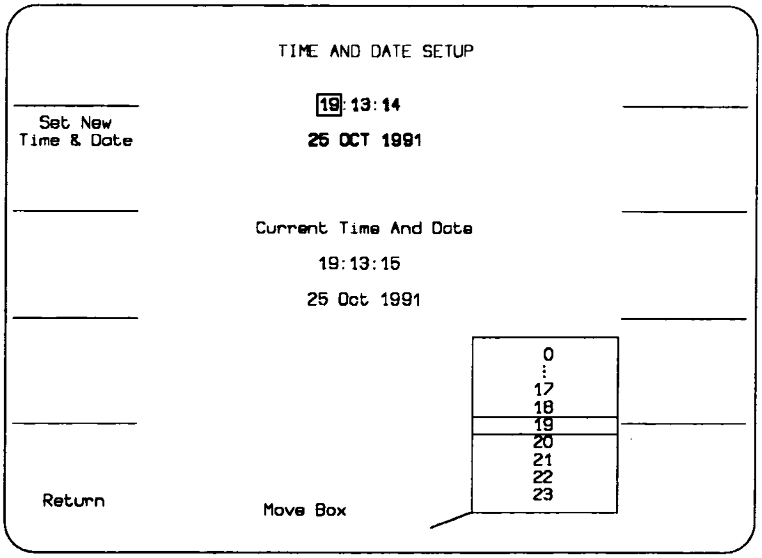


Figure 3.41: Set Time and Date Screen

Set Time and Date displays a screen which is used to set the time and date. These are used for marking acquisition records, annotating hardcopies, etc. They are backed up by battery and need only be set once.

Move the box on the highlighted fields to select the hour, minute, second, day, month, or year. Rotate the Modify Value knob to change the desired field's selection. Following modifications, press the **Set New Time & Date** softkey to record the changes. The new settings will be reflected in the Current Time and Date read-only field.

Communication Setup

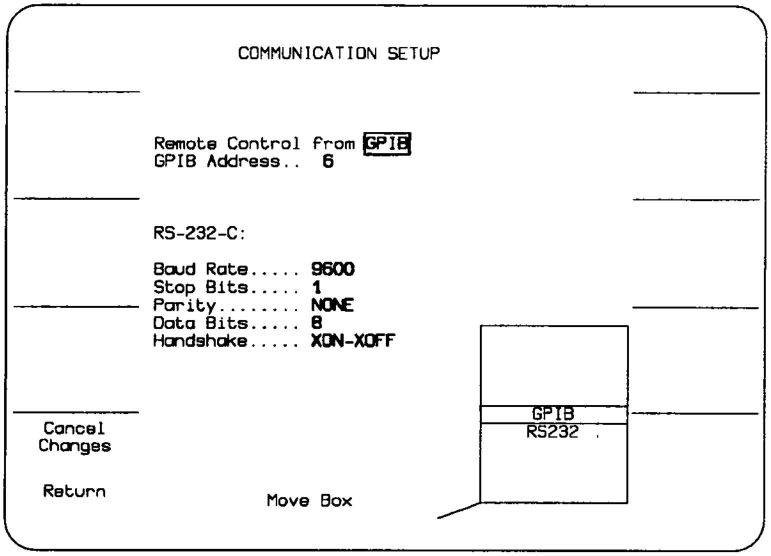


Figure 3.42: Example Communications Setup Screen

Communication Setup displays a screen which is used to set the system's GPIB and RS-232-C port parameters.

To select which Communication port the 7200A will use, rotate the Move Box knob onto the "Remote Control From" field. The only choices are GPIB and RS-232-C. To change the port rotate the Modify Value knob.

If GPIB is selected for Remote Control, the GPIB address field will appear. To select the GPIB address rotate the Move box knob onto the GPIB address field. Rotate the Modify Value knob to select the desired address.

If the same port is selected for both Remote Control and Hardcopy then pressing the local hardcopy key will not generate a hardcopy; instead, the User Request (URQ) bit in the Standard Event Status register (*ESR) will be set. If a remote Host is used, it should detect this bit and initiate the hardcopy remotely, once it has set up all connected devices. If a Remote Host is not connected, simply change the "Remote Control from" field so it does not conflict with the Hardcopy port, and local hardcopies will operate as normal.

The following fields appear to configure of the RS-232-C port:

Baud Rate Sets the baud rate. Choices are from 110 through 19200.

Stop Bits Sets the number of stop bits upon completion of an RS-232-C character transmission. The choices are 1 and 2.

Parity Sets the parity for transmission over the port. The choices are NONE, ODD, and EVEN.

Data Bits Sets the number of data bits per character used. The choices are 5, 6, 7, or 8 bits.

Handshake Sets the serial handshaking method. The choices are HARDWIRE or XON-XOFF. HARDWIRE requires extra lines to be connected in the RS-232-C cable (see information provided with device). XON-XOFF requires the minimum interface connection (transmit, receive, and ground).

Selections set on the Communication Setup screen are stored in non-volatile RAM but are not reset by the Default Settings softkey.

Acquisition Setup

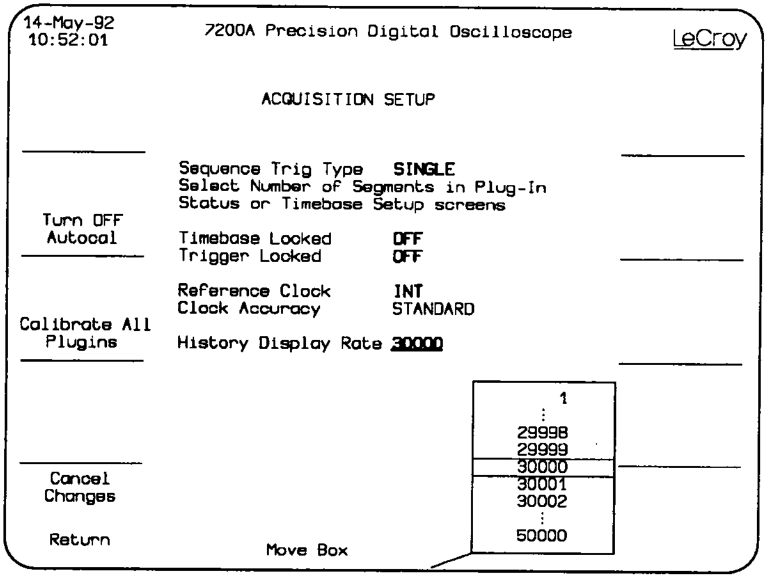


Figure 3.43: Acquisition Setup Screen

The Acquisition Setup Screen contains various options which will affect data acquisitions. This screen can be selected through the Configure System Setup screen or by pressing the modify key followed by a trigger mode key.

Acquisition Setup displays a screen containing the **Turn ON/OFF Autocal** softkey, the **Calibrate All Plug-ins** softkey and five fields.

Turn ON/OFF Autocal enables or disables automatic calibration of the plug-in(s). The label appearing on the screen for the Autocal softkey indicates the next possible choice.

At power-up, auto-calibration is turned ON. Automatic calibration enables periodic calibration of all input channels for the current gain, bandwidth, and timebase settings.

NOTE: This key is provided to allow continuous operation. However, if the temperature, etc. changes, the 7200A's accuracy will decrease.

Calibrate All Plug-ins allows starting a calibration of all plug-ins to ensures overall vertical, timebase, and trigger accuracy.

The Acquisition Setup screen fields are used to select sequence trigger type, whether or not plug-ins trigger together, and whether or not changes to the timebase or trigger settings in one plug-in will change those for the other plug-ins. The screen also allows selection of the system reference clock. The Clock Accuracy read only field indicates if the standard or high accuracy clock is installed.

Following are descriptions of the selectable fields:

Sequence Trig Type

Selects single or normal sequence acquisitions. Valid when in Sequence trigger mode.

Single	Acquires and displays a single sequence waveform
Normal	Acquires and displays sequence waveforms continuously until Sequence Trigger mode is pressed again.

Timebases

Determines if all plug-ins have the same timebase or if each one has its own. The choices are LOCKED and INDEPENDENT:

LOCKED	Forces all of the plug-ins to have the same timebases. Any changes to the timebase controls on one plug-in change the timebases on *all* the other plug-ins to the same settings. If plug-ins of different capabilities are used, only timebase settings common to all plug-ins can be selected.
INDEPENDENT	Allows each plug-in to have its own timebase. When set to this, timebase control changes on one plug-in have no effect on other plug-ins.

Triggers

Determines if all plug-ins trigger together or independently. The choices are LOCKED and INDEPENDENT:

LOCKED	Causes all plug-ins to trigger together. The trigger source may be on any plug-in and is selected by choosing the desired source on a given plug-in.
INDEPENDENT	Allows each plug-in to trigger independently. All the trigger controls apply only to the plug-in they are on.

Reference Clock

Selects the reference clock used as the reference for the plug-in timebases. The choices are INTERNAL and EXTERNAL.

INTERNAL	Selects the 7200A clock.
EXTERNAL	Selects an externally applied 10 MHz clock. The external clock signal is applied to the back of the 72

History Display Rate

This field allows the user to select how often the display is updated while a history function (histograms, averaging, etc.) is accumulating data. To increase the throughput, a longer time between updates should be used.

System Log

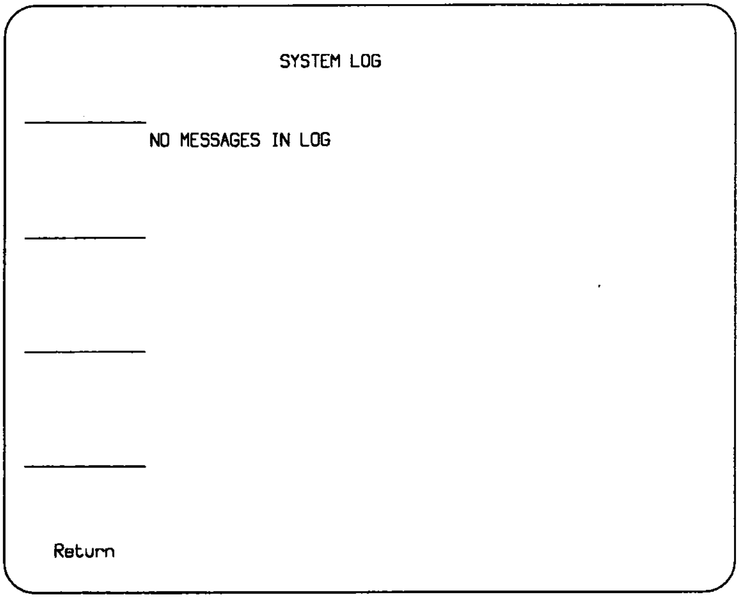


Figure 3.44 System Log Screen

The System Log displays a screen which contains a log of system messages which are recorded when the system detects a hardware or software condition which it did not expect. A single or infrequent message in the log indicates that although the condition was detected, the system was able to correct the condition. When the same message appears repeatedly in the log, contact the local service representative or the factory for further details.

The messages are listed in the order they were logged, from the most recent to the oldest. If the log gets filled, the last message recorded is overwritten by the most recent one. If more messages are logged than fit on the display at one time, rotating the Modify Value knob displays the rest of the log.

When messages are present, the Erase Log softkey appears. Pressing Erase Log clears the log of all messages.

Panel Settings

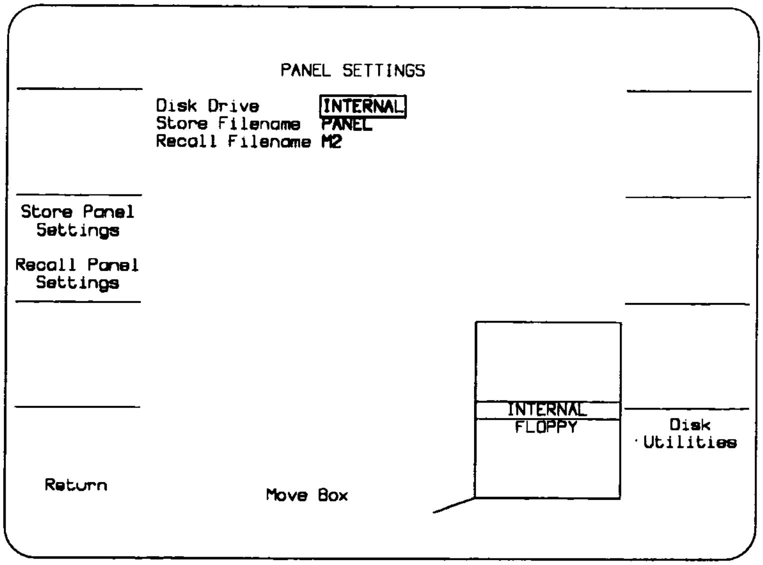


Figure 3.45: Panel Settings Screen

Panel Settings displays a screen which is used to store and recall front panel settings to and from either the 7200A's internal disk or MS-DOS formatted 3.5" floppy diskettes.

When Panel Settings is selected in the Configure System screen, the following fields and softkeys appear:

Disk Drive Specifies the disk drive for panel settings store and recall operations. The choices are INTERNAL and FLOPPY.

Store Filename Specifies the name of the file in which to store panel settings. When the box is on this field, the Edit Text softkey appears in the upper left corner of the screen. Press it to edit the filename letter-by-letter. The Insert Character, Delete Character, and Default Text softkeys will appear:

Insert Character — Press the Insert Character softkey once for each character to be inserted. Each new character will be displayed to the right of the box and will match the character in the box. After adding a character(s), use the Modify Value knob to change the character as desired.

Delete Character	Press the Delete Character softkey to delete the character in the box.
Default Text	Press the Default Text softkey to restore the default filename, "PANEL"

Once the desired changes are made, press the Return softkey to save the edited filename and regain access to other fields and softkeys in the Panel Settings screen. If the changes are not desired, press the Cancel Changes softkey to restore the original filename.

Recall Filename

Specifies the file from which panel settings will be recalled. The available choices are all the panel settings files on the selected disk with the date and time of the file displayed next to this field. If the selected disk drive is FLOPPY and you wish to recall from a different diskette, insert the new diskette and press the Read New Floppy Disk softkey. The new floppy's files will be displayed in the options list.

Store Panel Settings

Press the Store Panel Settings softkey to store the current front panel settings to the selected disk and filename. If the file already exists the following warning prompt will appear in the message area:

"OVERWRITE "filename"? (PRESS YES OR NO)"

and the YES and NO softkeys will appear:

YES OVERWRITE	Press YES to overwrite file name.
NO	Press NO to cancel the store operation.

Recall Panel Settings

Press the Recall Panel Settings softkey to recall front panel settings from the selected disk and filename. After the softkey is pressed, the following warning prompt will appear in the message area:

"RECALL PANEL SETTINGS? (PRESS YES OR NO)"

and the YES and NO softkeys will appear:

YES	Press YES to recall panel settings.
NO	Press NO to cancel the recall operation.

Disk Utilities

This softkey displays the Disk Utilities screen (see page 3-118) which can be used to format floppy diskettes or to examine or delete files from a disk.

Program Setup

Program enables the 7200A to learn a sequence of key presses and knob changes. Once learned, the sequence, or program, can be executed repeatedly for automatic operation. The program can also be stored and recalled to and from disk for later use.

It is also possible to create programs which can interact with the operator and can make decisions based on waveform values or front panel settings. To do this, you need to use a computer as described in section 7 of the Remote Programmer's manual.

NOTE: If upon power-up a diskette containing a program named STARTUP is in the floppy drive, it will be run automatically. For more information on STARTUP programs, see the LeCroy 7200A Precision Digital Oscilloscope Remote Programming Manual.

To examine and modify programs, or to save and recall them to and from disk, use the Program Setup screen. To display the Program Setup screen, press MODIFY (24) and then the Program softkey (3). The Program Setup screen will display its current selections. Figure 3.46 shows an example Program Setup screen.

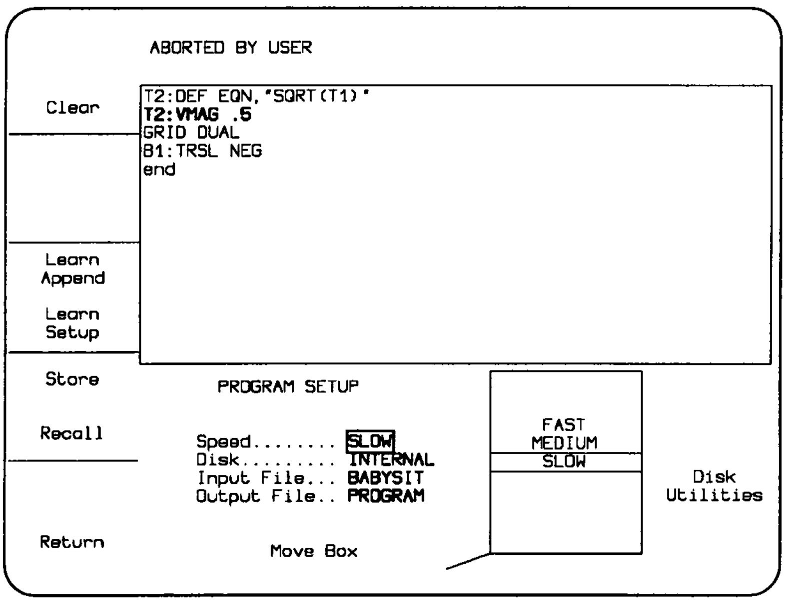


Figure 3.46: Example Program Setup Screen

In Figure 3.46, the upper half of the screen shows the current program. One command is on each line of the program. Commands result from key presses and knob changes.

When learning a program and successive changes affect the same parameter, the command summarizes the result. Only one command is included.

A Program command may be any remote command described in the *LeCroy 7200A Precision Digital Oscilloscope Remote Programmer's Manual.* For example, GRID DUAL indicates that two grids have been selected. In Figure 3.46, the DEF command indicates the new equation for trace 2, the square root of trace 1. This command results from using the Trace Setup screen.

In Figure 3.46, the VMAG (vertical expansion magnitude) command is highlighted. A highlighted command indicates where the program was terminated during execution. The highlighted command was not completed. A message at the top of the screen indicates that the program was aborted by the user.

Fields which appear below the program are used to modify program operation. To modify the program settings, rotate the Move Box knob onto the desired field. The options list in the lower right screen will indicate available choices, with the current choice in the center of the list. To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the previous selection in the box.

After completing selections, press the Return softkey to save the changes and display the Main Screen. Entering another setup screen without first pressing Return in the Program Setup will first save any Program Setup changes.

The Program Setup softkeys and selections follow:

Clear

Clears the currently displayed program. The 7200A is then ready to learn a new program. If the current program was learned, the following warning prompt will appear in the message area:

"ARE YOU SURE? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

YES	Pressing YES clears the program.
NO	Pressing NO cancels the clear operation.

Prev Page

View the commands previous to those on the screen. This softkey appears only when there are previous commands that do not fit on the screen at one time.

Next Page	View the commands after those shown on the screen. This softkey appears only when there are additional commands that do not fit on the screen at one time.
Learn Append	Exits Program Setup, displays the Main Screen, and continues the learning process. Once in the Main Screen, any command (key press or knob change) is added to the end of the current program. The Program softkey indicates "Stop Learn" to allow termination of the learning process. When setup is exited in this way, any changes to fields are automatically saved.
Learn Setup	Learns a program which contains all the commands necessary to recreate the current panel settings. The program will be displayed in the upper screen.
Store	Stores the displayed program onto the selected disk (floppy or internal) as indicated in Store File. If a file with the same name already exists, the following warning prompt will appear in the message area:

OVERWRITE "filename"? (PRESS YES OR NO)

and the YES and NO softkeys will appear.

YES	Pressing YES overwrites the old program.
NO	Pressing NO cancels the Store operation.

Recall

Retrieves a program from the selected disk using the file indicated by the Recall File.

If the program has not been compiled or is out of date the 7200A will automatically compile the program. If an error occurs, the program will be displayed and the line which has the error will be highlighted. Once retrieved, the program appears in the upper screen. Press the Recall softkey after selecting the Disk and Input File. Once pressed, the first few lines of the retrieved program are displayed. The 7200A is ready to execute the retrieved program.

If the current program was learned, the following warning prompt will appear in the message area:

"ARE YOU SURE? (PRESS YES OR NO)"

and the YES and NO softkeys will appear.

YES	Pressing YES replaces the old program.

NO — Pressing NO cancels the Recall operation.

NOTE: When Recall is pressed, the Input File name is copied onto the Output File name. This facilitates copying files between disks without manually entering every character of the Output File name.

Speed

Determines the rate the program is executed when "Run" is pressed from the Main Screen. When the Speed field is selected, the choices are SLOW, MEDIUM, and FAST:

SLOW — Selecting SLOW helps verify the program. It executes one command per second and displays it at the top of the screen.

MEDIUM — Executes the program with a short delay after each command. This delay allows the screen to be updated so you can see the effect of individual commands. Commands are not displayed.

FAST — Executes the program quickly without indicating commands.

Disk

Selects which disk, floppy or internal, is used when the Store or Recall softkey is pressed. If FLOPPY is selected when entering the Program setup, the floppy disk directory is read.

Recall File

Indicates the name of the file containing the program to be retrieved from disk when the Recall File softkey is pressed. Available selections are those files present on the floppy or internal disk.

Store File

Indicates the name of the file to be used when the Store File softkey is pressed to save the program on disk. When the box is moved to this field, the Edit Text softkey appears in the upper left corner of the screen. Pressing it will cause the Insert Character and Delete Character softkeys to appear:

Insert Character — Press the Insert Character softkey once for each character to be inserted. Each new character will match the character displayed in the box and will be displayed to the right of the box. After adding a character(s), use the Modify Value knob to change the character as desired.

Delete Character	Press the Delete Character softkey for each character to be deleted. Characters are deleted from the right of the box.

When you are finished editing, press the Return softkey to save the changes and continue modifying other fields on the Program Setup screen. If the changes are not desired, press the Cancel Changes softkey to restore the original filename.

Disk Utilities

Displays the Disk Utilities screen. This screen can be used to examine the directory or delete files from a disk, including those other than for Programs. Refer to Disk Utilities, page 3-118, for more details.

Read New Floppy Disk

Reads the floppy disk directory. If a new floppy disk is inserted while displaying the Program Setup screen, press this softkey to read it.

Product Description

The 7242 Series

The 7242 series of plug-in modules consists of three models which include the 7242, 7242A, and 7242B. All 7242 series plug-ins are 2 channel, 1GS/s, 8-bit digitizers. Detailed specifications for each model are included later in this section.

Accessories and Options

The following standard and optional accessories are available.

Probes	All 7242 series plug-ins are supplied with two probes. The probes have 10 MΩ input impedance and approximately 15pF capacitance. The system Bandwidth with these probes is typically DC to 250MHz when 1MΩ DC coupled, and less than 10Hz to 250MHz when 1MΩ coupled.
7291 2GS/s Adapter	The 7291 is supplied as a standard accessory with the 7242A and 7242B. It is an optional accessory for the 7242. The 7291 adapter may be used to increase the maximum single-shot sampling rate to 2GS/s.
Option-L1	An extended memory option is available for the 7242B which extends acquisition memory to 1M samples per channel.

Specifications

VERTICAL

Channels:	2 Channels
Analog Bandwidth (-3dB):	50Ω input coupling 400MHz (7242) 50Ω input coupling 500MHz (7242A, 7242B) 1MΩ DC coupling 250 MHz 1MΩ AC coupling 10Hz to 250MHz
Resolution:	8bits
Enhanced Resolution:	Vertical Resolution from 8 bits to 11 bits, at reduced bandwidth: Adjustable in 0.5 bit increments.
Total Accuracy:	±2% at DC, full scale.

Input Sensitivity:	Fixed 5 mV/div to 1 V/div Variable from x1 to x2.5 of fixed range in steps of 0.01
Offset Range (minimum)	±10 div in 0.02 V/div steps.
Maximum Input Voltage:	±5 V DC or 5 V rms into 50Ω, 250 V (DC + peak AC) into 1 MΩ input.

TIMEBASE

Single-shot:	2 ns/div to 10 Ks/div
Repetitive:	200 ps/div to 200 ns/div

SAMPLE CLOCK

Internal:	0.4 S/s to 2 GS/s accuracy is equal to the mainframe reference
External:	0 dBm to 10 dBm sine wave 50 MHz to 1 GHz

MEMORY

Acquisition Memory	50k samples per channel (7242, 7242A) 200k samples per channel (7242B) 1M samples per channel (7242B with Option-L1)
Segmentable Memory	200 segments (7242, 7242A) 1k segments with re-arm rate of 25 KHz (7242B) 4k segments with slower re-arm rates (7242B) 4k segments with re-arm rate of 25 KHz (7242B w/Option-L1)

Installation

Install the Plug-in(s)

CAUTION: ***Do not install or remove a plug-in while the 7200A mainframe is powered on.***

To install, align the plug-in's bottom grooves with the guide rails at the bottom of the mainframe's plug-in compartment. Next, slide the plug-in toward the rear of the mainframe until it latches into place. See Figure 4.1. Remove the plug-in by pulling out its latch and sliding it out.

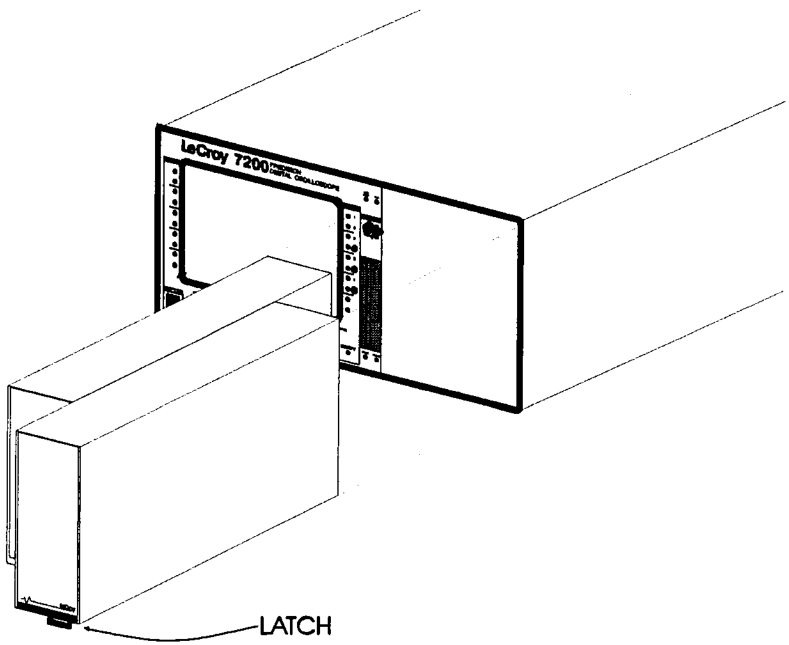


Figure 4.1: 7242 Plug-in Installation

This section describes the 7242 Series Plug-in front panel controls and their associated displays. In addition, it discusses how to perform calibration of the accessory probes and optional 7291 adapter.The front panel control descriptions are arranged into functional groups which include vertical, timebase, trigger, and status. Refer to Figure 4.2 which illustrates how the controls are arranged on the 7242 Series front panels..Additional controls on the 7200A mainframe front panel:

Initiate auto setup;	Perform cursor measurements;
Select trigger modes;	Setup and configure hardcopy;
Perform processing;	Select independent timebase and triggering;
Display and archive data;	Operate on-line Help.

For a description of the mainframe controls, refer to Section 3 of the *LeCroy 7200A Precision Digital Oscilloscope Operator's Manual.*

Probes

Two Model 7200A-P12 passive probes are supplied with each module. These probes have 10 MΩ input impedance and approximately 15 pF capacitance. The system bandwidth with 7200A-P12 probes is DC to 250 MHz (typical) with 1MΩ DC coupling, and less than 10Hz to 250 MHz with AC coupling. If attenuation-coded probes are used, the probe-coding contact rings surrounding the CH1and CH2 BNC connectors recognize the attenuation factors of the probes. These factors are included in the vertical sensitivity indication.

Probe Calibration

To calibrate the 7200A-P12 Probe, connect it to either the BNC connector labelled CH 1 or CH 2. Connect the probe's grounding clip to the front panel ground lug of the oscilloscope and connect the tip to the signal lug. Press the mainframe Auto Setup key to obtain a signal. If over- or undershooting of the displayed signal occurs, you can adjust the 7200A-P12 Probe by inserting the small screwdriver supplied with the probe package into the trimmer on the probe's barrel. Turn the screwdriver either clockwise or counterclockwise to achieve the optimal square wave contour.

Control Layout

7242 Series Plug-in Module controls are arranged in four groups.

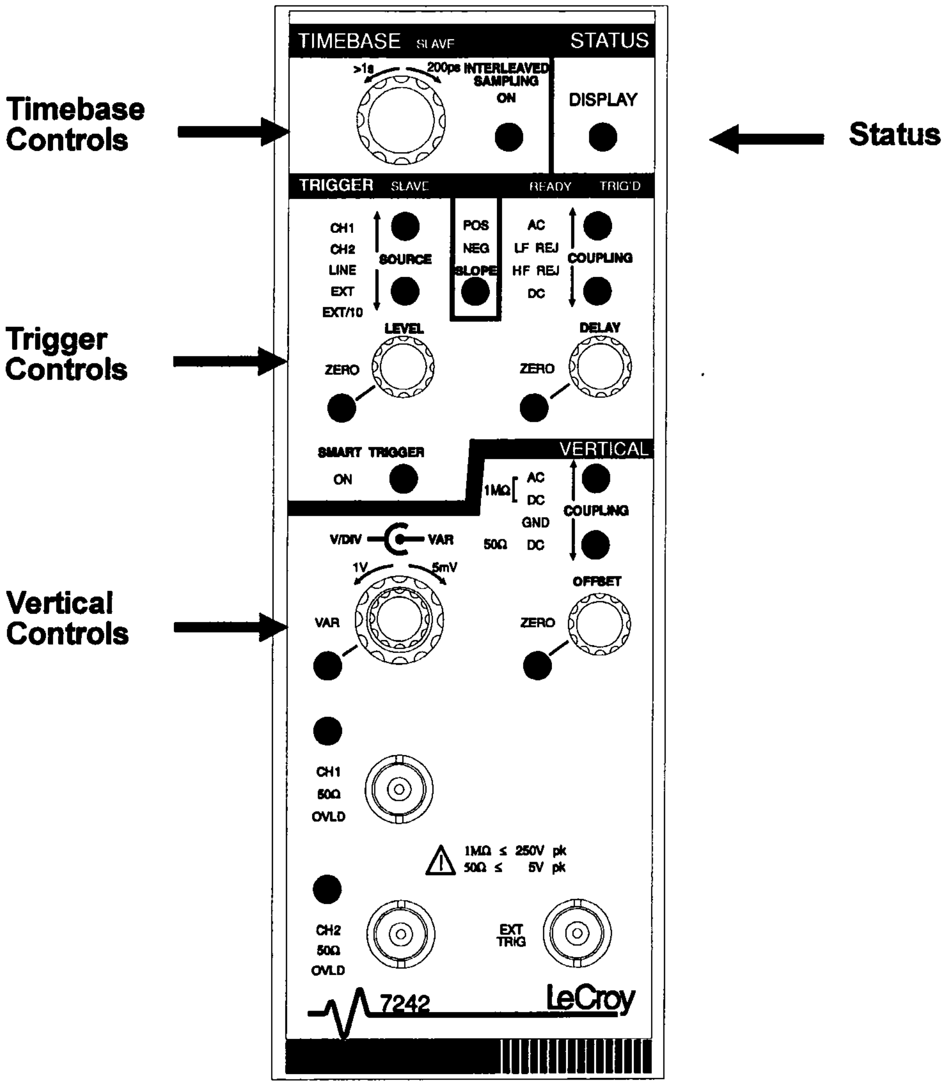


Figure 4.2: Typical 7242 Series Plug-in Control Groups

Display of Acquisition Settings

Acquisition settings may be viewed in a variety of ways. These include the System Message Area and the Timebase, Vertical, Trigger, and General Status Screens.

System Message Area

Whenever a front panel control is adjusted, the plug-in timebase, trigger level, trigger delay, and various vertical control settings are displayed in the System Message Area for approximately 10 seconds. Figure 4.3 shows a typical summary of control settings.

In addition to the information in the System Message Area, the time per division and vertical units per division may also be displayed under the trace label.

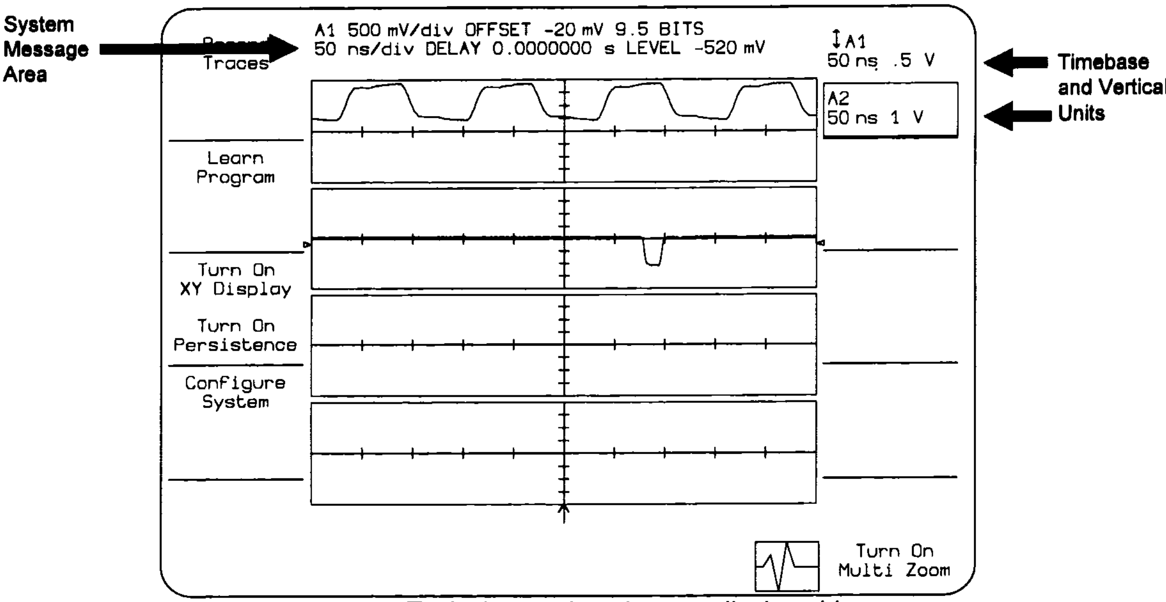


Figure 4.3: Typical control settings as displayed in the System Message Area and the trace labels.

As shown above, the fields in the acquisition setting summary indicate the following:

A1, A2, A
B1, B2, B
Identifies the plug-in slot being summarized and the vertical channel controls being adjusted. A plug-in slot letter (e.g: "A") that is not followed by a channel number specifies that CH1 and CH2 vertical controls are locked together. (Locking occurs by

pressing the Select All Channels button in Vertical and Status Screen.)

Total V/DIV	Indicates the actual volts/division. this includes the settings of the V/DIV and VARIABLE SENSITIVITY knobs. A probe multiplier is indicated if it is not unity.
OFFSET	Indicates the vertical offset as selected by the OFFSET KNOB and its ZERO key.
NUMBER OF BITS	Indicates the resolution of the data.
BWL	Indicates when the BANDWIDTH LIMIT is on.
TDIV	Indicates the timebase as adjusted by the T/DIV knob.
DELAY	Indicates the Trigger delay as selected by the DELAY knob and its ZERO key.
LEVEL	Indicates the Trigger level as selected by the LEVEL knob and its ZERO key.

***NOTE:** The settings appear when the control is adjusted, so the display indicates settings for the next acquisition. They may differ from those indicated under the trace label which were used to acquire the currently displayed trace.*

Status Screens

The Plug-in Status screen enables simultaneous viewing of a plug-in's Vertical, Trigger, and Timebase settings. To display the Plug-in Status screen, press the plug-in DISPLAY key. Pressing the mainframe MODIFY key before pressing DISPLAY will also display this screen. The Plug-in Status screen is described in detail on page 4-51.

To view changes in the waveforms as the control settings are adjusted, one of three other screens can be displayed: the Vertical, Timebase, and Trigger Status screens. Each screen shows all the displayed waveforms on a half-screen grid. Below the grid are the settings of the selected control group. As settings are changed, the effects on traces are shown on the next acquisition.

To display one of these screens, press MODIFY and then press any key or adjust any knob within the desired control group. Adjusting a knob or pressing a key after pressing MODIFY will not affect its setting.

7242 Series Plug-in Front Panel Controls

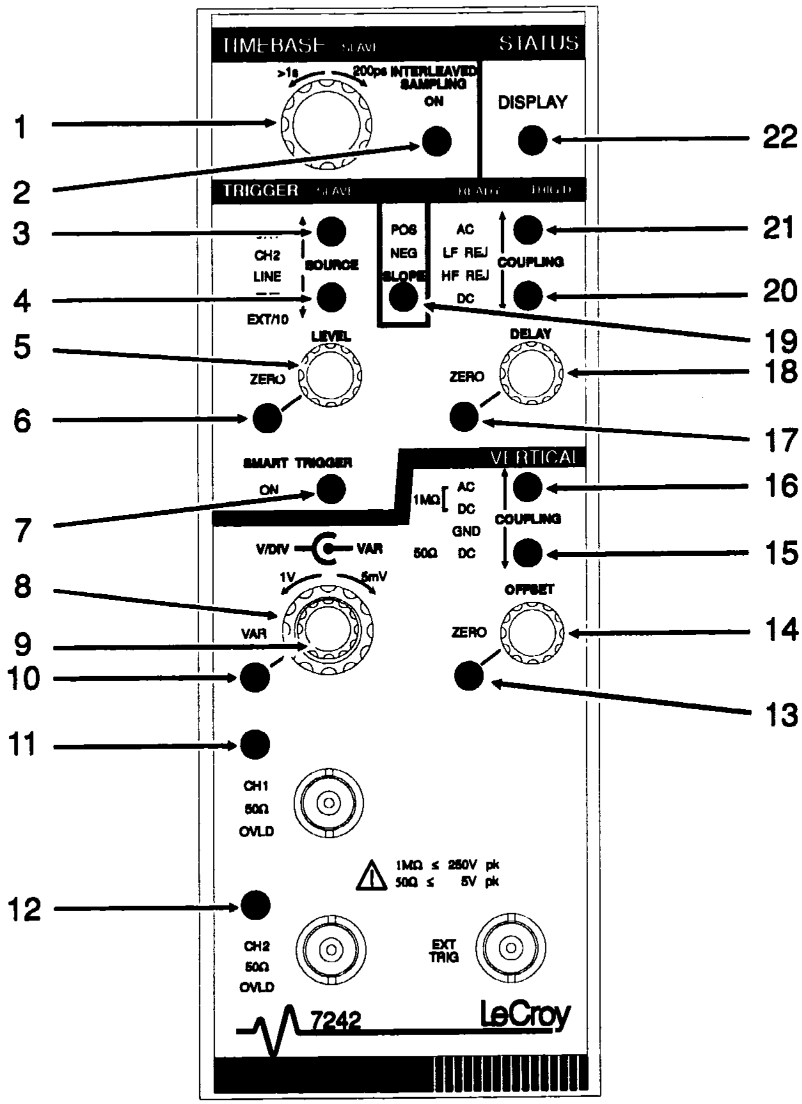


Figure 4.4: Typical 7242 Plug-in Front Panel Controls

Index to Controls

Following are descriptions of the 7242 Series plug-in front panel controls. The number in parentheses locates the control on the 7242 Series Plug-in front panel drawing (Figure 4.4, page 4-8).

Vertical Controls

Vertical Sensitivity and Offset

V/DIV (8)

Selects the vertical sensitivity, or fixed gain, in multiples of 1, 2, and 5. The range of the fixed gain is 5 mV to 1 V/div at both 1 MΩ and 50Ω input impedances.

The maximum permissible input voltage to either channel is 250 V (DC + peak AC) in 1MΩ and 5 V (DC +Peak AC) in 50Ω input impedance.

VAR (9)

The inner knob (9) of the V/DIV control provides continuously variable vertical sensitivity within the V/DIV knob settings. The variable setting knob increases the vertical range up to 2.5 times the V/DIV knob setting. When VAR is rotated to adjust the vertical sensitivity between fixed settings, the VAR LED to the left of the knob lights "VAR" and the fixed gain indication on the screen is preceded by a ">". The resulting vertical sensitivity is indicated as "Total V/DIV" on the status screen.

To use the full dynamic range of the channel's analog-to-digital converter (ADC), use the knob to fit the signal onto the entire vertical range.

VAR (10)

The VAR key (10) adjacent to the V/DIV knob toggles between selecting or de-selecting the variable setting to increase the vertical range.

OFFSET (14)

Adjusts the voltage offset used to position the signal within the amplifier's input range. The maximum offset depends on the fixed V/DIV: if the fixed V/DIV is 1 V, the maximum offset is ± 10 times the fixed V/DIV without variable gain and ± 4 V with variable gain;if the fixed V/DIV is from 20 mV through .5 V, the maximum offset is ± 12 times the fixed V/DIV;if the fixed V/DIV is 10 mV, the maximum offset is ± 24 times the fixed V/DIV; if the fixed V/DIV is 5 mV, the maximum offset is ±48 times the fixed V/DIV. It is adjustable in 0.02 division increments.

A pair of upward– or downward–pointing double–shaft arrows on the grid's upper or lower edge indicate when the trace has been positioned outside of the grid, as shown in Figure 4.5. (The VERTICAL POSITION knob under the screen can also move the trace outside of the grid. That knob, however, only affects the display position and not the amplifier offset setting.) Note that the View Port is not affected by the offset.

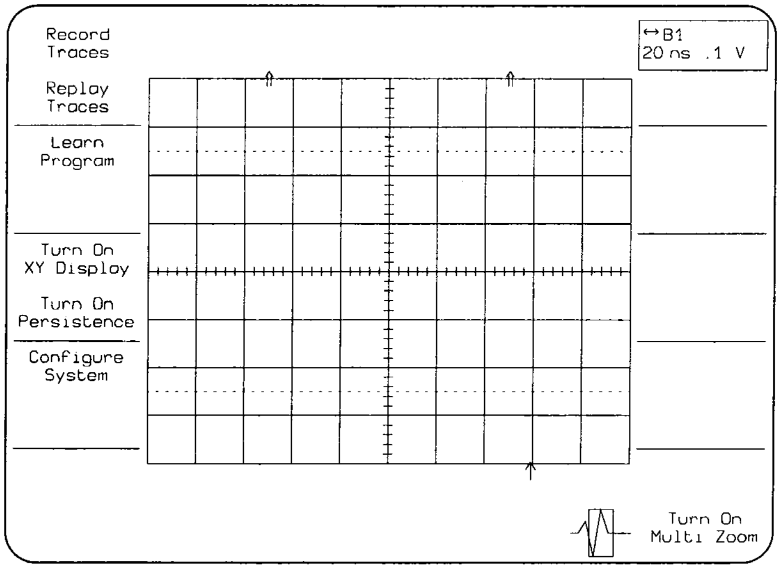


Figure 4.5: Upward-pointing arrows indicate that a waveform(s) is off the screen

ZERO (13) Toggles between the selected offset value and a zero offset. An LED next to the key lights "ZERO" to indicate zero offset.

CH 1 (11), or CH 2 (12) Pressing the CH1 or CH2 key selects which channel the Vertical controls will modify. For example, when CH1 is pressed, adjusting a Vertical control such as the V/DIV knob, affects CH1 signal input. CH2 settings remain unchanged. The channel LED next to the key is lit to indicate the selected channel.

Signal Coupling and Input Impedance

COUPLING ((15) and (16))

Selects how to couple the signal to the vertical amplifier input. As the keys are pressed to step through each coupling option, LEDs to the left of them indicate the selection. Possible selections are as follows:

AC — Couples signals capacitively to the input amplifier, blocking the input signal's DC component. It limits the signal frequencies to more than 10 Hz. The input impedance is 1MΩ.

DC — Connects signals directly to the amplifier, using 1MΩ input

GND — Disconnects the input signal from the amplifier, and applies ground to the amplifier input. If the offset is non-zero, the trace will be at the offset value.

DC 50Ω — Connects signals directly to the amplifier, using 50Ω input impedance. The maximum dissipation into 50Ω is 0.5W, which corresponds to 5 V DC or 5 V rms. When selected, an LED ("50 Ω") next to the input connector will light.

Signals will be automatically disconnected from the amplifier whenever the maximum dissipation is exceeded when 50Ω input impedance has been selected. If an overload condition is detected, a warning LED ("OVLD") next to the input connector is lit, and the input coupling is switched to GND.To clear the overload condition, remove the signal from the input and re-select the desired coupling.

Timebase Controls

TIMEBASE (1)

Selects the amount of time each horizontal division represents. The knob selects the TIMEBASE in a 1-2-5 sequence from 200 ps/DIV to 10,000 sec/div

The TIMEBASE setting, the acquisition memory size, and if in SEQuence Trigger Mode, the number of segments determine the sample rate and the number of sample points displayed per division. The Plug-in Status and the Timebase Status screens indicate the time per point and points per division. The maximum memory size and number of segments can be selected in the Plug-in status or the Timebase Status screen.

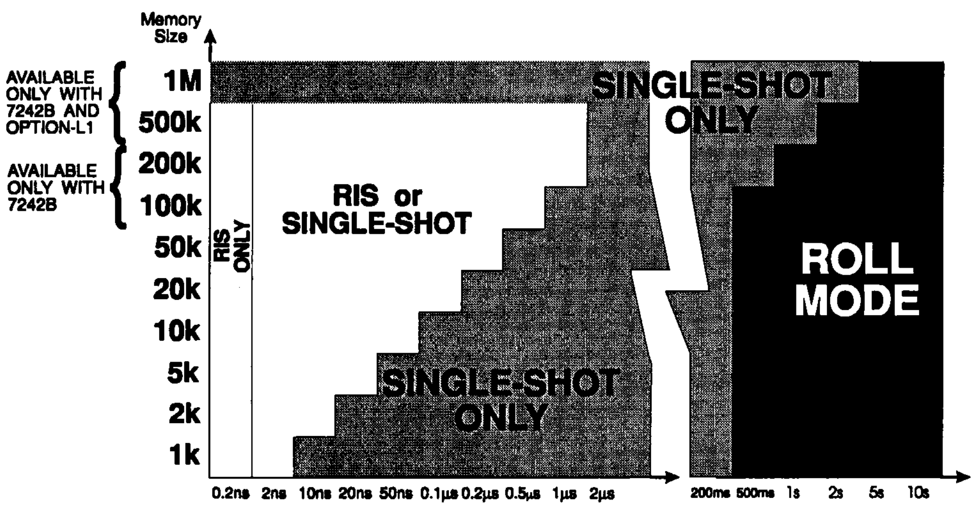
INTERLEAVED SAMPLING (2)

Turns on or off the Random Interleaved Sampling (RIS) acquisition mode, depending on the timebase. When selected, an "ON" LED will light. When the ON LED is not lit, single shot acquisition is used.

At timebase settings from 200 ps/div to 1 nsec/div inclusive, the 7242 Series automatically use RIS for signal acquisition. Repetitive waveforms and a stable trigger are required. Waveforms are digitized with a sample interval of 50 psec for an equivalent sampling rate of 20 gigasamples/sec.

When the timebase is set between 2ns/div and 1s/div, RIS or single-shot acquisition may be selected depending upon the memory size selected.

If the memory size and timebase settings are as shown in the unshaded portion of figure 4.6, then the INTERLEAVED SAMPLING key is used to select the acquisition mode.



Roll Mode only available for 7242B

Figure 4.6: Interleaved Sampling

The 7242 series plug-ins can record waveforms using single shot acquisition for timebase settings from 5 nsec to 200 msec/div. Sampling rates up to 1 gigasample/sec are possible in the single shot mode.

When interleaved sampling is on, sampling options can be selected in the Plug-in Status or the Timebase Status screens.

Trigger Controls

SOURCE ((3) and (4))

Selects the signal used as the trigger source. The LED next to the keys is lit to indicate the selected trigger source. Adjusting the other trigger controls affects triggering for the selected source. If the source is changed, the other controls affect triggering for the new source. For example, when CH1 is selected, adjusting a trigger control, such as the LEVEL knob, affects triggering when
CH1 is used. The CH2 settings remain unchanged.

CH1 Uses signal applied to CH 1 input connector

CH2 Uses CH 2 signal input

LINE Selects the line voltage which powers the Mainframe. Provides a stable display of signals synchronous with the power line.

EXT Selects a signal applied to the BNC connector labeled "EXT TRIG". The maximum usable signal range is ± 2 V with a probe attenuation of 1.

EXT/10 Selects a signal applied to the BNC connector labeled "EXT TRIG" and divides it by 10, maximum usable signal range of ± 20 V with a probe attenuation of 1.

The BNC input labelled "EXT TRIG" accepts an external trigger signal. Probes of greater attenuation increase the maximum usable signal range. For example, an attenuation of 10 increases the EXT range to ±20V and the EXT/10 range to ±200V. Although the usable range is ± 2 or 20 V, the maximum signal that can be applied without risk of damage is ± 250 V DC, depending on coupling. Input impedance is 1 MΩ in parallel with <30 pF.

COUPLING ((20) and (21))

Selects the method used to couple the trigger source to the input of the trigger circuit. As the keys are pressed to step through each coupling method, LEDs to the left of them indicate the selection. Possible selections are as follows:

AC — Couples the source capacitively to the trigger circuit, DC levels are rejected and frequencies below 50 Hz for CH1 and CH2, and 8 Hz for EXT and EXT/10 are attenuated.

LF REJ — Couples the source capacitively with a high-pass filter network. DC is rejected and signal frequencies below 50 KHz are attenuated.

HF REJ — Connects the source directly to the trigger circuit. A low pass filter network attenuates frequencies above 50 KHz. The HF REJ trigger mode is used to reject high frequency signals.

DC — Couples all of the signal's frequency components to the trigger circuit.

The coupling is adjusted independently for each trigger source. Therefore, changing the source can also change the trigger coupling. Coupling is set to AC when the trigger source is LINE.

DELAY (18)

Adjusts the amount of signal recorded before (pre-trigger) or after (post-trigger) the trigger occurs. The pre-trigger amount depends on the timebase, memory size, and in SEQuence Trigger Mode, the number of segments. The maximum delay limit is 0.5 x the time/div to 100,000 x the time/div, or 0% to 100% if the trigger delay units are in percent.

The arrow under the grid indicates the trigger point of the displayed trace.

ZERO (17) — Toggles between the selected delay setting and a trigger delay of zero, which would put the trigger at the center of the grid. An LED next to the key lights "ZERO" to indicate zero trigger delay.

LEVEL (5)

Adjusts the voltage level at which triggering will occur. When the trigger level is increased, the trigger circuit will respond at a higher voltage level. If vertical sensitivity is adjusted such that the previously selected trigger level exceeds the sensitivity range, the trigger level is automatically reduced to fit the new range.

The trigger level indicator arrows appear only on the selected trace if: the trace is defined to be an unprocessed acquisition channel, the channel is selected as the trigger source, and the trigger coupling is DC or HF REJ.

The range of trigger levels is as follows:

Trigger Source	Trigger Range
CH1 or CH2	±5 screen divisions · total gain referred to the center of the screen.
LINE	Power Line voltage range
EXT	± 2 Volts
EXT/10	± 20 Volts

Probes of greater attenuation increase the trigger range. For example, an attenuation of 10 increases the EXT range to ±20V and the EXT/10 range to ±200V.

ZERO (6) Toggles between the selected trigger level and a trigger level of 0.0 V. An LED next to the key lights "ZERO" to indicate zero trigger level.

LEVEL is not used if the Trigger Source is LINE.

SLOPE (19)

Selects the signal edge used to activate the trigger circuit. The slope of the trigger can be adjusted for each individual trigger source and is indicated by LEDs above the SLOPE key.

POS	Requires a positive-going edge to trigger.
NEG	Requires a negative-going edge to trigger.
SLOPE	is set to pos if the trigger source is LINE.

SMART TRIGGER (7)

Toggles between selecting the Standard trigger and Smart™ Trigger. Smart™ Trigger is setup from within either the Trigger Status or Plug-in status screens. An LED next to the key will light "ON" to indicate Smart™ Trigger is selected. The Trigger Status screen is displayed by pressing MODIFY on the mainframe and any trigger control. The Plug-in status screen is displayed by pressing the DISPLAY key on the plug-in.

Trigger Mode

The Trigger Mode selects the mode of trigger operation: SEQuence, AUTO, NORM, and SINGLE. It is selected on the mainframe front panel using keys (28) and (29) as shown in Figure 3.9 (page 3-8) in the *LeCroy 7200A Precision Digital Oscilloscope Operator's Manual.* Pages 3-12 through 3-14 of the same manual describe each trigger mode in detail.

Trigger State

A "READY" LED on each plug-in indicates that the trigger circuit has been armed and the plug-in is acquiring input signals. The "TRIG'D" LED is lit whenever the timebase is stopped (normally after a valid trigger).

After a valid trigger is detected, a time lag (as set by the Trigger Delay knob) may occur before the acquisition stops and the waveform is displayed.

VERTICAL Status

The Vertical Status screen provides a summary of all the Vertical control settings. It also allows adjustments of settings that are not controlled from the front panel.

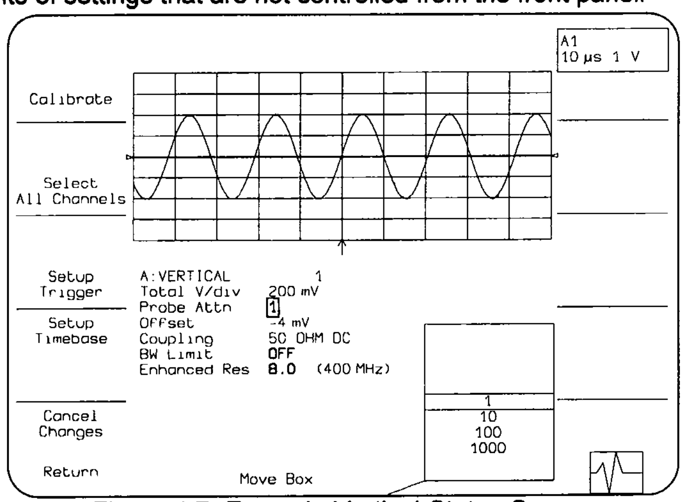


Figure 4.7: Example Vertical Status Screen

To display the Vertical Status screen, press the MODIFY key on the mainframe and then adjust any Vertical control on the plug-in front panel. Adjusting a Vertical control after pressing MODIFY will not affect its setting.

In this screen, all the displayed traces are shown in a half-screen grid above the screen's fields. As Vertical controls are changed, the effects on traces are shown on the next acquisition. Figure 4.7 shows an example of the Vertical Status screen.

Once a screen is displayed, move the box onto a field to be modified. The box will only move onto fields that do not have a front panel key or knob. These fields are highlighted. The options list will indicate available choices, with the current choice in the center.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The Vertical Status screen contains the following softkeys and fields:

Calibrate — Ensures overall vertical and timebase accuracy. (Calibration is also performed when the Mainframe is initially powered and the Vertical and Timebase controls are adjusted, and periodically thereafter.)

Select All Channels — When the probe attenuation on each channel is matched, Select All Channels sets all vertical control settings for every channel of the plug-in to be the same as the currently selected channel . Both channel LEDs are then lit and changing any of the Vertical controls affects both Channels until one of the Channel keys is pressed.

Setup Trigger — Displays the Trigger Status Screen.

