



OPERATING AND SERVICE MANUAL

MODEL 1950A EXPANSION MODULE

SERIAL NUMBERS

This Manual applies directly to instruments with serial numbers prefixed **1949A**.

For additional information about serial numbers, refer to **INSTRUMENTS COVERED BY MANUAL**, in Section I.

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SAFETY CONSIDERATIONS

GENERAL—This is a Safety Class I instrument (provided with terminal for protective earthing).

OPERATION—BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument's external markings which are described under "Safety Symbols."

WARNINGS

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminal of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection.

If this instrument is to be energized via an auto-transformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury.

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

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the product.



Indicates hazardous voltages.



Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

WARNING

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

CAUTION

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

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

The 1950A is a two channel, 100 MHz Expansion Module for the 1980A/B. A 1980A/B with a 1950A installed becomes a four channel oscilloscope measurement system.

Local operation of the 1950A is identical to local operation of the 1980A/B vertical section. Several of the 1950A display functions (sweep speed, dual, etc.) are controlled by the 1980A/B. Front panel key interaction between the 1980A/B and 1950A is required to call some functions.

Remote operation of the 1950A is similar to remote operation of the 1980A/B, however, the 1950A has its own set of commands.

The 1950A Operating and Service Manual has eight major sections. The manual contains the following information.

Section I, General Information: describes the instruments documented by this manual. It also provides a basic description of the Expansion Module which includes accessories, and specifications.

Section II, Installation: provides information about initial inspection, preparation for use, storage and shipment.

Section III, Operation: provides detailed operating information for the instrument, including remote (HP-IB) operation and operator's checks and maintenance.

Section IV, Performance Tests: presents the procedures required to check the performance of the instrument against the critical specifications in table 1-1.

Section V, Adjustments: provides instructions for properly adjusting the instrument.

Section VI, Replaceable Parts: provides ordering information for all replaceable parts and assemblies.

Section VII, Manual Changes: contains manual change information necessary to document all serial prefixes listed on the title page of this manual. In addition, this section also contains recommended modifications for earlier instrument configurations.

Section VIII, Service: provides the information required to repair the instrument.

One copy of the 1950A Operating and Service Manual is supplied with each instrument. Additional copies may be ordered separately through your nearest Hewlett-Packard Sales and Service office. The part number for the complete Operating and Service Manual is listed on the title page of this manual.

Also listed on the title page is the part number for a microfiche version of the complete Operating and Service Manual. The microfiche are 100 × 150 mm (4 × 6 inch) microfilm transparencies of the manual. Each microfiche contains up to 96 photo duplicates of manual pages. The microfiche package also includes the latest Manual Changes supplement.

1-2. SPECIFICATIONS.

Specifications and supplemental characteristics of the 1950A Expansion Module are listed in table 1-1. This instrument will meet the electrical characteristics listed following complete calibration as given in the Adjustments section of the manual. These electrical characteristics apply over the ambient temperature range of 0 to 55°C except as otherwise noted. Warm-up time for given accuracy is 30 minutes.

1-3. SAFETY CONSIDERATIONS.

WARNING

To prevent personal injury, observe all safety precautions and warnings stated on the instrument and in the manual.

The 1950A and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of general safety information. Safety precautions for installation, operation, and servicing are found in appropriate locations throughout the Operating and Service Manual. These precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in the manual violates safety standards of design, manufacture, and intended use of this instrument. Hewlett-Packard assumes no liability for failure to comply with these requirements.

1-4. INSTRUMENTS COVERED BY MANUAL.

Attached to the instrument is a serial number plate. The serial number is in the form: 0000A00000. It is in two parts: the first four digits and the letter are the serial number prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The letter in the prefix designates the country in which the instrument was manufactured. (A=USA; G=West Germany; J=Japan; S=Singapore.) The suffix, however, is assigned sequentially and is unique to each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. Manuals accompanying these newer instruments include a Manual Changes supplement. The supplement contains change instructions for the entire Operating and Service Manual.

In addition to change information, the supplements may contain information for correcting errors in the manuals. To keep your manuals as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. These supplements are identified with the print date and part number that appears on the title page of this manual. Complimentary copies of these supplements are available from Hewlett-Packard.

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard Sales and Service office.

1-5. DESCRIPTION.

The 1950A Expansion Module is a complete two channel, 100 MHz Plug-in Expansion Module for the 1980A/B. It features 2 mV/div deflection factor, and delta voltage functions.

In addition, the 1950A has these special features:

- * All functions are programmable via HP-IB (HP's implementation of IEEE Std 488) for automatic or semi-automatic measurement applications.
- * Expandable with the 1980A/B system with feature ROMs and other option links.
- * Calibration can be performed on-site, without removing 1950A Expansion Module and requires little or no test equipment. Complete, step by step instructions are displayed on the CRT.
- * Performance verification through front panel selected confidence test and memory checks.
- * Uses all 1980A/B functions such as Autoscope and Save-Recall.
- * Probe recognition—deflection factor, ΔV , or external trigger level readout is automatically adjusted for division ratio of recommended 1:1 or 10:1 probes.

1-6. OPTIONS.

1-7. Electrical Options.

Option 080: Supplies two, 10080A 10:1, 1 M (3.3 ft) probes instead of two 10081A probes.

Option 082: Supplies two, 10082A 10:1, 3 M (10 ft) probes instead of two 10081A probes.

Option 083: Supplies two, 10083A 1:1, 1 M (3.3 ft) probes instead of two 10081A probes.