Setup Timebase — Displays the Timebase Status Screen.

VERTICAL — Indicates the selected channel.

Total V/DIV — Indicates the actual Volts/division. This includes the settings of the V/DIV (8) and variable sensitivity (9) (10) knobs and the Probe Attenuation.

Probe Attn — Indicates the probe attenuation factor included in the vertical sensitivity indication. If attenuation-coded probes are used, the probe-coding contact rings surrounding the CH1 and CH2 BNC connectors recognize the attenuation factors of the probes, and this field cannot be modified. If this type of probe is not used, the probe attenuation can be selected for this field to reflect the attenuation for the probe being used. The choices are x1 to x1000.

BW Limit

Reduces the bandwidth to 95 MHz. It is useful in reducing signal noise. It can also prevent high frequency aliasing for single shot events at sampling rates below 10MS/s. The choices are ON and OFF.

Enhanced Res

Selects the amount of digital filtering for enhancing resolution. By limiting the system bandwidth, noise can be filtered and reduced. Thus, the effective resolution can actually be improved beyond the ADC's ideal performance. Selecting greater values of this parameter increasingly filters noise. Since the ADCs each have
8 bits, selecting the lowest value removes the filter. The effective system bandwidth is indicated next to the number of bits. Enhanced Res cannot be used when the trigger mode is Sequence.

Offset

Indicates the vertical offset as selected by the OFFSET (14) knob and its ZERO (13) key.

Coupling

Indicates the vertical coupling as set by the COUPLING (15) (16) keys.

TIMEBASE Status

The Timebase Status screen provides a summary of all the Timebase settings. It also allows adjustments of settings that are not controlled from the front panel. To display the Timebase Status screen, press the MODIFY key on the mainframe and then adjust any Timebase control on the plug-in front panel. Adjusting the Timebase control after pressing MODIFY will not affect its setting.

In this screen, all the displayed traces are shown in a half-screen grid above the selection fields. As Timebase controls are adjusted, the effects on traces are immediately shown. Figure 4.8 shows an example of the Timebase Status screen.

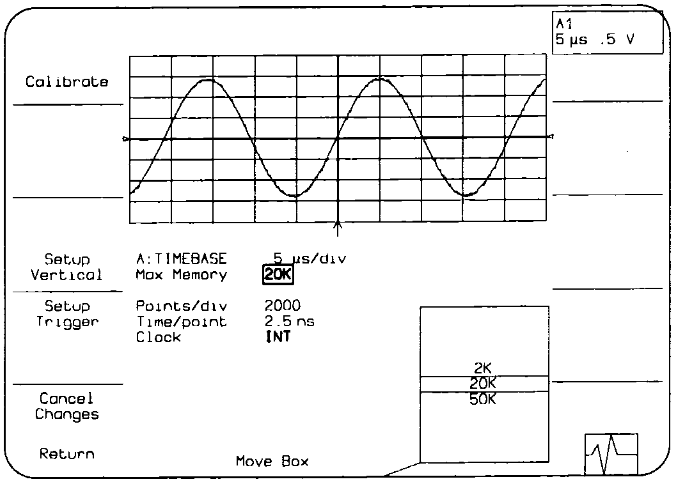


Figure 4.8: Example Timebase Status Screen

Once a screen is displayed, the Move Box knob under the center of the screen is used to select a field to be modified. The box will only move onto fields that do not have a front panel key or knob. These fields are highlighted in bold type. The options list in the lower right screen will indicate available choices, with the current choice in the center.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes in non-volatile memory and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The TIMEBASE Status screen contains the following softkeys and fields:

Calibrate Ensures overall vertical and timebase accuracy. (Calibration is also performed when the 7200A is powered and the Vertical and Timebase controls are adjusted, and periodically thereafter).

Setup Vertical Displays the Vertical Status screen.

Setup Trigger Displays the Trigger Status screen.

Max Memory Indicates the maximum number of sample points to represent each waveform. Together with the timebase setting (and if in SEQuence mode, the number of segments), it determines the sample rate. The choices are:

1k, 2k, 5k, 10k, 20k, 50k for 7242
1k, 2k, 5k, 10k, 20k, 50k, 100k, 200k for 7242B
1k, 2k, 5k, 10k, 20k, 50k, 100k, 200k, 500k, 1M for 7242B (option L1)

Acquire 1,000 samples to achieve maximum waveform throughput. Obtaining 200kpoints(for 7242B), or 1MB(for 7242B option-L1) provides a greater time window of the signal, requiring more time to process the additional points.

Clock Selects whether to use an internal or external sample clock which is applied to the back panel. With an external clock, the suggested clock rate is specified. The maximum sample rate is 1 gigasample.

TIMEBASE Indicates the time per division setting of the TIMEBASE knob. If Random Interleaved Sampling (RIS) is selected, "RIS" also appears on this line.

Points/div Indicates how often the input signal is sampled for each division of the display grid. If the waveform is not expanded or decimated by processing, the timebase, and Max Memory size determine its value. When the trigger mode is Sequence, the field becomes points per segment. If the waveform is not expanded or decimated by processing, the timebase, number of segments, and max memory size determine its value.

Time/point

Indicates the sample rate (i.e., time between digitized sample points) for the corresponding timebase setting.

Sequence trigger mode involves multi-segment acquisitions. The manner in which these multiple segments are handled in the 7242B is further classified as either Sequential or Synchronous Averaging. In Sequential sequence, the requested number of segments are acquired and displayed individually. In Synchronous Averaging, the requested number of sweeps are acquired, averaged together, and displayed as a single waveform. In Alternate Synchronous Averaging, two waveforms are acquired per sweep from Channel 1, each on a different trigger slope, and both are averaged independently and displayed as a dual waveform. In this mode, Channels 2 can not acquire data but may be used as a trigger source.

If the trigger mode is Sequential Sequence, the following fields are present:

If the trigger mode is Sequence, the following fields are present:

Maximize (Available only with the 7242B)

Selects the method used to acquire each segment. The two methods are to maximize trigger rate and points per segment. Selection of maximize trigger rate will tradeoff the number of segments and segment size for a greater trigger rate. (The time from one trigger to the next). This method can acquire a maximum of 1000 segments between screen updates due to the limitations in acquisition memory. Selection of maximize points per segment will maximize the number of segments and points per segment. This method processes each segment as it is acquired. This method can acquire a maximum of 4000 segments between screen updates, because it is not limited by acquisition memory, but by processing memory. Both methods trigger rate will vary with the length of each segment and the number of channels acquiring data.

Trig Rate (Available only with the 7242B)

Indicated the maximum rate at which triggers can be accepted without missing one.

Num Segments

Indicates the number of segments in a sweep if the Sequence Trigger Mode is selected. Otherwise this field does not appear.

In Sequence mode, the timebase setting determines the total duration of each segment. A segment's duration is determined by multiplying the time/div setting by 10. Changing Num Segments does not change the timebase; it affects the number of data points (record length) per segment and the time per point.

Select Sync Avg (Available only with the 7242B)

This softkey selects Synchronous Averaging Sequence. This is a different type of sequence trigger mode in which all acquired segments are averaged together rather than displayed individually.

If the trigger mode is Synchronous Averaging Sequence, the following fields are present:

Average Mode (Available only with the 7242B)

Selects between Synchronous Averaging (STANDARD) and Alternate Synchronous Averaging (ALTERNATE). STANDARD waveforms are all acquired on the programmed trigger slope while ALTERNATE waveforms are dual waveforms consisting of averaged sweeps from both trigger slopes.

Num Sweeps (Available only with the 7242B)

Selects the number of sweeps to be averaged together. Since there are no intermediate screen updates until all sweeps are acquired, the Main Screen displays a one second count of the sweeps acquired thus far. As soon as either channel has reached its Num Sweeps, the averaging stops and the number of sweeps contributing to each channel is displayed in the trace label for that channel. In Alternate Synchronous Averaging, as soon as the Num Sweeps for either trigger slope is reached, the averaging stops and the greater of the two values is displayed in the trace label for the channel. The ROOF and FLOOR trace edit functions can be used to separate the dual waveform into its constituent parts. These functions also display the exact number of sweeps that were averaged together for each part.

Points/sweep (Available only with the 7242B)

Indicates the number of samples that were acquired on each trigger and hence the number of points in the final averaged waveform.

Turn ON Art Reject (Available only with the 7242B)

This softkey turns artifact rejection on or off. When enabled, any waveform with an underflow or overflow value is not included in the computation. If Artifact Reject is turned OFF, any overflows are set to the maximum possible value of the ADC and any underflows to the minimum value.

Select Sequential (Available only with the 7242B)

This softkey selects Sequential Sequence. This sequence Sequential trigger mode displays all the acquired segments individually.

MAXIMUM RECORD LENGTH IN SYNCHRONOUS AVERAGING (7242B ONLY)		
	STANDARD	ALTERNATE (Ch1 only)
Time per point = 500psec	100k	50k
Time per point = 1nsec	50k	50k
Time per point = 2.5nsec	100k	100k
Time per point > 2.5nsec	200k	200k

Table 4.1

If Interleaved Sampling is on then the following field is present:

Sampling

Selects the sampling method to use in Random Interleaved Sampling Mode (RIS), Random or Interpolated. RIS data has inherently non-uniform sampling intervals. Because RIS waveforms are generally highly oversampled (i.e. the effective sample rate is many times higher than the signal bandwidth) the non-uniformity of sample spacing has subtle implications. The INTERPOLATED Sampling option uses a linear interpolation algorithm and the nearest neighboring samples to create a RIS record with uniform sampling intervals. The RANDOM option does not perform this interpolation. INTERPOLATED is generally the most useful choice, however in cases where the fundamental assumptions of RIS sampling are in question (not truly repetitive signal), RANDOM Sampling is preferred. For example, if Persistence Display is to be used to analyze varying timing, and the timebase selection is such that RIS is required, then RANDOM Sampling should be used. Eye Diagram analyses are inherently non-repetitive, and care must be taken in attempting this kind of analyses with RIS acquisition. This field only appears in RIS mode.

TRIGGER Status

The 7242 Series offers two independent triggering methods: Standard and Smart™trigger. Standard trigger provides basic trigger functions. Smart Trigger adds additional qualifications to the trigger source(s). The Smart Trigger key (7) on the plug-in front panel toggles between selecting either method. The LED will be lit when Smart Trigger is selected.

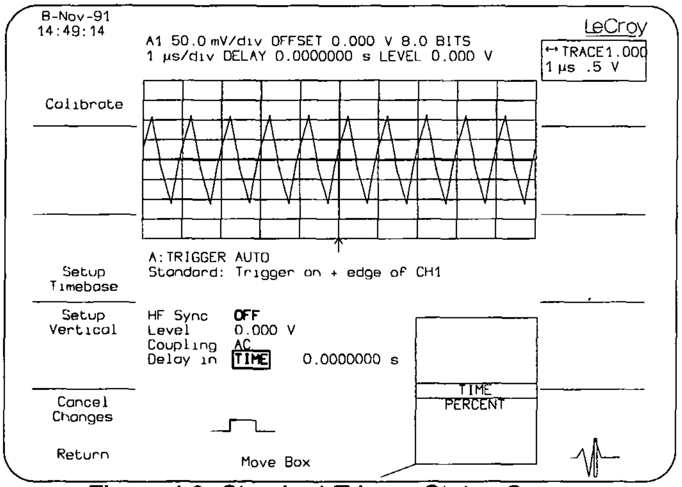


Figure 4.9: Standard Trigger Status Screen

The Plug-in Trigger Status screens for either triggering method provides a summary of all the trigger settings. The screens allow adjustments of settings that are not controlled from the front panel.

To display a Trigger status screen, press the MODIFY key on the mainframe and then adjust any trigger control on the plug-in front panel. Adjusting the trigger control after pressing MODIFY will not affect its setting. In the status screen, all the displayed traces are shown in a half-screen grid above the trigger fields. As trigger settings are changed, the effects on traces are shown on the next acquisition. Figure 4.9 (previous page) shows an example of the Standard Trigger Status screen.

Once a screen is displayed, the outer knob under the center of the screen is used to position the box on the field being modified. The box will only move onto fields that do not have a front panel key or knob. These fields are highlighted in bold type. The options list in the lower right screen will indicate available choices, with the current choice in the center. To change the selection, rotate the inner knob to move the desired choice to the center of the list. The new choice will also replace the previous selection in the box.

After changing the selections, press the Return softkey and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original selected values, and displays the Main Screen.

The Trigger Status screens have some softkeys and fields which are present for all trigger types; however, others are specific to an individual trigger type. The softkeys and fields which appear for all Trigger Status screens are listed below. Following them are explanations of each trigger type and the fields specific to its use.

Calibrate — Ensures overall vertical and timebase accuracy. (Calibration is also performed when the 7200A is powered and the Vertical and Timebase controls are adjusted, and periodically thereafter.)

Setup Timebase — Displays the Timebase Status Screen.

Setup Vertical — Displays the Vertical Status Screen.

TRIGGER — Indicates the currently selected mode.

Level — Shows the trigger level for the trigger source, as selected by the LEVEL (5) knob and its ZERO (6) key.

Coupling — Shows the trigger coupling for the trigger source, as selected by the COUPLING (20) (21) front panel keys.

HF Sync — Selects whether the trigger source has its frequency rate divided by four. Select ON to allow stable triggering for sources greater than 200 Mhz. This feature is not available with Smart Trigger, or when Trigger Source is Line .

Delay

Indicates the Trigger delay as selected by the DELAY (18) knob and its ZERO (17) key, also indicates the trigger delay units. Trigger delay may be expressed in terms of time or percentage of the screen. The percentage is applicable fro pretrigger delay settings only.

Standard Trigger

Standard trigger causes a trigger to occur whenever the selected trigger source meets its trigger conditions. The trigger condition is defined by the trigger level, coupling, high frequency sync, and slope. The Standard trigger is set by the front panel trigger controls and from within the status screen. The status screen indicates all the trigger settings. Only high frequency sync can be selected using this screen.

As shown in Figure 4.9, page 4-25, the Standard Trigger Status screen contains these additional fields:

Trigger on

Indicates the selected trigger edge, positive or negative, as selected by the SLOPE (19) key.

If the selected trigger slope is positive, a trigger is generated when the source signal crosses above the trigger level. If a negative slope is selected, a trigger occurs when the source crosses below the level.

edge of

Indicates the trigger source, as selected by the SOURCE (3) (4) front panel key.

Smart Trigger

The Smart Trigger allows setting additional qualifications before a trigger is generated. These qualifications can be used to capture rare phenomena such as glitches or spikes, specific logic states, or missing bits. One qualification can include, for example, generating a trigger only on a pulse wider or narrower than specified. Or it can require three trigger sources to exceed specific levels for a minimum time. In general, Smart Trigger offers a variety of trigger qualifications based on three abilities:

- To count a specified number of events (1 to 15,000,000).
- To measure time intervals (1 nsec up to 680 sec).
- To recognize a pattern input to the selected trigger sources.

To select the qualifications for Smart Trigger, display the Trigger Status screen as shown in Figure 4.10 by pressing Modify and selecting any Trigger control.

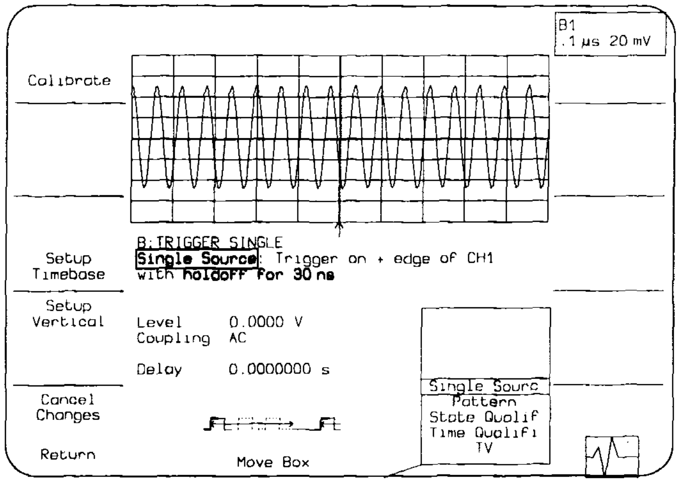


Figure 4.10: Example Smart Trigger Status Screen

In Figure 4.10, the first field below "TRIGGER" indicates a description of the trigger method. When Smart Trigger is selected on the plug-in front panel, one of five Smart Trigger methods may be selected in this field:

Single Source

Trigger on the selected source when the trigger conditions and one of the following qualifications are met:

- Holdoff for 30 nsec up to 680 sec.
- Holdoff for 1 to 15,000,000 events.
- Interval < 30 nsec up to 680 sec.
- Interval > 30 nsec up to 680 sec.
- Pulse < 1 nsec up to 680 sec.
- Pulse > 1 nsec up to 680 sec.

Pattern

Trigger whenever the selected combination of signals occurs and one of the following qualifications are met:

- Holdoff for 30 nsec up to 680 sec.
- Holdoff for 1 to 15,000,000 events.
- Interval < 30 nsec up to 680 sec.
- Interval > 30 nsec up to 680 sec.
- Time between patterns > 1 nsec to 680 sec (trigger on entering).
- Time between patterns < 1 nsec to 680 sec (trigger on entering).

Pattern width > 1 nsec to 680 sec (trigger on exiting).
Pattern width < 1 nsec to 680 sec (trigger on exiting).

State Qualified

Trigger whenever the trigger source meets its trigger condition during the selected pattern and one of the following qualifications are met:
Wait for 10 nsec up to 680 sec.
and before 10 nsec up to 680 sec.
Trigger on 1 to 15,000,000 'th event.

Time Qualified

Trigger whenever the trigger source meets its trigger condition after the selected combination begins and one of the following qualifications are met:
Wait for 10 nsec up to 680 sec.
and before 10 nsec up to 680 sec.
0 to 15,000,000 'th event.

TV

Trigger on the selected horizontal scan line of the composite sync signal connected to the EXT trigger input.
Select a horizontal scan line between 10 and 2500 to trigger on.
Further qualify the trigger point by selecting the frame in which the line occurs as either even, odd, or both.
Select the horizontal scan rate (15 to 20 Khz, 20 to 30 Khz, or 30 to 63 Khz).

Move the box and adjust the Modify Value knob to select among the five Smart Trigger choices. The following sections contain explanations of each Smart trigger method.

Single Source

Single Source triggering is similar to Standard triggering because one trigger source is used to define a trigger condition. Single Source allows an additional qualification before a trigger can occur. Qualifications can be:

- holdoff for 30 nsec up to 680 sec.
- holdoff for 1 to 15,000,000 events.
- interval < 30 nsec up to 680 sec.
- interval > 30 nsec up to 680 sec.
- pulse < 1 nsec up to 680 sec.
- pulse > 1 nsec up to 680 sec.

As shown in Figure 4.11, the Single Source Trigger Status screen contains additional fields:

Trigger on — Indicates the selected trigger edge, positive or negative, as selected by the SLOPE (19) key.

edge of — Indicates the trigger source, as selected by the SOURCE (3) (4) front panel key.

Holdoff for time — Selects a minimum time between triggers. A trigger is generated when the trigger condition is met after the selected delay from the last trigger. The timing for the delay is initialized and started on each trigger. Select from 30 nsec through 680 sec.

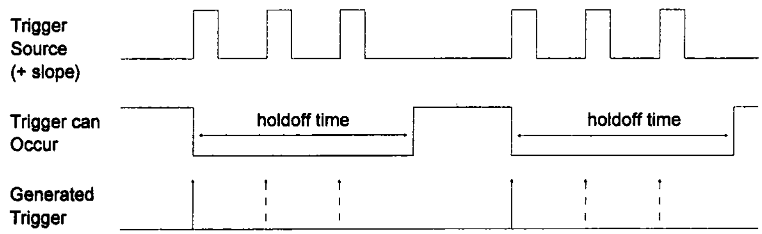


Figure 4.11: Single source with holdoff for time

Holdoff for events — Selects a minimum number of events between triggers. An event is generated when the trigger source meets its trigger conditions. A trigger is generated when the trigger condition is met after the selected number of events from the last trigger. The holdoff for events is initialized and started on each trigger. Select from 1 through 15,000,000 events.

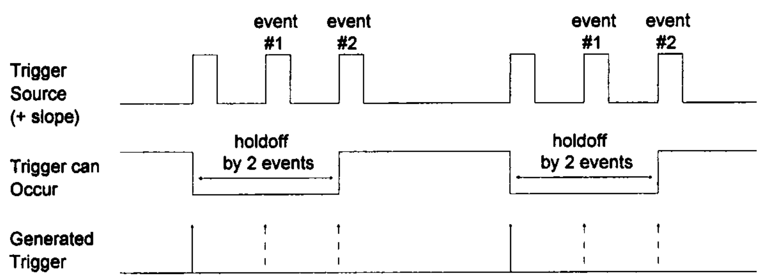


Figure 4.12: Single source with holdoff for events

The field to the right indicates the units for holdoff:

s Indicates the delay is in seconds.

events Indicates the number of times the trigger condition is met after the last trigger. If the number is selected as four, for example, the trigger would occur on the fifth event.

interval <

Selects a maximum interval between two edges of the same slope. The trigger is generated on the second edge if it occurs within the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. Select an interval from 30 nsec to 680 sec.

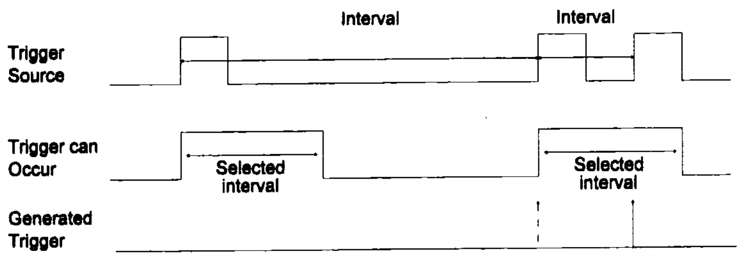


Figure 4.13: Trigger if interval < selected interval

inte rval >

Selects a minimum interval between two edges of the same slope. The trigger is generated on the second edge if it occurs after the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. Select an interval from 30 nsec to 680 sec.

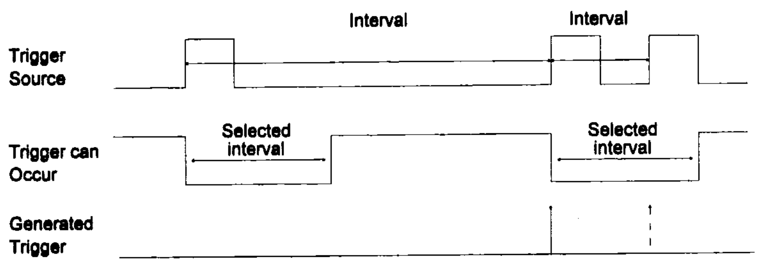


Figure 4.14: Trigger if interval > selected interval

pulse <

Selects a maximum pulse width. The trigger is generated on the selected edge when the pulse width is less than the selected width. The timing for the width is initialized and restarted on the slope opposite to the edge selected. Select a width from 1 nsec to 680 sec.

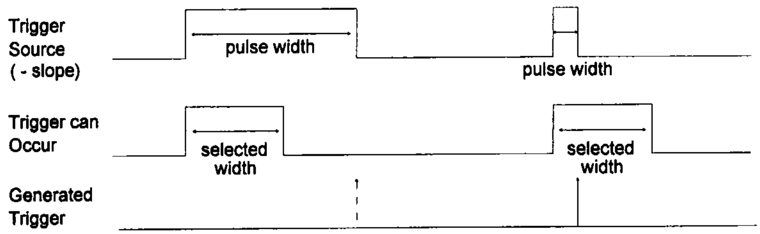


Figure 4.15: Trigger if pulse width < selected width

NOTE: To trigger on a positive pulse, select negative slope. The trigger is generated by the trailing edge of the pulse.

pulse >

Selects a minimum pulse width. The trigger is generated on the selected edge when the pulse width is greater than the selected width. The timing for the width is initialized and restarted on the edge opposite to the edge selected. Select a width from 1 nsec to 680 sec.

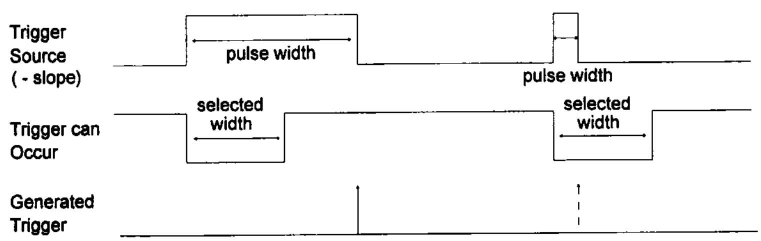


Figure 4.16: trigger if pulse > selected width

NOTE: To trigger on a positive pulse, select negative slope. The trigger is generated by the trailing edge of the pulse.

Summary: Setting up Single Source Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Single Source.
4. Using the front panel controls, select the desired trigger condition.
5. Select "Holdoff for time", or "Holdoff for events": "interval <", "interval >", "pulse <", or "pulse >".
6. Select the desired number of events or time.

Pattern

The pattern trigger logically combines the states of up to three inputs: channel 1, channel 2, and either EXT TRIG or EXT TRIG/10. The combination, called a pattern, is defined as the logical AND of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level. For example, the pattern can be defined as present when the trigger state for channel 1 is high, 2 is low, and EXT is high. If any are not met, the pattern state is considered absent.

Once the pattern is defined, one of two transitions can be used to generate the trigger. When the pattern begins, called "entering" the pattern, a trigger can be generated. Alternatively, a trigger can be generated when the pattern ends, "exiting" the pattern.

Pattern triggering allows an additional qualification once the selected pattern transition occurs.

With Pattern triggering, as in single source, one of the following qualifications can be selected:

- Holdoff for time
- Holdoff for events
- Interval <
- Interval >
- Time between patterns > trigger on entering
- Time between patterns < trigger on entering
- Pattern width > trigger on exiting
- Pattern width < trigger on exiting

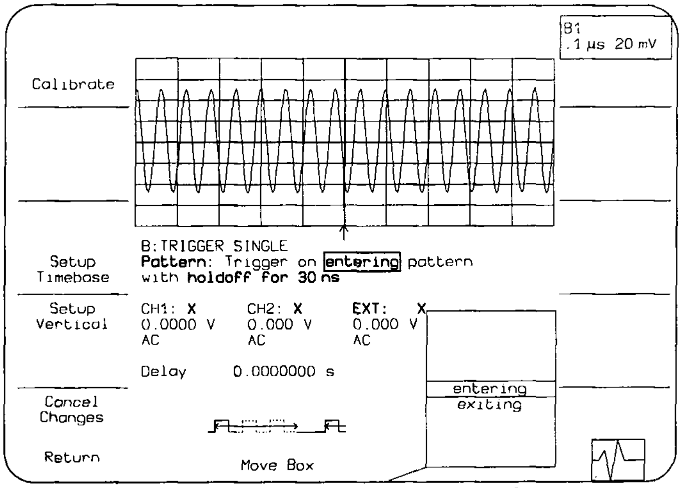


Figure 4.17: Pattern Trigger Status Screen

As shown in Figure 4.17, the Pattern Trigger Status screen contains these additional fields:

Trigger on Defines the selected pattern transition. The choices are:

entering	trigger when the pattern begins
exiting	trigger when the pattern ends

When Pattern triggering is selected, additional fields appear. The next three fields allow selection of the pattern from up to three sources in logical AND: CH1· CH2 · EXT. Alternatively, EXT/10 may be selected instead of EXT. This combination defines the presence of the pattern.

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

H Requires that the signal for this channel be greater than the trigger level.

L Requires that the signal for this channel must be below the trigger level.

X	Do not use the signal for this channel to define the pattern (don't care).
CH2:	Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.
EXT, or EX10:	Selects whether to use the trigger condition for EXT TRIG or EXT/10. Once selected, the field to its right indicates how to use it. The choices are H, L, and X.

The following fields indicate the qualifications for Pattern triggering:

Holdoff for time Selects a minimum time between triggers. A trigger is generated when the trigger condition is met after the selected delay from the last trigger. The timing for the delay is initialized and started on each trigger. Select from 30 nsec through 680 sec.

Holdoff for events Selects a minimum number of events between triggers. An event is generated when a trigger source meets its trigger conditions. A trigger is generated when the trigger condition is met after the selected events from the last trigger. Holdoff is initialized and started on each trigger. Select from 1 through 15,000,000 events.

interval < Selects a maximum interval between two signal edges of the same slope. The trigger is generated on the second edge if it occurs within the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. Select an interval from 30 nsec to 680 sec.

interval >

Selects a minimum interval between two signal edges on the same slope. The trigger is generated on the second edge if it occurs after the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. Select an interval from 30 nsec to 680 sec.

time between patterns <

Selects a maximum delay between exiting one pattern and entering the next. The trigger is generated on entering the second pattern within the selected time. The timing for the delay is initialized and restarted whenever the pattern is exited, regardless of whether a trigger is generated. Select time from 1 nsec to 680 sec.

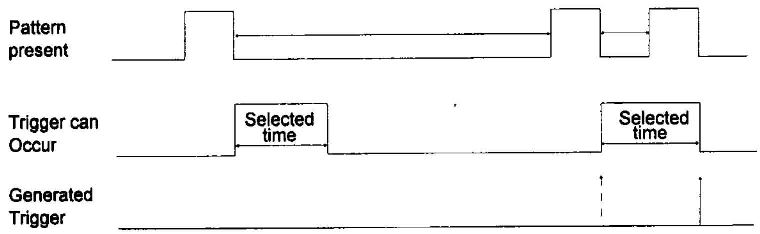


Figure 4.18: Pattern Trigger with time between patterns <selected time

time between patterns >

Selects a minimum delay between exiting one pattern and entering the next. The trigger is generated on entering the second pattern after the selected minimum time. The timing for the delay is initialized and restarted whenever the pattern is exited, regardless of whether a trigger is generated. Select time from 1 nsec to 680 sec.

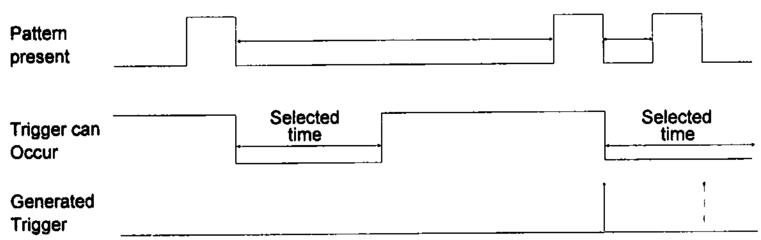
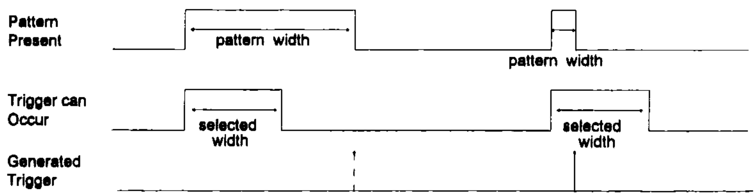


Figure 4.19: Pattern Trigger with time between patterns > selected time

pattern width < Selects a maximum pattern width. If the width is less than the selected width, the trigger is generated when the pattern ends. The timing for the width is initialized and restarted at the beginning of the pattern. Select a width from 1 nsec to 680 sec.



Fiugure 4.20: Trigger if pattern width < selected width

pattern width > Selects a minimum pattern width. If the width is greater than the selected width, the trigger is generated when the pattern ends. The timing for the width is initialized and restarted at the beginning of the pattern. Select a width from 1 nsec to 680 sec.

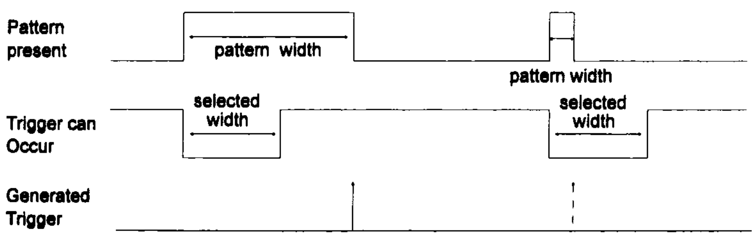


Figure 4.21: Trigger if pattern wisth > selected width

Summary: Setting up Pattern Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Pattern Trigger.
4. Select the triggering transition: “entering” or “exiting”.
5. Define the pattern: for channels 1 and 2, select H for high, L for low, and X for don't care. Select EX or EX10 and then a trigger state: H, L, or X.

6. Using the front panel controls, select the desired trigger condition.
7. Select: "Holdoff for", "interval <", "interval >", etc.
8. Select the desired number of events or reference time.

State Qualified

State Qualified triggering lets the user choose whether a trigger is generated while the selected pattern is present or absent. A pattern is defined as a logical AND combination of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level.

For example, a pattern is selected to be present when the trigger states for channels 1 and 2 are high and EXT is low. If any are not met, the pattern state is considered absent.

For State triggering, the pattern is used to qualify a trigger without actually generating the trigger. A trigger will occur when another signal, the trigger source, meets its trigger condition *while* the pattern is present. The trigger source is not allowed in the pattern. As shown in Figure 4.23, while the pattern is present CH2 high, a trigger occurs when CH1, the trigger source, has met its trigger condition.

State Qualified triggering allows an additional qualification once the selected pattern state occurs after meeting the pattern conditions.

- Wait for 10 nsec up to 680 sec.
- and before 10 nsec up to 680 sec.
- Trigger on 1 to 15,000,000 th event.

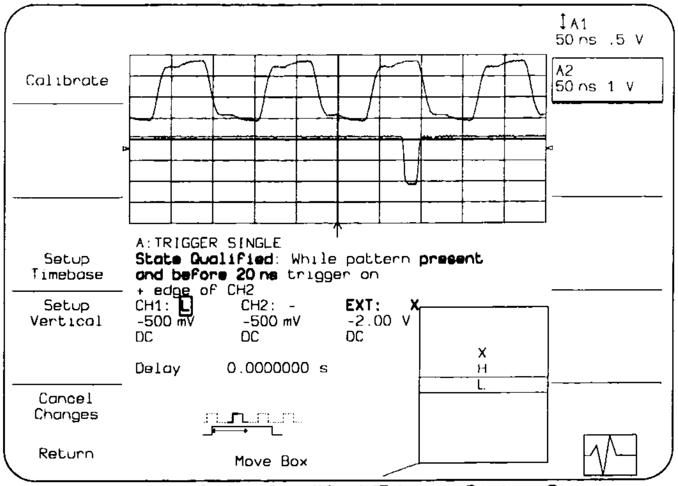


Figure 4.22: State Qualified Trigger Status Screen

As shown in Figure 4.22, the State Trigger Status screen contains additional fields:

Trigger on Defines the selected pattern. The choices are:

present	Trigger during the pattern.
absent	Trigger after the pattern ends.

When State Qualified Triggering is selected, a pattern must be selected to define the qualifications.

> ***NOTE:*** *The trigger source currently selected on the front panel serves as the trigger source and cannot be used in the pattern.*

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

- H Requires that the signal for this channel be greater than the trigger level.
- L Requires that the signal for this channel must be below the trigger level.
- X Do not use the signal for this channel to define the pattern (don't care).

CH2: Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X. EXT: or, EX10:

Selects whether to use the trigger condition for EXT TRIG or EXT/10. Once selected, the field to its right indicates how to use it. The choices are H, L, and X. If the trigger source on the front panel is EXT or EXT/10, this field can not be selected and will match the front panel selection.

The following fields indicate the qualifications for State Qualified triggering:

wait

Selects a delay from the start of the desired pattern. After the delay and before the end of the pattern, a trigger is generated when the trigger meets its conditions. The timing for the delay is restarted when the selected pattern begins. Select time from 10 nsec to 680 sec.

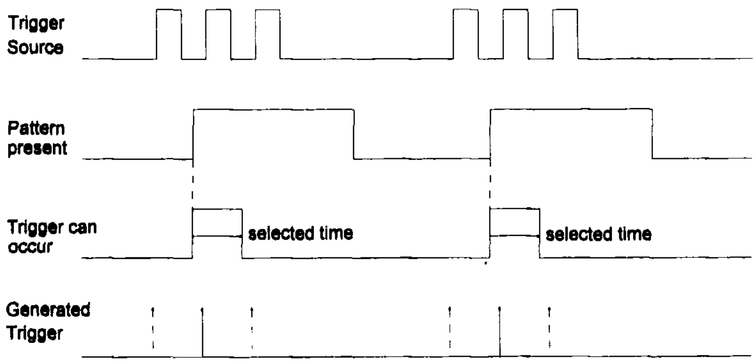


Figure 4.23: State Qualified Triggering with wait

When wait is selected, the following fields appear :

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the trigger source.

and before

Selects a time from the start of the desired pattern. Before the end of the selected time and before the end of the pattern, a trigger can occur. The selected time is restarted when the selected pattern begins. Select a time from 10 nsec to 680 sec.

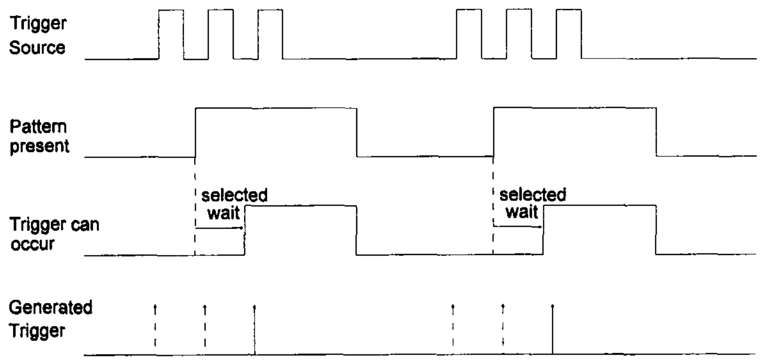


Figure 4.24: State Qualified Triggering and before

When "and before" is selected, the following fields appear:

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the trigger source.

trigger on

Selects a minimum number of events of the trigger source. An event is generated when a trigger source meets its trigger conditions. On the selected event of the trigger source and before the end of the pattern, a trigger can occur. The count is initialized and started whenever the selected pattern begins. It continues while the pattern remains. When the selected count is reached, the trigger occurs. Select from 1 through 15,000,000 events.

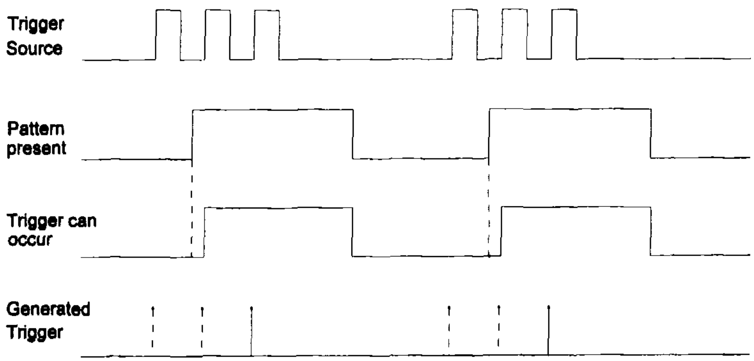


Figure 4.25: State Qualified Triggering with trigger on the second event

Summary: Setting up State Qualified Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select State Qualified Trigger.
4. Select the qualifying pattern: "present" or "absent".
5. Define the pattern: for channels 1 and 2, select H for high, L for low, or X for don't care. Select EXT or EXT10 and then a trigger state: H, L, or X.
6. Using the front panel controls, select the desired trigger condition.
7. Select: "wait", "and before", or "trigger on".
8. Select the desired number of events or time.

Time Qualified

Time Qualified triggering generates a trigger when the trigger source meets its trigger condition after entering or exiting the pattern. The trigger can occur even if the pattern disappears before the trigger meets its trigger conditions. A pattern is defined as a logical AND of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level. For example, the pattern can be defined as present when the trigger states for channels 1 and 2 are high and EXT is low. If any are not met, the pattern state is considered absent.

Once the pattern is defined, one of two transitions can be used. When the pattern begins, called "entering" the pattern, a trigger can occur. Alternatively, a trigger can be generated when the pattern ends, called "exiting" the pattern.

For Time qualified triggering, the pattern is used to qualify a trigger without actually generating the trigger. A trigger will occur when another signal, the trigger source, meets its trigger condition *after* the pattern is entered or exited.

Time Qualified triggering allows an additional qualification once the selected pattern transition occurs and after meeting the pattern conditions:

- Wait for 10 nsec up to 680 sec.
- and before 10 nsec up to 680 sec.
- 1 to 15,000,000 'th event.

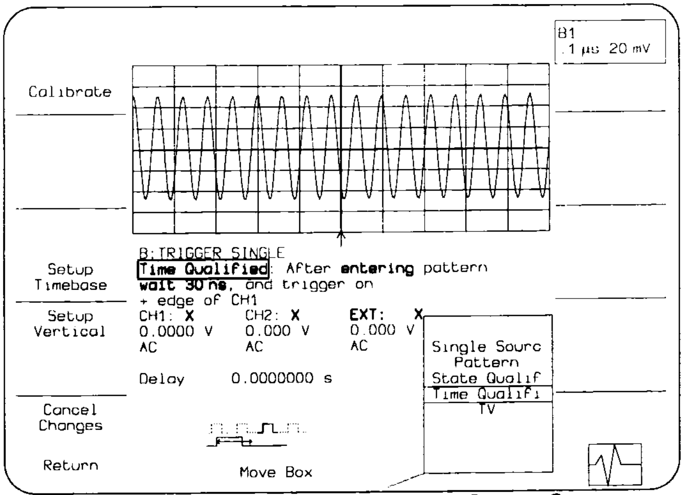


Figure 4.26: Time Qualified Trigger Status Screen

As shown in Figure 4.26, the Time Qualified Trigger Status screen contains these additional fields:

Trigger after — Defines the selected pattern transition. The choices are:

- entering — Trigger when the pattern starts.
- exiting — Trigger when the pattern ends.

When Time Qualified triggering is selected, a pattern must be selected to define the qualifications.

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

- H — Requires that the signal for this channel be greater than the trigger level.
- L — Requires that the signal for this channel must be below the trigger level.
- X — Do not use the signal for this channel to define the trigger pattern.

CH2: Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

EXT or EX10: Selects whether to use the trigger condition for EXT TRIG or EXT/10. Once selected, the field to its right indicates how to use it. The choices are H, L, and X. If the trigger source on the front panel is EXT or EXT/10, this field can not be selected and will match the front panel selection.

The following fields indicate the qualifications for Time Qualified triggering:

wait Selects a delay from entering or exiting the pattern. After the delay, a trigger is generated when the trigger meets its trigger conditions. The timing for the delay is always initialized and restarted on the selected pattern condition. Select a time from 10 nsec to 680 sec.

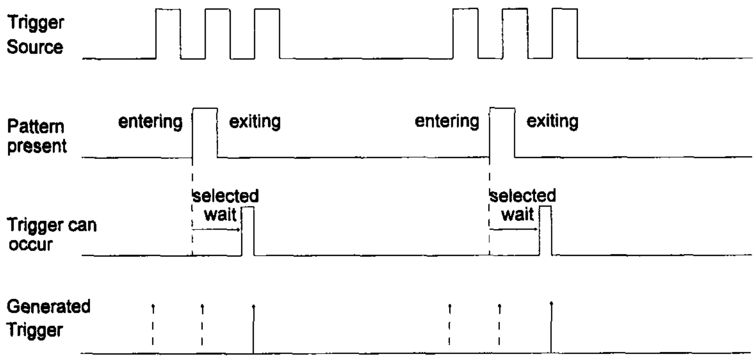


Figure 4.27: Time Qualified Triggering with wait

When wait is selected, the following fields appear:

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the trigger source.

and before

Selects a time from entering or exiting the pattern. Before the end of the selected time, a trigger can occur. The selected time is restarted on the selected pattern condition. Select a time from 10 nsec to 680 sec.

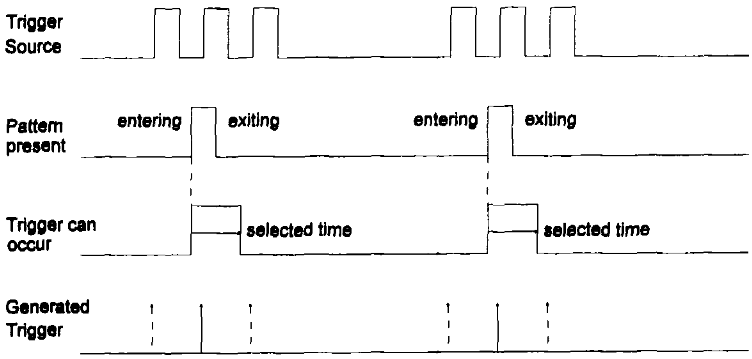


Figure 4.28: Time Qualified Triggering and before

When "and before" is selected, the following fields appear:

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the enabling trigger source.

trigger on

Selects a minimum number of events. An event is generated when a trigger source meets its trigger conditions. On the selected event of the trigger source and before the next pattern condition, a trigger can occur. The count is initialized and started on the selected pattern condition. It continues until the next pattern condition. Select from 1 through 15,000,000 events.

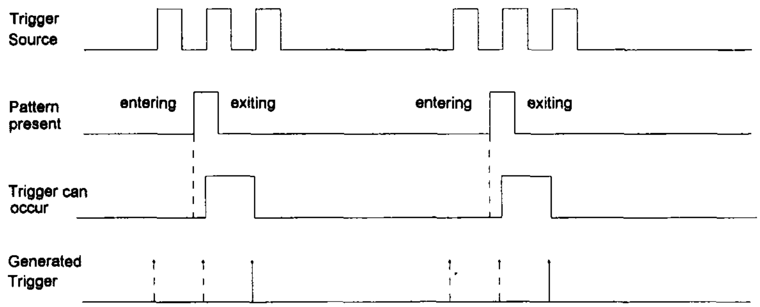


Figure 4.29: Time Qualified Triggering and trigger on the second event

Summary: Setting Up Time Qualified Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Time Qualified Trigger.
4. Select the pattern condition: "entering" or "exiting".
5. Define the pattern: for channels 1 and 2, select H for high, L for low, or X for don't care. Select EXT or EXT10 and then a trigger state: H, L, or X.
6. Using the front panel controls, select the desired trigger condition.
7. Select : "wait", "and before", or "trigger on".
8. Select the desired number of events or reference time.

TV

TV Trigger will trigger on the selected horizontal scan line of the composite sync signal connected to the EXT trigger input.

- Select a horizontal scan line from 10 to 2500 to trigger on.
- Further qualify the trigger point by selecting the frame in which the line occurs as either even, odd, or both.
- Select the horizontal scan rate (15 to 20 KHz, 20 to 30 KHz, or 30 to 63 KHz).

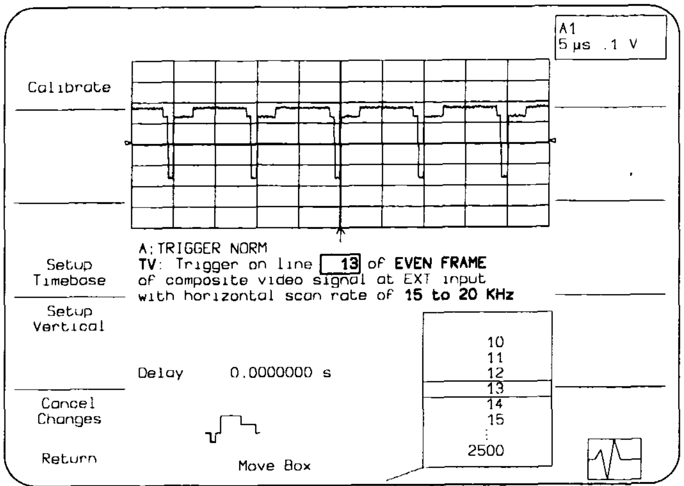


Figure 4.30: Example TV Trigger Status Screen

Trigger on line	Selects the horizontal scan line from 10 to 2500 to trigger on.
of	Selects the frame the line is selected from. The choices are EVEN FRAME, ODD FRAME, or BOTH FRAMES.
horizontal scan rate	Selects the horizontal scan rate. The choices are 15 to 20 KHz, 20 to 30 KHz, or 30 to 63 KHz.

Plug-in Status

The Plug-in Status screen provides a summary of all the acquisition settings. It also allows adjustments of settings not controlled from the front panel. A hardcopy of this screen (see Hardcopy Setup, page 3-103) provides complete documentation of the acquisition settings.

To display the Plug-in Status screen, press the plug-in DISPLAY key. Pressing the mainframe MODIFY key before pressing DISPLAY will also display this screen:

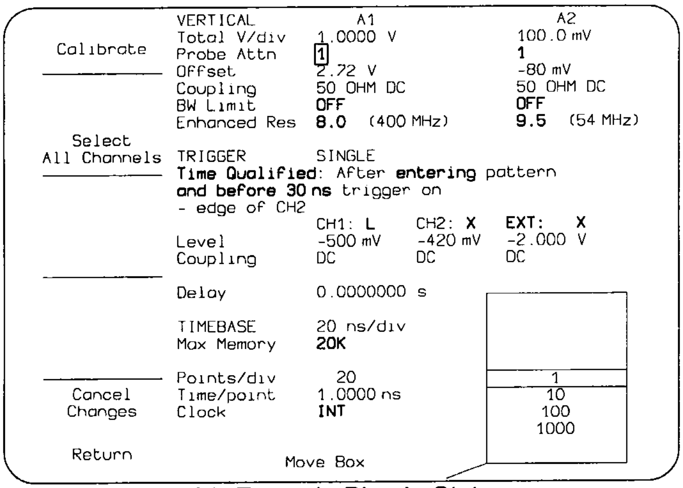


Figure 4.31: Example Plug-in Status screen

Once a screen is displayed, the Move Box knob is used to select a field to be modified. (Only highlighted fields can be modified from this screen.) The options list in the lower right screen will indicate available choices, with the current one in the center.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes in non-volatile memory and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The settings are arranged on the screen by control group (i.e., VERTICAL, TRIGGER, and TIMEBASE). Each group includes the fields from one status screen. For explanations of fields specific to an individual status screen, refer to the section in Operation which details its use.

For the Vertical section, the settings for each channel are shown in two columns.

If Smart Trigger™ is selected and uses a combination, or pattern, of trigger sources, the trigger settings for each source in the pattern are shown in three columns. As shown in Figure 4.31, all the plug-in's settings are displayed.

Product Description

LeCroy's Four channel 7234 Plug-in Module, with DC-500MHz bandwidth, accurately captures fast waveforms. The 7234 Plug-in can record single-shot signals with 5 ns time resolution and 8 to 11 bits vertical resolution. Capture repetitive waveforms with 50 ps time resolution and over 11 bits vertical resolution.

Deep 50,000 point memory per channel stores long waveform records. Reducing the number of channels data is being acquired on results in 100,000 point memory for 2 channels or 200,000 point memory for 1 channel. Using it's full 200k sample memory, the 7234 maintains its full 200MS/s digitizing rate on timebase settings as low as 100 μs/div.

Features

- Four, Two or One channel 8-bit 200MS/sec single-shot recording.
- 50 Ω (DC) or 1 MΩ (AC or DC) input coupling.
- DC to 500 MHz (-3dB) analog Bandwidth for 50 Ω operation.
- DC to 250 MHz (-3dB) analog bandwidth for 1 MΩ operation.
- Continuously variable Gain 5 mV/div to 2.5 V/div, to make full use of digitizing range.
- 50,000 Samples, digitizing memory for each channel, for four channel operation, 100,000 samples for two channel, or 200,000 samples for 1 channel.
- 10 to 48 divisions of offset control.
- Internal or external timebase.
- Automatically synchronized timebase and trigger with other 7200 series plug-ins.
- Real-time digital filtering allows you to trade bandwidth for resolution, increasing it from 8 to 11 bits. For repetitive signals, resolution can be further enhanced with signal averaging.
- Random Interleaved Sampling(RIS) at 20 GS/s(50 ps resolution) for repetitive waveforms.
- Standard triggering features plus SMART TRIGGER™ for easy triggering in tough applications, including: pulse width, interval, logic, and others.
- Fully programmable from remote control.
- Automatic sensing of Probe attenuation.
- Self-calibrating

This page is intentionally blank

Install the Plug-in(s)

CAUTION: Do not install or remove a plug-in while the 7200A mainframe is powered on.

To install, align the plug-in's bottom grooves with the wire guides at the bottom of the mainframe's plug-in compartment. Next, slide in the plug-in until it latches into place. See Figure 4.1 Remove the plug-in by pulling out its latch and sliding it out.

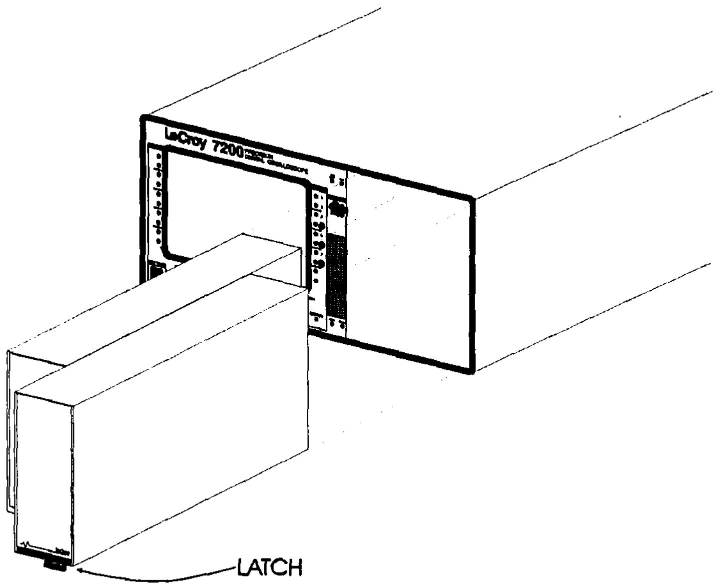


Figure 4.1: 7234 Plug-in Installation

This page is intentionally blank

Operation

This section describes the 7234 Plug-in front panel controls and their associated displays. The controls affect the signal amplifiers, timebase, and trigger conditions. Their settings are summarized in the System Message Area (upper section of screen) whenever one is adjusted.

Additional controls on the 7200A mainframe front panel:

Initiate auto setup;	Perform cursor measurements;
Select trigger modes;	Setup and configure hardcopy;
Perform processing;	Select independent timebase and triggering;
Display and archive data;	Operate on-line Help.

For a description of the mainframe controls, refer to Section 3 of the *LeCroy 7200 Series Precision Digital Oscilloscope Operator's Manual.*

Probes

Four Model 7200-P12 passive probes are supplied with the 7234. These probes have 10 MΩ input impedance and approximately 15 pF capacitance. The system bandwidth with 7200-P12 probes is DC to 350 MHz with 1MΩ DC coupling, and less than 1 Hz to 250 MHz with AC coupling. If attenuation-coded probes are used, the probe-coding contact rings surrounding each channels connector recognizes the attenuation factors of the probes. These factors are included in the vertical sensitivity indication.

Probe Calibration

To calibrate the 7200-P12 Probe, connect it to either the BNC connector labelled CH1, CH2, or CH3. Connect the probe's grounding clip to the front panel ground lug of the oscilloscope and connect the tip to the signal lug. Press the mainframe Auto Setup key to obtain a signal. If over- or undershooting of the displayed signal occurs, you can adjust the 7200-P12 Probe by inserting the small screwdriver supplied with the probe package into the trimmer on the probe's barrel. Turn the screwdriver either clockwise or counterclockwise to achieve the optimal square wave contour.

Control Layout

7234 Plug-in Module controls are arranged in four groups:

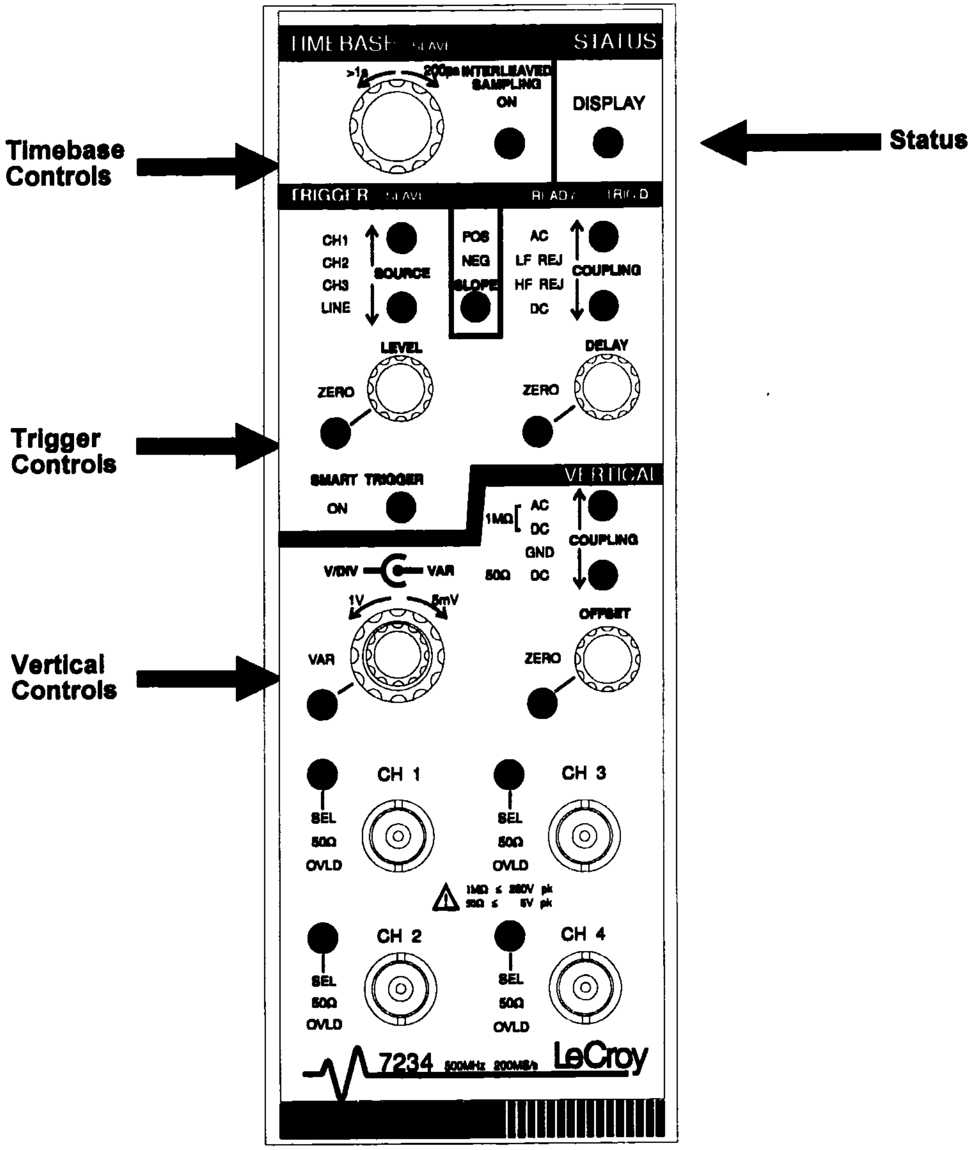


Figure 4.2 7234 Plug-in Front Panel Controls

Display of Acquisition Settings

The 7234 displays acquisition settings which match its operation. Whenever a plug-in front panel control is adjusted, all its knob settings are displayed in the System Message Area for about thirty seconds. In Figure 4-3 the control settings are being displayed.

Notice also that unless cursor measurements are being performed, the timebase and vertical units are displayed under the trace label.

Separate status screens summarize the settings of the Vertical, Timebase, and Trigger control groups. Each includes a half-screen display of all the traces. A fourth Status screen summarizes all the plug-in settings.

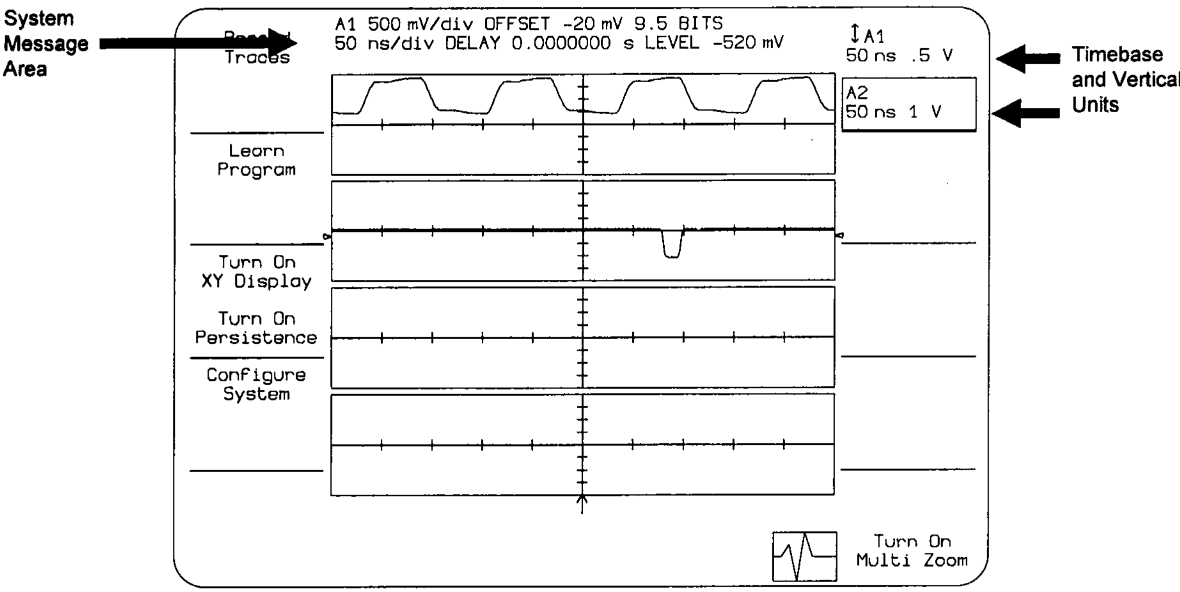


Figure 4.3: Control settings, and Timebase and Vertical Units

As shown above, the fields in the acquisition setting summary indicate the following:

A 1, A 2, A 3, A 4, A B 1,B 2, B 3, B 4, B	Identifies the plug-in slot being summarized and the vertical channel controls being adjusted. A plug-in slot letter (e.g: "A") that is not followed by a channel number specifies that CH1,CH2, CH3, and CH4 vertical controls are locked together. (Locking occurs by pressing the Select All Channels button in the Vertical and Status Screens.)

Total V/DIV	Indicates the actual volts/division. this includes the settings of the V/DIV and VARIABLE SENSITIVITY knobs. A probe multiplier is indicated if it is not unity.
OFFSET	Indicates the vertical offset as selected by the OFFSET KNOB and its ZERO key.
NUMBER OF BITS	Indicates the resolution of the data.
BWL	Indicates when the BANDWIDTH LIMIT is on.
TDIV	Indicates the timebase as adjusted by the T/DIV knob.
DELAY	Indicates the Trigger delay as selected by the DELAY knob and its ZERO key.
LEVEL	Indicates the Trigger level as selected by the LEVEL knob and its ZERO key.

***NOTE:** The settings appear when the control is adjusted, so the display indicates settings for the next acquisition. They may differ from those indicated under the trace label which were used to acquire the currently displayed trace.*

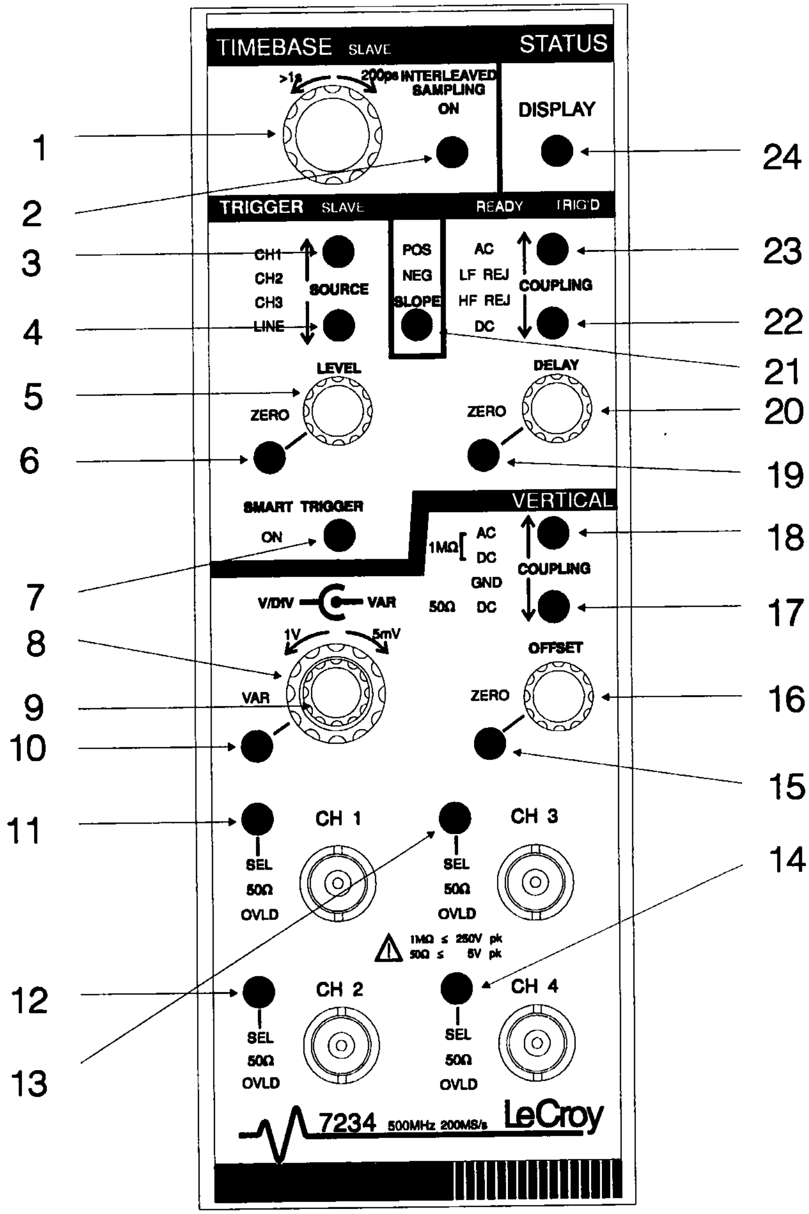
Status Screens

The Plug-in Status screen enables simultaneous viewing of a plug-in's Vertical, Trigger, and Timebase settings. To display the Plug-in Status screen, press the plug-in DISPLAY key. Pressing the mainframe MODIFY key before pressing DISPLAY will also display this screen. The Plug-in Status screen is described in detail on page 4-104.

To view changes in the waveforms as the control settings are adjusted, one of three other screens can be displayed: the Vertical, Timebase, and Trigger Status screens. Each screen shows all the displayed waveforms on a half-screen grid. Below the grid are the settings of the selected control group. As settings are changed, the effects on traces are shown on the next acquisition.

To display one of these screens, press MODIFY and then press any key or adjust any knob within the desired control group. Adjusting a knob or pressing a key after pressing MODIFY will not affect its setting.

7234 Plug-in Front Panel Controls:



Index to Controls

Vertical Controls

Following are descriptions of the 7234 plug-in front panel controls. The number in parentheses locates the control on the 7234 Plug-in front panel drawing.

Vertical Sensitivity and Offset

V/DIV (8)

Selects the vertical sensitivity, or fixed gain, in multiples of 1, 2, and 5. The range of the fixed gain is 5 mV to 1 V/div at both 1 MΩ and 50Ω input impedances.

The maximum permissible input voltage to either channel is 250 V (DC + peak AC) in 1MΩ and 5 V (DC +Peak AC) in 50Ω input impedance.

VAR (9)

The inner knob (9) of the V/DIV control provides continuously variable vertical sensitivity within the V/DIV knob settings. The variable setting knob increases the vertical range up to 2.5 times the V/DIV knob setting. When VAR is rotated to adjust the vertical sensitivity between fixed settings, the VAR LED to the left of the knob lights "VAR" and the fixed gain indication on the screen is preceded by a ">". The resulting vertical sensitivity is indicated as "Total V/DIV" on the status screen.

To use the full dynamic range of the channel's analog-to-digital converter (ADC), use the knob to fit the signal onto the entire vertical range.

VAR (10)

The VAR key (10) adjacent to the V/DIV knob toggles between selecting or de-selecting the variable setting to increase the vertical range.

OFFSET (16)

Adjusts the voltage offset used to position the signal within the amplifier's input range. The maximum offset depends on the fixed V/DIV: if the fixed V/DIV is 1 V, the maximum offset is ± 10 times the fixed V/DIV without variable gain and ± 4 V with variable gain;if the fixed V/DIV is from 20 mV through .5 V, the maximum offset is ± 12 times the fixed V/DIV;if the fixed V/DIV is 10 mV, the maximum offset is ± 24 times the fixed V/DIV; if the fixed V/DIV is 5 mV, the maximum offset is ±48 times the fixed V/DIV. It is adjustable in 0.02 division increments.

A pair of upward– or downward–pointing double–shaft arrows on the grid's upper or lower edge indicate when the trace has been positioned outside of the grid, as shown in Figure 4.4. (The VERTICAL POSITION knob under the screen can also move the trace outside of the grid. That knob, however, only affects the display position and not the amplifier offset setting.) Note that the View Port is not affected by the offset.

ZERO (15) Toggles between the selected offset value and a zero offset. An LED next to the key lights "ZERO" to indicate zero offset.

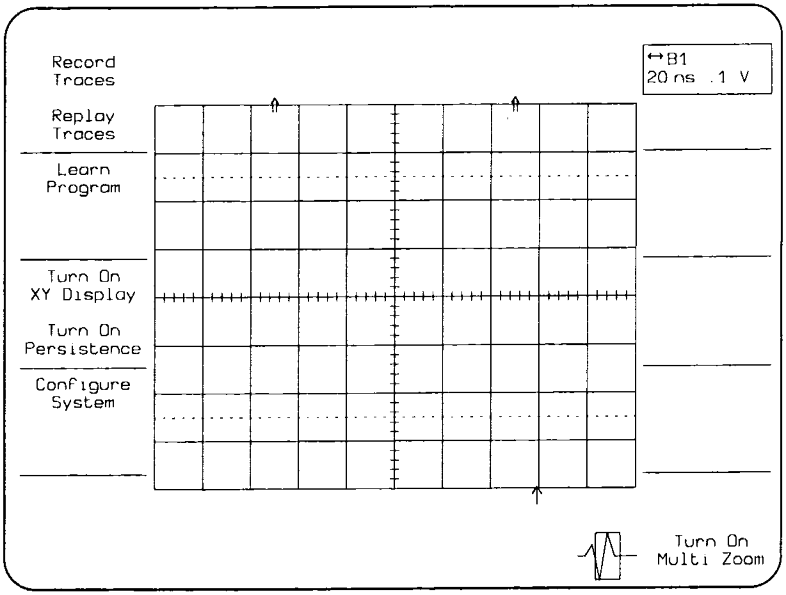


Figure 4.4: Upward-pointing arrows indicate that a waveform(s) is off the screen

CH 1(11), CH 2 (12), CH 3(13), or CH 4(14) Pressing the CH 1,CH 2, CH 3, or CH 4 key selects which channel the Vertical controls will modify. For example, when CH 1 is pressed, adjusting a Vertical control such as the V/DIV knob, affects CH 1 signal input. CH 2 settings remain unchanged. The channel LED next to the key is lit to indicate the selected channel.

Signal Coupling and Input Impedance

COUPLING ((17) and (18))

Selects how to couple the signal to the vertical amplifier input. As the keys are pressed to step through each coupling option, LEDs to the left of them indicate the selection. Possible selections are as follows:

1MΩ AC	Couples signals capacitively to the input amplifier, blocking the input signal's DC component. It limits the signal frequencies to more than 10 Hz. The input impedance is 1MΩ.
1MΩ DC	Connects signals directly to the amplifier, using 1MΩ input
GND	Disconnects the input signal from the amplifier, and applies ground to the amplifier input. If the offset is non-zero, the trace will be at the offset value.
50Ω DC	Connects signals directly to the amplifier, using 50Ω input 50Ω impedance. The maximum dissipation into 50Ω is 0.5W,which corresponds to 5 V DC or 5 V rms. When selected, an LED ("50 Ω") next to the input connector will light.

Signals will be automatically disconnected from the amplifier whenever the maximum dissipation is exceeded when 50Ω input impedance has been selected. If an overload condition is detected, a warning LED ("OVLD") next to the input connector is lit, and the input coupling is switched to GND.To clear the overload condition, remove the signal from the input and re-select the desired coupling.

Timebase Controls

TIMEBASE (1)

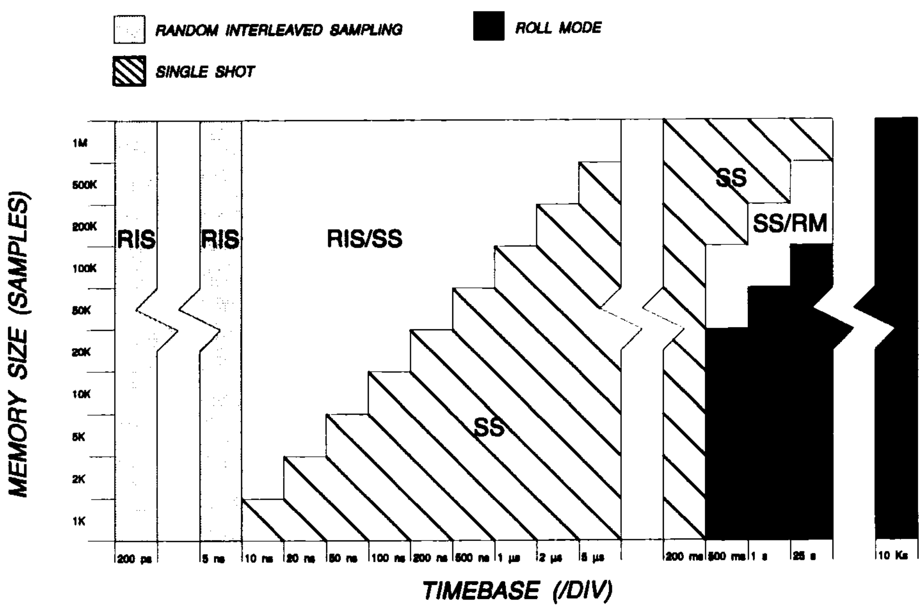
Selects the amount of time each horizontal division represents. The knob selects the TIMEBASE in a 1-2-5 sequence from 200 ps/DIV to 10,000 sec/DIV.

The TIMEBASE setting, the acquisition memory size, the number of channels acquiring data and if in SEQuence Trigger Mode, the number of segments and trigger rate selection determine the sample rate and the number of sample points displayed per division. The Plug-in Status and the Timebase Status screens indicate the time per point and points per division. The maximum memory size,trigger rate, and number of segments can be selected in the Plug-in status or the Timebase Status screen.

INTERLEAVED SAMPLING (2)

Turns on or off the Random Interleaved Sampling (RIS) acquisition mode, depending on the timebase. When selected, an "ON"

Figure 4.5: 7234 Acquisition Modes



LED will light. When the ON LED is not lit, single shot acquisition is used.

At timebase settings from 200 ps/div to 5 nsec/div inclusive, the 7234 automatically uses RIS for signal acquisition. Repetitive waveforms and a stable trigger are required. Waveforms are digitized with a sample interval of 50 psec for an equivalent sampling rate of 20 gigasamples/sec.

At timebase settings of 10 ns/div to ms/div the 7234 uses either RIS or single shot depending on the memory size as shown in figure 4.5. The INTERLEAVED SAMPLING key is used to switch between RIS and single shot when both are possible. When interleaved sampling is on sampling options can be selected in the Plug-in Status or the Timebase Status screens.

As shown in figure 4.5 the 7234 uses only single shot at timebase settings of 10 μs/div to 200 ms/div. The 7234 can record waveforms using single shot acquisitions for timebase settings of 10 ns/div to 200 ms/div. Sampling rates up to 200 megasample/sec are possible in single shot mode.

At timebase settings of 500 ms/div to 10 Ks/div the 7234 uses roll mode acquisitions, except as shown in figure 4.5. When both single shot and roll mode are possible changing the number of active channels will switch between single shot and roll mode.

Trigger Controls

SOURCE ((3) and (4))

Selects the signal used as the trigger source. The LED next to the keys is lit to indicate the selected trigger source. Adjusting the other trigger controls affects triggering for the selected source. If the source is changed, the other controls affect triggering for the new source. The 7234 saves the settings for each source independently. For example, when CH 1 is selected, adjusting a trigger control, such as the LEVEL knob, affects triggering when CH 1 is used. The CH2 and CH3 settings remain unchanged.

CH 1	Uses signal applied to CH 1 input connector
CH 2	Uses CH 2 signal input

CH 3 — Uses CH 3 signal input

LINE — Selects the line voltage which powers the 7200A. Provides a stable display of signals synchronous with the power line.

COUPLING ((22) and (23))

Selects the method used to couple the trigger source to the input of the trigger circuit. As the keys are pressed to step through each coupling method, LEDs to the left of them indicate the selection. Possible selections are as follows:

AC — Couples the source capacitively to the trigger circuit, DC levels are rejected and frequencies below 50 Hz are attenuated.

LF REJ — Couples the source capacitively with a high-pass filter network. DC is rejected and signal frequencies below 50 KHz are attenuated.

HF REJ — Connects the source directly to the trigger circuit. A low pass filter network attenuates frequencies above 50 KHz. The HF REJ trigger mode is used to reject high frequency signals.

DC — Couples all of the signal's frequency components to the trigger circuit.

The coupling is adjusted independently for each trigger source. Therefore, changing the source can also change the trigger coupling. Coupling is set to AC when the trigger source is LINE.

DELAY (20)

Adjusts the amount of signal recorded before or after the trigger occurs. The minimum delay is -5 x the time/div. The maximum delay is 100,000 x the time/div.

The arrow under the grid indicates the trigger point of the displayed trace.

ZERO (19) — Toggles between the selected delay setting and a trigger delay of zero, which would put the trigger at the center of the grid. An LED next to the key lights "ZERO" to indicate zero trigger delay.

LEVEL (5)

Adjusts the voltage level at which triggering will occur. When the trigger level is increased, the trigger circuit will respond at a higher voltage level. If vertical sensitivity is adjusted such that the previously selected trigger level exceeds the sensitivity range, the trigger level is automatically reduced to fit the new range.

The trigger level indicator arrows appear only on the selected trace if: the trace is defined to be an unprocessed acquisition channel, the channel is selected as the trigger source, and the trigger coupling is DC or HF REJ.

The range of trigger levels is as follows:

Trigger Source	Trigger Range
CH 1, CH 2 or CH 3	± 5 screen divisions · total gain referred to the center of the screen.
LINE	Fixed at zero.
ZERO (6)	Toggles between the selected trigger level and a trigger level of 0.0 V. An LED next to the key lights "ZERO" to indicate zero trigger level.

LEVEL is not used if the Trigger Source is LINE.

SLOPE (21)

Selects the signal edge used to activate the trigger circuit. The slope of the trigger can be adjusted for each individual trigger source and is indicated by LEDs above the SLOPE key.

POS	Requires a positive-going edge to trigger.
NEG	Requires a negative-going edge to trigger.
SLOPE	The Slope is set to POS when the trigger source is LINE.

SMART TRIGGER (7)

Toggles between selecting the Standard trigger and Smart™ Trigger. Smart™ Trigger is setup from within either the Trigger Status or Plug-in status screens. An LED next to the key will light "ON" to indicate Smart™ Trigger is selected. The Trigger Status screen is displayed by pressing MODIFY on the mainframe and any trigger control. The Plug-in status screen is displayed by pressing the DISPLAY key on the plug-in.

Trigger Mode

The Trigger Mode selects the mode of trigger operation: SEQuence, AUTO, NORM, and SINGLE. It is selected on the mainframe front panel using keys (28) and (29) as shown in the *LeCroy 7200 Series Modular Oscilloscope System Operator's Manual.*

Trigger State

A "READY" LED on each plug-in indicates that the trigger circuit has been armed and the plug-in is acquiring input signals. The "TRIG'D" LED is lit whenever the timebase is stopped (normally after a valid trigger).

After a valid trigger is detected, a time lag (as set by the Trigger Delay knob) may occur before the acquisition stops and the waveform is displayed.

VERTICAL Status

The Vertical Status screen provides a summary of all the Vertical control settings. It also allows adjustments of settings that are not controlled from the front panel. To display the Vertical Status screen, press the MODIFY key on the mainframe and then adjust any Vertical control on the plug-in front panel. Adjusting the Vertical control after pressing MODIFY will not affect its setting.

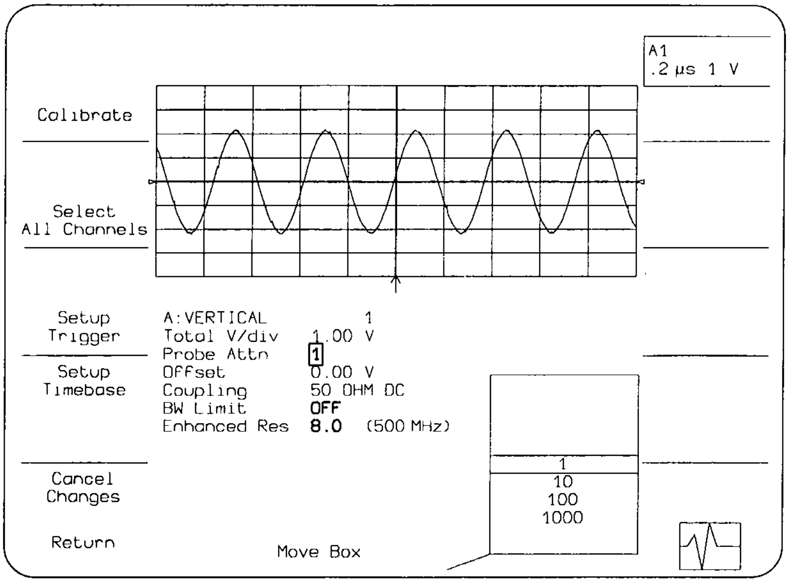


Figure 4.6: Example Vertical Status Screen

In this screen, all the displayed traces are shown in a half-screen grid above the screen's fields. As Vertical controls are changed, the effects on traces are shown on the next acquisition. Figure 4.6 shows an example of the Vertical Status screen.

Once a screen is displayed, move the box onto a field to be modified. The box will only move onto fields that do not have a front panel key or knob. These fields are highlighted. The options list will indicate available choices, with the current choice in the center.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The Vertical Status screen contains the following softkeys and fields:

Calibrate	Ensures overall vertical and timebase accuracy. (Calibration is also performed when the 7200A is powered on, and periodically thereafter, and when Vertical controls are adjusted).
Select All Channels	When the probe attenuation on each channel is matched, Select All Channels sets all vertical control settings for every channel of the plug-in to be the same as the currently selected channel . All channel LEDs are then lit and changing any of the Vertical controls affects all Channels until one of the Channel keys is pressed.
Setup Trigger	Displays the Trigger Status Screen.
Setup Timebase	Displays the Timebase Status Screen.
VERTICAL	Indicates the selected channel.
Total V/div	Indicates the actual Volts/division. This includes the settings of the V/DIV (8) and variable sensitivity (9) (10) knobs and the Probe Attenuation.
Probe Attn	Indicates the probe attenuation factor included in the vertical sensitivity indication. If attenuation-coded probes are used, the probe-coding contact rings surrounding the CH1, CH2, CH3, and CH4 BNC connectors recognize the attenuation factors of the probes, and this field cannot be modified. If this type of probe is not used, the probe attenuation can be selected for this field to reflect the attenuation for the probe being used. The choices are x1 to x1000.
BW Limit	Reduces the bandwidth to 95 MHz. It is useful in reducing signal noise. It can also prevent high frequency aliasing for single shot events at timebases below 2 ms/div @ 200K memory, 1 ms/div @ 100K, 500 ms/div @ 50K , 200 µs/div @ 20K, 100 ms/div @ 10K, 50 ms/div @ 5K, 2 µs/div @ 2K, and 10 ms/div @ 1K. The choices are ON and OFF.
Enhanced Res	Selects the amount of digital filtering for enhancing resolution. By limiting the system bandwidth, noise can be filtered and reduced. Thus, the effective resolution can actually be improved beyond the ADC's ideal performance. Selecting greater values

of this parameter increasingly filters noise. Since the ADCs each have 8 bits, selecting the lowest value removes the filter. The effective system bandwidth is indicated next to the number of bits. Enhanced Res cannot be used when the trigger mode is Sequence.

Offset Indicates the vertical offset as selected by the OFFSET (16) knob and its ZERO (15) key.

Coupling Indicates the vertical coupling as set by the COUPLING (17) (18) keys.

TIMEBASE Status

The Timebase Status screen provides a summary of all the Timebase settings. It also allows adjustments of settings that are not controlled from the front panel. To display the Timebase Status screen, press the MODIFY key on the mainframe and then adjust any Timebase control on the plug-in front panel. Adjusting the Timebase control after pressing MODIFY will not affect its setting.

In this screen, all the displayed traces are shown in a half-screen grid above the selection fields. As Timebase controls are adjusted, the effects on traces are immediately shown. Figure 4.7 shows an example of the Timebase Status screen.

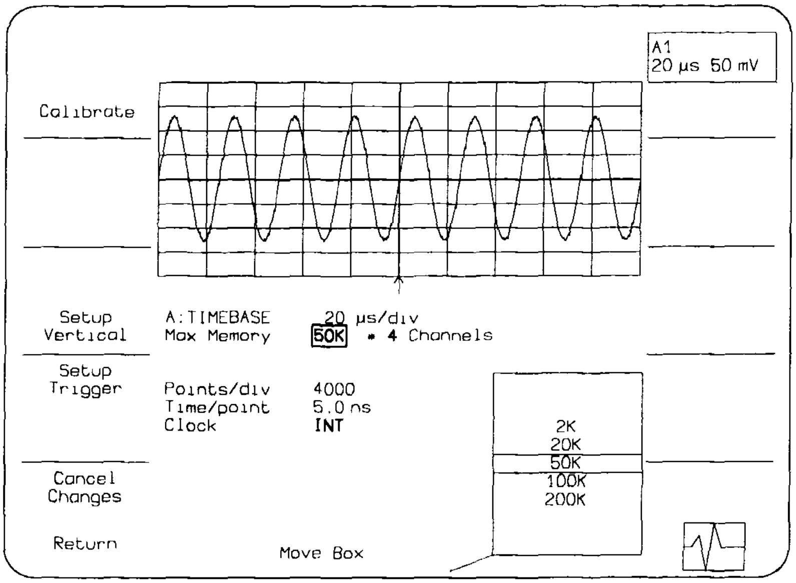


Figure 4.7: Example Timebase Status Screen

Once a screen is displayed, the Move Box knob under the center of the screen is used to select a field to be modified. The box will only move onto fields that do not have a front panel key or knob. These fields are highlighted in bold type. The options list in the lower right screen will indicate available choices, with the current choice in the center.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes in non-volatile memory and display the

Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The TIMEBASE Status screen contains the following softkeys and fields:

Calibrate	Ensures overall vertical and timebase accuracy. (Calibration is also performed when the 7200A is powered on and periodically thereafter and when the Vertical controls are adjusted).
Setup Vertical	Displays the Vertical Status screen.
Setup Trigger	Displays the Trigger Status screen.
Max Memory	Indicates the maximum number of sample points to represent each waveform. Together with the timebase setting, the number of channels acquiring data, (and if in SEQuence mode, the number of segments and trigger rate), it determines the sample rate. The choices are 1,000, 2,000, 5,000, 10,000, 20,000, 50,000, 100,000, 200,000 points. Acquire 1,000 samples to achieve maximum waveform throughput. Obtaining 200,000 points provides a greater time window of the signal, requiring more time to process the additional points.
Number of Acquisition Channels	Selects the number of channels which will acquire data. The choices are 4, 2, and 1. Selection of 4 channels provides data on all channels with a maximum of 50K memory per channel, 2 channels @ 100K, and 1 channel @ 200K. Together with the timebase setting, max memory size (and if in SEQuence mode, the number of segments and the trigger rate), determines the sample rate. Channels not acquiring data are available as trigger sources.
Clock	Selects whether to use an internal or external sample clock which is applied to the back panel. With an external clock, the suggested clock rate is specified. The maximum sample rate is 200 Megasamples.
TIMEBASE	Indicates the time per division setting of the TIMEBASE knob. If Random Interleaved Sampling (RIS) is selected, "RIS" also appears on this line.
Points/div	Indicates how often the input signal is sampled for each division of the display grid. If the waveform is not expanded or decimated by processing, the timebase, and Max Memory size determine its value. When the trigger mode is Sequence, and not deci-

mated by processing, the timebase, number of segments, trigger rate and max memory size determine its value.

Time/point Indicates the sample rate (i.e., time between digitized sample points) for the corresponding timebase setting.

If the trigger mode is Sequence, the following fields are present:

Maximize Selects the method used to acquire each segment. The two methods are to maximize trigger rate and points per segment. Selection of maximize trigger rate will tradeoff the number of segments and segment size for a greater trigger rate. (The time from one trigger to the next). This method can acquire a maximum of 1000 segments between screen updates due to the limitations in acquisition memory. Selection of maximize points per segment will maximize the number of segments and points per segment. This method processes each segment as it is acquired. This method can acquire a maximum of 4000 segments between screen updates, because it is not limited by acquisition memory, but by processing memory. Both methods trigger rate will vary with the length of each segment and the number of channels acquiring data.

The table shown in Table 4.1 shows the relationship of maximum memory size, number of channels acquiring data, and maximum number of segments, for each method:

Table 4.1: Maximum Number of Segments

	Maximize Trigger Rate			**Maximize Points Per Segment**		
Memory Size	**Number of Channels Active**					
	1	**2**	**4**	**1**	**2**	**4**
1 K	50	50	50	4000	4000	4000
2 K	100	100	100	4000	4000	4000
5 K	200	200	200	4000	4000	4000
10 K	500	500	500	4000	4000	4000
20 K	1000	1000	500	4000	4000	4000
50 K	1000	1000	500	4000	4000	4000
100 K	1000	1000	500	4000	4000	4000
200 K	1000	1000	500	4000	4000	4000

Trig Rate

Indicates the maxmum rate at which Triggers can be accepted without missing one.

Num Segments

Indicates the numberof segments in a sweep if the Sequence Trigger Mode is selected. Otherwise this field does not appear.

In Sequence mode, the timebase setting determines the total duration of each segment. A segment's duration is determined by multiplying the time/div setting by 10. Changing Num Segments does not change the timebase; it affects the number of data points (record length) per segment and the time per point.

Select Sync Avg

This softkey selects Synchronous Averaging Sequence. This is a different type of sequence trigger mode in which all acquired segments are averaged together rather than displayed individually.

If the trigger mode is Synchronous Averaging Sequence, the following fields are present:

Average Mode

Selects between Synchronous Averaging (STANDARD) and Alternate Synchronous Averaging (ALTERNATE). STANDARD waveforms are all acquired on the programmed trigger slope while ALTERNATE waveforms are dual waveforms consisting of averaged sweeps from both trigger slopes.

Num Sweeps

Selects the number of sweeps to be averaged together. Since there are no intermediate screen updates until all sweeps are acquired, the Main Screen displays a one second count of the sweeps acquired thus far. As soon as any channel has reached its Num Sweeps, the averaging stops and the number of sweeps contributing to each channel is displayed in the trace label for that channel. In Alternate Synchronous Averaging, as soon as the Num Sweeps for either trigger slope is reached, the averaging stops and the greater of the two values is displayed in the trace label for the channel. The ROOF and FLOOR trace edit functions can be used to separate the dual waveform into its constituent parts. These functions also display the exact number of sweeps that were averaged together for each part.

Points/sweep

Indicates the number of samples that were acquired on each trigger and hence the number of points in the final averaged waveform.

Turn ON Art Reject

This softkey turns artifact rejection on or off. When enabled, any waveform with an underflow or overflow value is not included in the computation. If Artifact Reject is turned OFF, any overflows are set to the maximum possible value of the ADC and any underflows to the minimum value.

Select Sequential

This softkey selects Sequential Sequence. This sequence trigger mode displays all the acquired segments individually.

Maximum record Length in Synchronous Averaging		
	Standard	Alternate
4 Channel Mode	50k	N/A
2 Channel Mode	100k	N/A
1 Channel Mode	200k	200k
4 Channel Mode	100k	N/A
2 Channel Mode	200k	N/A
1 Channel Mode	500k	200k

Table 4.2

If Interleaved Sampling is on then the following field is present:

Sampling

Selects the sampling method to use in Random Interleaved Sampling Mode (RIS), Random or Interpolated. RIS data has inherently non-uniform sampling intervals. Because RIS waveforms are generally highly oversampled (i.e. the effective sample rate is many times higher than the signal bandwidth) the non-uniformity of sample spacing has subtle implications. The INTERPOLATED Sampling option uses a linear interpolation algorithm and the nearest neighboring samples to create a RIS record with uniform sampling intervals. The RANDOM option does not perform this interpolation. INTERPOLATED is generally the most useful choice, however in cases where the fundamental assumptions of RIS sampling are in question (not truly repetitive signal), RANDOM Sampling is preferred. For example, if Persistence Display is to be used to analyze varying timing, and the timebase selection is such that RIS is required, then RANDOM Sampling should be used. Eye Diagram analyses are inherently non-repetitive, and care must be taken in attempting this kind of analyses with RIS acquisition. This field only appears in RIS mode.

TRIGGER Status

The 7234 offers two independent triggering methods: Standard and Smart™ trigger. Standard trigger provides basic trigger functions. Smart Trigger adds additional qualifications to the trigger source(s). The Smart Trigger key (7) on the plug-in front panel toggles between selecting either method. The LED will be lit when Smart Trigger is selected.

The Plug-in Trigger Status screens for either triggering method provides a summary of all the trigger settings. The screens allow adjustments of settings that are not controlled from the front panel.

To display a Trigger status screen, press the MODIFY key on the mainframe and then adjust any trigger control on the plug-in front panel. Adjusting the trigger control after pressing MODIFY will not affect its setting. In the status screen, all the displayed traces are shown in a half-screen grid above the trigger fields. As trigger settings are changed, the effects on traces are shown on the next acquisition. Figure 4.8 shows an example of the Standard Trigger Status screen.

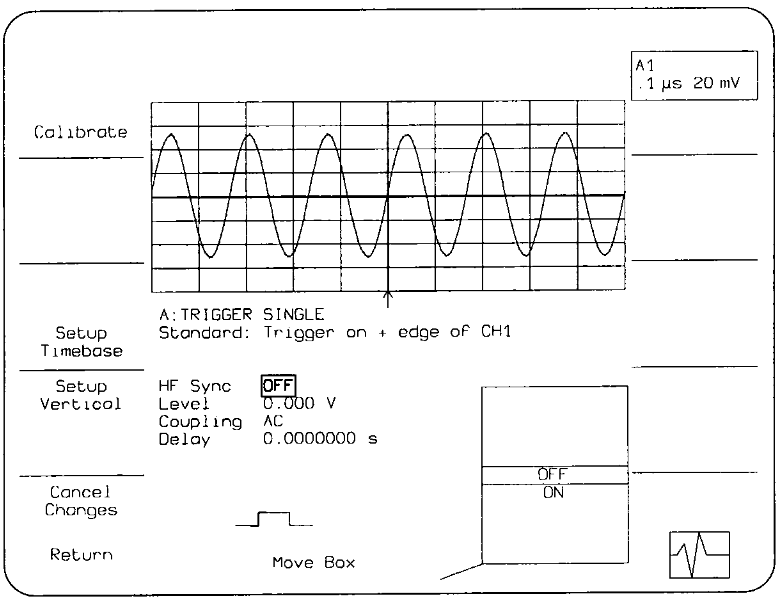


Figure 4.8: Standard Trigger Status screen

Once a screen is displayed, the outer knob under the center of the screen is used to position the box on the field being modified. The box will only move onto fields that do not have a front panel key or knob. These fields are highlighted in bold type. The options list in the lower right screen will indicate available choices, with the current choice in the center. To change the selection, rotate the inner knob to move the desired choice to the center of the list. The new choice will also replace the previous selection in the box.

After changing the selections, press the Return softkey and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original selected values, and displays the Main Screen.

The Trigger Status screens have some softkeys and fields which are present for all trigger types; however, others are specific to an individual trigger type. The softkeys and fields which appear for all Trigger Status screens are listed below. Following them are explanations of each trigger type and the fields specific to its use.

Calibrate	Ensures overall vertical and timebase accuracy. (Calibration is also performed when the 7200A is powered on and periodically thereafter, and when the Vertical controls are adjusted).
Setup Timebase	Displays the Timebase Status Screen.
Setup Vertical	Displays the Vertical Status Screen.
TRIGGER	Indicates the currently selected mode.
Level	Shows the trigger level for the trigger source, as selected by the LEVEL (5) knob and its ZERO (6) key.
Coupling	Shows the trigger coupling for the trigger source, as selected by the COUPLING (22) (23) front panel keys.
HF Sync	Selects whether the trigger source has its frequency rate divided. Select ON to allow stable triggering for sources greater than 200 MHz. This feature is not available with Smart Trigger, or when Trigger Source is Line .
Delay	Indicates the Trigger delay as selected by the DELAY (20) knob and its ZERO (19) key.

Standard Trigger

Standard trigger causes a trigger to occur whenever the selected trigger source meets its trigger conditions. The trigger condition is defined by the trigger level, coupling, high frequency sync, and slope. The Standard trigger is set by the front panel trigger controls and from within the status screen. The status screen indicates all the trigger settings. Only high frequency sync can be selected using this screen.

As shown in Figure 4.8, on page 4-79, the Standard Trigger Status screen contains these additional fields:

Trigger on	Indicates the selected trigger edge, positive or negative, as selected by the SLOPE (21) key. If the selected trigger slope is positive, a trigger is generated when the source signal crosses above the trigger level. If a negative slope is selected, a trigger occurs when the source crosses below the level.
edge of	Indicates the trigger source, as selected by the SOURCE (3) (4) front panel keys.

Smart Trigger™

The Smart Trigger allows setting additional qualifications before a trigger is generated. These qualifications can be used to capture rare phenomena such as glitches or spikes, specific logic states, or missing bits. One qualification can include, for example, generating a trigger only on a pulse wider or narrower than specified. Or it can require three trigger sources to exceed specific levels for a minimum time. In general, Smart Trigger offers a variety of trigger qualifications based on three 7234 abilities:

- To count a specified number of events (1 to 15,000,000).
- To measure time intervals (1 nsec up to 680 sec).
- To recognize a pattern input to the selected trigger sources.

To select the qualifications for Smart Trigger, display the Trigger Status screen as shown in Figure 4.9 by pressing Modify and selecting any Trigger control.

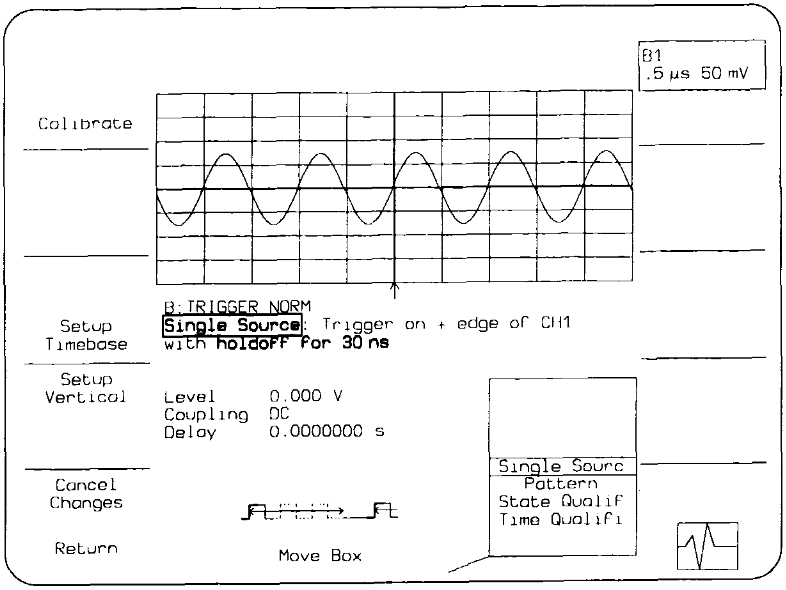


Figure 4.9: Example Smart Trigger Status screen

In Figure 4.9, the first field below "TRIGGER" indicates a description of the trigger method. When Smart Trigger is selected on the plug-in front panel, one of four Smart Trigger methods may be selected in this field:

Single Source Trigger on the selected source when the trigger conditions and one of the following qualifications are met:
- Holdoff for 30 nsec up to 680 sec.
- Holdoff for 1 to 15,000,000 events.
- Interval < 30 nsec up to 680 sec.
- Interval > 30 nsec up to 680 sec.
- Pulse < 1 nsec up to 680 sec.
- Pulse > 1 nsec up to 680 sec.

Pattern Trigger whenever the selected combination of signals occurs and one of the following qualifications are met:
- Holdoff for 30 nsec up to 680 sec.
- Holdoff for 1 to 15,000,000 events.
- Interval < 30 nsec up to 680 sec.
- Interval > 30 nsec up to 680 sec.
- Time between patterns > 1 nsec to 680 sec (trigger on entering).

Time between patterns < 1 nsec to 680 sec (trigger on entering).
Pattern width > 1 nsec to 680 sec (trigger on exiting).
Pattern width < 1 nsec to 680 sec (trigger on exiting).

State Qualified

Trigger whenever the trigger source meets its trigger condition during the selected pattern and one of the following qualifications are met:
Wait for 10 nsec up to 680 sec.
and before 10 nsec up to 680 sec.
Trigger on 1 to 15,000,000 'th event.

Time Qualified

Trigger whenever the trigger source meets its trigger condition after the selected combination begins and one of the following qualifications are met:
Wait for 10 nsec up to 680 sec.
and before 10 nsec up to 680 sec.
0 to 15,000,000 'th event.

Move the box and adjust the Modify Value knob to select among the four Smart Trigger choices. The following sections contain explanations of each Smart trigger method.

Single Source

Single Source triggering is similar to Standard triggering because one trigger source is used to define a trigger condition. Single Source allows an additional qualification before a trigger can occur. Qualifications can be:

- holdoff for 30 nsec up to 680 sec.
- holdoff for 1 to 15,000,000 events.
- interval < 30 nsec up to 680 sec.
- interval > 30 nsec up to 680 sec.
- pulse < 1 nsec up to 680 sec.
- pulse > 1 nsec up to 680 sec.

As shown in Figure 4.10, the Single Source Trigger Status screen contains additional fields:

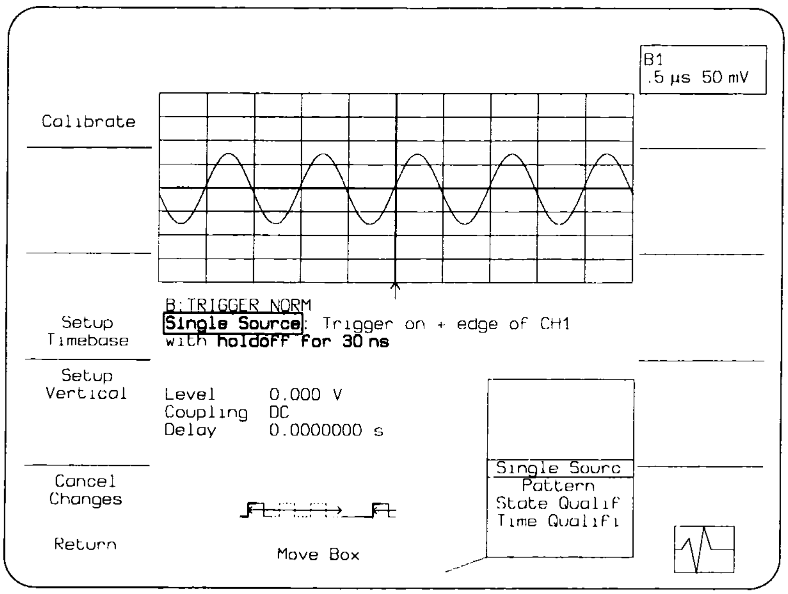


Figure 4.10: Smart Trigger Status screen

Trigger on

Indicates the selected trigger edge, positive or negative, as selected by the SLOPE (21) key.

edge of

Indicates the trigger source, as selected by the SOURCE (3) (4) front panel keys.

Holdoff for time

Selects a minimum time between triggers. A trigger is generated when the trigger condition is met after the selected delay from the last trigger. The timing for the delay is initialized and started on each trigger. Select from 30 nsec through 680 sec.

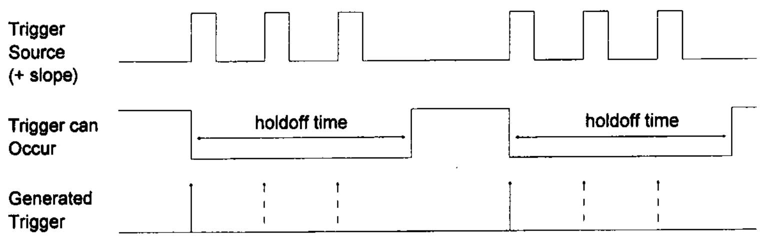


Figure 4.11: Single source with holdoff for time

Holdoff for events

Selects a minimum number of events between triggers. An event is generated when the trigger source meets its trigger conditions. A trigger is generated when the trigger condition is met after the selected number of events from the last trigger. The holdoff for events is initialized and started on each trigger. Select from 1 through 15,000,000 events.

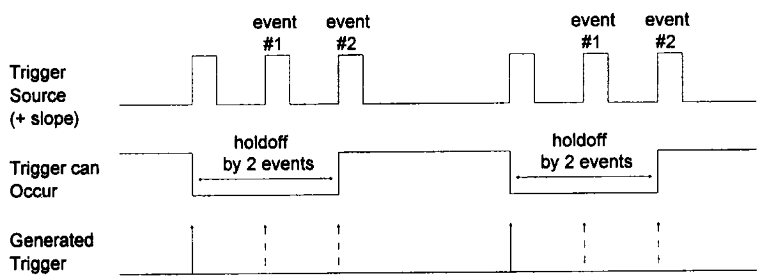


Figure 4.12: Single source with holdoff for events

The field to the right indicates the units for holdoff:

s Indicates the delay is in seconds.

events Indicates the number of times the trigger condition is met after the last trigger. If the number is selected as four, for example, the trigger would occur on the fifth event.

interval <

Selects a maximum interval between two edges of the same slope. The trigger is generated on the second edge if it occurs within the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. Select an interval from 30 nsec to 680 sec.

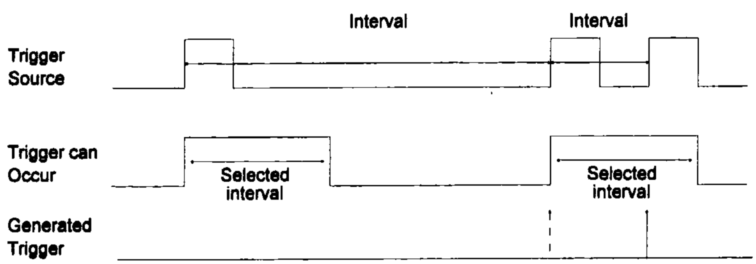


Figure 4.13: Trigger if interval < selected interval

interval >

Selects a minimum interval between two edges of the same slope. The trigger is generated on the second edge if it occurs after the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. Select an interval from 30 nsec to 680 sec.

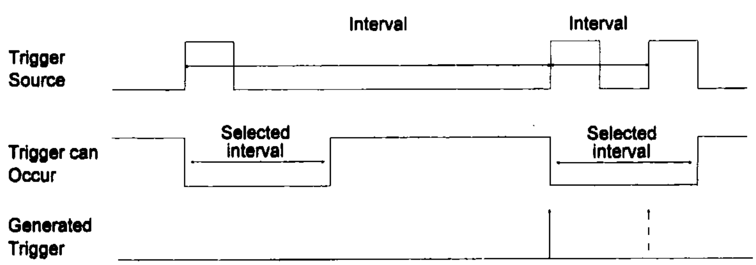


Figure 4.14: Trigger if interval > selected interval

pulse <

Selects a maximum pulse width. The trigger is generated on the selected edge when the pulse width is less than the selected width. The timing for the width is initialized and restarted on the slope opposite to the edge selected. Select a width from 1 nsec to 680 sec.

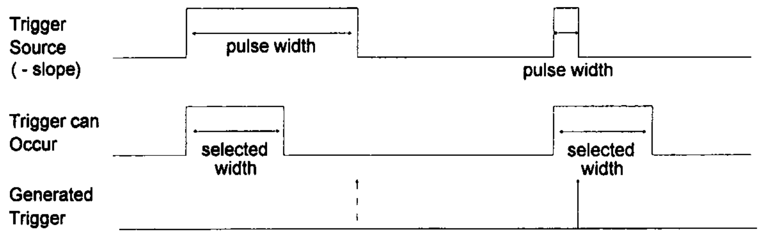


Figure 4.15: Trigger if pulse width < selected width

***NOTE**: To trigger on a positive pulse, select negative slope. The trigger is generated by the trailing edge of the pulse.*

pulse >

Selects a minimum pulse width. The trigger is generated on the selected edge when the pulse width is greater than the selected width. The timing for the width is initialized and restarted on the edge opposite to the edge selected. Select a width from 1 nsec to 680 sec.

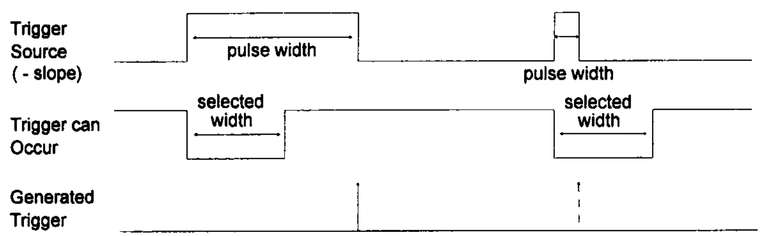


Figure 4.16: Trigger if pulse width > selected width

***NOTE**: To trigger on a positive pulse, select negative slope. The trigger is generated by the trailing edge of the pulse.*

Summary: Setting up Single Source Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Single Source.
4. Using the front panel controls, select the desired trigger condition.
5. Select "Holdoff for time", or "Holdoff for events": "interval <", "interval >", "pulse <", or "pulse >".
6. Select the desired number of events or time.

Pattern

The pattern trigger logically combines the states of up to three inputs: channel 1, channel 2, and channel 3. The combination, called a pattern, is defined as the logical AND of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level. For example, the pattern can be defined as present when the trigger state for channel 1 is high, 2 is low, and 3 is high. If any are not met, the pattern state is considered absent.

Once the pattern is defined, one of two transitions can be used to generate the trigger. When the pattern begins, called "entering" the pattern, a trigger can be generated. Alternatively, a trigger can be generated when the pattern ends, "exiting" the pattern.