Option 084: Supplies two, 10084A 1:1, 2 M (6.5 ft) probes instead of two 10081A probes.

Option 090: Deletes probes.

Option 910: Supplies one Additional Operating and Service Manual.

1-8. HEWLETT-PACKARD INTERFACE BUS (HP-IB).



1-9. Compatibility.

The standard 1950A Expansion Module makes use of the 1980A/B Oscilloscope Measurement Systems HP-IB interface and can be used in automatic system applications driven by an HP-IB equipped controller or computer.

For more information relating to remote operation of the 1950A Expansion Module, refer to Remote Operation, Hewlett-Packard Interface Bus in Section III of this manual and Section III of the 1980A/B Operating and Programming Manual.

1-10. ACCESSORIES SUPPLIED.

Accessories Supplied with the 1950A Expansion Module are shown in figure 1-1. Included with the instrument are: two 10081A, 10:1 divider probes and one Operating and Service Manual.

1-11. EQUIPMENT AVAILABLE.

The following accessories are available for servicing the 1950A Expansion Module:

64 Pin Hybrid Extender. Aids troubleshooting circuits containing 64 pin hybrids. Order HP part number 5081-7663.

Module Extender. Required to service plug-in Expansion Modules. Order HP Model 19807A.

1-12. RECOMMENDED TEST EQUIPMENT.

Table 1-2 lists equipment required for maintaining the 1950A. The Critical Specifications column describes the essential requirements for each piece of test equipment. Other equipment can be substituted if it meets or exceeds these critical specifications.

The Suggested Model column may suggest more than one model. The first model shown is usually the least expensive, single purpose model. Alternate models are suggested for additional features that would make them a better choice in some applications. For example, reasons for recommending an alternative model might be:

- * HP-IB programmability
-- or --
- * Multi-function capability (that is, one model can replace two or more single purpose models)

Table 1-3 presents the advantages of the alternate suggestions.

Table 1-1 Specifications

OPERATING MODES

Voltage vs time (V vs T) and channel 3 vs 2 (3 vs 2).

VERTICAL DISPLAY MODES (V vs T)

Channel 3; channel 4: channels 3 and 4 displayed on alternate sweeps (ALT); channels 3 and 4 displayed by switching between channels at approx 400 kHz rate with blanking during switching (CHOP); automatic selection of alternate for sweep speeds >1 ms/div and chop for sweep speeds ≤ 1 ms/div (AUTO-CHOP/ALT); channel 3 plus 4 algebraic addition (3+4), channel 3 and/or 4 may be inverted; and either main or delayed trigger signal.

VERTICAL AMPLIFIERS (2)

BANDWIDTH: 3 dB down from a 5 div reference signal (0 to $+40^\circ$ C).

DC-Coupled: dc to 100 MHz in 50Ω and 1 M Ω input modes.

AC-Coupled: <10 Hz to ≥ 100 MHz.

BANDWIDTH LIMIT: limits upper bandwidth to approx 20 MHz.

INPUT COUPLING: AC, DC, 50Ω (DC), Ground. Ground position disconnects input connector and grounds amplifier input.

INPUT RC

AC or DC: 1 M Ω $\pm 2\%$ shunted by approx 16 pF.

50 Ohm (DC): 50Ω $\pm 3\%$.

MAXIMUM INPUT VOLTAGE

50 Ohm: 5V rms.

1 Megohm: ac or dc coupled, 250V (dc + peak ac) at ≤ 1 kHz.

DEFLECTION FACTOR

Range: 2 mV/div to 10 V/div.

Resolution: 3 digits.

Adjustment: coarse stepping is in a 100, 150, 200, 300 ... 900 sequence; fine stepping is a change of 1 in the least significant digit.

Accuracy: $\pm 3\%$.

VERTICAL POSITION

Range: baseline can be adjusted ± 15 major div from center graticule line (possible 10 div off screen).

Resolution: 0.02 major division.

Adjustment: coarse or fine slew rates.

Accuracy: $\pm 2\%$ of reading $+0.3$ major div).

 ΔV (CHANNEL 3 OR 4)

Range: ± 15 times the deflection factor selected for that channel.

Resolution: 0.02 times the deflection factor for that channel.

Adjustment: coarse or fine slew rates.

Accuracy: $\pm 4\%$ (for a $\Delta \leq 10$ major divisions).

CHANNEL 3 + 4

Amplifier: bandwidth and deflection factors are unchanged.

Differential (Channel 3-4 or Channel 4-3): CMR is at least 20 dB from dc to 20 MHz with common mode signal amplitude equivalent to 10 div and one channel adjusted for optimum rejection.

3 vs 2 OPERATION**BANDWIDTH**

Y-Axis (Channel 3): same as channel 3 in V vs T.

X-Axis (Channel 2): dc to 4 MHz.

Phase Difference Between Channels: $\leq 3^\circ$ dc to 100 kHz.

Deflection Factors: same as Vertical Amplifiers.

OPERATING CHARACTERISTICS

AUTOSCOPE: seeks, scales, and displays input signals >20 mV and >50 Hz. Autoscope preselects V vs T operating mode, main sweep, assigns Control Knob to main sec/div, ac input coupling, character generator on, internal trigger source, positive slope, and trigger level to 0.5 div.

SELECTIVE AUTOSCOPE: seeks, scales, and displays selected channels in the same manner as autoscope except all setup functions below the variable function keys on the "VOLTAGE" and "TIME" panels are preserved.

PROBE RECOGNITION: deflection factor, ΔV , or external trigger level readout is automatically adjusted for division ratio of recommended 1:1 or 10:1 probes.

SAVE/RECALL REGISTERS: saves up to eight complete front panel setups in nonvolatile memory.

PRESET: sets front panel to V vs T, intensified sweep mode, 100 $\mu\text{s}/\text{div}$ main sweep, 10 $\mu\text{s}/\text{div}$ delayed sweep, channel 1 main trigger, channel 1 delayed trigger, 2 V/div on channels 1, 2, 3 and 4, and ac input coupling.

CRT DISPLAY READOUTS: displays selected trigger source and selected variable functions.

Trigger Source: time base, main or delayed for channels 1, 2, 3 and 4, external, and line.

Variable Functions: channels 1, 2, 3, and 4, volts/div and ΔV ; main and delayed sweep speeds; time delay, normal, numerical, and digital; normal and numerical ΔT ; and calculated frequency (reciprocal of ΔT) $1/\Delta T$.

LED DISPLAY READOUTS: all functions related to the Control Knob are displayed.

HORIZONTAL POSITION

Range: ± 6 major div from center vertical graticule line.

Resolution: 0.02 major divisions.

Adjustment: coarse or fine slew rates.

DUAL SEPARATION

Range: delayed sweep waveform can be adjusted ± 5 major vertical div from main sweep waveform.

Resolution: 0.02 major divisions.

Adjustment: coarse or fine slew rates.

PANEL INTENSITY: adjustable in relative steps of 1 from 0 to 99.

Table 1-1. Specifications (Cont'd)

GENERAL

BUS COMPATIBILITY: as defined in IEEE Std 488-1978 is: SH1, AH1, T5, TEO, L3, LEO, SR1, RL1, PPO, DC0, DT1, CO, and E2.

SELF CALIBRATION ROUTINE: self calibration routine can be performed at any time without altering front panel setup.

Balance Self Cal: DC balances vertical pre-amplifier inputs to minimize trace shift during deflection factor range changes.

FRONT PANEL CAL 1950A: Channel 3 and 4 position, and main and delayed trigger level are calibrated to specified accuracy using internally generated calibration signals. Channel 3 and 4 deflection factors, are calibrated to specified accuracies with externally

supplied calibration signals. Deflection factors are also supplied with internal calibration signals as a performance verification with approx $\pm 6\%$ accuracy.

POWER: all required power is supplied by the 1980A/B

OPERATING ENVIRONMENT:

Temperature: 0 to +55°C

Humidity: to 95% relative at +40°C

Altitude: to 4600 m (15000 ft)

Vibration: vibrated in three planes for 15 min. each with 0.38 mm (0.015 in.) excursion, 10 to 55Hz.

ACCESSORIES FURNISHED: two 10081A, 10:1 divider probes approximately 2m (6 ft) long and one Operating and Service Manual 01950-90901.

Weight: net, approximately 1.5 kg (3.3 lb); shipping weight, approximately 2.2 kg (4.8 lb).

Table 1-2. Recommended Test Equipment

Instrument	Critical Specifications	Suggested Model	Use*
Adapter	GR874 to female BNC	HP Part No. 1250-0850	P
Adapter	GR874 to male BNC	HP Part No. 1250-0859	P
Attenuator	6 dB	General Radio GR874-G6	P
BNC Tee	1 male, 2 female	HP Part No. 1250-0781	P
Cable Pair	50 ohm BNC male to BNC male, approximately 9 inches long. Pair must be of equal length.	HP 10502A	P
Controller, HP-IB	HP-IB compatibility as defined by IEEE Std 488 and the identical ANSI STD MC1.1: SH1, AH1, T2, TEO, L2, LEO, SRO, PPO, DCO, DTO, and C1, 2, 3, 4, 5.	HP 9825B with 98034A (revised) -or- HP 9835A with 98332A1/O ROM and 98034A (revised) -or- HP 85F	C,T
Digital Voltmeter (DVM)	range: 0 to 100 Vdc accuracy: $\pm 0.1\%$ input impedance: 10 M Ω	HP 3465A -or- HP 3438A	T
LCR Meter	range: 3 pF to 20 pF accuracy: $\pm 5\%$	HP 4332A	A
Oscilloscope	2 channels, delayed sweep (sensitivity:) 5 mV/div bandwidth: 100 MHz	HP 1740A	T
Peak to Peak Source	level: 20 mV to 100 V accuracy: $\pm 0.25\%$	Ballantine 6125B	A,P,T
Probe	input R: 1 M Ω shunt C: 12 pF division ratio: 10:1 division ratio: 10:1 comp. range: 20 to 26 pF	HP 10041A	A,P,T
Pulse Generator	Fast Rise Time	Ballantine 6125B	A
Sampling Voltmeter	bandwidth: 10 MHz to 100 MHz accuracy: $\pm 3\%$	HP 3406A with HP 11063A Sampling Tee	P
Signal Generator	range: 10 MHz to 100 MHz	HP 3200B	P,T
Signature Analyzer	No Substitute	HP 5004A	T
Square Wave Generator	range: 10 Hz to 100 kHz squarewave level: 0 to 10 Vp-p	Ballantine 6125B	A

* A = Adjustments, C = Operator's Checks, P = Performance Testing, T = Troubleshooting

Table 1-3. Alternate Test Equipment

Instrument Type	Suggested Alternate	Instrument Replaced	Advantages of Alternate
Controller, HP-IB	HP 9835A with 98332A and 98034A (revised) HP 85F	HP 9825B with 98213A and 98034A (revised) HP 9825B with 98034A (revised) 98213A	CRT Display HP Enhanced BASIC Larger Memory CRT Display HP Extended BASIC Lower Cost
Digital Voltmeter (DVM)	HP 3438A	HP 3465A	HP-IB*
* HP-IB is Hewlett-Packard's implementation of IEEE Std 488 and the identical ANSI Std MC1.1			

SECTION II

INSTALLATION

2-1. INTRODUCTION.