Pattern triggering allows an additional qualification once the selected pattern transition occurs.

With Pattern triggering, as in single source, one of the following qualifications can be selected:

- Holdoff for time
- Holdoff for events
- Interval <
- Interval >
- Time between patterns > trigger on entering
- Time between patterns < trigger on entering
- Pattern width > trigger on exiting
- Pattern width < trigger on exiting

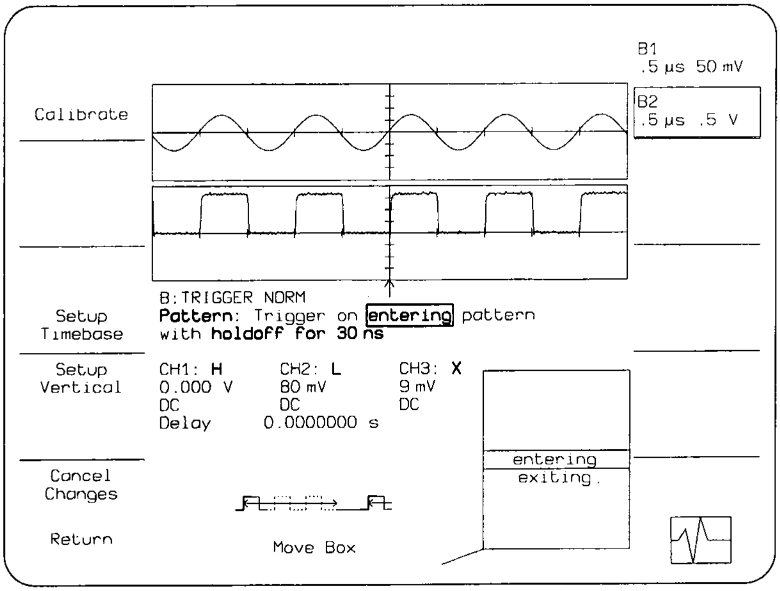


Figure 4.17: Pattern Trigger Status Screen

As shown in Figure 4.17, the Pattern Trigger Status screen contains these additional fields:

Trigger on Defines the selected pattern transition. The choices are:

- entering — trigger when the pattern begins
- exiting — trigger when the pattern ends

When Pattern triggering is selected, additional fields appear. The next three fields allow selection of the pattern from up to three sources in logical AND: CH1· CH2 · CH3. This combination defines the presence of the pattern.

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

- H Requires that the signal for this channel be greater than the trigger level.
- L Requires that the signal for this channel must be below the trigger level.

X Do not use the signal for this channel to define the pattern (don't care).

CH2: Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

CH3: Defines how to use the third channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

The following fields indicate the qualifications for Pattern triggering:

Holdoff for time Selects a minimum time between triggers. A trigger is generated when the trigger condition is met after the selected delay from the last trigger. The timing for the delay is initialized and started on each trigger. Select from 30 nsec through 680 sec.

Holdoff for events Selects a minimum number of events between triggers. An event is generated when a trigger source meets its trigger conditions. A trigger is generated when the trigger condition is met after the selected events from the last trigger. Holdoff is initialized and started on each trigger. Select from 1 through 15,000,000 events.

interval < Selects a maximum interval between two signal edges of the same slope. The trigger is generated on the second edge if it occurs within the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. Select an interval from 30 nsec to 680 sec.

interval > Selects a minimum interval between two signal edges on the same slope. The trigger is generated on the second edge if it occurs after the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. Select an interval from 30 nsec to 680 sec.

time between patterns < Selects a maximum delay between exiting one pattern and entering the next. The trigger is generated on entering the second pattern within the selected time. The timing for the delay is initialized and restarted whenever the pattern is exited, regardless of whether a trigger is generated. Select time from 1 nsec to 680 sec.

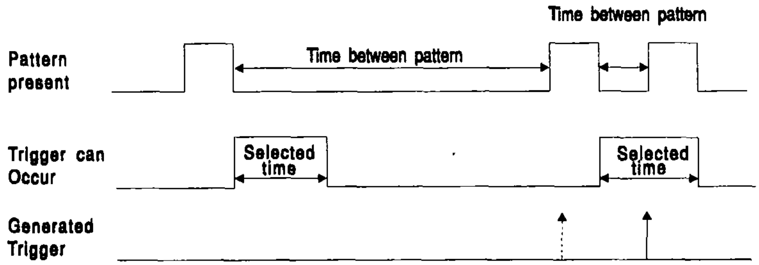


Figure 4.18: Pattern Trigger with time between patterns < selected time

time between patterns > Selects a minimum delay between exiting one pattern and entering the next. The trigger is generated on entering the second pattern after the selected minimum time. The timing for the delay is initialized and restarted whenever the pattern is exited, regardless of whether a trigger is generated. Select time from 1 nsec to 680 sec.

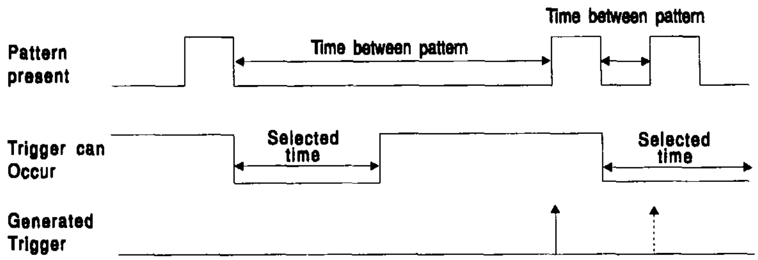


Figure 4.19: Pattern Trigger with time between patterns > selected time

pattern width <

Selects a maximum pattern width. If the width is less than the selected width, the trigger is generated when the pattern ends. The timing for the width is initialized and restarted at the beginning of the pattern. Select a width from 1 nsec to 680 sec.

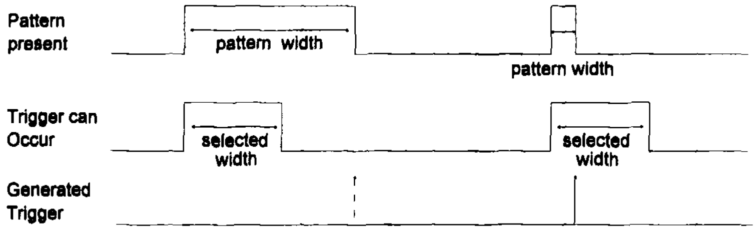


Figure 4.20: Trigger if pattern width < selected width

pattern width >

Selects a minimum pattern width. If the width is greater than the selected width, the trigger is generated when the pattern ends. The timing for the width is initialized and restarted at the beginning of the pattern. Select a width from 1 nsec to 680 sec.

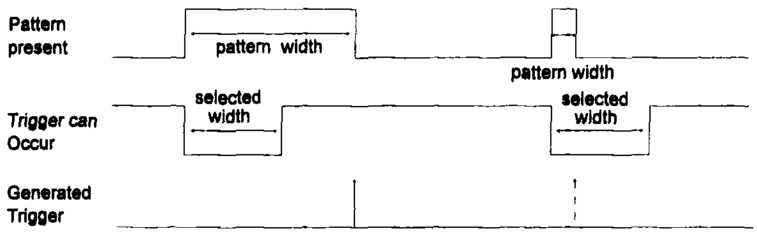


Figure 4.21: Trigger if pattern width > selected width

Summary: Setting up Pattern Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Pattern Trigger.
4. Select the triggering transition: "entering" or "exiting".

5. Define the pattern: for channels 1, 2 and 3, select H for high, L for low, and X for don't care.
6. Using the front panel controls, select the desired trigger condition.
7. Select: "Holdoff for", "interval <", "interval >", etc.
8. Select the desired number of events or reference time.

State Qualified

State Qualified triggering lets the user choose whether a trigger is generated while the selected pattern is present or absent. A pattern is defined as a logical AND combination of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level.

For example, a pattern is selected to be present when the trigger states for channels 1 and 2 are high and Channel 3 is low. If any are not met, the pattern state is considered absent.

For State triggering, the pattern is used to qualify a trigger without actually generating the trigger. A trigger will occur when another signal, the trigger source, meets its trigger condition while the pattern is present. The trigger source is not allowed in the pattern. As shown in Figure 4.22, while the pattern is present CH2 high, a trigger occurs when CH1, the trigger source, has met its trigger condition.

State Qualified triggering allows an additional qualification once the selected pattern state occurs after meeting the pattern conditions.

- Wait for 10 nsec up to 680 sec.
- and before 10 nsec up to 680 sec.
- Trigger on 1 to 15,000,000 th event.

State Qualified

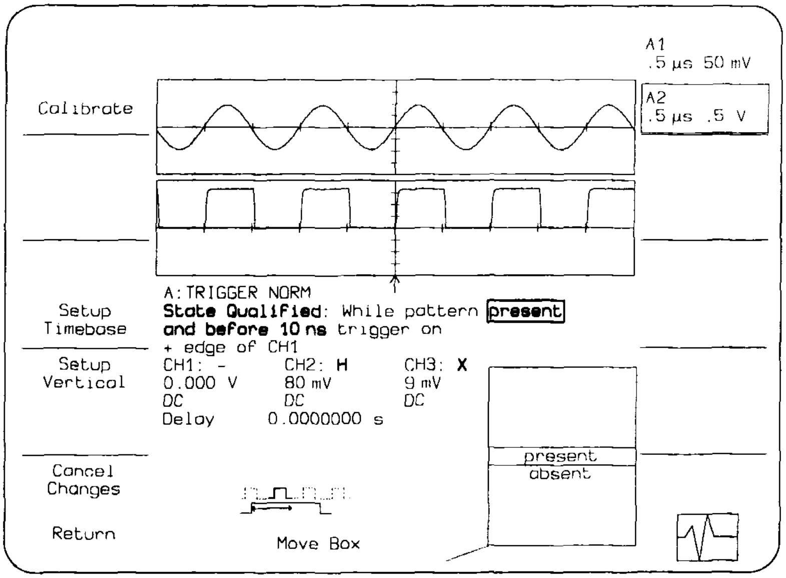


Figure 4.22: State Qualified Trigger Status Screen

As shown in Figure 4.22, the State Trigger Status screen contains additional fields:

Trigger on Defines the selected pattern. The choices are:

present	Trigger during the pattern.
absent	Trigger when pattern is not present.

When State Qualified Triggering is selected, a pattern must be selected to define the qualifications.

> ***NOTE**: The trigger source currently selected on the front panel serves as the trigger source and cannot be used in the pattern.*

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

- H Requires that the signal for this channel be greater than the trigger level.
- L Requires that the signal for this channel must be below the trigger level.
- X Do not use the signal for this channel to define the pattern (don't care).

CH2: Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

CH3: Defines how to use the third channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

The following fields indicate the qualifications for State Qualified triggering:

wait Selects a delay from the start of the desired pattern. After the delay and before the end of the pattern, a trigger is generated when the trigger meets its conditions. The timing for the delay is restarted when the selected pattern begins. Select time from 10 nsec to 680 sec.

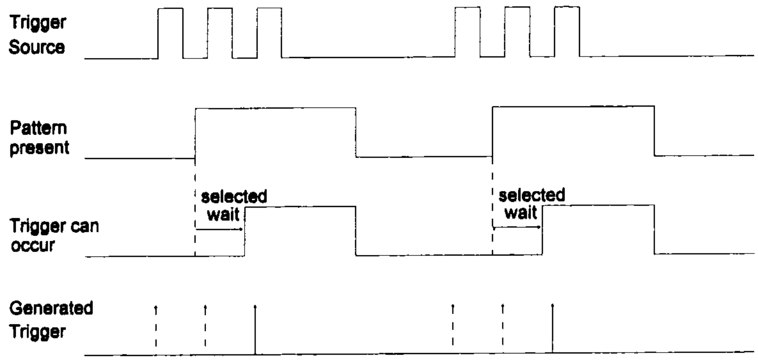


Figure 4.23: State Qualified Triggering with wait

When wait is selected, the following fields appear :

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the trigger source.

and before

Selects a time from the start of the desired pattern. Before the end of the selected time and before the end of the pattern, a trigger can occur. The selected time is restarted when the selected pattern begins. Select a time from 10 nsec to 680 sec.

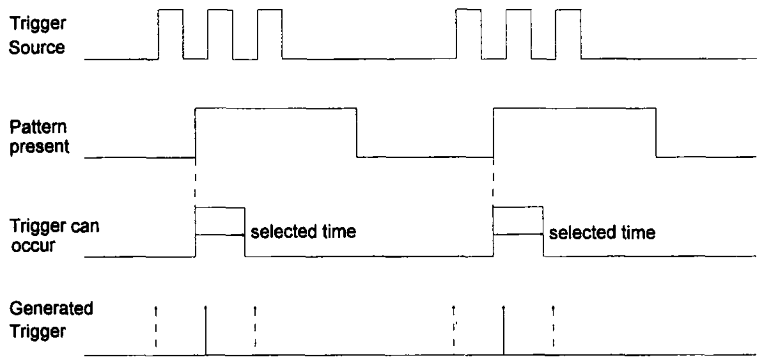


Figure 4.24: State Qualified Triggering and before

When "and before" is selected, the following fields appear:

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the trigger source.

trigger on

Selects a minimum number of events of the trigger source. An event is generated when a trigger source meets its trigger conditions. On the selected event of the trigger source and before the end of the pattern, a trigger can occur. The count is initialized and started whenever the selected pattern begins. It continues while the pattern remains. When the selected count is reached, the trigger occurs. Select from 1 through 15,000,000 events.

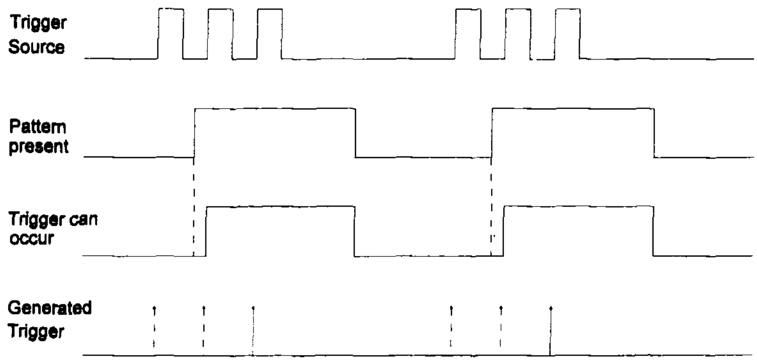


Figure 4.25: State Qualified Triggering with trigger on the second event

Summary: Setting up State Qualified Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select State Qualified Trigger.
4. Select the qualifying pattern: "present" or "absent".
5. Define the pattern: for channels 1, 2 and 3, select H for high, L for low, or X for don't care.
6. Using the front panel controls, select the desired trigger condition.
7. Select: "wait", "and before", or "trigger on".
8. Select the desired number of events or time.

Time Qualified

Time Qualified triggering generates a trigger when the trigger source meets its trigger condition after entering or exiting the pattern. The trigger can occur even if the pattern disappears before the trigger meets its trigger conditions. A pattern is defined as a logical AND of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level. For example, the pattern can be defined as present when the trigger states for channels 1 and 2 are high and channel 3 is low. If any are not met, the pattern state is considered absent.

Once the pattern is defined, one of two transitions can be used. When the pattern begins, called "entering" the pattern, a trigger can occur. Alternatively, a trigger can be generated when the pattern ends, called "exiting" the pattern.

For Time qualified triggering, the pattern is used to qualify a trigger without actually generating the trigger. A trigger will occur when another signal, the trigger source, meets its trigger condition *after* the pattern is entered or exited.

Time Qualified triggering allows an additional qualification once the selected pattern transition occurs and after meeting the pattern conditions:

- Wait for 10 nsec up to 680 sec.
- and before 10 nsec up to 680 sec.
- 1 to 15,000,000 'th event.

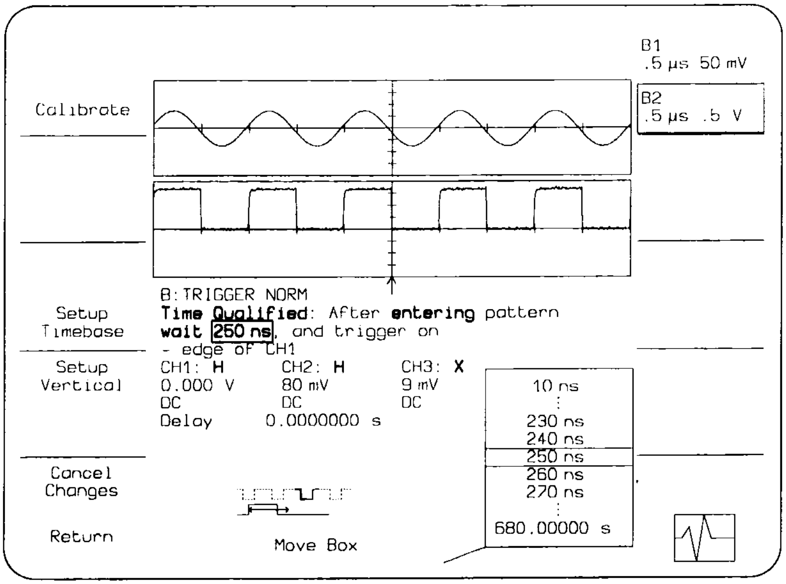


Figure 4.28: Time Qualified Trigger Status Screen

As shown in Figure 4.28, the Time Qualified Trigger Status screen contains these additional fields:

Trigger after Defines the selected pattern transition. The choices are:

- entering Trigger after the pattern starts.
- exiting Trigger after the pattern ends.

When Time Qualified triggering is selected, a pattern must be selected to define the qualifications.

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

- H Requires that the signal for this channel be greater than the trigger level.
- L Requires that the signal for this channel must be below the trigger level.

X Do not use the signal for this channel to define the trigger pattern.

CH2: Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

CH3: Defines how to use the third channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

The following fields indicate the qualifications for Time Qualified triggering:

wait Selects a delay from entering or exiting the pattern. After the delay, a trigger is generated when the trigger meets its trigger conditions. The timing for the delay is always initialized and restarted on the selected pattern condition. Select a time from 10 nsec to 680 sec.

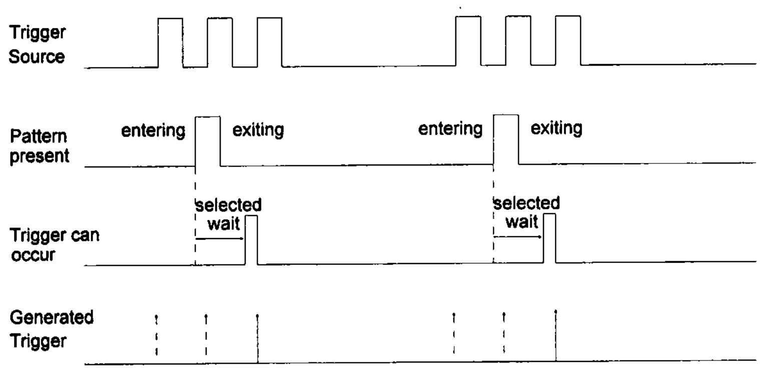


Figure 4.29: Time Qualified Triggering with wait

When wait is selected, the following fields appear:

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the trigger source.

Time Qualified

and before

Selects a time from entering or exiting the pattern. Before the end of the selected time, a trigger can occur. The selected time is restarted on the selected pattern condition. Select a time from 10 nsec to 680 sec.

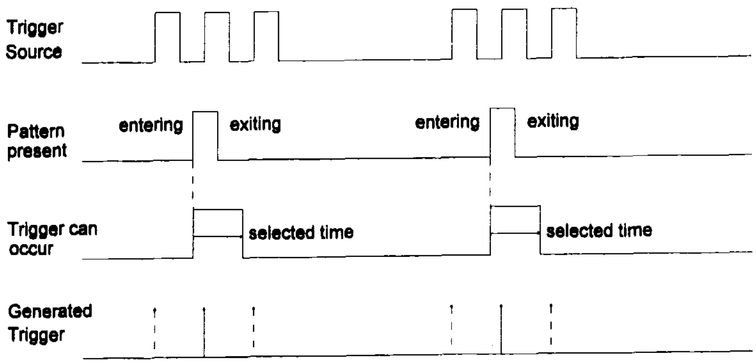


Figure 4.30: Time Qualified Triggering and before

When "and before" is selected, the following fields appear:

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the enabling trigger source.

trigger on

Selects a minimum number of events. An event is generated when a trigger source meets its trigger conditions. On the selected event of the trigger source and before the next pattern condition, a trigger can occur. The count is initialized and started on the selected pattern condition. It continues until the next pattern condition. Select from 1 through 15,000,000 events.

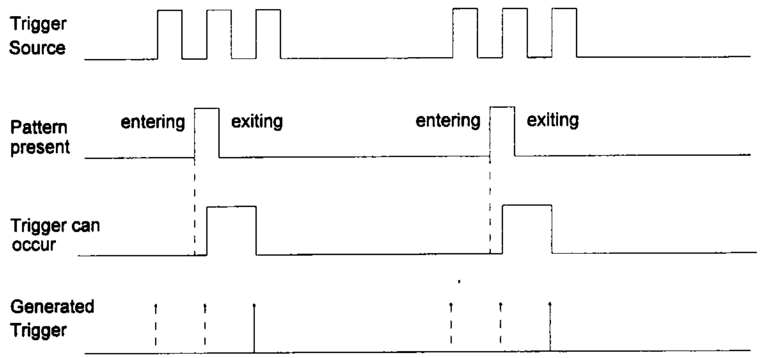


Figure 4.31: Time Qualified Triggering and trigger on the second event

Summary: Setting Up Time Qualified Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Time Qualified Trigger.
4. Select the pattern condition: “entering” or “exiting”.
5. Define the pattern: for channels 1, 2 and 3, select H for high,L for low, or X for don’t care.
6. Using the front panel controls, select the desired trigger condition.
7. Select : “wait”, “and before”, or “trigger on”.
8. Select the desired number of events or reference time.

Plug-in Status

The Plug-in Status screen provides a summary of all the acquisition settings. It also allows adjustments of settings not controlled from the front panel. A hardcopy of this screen (see Hardcopy Setup, refer to Section 3 of the LeCroy 7200A Precision Digital Oscilloscope Operator;s Manual) provides complete documentation of the acquisition settings.

To display the Plug-in Status screen, press the plug-in DISPLAY key. Pressing the mainframe MODIFY key before pressing DISPLAY will also display this screen:

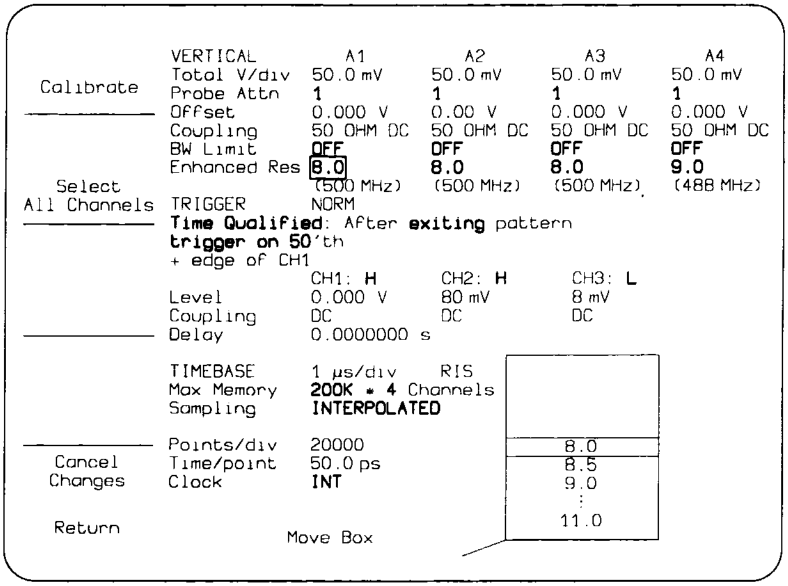


Figure 4.32: Example Plug-in Status screen

Once a screen is displayed, the Move Box knob is used to select a field to be modified. (Only highlighted fields can be modified from this screen.) The options list in the lower right screen will indicate available choices, with the current one in the center.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes in non-volatile memory and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The settings are arranged on the screen by control group (i.e., VERTICAL, TRIGGER, and TIMEBASE). Each group includes the fields from one status screen. For explanations of fields specific to an individual status screen, refer to the section in Operation which details its use.

For the Vertical section, the settings for each channel are shown in four columns.

If Smart Trigger™ is selected and uses a combination, or pattern, of trigger sources, the trigger settings for each source in the pattern are shown in three columns. As shown in Figure 4.32, all the plug-in's settings are displayed.

This page is intentionally blank

Product Description

The LeCroy 7262 Plug-in Module Operator's Manual provides information on product support, installation, specifications, and operation of the 7262 plug-in. The manual is arranged in two major sections which include:

Installation: Explains how to install a 7262 plug-in into the 7200 or 7200A Mainframe.

Operation: Details the 7262 operation into functional groups which include vertical, timebase, trigger, calibration, and system status information.

The Model 7262 plug-in is a 2 channel, 4 GHz bandwidth, 100GS/s (RIS), 10-bit digitizer. Detailed specifications for the plug-in are included later in this manual.

Accessories and Options

The following optional accessories are available.

Probes

Two optional probes are offered with the 7262. A 1 GHz active probe (AP-060) and an 8 GHz passive probe (PP-063)

PP-063 Specifications:

Attenuation	10:1
Bandwidth	Typ 8 GHz
Risetime	Typ 44 psec
Probe Length	1.0 meter
Input Capacitance	.5 pf
input Resistance	500 ohm when using 50 ohm scope input
maximum input	10 V RMS

AP-060 Specifications:

Attenuation	10:1
Bandwidth	DC - 1 GHz

Input Capacitance	1.9 pf
Input Resistance	1 Mohm
Maximum input	100 v pk

Accessory Kit

A basic kit of adapters and attenuators are provided in AK-062.

AK-062 includes 1 each of the following items:

SMA 20 dB Attenuator

SMA 6 dB Attenuator

SMA 3 dB Attenuator

SMA male to BNC female

BNC male to SMA female

SMA female Terminator

SMA female Short

SMA male Terminator

SMA male Short

7262 Specifications

Vertical

Inputs: 2 SMA Type

Coupling: DC, 50Ω 1%

Maximum Input: 2 Volts

Gain Accuracy: 3% at D.C.

# of Bits: 10 Bits

Channel Settings: 5mV/div to 200mV/div 1,2,5 sequence

Bandwidth:
4.0 GHz (200, 100, 50 mV/div)
3.0 GHz (20, 10, 5 mV/div)

Transition Time:
125 pSec (200, 100, 50 mV/div)
150 pSec (20, 10, 5 mV/div)

VSWR or Reflection Coefficient 1:1.25

V/DIV	FULLSCALE INPUT	OFFSET VOLTAGE RANGE	PEAK to PEAK NOISE
200 mV/div	8.06 dbm	±800 mVDC	20 mV
100 mV/div	2.04 dbm	±800 mVDC	20 mV
50 mV/div	-3.98 dbm	±800 mVDC	20 mV
20 mV/div	-11.96 dbm	±800 mVDC	2.0 mV
10 mV/div	-17.96 dbm	±800 mVDC	2.0 mV
5 mV/div	-23.98 dbm	±800 mVDC	2.0 mV

Channel Isolation: 60 dB minimum (ref 1 GHz)

Timebase

Settings
20 pS/div to 10 uS/div — RIS
20 uS/div to 200 mS/div — Single Shot
1,2,5 sequence

Time/Point	10 pS/point to 5 nS/point	RIS
	25 nS/point to 100 uS/point	Single Shot
	Accuracy/Resolution	.001% Standard (.00005% Optional)

Waveform Memory/CH: 500, 1k, 2k, 5k, and 20,000 samples

Internal Trigger

Source:	Ch1, Ch2, Pulse
Slope:	Positive or Negative
Coupling:	DC or HFSYNC

Level:

Range:	800 mV (200, 100, 50 mV/div) 80 mV (20, 10, 5 mV/div)
Resolution:	2% of V/div

Minimum Signal:

DC:	100 mV_{pp} (200, 100, 50 mV/div) 10 mV_{pp} (20, 10, 5 mV/div)
2 GHz:	400 mV_{pp} (200, 100, 50 mV/div) 40 mV_{pp} (20, 10, 5 mV/div)

Trigger Rate:

DC:	1.0 GHz
HFSYNC:	100 MHz to 2.5 GHz
Smart Trigger:	400 MHz with Pulse Width to 500 psec
Jitter:	5 psRMS, (psRMS w/averaging)
Delay Range:	10 * T/Div OR 100 nsec minimum pretrigger to 2 seconds

External Trigger

Input:	SMA Connector, 50 Ω 1%
Slope:	Positive or Negative
Coupling:	DC or HFSYNC

Maximum Input:	2 Volts
Level:	800 mV
Minimum Signal:	100 mV at DC raising to 400 mV at 2 GHz

Trigger Rate:

DC:	1.0 GHz
HFSYNC:	100 MHz to 3.0 GHz
Smart Trigger:	400 MHz with Pulse Width to 500 psec
Jitter:	5 pS_{RMS}, (2 psRMS w/averaging)
Delay Range:	10 * T/Div OR 100 nsec minimum pretrigger to 2 seconds

Smart Trigger

Sources:	CH1, CH2, EXT

Single Source and Pattern:

Holdoff by Time:	10 nsec to 100 sec
Holdoff by Events:	1 to 15 Million events
Interval:	2 nsec to 100 sec
Interval In or Out:	10 nsec to 100 sec
Width:	500 psec to 100 sec
Window In or Out:	10 nsec to 100 sec

State Qualified:

Wait for:	10 nsec to 100 sec
Before Time:	10 nsec to 100 sec
Before or Wait:	10 nsec to 100 sec
Wait and Before:	10 nsec to 100 sec
Trigger On:	1st to 15,000,000th event.

Time Qualified:

Wait for:	10 nsec to 100 sec
Before Time:	10 nsec to 100 sec
Before or Wait:	10 nsec to 100 sec
Wait and Before:	10 nsec to 100 sec
Trigger On:	1st to 15,000,000th event.

TDR

Pulse Outputs:	Independently selectable on CH1 and CH2
Trigger Source:	PULSE or Selected Channel
Duration:	200 nsec to 1 sec square wave period selectable in a 1, 2, 5 sequence
Falltime	100 psec
Amplitude	-400 mV to GND
Overshoot:	30% on negative edge
Aberrations	5% after 2 nsec

Mechanical

Dimensions :	3.0"(7.6 mm) Wide x 8.0"(203 mm) High x 18.5"(470 mm) Length
Weight :	6.9 lbs. (3.63 kg)

Environmental

Temperature :	0 to +40 Degrees C Operating (sea Level), derate linearly to 34 Degrees C at 10,000 ft. -40 to 70 Degrees C Non-operating
Humidity :	Up to 95% Relative , Non-condensing
Vibration :	0.25 g MAX , 5 to 85 Hz Operating 2.0 g MAX , 5 to 85 Hz Non-operating
Shock :	

	10.0 g max Operating 40.0 g max Non-operating
Elevation :	10,000 feet (2.9 Km)

Power

Input :	24 VDC
Wattage :	100 watts maximum

Installation

Installing the Plug-in

CAUTION: *Do not install or remove a plug-in while the 7200 or 7200A mainframe is powered on. To install, align the plug-in's bottom grooves with the guide rails at the bottom of the mainframe's plug-in compartment. Next, slide the plug-in toward the rear of the mainframe until it latches into place. See Figure 4.33. Remove the plug-in by pulling out its latch and sliding it out.*

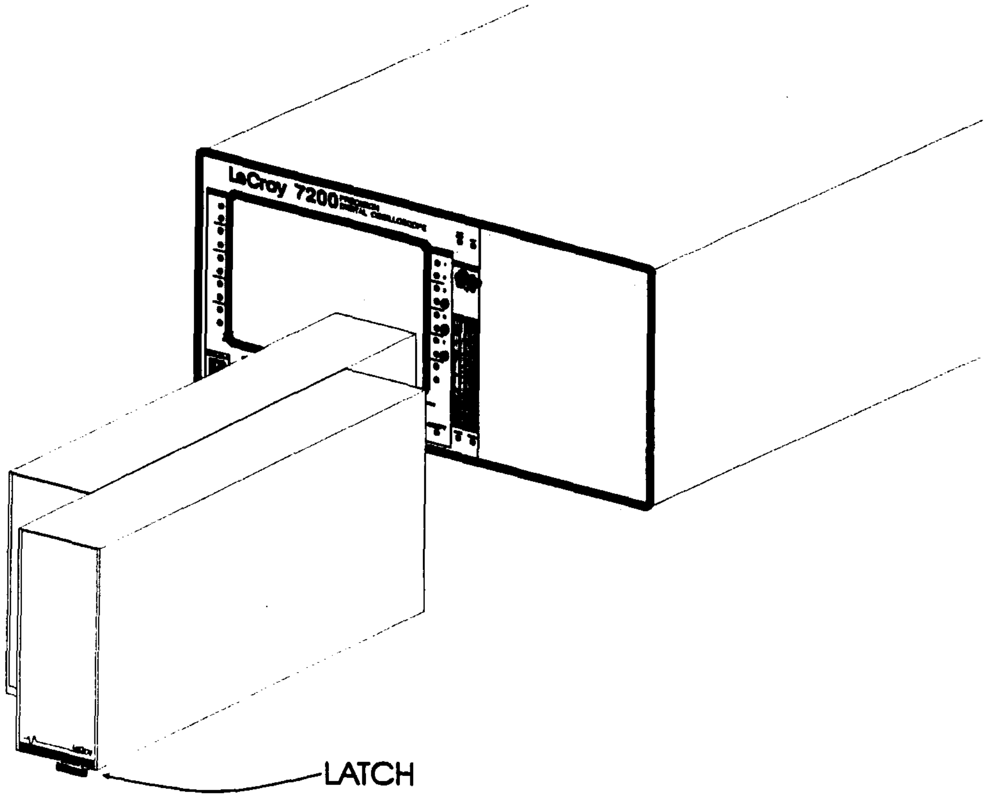


Figure 4.33: 7262 Plug-in Installation

Software Requirements

7200 mainframe: Software version 2.0.0 is required to operate the 7262 plug-in with a 7200 mainframe. To determine the software version installed on your mainframe, push the "configure system" softkey located on the left side of the mainframe beside the display. If your mainfarme does not have the correct software revision level, call the LeCroy customer service hotline at 1-800-5-lecroy.

7200A mainframe: Software version 3.0.0 is required to operate the 7262 plug-in with a 7200A mainframe. To determine the software version installed on your mainframe, push the "configure system" softkey located on the left side of the mainframe beside the display. If your mainfarme does not have the correct software revision level, call the LeCroy customer service hotline at 1-800-5-lecroy.

This section describes the 7262 Plug-in front panel controls and their associated displays. Installation of a 7200 series plug-in into a 7200 or 7200A mainframe, described on the previous page, results in certain nomenclature and channel identification conventions. Figure 4.34 indicates the nomenclature used to identify 7200 plug-in slots and the channels of the associated plug-ins. For example, the left plug-in slot of a 7200 series mainframe is known as slot "A" and an associated plug-in will have channels A1 and A2. The same plug-in installed in the right slot would be identified as having channels B1 and B2.

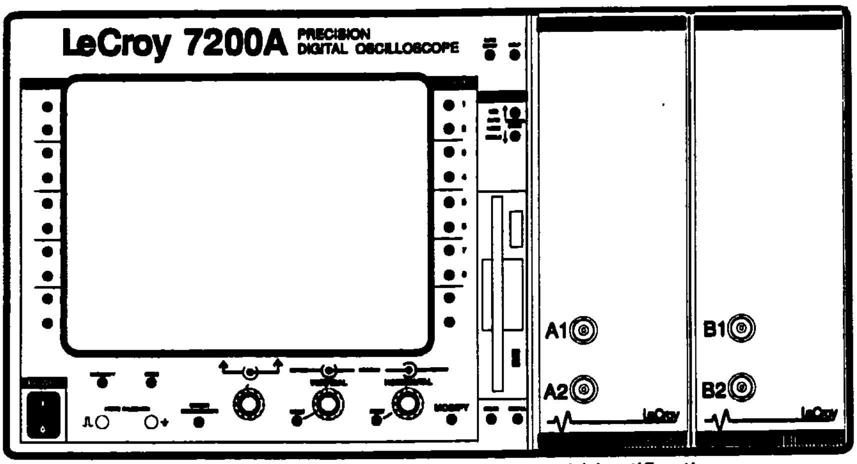


Figure 4.34: Plug-in slots and channel identification

Related controls on the 7200(A) mainframe include:

Initiate auto setup;	Perform cursor measurements;
Select trigger modes;	Setup and configure hardcopy;
Perform processing;	Select independent timebase and triggering;
Display and archive data;	Operate on-line Help.

For a description of the mainframe controls, refer to Section 3 of the LeCroy 7200A Modular Oscilloscope System Operator's Manual.

Front Panel Control Layout

The 7262 Plug-in front panel controls are arranged in four functional groups. These are vertical, timebase, trigger and status. Figure 4.35 indicates the layout and identifies these four functional groups. Each of these groups has an associated status display screen which gives detailed information concerning the current set-up of the plug-in. These status screens will be described in detail and examples of their use will be given.

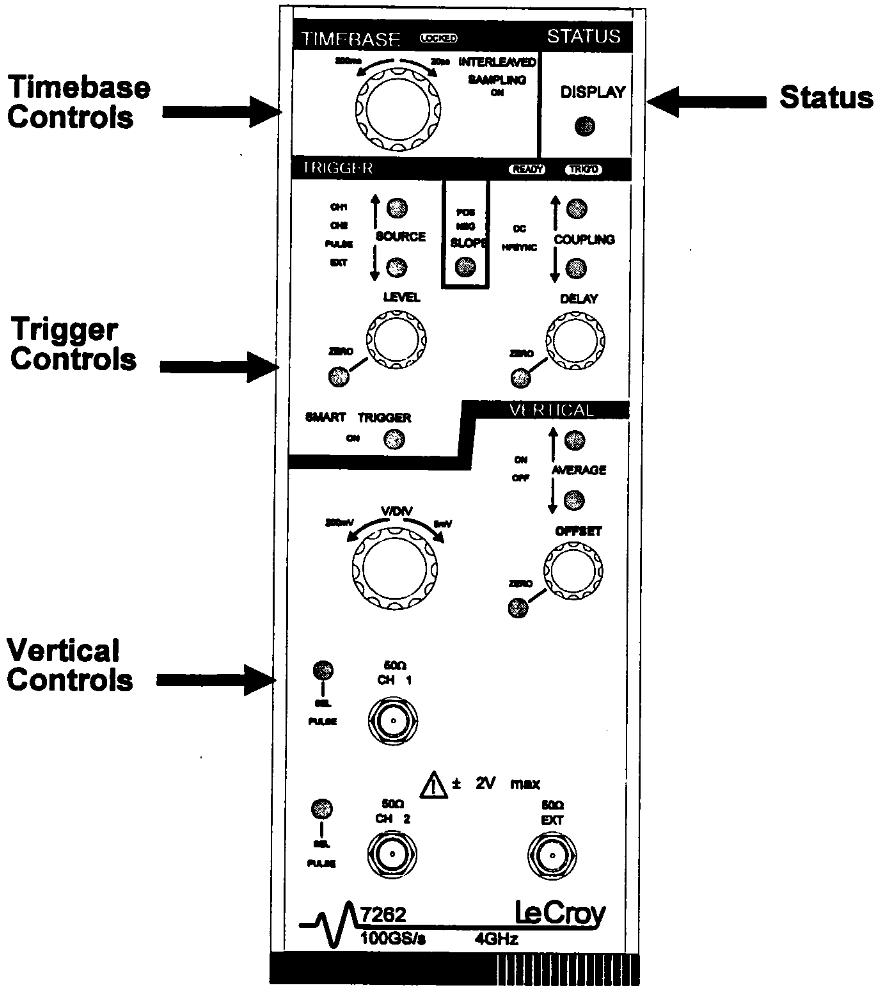


Figure 4.35: Typical 7262 Plug-in Control Groups

7262 Plug-in Front Panel Controls

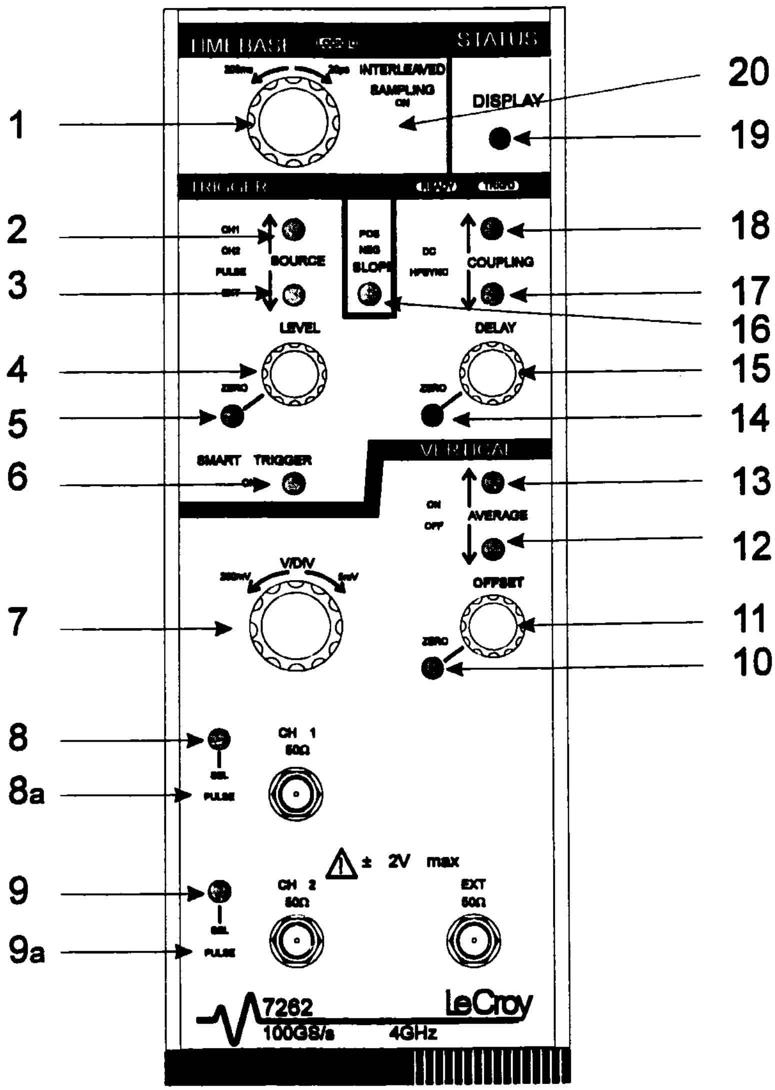


Figure 4.36: Typical 7262 Plug-in Front Panel Controls

Index to Controls

1 TIMEBASE
2 UPPER TRIGGER SOURCE KEY
3 LOWER TRIGGER SOURCE KEY
4 TRIGGER LEVEL KNOB
5 TRIGGER LEVEL ZERO
6 SMART TRIGGER KEY
7 VOLTS PER DIVISION KNOB
8 CHANNEL 1 SELECT KEY
8a PULSE OUTPUT INDICATOR
9 CHANNEL 2 SELECT KEY
9a PULSE OUTPUT INDICATOR
10 VERTICAL OFFSET ZERO KEY
11 VERTICAL OFFSET KNOB
12 AVERAGE OFF KEY
13 AVERAGE ON KEY
14 TRIGGER DELAY ZERO KEY
15 TRIGGER DELAY KNOB
16 TRIGGER SLOPE SELECT KEY
17 LOWER TRIGGER COUPLING KEY
18 UPPER TRIGGER COUPLING KEY
19 PLUG-IN STATUS DISPLAY KEY
20 INTERLEAVED SAMPLING INDICATOR

Vertical Controls

V/DIV (7)

Selects the vertical sensitivity, or fixed gain, in multiples of 1, 2, and 5. The range of the fixed gain is 5 mV to 200 mV/div.

OFFSET (11)

Adjusts the voltage offset used to position the signal within the amplifier's input range. The maximum offset depends on the selected V/DIV range. (refer to the specifications section for details)

A pair of upward– or downward–pointing double–shaft arrows on the grid's upper or lower edge indicate when the trace has been positioned outside of the grid, as shown in Figure 4.37 . (The VERTICAL POSITION knob under the screen can also move the trace outside of the grid. That knob, however, only affects the display position and not the amplifier offset setting.) Note that the View Port is not affected by the "OFFSET".

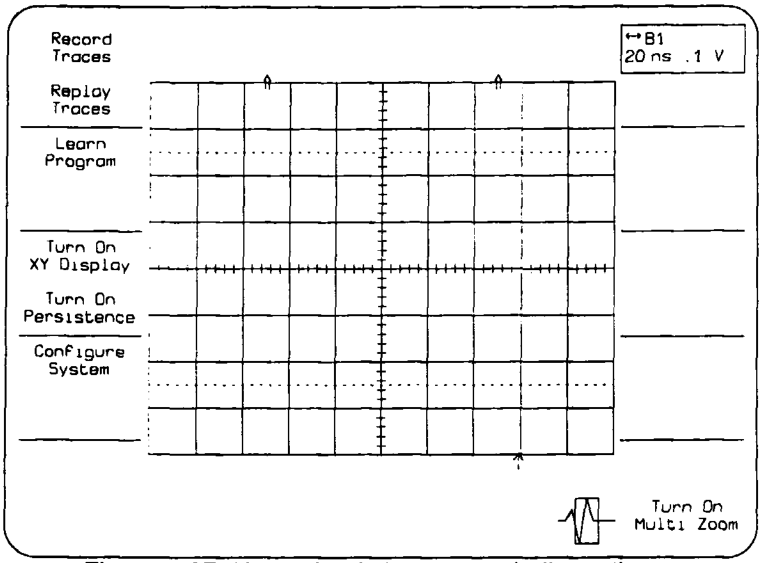


Figure 4.37: Upward pointing arrows indicate that a waveform is off screen

ZERO (10)

Toggles between the selected "OFFSET" value and a zero offset. An LED next to the key lights "ZERO" to indicate zero offset.

Channel Select

CH 1(8), or CH 2 (9) Pressing the CH1 or CH2 key selects which channel the Vertical controls will modify. For example, when CH1 is pressed, adjusting a Vertical control such as the V/DIV knob, affects CH1 signal input. CH2 settings remain unchanged. The channel LED next to the key is lit to indicate the selected channel.

PULSE OUTPUT LED (8a) Indicates when output pulse has been enabled, for Ch1.

PULSE OUTPUT LED (9a) Indicates when ouput pulse has been enabled for Ch2.

AVERAGE ON (13) Turns on waveform averaging in the plug-in. This is exponential averaging with a weighting factor determined in the vertical set-up menu. This will be described in the next section (see figure 4.40)

AVERAGE OFF (12) Turns off waveform averaging in the plug-in

Timebase Controls

TIMEBASE (1) Selects the amount of time each horizontal division represents. The knob selects the TIMEBASE in a 1-2-5 sequence from 20 psec/DIV to 200 msec/DIV

The TIMEBASE setting, and the acquisition memory size, determine the sample rate and the number of sample points displayed per division. The Plug-in Status and the Timebase Status screens indicate the time per point and points per division. The maximum memory size can be selected in the Plug-in status or the Timebase Status screen.

INTERLEAVED SAMPLING LED (20) Indicates when Random Interleaved Sampling (RIS) acquisition mode is enabled. When the LED is not lit, single shot acquisition is used. At timebase settings from 20 ps/div to 10 usec/div inclusive, the 7262 Series uses RIS for signal acquisition. Repetitive waveforms and a stable trigger are required. Waveforms are digitized at a maximum sampling rate of 100 GS/sec or sample interval of 10 psec. When the timebase is set between 20 us/div and 200 ms/div, single-shot acquisition is selected. The maximum single shot acquisition rate is 40 megasamples per second.

Trigger Controls

SOURCE ((2) and (3))

Selects the signal used as the trigger source. The LED next to the keys is lit to indicate the selected trigger source. Adjustment of the trigger controls affects triggering for the selected source. When the source is changed, the trigger setup may be uniquely defined. For example, when CH1 is selected, adjusting a trigger control, such as the LEVEL knob, affects triggering when CH1 is used. The CH2 settings remain unchanged.

CH1 Uses signal applied to CH 1 input connector

CH2 Uses CH 2 signal input

Pulse Provides a stable display of signals synchronous with the pulse output.

EXT Selects a signal applied to the SMA connector labeled "EXT TRIG". The maximum usable signal range is 2 volts with a probe attenuation of 1.

The SMA input labelled "EXT TRIG" accepts an external trigger signal. Probes of greater attenuation increase the maximum usable signal range. For example, an attenuation of 10 increases the EXT range to 20 volts.

COUPLING(17) and (18)

Selects the method used to couple the trigger source to the input of the trigger circuit. As the keys are pressed to step through each coupling method, a LED indicates the selection. Possible selections are as follows:

DC provides trigger capability with input signal from DC to 1GHz

HFSYNC provides a divide by 4 prescale to extend the trigger to 2.5 GHz. HFSYNC operates from 100 MHz to 2.5 GHz.

The coupling is adjusted independently for each trigger source. Therefore, changing the source can also change the trigger coupling.

DELAY (15)

Adjusts the amount of signal recorded before (pre-trigger) or after (post-trigger) the trigger occurs. The pre-trigger amount depends on the timebase, and memory size. The maximum delay limit is 10 x the T/div or 125 nsec, whichever is greater, to 2 seconds. Delay may also be set 0% to 100% if the trigger delay units are in Percent.

The arrow under the grid indicates the trigger point of the selected trace.

ZERO (14)

Toggles between the selected delay setting and a trigger delay of zero. A trigger delay of ZERO time is at the center of the grid or the 50% point. An LED next to the key lights to indicate zero trigger delay.

LEVEL (4)

Adjusts the voltage level at which triggering will occur. If vertical sensitivity is adjusted such that the previously selected trigger level exceeds the sensitivity range, the trigger level is automatically reduced to fit the new range.

The trigger level indicator arrows appear only on the selected trace if: the trace is defined to be an unprocessed acquisition channel, and the channel is selected as the trigger source.

ZERO (5)

Toggles between the selected trigger level and a trigger level of 0.0 volts. An LED next to the key indicates zero trigger level.

SLOPE (16)

Selects the signal edge used to activate the trigger circuit. The slope of the trigger can be adjusted for each individual trigger source and is indicated by LEDs above the SLOPE key.

POS	Requires a positive-going edge to trigger.
NEG	Requires a negative-going edge to trigger.
SLOPE	is set to POS if the trigger coupling is HFSYNC.

SMART TRIGGER (6)

Toggles between selecting the Standard trigger and Smart™ Trigger. Smart™ Trigger is setup from within either the Trigger Status or Plug-in status screens. An LED next to the key will light "ON" to indicate Smart™ Trigger is selected. The Trigger Status screen is displayed by pressing MODIFY on the mainframe and any trigger control. The Plug-in status screen is displayed by pressing the DISPLAY key on the plug-in.

TRIGGER STATE

A "READY" LED on each plug-in indicates that the trigger circuit has been armed and the plug-in is acquiring input signals. The "TRIG'D" LED is lit whenever the timebase is stopped (normally after a valid trigger).

After a valid trigger is detected, a time lag (as set by the Trigger Delay knob) may occur before the acquisition stops and the waveform is displayed.

Trigger Mode

The Trigger Mode push button is located on the 7200(A) mainframe front panel.

Trigger Mode selects the data acquistion method: SEQUENCE, AUTO, NORM, and SINGLE. It is selected on the mainframe front panel using keys (28) and (29) as shown in Figure 3.1 , page 3.1 in the *LeCroy 7200A Precision Digital Oscilloscope Operator's Manual.* Pages 3-12 through 3-14 of the same manual describe each trigger mode in detail.

***NOTE** :Sequence mode is disabled whenever a 7262 is installed in the mainframe.*

Status Displays

Acquisition settings may be viewed in a variety of ways. These include the System Message Area and the Timebase, Vertical, Trigger, and Plug-in Status Screens. The plug-in status screens will discussed individually in the next section.

System Message Area

Whenever a front panel control is adjusted, the plug-in timebase, trigger level, trigger delay, and various vertical control settings are displayed in the System Message Area for approximately 10 seconds. Figure 4.38 shows a typical summary of control settings.

In addition to the information in the System Message Area, the time per division and vertical units per division may also be displayed under the trace label.

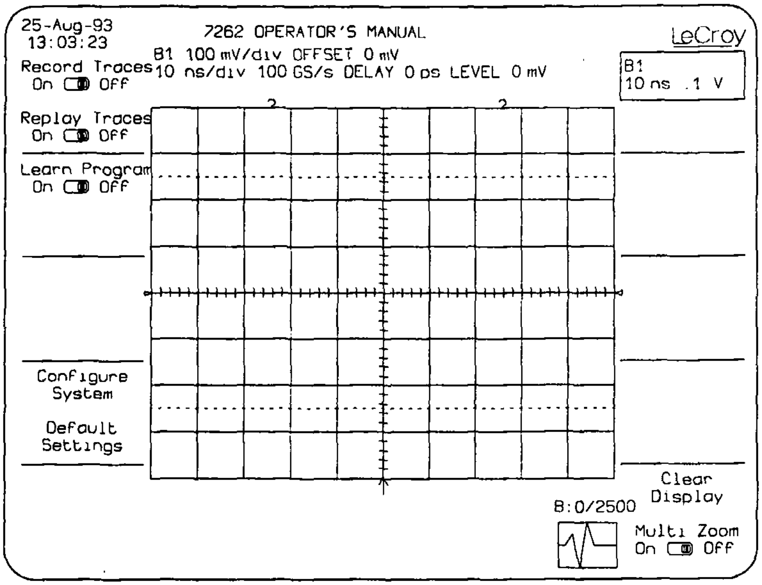


Figure 4.38: System Message Area

As shown above, the fields in the acquisition setting summary indicate the following:

A1, A2, A **B1, B2, B**	Identifies the plug-in slot being summarized and the vertical channel controls being adjusted. A plug-in slot letter (e.g: "A") that is not followed by a channel number specifies that CH1 and

CH2 vertical controls are locked together. (Locking occurs by selecting All Channels in the Vertical Status Screen.)

V/DIV	Indicates the actual volts/division.
PROBE ATTEN	Indicates the manually selected probe scale factor.
OFFSET	Indicates the vertical offset as selected by the OFFSET KNOB and its ZERO key.
T/DIV	Indicates the timebase as adjusted by the T/DIV knob.
SAMPLE RATE	Indicates the current sampling rate.
DELAY	Indicates the Trigger delay as selected by the DELAY knob and its ZERO key.
LEVEL	Indicates the Trigger level as selected by the LEVEL knob and its ZERO key.

NOTE: *The settings appear when the control is adjusted, so the display indicates settings for the next acquisition. They may differ from those indicated under the trace label which were used to acquire the currently displayed trace.*

Plug-in status

The Plug-in Status screen provides a summary of all the acquisition settings. It also allows adjustments of settings not controlled from the front panel. This screen can be displayed by pressing the plug-in status display key located in the upper right hand corner of the plug in front panel. This key is labeled # 19 in figure 4.36. A hardcopy of this screen (see Hardcopy Setup, page 3-103 in the LeCroy 7200 Precision Digital Oscilloscope Operator's Manual) provides complete documentation of the acquisition settings. Figure 4.39 below is an example of the plug-in status screen.