This section provides installation instructions for the 1950A Expansion Module. Also included is information pertinent to initial inspection, preparation for use, storage, and shipment.

2-2. INITIAL INSPECTION.

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers and panels).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. The contents of the shipment should be as shown in figure 1-1. Procedures for checking electrical performance are given in the Operator's Checks in Section III and Performance Tests in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard Sales and Service office. If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE.

If the 1950A Expansion Module is shipped separately or is installed in a different 1980A/B, Normal Calibration (Section V) should be performed.

2-4. Power Requirements.

All power required by the 1950A Expansion Module is supplied by the 1980A/B Oscilloscope Measurement System.

WARNING

Do not attempt to operate the 1950A Expansion Module from any power source except a 1980A/B.

CAUTION

Ensure the 1980A/B power is off prior to plugging 1950A into 1980A/B.

2-5. Mating Connectors.

Coaxial Connectors. Coaxial mating connectors used with the Measurement System should be 50 ohm BNC male connectors.

2-6. Operating Environment

Same as 1980A/B Oscilloscope Measurement System. See 1980A/B Oscilloscope Measurement System Operating and Programming Manual, Section II.

2-7. STORAGE AND SHIPMENT.

2-8. Environment.

The 1950A Expansion Module may be stored or shipped in environments within the following limits:

Temperature	-55°C to +75°C
Humidity	<95% relative
Altitude	<15 300 metres (50 000 feet)

Protect the instrument from conditions which would cause internal condensation.

2-9. Packaging.

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also mark the container FRAGILE to ensure careful handling. In correspondence, refer to the instrument by model number and full serial number.

Other Packaging. The following general instructions should be used for repackaging with commercially available materials:

- a. Wrap instrument in heavy paper or plastic. (If shipping to Hewlett-Packard office or service center, attach tag indicating type of service required, return address, model number, and full serial number.)
- b. Use strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.
- c. Use a layer of shock-absorbing material 75 to 100 mm (3- to 4-inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside container. Protect control panel with cardboard.
- d. Seal shipping container securely.
- e. Mark shipping container FRAGILE to ensure careful handling.
- f. In any correspondence, refer to instrument by model number and full serial number.

SECTION III

OPERATION

3-1. INTRODUCTION.

This section contains complete operating information for the 1950A Expansion Module. Included in this section are descriptions of all front panel features, local and remote operation, operators checks, adjustments, and maintenance.

3-2. Operating Characteristics.

The 1950A Expansion Module is a two channel, 100 MHz Expansion Module, for use in the 1980A/B Oscilloscope Measurement System, which can be controlled via HP-IB. Complete instrument setups can be programmed and measurement results can be reported under remote control. Eight nonvolatile registers within the 1980A/B can be used for saving and recalling complete instrument setups during local or remote operation.

Table 3-1 summarizes the major operating characteristics of the 1950A Expansion Module. For a complete description, refer to Table 1-1, Specifications.

3-3. Local Operation.


Instructions for local (i.e., front panel) operation are described in the following paragraphs.

Panel Features briefly describes all controls, connectors and indicators. Front panel features are discussed in figure 3-1.

Detailed Operating Instructions provide a complete operating reference for the Measurement System user. They include information about the various measurements that can be made, as well as complete descriptions of all controls and menu functions. The instructions are arranged alphabetically by subject.

Each instruction contains a general description that covers signal levels, ranges, measurement limits, and other general information. Following the description, local operating procedures are explained and an example is given to illustrate the procedures. At the end of each instruction, any special considerations are listed that might aid the user.

3-4. Remote Operation.

Knowledge of local operation is essential for the remote operator to use the full capabilities of the 1950A Expansion Module. Pages containing explanations of HP-IB related operations are noted with the  symbol. Instructions for HP-IB operation are in the following paragraphs.

Remote Operation, Hewlett-Packard Interface Bus in the 1980A/B Oscilloscope Measurement System Operating and Programming Manual, presents a complete description of the instrument's bus implementation. It covers bus compatibility, HP-IB message response, general Data message (input and output) format rules, and many other basic bus considerations.

Detailed Operating Instructions explain how to program instrument functions and make bus controlled measurements. Specific format rules and any special programming considerations are described. Each instruction includes two programming examples for reference.

HP-IB Codes and Format Summary condenses the programming information for the instrument. It is a quick reference for the experienced remote operator. The summary lists all program codes by function and includes a complete description of parameter range and format. Refer to the 1980A/B Oscilloscope Measurement System Operating and Programming Manual for condensed programming information for the 1980A/B.

Notation Conventions and Definitions explains the syntax conventions used in this manual.

3-5. Operator's Checks.

This section includes procedures that allow the operator to make a quick evaluation of instrument operation. The following checks are provided:

Confidence Test is a menu function that assures most of the instrument is operating properly. This procedure requires a 1:1 divider probe or BNC cable.

RAM TEST is a menu function that verifies operation of RAM memory. No additional equipment is required.

ROM CHECKSUM is a menu function that verifies the content and operation of ROM Memory. No additional equipment is required.

HP-IB I/O Check in the 1980A/B Oscilloscope Measurement System Operating and Programming Manual, confirms that the Measurement System responds properly to all HP-IB messages. This check assumes that local operation has been verified with the Confidence Test and Memory Check procedures. An HP-IB controller, interface and connecting cable are required.

3-6. Operator's Calibration and Adjustment.

This section provides several procedures that should be used periodically to ensure measurement accuracy. Each procedure includes a brief description of the adjustment and the recommended calibration cycle. The following procedures are provided:

Vertical Balance Self-cal is a menu function that nulls the offsets within the vertical amplifiers. Execute this routine if trace baselines shift as vertical deflection factor is changed.

Probe Compensation describes how to adjust the low frequency compensation of probes used with the Measurement System.

3-7. OPERATOR'S MAINTENANCE.

The only instrument maintenance an operator needs to perform is to occasionally clean the instrument front panel using a soft cloth and either a commercial glass cleaner, or a mild soap and water solution.

CAUTION

Do not use chemical cleaning agents or abrasive cleaners that might damage the plastics in this instrument. Recommended cleaning agents are isopropyl alcohol, kelite (1 part kelite, 20 parts water), or a solution of 1% mild detergent and 99% water.

3-8. GENERAL OPERATING INSTRUCTIONS.

CAUTION

Excessive input voltage will damage the input attenuators and amplifiers. Observe the maximum input rating described in Table 1-1, Specifications.

Switch off instrument power before installing or removing the 1950A Expansion Module. Otherwise, damage to the 1980A/B or 1950A Expansion Module could result.

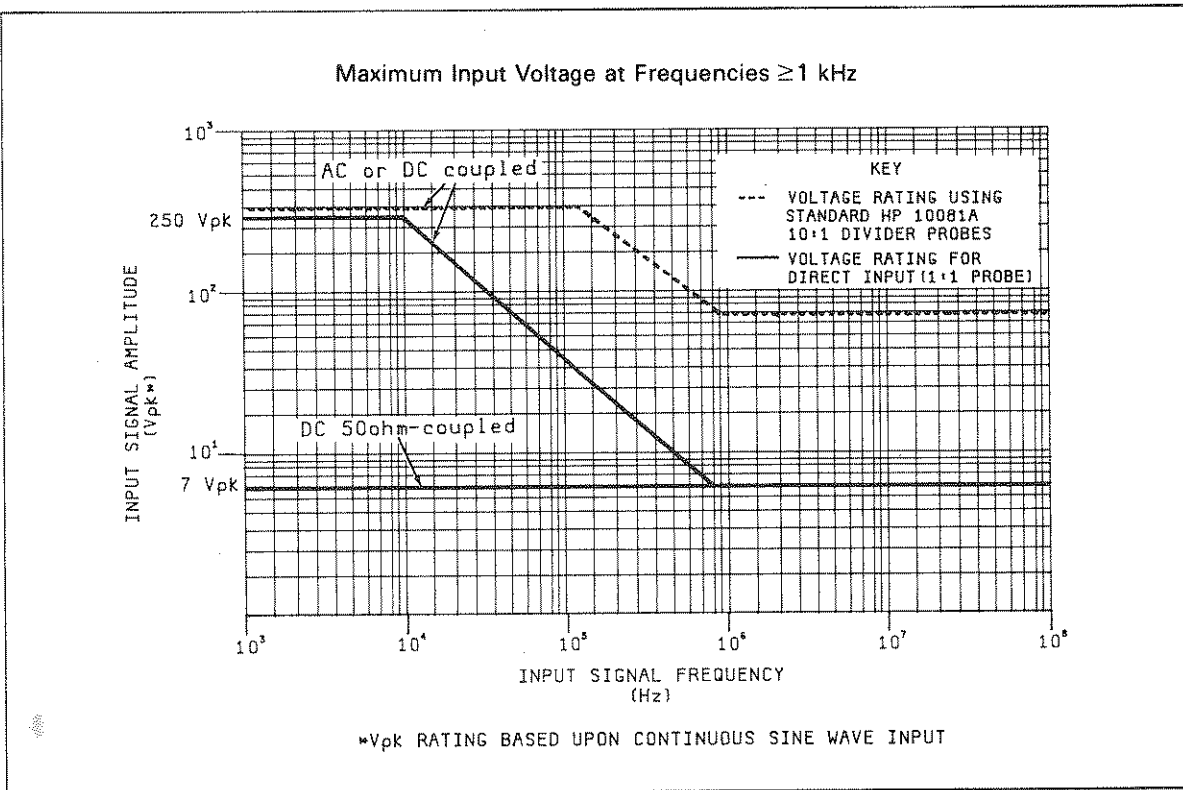
3-9. Power-on.