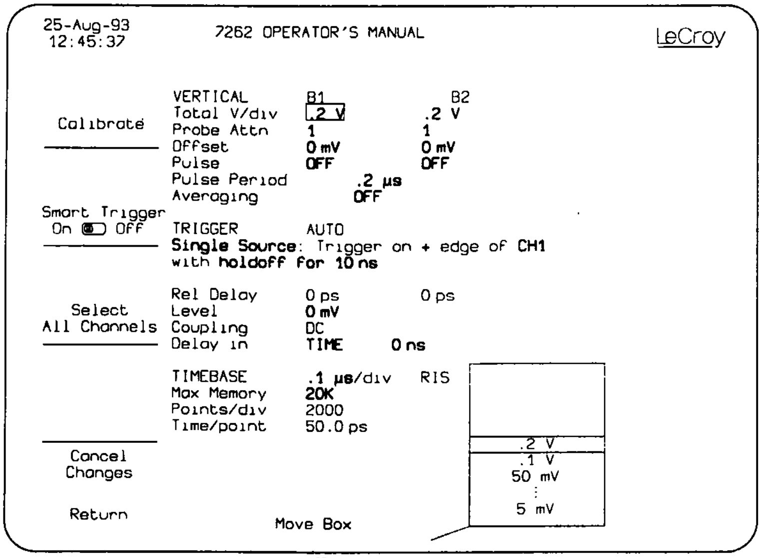


Figure 4.39:

The settings are arranged on the screen by control group (i.e., VERTICAL, TRIGGER, and TIMEBASE). Each group includes the fields from one status screen. For explanations of fields specific to an individual status screen, refer to the section in Operation which details its use.

To modify a setting use the control knob directly centered and below the CRT. These are the controls labeled 16 and 17 in figure 3.1 of the *"LeCroy 7200A precision digital oscilloscope operators manual"*. These controls are further discussed in section 3 of that manual. Once a status screen is displayed, move the SELECT BOX ICON onto the field to be modified. The SELECT BOX will only move onto the fields that are able to be adjusted and are highlighted accordingly. An options list will indicate available choices, with the current choice in the center.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes in non-volatile memory and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

Control Status Displays

Vertical Status

The Vertical Status screen provides a summary of all the Vertical control settings. It also allows an alternate way to adjust settings from the front panel.

To display the Vertical Status screen, press the MODIFY key on the mainframe and then adjust any Vertical control on the plug-in front panel. Adjusting a Vertical control after pressing MODIFY will not affect its setting.

In this display, all the enabled traces are shown in a half-screen grid above the Vertical Status information. As vertical controls are changed, the effects on the displayed traces are shown on the next acquisition. Figure 4.40 shows an example of the Vertical Status screen.

To modify a Vertical setting use the control knob directly centered and below the CRT. These are the controls labeled 16 and 17 in figure 3.1 of the *LeCroy 7200A precision digital oscilloscope operators manual.* These controls are further discussed in section 3 of that manual. Once a status screen is displayed, move the SELECT BOX ICON onto the field to be modified. The SELECT BOX will only move onto the fields that are able to be adjusted and are highlighted accordingly. An options list will indicate available choices, with the current choice in the center. In figure 4.40 on the following page, the select box is bracketing the choice for avg weight and the list at the left gives the possible options; 16 being currently selected.

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

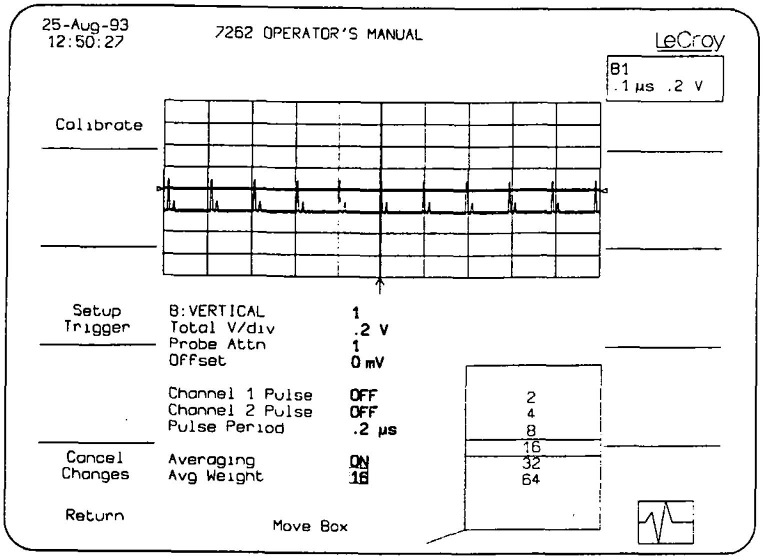


Figure 4.40:

The Vertical Status screen contains the following softkeys and fields:

SOFTKEYS

Calibrate — Ensures overall vertical and timebase accuracy. (Calibration is also performed when the Mainframe is initially powered and the Vertical and Timebase controls are adjusted, and periodically thereafter.)

Setup Trigger — Displays the Trigger Status Screen.

Cancel Changes — Cancels all previously made selections and returns to the main menu.

Return — Returns to the main menu

FIELDS

VERTICAL — Indicates the selected channel. Note this can be channel 1 channel 2 or ALL. When "ALL" is selected, the volts per division and probe attn controls will affect both channels.

Total V/DIV — Indicates the actual Volts/division. This includes the settings of the V/DIV (7) and the Probe Attenuation.

Probe Attn — Indicates the probe attenuation factor included in the vertical sensitivity indication. The choices are x1 to x100.

Offset — Indicates the vertical offset as selected by the OFFSET (11) knob and its ZERO (10) key.

Channel 1 pulse — Turns the internal pulse source for channel 1 either on or off.

Channel 2 pulse — Turns the internal pulse source for channel 2 either on or off.

Pulse Period — Sets the period for the channel 1 and channel 2 pulse sources between 200 nanoseconds and 1 second.

Averaging — Turns averaging in the plug in on or off. The averaging type is continuous or exponential averaging. The contents of the averaging buffer are determined by:

new average value = [(**wgt** -1)(**old average value**) + **new sample**]/**wgt**

where **wgt** is selectable from 8 to 64.

Timebase Status

The Timebase Status screen provides a summary of all the Timebase settings. It also allows adjustments of settings that are not controlled from the front panel. To display the Timebase Status screen, press the MODIFY key on the mainframe and then adjust any Timebase control on the plug-in front panel. Adjusting the Timebase control after pressing MODIFY will not affect its setting.

In this screen, all the displayed traces are shown in a half-screen grid above the selection fields. As Timebase controls are adjusted, the effects on traces are immediately shown. Figure 4.41 shows an example of the Timebase Status screen.

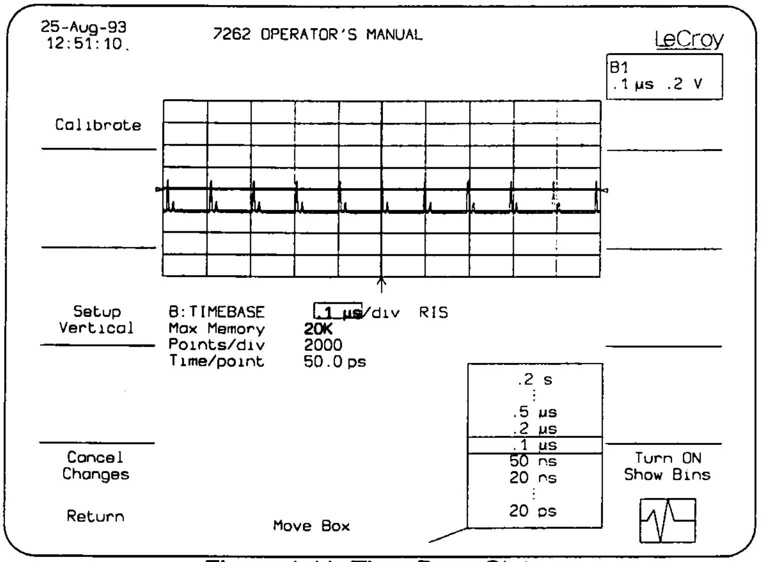


Figure 4.41: Time Base Status

To modify a timebase setting while in this display, use the control knob directly centered and below the CRT. A complete description of this knobs use is contained in section 3 of the *LeCroy 7200A Precision Digital Oscilloscope Operator's Manual.* Once a status screen is displayed, move the SELECT BOX ICON onto the field to be modified. The SELECT BOX will only move onto the fields that are able to be adjusted. These fields are highlighted. An options list will indicate available choices, with the current choice in the center

To change the selection, rotate the Modify Value knob to move the desired choice to the center of the list. The new choice will also replace the one in the box. After changing the selections, press the Return softkey to save the changes in non-volatile memory and display the

Main Screen. The Cancel Changes softkey cancels all changes, restores the original setup, and displays the Main Screen.

The TIMEBASE Status screen contains the following softkeys and fields:

Softkeys

Calibrate	Ensures overall vertical and timebase accuracy. (Calibration is also performed when the 7200A is powered and the Vertical and Timebase controls are adjusted, and periodically thereafter).
Setup Vertical	Displays the Vertical Status screen.
Cancel Changes	Cancels all previously made selections and returns to the main menu.
Return	Returns to the main menu

Fields

Timebase	Indicates the time per division setting of the TIMEBASE knob. If Random Interleaved Sampling (RIS) is selected, "RIS" also appears on this line.
Max Memory	Indicates the maximum number of sample points to represent each waveform. Together with the timebase setting , it determines the sample rate. The choices are: 500 ,1k, 2k, 5k, 10k, 20k.
Points/div	Indicates the actual points per division being acquired in the data record.
Time/point	Indicates the sample rate (i.e., time between digitized sample points) for the corresponding timebase setting.

Trigger Status

The 7262 Series offers two independent triggering methods:
Standard and Smart™ Trigger. Standard trigger provides basic trigger functions. Smart Trigger adds additional qualifications to the trigger source(s). The Smart Trigger key (6) on the plug-in front panel toggles between selecting either method. The plug-in front panel LED will be lit when Smart Trigger is selected.

The Plug-in Trigger Status screens for either triggering method provide a summary of all the trigger settings. The screens allow adjustments of settings that are not controlled from the front panel.

To display a Trigger status screen, press the MODIFY key on the mainframe and then adjust any trigger control on the plug-in front panel. Adjusting the trigger control after pressing MODIFY will not affect its setting. In the status screen, all the displayed traces are shown in a half-screen grid above the trigger fields. As trigger settings are changed, the effects on traces are shown on the next acquisition. Figure 4.42 shows an example of the Standard Trigger Status screen.

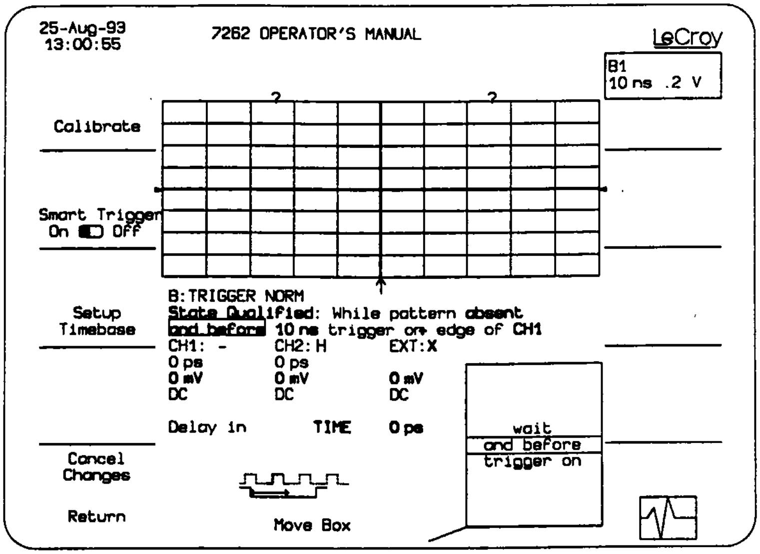


Figure 4.42: Standard Trigger Status Screen

Once a screen is displayed, the outer knob under the center of the screen is used to position the box on the field being modified. The box will only move onto fields that do not have a front panel key or knob. These fields are highlighted in bold type. The options list in the lower right screen will indicate available choices, with the current choice in the center. To change the selection, rotate the inner knob to move the desired choice to the center of the list. The new choice will also replace the previous selection in the box.

After changing the selections, press the Return softkey and display the Main Screen. The Cancel Changes softkey cancels all changes, restores the original selected values, and displays the Main Screen.

The Trigger Status screens have some softkeys and fields which are present for all trigger types; however, others are specific to an individual trigger type. The softkeys and fields which appear for all Trigger Status screens are listed below. Following them are explanations of each trigger type and the fields specific to its use.

Softkeys

Calibrate — Ensures overall vertical and timebase accuracy. (Calibration is also performed when the 7200A is powered and the Vertical and Timebase controls are adjusted, and periodically thereafter.)

Smart trigger — Turns smart trigger on or off

Setup Timebase — Displays the Timebase Status Screen.

cancel changes — Cancels all changes and returns to the main menu

Fields

Trigger — Indicates the currently selected data acquistion method.(Auto, Normal or Single) Note: Sequence mode is disabled if a 7262 plug-in is installed in the mainframe.

Ch 1 rel delay — delays or advances channel 1 relative to channel 2 and the trigger source.

Ch 2 rel delay — delays or advances channel 2 relative to channel 1 and the trigger source

Level — Shows the trigger level for the trigger source, as selected by the LEVEL (4) knob and its ZERO (5) key.

Coupling — Shows the trigger coupling for the trigger source, as selected by the COUPLING (17) (18) front panel keys. DC coupling lets all frequencies pass whereas HF SYNC imposes a divide by 4 prescaler

Delay — Indicates the Trigger delay as selected by the DELAY (15) knob and its ZERO (14) key, also indicates the trigger delay units. Trigger delay may be expressed in terms of time or percentage of the screen. The percentage is applicable for pretrigger delay settings only.

Trigger Operation

Standard Trigger

Standard trigger causes a trigger to occur whenever the selected trigger source meets its trigger conditions. The trigger condition is defined by the trigger level, coupling, high frequency sync, and slope. The Standard trigger is set by the front panel trigger controls and from within the trigger status screen. The status screen indicates all the trigger settings. Only high frequency sync (HFSYNC) cannot be selected using this screen.

As shown in Figure 4.43 the Standard Trigger Status screen contains these additional fields:

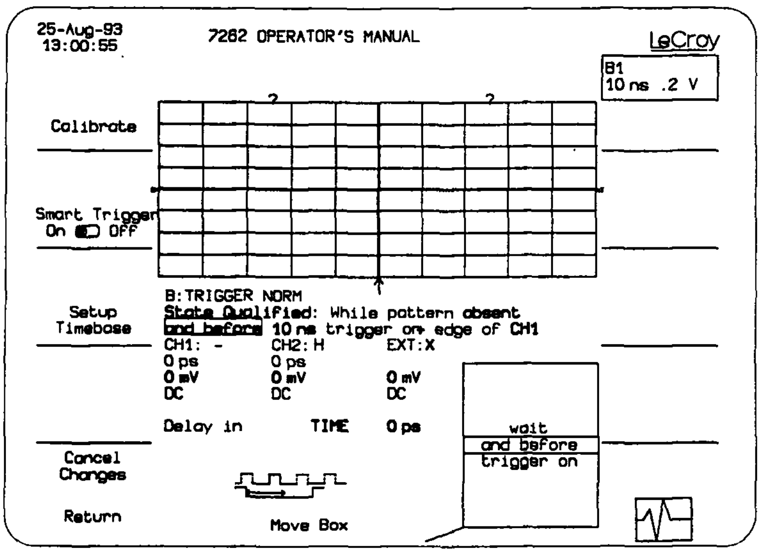


Figure 4.43:

Trigger on — Indicates the selected trigger edge, positive or negative, as selected by the SLOPE (16) key.

If the selected trigger slope is positive, a trigger is generated when the source signal crosses above the trigger level. If a negative slope is selected, a trigger occurs when the source crosses below the level.

edge of

Indicates the trigger source, as selected by the SOURCE (2) (3) front panel key.

Smart™ Trigger

The Smart Trigger allows setting additional qualifications before a trigger is generated. These qualifications can be used to capture rare phenomena such as glitches or spikes, specific logic states, or missing bits. One qualification can include, for example, generating a trigger only on a pulse wider or narrower than a user specified limit. Or it can require three trigger sources to exceed specific levels for a minimum time. In general, Smart Trigger offers a variety of trigger qualifications based on three abilities:

1) To count a specified number of events (1 to 15,000,000).

2) To measure time intervals (500 psec up to 100 sec).

3) To recognize a pattern input.

To select the qualifications for Smart Trigger, display the Trigger Status screen as shown in Figure 4.43 by pressing Modify and selecting any Trigger control. Now press the softkey labeled "Smart Trigger On". Alternately, the Smart Trigger key on the front of the plug-in (# 6 in figure 4.36) can be pressed.

As shown in figure 4.44, the first field below "TRIGGER" indicates a description of the trigger method. When Smart Trigger is selected on the plug-in front panel, one of four Smart Trigger methods may be selected in this field:

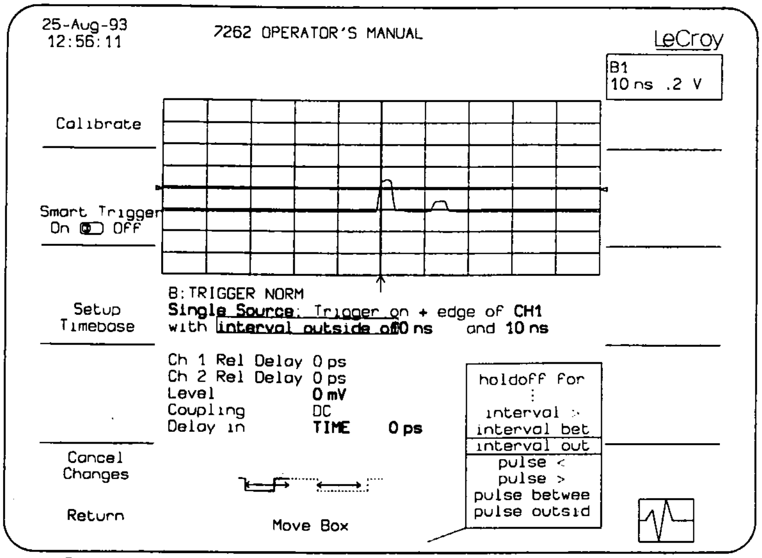


Figure 4.44: Single Source Smart Trigger Status Screen

1) Single Source Trigger on the selected source when the Standard trigger conditions and one additional qualification (detailed below) are met.

2) Pattern Trigger whenever the Standard trigger conditions, for the selected combination of inputs occurs and one additional qualification are met.

3) State Qualified Trigger whenever the trigger source meets the standard trigger condition, during the selected pattern, and one additional qualification are met.

4) Time Qualified Trigger whenever the trigger source meets the standard trigger condition, after the selected combination begins, and one additional qualification are met.

Move the box and adjust the Modify Value knob to select among the four Smart Trigger choices. The following sections contain explanations of each Smart trigger method.

Single Source

Single Source triggering is similar to Standard triggering because one trigger source is used to define a trigger condition. Single Source allows an additional qualification before a trigger can occur. Qualifications can be:

*holdoff for 10 nsec up to 100 sec.

*holdoff for 1 to 15,000,000 events.

*interval < 2 nsec up to 100 sec.

*interval > 2 nsec up to 100 sec.

*interval between 10 nsec and 100 sec

*interval outside 10 nsec and 100 sec

*pulse < 500 psec up to 100 sec.

*pulse > 500 psec up to 100 sec.

*pulse between 10 nsec and 100 sec

*pulse outside 10nsec and 100 sec

A detailed description of each field (reference figure 4.12) of "Single Source" Smart Trigger type follows.

Fields

Trigger on

Indicates the selected trigger edge, positive or negative, as selected by the SLOPE (19) key.

edge of

Indicates the trigger source, as selected by the SOURCE (2) (3) front panel key.

Qualifications

Holdoff for time

Selects a minimum time between triggers. A trigger is generated when the trigger condition is met after the selected delay from the last trigger. The timing for the delay is initialized and started on each trigger.

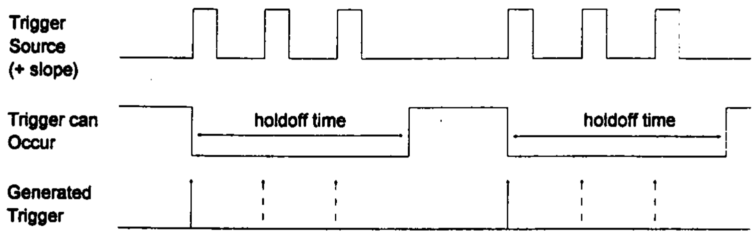


Figure 4.45: Single source with holdoff for time

Holdoff for events

Selects a minimum number of events between triggers. An event is generated when the trigger source meets its trigger conditions. A trigger is generated when the trigger condition is met after the selected number of events from the last trigger. The holdoff for events is initialized and started on each trigger.

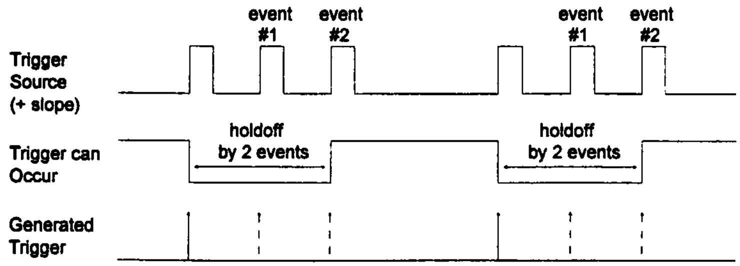


Figure 4.46: Single source with holdoff for events

The field to the right indicates the units for holdoff:

s Indicates the delay is in seconds.

events Indicates the number of times the trigger condition is met after the last trigger. If the number is selected as four, for example, the trigger would occur on the fifth event.

interval < Selects a maximum interval between two edges of the same slope. The trigger is generated on the second edge if it occurs within the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs.

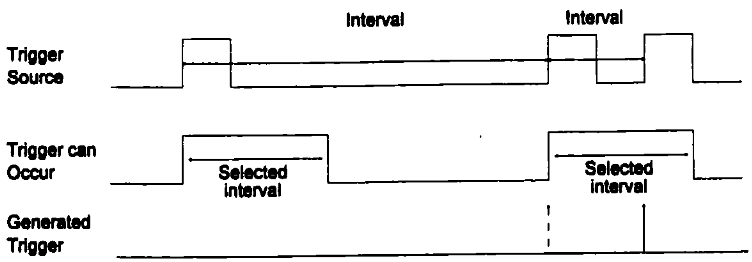


Figure 4.47: Single source with interval < selected interval

interval > Selects a minimum interval between two edges of the same slope. The trigger is generated on the second edge if it occurs after the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs.

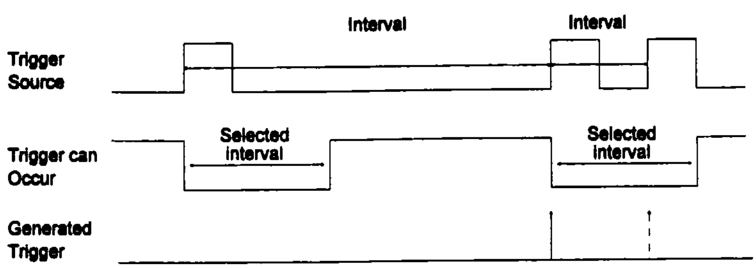


Figure 4.48: Trigger if interval > selected interval

interval between

Compares the width of an interval (defined as two edges of the same polarity as selected by trigger slope) to a predetermined range of values. A valid trigger condition is generated if the interval is within the prescribed range of values

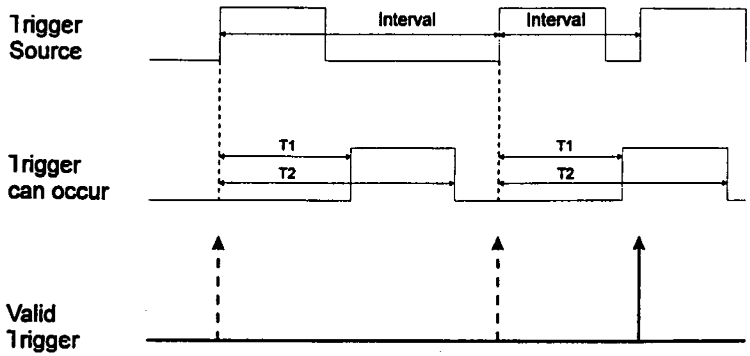


Figure 4.49: Trigger if interval between

interval outside

Compares the width of an interval (defined as two edges of the same polarity as determined by trigger slope) to a pre-determined range of vales. A valid trigger condition is generated if the interval is outside the range of allowable values.

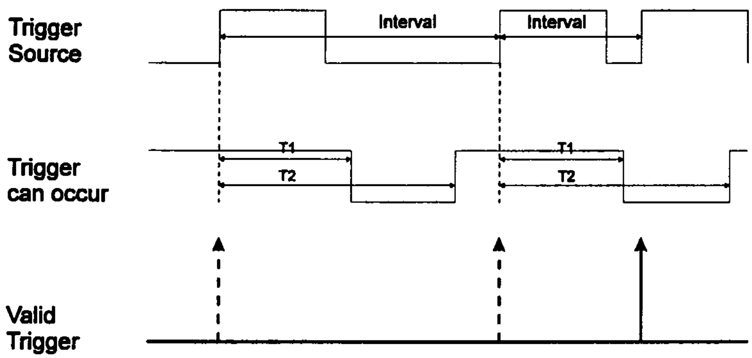


Figure 4.50: Trigger if interval outside

pulse <

Selects a maximum pulse width. The trigger is generated on the selected edge when the pulse width is less than the selected width. The timing for the width is initialized and restarted on the slope opposite to the edge selected.

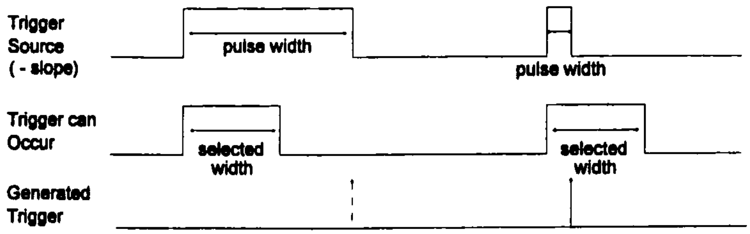


Figure 4.51: Trigger if pulse width < selected width

NOTE: *To trigger on a positive pulse, select negative slope. The trigger is generated by the trailing edge of the pulse.*

pulse >

Selects a minimum pulse width. The trigger is generated on the selected edge when the pulse width is greater than the selected width. The timing for the width is initialized and restarted on the edge opposite to the edge selected.

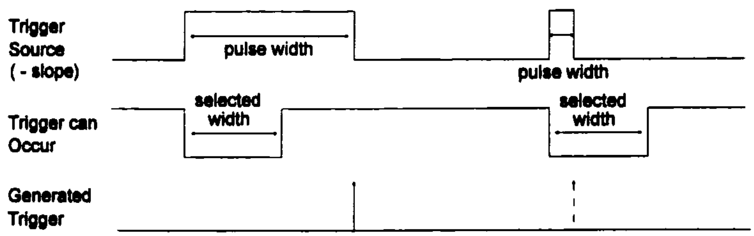


Figure 4.52: Trigger if pulse width > selected width

NOTE: *To trigger on a positive pulse, select negative slope. The trigger is generated by the trailing edge of the pulse.*

pulse between

Compares the width of a pulse to a preselected range of values. A valid trigger is generated if the pulse width falls between the alowable values.

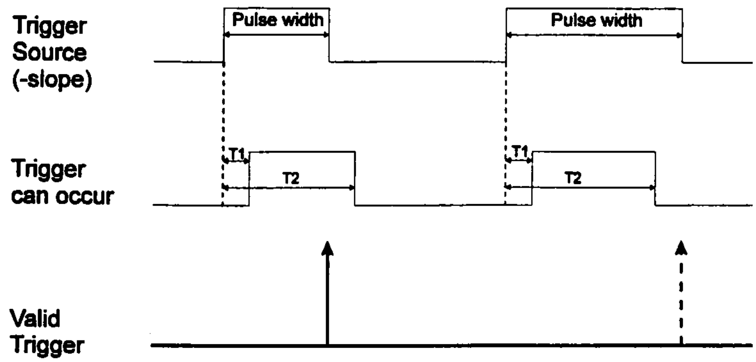


Figure 4.53: Trigger on pulse width between selected width

pulse outside

Compares the width of a pulse to a preselected range of values. A valid trigger is generated if the pulse width falls outside the allowable values.

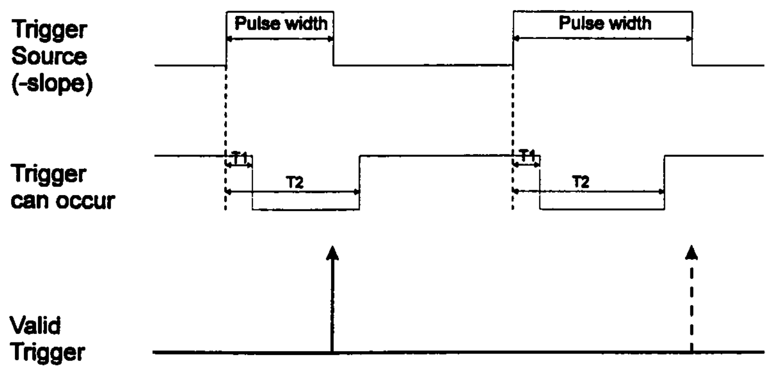


Figure 4.54

Summary: Setting up Single Source Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Single Source.
4. Using the front panel controls, select the desired trigger condition.
5. Select "Holdoff for time", or "Holdoff for events": "interval <", "interval >", "interval between", "interval outside", "pulse <", "pulse >", "pulse between", or "pulse outside".
6. Select the desired number of events or time.

Pattern

The pattern trigger logically combines the states of up to three inputs: channel 1, channel 2, and EXT TRIG. The combination, called a pattern, is defined as the logical AND of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level. For example, the pattern can be defined as present when the trigger state for channel 1 is high, 2 is low, and EXT is high. If any are not met, the pattern state is considered absent.

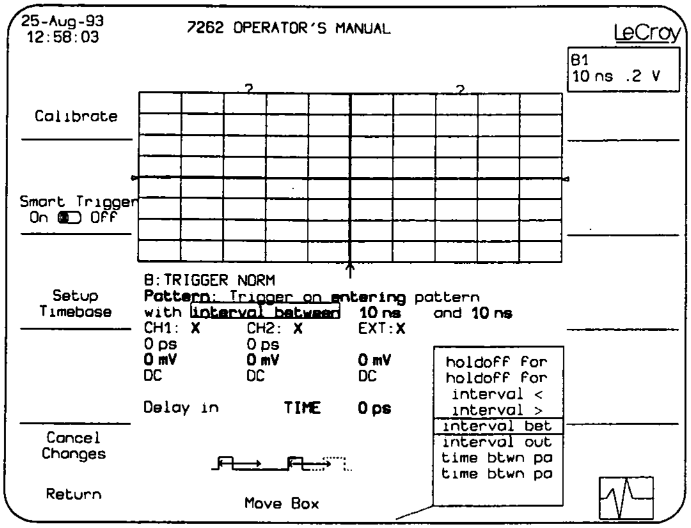


Figure 4.55: Smart Trigger: Pattern

Once the pattern is defined, one of two transitions can be used to generate the trigger. When the pattern begins, called "entering" the pattern, a trigger can be generated. Alternatively, a trigger can be generated when the pattern ends, "exiting" the pattern.

Pattern triggering allows an additional qualification once the selected pattern transition occurs.

With Pattern triggering, as in single source, one of the following qualifications can be selected:

*Holdoff for 10 usec upto 100 sec.

*Holdoff for 1 to 15,000,000 events.

*Interval < 2nsec upto 100 sec.

*Interval > 2nsec up to 100 sec.

*interval between 10 usec and 100 sec.

*interval outside 10 usec and 100 sec.

*width < 500 psec upto 100 sec.

*width > 500 psec upto 100 sec.

*width between 10 nsec and 100 sec.

*width outside 10 usec and 100 sec.

Fields

As shown in Figure 4.55, the Pattern Trigger Status screen contains these additional fields:

Trigger on Defines the selected pattern transition. The choices are:

- entering — trigger when the pattern begins
- exiting — trigger when the pattern ends

When Pattern triggering is selected, additional fields appear. The next three fields allow selection of the pattern from up to three sources in logical AND: CH1 CH2 EXT. This combination defines the presence of the pattern.

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

- H Requires that the signal for this channel be greater than the trigger level.
- L Requires that the signal for this channel be less than the trigger level.
- X Do not use the signal for this channel to define the pattern (don't care).

CH2: Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

EXT: Selects whether to use the trigger condition for EXT TRIG. Once selected, the field to its right indicates how to use it. The choices are H, L,and X.

The following fields indicate the qualifications for Pattern triggering. Refer to figures 4.13 through 4.22 using "Pattern Present" as Trigger Source.

Holdoff for time Selects a minimum time between triggers. A trigger is generated when the trigger condition is met after the selected delay from the last trigger. The timing for the delay is initialized and started on each trigger. (ref fig 4.13)

Holdoff for events — Selects a minimum number of events between triggers. An event is generated when a trigger source meets its trigger conditions. A trigger is generated when the trigger condition is met after the selected events from the last trigger. Holdoff is initialized and started on each trigger.(ref fig 4.14)

interval < — Selects a maximum interval between the start of succesive patterns. The trigger is generated on the second occurence of the pattern if it occurs within the selected interval. The timing for the interval is initialized and restarted whenever the selected pattern becomes true. (ref fig 4.15)

interval > — Selects a minimum interval between the start of successive patterns. The trigger is generated on the second occurence of the pattern after the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs. (ref fig 4.16)

interval between — Compares the time interval between the occurences of a valid pattern to a pre-selected range of times. Generates a valid trigger if the time between occurences of the pattern is within the specified time ineterval. (ref fig 4.17)

interval outside — Compares the time interval between the occurences of a valid pattern to a pre-selected range of times. Generates a valid trigger if the time between occurences of the pattern is outside the specified time interval.(ref fig 4.18)

width < — Selects a maximum pattern width or time between exiting one pattern and entering the next. The trigger is generated on entering the second pattern within the selected time. The timing for the delay is initialized and restarted whenever the pattern is exited, regardless of whether a trigger is generated. (ref fig 4.19)

width > — Selects a minimum delay between exiting one pattern and entering the next. The trigger is generated on entering the second pattern after the selected minimum time. The timing for the delay is initialized and restarted whenever the pattern is exited, regardless of whether a trigger is generated. (ref fig 4.20)

width between

Compares the width of a pulse to a preselected range of values. A valid trigger is generated if the pulse width falls between the alowable values.

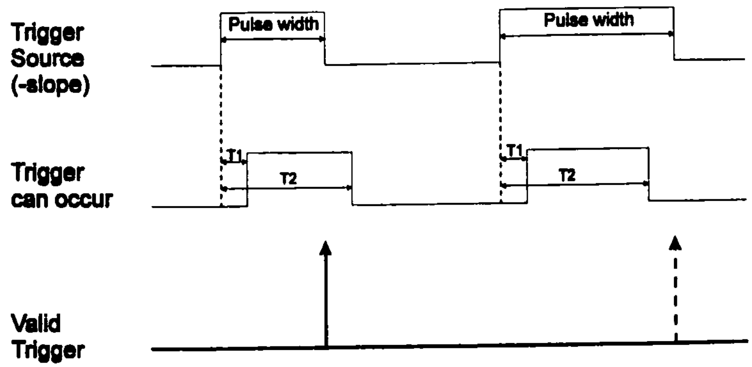


Figure 4.56: Trigger on pulse width between selected width

width outside

Compares the width of a pulse to a preselected range of values. A valid trigger is generated if the pulse width falls outside the allowable values.

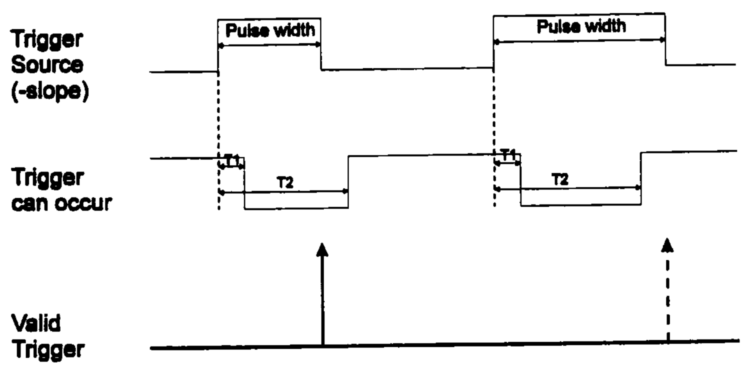


Figure 4.57

Summary: Setting up Pattern Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Pattern Trigger.
4. Select the triggering transition: "entering" or "exiting".
5. Define the pattern: for channels 1, 2 and EXT, select H for high, L for low, and X for don't care.
6. Using the front panel controls,set the desired levels for H and L
7. Select: "Holdoff for", "interval <", "interval >", etc.
8. Select the desired number of events or reference time.

State Qualified

State Qualified triggering lets the user choose whether a trigger is generated while the selected pattern is present or absent. A pattern is defined as a logical AND combination of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level.

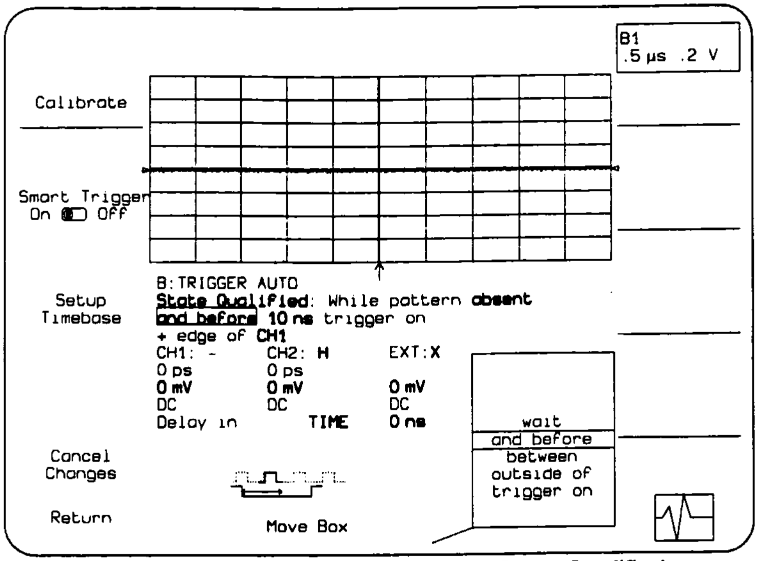


Figure 4.58: Smart Trigger Status: State Qualified

For example, a pattern is selected to be present when the trigger states for channels 1 and 2 are high and EXT is low. If any are not met, the pattern state is considered absent.

For State triggering, the pattern is used to qualify a trigger without actually generating the trigger. A trigger will occur when another signal, the trigger source, meets its trigger condition *while* the pattern is present. The trigger source is not allowed in the pattern. As shown in Figure 4.58, while the pattern is absent, CH2 high, a trigger occurs when CH1, the trigger source, has met its trigger condition.

State Qualified triggering allows an additional qualifications once the selected pattern state occurs.

*Wait for 10 nsec up to 100 sec.

*and before 10 nsec up to 100 sec.

*Trigger on 1st to 15,000,000 th event.

*between 10 usec and 100 sec.

*outside of 10 usec and 100 sec.

Fields

As shown in Figure 4.58, the State Trigger Status screen contains the following setup fields:

while pattern

Defines the state of the pattern. The choices are:

present Trigger during the pattern.

absent Trigger after the pattern ends.

trigger on Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of Indicates the current trigger source as selected from the front panel. This source acts as the trigger source.

The following fields are used to define the pattern.

NOTE: *The trigger source currently selected on the front panel serves as the trigger source and cannot be used in the pattern.*

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

- H Requires that the signal for this channel be greater than the trigger level.
- L Requires that the signal for this channel must be below the trigger level.
- X Do not use the signal for this channel to define the pattern (don't care).

CH2: Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

EXT: For all of the qualifiers available for state qualified triggering, the following fields appear:

he following fields indicate the qualifications for State Qualified triggering:

wait

Selects a delay from the start of the desired pattern. After the delay and before the end of the pattern, a trigger can occur. The timing for the delay is restarted when the selected pattern begins. Select time from 10 nsec to 100 sec.

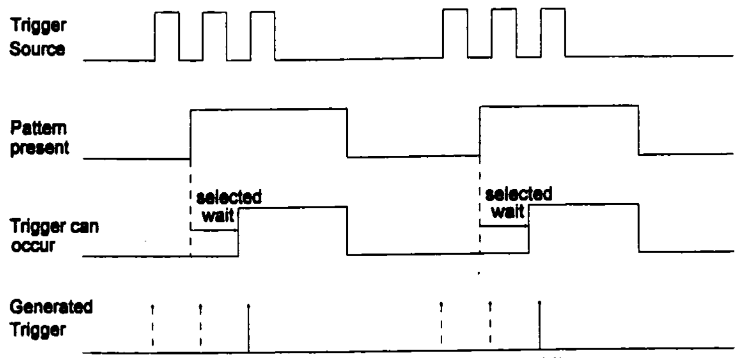


Figure 4.59: State qualified "wait"

and before

Selects a time from the start of the desired pattern. Before the end of the selected time and before the end of the pattern, a trigger can occur. The selected time is restarted when the selected pattern begins. Select a time from 10 nsec to 100 sec.

trigger on

Selects a minimum number of events of the trigger source. An event is generated when a trigger source meets its trigger conditions. On the selected event of the trigger source and before the end of the pattern, a trigger can occur. The count is initialized and started whenever the selected pattern begins. It continues while the pattern remains. When the selected count is reached, the trigger occurs.

width between

Compares the width of a pulse to a preselected range of values. A valid trigger is generated if the pulse width falls between the alowable values.

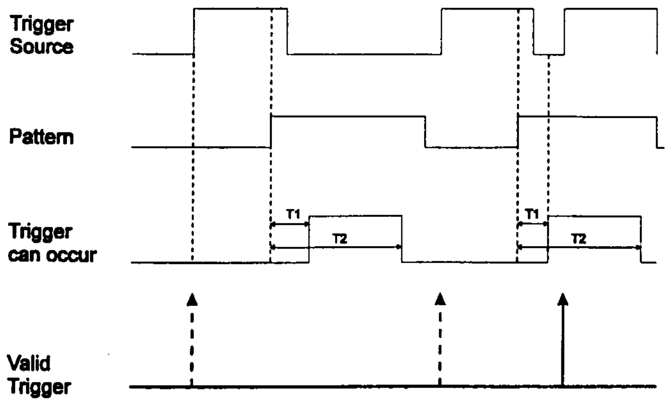


Figure 4.60: State qualified "between"

width outside

Compares the width of a pulse to a preselected range of values. A valid trigger is generated if the pulse width falls outside the allowable values.

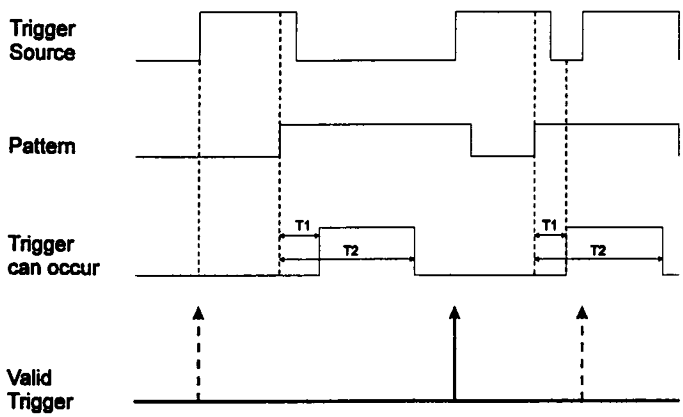


Figure 4.61: State Qualified "outside"

Summary: Setting up State Qualified Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select State Qualified Trigger.
4. Select the qualifying pattern: "present" or "absent".
5. Define the pattern: for channels 1, 2 and EXT, select H for high, L for low, or X for don't care.
6. Using the front panel controls, select the desired trigger condition.
7. Select: "wait", "and before", "between", "outside of", or "trigger on".
8. Select the desired number of events or time.

Time Qualified

Time Qualified triggering generates a trigger when the trigger source meets its trigger condition after entering or exiting the pattern. The trigger can occur even if the pattern disappears before the trigger meets its trigger conditions. A pattern is defined as a logical AND of trigger states. A trigger state is either high or low; high when a trigger source is greater than the trigger level and low if it is less than the trigger level. For example, the pattern can be defined as present when the trigger states for channels 1 and 2 are high and EXT is low. If any are not met, the pattern state is considered absent.

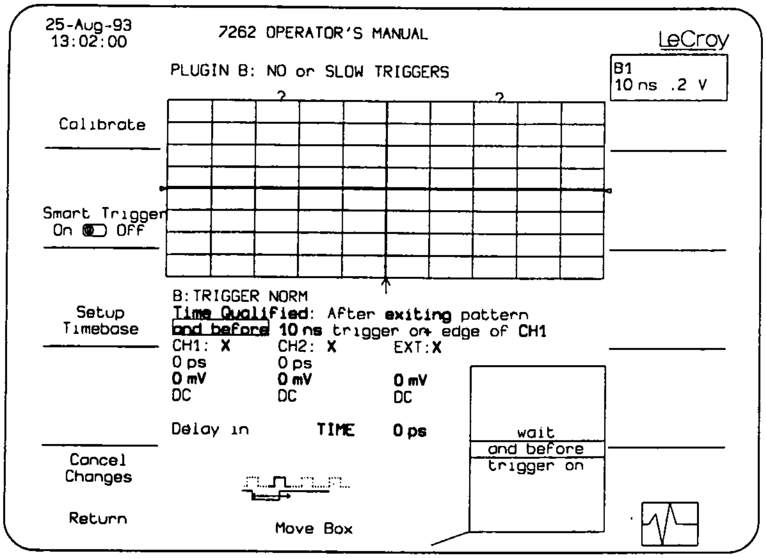


Figure 4.62: Smart Trigger: Time Qualified

Once the pattern is defined, one of two transitions can be used to qualify the trigger source, when the pattern begins, called "entering" the pattern, or when the pattern ends, called "exiting" the pattern. For Time qualified triggering, the pattern is used to qualify a trigger without actually generating the trigger. A trigger will occur when another signal, the trigger source, meets its trigger condition after the pattern is entered or exited.

Time Qualified triggering allows an additional qualification once the selected pattern transition occurs:

*wait for 10 nsec up to 100 sec.

*and before 10 nsec up to 100 sec.

*between 10 usec and 100 sec.

*outside of 10 usec and 100 sec.

*trigger on 1st to 15,000,000 th event.

As shown in Figure 4.62 the Time Qualified Trigger Status screen contains these additional fields:

Trigger after — Defines the selected pattern transition. The choices are:

- entering — Trigger when the pattern starts.
- exiting — Trigger when the pattern ends.

When Time Qualified triggering is selected, a pattern must be selected to define the qualifications.

CH1: Defines how to use the first channel trigger condition in defining the trigger pattern. The choices are:

- H — Requires that the signal for this channel be greater than the trigger level.
- L — Requires that the signal for this channel be less than the trigger level.
- X — Do not use the signal for this channel to define the trigger pattern.

CH2: Defines how to use the second channel trigger condition in defining the trigger pattern. The choices are: H, L, and X.

For all qualifiers available for Time Qualified Triggers, the following fields appear:

trigger on — Indicates the trigger edge, positive or negative, as selected by the SLOPE key.

edge of — Indicates the current trigger source as selected from the front panel. This source acts as the trigger source.

The following fields indicate the qualifications for Time Qualified triggering:

wait — Selects a delay from entering or exiting the pattern. After the delay, a trigger is generated when the trigger meets its trigger conditions. The timing for the delay is always initialized and restarted on the selected pattern condition. Select a time from 10 nsec to 100 sec.

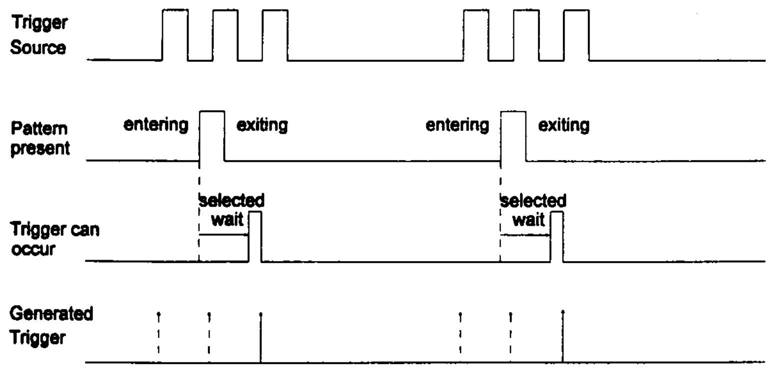


Figure 4.63: Time qualified trigger with wait

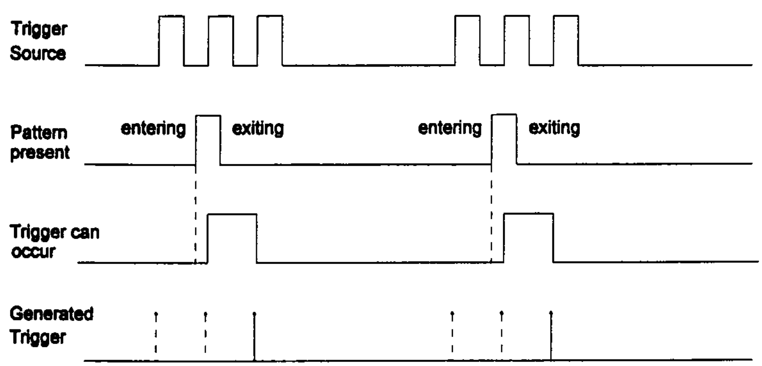


Figure 4.64: Time qualified triggering and trigger on the 2nd event

and before

Selects a time from entering or exiting the pattern. Before the end of the selected time, a trigger can occur. The selected time is restarted on the selected pattern condition. Select a time from 10 nsec to 100 sec.

trigger on

Selects a minimum number of events. An event is generated when a trigger source meets its trigger conditions. On the selected event of the trigger source and before the next pattern condition, a trigger can occur. The count is initialized and started on the selected pattern condition. It continues until the next pattern condition. Select from 1 through 15,000,000 events.

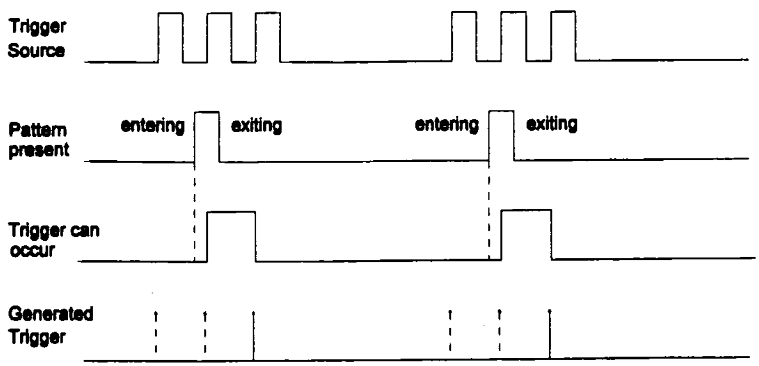


Figure 4.65: Time Qualified triggering and trigger on the 2nd event

Summary: Setting Up Time Qualified Triggering

1. Turn on Smart trigger from the plug-in front panel.
2. Display the Trigger Status screen by pressing MODIFY and any trigger control on the desired plug-in.
3. Select Time Qualified Trigger.
4. Select the pattern condition: "entering" or "exiting".
5. Define the pattern: for channels 1, 2, and EXT, select H for high, L for low, or X for don't care.
6. Using the front panel controls, select the desired trigger condition.
7. Select : "wait", "and before", "between", "outside of" or "trigger on".
8. Select the desired number of events or reference time.

Introduction

Waveform parameters supported by the 7200A Modular Oscilloscope System are described in the following pages in alphabetical order. The description of each parameter follows the form shown below. If a section is not needed for a particular parameter, it is omitted.

NAME Full Name

Description:	This section contains a brief description of the parameter. It is intended to convey the meaning and use of the parameter without getting into technical details.
Definition:	This is a more technical description of the parameter than the one given above.
Diagram:	Diagrams referenced by the current parameter are given here. At the end of the section on parameters, there are several pages containing diagrams which help to explain the definitions of the parameters.
Restrictions:	This indicates conditions necessary for the computation of the parameter. There are three main types of waveforms: time domain, frequency domain, and histogram. In most cases, the restrictions list the types of waveforms on which the parameter can be computed.
Special cases:	This describes situations in which the parameter may be computed differently depending on the data in the waveform.
Units:	The units of the parameter are given here.
Notes:	This section describes any unusual or unexpected behaviors of the parameter. It may indicate the differences between this and related parameters.
Arguments:	If the parameter requires arguments, they are described in a table which indicates: the name as shown on the display, the name as used in remote commands, the lower and upper limits of the value, and the default value. A description of each argument follows the table.
Events/Waveform:	Some parameters, when used in a trend or histogram, provide the field “Events per Waveform”. The different choices are described here.
References:	Following the alphabetical listing of the parameters are in-depth discussions of the algorithms used to compute parameters. The sections describing the current parameter are indicated here.

AMPL Amplitude

Description: AMPL measures the difference between the upper and lower levels in a two-level signal. This differs from the PKPK parameter because noise, overshoot, undershoot, and ringing do not affect the measurement.

If a signal does not have two major levels, such as a triangle or sawtooth wave, AMPL returns the same value as PKPK.

Definition: TOP - BASE

Diagram: Fold-Out Figures 1 and 3

Restrictions: Time Domain Waveforms and Histograms only.

Units: Time Domain Waveforms: same as vertical unit of source. Histograms: same as horizontal unit of source.

Notes: AMPL gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform. The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

References: Amplitude Computations on Waveforms

AREA — Integral of Data

Description: This parameter computes the area of the waveform between the cursors relative to the zero level. Values greater than zero contribute positively to the area, while values less than zero contribute negatively.

Definition: Sum from FIRST to LAST of data multiplied by the horizontal time between points.

Diagram: Fold-Out Figure 2

Restrictions: Time Domain Waveforms only.

Units: Product of horizontal and vertical units of source.

BASE Lower of Two Most Probable States

Description: BASE measures the lower level in a two-level signal. This differs from the MIN parameter because noise, undershoot, and ringing do not affect the measurement.

If a signal does not have two major levels, such as a triangle or sawtooth-wave, BASE returns the same value as MIN.

Definition: Value of most probable lower state.

Diagram: Fold-Out Figures 1 and 3

Restrictions: Time Domain Waveforms and Histograms only.

Units: Time Domain Waveforms: same as vertical unit of source. Histograms: same as horizontal unit of source.

Notes: BASE gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform.
The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

References: Amplitude Computations on Waveforms

CYCL — Number of Cycles

Description: CYCL determines the number of cycles of a periodic waveform which lie between the cursors. The first cycle begins at the first transition after the left cursor. The transition may be either positive-going or negative-going.

Definition: Number of cycles of periodic waveform.

Diagram: Fold-Out Figure 2

Restrictions: Time Domain Waveforms only.

Units: dimensionless

References: Edge Analysis of Waveforms

Data Value at Left Cursor

Description: DATA measures the value of the waveform at the location of the left cursor. When used in Extended Parameters, it can be used to determine manually the value at any point in a waveform. It can also be used to present an entire waveform to a trend or histogram for further analysis.

Definition: Data value at left cursor.

Diagram: Fold-Out Figure 2

Units: Same as vertical unit of source.

Events/Waveform: FIRST provides a trend or histogram with the data value at the left cursor.

ALL provides a trend or histogram with each data value between the cursors.

DATE — Date of Acquisition

Description: The DATE and TIME parameters can be used to label a waveform plot to indicate when the waveform was acquired.

Definition: Date of acquisition. If more than one trigger contributed to the waveform, the date is that of the first trigger.

Time From Trigger to Transition

Description: DLY measures the time between the trigger and the first 50% crossing after the left cursor. It can be used to measure the propagation delay between two signals by triggering on one of the signals and determining the delay of the other.

Definition: Time between the trigger and the first 50% crossing after the left cursor.

Diagram: Fold-Out Figure 2

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for trends it may also be events.

Events/Waveform: FIRST provides a trend or histogram with the time of the first 50% crossing between the cursors.

ALL provides a trend or histogram with the time of each 50% crossing (rising and falling) between the cursors.

References: Edge Analysis of Waveforms

DUR — Duration of Acquisition

Description: DUR is the time used to acquire a waveform.

Definition: For a single sweep waveform, DUR is 0. For a sequence waveform, DUR is the time from the trigger of the first segment to the trigger of the last segment. For a single segment of a sequence waveform, DUR is the time from the trigger of the previous segment to the trigger of the current segment. For a waveform produced by a history function (eg. AVGS), DUR is the time from the trigger of the first waveform accumulated to the trigger of the last waveform accumulated.

Units: Seconds

DUTY — Duty Cycle

Description:	DUTY measures the percentage of time which a periodic signal spends above its mid-point.
Definition:	WID / PER, expressed as a percent, for positive pulses. 100 - WID / PER for negative pulses. If the first transition after the left cursor is a rising edge, the waveform is considered to consist of positive pulses. Conversely , if the first transition after the left cursor is a falling edge, the waveform is considered to consist of negative pulses.
Diagram:	Fold-Out Figure 2
Restrictions:	Time Domain Waveforms only.
Units:	Percent
Events/Waveform:	FIRST provides a trend or histogram with the duty cycle of the first pulse between the cursors. ALL provides a trend or histogram with the duty cycle of all pulses between the cursors. AVERAGE provides a trend or histogram with the average of the duty cycles of all pulses between the cursors.
References:	Edge Analysis of Waveforms

FALL — Fall Time

Description: FALL measures the time between two specified values on the falling edges of a waveform. The FALL times for each falling edge in the waveform are averaged to produce the final result.

The waveform is assumed to have two major levels. For signals in which this is not true, such as triangle or sawtooth waves, FALL may not give predictable results.

Definition: Time at Lower Threshold - Time at Upper Threshold averaged over each falling edge.

Diagram: Fold-Out Figure 1

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower limit	Upper limit	Default
Lower Threshold	LOW	1 %	45 %	10 %
Upper Threshold	HIGH	55 %	99 %	90 %

The threshold arguments specify the two vertical values on each edge which are used to compute the fall time. The formulas for the upper and lower values are:

lower value = lower threshold * AMPL / 100 + BASE
upper value = upper threshold * AMPL / 100 + BASE

Note that the lower value refers to the threshold which is in a lower position on the screen. It is NOT the threshold which is crossed first during the falling transition.

Events/Waveform: FIRST provides a trend or histogram with the fall time of the first falling edge between the cursors.
ALL provides a trend or histogram with the fall time of all falling edges between the cursors.
AVERAGE provides a trend or histogram with the average of the fall times of all falling edges between the cursors.

References: Edge Analysis of Waveforms .

FREQ — Frequency

Description:	The period of a cyclic signal is measured as the time between every other pair of 50% crossings. Beginning with the first transition after the left cursor, the period is measured for each pair of transitions. These values are averaged, and the reciprocal is taken to produce the frequency.
Definition:	1 / PER
Diagram:	Fold-Out Figure 2
Restrictions:	Time Domain Waveforms only.
Units:	Hz
Events/Waveform:	FIRST provides a trend or histogram with the frequency computed from the first cycle between the cursors. ALL provides a trend or histogram with frequency values computed from all cycles between the cursors. AVERAGE provides a trend or histogram with the average of the frequency values computed from all cycles between the cursors.
References:	Edge Analysis of Waveforms

Position of Left Cursor

Description: FRST indicates the value of the horizontal axis at the left cursor. Together with the DATA parameter, this gives the same information as the horizontal absolute cursor (marker).

Definition: Horizontal axis value at left cursor.

Diagram: Fold-Out Figures 2 and 3

Units: Same as horizontal unit of source.

Notes: FRST and LAST indicate the locations of the left and right cursors, respectively. The cursors may be interchanged. For example, the left cursor may be moved to the right of the right cursor. After the change, FRST will give the location of the cursor which was formerly on the right because it is now on the left.

FWHM — Full Width at Half Maximum

Description: FWHM determines the width of the highest peak, measured between points on either side of the peak having population equal to half of the peak population.

If several peaks have height equal to the maximum population, the width of the leftmost is computed.

Definition: Full width at half maximum of highest peak.

Diagram: Fold-Out Figure 4

Restrictions: Histograms only.

Units: Same as horizontal unit of source.

Note: The WID parameter is similar to FWHM, except that it applies to time domain waveforms.

FWXX Full Width at Specified Percentage of Maximum

Description: FWXX determines the width of the highest peak, measured between points on either side of the peak having a population equal to a specified percentage of the peak population.

If several peaks have height equal to the maximum population, the width of the leftmost one is computed.

Definition: Full width at specified percentage of highest peak.

Diagram: Fold-Out Figure 4

Restrictions: Histograms only.

Units: Same as horizontal unit of source.

Notes: With the default value of the threshold (50%), FWXX is the same as FWHM.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Threshold	THR	0 %	100 %	50 %

The full width is computed using the threshold value:

value = threshold * MAXP / 100

LAST — Position of Right Cursor

Description: LAST indicates the value of the horizontal axis at the right cursor.

Definition: Horizontal axis value at right cursor.

Diagram: Fold-Out Figures 2 and 3

Units: Same as horizontal unit of source.

Notes: FRST and LAST indicate the locations of the left and right cursors, respectively. The cursors may be interchanged. For example, the right cursor may be moved to the left of the left cursor. After the change, LAST will give the location of the cursor which was formerly on the left because it is now on the right.

LMAX Local Maximum

Description: LMAX locates local peak-trough pairs in the input waveform, determines the maximum value of each peak, and computes the average over all pairs.

Definition: Value at highest point of local peak, averaged over all peaks.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as vertical unit of source.

Arguments:

Name	Remote	Lower LImit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the maximum value of the first peak between the cursors.

ALL provides a trend or histogram with the maximum value of all peaks between the cursors.

AVERAGE provides a trend or histogram with the average of the maximum values of all peaks between the cursors.

References: Local Feature Computations

LMIN — Local Minimum

Description: LMIN locates local peak-trough pairs in the input waveform, determines the minimum value of each trough, and computes the average over all pairs.

Definition: Value at lowest point of local trough, averaged over all troughs.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as vertical unit of source.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the minimum value of the first trough between the cursors.

ALL provides a trend or histogram with the minimum value of all troughs between the cursors.

AVERAGE provides a trend or histogram with the average of the minimum values of all troughs between the cursors.

References: Local Feature Computations

Description: LNUM determines the number of local peak-trough pairs in the input waveform.

Definition: Number of local features (peak followed by trough) found.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: dimensionless

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

References: Local Feature Computations

Description: LPP locates local peak-trough pairs in the input waveform, determines the difference between the peak and trough values, and computes the average over all pairs.

Definition: LMAX - LMIN

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as vertical unit of source.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the peak-to-peak value of the first peak-trough pair between the cursors.

ALL provides a trend or histogram with the peak-to-peak value of all peak-trough pairs between the cursors.

AVERAGE provides a trend or histogram with the average of the peak-to-peak values of all peak-trough pairs between the cursors.

References: Local Feature Computations

Description: LTBP locates local peak-trough pairs in the input waveform and determines the time of the maximum value of each peak. For each pair of adjacent peaks, the time difference is determined, and these differences are averaged.

Definition: Difference of LTMX values for adjacent local peaks, averaged over all pairs of adjacent peaks.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the time between the first two peaks between the cursors.

ALL provides a trend or histogram with the time between all pairs of adjacent peaks between the cursors.

AVERAGE provides a trend or histogram with the average time between all pairs of adjacent peaks between the cursors.

References: Local Feature Computations

LTBT Local Time Between Troughs

Description: LTBT locates local peak-trough pairs in the input waveform and determines the time of the minimum value of each trough. For each pair of adjacent troughs, the time difference is determined, and these differences are averaged.

Definition: Difference of LTMN values for adjacent local troughs, averaged over all pairs of adjacent troughs.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the time between the first two troughs between the cursors.

ALL provides a trend or histogram with the time between all pairs of adjacent troughs between the cursors.

AVERAGE provides a trend or histogram with the average time between all pairs of adjacent troughs between the cursors.

References: Local Feature Computations

LTMN — Local Time at Minimum

Description: LTMN locates local peak-trough pairs in the input waveform and determines the time of the minimum value of each trough.

Definition: Time at lowest point of first local trough.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the time of the first trough between the cursors.

ALL provides a trend or histogram with the time of each trough between the cursors.

References: Local Feature Computations

Description: LTMX locates local peak-trough pairs in the input waveform and determines the time of the maximum value of each peak.

Definition: Time at highest point of first local peak.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the time of the first peak between the cursors.

ALL provides a trend or histogram with the time of each peak between the cursors.

References: Local Feature Computations

LTOT Local Time Over Threshold

Description: LTOT locates local peak-trough pairs in the input waveform and determines the local peak-to-peak value and the location of the peak. The time spent by the waveform above a specified threshold is then computed and averaged over all peak-trough pairs.

Definition: Time between rising and falling crossings through the specified threshold in the vicinity of a local peak, averaged over all peaks.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV
Threshold	THR	0 %	100 %	50 %

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

The time over threshold is computed using the threshold value:

value = threshold * LPP / 100 + LMIN

Events/Waveform: FIRST provides a trend or histogram with the time over threshold of the first peak between the cursors.

ALL provides a trend or histogram with the time over threshold of all peaks between the cursors.

AVERAGE provides a trend or histogram with the average time over threshold for all peaks between the cursors.

References: Local Feature Computations

LTPT Local Time Between Peak and Trough

Description: LTPT locates local peak-trough pairs in the input waveform and determines the times of the maximum and minimum values of each trough. For each pair, the time difference from the maximum to the minimum is determined, and these differences are averaged.

Definition: LTMN-LTMX

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the time between the first two troughs between the cursors.

ALL provides a trend or histogram with the time between all pairs of adjacent troughs between the cursors.

AVERAGE provides a trend or histogram with the average time between all pairs of adjacent troughs between the cursors.

References: Local Feature Computations

LTTP Local Time Between Trough and Peak

Description: LTTP locates local peak-trough pairs in the input waveform and determines the timess of the maximum and minimum values of each trough. For each pair of adjacent features, the time difference from the minimum of the first to the maximum of the next is determined, and these differences are averaged.

Definition: Difference of LTMX and LTMN values for adjacent local troughs, averaged over all pairs of adjacent troughs.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

Events/Waveform: FIRST provides a trend or histogram with the time between the first two troughs between the cursors.

ALL provides a trend or histogram with the time between all pairs of adjacent troughs between the cursors.

AVERAGE provides a trend or histogram with the average time between all pairs of adjacent troughs between the cursors.

References: Local Feature Computations

Description: LTUT locates local peak-trough pairs in the input waveform and determines the local peak-to-peak value and the location of the trough. The time spent by the waveform below a specified threshold is then computed and averaged over all peak-trough pairs.

Definition: Time between falling and rising crossings through the specified threshold in the vicinity of a local trough, averaged over all troughs.

Diagram: Fold-Out Figure 5

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Hysteresis	HYS	0.01 DIV	8 DIV	0.5 DIV
Threshold	THR	0 %	100 %	50 %

The hysteresis argument is used to discriminate peaks from noise in the data. A good value is between half of the expected peak-to-peak value of the signal and twice the expected peak-to-peak value of the noise.

The time under threshold is computed using the threshold value:

value = threshold * LPP / 100 + LMIN

Events/Waveform: FIRST provides a trend or histogram with the time under threshold of the first trough between the cursors.

ALL provides a trend or histogram with the time under threshold of all troughs between the cursors.

AVERAGE provides a trend or histogram with the average time under threshold for all troughs between the cursors.

References: Local Feature Computations

MAX Maximum

Description: MAX measures the highest point in a waveform. Unlike TOP, which assumes that the waveform has two basic levels, MAX makes no such assumptions.

Definition: Highest value in the waveform between the cursors.

Diagram: Fold-Out Figures 1 and 3

Units: Same as vertical unit of source.

Notes: MAX gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform. The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

MAX, when applied to a histogram, should not be confused with the MAXP parameter. For a histogram, MAX computes the horizontal axis location of the rightmost non-zero bin.

MAXP Maximum Population

Description:	MAXP is the highest population (vertical value) in a histogram.
Definition:	Highest population in the histogram between the cursors.
Diagram:	Fold-Out Figure 4
Restrictions:	Histograms only.
Units:	Events
Notes:	This should not be confused with the MAX parameter applied to a histogram. For a histogram, MAX computes the horizontal axis location of the rightmost non-zero bin.

Description: For a time domain waveform, the data is averaged to produce the MEAN. For a histogram, the MEAN is computed as the centroid of the distribution.

Definition: Average of data.

Diagram: Fold-Out Figure 2

Restrictions: Time Domain Waveforms and Histograms only.

Special cases: When the input is a periodic time domain waveform, MEAN is computed on an integral number of periods.

Units: Time Domain Waveforms: same as vertical unit of source. Histograms: same as horizontal unit of source.

Notes: MEAN gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform. The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

MEDI Median

Description: MEDI computes the value which separates the data in a waveform into two equal parts. For a time domain waveform, this is a vertical value below which the waveform spends half of the time. For a histogram, it is a horizontal value to the left of which is half of the total population.

Definition: Median value of data.

Diagram: Fold-Out Figure 2

Restrictions: Time Domain Waveforms and Histograms only.

Special cases: When the input is a periodic time domain waveform, MEDI is computed on an integral number of periods.

Units: Time Domain Waveforms: same as vertical unit of source. Histograms: same as horizontal unit of source.

Notes: MEDI gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform.
The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

References: Amplitude Computations on Waveforms

MIN — Minimum

Description: MIN measures the lowest point in a waveform. Unlike BASE, which assumes that the waveform has two basic levels, MIN makes no such assumptions.

Definition: Lowest value in the waveform between the cursors.

Diagram: Fold-Out Figures 1 and 3

Restrictions: Time Domain Waveforms and Histograms only.

Units: Time Domain Waveforms: same as vertical unit of source. Histograms: same as horizontal unit of source.

Notes: MIN gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform.
The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

MODE — Modal Value

Description: MODE is the most frequently occurring data value. For time domain waveforms, vertical values are collected into 256 bins for the purpose of determining the MODE. For histograms, MODE is the horizontal axis location of the bin containing the maximum population.

Definition: Most common data value.

Diagram: Fold-Out Figure 2

Restrictions: Time Domain Waveforms and Histograms only.

Special cases: When the input is a periodic time domain waveform, MODE is computed on an integral number of periods.

Units: Time Domain Waveforms: same as vertical unit of source. Histograms: same as horizontal unit of source.

Notes: MODE gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform. The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

References: Amplitude Computations on Waveforms

Description: Narrow Band Phase is the angle of the specified frequency component of the input data, measured at the left cursor.

Definition: The angle of the Discrete Fourier Transform computed on the waveform at the specified frequency.

Restrictions: Time Domain Waveforms with vertical axis in volts.

Units: Degrees

Notes: The DFT is computed over an integral number of cycles of the frequency specified by the argument. In most cases, this means that not all of the waveform between the cursors will be used to compute NBPH. If necessary, points are ignored at the right end of the waveform.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Frequency	FRQ	1 Hz	1 GHz	1 KHz

Note that the frequency is entered in KHz. Therefore, if a frequency of 10 Hz is desired, it should be entered as 0.010 KHz.

References: Narrow Band Power Computations

Description: Narrow Band Power is the magnitude of the specified frequency component of the input data.

Definition: The magnitude of the Discrete Fourier Transform computed on the waveform at the specified frequency.

Restrictions: Time Domain Waveforms with vertical axis in volts.

Units: dBV

Notes: The DFT is computed over an integral number of cycles of the frequency specified by the argument. In most cases, this means that not all of the waveform between the cursors will be used to compute NBPW. If necessary, points are ignored at the right end of the waveform.

This differs from TPWR in that NBPW does not allow you to specify the range of frequencies over which the power is computed. However, NBPW is faster because it does not require computing the FFT of the waveform.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Frequency	FRQ	1 Hz	1 GHz	1 KHz

Note that the frequency is entered in KHz. Therefore, if a frequency of 10 Hz is desired, it should be entered as 0.010 KHz.

References: Narrow Band Power Computations

OVSN — Overshoot (Negative)

Description: OVSN is the amount of overshoot following a falling edge specified as a percent of the amplitude.

The amplitude measurement requires the signal to be two-leveled. If a signal does not have two major levels, such as a triangle or sawtooth wave, OVSN may not give predictable results.

Definition: (BASE - MIN) / AMPL * 100

Diagram: Fold-Out Figure 1

Restrictions: Time Domain Waveforms only.

The waveform must contain at least one falling edge.

Units: Percent

References: Amplitude Computations on Waveforms

OVSP Overshoot (Positive)

Description: OVSP is the amount of overshoot following a rising edge specified as a percent of the amplitude.

The amplitude measurement requires the signal to be two-leveled. If a signal does not have two major levels, such as a triangle or sawtooth wave, OVSN may not give predictable results.

Definition: (MAX - TOP) / AMPL * 100

Diagram: Fold-Out Figure 1

Restrictions: Time Domain Waveforms only.

The waveform must contain at least one rising edge.

Units: Percent

References: Amplitude Computations on Waveforms

PCTL Percentile

Description: PCTL computes the horizontal axis value which separates the data in a histogram such that the population on the left is a specified percentage of the total population. When the threshold is set to 50%, PCTL is the same as MEDI.

Definition: Horizontal axis value just to the right of a specified percentage of the total population.

Restrictions: Histograms only.

Units: Same as horizontal unit of source.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Threshold	THR	0 %	99 %	95 %

The percentile is computed using the threshold value:

value = threshold * TOTP / 100

PER — Period

Description: The period of a cyclic signal is measured as the time between every other pair of 50% crossings. Beginning with the first transition after the left cursor, the period is measured for each pair of transitions. These values are averaged to produce the final result.

Definition: Time between odd numbered 50% crossings beginning with the leftmost crossing between the cursors, averaged over all such pairs of crossings.

Diagram: Fold-Out Figure 2

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Events/Waveform: FIRST provides a trend or histogram with the period computed from the first cycle between the cursors.

ALL provides a trend or histogram with period values computed from all cycles between the cursors.

AVERAGE provides a trend or histogram with the average of the period values computed from all cycles between the cursors.

References: Edge Analysis of Waveforms

PKPK Peak-to-Peak

Description: PKPK measures the difference between the highest and lowest points in a waveform. Unlike AMPL, which assumes that the waveform has two basic levels, PKPK makes no such assumptions.

Definition: MAX - MIN

Diagram: Fold-Out Figures 1 and 3

Restrictions: Time Domain Waveforms and Histograms only.

Units: Time Domain Waveforms: same as vertical unit of source.
Histograms: same as horizontal unit of source.

Notes: PKPK gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform. The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

Description:	PKS is the number of peaks found in a histogram.
Definition:	The number of peaks found in the histogram.
Diagram:	Fold-Out Figure 3
Restrictions:	Histograms only.
Units:	Events
References:	Peak Computations on Histograms

Description: PNTS is the number of points in the waveform between the cursors.

Definition: The number of points between the cursors.

Diagram: Fold-Out Figure 2

Units: dimensionless

Description: RISE measures the time between two specified values on the rising edges of a waveform. The RISE times for each rising edge in the waveform are averaged to produce the final result.

The waveform is assumed to have two major levels. For signals in which this is not true, such as triangle or sawtooth waves, RISE may not give predictable results.

Definition: Time at Upper Threshold - Time at Lower Threshold averaged over each rising edge.

Diagram: Fold-Out Figure 1

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Lower Threshold	LOW	1 %	45 %	10 %
Upper Threshold	HIGH	55 %	99 %	90 %

The threshold arguments specify the two vertical values on each edge which are used to compute the rise time. The formulas for the upper and lower values are:

lower value = lower threshold * AMPL / 100 + BASE
upper value = upper threshold * AMPL / 100 + BASE

Events/Waveform: FIRST provides a trend or histogram with the rise time of the first rising edge between the cursors.

ALL provides a trend or histogram with the rise time of all rising edges between the cursors.

AVERAGE provides a trend or histogram with the average of the rise times of all rising edges between the cursors.

References: Edge Analysis of Waveforms

Description:	RMS is the root mean square of the data between the cursors. For a waveform with a mean of zero, this is approximately the same as SDEV.
Definition:	SQRT (sum of squares of data / number of points)
Diagram:	Fold-Out Figure 2
Restrictions:	Time Domain Waveforms and Histograms only.
Special cases:	When the input is a periodic time domain waveform, RMS is computed on an integral number of periods.
Units:	Time Domain Waveforms: same as vertical unit of source. Histograms: same as horizontal unit of source.
Notes:	RMS gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform. The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

Description:	SDEV is the standard deviation of the data between the cursors. For a waveform with a mean of zero, this is approximately the same as RMS.
Definition:	SQRT (sum of squares of (data - mean) / (number of points - 1))
Diagram:	Fold-Out Figure 2
Restrictions:	Time Domain Waveforms and Histograms only.
Special cases:	When the input is a periodic time domain waveform, SDEV is computed on an integral number of periods.
Units:	Time Domain Waveforms: same as vertical unit of source. Histograms: same as horizontal unit of source.
Notes:	SDEV gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform. The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

Time at Falling Transition

Description: TAFL measures the time between the trigger and the first falling edge after the left cursor. It can be used to measure the propagation delay between two signals by triggering on one of the signals and determining the time of the first falling edge of the other.

Definition: Time of first falling 50% crossing.

Diagram: Fold-Out Figure 1

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Events/Waveform: FIRST provides a trend or histogram with the time of the first falling 50% crossing between the cursors.

ALL provides a trend or histogram with the time of each falling 50% crossing between the cursors.

References: Edge Analysis of Waveforms

TARS — Time at Rising Transition

Description: TARS measures the time between the trigger and the first rising edge after the left cursor. It can be used to measure the propagation delay between two signals by triggering on one of the signals and determining the time of the first rising edge of the other.

Definition: Time of first rising 50% crossing.

Diagram: Fold-Out Figure 1

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Events/Waveform: FIRST provides a trend or histogram with the time of the first rising 50% crossing between the cursors.

ALL provides a trend or histogram with the time of each rising 50% crossing between the cursors.

References: Edge Analysis of Waveforms

Time of Acquisition

Description: The DATE and TIME parameters can be used to label a waveform plot to indicate when the waveform was acquired.

Definition: Time of acquisition. If more than one trigger contributed to the waveform, the time is that of the first trigger.

TOP — Higher of Two Most Probable States

Description: TOP measures the upper level in a two-level signal. This differs from the MAX parameter because noise, overshoot, and ringing do not affect the measurement.

If a signal does not have two major levels, such as a triangle or sawtooth wave, TOP returns the same value as MAX.

Definition: Value of most probable upper state.

Diagram: Fold-Out Figures 1 and 3

Restrictions: Time Domain Waveforms and Histograms only.

Units: Time Domain Waveforms: same as vertical unit of source.
Histograms: same as horizontal unit of source.

Notes: TOP gives a similar result when applied to a time domain waveform and when applied to a histogram of DATA of the same waveform. The difference is that, when used with a histogram, the result may include contributions from more than one acquisition.

References: Amplitude Computations on Waveforms

TOTP — Total Population

Description:	TOTP computes the sum of the populations between the cursors in a histogram.
Definition:	Total number of events between the cursors.
Diagram:	Fold-Out Figure 3
Restrictions:	Histograms only.
Units:	Events

TPWR — Total Power

Description: TPWR computes the integral of the power density spectrum between the cursors.

Definition: Integral of the power density spectrum between the cursors.

Restrictions: Only computed for result of FFTPWD when applied to a 50 Ohm coupled input signal. This is indicated by a vertical unit of "dB" in the source.

Notes: This differs from NBPW in that TPWR allows you to specify the range of frequencies over which the power is computed.

Units: Watts

WID — Pulse Width

Description: The width of a cyclic signal is determined by examining 50% crossings in the input data. If the first transition after the left cursor is a rising edge, the waveform is considered to consist of positive pulses. In this case, WID is the time between adjacent rising and falling edges.

Conversly, if the first transition after the left cursor is a falling edge, the waveform is considered to consist of negative pulses. In this case, WID is the time between adjacent falling and rising edges.

In either case, the widths of all pulses in the waveform are averaged to produce the final result.

Definition: Width of the first pulse (either positive or negative), averaged for all similar pulses.

Diagram: Fold-Out Figures 1 and 2

Restrictions: Time Domain Waveforms only.

Units: Same as horizontal unit of source. Usually, this is seconds, but for Trends it may also be events.

Note: The FWHM parameter is similar to WID, except that it applies to histograms.

Events/Waveform: FIRST provides a trend or histogram with the width of the first pulse, either positive or negative between the cursors.

ALL provides a trend or histogram with the width of all pulses between the cursors having the same polarity as the first pulse.

AVERAGE provides a trend or histogram with the average of the width of all pulses between the cursors having the same polarity as the first pulse.

References: Edge Analysis of Waveforms

XAMN Horizontal Location of Minimum

Description: XAMN determines the horizontal axis location of the minimum value between the cursors.

Definition: Horizontal location of lowest value between cursors.

Diagram: Fold-Out Figure 1

Restrictions: Time and Frequency Domain Waveforms only.

Units: Same as horizontal unit of source.

XAMX Horizontal Location of Maximum

Description: XAMX determines the horizontal axis location of the maximum value between the cursors.

Definition: Horizontal location of highest value between cursors.

Diagram: Fold-Out Figure 1

Restrictions: Time and Frequency Domain Waveforms only.

Units: Same as horizontal unit of source.

Description: XAPK is the horizontal location of specified peak in a histogram.

Definition: Centroid of specified peak.

Diagram: Fold-Out Figure 3

Restrictions: Histograms only.

Units: Same as horizontal unit of source.

Notes: The parameter MEAN can also be used to compute the centroid of a peak. In this case, the cursors are used to enclose the peak to be examined.

Arguments:

Name	Remote	Lower Limit	Upper Limit	Default
Peak Number	PEAK	1	100	1

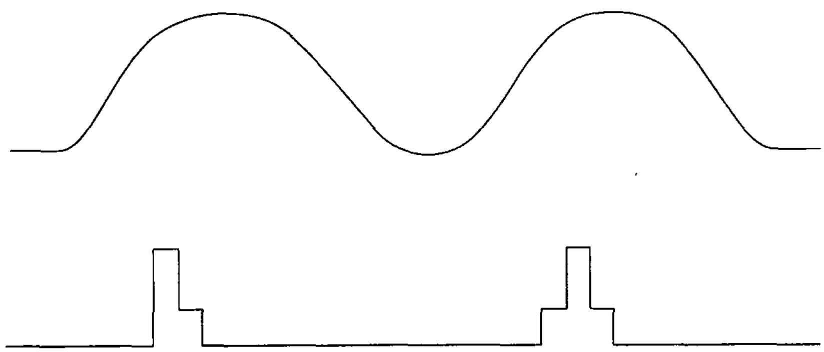
Peaks are sorted by decreasing area. The peak number argument is used to specify which peak location is desired. The default value of 1 causes the location of the largest peak to be computed.

References: Peak Computations on Histograms

Amplitude Computations on Waveforms

Several parameters computed by the 7200 result from a statistical analysis of the vertical component of time domain waveforms. These are: AMPL, BASE, MEDI, MODE, OVSN, OVSP, and TOP.

The analysis begins by computing a histogram of the waveform data. In the figure below, the upper waveform contains the data to be analyzed, and the lower waveform is the histogram of its data.



Since the upper waveform spends most of the time in one of two states, the histogram contains two peaks. Points on the edges in the upper waveform are few, and contribute to a small background level between the peaks in the histogram.

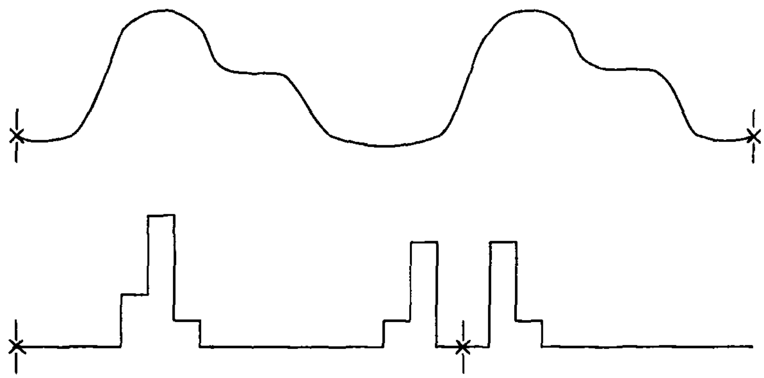
The histogram is searched to locate the two peaks. The section starting on page 61 in this manual discusses the procedures used to locate peaks in a histogram.

When searching for the lower peak, only the left half of the histogram is examined, and peaks on the left are favored. Conversely, when searching for the upper peak, only the right half is examined, and peaks on the right are favored.

After the peaks are located, the centroids are computed. The centroid of the left peak is the BASE value, and the centroid of the right peak is the TOP value.

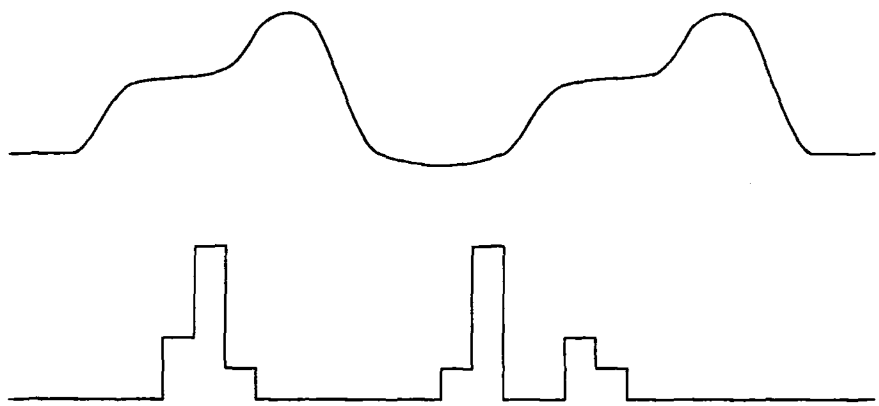
MEDI is computed by locating the horizontal axis value in the histogram which divides the population into two equal parts. MODE is the horizontal location of the bin in the histogram with the largest population.

Let us examine what happens when the input waveform is not two-valued. For example, there might be three common voltage levels as in the following figure.

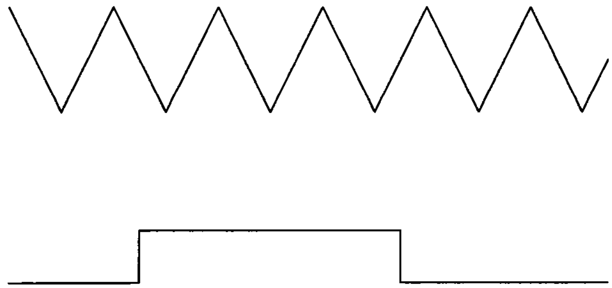


In this case, the TOP value is determined by the rightmost peak, since it's size is approximately the same as the middle peak, and peaks on the right are favored.

In the next example, the waveform also has three common voltage values. But now, the middle peak is larger than the right peak. Therefore, the TOP value is computed from the middle peak.



Now consider a triangle waveform, as shown in the following figure.



Since there are no peaks in the histogram of the data, BASE and TOP cannot be determined. In this case, BASE and TOP are approximated by the minimum and maximum values, respectively. As a result, AMPL is given the same value as PKPK.

In the above discussion, the parameters were computed on a time domain waveform. These parameters can also be computed on histograms. All of the procedures described above are still applied, except for the first step, which creates a histogram from the waveform.

You can set up a trace equation to compute the histogram of the data of a waveform. For example, set

T1 = A1

T2 = HIST(T1) with parameter = DATA

In this case, AMPL, BASE, MEDI, MODE, and TOP will give similar results on T1 and T2. There may be differences for several reasons.

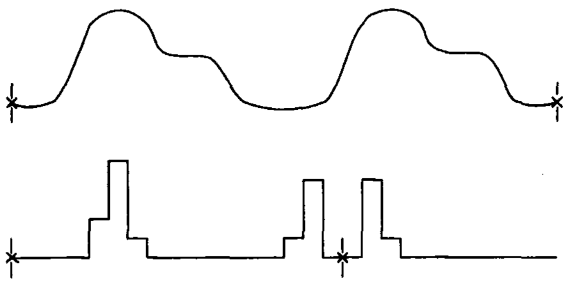
First, the HIST function allows you to select scaling factors and the number of bins. These choices affect the resolution used to store the source waveform's data in the histogram. When the parameter is computed on a time domain waveform, these choices are fixed; 256 bins are used. Usually, differences in binning will result in only minor differences in the parameter values.

Second, the amount of data used in computing the parameters may be different. When computed on a time domain waveform, the number of data values is determined by the positions of the cursors.

When computed on a histogram, several factors determine the number of points used. In our example, the cursors for T1 select the points in the source waveform which are entered into the histogram in T2. The "Max Events" parameter in the HIST function determines the number of points which are kept. If this is large, many sweeps of T1 will contribute to T2. If it is small, only data from the most recent sweep will contribute.

Differences due to source data selection may be quite large. Histograms collecting data over many sweeps perform a kind of averaging. If the source waveform is stable, the parameter from the histogram tends to be more accurate than the parameter from the source waveform. If the source waveform is not reasonably stable, the effects may be unpredictable because multiple peaks may develop which don't represent multiple levels in any single waveform.

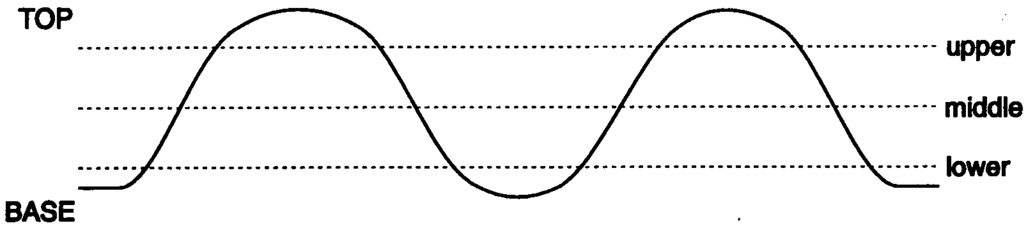
Finally, the parameter cursors for T2 determine the data in the histogram over which the parameter is computed. This technique can be used to examine a limited range of voltages. In a previous example, if the cursors were placed as shown below, the rightmost peak would be eliminated from the computation. This would force TOP to be the centroid of the middle peak, rather than the right one.



Edge Analysis of Waveforms

The following parameters involve an analysis of the edges of the waveform: CYCL, DLY, DUTY, FALL, FREQ, PER, RISE, TAFL, TARS, and WID. An edge is a transition between the lower state and upper states of a waveform. This assumes that the waveform has two basic states, as described on page 55 in this manual. If this is not the case, the minimum and maximum values are substituted for the BASE and TOP.

Consider the following input waveform:



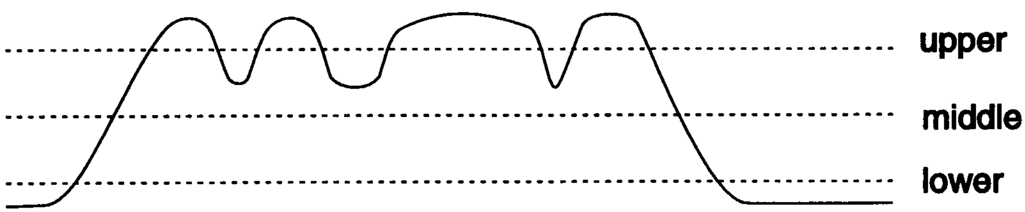
The three thresholds indicated above (upper, middle, and lower) are computed from the values of BASE and TOP:

upper = HIGH * TOP + (1 - HIGH) * BASE
middle = 1/2 * TOP + 1/2 * BASE
lower = LOW * TOP + (1 - LOW) * BASE

The HIGH and LOW values are specified explicitly for the FALL and RISE parameters through their arguments. For the other parameters, HIGH is 90%, and LOW is 10%.

The waveform is examined for crossings through these thresholds. For a waveform which starts in its lower state, the expected sequence is: lower, middle, upper, upper, middle, lower, lower, middle, upper, etc. For a waveform starting in its upper state, the expected sequence is the same, except it begins with the upper crossing rather than the lower crossing.

It is possible to find several crossings in a row through the same threshold. In the case of the lower and upper thresholds, only the first and last are kept. This assumes that the first crossing indicates movement of the signal from the center values toward the extreme, and that the last indicates movement back towards the center, as illustrated below:



If several middle crossings in a row are found, only the first is kept. For all crossing types, the actual time at the crossing is determined using linear interpolation of the two samples which lie on either side of the threshold.

After the threshold crossings are located, each edge is described by three crossings. Rising edges consist of lower, middle, and upper crossings. Falling edges consist of upper, middle, and lower crossings.

The FALL and RISE parameters are computed using the lower and upper crossing times of their respective edges. All of the other parameters use only the middle crossing times.

Peak Computations on Histograms

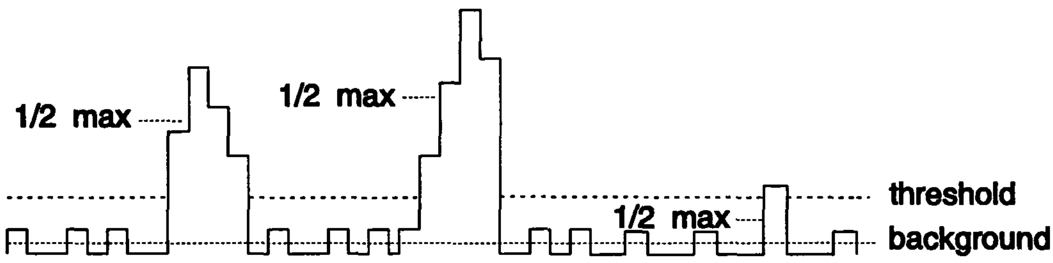
Two parameters are provided by the 7200 Precision Digital Oscilloscope to report information about peaks in histograms: PKS and XAPK. In addition, the AMPL, BASE, and TOP parameters work by finding peaks in histograms. This section discusses the procedures used to find peaks.

A peak is considered to be a group of bins in the histogram, each bin having a population significantly greater than the background. The background is assumed to be uniformly distributed.

The first step is to determine the level of the background. This is done in two steps. First, the background is estimated to be the average population in the histogram. Second, the average and standard deviation are computed on all bins having population below or near the initially estimated background. The average is then taken to be the actual background level.

A threshold is set which is equal to the background plus 3 standard deviations. This is used to discriminate peak values from values in the background. With this threshold value, there is only a 3% chance that a bin will be mistakenly considered part of a peak when it is really part of the background.

The histogram is now scanned for groups of bins having populations above the threshold. The following figure illustrates the process. Three groups of bins are found which have values above the threshold.



For each group, the maximum value and the 1/2 maximum value above the background is determined. If the 1/2 maximum value is below the threshold, the group is discarded. In the example above, the rightmost group is not used.

Peaks must be separated by at least 2% of the distance between the leftmost and rightmost non-empty bins in the histogram. If the separation between a group of bins and the peak to its left is the less than this, the group is rejected.

If two group of bins are very close together, they may be considered a single group. This is done when the groups are so close that they are displayed on the screen without any space between them. Therefore, if they look like a single group on the display, they are combined.

Once a peak is identified, its centroid and area are computed. First, the width of the group is adjusted to enclose bins having population at least equal to the 1/2 maximum value above the background. Next, these bins are examined to compute the centroid and total area. Finally, the background area is subtracted from the peak area.

As a final step, the peaks are sorted by decreasing area. XAPK returns the centroid of the peak indicated by its argument. Peak 1 is the largest peak. The total number of peaks found is returned by the PKS parameter.

Narrow Band Power Computations

The narrow band parameters, NBPH and NBPW, are determined by computing a Discrete Fourier Transform (DFT) on the data in the waveform beginning at the left cursor. The DFT produces a complex result from which the phase (angle) and power (magnitude) are computed.

$$REAL = \sum_{i=0}^{N} [DATA(i) * \sin(i*DR)]$$

$$IMAG = \sum_{i=0}^{N} [DATA(i) * \cos(i*DR)]$$

In the above formulas:

DATA(i) is the i-th waveform data sample. The sample at the left cursor is numbered zero.

DR is the spacing between samples in the waveform, expressed in radians. It depends on both the time between samples *(DT)* and the frequency specified for the narrow band parameter *(FREQ):*

$$DR = 2 * \Pi * FREQ * DT$$

N is the number of points to be used in the computation. It is chosen to make the duration of the waveform data used *(N * DT)* correspond to an integral number of cycles of the frequency specified. N is never greater than the number of points between the cursors, nor less than half the number of points between the cursors.

Note that since *N* may be less than the number of points between the cursors, some points may be ignored during the calculation. If this is the case, the ignored points are on the right end of the waveform.

For NBPH, the angle is computed from the values of *REAL* and *IMAG* given above. A value of 0 degrees corresponds to a sine wave which crosses upward through zero at the left cursor.

For NBPW, the power is computed from the magnitude of the complex value

$$POWER = \sqrt{(REAL^2 + IMAG^2)}$$

Before taking the base 10 log to produce dB, the power is divided by the power which would be obtained from a 1 VRMS signal. Thus, the result has units of dBV, which is zero for a 1 VRMS signal.

The frequency resolution of the DFT is given by the formula:

$$RESOLUTION = 1/(N * DT)$$

Note that this will vary somewhat with the specified frequency, since the frequency determines the value of *N* through the requirement of an integer number of cycles. However, if the distance between the cursors contains many cycles of the frequency, *N* will remain approximately constant.

Local Feature Computations

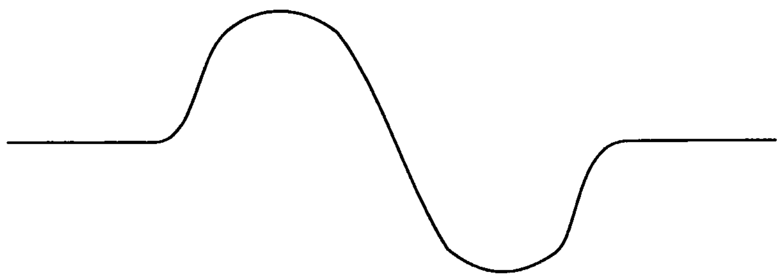
The local feature parameters supported by the 7200 Precision Digital Oscilloscope are: LMAX, LMIN, LNUM, LPP, LTBP, LTBT, LTMN, LTMX, LTOT, and LTUT. These parameters were designed to support the media testing and communications industries but have proved to be useful in other fields as well.

The term "local" indicates that a parameter computed on a waveform feature is determined only by information in the immediate vicinity of the feature.

This is in contrast with most other parameters which are affected by values throughout the waveform. For example, the MAX parameter is the value of the highest point in the waveform. Consider also the WID parameter, which measures the time between crossings of the 50% point of the waveform. The 50% point is determined from the BASE and TOP values, which are computed using all of the data in the waveform.

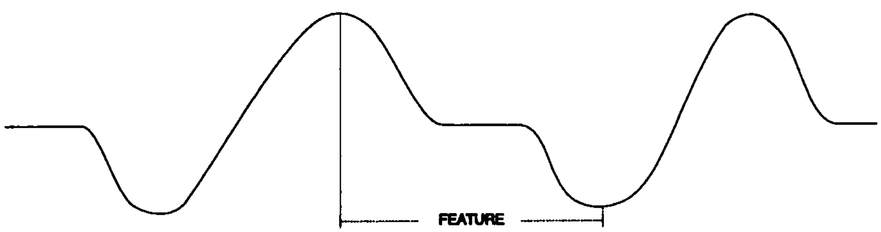
The local parameter which corresponds most closely to the WID parameter is LTOT (local time over threshold). In this case, the threshold is set by examining only the data in the vicinity of the pulse whose width is being measured.

A "feature" is a peak followed by a trough, as illustrated in the following figure.

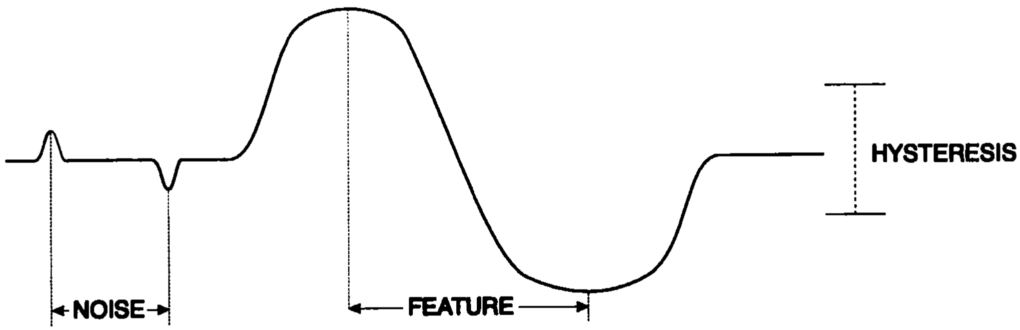


It is not necessary that the feature be surrounded by a baseline signal as shown. However, this illustrates the fact that there is no assumption made that the waveform has two basic levels, as is true for the BASE, TOP, and AMPL parameters.

Note that a feature is NOT a trough followed by a peak. In the following example, there is ONE feature. It consists of the first peak and the trough which follows it.



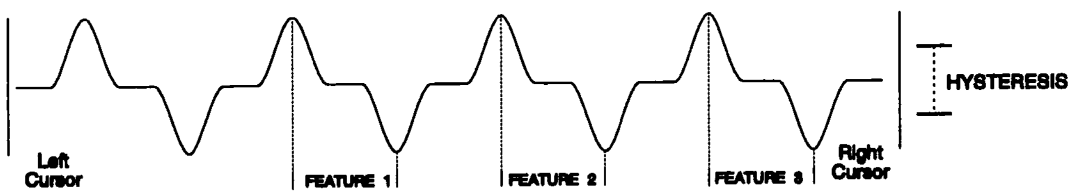
Noise in the input signal may generate shapes in the waveform which look like features:



The hysteresis argument is provided to prevent noise from being mistaken for features. It specifies the minimum peak-to-trough value which will be recognized as a feature. A good choice for the hysteresis value is between half of the expected peak-to-trough value of the signal and twice the expected peak-to-trough value of the noise.

The first step in determining the value of one of the local feature parameters is locating the features.

The search for features begins at the left cursor and proceeds toward the right. Before the first peak is accepted, the waveform must change by an amount at least equal to the hysteresis value. This means that the first peak after the left cursor might be missed.

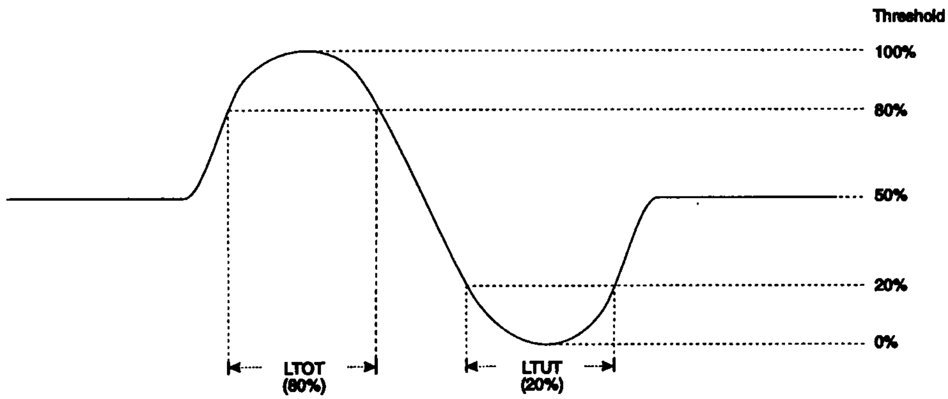


In the above example, if the hysteresis is greater than half of the peak-to- trough value, the first peak will be missed because the waveform at the left cursor is half way between the peak and trough values. Not until the waveform goes from the first peak and then into the first trough does it change by more than the hysteresis value. At that time it is ready to begin accepting features.

Once the features are located, the parameter values are computed. LNUM returns the number of features which were found. This parameter can help you determine if the hysteresis and the location of the left cursor are appropriate. By increasing the hysteresis until LNUM decreases to an appropriate value, you can be sure that noise is not being misinterpreted as features. Moving the left cursor toward the right will decrease LNUM by 1 when the first peak begins to be rejected.

The LMAX, LMIN, and LPP parameters use the vertical axis values at the peak and trough. These values are determined using quadratic interpolation of the three waveform values which are closest to the extreme. This same interpolation is also used to determine the horizontal axis value at the peak and trough for the LTBP, LTBT, LTPT, LTTP, LTMN, and LTMX parameters. LTOT and LTUT use linear interpolation to determine the time the waveform crosses the threshold value. LTOT is the time between the rising and falling crossings through the threshold. LTUT is the time between the falling and rising crossings through the threshold.

The threshold argument of LTOT and LTUT is based on the peak-to-trough (LPP) and trough minimum (LMIN) values for the current feature, as illustrated below.



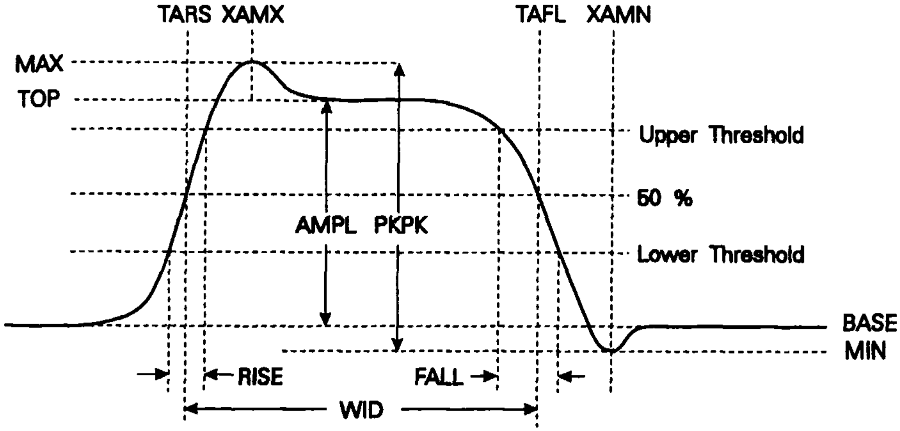


Figure 5.1.

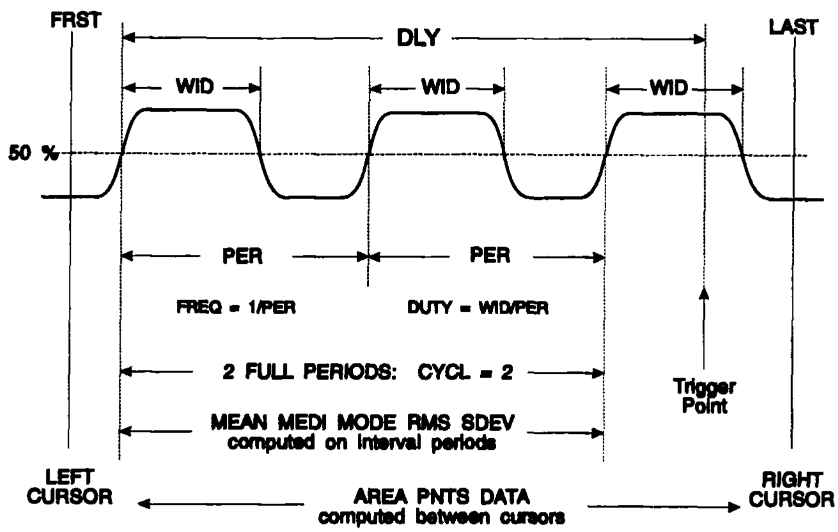


Figure 5.2.

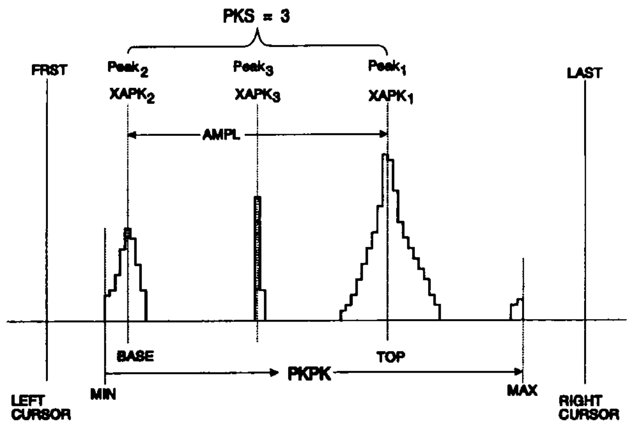


Figure 5.3.