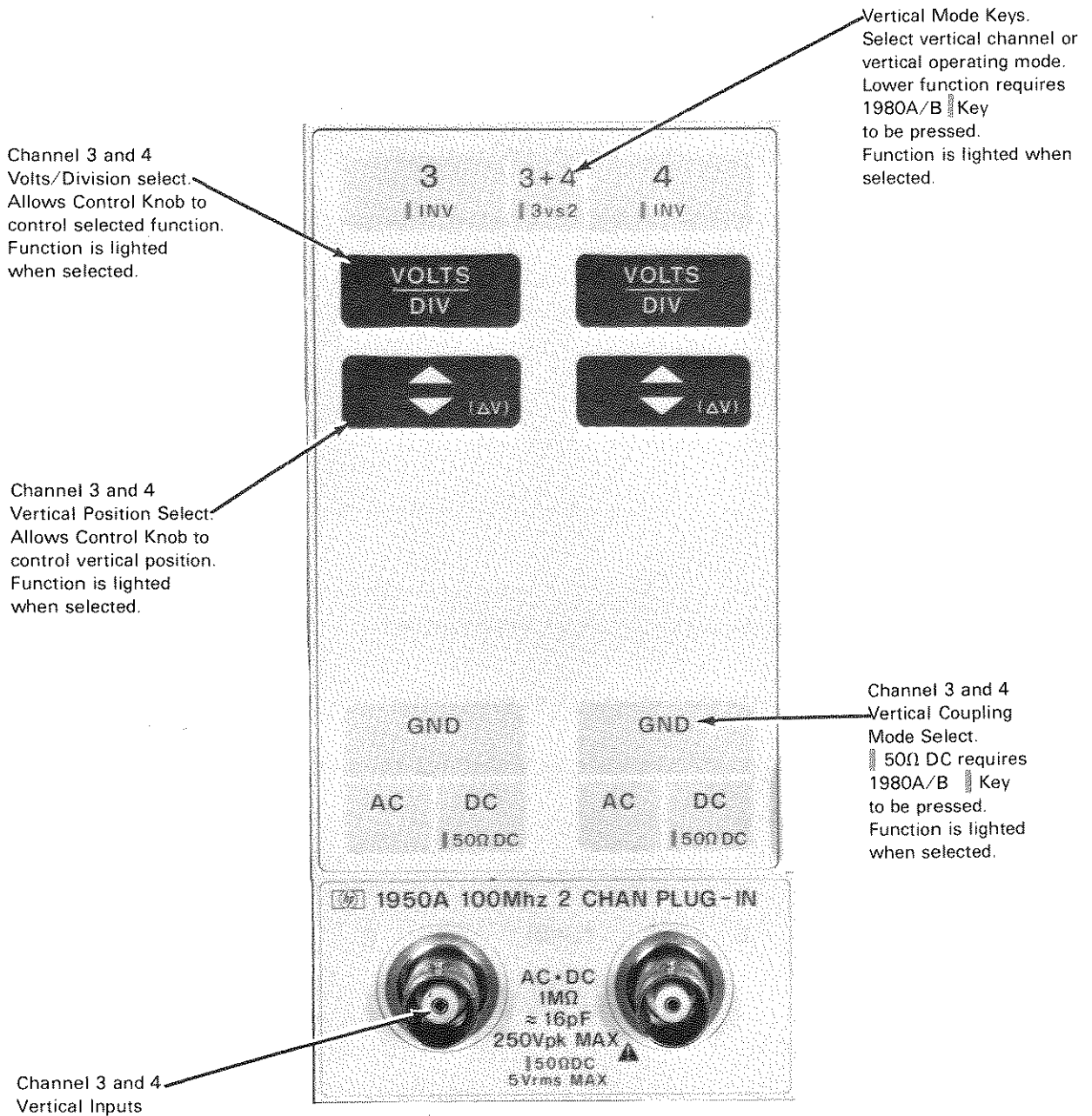
Power-on Configuration. The 1980A/B Measurement System and 1950A Expansion Module Powers on with the same settings it had before it was switched off (that is, if line power was removed). The exceptions to this rule are described in the "Power-on Sequence and Default Conditions" Detailed Operating Instruction. The primary default conditions are:

- * Any DC 50 ohm vertical coupling are changed to DC.
- * All HP-IB conditions default except address and addressing mode selection.

Table 3-1. Operating Characteristics

Operating Parameter	Capability
Autoscope	Autoscope autoranges trigger level, deflection factor, and sweep speed for repetitive input signals > 20 mV p-p and > 50 Hz.
Delta Volts (channel 3 and 4)	Range: ± 15 times channel deflection factor
Vertical Deflection (channel 3 and 4)	Range: 2 mV/div to 10 V/div
Vertical Position (channel 3 and 4)	Range: ± 15 major divisions
Maximum Input Voltage (channel 3 and 4) DC 50 ohm-coupled DC or AC-coupled	Level: 5 Vrms Level: 250 V (dc + peak ac) at < 1 kHz



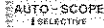


VARIABLE FUNCTION keys are color coded dark brown (). They assign the Control Knob to the variable function parameter to be changed.

Figure 3-1. Front Panel Features

3-10. SIMPLIFIED OPERATION

Obtaining a Basic Display

Use autoscope to quickly set up the 1980A/B and 1950A for a basic, triggered display. Connect the signal to be viewed to channel 3 or 4, and press .

Indications

Active functions or operating modes are indicated by the lighted keys and the CRT readout.

Primary variable function values are displayed in the CRT readout for convenient reference.

Advisory messages are displayed on the CRT as an operator's aid. They are displayed momentarily when an illegal key entry is made or when other conditions occur that may require additional information.


Changing Values

Variable function values can be changed with the Control Knob.

Assign the Control Knob to a variable function by pressing the corresponding variable function key:

	(ch 3 or 4)	deflection factor
	(ch 3 or 4)	vertical position


Then increment or decrement the function value by rotating the Control Knob.

The Control Knob is a stepping control. Coarse or fine step resolution can be selected with .