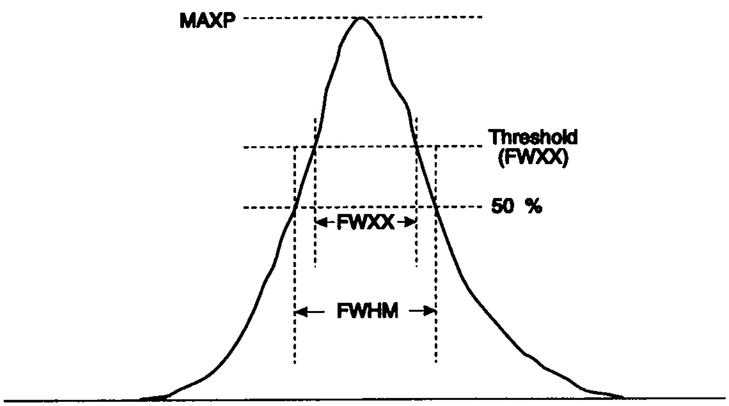


Figure 5.4

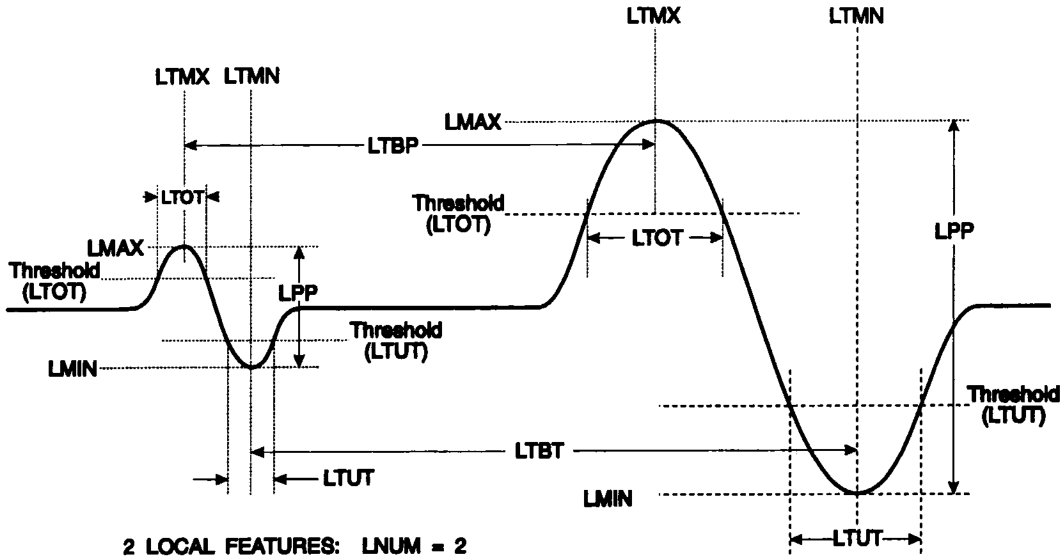
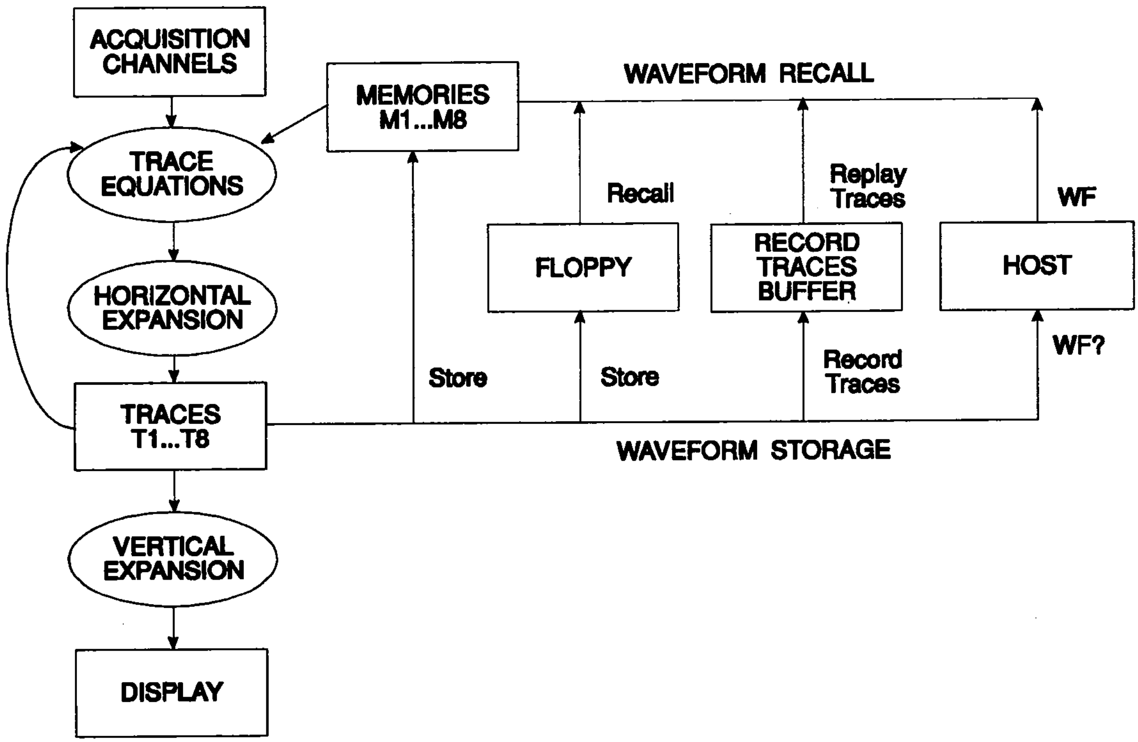

LTMX
LTMN
LTMX LTMN
LMAX
LTBP
LTOT
Threshold
(LTOT)
LTOT
LPP
LMAX
Threshold
(LTOT)
LPP
Threshold
(LTUT)
LMIN
Threshold
(LTUT)
LTBT
LTUT
LMIN
LTUT
2 LOCAL FEATURES: LNUM = 2

Figure 5.5

Appendix A

Summary of Waveform Processing, Display, and Storage



Waveforms produced and displayed by the 7200A are called traces. The 7200A has 8 traces, designated T1...T8. Each trace is defined by a mathematical equation called the trace equation which specifies the source(s) of data and the processing, if any, performed on the data. Each trace can be defined to be unprocessed data from any acquisition channel (A1, A2, B1, B2, ...) or internal waveform memory (M1...M8). Alternatively, any trace can be defined to be the result of processing channel data, waveforms stored in memories, and/or other traces.

Processing which may be specified in the trace equation includes addition, subtraction, multiplication, division, differentiation, integration, smoothing, averaging, extrema, FFT, square, square-root, histogramming, trending, log, etc.

The 7200A displays traces (T1...T8). Data acquired by a plug-in channel (A1, A2, B1, B2, ...) or a waveform stored in memory (M1...M8) can be displayed as a trace by changing the trace equation to specify the channel or memory as the source.

For example, to display the acquisitions of channel A2 as trace 1, change the trace equation for trace 1 to be T1 = A2. To display the waveform stored in memory M3 as trace 7, change the trace equation for trace 7 to be T7 = M3. By default, each trace is defined to have an acquisition channel as its single source with no processing.

In addition to the waveform processing specified in the trace equation, each of the 8 traces can be expanded and repositioned both vertically and horizontally. Vertical expansion and position magnify and move the trace vertically on the display screen to facilitate viewing magnitude variations and overlaying traces for comparision. The vertical controls do not affect the actual data values comprising the trace waveform.

Horizontal expansion and position magnify and move the trace horizontally to facilitate viewing horizontal variations and to select the portion of interest of the trace. Unlike the vertical controls, the horizontal controls actually change which data points are included in the trace waveform. Horizontally expanding a trace reduces the number of data points comprising the trace, and horizontally repositioning a trace changes the set of data points included in the trace.

When a trace has been horizontally expanded and repositioned, it consists of only those data points which are displayed on the screen. When a trace is used as a source for subsequent trace equations or is stored to disk or remote host, only those data points displayed on the screen as selected by the horizontal expansion and position controls are used.

For example, if the trace equation for trace 2 is T2 = T1, horizontally expanding trace 1 will cause trace 2 to change (because its source waveform has changed). Vertically expanding trace 1, however, changes only the way it is displayed and will not affect trace 2. Horizontally or vertically expanding trace 2 will not affect trace 1.

The 7200A has several options for storing traces. When a trace is stored, only those data points selected by horizontal expansion and position are included.

A trace waveform can be stored to one of the 8 internal non-volatile waveform memories M1...M8. The waveform stored in the memory can later be displayed and/or processed by selecting the memory as a source in a trace equation.

A trace can also be stored on an MS-DOS formatted 3.5" floppy diskette. The waveform can later be recalled from the diskette and loaded into one of the 8 internal waveform memories

M1...M8. The waveform can then be displayed and/or processed by selecting the memory as a source in a trace equation. (The Waveform Recall Setup may be configured to automatically change a trace equation to display the waveform recalled into internal memory. For example, if this option is chosen and a waveform is recalled into memory M4, the 7200A will automatically change the trace equation defining trace 4 to be T4 = M4 and turn on trace 4, so that the recalled waveform will be displayed as trace 4.)

When Record Traces is enabled, all displayed traces are automatically recorded in an internal non-volatile circular buffer each time they are updated with new data. Using Replay Traces, the recorded trace waveforms may later be retrieved from the buffer and loaded into the internal waveform memories M1...M8. The waveforms can then be displayed and/or processed by selecting the memories as sources in trace equations. When Replay Traces is enabled, the 7200A automatically stops acquiring data and switches from the acquisition set of trace equations to the replay set of trace equations, which are by default T1 = M1, T2 = M2, ... T8 = M8. Thus, by default, the replayed waveforms will be displayed in the same traces they originally were recorded from. If desired, the replay trace equations may be modified to perform processing on the replayed waveforms in the memories. Any processing which can be specified in the acquisition trace equations can also be specified in the replay trace equations. For example, the replay trace equations may be configured to average together all replayed waveforms. The only restriction is that acquisition channels cannot be used as sources in replay trace equations.

Over GPIB or RS-232-C, a trace can be transferred from the 7200A to a remote host. The waveform can later be transferred back into the 7200A and loaded into one of the 8 internal waveform memories, M1. . . M8. The waveform can then be displayed and/or processed by selecting the memory as a source in a trace equation.

This page is intentionally blank

Appendix B

Rackmount Installation

Option # 7200-RKMT converts the standard benchtop 7200A mainframe to a rackmount version. (See Appendix C: Accessories, for ordering information.) The 7200A mounts with its slide in a 19" standard EIA rack size with standard 10 1/2" panel height and a 24" standard depth. The customer must provide a rear bracket when mounting the 7200A in a rack greater than 24" deep.

> **CAUTION:** *Do not fasten the 7200A to a rack using only its front panel screws. The oscilloscope's weight must rest on supports.*

Installation Procedure

1. Install mounting brackets to cabinet members on slides as shown in Figure 1. After inserting the screws through the front mounting brackets, slide the brackets back as far as possible before tightening. Leave the rear brackets a bit loose for later adjustment.

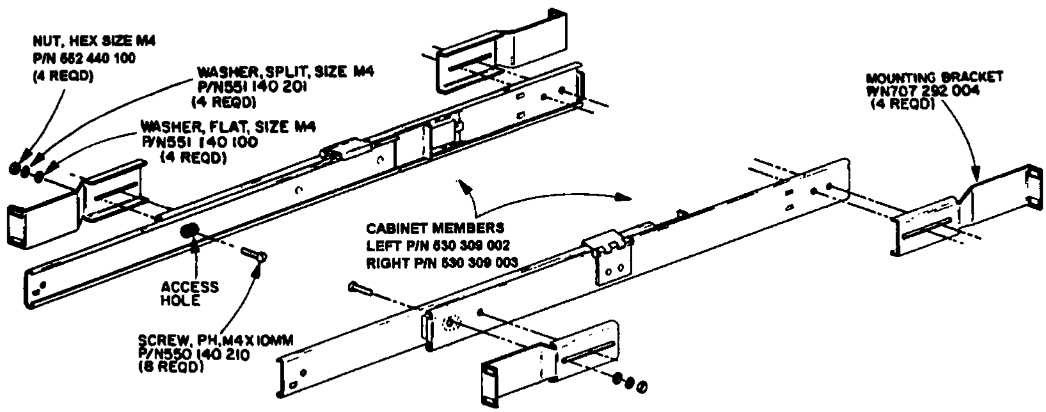


Figure 1: Cabinet Member Assembly

2. Use left ear (P/N 707292002) and right ear (P/N 707292001) as templates. Place each ear against the rack using its center holes to determine height for mounting the cabinet member assembly. First secure the front mounting bracket of the cabinet member assembly to the rack. Then slide the rear mounting bracket to fit the rack as shown in Figure 2. Tighten the loose hardware for the rear bracket to cabinet member of slide. Leave all mounting hardware for brackets to rack a little loose for aligning the 7200A in the rack.

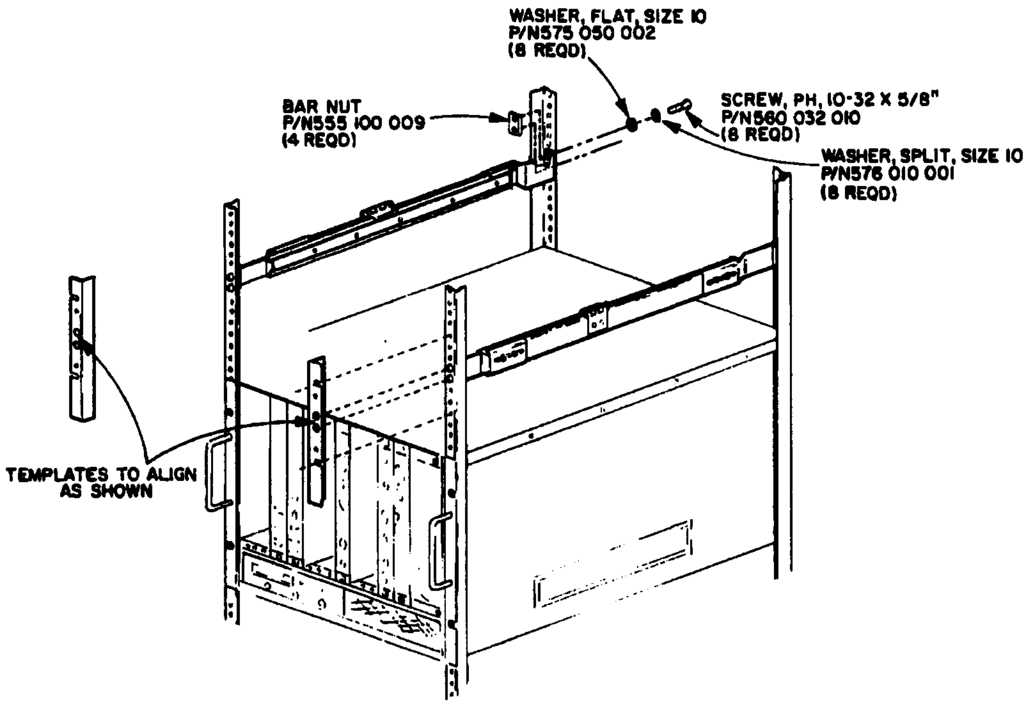


Figure 2: Rack Assembly

3. Remove the carrying handle from the 7200A right side panel as follows: first remove the top and bottom covers. Next remove the right side panel only. Loosen four nuts from inside the right panel and pull out the handle. Reassemble right side panel, top cover, and bottom cover.

4. Install drawer members of the slides to both side panels as shown in Figure 3. Also mount filler plate, handle, left ear and right ear.

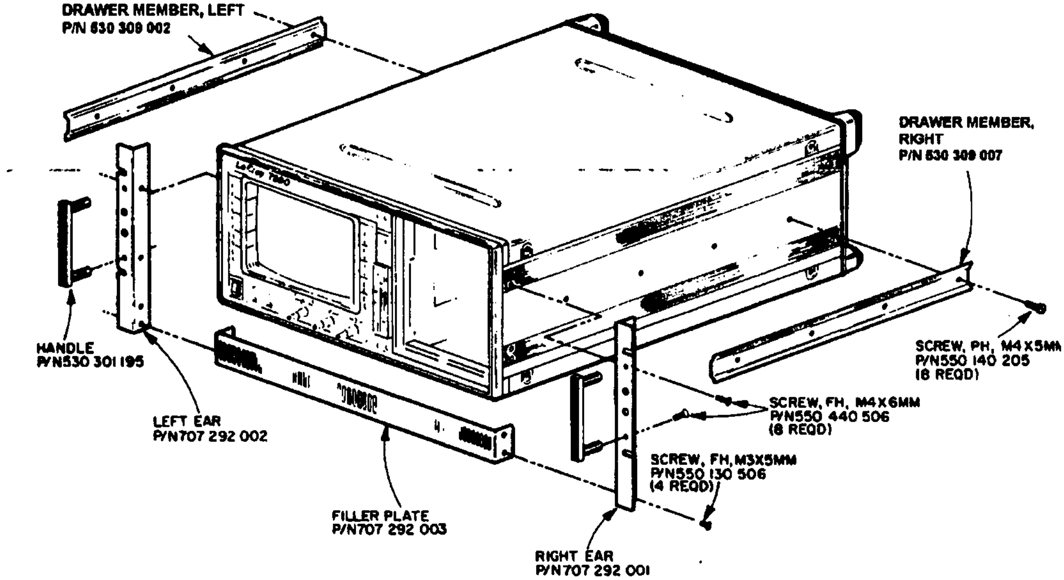


Figure 3: 7200 Preassembly

5. Pull inside member of slide all the way out to lockout position. Lift the 7200A and insert the drawer member into the inside member. Then slide the 7200A in until it locks into position. (see Figure 4). Elevate the lever upward to slide the 7200A all the way in. Pull the unit out once and slide it back in for proper alignment. Then tighten all the loose hardware for mounting brackets to rack. Secure the 7200A in rack using four mounting screws and Tinnerman clips as shown.

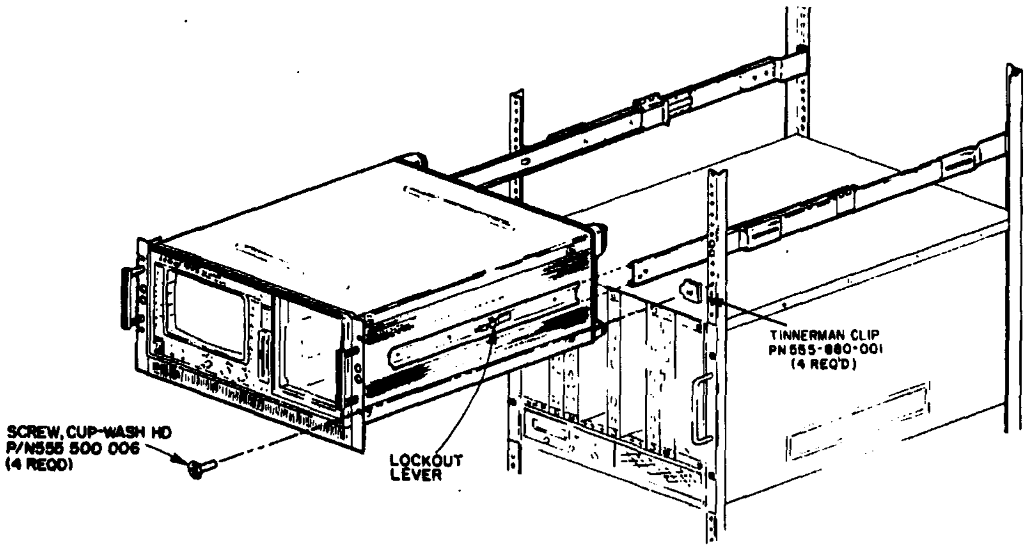


Figure 4: Final Assembly

To dismount the unit from rack, remove the four screws from front that holds the unit in. Then pull out the unit by handles and actuate the lockout lever to disengage the unit from the rack.

Appendix C

Accessories

Please reference the following part numbers when ordering LeCroy 7200 Series components and accessories. In the USA, call your local LeCroy Sales Office at **1-800-5-LECROY**.

Also, the "General Information" section of this manual contains the PHONE and FAX numbers of the LeCroy regional field service office nearest you.

7200A	DSO Mainframe, Color Display ■ Warranty with software updates ■ Operator's and Programmer's Manuals ■ Getting Started Guide
7234	Four-Channel Digitizing Plug-in with ■ (4) 7200-P12 10:1 probes ■ Operator's and Programmer's Manuals
7242 Series	Dual-Channel Digitizing Plug-in with ■ Warranty with software updates ■ (2) 7200-P10 probes ■ Operator's and Programmer's Plug-in section

7200-P12 Kit	10:1 Oscilloscope Probe (2)
7200-P21	500 Ohm Oscilloscope Probe
7291	2 GS/sec Adapter for 7242 Series Plug-ins
7210A	Removable Hard Disk Drive
7200-RKMT	Rackmount Kit
DP9001	Digital Plotter, 8-pen A4 size
7200-SHIP	Rugged shipping case
7200-SOFT	Soft carry case
7200-OM	Operator's manual
7200-PM	Remote Programmer's Manual
7200-SUP	1 year additional Software Update
DC/GPIB-2	2 meter GPIB cable

Extended Warranty: 1 year extended warranty available

This page is intentionally blank

7291 2GS/sec Adaptor

The LeCroy 7291 is a low cost adaptor that doubles the maximum single shot digitizing rate of a 7242 plug-in. It implements 2GS/s sampling by "interleaving" two 1GS/s digitizing channels. The Model 7291 adaptor may be used with new or previously purchased 7200/7242 systems which are running software version 1.2.0 or greater.

Two channel digitizing at 2GS/s requires two adaptors, one for each of two 7242 plug-ins. Only LeCroy's 7200 Series oscilloscopes offer 2-channel transient capture at a maximum digitizing rate of 2GS/s. For applications requiring the capture of ultra-fast single-shot signals, the Model 7200 mainframe, the 7242 plug-ins, and 7291 adaptors ensure the capture of glitches and waveforms details with samples spaced 500 ps apart. In the 2GS/s mode, the input sensitivity of 10mV/div to 1V/div in a 1,2,5 sequence.

Features

- Automatic recognition of the LeCroy 7291 2GS/s adaptor.
- Single-channel 8-bit 2GS/s single-shot recording.
- 50 Ohm (DC) input coupling.
- DC to 500 MHz (-3dB) analog bandwidth.
- 1,000,000 sample digitizing memory.
- Automatically synchronized timebase and trigger with other 7200 Series plug-ins.
- Real-time digital filtering allows you to trade bandwidth for resolution, increasing it from 8 bits to 11 bits, For repetitive signals, resolution can be further enhanced with signal averaging.
- Standard triggering features plus SMART TRIGGER for easy triggering in tough applications, including: TV, pulse width, interval, logic, and others.
- Continuously adjustable controls for timebase, trigger level, offset etc. with push button controls for zeroing, trigger source selection, coupling, and slope.
- Rapid sequence mode acquisitions (>20k segments/s), with timestamp accurate to a single sample interval.
- Fully programmable from remote control.

Calibration

The calibration procedure is required to match the 7291 to a particular 7242 delay. Delay is adjusted using the switches mounted on the side panel of the 7291. The delay can be adjusted from 50ps to 750ps with a resolution of 50ps. The switch values are: SWO-50ps, SW1=100ps, SW2=200ps, and SW3=400ps. See Figure 7291.1.

To calibrate the 7291:

1. Turn on the 7200 and allow the system to warm up for ten minutes.
2. Install the 7291 to the front panel of the 7242 plug-in.

3. Attach the SMA end of the supplied coax cable to the TRIG OUT connector on the right rear panel of the 7200. Attach the BNC end to the input of the 7291.

4. Connect a P10 probe between the PROBE CALIBRATOR connector on the 7200 front panel and the EXT TRIG input on the 7242. An external signal of 0.5 V peak to peak at more than 1 kHz is also satisfactory.

If no signal is attached to the external trigger, LINE trigger is used to perform the calibration. this takes approximately one minute.

Pressing CALIBRATE DELAY during calibration will abort the calibration.

5. Press the DISPLAY (22) key calibration will abort the calibration.
6. Press the MODIFY key, then press softkey (1) Calibrate.

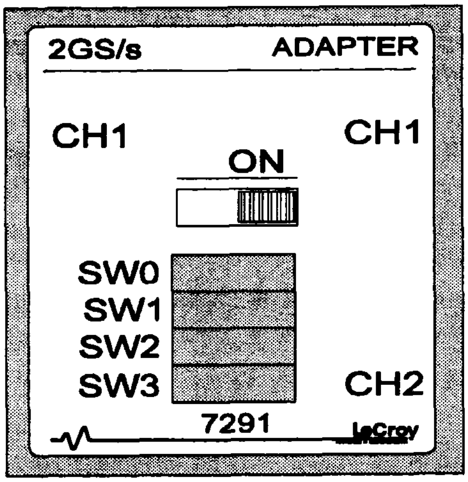


Figure 7291.1. Calibration switches on the 7291

7. The calibration procedure for the 7291 will be displayed on the screen. see figure 7291.2

   If, after following steps 1 through 6 the calibration procedure does not appear on the screen, check to make sure the 7291 is fully seated on the 7242, the connectors are rotated fully clockwise, and you have a software revision 1.2.0 or greater (call LeCroy for an update).

8. Adjust the switches on the 7291 side panel to match the screen (off position).
9. Press the softkey labeled CALIBRATE DELAY on the front panel of the 7200. The calibration procedure will take approximately 5 seconds.
10. A Delay value and a diagram of the switch positions will be displayed.
11. Use the diagram of the switch positions to set the switches of the 7291. refer to Figure 7291.1 for location of the switches on the 7291.

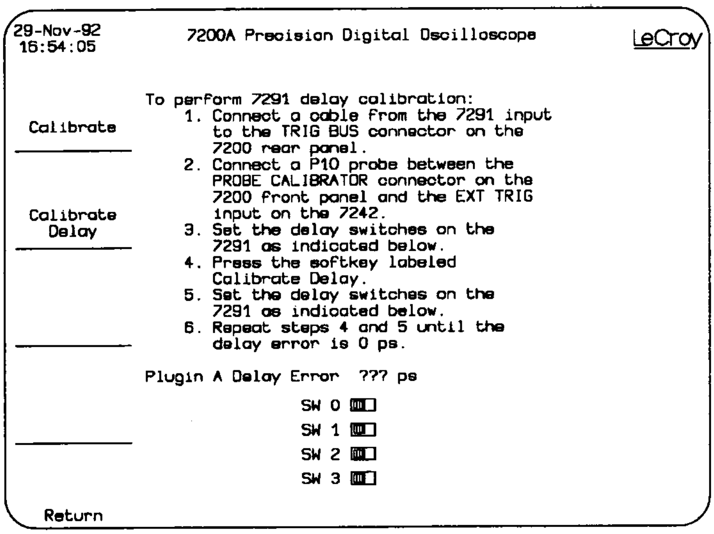


Figure 7291.2 7291 Calibration Screen

To Remove the 7291 2GS/s adaptor:

It is advisable to save a panel setting before removing the 7291.

1. Removing the adaptor by rotating the BNC connectors counterclockwise and gently pulling it off.
2. Check panel settings.

Operation

This section describes the 7291 adaptor front panel controls. When the 7291 adaptor is on the 7242, all 7242 controls are active with the following exceptions:

1. RIS is disabled
2. Channel 2's trigger source and channel selection from front panel and remote are disabled.
3. Vertical coupling allows only DC 50Ω and GND.
4. Vertical VAR knob is disabled.
5. 7291 will not select attenuation coded probes.
6. External clock selection is disabled.

In addition the following controls have been modified:

1. Single Shot Resolution is 8 bits to 400 MHz, 11 to 16 MHz, selectable in 0.5 bit steps.
2. The range of the fixed gain (Volts/div) is 10mV to 1V/div in a 1, 2, 5 sequence.
3. The TIMEBASE ranges from 2nsec/div to 2µsec/div in a 1, 2, 5 sequence.
4. Smart Trigger on all trigger Sources except CH2 (for multi-source modes only CH1 and External are available).
5. The maximum number of segments is 100.

All other controls operate as described in Section 4, 7242 Plug-in Module, of the LeCroy 7200 Modular Oscilloscope System Operator's Manual.

How to Use This Manual

The purpose of this manual is to provide the 7200A-RCLK (Reference Clock) user with the technical information needed to perform Reference Clock calibration.

Installation and setup information is provided only for qualified service personnel. Reference Clock calibration is easily accomplished by following the procedure outlined in this manual.

Product Description

The 7200ARCLK is a mainframe option board which generates a high accuracy 10MHz system reference clock and provides rear panel I/O for the mainframe System clock and Plug-in Sample clocks. The 7200A system indicates that this option has been installed by indicating "**Clock Accuracy HIGH**" in the ACQUISITION SETUP menu (**STD** is the normal indication). Selection of either internal or external REFERENCE CLOCK is also enabled through the mainframe ACQUISITION SETUP menu. This setup menu is shown in figure E-1.

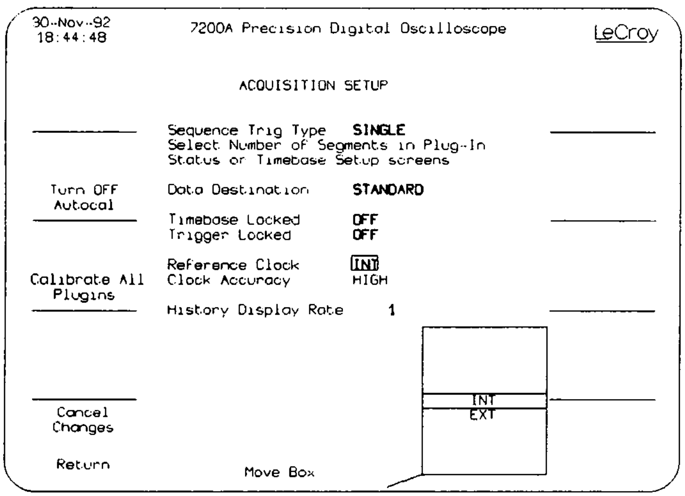


Figure E-1

Selection of either internal or external SAMPLE CLOCK is enabled through the specific Plug-in DISPLAY SETUP menu. Shown in figure E-2 is the DISPLAY SETUP menu for plug-in A. Selection and use of these setup menus is described in the "LeCroy 7200 Series Modular Oscilloscope Operators Manual".

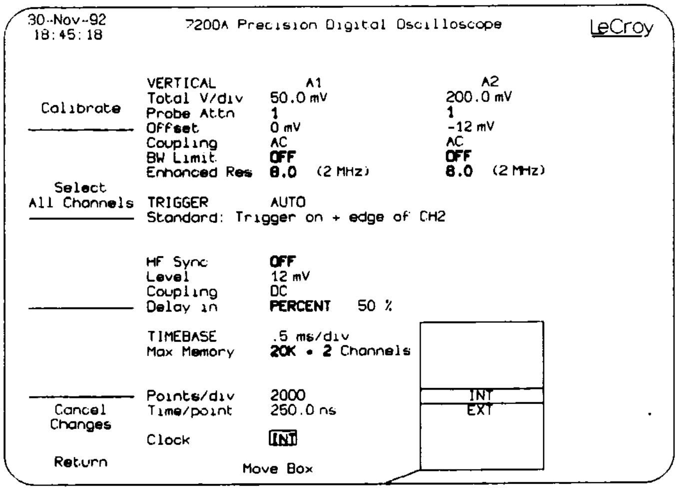


Figure E-2

Specifications:

Frequency: 10 MHz

Stability: ±1.0 ppm (+15 to +25 °C) *

±2.5 ppm (+4 to +40 °C) *

Rear Panel I/O :4 SMA type connectors

- SAMPLE CLK A IN (J5): Input is AC coupled terminated in 50 ohms. The input signal is either a 0 dBm sinewave 200 MHz to 1 GHz or a 0.6 V_{p-p} squarewave DC to 1 GHz.
- SAMPLE CLK B IN (J6): Input is AC coupled terminated in 50 ohms. The input signal is either a 0 dBm sinewave 200 MHz to 1 GHz or a 0.6 V_{p-p} squarewave DC to 1 GHz.

* 7200A Ambient Temperature

- 10 MHz OUT (J7):	Reference Clock Out is a 10 MHz square wave at 0.7 ±0.1 $V_{p\text{-}p}$. The output is AC coupled with a source impedance of 50 ohms.
- 10 MHz IN (J8):	Reference Clock In is defined as 10 MHz. The input is optimized for ECL logic but will accept sinewave inputs between 0 and 20 dBm. The input is AC coupled and terminated in 50 ohms. Maximum DC input voltage is 25V.

Installation

Required:

7200A RCLK KIT

a) 7200ARCLK board assembled (PN# 7200ARCLK)

b) SMB to COAXIAL PIN cables (2) (PN# C7200ARCLK1)

c) SMB to SMB cables (2) (PN# C7200ARCLK2)

d) Installation Procedure (PN# 7200ARCLK-SM)

e) D.V.M (e.g.: KEITHLEY 175 or equivalent)

Installation

- Turn 7200A power OFF and remove power cord.
- Remove Plugins present in any slot.
- Remove 7200A top cover.
- Remove 7200A rear face plate.
- Remove 4 screws on the power supply (3 short, 1 long).
- Remove power supply by first sliding it carefully out to the rear of unit, second disconnect the 3 cables then remove the supply. (See figure E-3).
- Remove 2 screws on plugins fan cage.
- Remove fan cage. (See figure E-3).
- Disconnect 96 pin ribbon cable from 7200AMDIO board installed in slot 3.
- Install RCLK in available slot 4,5, or 6 (use mounting screw)
- Connect cables from 7200ARCLK to 7200AMDBP as follows:

From	To	
7200ARCLK - J3	7200AMDBP - P113B-5	SMB-COAXIAL PIN
7200ARCLK - J4	7200AMDBP - P113A-5	SMB-COAXIAL PIN
7200ARCLK - J1	7200AMDBP - P131	SMB-SMB
7200ARCLK - J2	7200AMDBP - P130	SMB-SMB

- Install fan cage back replace 2 screws
- Install power supply half way back.
- Reconnect the 3 keyed power supply cables.

-5V adjust:

With the power supply half way installed

- Install the power cord
- Power up the 7200A.
- Using the D.V.M Measure and adjust the -5V between GROUND and L3 by adjusting the POT R3. Adjust to -5V ± 25mV (See figure E-4)
- Turn 7200A power OFF
- Reconnect 96 pin ribbon cable to the 7200AMDIO board.
- Install power supply back with the 4 screws. The long screw in the rear next to fan cage (See figure E-3)
- Install rear panel face plate.
- Replace top cover back with the 4 screws.
- Perform the 7200ARCLK calibration procedure.

Calibration

Required:

a) Reference frequency: 10MHz ± 0.00002%
500mV into 50 Ohms amplitude, AC coupled
(e.g.: Marconi 2022C or equivalent)

(NIST) certification is available upon request.

b) LeCroy 7200A mainframe with 7242/A/B, 7234 module.

7200A should have system software installed rev 2.2.0 or higher.

c) 7200A ICL program ref_clka.src on 3.5" floppy diskette

- Insert Plugin in slot A.
- Insert diskette with ref_clka.src into floppy drive.
- Connect reference frequency source output to CH1 of plugin A.
- Turn 7200A power ON.
- Turn Frequency reference source on.
- Wait for 20 minutes for warm up and stabilization.
- Press Modify, Learn/program.
- Select : Speed FAST, Disk FLOPPY, Recall FILE ref_clka.
- Press Recall to recall ref_clka.src program.
- Press Return.
- Press Run to start running the calibration program.
- Follow instructions on 7200A display.

The program will try to adjust the RCLK CRYSTAL OSCILLATOR to the maximum accuracy .

The difference between the input reference and the adjusted RCLK frequency will be displayed on screen. When the program is done, the frequency should be less than or equal to 5Hz you may run the program again if desired.

Test

Required :

a) SMA TO BNC cable (1.5 METER LENGTH) (PN# 480-220-200)

b) Clip TO BNC cable (PN# 589-302-520)

Refer to rear panel option labeling for rear panel connection

RCLK 10MHz Out Test:

Purpose: To test the internal reference clock out circuit.

- Connect (10MHz OUT) on rear panel with (SMA to BNC) cable to CH1 (Plug-in A)
- Set plug-in timebase to .1us/div, set vertical sensitivity to .2V/div.
- Set input coupling of plug-in to DC 50 ohms.
- The displayed frequency for Trace 1 should read 10MHz ± 0.01%

RCLK EXT Clock in Test:

Purpose: To test the external circuit path to module reference clock input.

- Remove cable from CH1.
- Connect front panel probe calibrator (1kHz frequency) to CH1 using the clip to BNC cable.
- Change input coupling of plug-in to AC.
- Change plug-in timebase to .5ms.
- The displayed frequency should read 1kHz ± 1%
- Connect 10MHz reference clock source to (10MHz IN) on the rear panel.
- Press Modify then Trigger Mode UP on 7200A mainframe.
- Change Reference clock to EXT, Press Return.
- The Displayed frequency should still read 1kHz ± 1%
- Remove the 10MHz reference frequency from 7200ARCLK (10MHz IN).

  The 7200A should display message 'PLUGIN A TIMEBASE PHASE UNLOCKED' and the displayed frequency should change and vary.
- Press Modify Trigger Mode UP again
- Change Reference clock to INT, Press Return

The 7200A should display message 'PLUGIN A TIMEBASE PHASE LOCKED' and the displayed frequency should return to 1kHz ±1%

RCLK SAMP Clock Module a Test:

Purpose: To test the continuity path to module external sampling clock in

- Connect 10MHz frequency source to (A CLK IN) on rear panel.
- Press Modify then Interleaved Sampling ON
- Set CLOCK to EXT, Press Return
- The Displayed frequency should read:

  80kHz ±1% for module 7242/A/B
  1kHz ±1% for module 7234

The displayed waveform could be noisy

- Press Modify then Interleaved Sampling ON
- Set CLOCK to INT, Press Return

RCLK SAMP Clock Module B:

Purpose: To test the continuity path to module external sampling clock in

- Turn 7200A power OFF, and move plugin from slot A to slot B
- Disconnect 10MHz frequency source from (A CLK IN) and connect to (B CLK IN)
- Connect front panel probe calibrator (1kHz frequency) to CH1
- Turn 7200A power on
- Set V/DIV to .2V, Timebase to .5ms, and Coupling to DC.
- Press Modify then Interleaved Sampling ON
- Set CLOCK to EXT, Press Return
- The Displayed frequency should read :

  80kHz ±1% for module 7242/A/B
  1kHz ±1% for module 7234

- Press Modify then Interleaved Sampling ON
- Set CLOCK to INT, Press Return

Disconnect all cables.

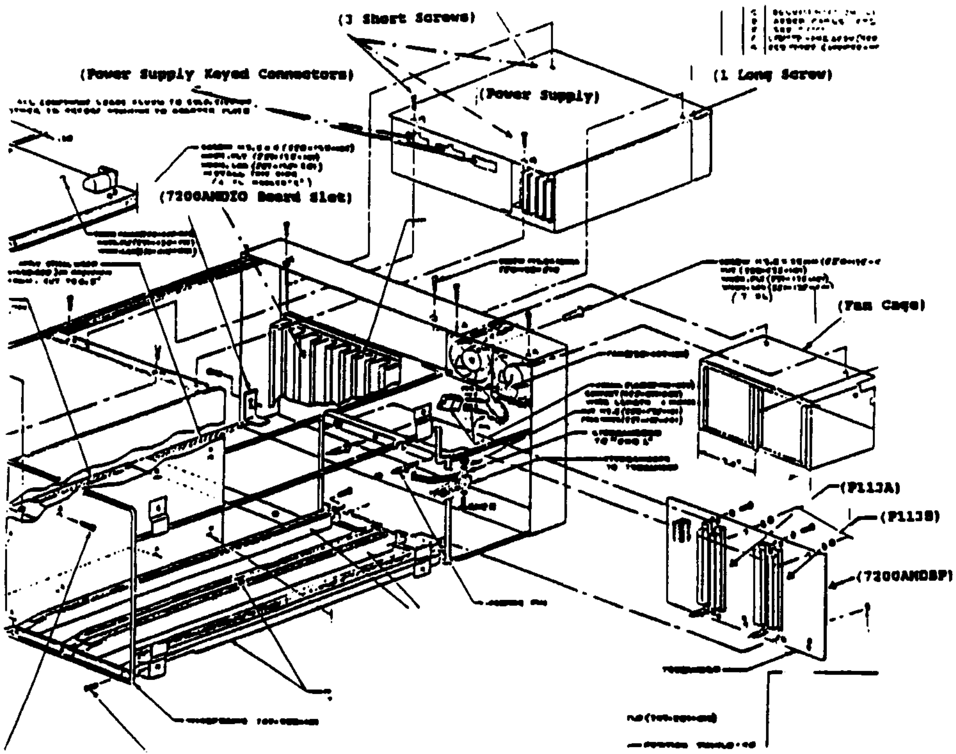

(3 Short Screws)
(Power Supply Keyed Connectors)
(Power Supply)
(1 Long Screw)
(7200AMDIO Board Slot)
(Fan Cage)
(P113A)
(P113B)
(7200AMDBP)

Figure E-3

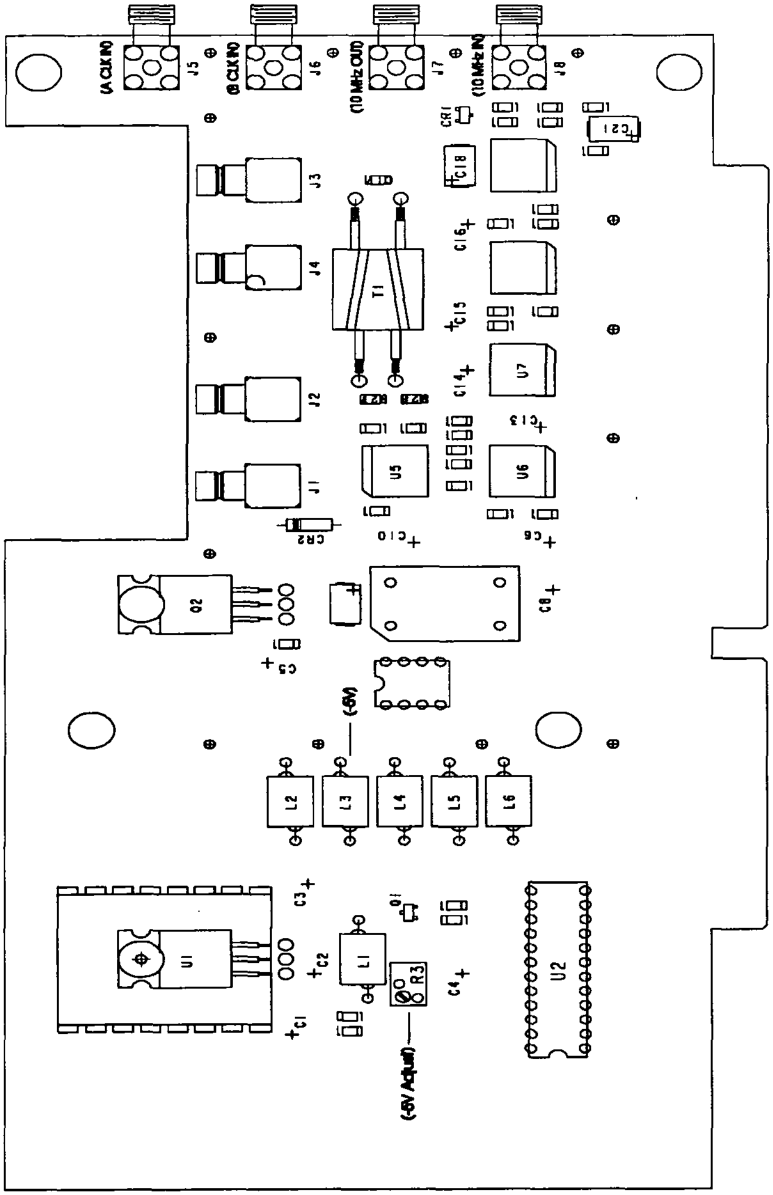


Figure E-4. 7200ARCLK Assembly Drawing

This page left intentionally blank

Appendix F - IF2 Installation & System Test Manual

How To Use This Manual

LeCroy has prepared this manual to provide the 7200A-IF2 (SCSI Output Data Port Option) user with the technical information needed to perform a system test.

Installation information is provided only for qualified service personnel. A system test is easily accomplished by following the procedure outlined in this manual.

Product Description

The 7200A-IF2 (SCSI Output Data Port Option) is a mainframe option board which provides a rear panel, high speed data output port. The 7200A system indicates that this option has been installed by displaying "**SCSI:**" Interface Status in the COMMUNICATION SETUP menu. This setup menu is shown in figure F-1.

The IF2 option is enabled during a 7200A acquisition mode called SEQUENCE. Sequence mode is a method of data acquisition which maximizes the system throughput by collecting and storing data from many triggers before displaying any information. Use of the IF2 option allows for very large quantities of data (limited only by the Host) to be acquired. The ACQUISITION SETUP menu shown in figure F-2 shows the selection of SCSI as the data destination for SEQUENCE mode. STANDARD refers to internal memory. A complete description of SEQUENCE trigger operation is described in the "LeCroy 7200 Series Modular Oscilloscope Operators Manual".

Communication with any SCSI-1 compatible Host is possible. Included with this manual are a group of PC-AT compatible utility programs which can be used to fully test the IF2 interface. These programs are sufficient to use this interface in most applications. Source code is provided for user optimization or transport to other Host hardware environments.

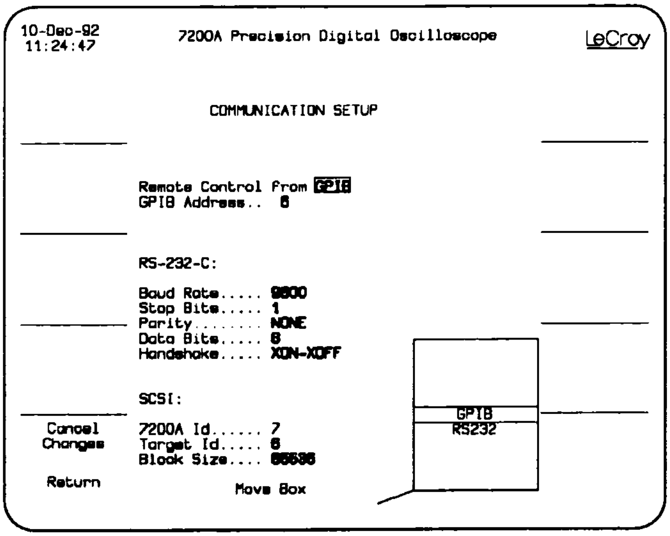


Figure F-1

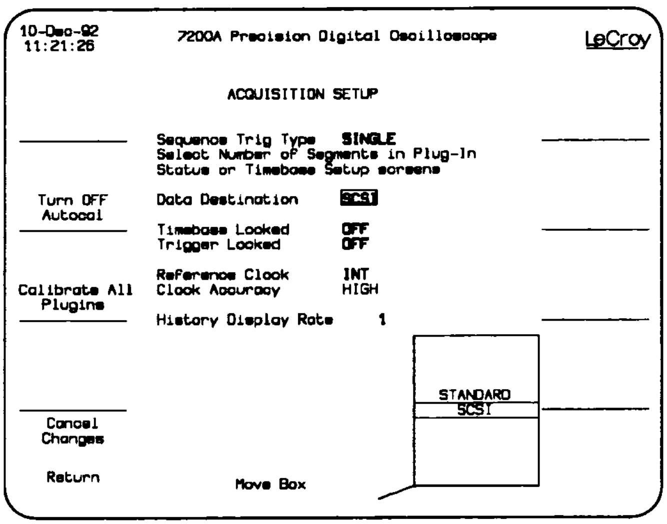


Figure F-2

Specifications

Data Rate : 900 Kbytes/sec

Note :Data rate is defined for a 7200A-PR2 and a PC-AT compatible (386-16MHz) using the Utility program ACQUIRE.EXE. BLOCK SIZE = 65536, and points/segment = 50,000. Data transfer is to memory.

Rear Panel I/O : SCSI-1 Connector

PC Utilities Operation and Description

This section explains how to use the IF2 option and the MS-DOS utilities provided. For a more detailed explanation of the controls, remote commands, and the format of the data transferred.

When transferring data in SCSI sequence mode, the 7200A maximizes throughput. To do this, data is transferred in uncorrected form (8 bit format) from successive triggers. It also uses low level SCSI protocol for the transfers. The following MS-DOS utilities (with full source code on the accompanying disk) are provided:

ACQUIRE.EXE:Transfers the data from 7200A over SCSI bus to disk or memory

SEQTRAN.EXE:Selects and Corrects (ie. converts the raw 8 bit data to a corrected 16 bit format) the data transferred from the SCSI port.

These utility programs are used to demonstrate the functionality and capabilities of the IF2 Option. These programs may be used as is or embedded into custom applications.

Host Requirements

The host computer minimum requirements to use these utilities is an IBM PC AT or Compatible with the following:

* MS DOS 3.2 or higher

* Adaptec AHA-1540B SCSI board setup as (refer to figure F-3):

Recommended Setup:

SCSI address = 6

DMA channel = 5

Interrupt channel = 11

Specifications

ss = 330h

r Speed = 5.0

p:

led

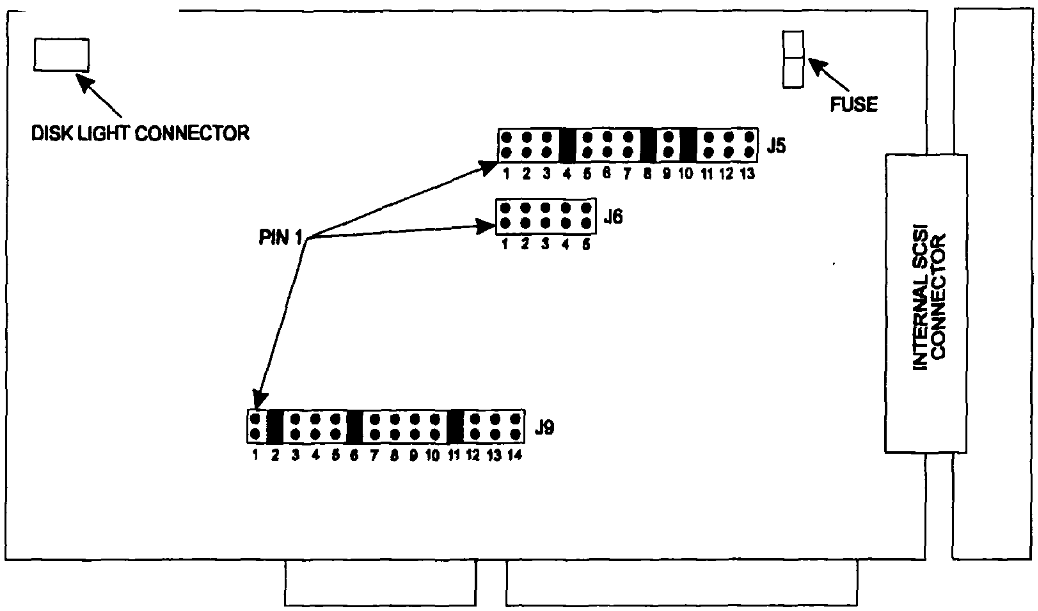


Figure F-3. Jumper Configuration for Host
Adaptec AHA-1540B SCSI Adapter

PC Utility Software Installation

Use the following example DOS commands and copy ACQUIRE.EXE, SEQTRAN.EXE, PLOT.EXE and 7200.TPL from the SCSI PC Utilities disk included with this manual to the PC harddrive.

- MKDIR C:\SCSI
- CD SCSI
- Insert 'SCSI PC UTILITIES' disk in drive A

- COPY A:*.exe
- COPY A:\7200.TPL
- DIR C:\SCSI {To verify the following files}
- ACQUIRE.EXE
- SEQTRAN.EXE
- PLOT.EXE
- 7200.TPL

7200 Requirements

The 7200A must be equipped with the IF2 option and have version 2.2.0 (or later) software. Only 7242B-F2 or 7234-F2 (or both) plugins may be used.

System Setup and Operation

The following is a discussion of the procedure to operate the 7200A in SCSI SEQUENCE MODE to acquire, translate and display a simple waveform.

(1) Data communication between a 7200A and a Host computer requires only the SCSI connection. If automated control is also desired then use of the GPIB is required. The following procedure requires only the IF2 (SCSI) interface connection.

(2) The 7200A requires the **"TARGET ID"** (ie. The SCSI address of the Host computer) and the **"BLOCK SIZE"** to be set. This may be accomplished by either the use of GPIB remote commands or by setting it manually in the 7200A's COMMUNICATION SETUP menu (refer to figure F-1). *(Note: Performance benchmarks have shown that larger block sizes guarantee faster transfer rates.).*

(3) Setup the Plugin(s) data acquisition parameters (Volts/div, Trigger level, etc). Once the acquisition setup has been completed, execute ACQUIRE.EXE (see below) on the Host computer; the Host computer is now ready to receive data from the 7200A via the SCSI bus.

PC COMMAND: **ACQUIRE**

This command will transfer all data to a file named "OUTPUT" in the current directory.

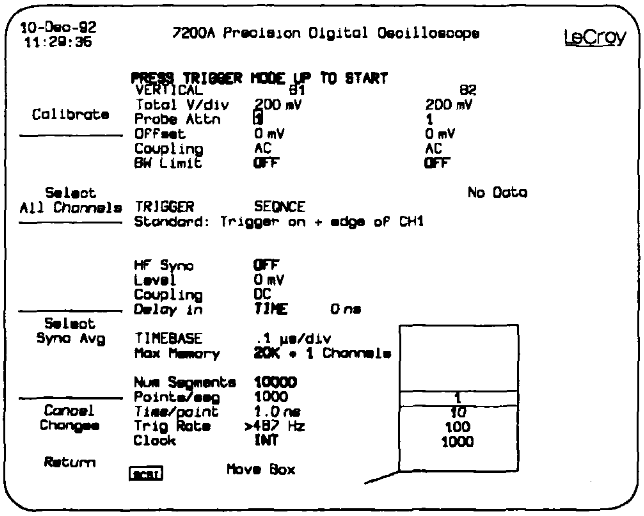


Figure F-4

(4) On the 7200A, press "Trigger Mode Up" button until SEQ is selected and define the sequence mode acquisition parameters (Time/div, number of segments, points/segment, etc) thru the PLUGIN STATUS menu (refer to figure F-4). For this test the number of segments should be small (eg. 10) and the number of points per segment should also be small (eg. 1000). Next, set the Data Destination field in the Acquisition Setup screen to SCSI (refer to figure F-2).

(5) Press the Trigger Mode Up button again, the plugin will be armed, and the preamble information will be sent over the SCSI port (waveform descriptors for all active channels). Data transfer begins as soon as the plugin receives a trigger. Data acquisition will continue until the defined number of segments have been collected. To terminate the transfer before all segments have been acquired, press the "TRIGGER MODE UP" button. This will terminate transfers after the current segment is sent. Alternatively any key pressed on the PC will terminate "ACQUIRE" but leave the 7200A in a retry state looking for a host.

(6) To process the captured data, run the SEQTRAN program (see below). This program, in conjunction with PLOT or your favorite graph program, will allow you to view the segments on your computer. Should you wish to send the data back into the 7200A for viewing/processing, select the file output option. The file may be copied onto a floppy and read into the 7200A.

PC COMMAND: **SEQTRAN OUTPUT -s>DATA** This command translates all the segments and writes the corrected waveforms to a file "DATA" in the current directory.

PC COMMAND: **PLOT DATA** This command Plots the first 500 points of the corrected waveforms.

OR

PC COMMAND: **PLOT -l20000 DATA** This command Plots the first 20000 points of the corrected waveforms.

Utility Program Definition

Seqtran

Reads the output file from ACQUIRE, corrects the segments and outputs the results to a file or to the screen.

NOTE: The command line is limited to 127 characters.

usage: seqtran ***[-t -a -s -f -o -d -p -v]***

where: file = SCSI data file

-t = Print the times of all segments relative to segment 1 to the screen as hours:minutes: seconds. (default = off)

-a =Print acquisition parameters (descriptors) to the screen. (default = off)

ex:-aA1,B2(Print descriptor for plugin A, channel 1 and plugin B, channel 2)

-aB(Print descriptor for plugin B all channels)

-a(Print descriptors for all plugins, all channels)

-s =Segment number(s) to correct. (default = no segments)

ex:-sA2,25,63,B1,100-150 (Plugin A, chan 2, segs 25 and 63, Plugin B, chan 1, segs 100 thru 150)

-sA3,1:20:15-25:0:0 (Plugin A, chan 3, segs acquired 1 hour, 20 minutes and 15 seconds after seg 1 and before 25 hours after seg 1)

-sB,2:20,A2,99 (The first segment of all channels of plugin B acquired 2 hours, 20 minutes and 0 seconds after the first segment, plugin A channel 2 segment 99)

-sA,13,52(Segs 13 & 52 of all channels of plugin A)

-sA2,B1(All segs of plugin A, channel 2 and plugin B channel 1)

-sA(All segs of all channels of plugin A)

-s(All segs of all channels of all plugins)

-f = Format of the data. (default = COM)

Options:-fRAW[,fmt] = uncorrected raw data, promoted to 16 bits. (default fmt=%d)

-fCOR[,fmt] = corrected with filter coefficients. (default fmt=%d)

-fCOM[,fmt] = corrected and compensated for vertical gain. (default fmt=%g)

fmt, if specified, overrides the default.

ex:-fRAW,%04x outputs raw uncorrected data in hexadecimal

-o =Output destination for results. (default = -o1)

Options:

-oF = write complete corrected waveform (descriptor + data) to disk file in binary starting with trace_PC.000 to trace_PC.999 where P=plugin, C=channel (max 1000 segs for each plugin/chan). Note that -f does not apply with this option and is fixed as COR.