Soft Key Menus

The function of the soft keys is changed when a menu is called to the CRT. Menus redefine the soft keys with displayed labels such as:



The menus can be turned on and off by pressing .

3-11. PANEL FEATURES.

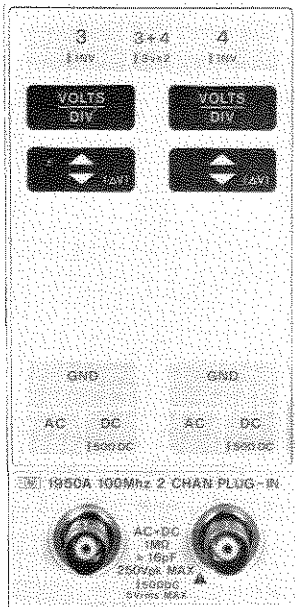


Figure 3-2. 1950A Front Panel.

Vertical Mode

and toggle corresponding channels on and off. turns on channel 3 and 4, displays algebraic sum. Can be used for differential measurements when one channel is inverted with respect to the other.

Vertical Deflection Factor

(ch 3 or 4) assigns Control Knob to vertical deflection factor.
 inverts channel 3.
 inverts channel 4.

Vertical Position

(ch 3 or 4) assigns Control Knob to vertical position.

Scope Mode

selects X-Y mode, channel 3 signal (Y-axis) plotted vs channel 2 (X-axis).

Vertical Coupling

, , , and (ch 3 or 4) select the input signal coupling.

Channel Inputs

Channel 3 and 4 inputs are female BNC connectors which have the special probe key contact. When the recommended HP probes are connected, channel deflection factor is displayed as the total value at the probe tip. Pressing the probe key on the HP recommended probe when connected to channel 3 or channel 4 input will deflect the displayed trace for identification.

3-12. REMOTE OPERATION, HEWLETT-PACKARD INTERFACE BUS.








For general HP-IB operation of the 1980A/B Oscilloscope Measurement System and 1950A Expansion Module, refer to section III of the 1980A/B Oscilloscope Measurement System Operating and Programming Manual.


For specific programming codes and formats for the 1950A Expansion module, refer to the detailed operating instructions in this manual.

3-13. OPERATOR'S CHECKS.

3-14. Confidence Test.

Description Confidence Test can be executed from the front-panel to confirm that the internal 1950A hardware and software is functional. This test does not verify that the 1950A is operating to specifications. A 1:1 probe or BNC cable is required to execute Confidence Test.

Procedure Select the CONFIDENCE TEST menu by pressing ,  1950A,  CONFIDENCE TEST 1950A. Then, connect the calibrator signal to the vertical channel to be tested. To execute the test, press any key except  PREVIOUS MENU or .

To exit the CONFIDENCE TEST menu without performing the test, press  PREVIOUS MENU.

Indication If the instrument passes the Confidence Test, the PASSED TEST advisory message is displayed on the CRT.

If the instrument fails the Confidence Test, an error message is displayed in the LED Readout that indicates which failure was detected. The test is then aborted, the 1980A/B executes an autoscope to initialize itself, and the 1950A, and the advisory FAILED TEST is displayed. The error messages that may be displayed during the Confidence Test are listed in table 3-2.






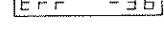
If no signal is applied to an input channel when the Confidence Test is executed, the advisory message SIGNAL NOT FOUND is displayed on the CRT in addition to the error message .


Table 3-2. Confidence Test Error Messages

Error Message	Error Description
	No signal found.
	10 V range error
	1 V range error
	0.1 V range error
	0.02 V range error

Response If a failure is detected by the Confidence Test, the instrument might be useable but it does require servicing.

Comments At the end of the Confidence Test, the Measurement System executes an autoscope on the calibrator signal (at output level of 1 Vp-p). Previous front-panel settings are not preserved by this test. However, the Save/Recall registers and HP-IB status information are not changed.

The Confidence Test requires a front panel key closure to execute. The test cannot be executed via the HP-IB.

 can not be used to turn off the menus when the CONFIDENCE TEST 1950A menu is displayed.

3-15. RAM Test.

Description RAM Test is a menu function that assures the 1950A RAM memory is operating properly.

Note


The rear panel CAL switch must be placed in the NOT-PROTECTED position to run the RAM TEST. Be sure to return the CAL switch to the PROTECTED position after the test is completed or calibration factors may be changed.

Procedure RAM Test is called with the following key sequence:

```

OPTION
MENU
7 RECALL 1950A
* RAM TEST

```

RAM Test is executed when key  RAM TEST is pressed. This check can also be executed via the HP-IB by sending the data message:

SK0, 7, 5 <CR><LF>



Indication When the instrument passes the RAM Test, the advisory **PASSED TEST** is displayed on the CRT.

If the instrument fails RAM Test, an error message is displayed in the LED readout that indicates where in memory the failure occurred. When the first error is detected, the routine is aborted and the advisory **FAILED TEST** is displayed. Refer to Table 3-3 for error messages.

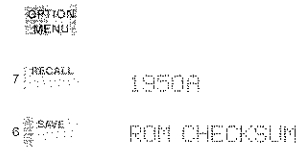
Response If the instrument fails the RAM Test, it might be useable, but it does require servicing.

Comments Executing the RAM Test causes the advisory messages to be enabled. However, there are no other changes in instrument front-panel settings or status.

3-16. ROM Checksum

Description ROM Checksum is a menu function that verifies the content and operation of ROM memory.