-o1 = print data only in ASCII to the screen in 1 column

-o2 = print time,data in ASCII to the screen in 2 columns

-d = Diagnostic test mode: compare last segment to corrected segment (all channels) and print any differences as a byte offset. (Note: Data must have been acquired in diagnostic mode. Diagnostic Mode is entered by using remote command "COSC DIAG, ON")

-p = Print filter coefficients to the screen (default = off)

-v = Verbose mode: print diagnostic and status messages (default = off)

-h = Print this message.

Acquire

Transfer data from a 7200A with option IF2 to an IBM PC or compatible SCSI port.

usage:acquire **[-h -v -t -m -bs -nb -id]**

where:		
	file=name	Output file name. (Default is "OUTPUT")
	-h	Print this message.
	-v	Print diagnostic and status messages.
	-t	Time SCSI transfers to disk.
	-m	Time SCSI transfers to memory (no disk output).
	bs=#	Set SCSI block size to #. (Default is 65536)
	nb=#	Allocate # SCSI blocks. (Default is 10)
	id=#	SCSI identifier of scope. (Default is 7)

Plot

Plot waveform data to the PC screen.

usage:plot [-m -e -v -a -o -rB,T -l -d -s -pM -t"TITLE" -h]

where:		
	file=name	Required input file name. (Corrected waveform data)
	-m	Monochrome display (640x200)
	-e	EGA display (640x350)
	-v	VGA display (640x480)
	-a	Monochrome AT&T display (640x400)
	-o	Enhanced AT&T display (640x400)
	-rB,T	Specify Bottom,Top display values
	-l	# of points to display. (Default is 500 points)
	-d	Display point only
	-s	Display small dots
	-pM	Start with M^{th} symbol

-t"TITLE"	Display a title above the graph
-h	Print this message

example: plot -e -r-150,150 s.wav

Plots file name "s.wav" on an EGA display with ±150 range.

7200A-IF2 Installation Procedure

INSTALLATION: SCSI board(Adaptec AHA-1540B)

Refer to figure F-5 for jumper configuration

- Turn power OFF and remove power cord
- Remove 7200A top cover.
- Remove 7200A rear face plate.
- Remove 4 screws on the power supply (3 short, 1 long). Refer to figure F-6.
- Remove power supply by first sliding it carefully out to the rear of unit, second disconnect the 3 cables then remove the supply. (Refer to figure F-6)
- Disconnect 96 pin ribbon cable from 7200AMDIO board installed in slot 3.
- Install SCSI board in available slot 4, 5, or 6.
- Reconnect the 96 pin ribbon cable to 7200AMDIO.
- Install power supply back with the 4 screws. The long screw in the right, rear (@ the front of the 7200A). Refer to figure F-6.
- Install 7200A rear face plate.
- Install 7200A top cover.
- Install power cord.
- Insert plugin(s) in SLOT(s) A, B or A&B
- Connect probe calibrator to CH1 of plugin(s)

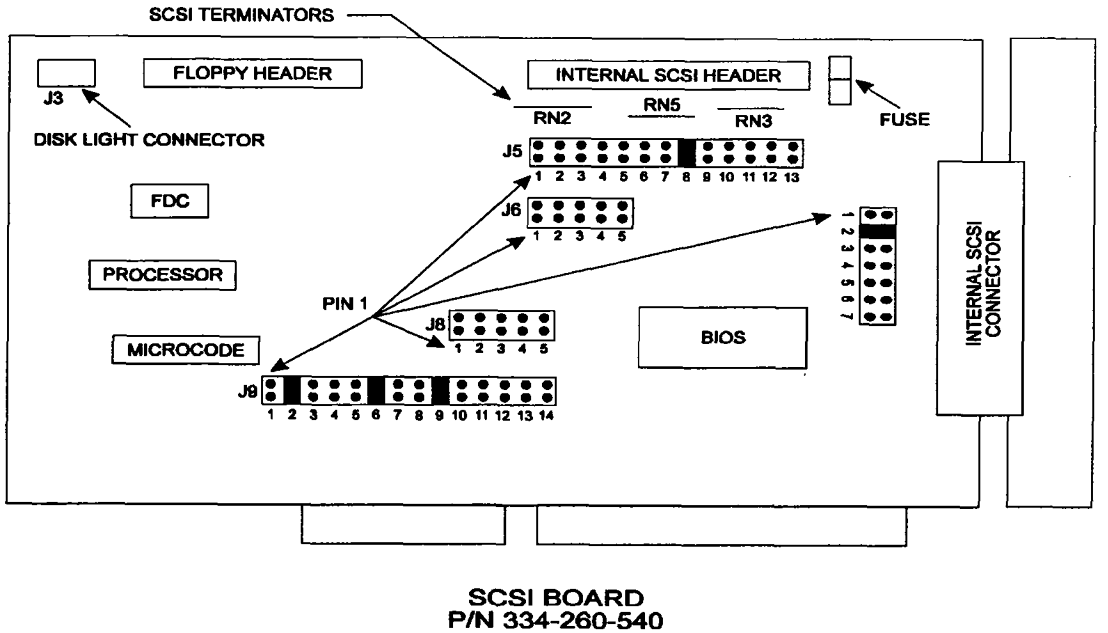


Figure F-5. Jumper Configuration for SCSI Board Installed in 7200A

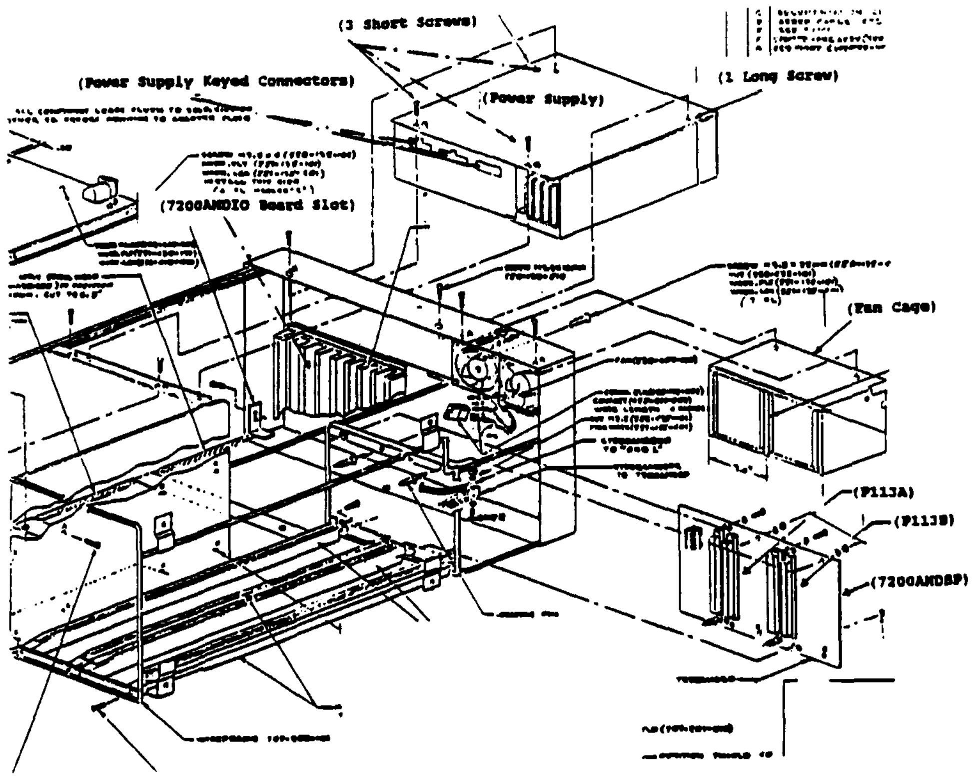

(3 Short Screws)
(Power Supply Keyed Connectors)
(Power Supply)
(1 Long Screw)
(7200AMDIO Board Slot)
(Fan Cage)
(P113A)
(P113B)
(7200AMDSP)

Figure F-6.

Appendix G - 7200A Software Version 2.2.0 Addendum

Keyboard Support

File Editor

To access the 7200A's file editor, you simply press the "Edit File" softkey. The "Edit File" softkey appears when you move onto the Recall Filename field in the Display Setup, Panel Setup, and Program Setup Screens or when in the Disk Utility Screen. The file selected in the Recall Filename field is read in from the specified disk when the "Edit File" softkey is pressed.

Additionally, if an error occurs while compiling an ICL program, the editor will automatically be invoked and the cursor placed at the line that the error occurred.

When in the Edit File Screen, you can use the optional PC Keyboard to enter/modify your file or use the softkeys listed below for simple changes.

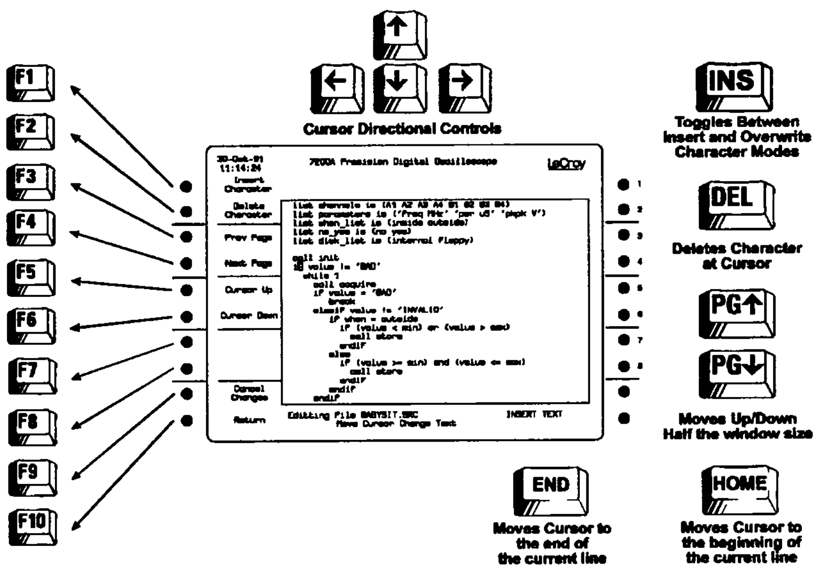


Figure G-1. PC Keyboard Controls for File Editor

The following softkeys are available in the file editor.

Next / Prev Page	Moves Up/Down by half the window size
Insert Character	insert a character before the cursor
Delete Character	Deletes the character at the cursor
Cursor Up/Down	Moves the cursor from line to line
Move Cursor Knob	Moves the cursor along the line
Change Text Knob	Scrolls through list of characters
Cancel Changes	Prompts user if sure, then aborts edit and exits menu
Return	Writes buffer out to file and exits menu

Additional Keyboard Support

Besides using the keyboard for editing files, you can use it to make changes in the 7200A's Setup Screens. When in a Setup Screen (other than the editor), the keyboard works as follows:

Left and Right Arrow Keys	Move box from field to field
Function Keys (F1-F10)	These keys are mapped to the softkeys on the left side of the screen

When the box is on a field that has a list of choices:

Up/Down Arrow Keys	Selects the Next/Previous choice
Home Key	Selects the first item in the list
End Key	Selects the last item in the list

Any Alphanumeric Key:

Will go to the first item in the list that matches the character(s) typed in, if any. The entered characters will be highlighted in the currently selected option. Note, that backspace can be used to remove a highlighted character.

When the box is on a field that has a number:

Any Numeric key: Will go to the first item in the list that matches the characters(s) typed in, if any. The entered characters will be highlighted in the currently selected option. Note, that backspace can be used to remove a highlighted character.

New Display Options

Two new display options, Grid Style and Dot Join have been added. These controls are located in the Display Options Setup Screen which can be accessed by pressing "MODIFY" and then GRIDS.

"Dot Join"

When this field is ON, lines are drawn between acquired data points in waveforms. When OFF, only the data points are drawn.

"Grid Style"

Is used to set the style to be used for grids. Choices include STANDARD, DOTS, CROSSHAIR, and BOX.

SCSI Sequence

The 7200A with option IF2 (and a 7242B or 7234 plugin with option F2) provides very high speed data transfer via the SCSI bus. This section explains how to use the option, the format of the data transferred, and how to perform corrections on the data. The corrections are necessary since the data is read out in "raw" format to increase the throughput.

In order to use this feature, the 7200A must be equipped with the IF2 option and have version 2.2.0 (or later) software. Either 7242B-F2 or 7234-F2 (or both) plugins may be used.

Several IBM PC utilities are provided in order to demonstrate this capability. The source code for these utilities are also provided so that you may modify it to suit your needs, include parts of it in your own application or port to another computer.

Front Panel Control Changes

The 7242B and 7234 Timebase Setup Screen and Display Status Screen are changed while in SCSI sequence: The Maximize option is not available and the Maximum Number of Segments increases.
(Note, that you can now select 0 channels to disable the plugin without removing it from the mainframe.)

Communications Setup Screen menu has the following new fields:

SCSI:	7200A Id	0..7
	Target Id	0..7
	Block Size	16..65536

Acquisition Setup menu screen has the following new fields:

Sequence Trig Type	SINGLE/NORMAL
Data Destination	STANDARD/SCSI

Select Number of Segments in Plug-In, Status or Timebase Setup screens

SCSI Sequence Operation

Sequence mode is selected by pushing the Trigger Mode Up button until the SEQ LED is lit. If the "Data Destination" field in the Acquisition Setup screen is set to STANDARD, then the plugin immediately arms and begins to acquire its segments. If the "Data Destination" is SCSI, or if SCSI is selected after the Trigger Mode is set to SEQUENCE, then the following events occur:

1. The plugin is placed in the triggered state
2. A SCSI icon appears at the bottom of the screen
3. The "Maximize" field in the Timebase menu screen disappears since in this mode both points/seg and trigger rate are maximized.
4. The "Trigger Rate" field in the Timebase menu screen is re-calculated based on the SCSI transfer rate, sampling rate, etc.
5. The "Num Segments" field in the Timebase menu screen is replaced with the stored value and limits for SCSI.
6. The prompt "PRESS TRIGGER MODE UP TO START" appears

You can change the acquisition parameters at this point. Once the Trigger Mode Up button is pressed again, the following events occur:

1. The prompt disappears
2. Calibrations occur if necessary
3. The preamble is formatted and sent over SCSI
4. The plugin is placed in the armed state

As the data for each segment is acquired, it is sent over SCSI. If the "Sequence Trig Type" is SINGLE, then when the last segment has been acquired the following events occur:

1. The plugin is put into the triggered state
2. The prompt "PRESS TRIGGER MODE UP TO START" appears

If the "Sequence Trig Type" is NORMAL, then the "Num Segments" field in the Timebase menu is irrelevant and the plugin continuously rearms for more segments.

This cycle continues until either the "Data Destination" field in the Acquisition Setup screen is changed to STANDARD or the Trigger Mode is changed to SINGLE, NORMAL or AUTO. If any of these occur, then the following events take place:

1. The prompt disappears
2. The SCSI icon disappears
3. The "Maximize", "Trigger Rate", and "Num Segments" fields are restored to their prior values.
4. The plugin is placed in the armed state and begins acquiring data.

While in SCSI sequence mode, if any plugin control changes while the plugin is armed, or if the Trigger Mode Up button is pressed, or if the SCSI block size is changed, then the following events occur:

1. The plugin is put into the triggered state
2. All SCSI output is terminated
3. The prompt "PRESS TRIGGER MODE UP TO START" appears. Once the Trigger Mode up button is pressed, the acquisition cycle will begin again, with the new control settings.

The data acquired in SCSI sequence is not accessible to the 7200A for any internal processing or display; it merely passes through from the plugin to the SCSI port. Therefore, the display of all traces is automatically disabled and no computational processes can be applied to the data.

As the segments are sent over SCSI, the number at the bottom right corner of the main screen will increment indicating the last segment acquired. This field is updated once per second. If the display is turned off (DISPLAY OFF remote command) or if the main screen is not displayed, this field will not appear which will take less time away from the SCSI process.

In order to maximize SCSI throughput in a 2 plugin system, each plugin can be turned off by selecting 0 Channels in the Timebase menu screen or Display Status screen. Thus, any triggers acquired by a "0 Channels" plugin will not be processed and can never be retrieved.

SCSI Data Format

Format of Preamble

The first block of data that is output is the preamble. There is a unique preamble for each active channel (i.e., one for a 7242B with 7291, 1 or 2 for a 7242B, 1,2 or 4 for a 7234). There are separate preambles for each plugin. The first two bytes of the preamble are the SCSI packet identifier which identifies which plugin this preamble describes.The next four bytes are the SCSI block size read as a 32-bit long word. The next two bytes are the number of channels for this plugin. The next two bytes are the block size used by the timebase which is needed to determine the time of each segment. The rest of the preamble consists of the waveform descriptors, one descriptor for each active channel. The waveform descriptor is fully described in "Section 3: Waveform Transfer" of the Remote Programmer's Manual. That section describes how to interpret all information based on the 7200.tpl template file. It also describes how to determine the size of the descriptor so that one may determine the end of one channel's preamble and the beginning of the next. The size of the USERTEXT and WAVE_ARRAY_2 blocks will be 0; the TRIG_TIME_ARRAY block is used to hold the filter coefficients.

In order to support uncorrected raw data read-out, the waveform descriptor contains additional information which differs from a normal descriptor. These are:

1. A new RECORD_TYPE called raw_streaming_sequence. (see new 7200.tpl file)
2. Use of TRIG_TIME_ARRAY to contain the filter coefficients. The format of the data in this block is dependent on the sampling rate as follows.

The number of filter coefficients is variable depending on the particular setup of a channel. Each coefficient is a 16-bit signed 2's-compliment integer. If we represent the filter coefficients as h[flash][k] where k is one of n coefficients associated with a particular flash ADC, then we have the following:

Sample Rate	Format of TRIG_TIME_ARRAY	Flash/Chan
200 MS/s:	1, 2,h[A][0], h[A][1]	A
400 MS/s:	2, 7,h[A][0], h[A][1],.....,h[A][6],	A
	7,h[C][0], h[C][1],.....,h[C][6],	C
1 GS/s:	4, 13,h[A][0], h[A][1],.....,h[A][12],	A
	13,h[B][0], h[B][1],.....,h[B][12],	B
	13,h[C][0], h[C][1],.....,h[C][12],	C
	13,h[D][0], h[D][1],.....,h[D][12],	D
2 GS/s:	9, 13,h[A1][0],h[A1][1],....,h[A1][12],	A1
	13,h[B1][0],h[B1][1],....,h[B1][12],	B1

```
13,h[C1][0],h[C1][1],...,h[C1][12],C1
13,h[D1][0],h[D1][1],...,h[D1][12],D1
13,h[A2][0],h[A2][1],...,h[A2][12],A2
13,h[B2][0],h[B2][1],...,h[B2][12],B2
13,h[C2][0],h[C2][1],...,h[C2][12],C2
13,h[D2][0],h[D2][1],...,h[D2][12],D2
63,h[0],h[1],...,h[62]  (2 GS/s filter)
```

As an example of a 2-channel 7242B in slot A and a 4-channel 7234 in slot B, the two separate preambles would look as follows:

BYTE OFFSET	DESCRIPTION (PLUGIN A)
0	LS byte of packet number (first packet = 0)
1	MS byte of packet number (MS bit: 0 = plugin A)
2	SCSI block size (32-bit LONG) (bits 0 - 7)
3	SCSI block size (32-bit LONG) (bits 8 - 15)
4	SCSI block size (32-bit LONG) (bits 16 - 23)
5	SCSI block size (32-bit LONG) (bits 24 - 31)
6	number of channels for plugin A (ie., 2 for 7242B)
7	MS byte of number of channels (always 0)
8	TMB block size for time conversions (LSB)
9	TMB block size for time conversions (MSB)
10	byte 1 of waveform descriptor for plugin A channel 1
11	byte 2 of waveform descriptor for plugin A channel 1
:	: : : :
q-1	byte n-1 of waveform descriptor for plugin A channel 1
q	byte n of waveform descriptor for plugin A channel 1
q+1	byte 1 of waveform descriptor for plugin A channel 2
q+2	byte 2 of waveform descriptor for plugin A channel 2
:	: : : :
r-1	byte n-1 of waveform descriptor for plugin A channel 2
r	byte n of waveform descriptor for plugin A channel 2

BYTE OFFSET	DESCRIPTION (PLUGIN B)
0	LS byte of packet number (first packet = 0)
1	MS byte of packet number (MS bit: 1 = plugin B)
2	SCSI block size (32-bit LONG) (bits 0 - 7)
3	SCSI block size (32-bit LONG) (bits 8 - 15)
4	SCSI block size (32-bit LONG) (bits 16 - 23)
5	SCSI block size (32-bit LONG) (bits 24 - 31)
6	number of channels for plugin B (ie., 4 for 7234)

7	MS byte of number of channels (always 0)
8	TMB block size for time conversions (LSB)
9	TMB block size for time conversions (MSB)
10	byte 1 of waveform descriptor for plugin B channel 1
11	byte 2 of waveform descriptor for plugin B channel 1
:	: : : ::
m- 1	byte n-1 of waveform descriptor for plugin B channel 4
m	byte n of waveform descriptor for plugin B channel 4

Format of Uncorrected Sequence Data

Once the trigger event occurs, data will be sent by the 7200A as soon as the programmed SCSI block size samples have been acquired. Each segment is preceded with a preamble that applies to all channels of the plugin. This preamble always precedes channel 1 of any segment and consists of a segment tag (0xFFFF), last ADC flash used to acquire the data, TDC fine count, and a 64-bit timestamp. These values are needed to correct the data. (NOTE: taken as 16-bit words, data is in Intel LSB/MSB format). The format of k data bytes describing j segments from 2 channels is as follows:

BYTE OFFSET	DESCRIPTION
0	LS byte of packet number (first packet = 1)
1	MS byte of packet number (MS bit=plugin: 0=A,1=B)
2	LS byte of Segment tag: 0xFF
3	MS byte of Segment tag: 0xFF
4	lastflash: A1=0,B1=1,C1=2,D1=3,A2=4,B2=5,C2=6,D2=7
5	not used (MS byte of last flash)
6	TDC fine count LS byte (bits 0 - 7)
7	TDC fine count MS byte (bits 8 - 15)
8	Timestamp of segment 1 (bits 48 - 55)
9	Timestamp of segment 1 (bits 56 - 63)
10	Timestamp of segment 1 (bits 32 - 39)
11	Timestamp of segment 1 (bits 40 - 47)
:	: : : :
14	Timestamp of segment 1 (bits 0 - 7)
15	Timestamp of segment 1 (bits 8 - 15)
16	Data Byte 1 of Channel 1 of segment 1
17	Data Byte 2 of Channel 1 of segment 1
18	Data Byte 3 of Channel 1 of segment 1
19	Data Byte 4 of Channel 1 of segment 1
:	: : : :
p-1	Data Byte n-1 of Channel 1 of segment 1

p	Data Byte n of Channel 1 of segment 1
p+1	Data Byte 1 of Channel 2 of segment 1
p+2	Data Byte 2 of Channel 2 of segment 1
:	: : : :
m-1	Data Byte n-1 of Channel 2 of segment 1
m	Data Byte n of Channel 2 of segment 1
m+1	LS byte of Segment tag: 0xFF
m+2	MS byte of Segment tag: 0xFF
m+3	last_flash for segment 2
m+4	not used (MS byte of last flash)
m+5	TDC fine count LS byte for segment 2
m+6	TDC fine count MS byte for segment 2
m+7	Timestamp of segment 2 (bits 48 - 55)
m+8	Timestamp of segment 2 (bits 56 - 63)
m+9	Timestamp of segment 2 (bits 32 - 39)
:	: : : :
m+13	Timestamp of segment 2 (bits 0 - 7)
m+14	Timestamp of segment 2 (bits 8 - 15)
m+15	Data Byte 1 of Channel 1 of segment 2
m+16	Data Byte 2 of Channel 1 of segment 2
:	: : : : :
k-1	Data Byte n-1 of Channel 2 of segment j
k	Data Byte n of Channel 2 of segment j

In order to correctly identify the boundaries between the end of one segment and the beginning of the next, the information in the preamble (reorder size, sampling rate, ...) is needed.

The last flash, TDC fine count, and trigger timestamp are the only values not known until the data is acquired. Therefore, these values are needed to correct the data and modify the waveform descriptor.

At sample rates of 200 MS/s or less, the number of data bytes for each segment is odd (due to the one extra sample needed for the correction filter). However, to maintain 16-bit word alignment padding is used and thus each segment will have one extra sample at the end of each record at these sample rates. This information must be used to determine the end of one segment and the start of the next.

At sample rates of 2 GS/s, the extra samples needed for the 7291 filter would normally be 62 to handle the 63-point filter; however, since this data is gotten from 2 separate channels that are interleaved, each channel needs to acquire 63/2 extra samples. Since this number is odd, each channel acquires 32 extra samples which results in 64 extra samples generated in the SCSI data. When correcting, the last 2 points can be ignored.

SCSI Block Size

The SCSI block size is the amount of data that the 7200A must accumulate before sending anything over SCSI. Small block sizes will send data over SCSI sooner but it is less efficient since there is a certain amount of overhead associated with formatting each block. Larger block sizes transfer data more efficiently but take longer to start. Knowledge of the amount of data expected will help to set a compatible block size.

The block size is set in the Communication Setup screen or by remote command. (ie., "COSC BS,2048" sets block size to 2K).

To allow the target SCSI device to automatically detect the block size, the 7200A will pad all partial blocks with 0 in order to only send complete blocks. Thus, the target will know the length of the first buffer of data that it receives and it can use that size as the programmed block size. The only partial blocks that can ever occur are at the last block of the preamble and the last block of sequence data; all intermediate blocks must consist of complete blocks of data.

SCSI Packet Description

Every block of data sent from the 7200A over SCSI contains a packet identifier. The most significant bit of this identifier indicates the plugin which sourced this data:

0 = plugin A
1 = plugin B

The remaining 15 bits indicate the packet number starting with 0 for the first block, 1 for the second block, and so forth. For example, packet id=0x8003 indicates the fourth block transfer from plugin B.

A packet number of 0x0000 or 0x8000 is special. It can only identify the very first block of the first preamble for plugin A or plugin B and indicates that sequence data will be forthcoming after the preamble has been accepted. This also implies that a previous SCSI transfer that may have been in progress has terminated, perhaps due to an acquisition control change or Trigger Mode change.

A packet number of 0x7FFF or 0xFFFF is special. It can only identify the very last block of sequence data. Thus, although consecutive packets from a plugin have sequential packet numbers, when this packet number is detected it identifies this packet as the last one in the data stream.

Since the packet number consists of 15 bits, its range is from 0x0001 to 0x7FFE (0x8001 to 0xFFFE), since 0x7FFF (0xFFFF) is a reserved packet number. If the data records are large enough, more than 32767 blocks may need to be sent in which case the packet number will wrap to 0x0001 (0x8001) and continue sequentially from there. The packet number never wraps to 0x0000 (0x8000) since this uniquely identifies a new transmission of data starting from segment 1 of the sequence.

The packet ID can be used by the target SCSI device for retries of the last block if there was some trouble receiving that block.

Last Flash

There are several sets of filters, each specific to the order of the flashes used to acquire the data. This order is tagged according to the last flash (of filter length samples) used to acquire the data. The last flash number is associated with the channel/flash as follows:

last flash	channel	flash
0	1	A
1	1	B
2	1	C
3	1	D
4	2	A
5	2	B
6	2	C
7	2	D

Once the last flash is known, the proper set of filter coefficients can be applied to correct the data based on the sampling rate.

TDC Fine Count

The Horizontal Offset given in the waveform descriptor portion of the preamble is not accurate for the acquired waveform; this value must be calculated after the trigger event when the TDC fine count is known. The Horizontal Offset describes the actual trigger delay; that is, the time in seconds from the trigger to the first data point. The TDC fine count describes this resolution to an accuracy of less than a sample interval (which varies based on the sampling rate which is identified by the Horizontal Interval). The two bytes of the TDC fine count form a 16-bit word that ranges from 0 to 32768 and is used to calculate the Horizontal Offset as follows:

```
if (2 GS/s sampling)
        trigger_delay = (2*TDC fine count * Horizontal Interval) / 32768
else
        trigger_delay = (TDC fine count * Horizontal Interval) / 32768
Horizontal Offset = Pixel Offset - (Horizontal Interval - trigger_delay)
```

Where:

TDC fine count = found at the start of a segment's SCSI data
Horizontal Interval = HORIZ_INTERVAL part of waveform descriptor
Pixel Offset = PIXEL_OFFSET part of waveform descriptor

The calculated Horizontal Offset should replace the HORIZ_OFFSET field in the waveform descriptor for a particular channel in order to appropriately describe the corrected waveform. This field is a double (64-bit IEEE floating point value).

Trigger Timestamp

The trigger timestamp accurately describes the relative time between each segment's trigger. These 8-byte fields form a 64-bit value which is the output of a 64-bit counter running continuously that counts in 64 sample increments while the sample rate is unchanged. To get the time resolution better than 64 samples, there is the TDC count which consists of a coarse and a fine count. The coarse count measures integral sample intervals and the fine count measures fractional sample intervals accurate to within 5 psec. The timestamp counter is clocked at the current sample rate while the coarse and fine counts are clocked by the current flash clock. The flash clock is 250 MHz (4ns) at 1 GS/s and 200 MHz (5ns) at all other sample rates. Also, the coarse count measures from the first flash clock after the trigger until the last sample of its corresponding 64 sample set whereas the fine count measures the fraction of a flash clock from the trigger point to the next flash clock. The 7234 is a little different in that the 64 sample increments of the timestamp counter are divided by the number of active channels.

Thus, a segment's relative time can be determined as follows:

segment time = 64-bit timestamp * TMB block size * time/point
+ (64-coarse count-(fine count/32768))/flash clock

where: block size = found at the start of preamble
time/point = 1ns, 2.5ns, 5ns,... as stated in the HORIZ_INTERNAL portion of the waveform descriptor
flash_clock = 250 MHz at >= 1GS/s
= 200 MHz at < 1GS/s

If the time resolution requirements are not finer than a time/point, then the coarse and fine count are not necessary in the above calculations.

This time is relative, not absolute, and therefore only the difference between two segments' times has any real meaning. Thus, when the above equation is used on two different segments only the difference between the two segments should be considered. To obtain an absolute timestamp on the first segment would require additional information from the real-time clock which is only accurate to within 10ms. If a time accuracy of better than the sample rate is required, then the coarse count must be provided. This can easily be added if the additional time resolution is required, which would yield an accuracy of 5psec, the resolution of the TDC counter.

Example Post-Trigger SCSI data

If the Block Size is 16 and there are 2 plugins in the 7200A mainframe, then an example of the SCSI data that could be sent from the 7200A after the trigger is as follows (in hexadecimal):(Note: Assume first 4 blocks were pre-trigger preamble information)

```
04 00 02 00 34 12 00 00 3E 00 A5 30 94 16 B0 B1
04 80 03 00 78 56 00 00 00 00 0C 06 46 3E 50 51
05 00 B2 B3 B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF
05 80 52 53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F
```

Translating this information we have:

BYTES OFFSET	DESCRIPTION
0..15	Plugin A, packet 4, last flash C, fine count=0x1234, timestamp = Ox3E30A51694 first 2 data bytes=B0, B1
16..31	Plugin B, packet 4, last flash D, fine count=0x5678, timestamp = 0x60C3E46 first 2 data bytes=50, 51
32..47	Plugin A, packet 5, next 14 data bytes = B2,B3,B4,B5,B6,B7,B8,B9,BA,BB,BC,BD,BE,BF
48..63	Plugin B, packet 5, next 14 data bytes = 52,53,54,55,56,57,58,59,5A,55,5C,5D,5E,5F

Format of Diagnostic Sequence Data

In order to verify the host system's correction algorithm, there exists a diagnostic mode. Diagnostic mode can only be turned on by sending the following remote command: COSC DIAG,ON

When diagnostic mode is on, after the last segment is output over SCSI uncorrected, the 7200 corrects all channels of the last segment and sends out the corrected 16-bit results. For sample rates less than 2 GS/s, this diagnostic data appears in reverse order; for records acquired at 2 GS/s, this data appears in order. In order to distinguish 16-bit diagnostic data from uncorrected 8-bit data the diagnostic segment is preceded by the 16-bit tag 0x4444 or ASCII 'DD'. The normal segment preamble (last flash, fine count, and timestamp) are not output since these values have already been used to correct the data.

For example, if we have a 7234 in 1 channel mode, 20 points/segment, *and the 1-flash correction coefficients are:*

0x4876 0xfdf0

Then the uncorrected data (in hex) would be sent as:

```
ff ff 00 00 02 5b 00 00 13 00 c0 0a bc 34
bb bb bb bb bb bb bb bb bb bb bc 33 4a 48
48 48 48 49 48 4a 48 4a 49 49
```

where:

ffff = channel tag
0000 = last flash (A)
5b02 = TDC fine count
000000130ac034bc = timestamp
bb = first uncorrected data point
: :
49 = last uncorrected data point

And the corrected diagnostic data (in hex) would be follow as:

```
44 44 4c 50 44 50 6e 51 4c 50 4c 50 4c 50 54 50 32 4f 32 4f
2a 4f a6 50 62 48 3a b5 1a b4 1a b4 1a b4 1a b4 1a b4 1a b4
1a b4 22 b4 f8 b2
```

where:

4444 = Diagnostic tag ("DD")
504c = last corrected data point
5044 = second to last corrected data point
: : : : : :
b2f8 = first corrected data point

Correcting Raw Data

When uncorrected data is requested in SCSI Sequence Mode, the data must first be filtered before using it. The filter will compensate for sampling efficiency, ADC gain, and ADC leveling characteristics. The type of filter to be applied is a Finite Impulse Response (FIR) filter. The number of coefficients used in each filter is based on the sampling rate. When a filter is used to process the data, *the corrected output consists of filter length - 1 fewer* points. Therefore, the SCSI data contains filter length -1 extra points. This fact is important when correcting the data as well as determining the boundaries between each channel's raw data in the SCSI data stream.

Application of filter coefficients

The FIR algorithm used is based on the following relationship between the filter input sequence x(n) and the filter output sequence y(n):

$$y[n] = \sum_{k=0}^{M-1} h[f][k]\, x[n-k] \quad \text{where} \quad \sum_{k=0}^{M-1} \quad \text{is the sum from } k=0 \text{ to } M-1$$

M = filter length
h[f][k] = filter coefficients
  f = last flash (0 - 7)
  k = index to coefficient
y[n] = output samples
x[n] = current input sample
x[n-k] = previous input samples

So that for filter length M=7, 400 MS/s sampling, last flash = C,
flash order = ...C A C A C A..., we have the following:

```
y[0]=h[C][0]*x[0] + h[C][1]*x[-1] + ... +h[C][6]*x[-6]
y[1]=h[A][0]*x[1] + h[A][1]*x[0]  + ... +h[A][6]*x[-5]
y[2]=h[C][0]*x[2] + h[C][1]*x[1]  + ... +h[C][6]*x[-4]
:           :           :           :       :
y[n]=h[f][0]*x[n] + h[f][1]*x[n-1]+ ... +h[f][6]*x[n-6]
```

As one can see, we always need (filter_length - 1) previous input samples before we can generate the first output sample. Therefore, we lose (filter_length - 1) input samples after the FIR filter is applied. This is the reason that the waveform data array contains (filter_length - 1) extra points. The data array is also acquired with the proper trigger delay such that after the filter is applied, the filtered waveform exhibits the programmed trigger delay (which implies that the uncorrected data exhibits an incorrect trigger delay). Therefore, the procedure to correct the uncorrected data is to pre-read (filter_length - 1) input samples from the data array, then apply the above filters to produce the corrected data array.

Note that for any given filter_length samples, the filter that is applied is the one associated with the flash ADC (A,B,C or D) that was used to acquire that last sample. As the filter "moves" across the data, the last flash changes and so must the filter coefficients.

In order to execute the FIR filter, one needs to know the format of the input samples (x[n]) and the format of the filter coefficients(h[f][k]). The input samples in the waveform data array read over the SCSI interface exist in binary form. The input samples are the raw digitized 8-bit ADC values given in signed 2's complement form as follows:

ADC value Hex	Decimal	Analog magnitude(volts)
7F	127	+ FULL_SCALE-1
01	1	+ (1/128)*FULL_SCALE
00	0	0
FF	-1	- (1/128)*FULL_SCALE
:	:	:
80	-128	- FULL_SCALE

where: FULL_SCALE = (4 divisions) * (Volts/Div) volts

The format of the filter coefficients are integers with the following relationship:

Filter Coefficient Hex	**Decimal**	**Floating Point Equivalent**
7FFF	32767	1.9999
:	:	:
4000	16384	1.0000
:	:	:
2000	8192	0.5
:	:	:
0000	0	0
:	:	:
E000	-8192	-0.5
:	:	:
C000	-16384	-1.0000
:	:	:
8000	-32768	-2.0000

The filter coefficients are contained in the TRIG_TIME_ARRAY block of the preamble for each channel. The coefficients themselves are to be considered as 16-bit words in Intel LO/HI byte format so that we have:

BYTE OFFSET	DESCRIPTION
0	LSB of correction format word (always 0)
1	MSB of correction format word (always 0)
2	number of filters (1,2,4 or 9)
3	number of coefficients per filter (2,7,13, or 63)
4	LSB of coefficient 1 (bits 0..7)
5	MSB of coefficient 1 (bits 8..15)
6	LSB of coefficient 2 (bits 0..7)
:	: : :

n-1	LSB of coefficient m (bits 0..7)
n	MSB of coefficient m (bits 8..15)

Once the last flash is known, the proper set of filter coefficients can be applied to the data based on the sampling rate. For sampling rates that interleave flash ADCs, three filters must really be applied. The first two must be applied to each flash individually: a simple gain filter and a sampling efficiency filter; the last filter is applied to all interleaved flashes from a channel to correct for overall leveling characteristics. However, since this would require (2*num_flashes)+1 FIR passes across the data, we have developed a faster method. The three filters have been convolved into one filter per last flash of filter length samples. Thus, only one pass must be made thru the data. Since the order of the interleaved flashes is fixed for a given sampling rate, use the filter associated with the last flash of any given filter length samples to determine the corrected output sample for that FIR.

The sampling rate determines the order that the flashes are interleaved. The combinations are (Note: A1=flash A, channel 1):

Sampling Rate	filter length	# of filters	Order that flash ADCs are interleaved
<=200 MS/s	2	1	... A A A A A A A A A A
400 MS/s	7	2	... C A C A C A C A C A
1 GS/s	13	4	... D B C A D B C A D B
2 GS/s	13/ch	4/ch	... D2 D1 C2 C1 B2 B1 A2 A1 D2 D1

EXAMPLE:

Given a 400 MS/s waveform, then based on the following filter coefficients, the first 3 output points would be as follows:

FILTER COEFFICIENTS

flash(f)	h[0]	h[1]	h[2]	h[3]	h[4]	h[5]	h[6]
flash A:	18229	0	-207	0	0	0	0
flash C:	18646	-742	269	-131	-19	-1	0

INPUT SAMPLES

Sample	Flash	Value Decimal	(Hex)
x[0]	C	-85	(AB)
x[1]	A	-84	(AC)
x[2]	C	-83	(AD)
x[3]	A	-82	(AE)
x[4]	C	-81	(AF)
x[5]	A	-30	(E2)
x[6]	C	25	(19)
x[7]	A	75	(4B)
x[8]	C	78	(4E)
x[9]	A	79	(4F)
x[10]	C	80	(50)
x[11]	A	81	(51)

OUTPUT SAMPLES

Since we have a 7-tap filter, the flash that acquired the last sample of the first 7 taps (x[6]) is flash C. Therefore, the coefficients for flash C are applied first, then flash A, then flash C, and so on:

```
y[0]  = h[C][0]*x[6]  +  h[C][1]*x[5] +  h[C][2]*x[4] + ... +  h[C][6]*x[0]
      = 18646*25      +  -742*(-30)   +  269*(-81)    + ... +  0*(-85)
      = 479024

y[1]  = h[A][0]*x[7]  +  h[A][1]*x[6] +  h[A][2]*x[5] + ... +  h[A][0]*x[1]
      = 18229*75      +  0*25         +  -207*(-30)   + ... +  0*(-84)
      = 1373385

y[2]  = h[C][0]*x[8]  +  h[C][1]*x[7] +  h[C][2]*x[6] + ... +  h[C][0]*x[2]
      = 18646*78      +  -742*75      +  269*25       + ... +  0*(-83)
      = 1411014

y[3]  = h[A][0]*x[9]  +  h[A][1]*x[8] +  h[A][2]*x[7] + ... +  h[A][0]*x[3]
      = 18229*79      +  0*78         +  -207*75      + ... +  0*(-84)
      = 1424566

  :       :      :      :      :      :      :             :
```

Since the coefficients are scaled such that 16384 = 1.0, the output samples (y[ ]) are scaled by 64 to go from 8 to 16 bits of accuracy (16384/64 = 256 or 8 extra bits of accuracy):

```
y[0] = 479024/64  = 7484  (0x1d3c)
y[1] = 1373385/64 = 21459 (0x53d3)
y[2] = 1411014/64 = 22047 (0x561f)
y[3] = 1424566/64 = 22258 (0x56f2)
  :        :         :       :
```

Special 2 GS/s filter

Since waveforms acquired at 2 GS/s have data from both channel 1 and channel 2 interleaved, first the channel-specific flash filters must be applied to each channel's data. That is, for each channel, a 13-tap FIR must be applied to correct the data for sampling efficiency, flash ADC gain, and flash ADC leveling characteristics. This will produce a flash-corrected interleaved record. A final 63-tap filter must then be applied to the interleaved record. This last filter is symmetrical so the order of application is not important. The coefficients of this filter will limit the bandwidth of the input signal based on the "Opt Pulse Res" field of the Vertical menu screen or the P91_FILTER remote command as follow.

YES = use a wideband filter: slow roll-off starting at 500 MHz
NO = use a 500MHz sharp cutoff filter

EXAMPLE:

Given the input data as:

```
x[0] x [1] x [2] x [3] x [4] x [5] x [6] x [7] x [8] x [9] x [10] x [11] x [12]...
 B1   A2   A1   D2   D1   C2   C1   B2   B1   A2    A1    D2    D1...

... x [20] x [21] x [22] x [23] x [24] x [25] x [26] x [27] x [28]
... D1     C2     C1     B2     B1     A2     A1     D2     D1
```

Given the filter coefficients as:

h[A1][0..12] = 13 coefficients for last flash = A from Channel 1
h[B1][0..12] = 13 coefficients for last flash = B from Channel 1
h[C1][0..12] = 13 coefficients for last flash = C from Channel 1
h[D1][0..12] = 13 coefficients for last flash = D from Channel 1
h[A2][0..12] = 13 coefficients for last flash = A from Channel 2
h[B2][0..12] = 13 coefficients for last flash = B from Channel 2
h[C2][0..12] = 13 coefficients for last flash = C from Channel 2
h[D2][0..12] = 13 coefficients for last flash = D from Channel 2

Then the flash-correction filters are applied as:

y[0] = h[B1][0]*x[24] + h[B1][1]*x[22] + ... + h[B1][12]*x[0] (Chan 1)
y[1] = h[A2][0]*x[25] + h[A2][1]*x[23] + ... + h[A2][11]*x[1] (Chan 2)
y[2] = h[A1][0]*x[26] + h[A1][1]*x[24] + ... + h[A1][11]*x[2] (Chan 1)

y[3] = h[D2][0]*x[27] + h[D2][1]*x[25] + ... + h[D2][11]*x[3] (Chan 2)
: : : : :

This produces an interleaved flash-corrected record as follows:

y[0] y[1] y[2] y[3] y[4] y[5] y[6] y[7] y[8] y[9] y[10] y[11] y[12] ...

This interleaved record is then filtered with the 63-point 2 GS/s filter as follows:

Filter Coefficients: b[0] b[1] b[2] .... b[60] b[61] b[62]

Y[0] = b[0]*y[62] + b[1]*y[61] + ... + b[61]*y[1] + b[62]*y[0]
Y[1] = b[0]*y[63] + b[1]*y[62] + ... + b[61]*y[2] + b[62]*y[1]
Y[2] = b[0]*y[64] + b[1]*y[63] + ... + b[61]*y[3] + b[62]*y[2]
Y[3] = b[0]*y[65] + b[1]*y[64] + ... + b[61]*y[4] + b[62]*y[3]
: : : : :

This produces a final corrected and interleaved record as follows:

Y[0] Y[1] Y[2] Y[3] Y[4] Y[5] Y[6] Y[7] Y[8] Y[9] Y[10] Y[11] Y[12] ...

7200A Index

C

D

N

O

P

R

S

T

U

V

7200A Install / Archive Utility

The LeCroy 7200A Precision Digital Oscilloscope is shipped with the latest software version installed. In addition, when you fill out and return the USER REGISTRATION card provided in the operating manual, you will receive software updates via floppy disk for the warrantly period. Following are instructions for loading software and configuring the 7200A.

With the 7200A powered off:

1. Insert Installation Disk 1 in the 7200A.
2. Power on the 7200A. The screen will remain blank for a few seconds while the 7200A performs self tests. Then a message will inform you that software is loading.
3. To Install new software see Installation of New Software page 2.
4. To Backup or Restore software see 7200A Backup/Restore Utility page 5.

ROM version
System Self Test Passed
Loading . . .

LeCroy

Figure 2

7200A Installation of New Software

The MS-DOS Copy should be used to save user files when installing a new version.

1. Press the Install softkey. The Install Program Main screen will appear. See Figure 2.

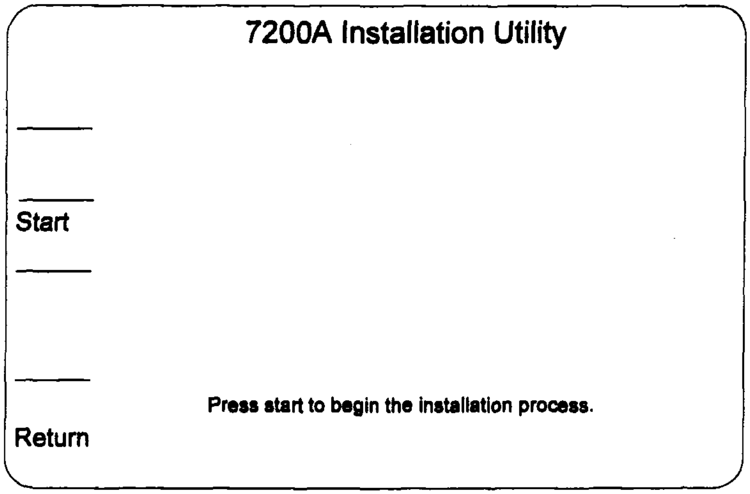


Figure 3

The Install Program Main Screen has two choices.

- To Install new software press the Start softkey.
- To return to the main screen press the Return softkey.

2. Press the Start softkey to begin installation of new software. While the software is loading the following message will appear on the screen. See Figure 2.

   Installing . . .

3. If the User Partition (area where the Panel files and RCL programs are stored) is to be modified, the following prompt appears

   Partition USER exists, do you want to erase all old files?

the Yes and No softkeys will appear on the screen.

- Press the Yes softkey to erase all old files including Panel setups and RCL programs.
- Press the No softkey to leave the existing files on the hard disk.

  Any files with the same name as new files being installed will be overwritten.

4. The message Installing. . . will be displayed.
5. When disk 1 has finished installing, the prompt for disk 2 will appear.

   Please insert disk 2
6. Insert disk 2 and the installation will automatically continue.
7. When disk 2 is finished installing you will be prompted for additional disks until complete.
8. When the installation is complete the following prompt will appear.

   Remove floppy disk and press Return
   key to return to main screen.
9. Remove the floppy disk, press the Return softkey. The System Utilities Main Screen will appear.
10. Press the Exit softkey to reset the 7200A and load the main program.

MS-DOS Copy

Pressing the MS-DOS Copy softkey on the Backup screen will bring up a screen which allows all files from the USER area of the internal disk to be copied to MS-DOS formatted floppies. See Figure 3.

COPY USER FILES TO MSDOS FLOPPY

Please insert first disk for file copy
(you will be prompted for additional
disks if required) and press Start
to begin copying files or Return
to abort the file copy.

Start
Return

Figure 4

If the installation disk is still in the drive when Start is pressed, the program will prompt "Please insert the copy disk". It will also complain if you atttempt to copy files to 7200A format disks. Unformatted blank disks may be used and they will automatically be formatted.

If files of the same name as the source file on the internal drive exist on the floppy you will be prompted to confirm overwrite of the floppy file:

Overwrite "filename.ext"?

Yes and No softkeys will be displayed. Selecting No will not copy that file and skip to the next file. Selecting Yes will copy the file onto the floppy.

When the copy operation is complete the program prompts:

File copy complete. Please remove floppy.

Press Return to continue.

Pressing the Retun softkey will return to the Install/Archive main screen.

7200A Back Up / Restore Utility

The 7200A Back Up / Restore Utility is located on the 7200A Systems Utilities diskette. It allows you to make a copy of all or part of the 7200A's internal disk drive on floppy diskettes for archival purposes.

Use MS-DOS Copy to move user files to a new 7200A version. The backup utility does not necessary allow user files to be restored to a different version of 7200A software.

If for any reason your installation diskettes have been lost, it is highly recommended that you make a complete back up of your 7200A before installing a new software update. The installation process is not dangerous, but you may wish to return to the previous revision.

Back Up / Restore Setup Screen

Select either the Backup or Restore softkey. when either the Backup or Restore softkey is pushed, the Backup/Restore Setup screen appears. See figure 4. Selection of choices is the same as it is in other 7200A setup screens. Turn the detented knob below the center of the display to move the cursor box to the desired choice. Then turn the continuous knob to select the value. The individual fields are described in the next section.

7200A Back Up/Restore Utility

MS-DOS Copy	Disk Operation	BACKUP
	DISK CONFIGURATION	NO
	NON-VOLATILE MEMORY	YES
	WAVEFORM MEMORIES	YES
	RECORDED TRACES	YES
	7200A SYSTEM CODE	YES
	SYSTEM FILES	YES
	USER FILES	YES
Start		
Return		

Figure 4

Setup Screen Selections

The fields indicate areas of the internal disk drive which may be backed up or restored.

DISK CONFIGURATION	At the beginning of the internal disk drive is a block of data which describes the properties of the drive.
NON-VOLATILE MEMORY	This area is actually the battery backed up memory (BRAM). It contains the current front-panel setup well as information about the WAVEFORM MEMORIES and RECORDEDTRACES.

WAVEFORM MEMORIES	The waveform memories, M1 through M8, are saved on this area of the disk.
RECORDED TRACES	When you press "Record Traces" in the Main Screen during normal 7200A operation, this area is used to record the waveform data.
7200A SYSTEM CODE	This area is used to store the program which is normally executed when the power is turned on.
SYSTEM FILES	During the software installation procedure, several files are written on the internal disk. These include device drivers, the on-line help manual,the waveform template, and several other files.Together, these are the system files.
USER FILES	In addition, you may write panel setup and RCL program files on the internal drive if you wish. These are the user files.

Restrictions

1. The DISK CONFIGURATION area includes the bad track information. The 7200A uses this to avoid unreliable places on the disk. For this reason, it is imperative that the DISK CONFIGURATION information not be copied from one internal disk to another. If you attempt to restore this information, you will be prompted with the following message to verify that the information is being restored to the drive from which it was saved.

> *Restoring the configuration to a different drive will destroy the bad track information. Is this the drive which was backed up?*
>
> *If this is the same disk, press YES. Otherwise, press NO.*

2. The NON-VOLATILE MEMORY, WAVEFORM MEMORIES, and RECORDED TRACES areas are locked together. If one is selected for back up or restore, they are all selected.

3. The 7200A SYSTEM CODE and the SYSTEM FILES areas are locked together. If one is selected for back up or restore, both are selected.

Back Up and Restore Operation

After you have selected the areas to be backed up or restored, press the Start softkey. The highlighted areas of the setup screen are removed, indicating that it is no longer possible to make changes.

You will be prompted to insert disks as required. A message of the form "You may now insert disk..." indicates that you may insert the next floppy. The program is not ready to use it at this time, but will not be delayed when the disk is needed if you insert it now.

A message of the form "Please insert disk..." indicates that the program now needs the next floppy, and is waiting for you to insert it. When this type of message appears, the 7200A beeps to alert you.

During back up, a rough approximation of the number of floppy disks necessary is displayed. This number is updated after each floppy is finished. The first estimate is usually too large by quite a bit. It gets better as the back up proceeds.

During back up, floppies are automatically formatted if necessary. If an error occurs when writing to the floppy, you will be prompted to insert an alternate floppy.

When a restore operation is started, the first disk is read to see which areas were backed up. Any areas selected for restore which are not on the floppy disks are indicated with the word "ABSENT".

Note that the program will refuse to write on a 7200A CONFIGURATION disk, a 7200A INSTALL disk, or the 7200A Back Up / Restore disk. This prevents you from destroying important infomation. In some cases, it may be proper to write on such floppies, such as when a new disk of the same type is received from the factory. In this case, first format the floppy using the For-

Note that the program will refuse to write on a 7200A CONFIGURATION disk, a 7200A INSTALL disk, or the 7200A Back Up / Restore disk. This prevents you from destroying important information. In some cases, it may be proper to write on such floppies, such as when a new disk of the same type is received from the factory. In this case, first format the floppy using the Format softkey in the Disk Configuration setup screen before loading the 7200A Back Up / Restore program.

Progress Display

During the back up and restore operation, a bar graph appears at the bottom of the screen to indicate the progress of the operation, as illustrated in figure 5.

|————————————| FLOPPY 1 WRITING

|——————————————————————| FLOPPY 2 PACKING

|—————| WAVEFORMS BACKING UP

Figure 5

The first two lines indicate data for the current and next floppy disk. The third line indicates data for the internal disk. The length of each line represents the amount of data. As data is obtained, the line grows from left to right. As it is used up, it disappears from left to right.

For the floppies, the total length of each line represents the amount of data which can be stored on a floppy, approximately 750,000 characters.

For the internal disk, the total length of the line indicates the amount of data to be processed. During back up, this is the sum of the lengths of the areas

During back up, the floppies go through one or more of the following phases:

PACKING	Data from the internal disk is being compressed for writing.
IDLE	The program is waiting for a previous write to finish.
WAITING	The program is waiting for you to insert the next disk.
FORMATTING	The floppy is being formatted prior to writing.
WRITING	Data is being transferred to the disk.
DONE	All processing has been completed.

During restore, the floppies go through one or more of the following phases:

WAITING	The program is waiting for you to insert the next disk.
READING	Data is being read from the floppy.
UNPACKING	Data is being decompressed for writing to the internal disk.
IDLE	The program is waiting for a previous UNPACK to finish.
DONE	All processing has been completed.

The internal disk can be in one of the following states:

BACKING UP	Data is being read from the internal disk for back up.
RESTORING	Data is being written to the internal disk during restore.
SKIPPING	Data is being read from the floppy during restore, but it will not be written to the hard disk.