Procedure ROM Checksum is called with the following key sequence:



ROM Checksum is executed when key ROM CHECKSUM is pressed. This check can also be executed via the HP-IB by sending the data message:

SK0, 7, 6 <CR><LF>

Indication When the instrument passes the ROM Checksum, the advisory PASSED TEST is displayed on the CRT.

If the instrument fails the ROM Checksum, an error message is displayed in the LED readout that indicates where in memory the failure occurred. When the first error is detected, the routine is aborted and the advisory FAILED TEST is displayed. Refer to Table 3-3 for error messages.

Response If the instrument fails the ROM Checksum, it must be serviced.

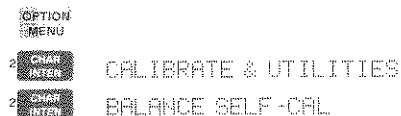
Comments Executing the ROM Checksum causes the advisory messages to be enabled. However, there are no other changes in instrument front-panel settings or status.

3-17. OPERATOR'S CALIBRATION AND ADJUSTMENT.

3-18. Vertical Balance Self-cal.

Description The vertical balance self-cal routine nulls gain dependent offsets in the vertical pre-amplifiers. The self-cal routine virtually eliminates baseline shift as vertical deflection factor is changed. The balance self-cal should be performed whenever there is noticeable shift of the vertical baseline as deflection factor is changed.

Procedure To execute the balance self-cal from the front panel of the 1980A/B, press the following key sequence:



The balance self-cal can be executed via HP-IB by sending the Data message:

SK0,2,2 <CR><LF>

Note

Do not apply a signal to any channel input while executing the balance self-cal procedure.

Indication While balance self-cal is executing, advisory message `BALANCE SELF-CAL CH1` (or `CH2`, `CH3`, `CH4`) is displayed on the CRT. When the balance routine is finished, the Measurement System is restored to the same settings it had before the self-cal was initiated.

If the balance routine cannot calibrate one of the vertical channels, an error message is displayed in the LED readout to indicate which channel failed. The instrument can be programmed to issue the Require Service message to signal this failure, see the "Error Messages" and "Service Request Condition" Detailed Operating Instructions for further information.

Response Although a vertical balance self-cal failure indicates the Measurement System should be checked by qualified service personnel, the instrument may still be useable.

3-19. Probe Compensation.

Description Probe compensation may be required because of variations in total input resistance and capacitance from one instrument or input to another. To compensate a probe, proceed as follows:

Procedure Connect probe to the input of desired vertical channel.

Connect the probe tip to the front-panel calibrator terminal.

Execute an autoscope by pressing `AUTO-SCOPE`.

Select DC Coupling for the channel in use by pressing `DC`.

Adjust divider probe low frequency compensation for correct display (figure 3-3).

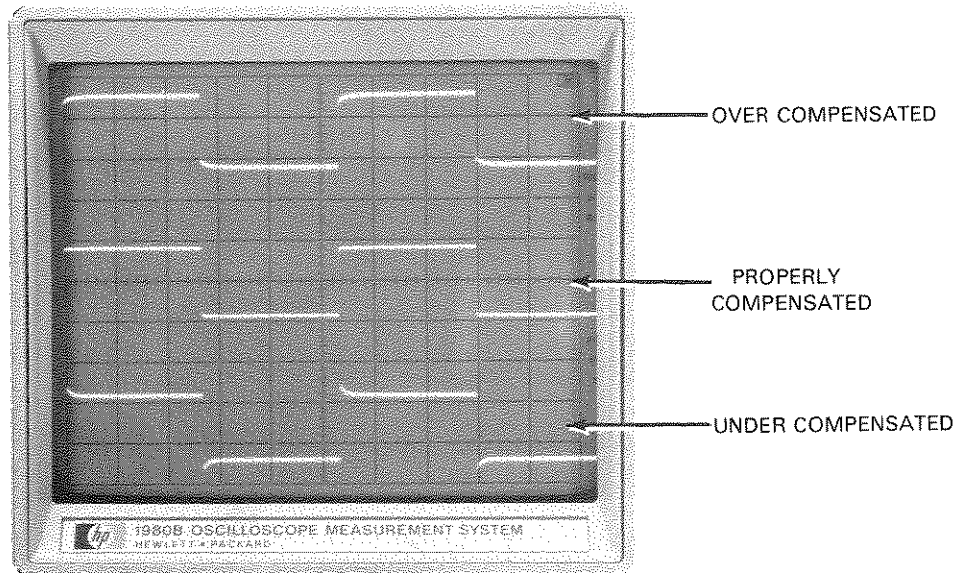


Figure 3-3. Divider Probe Adjustment Display

NOTES

3-20. DETAILED OPERATING INSTRUCTIONS.

3-21. Using the Detailed Operating Instructions.

The Detailed Operating Instructions contain all the information needed to operate the 1950A. The Detailed Operating Instructions are arranged alphabetically.

The following considerations should be remembered when using the Detailed Operating Instructions:

- * Procedures and examples assume the instrument has been powered up and the Auto-Scope pressed with no signal applied.
- * The procedures and examples for HP-IB operation include only the program codes (device dependent commands) needed for remote operation. The HP-IB command mode messages (such as REN, MLA, MTA, and UNL) that are required in bus data transfers are not listed.
- * HP-IB program codes are listed in ASCII code.
- * The notation conventions used to describe HP-IB codes are defined in Notation Conventions and Definitions at the end of this section.

Control Knob

Description The Control Knob is used to change the value of variable function parameters. The knob is assigned to a variable function by pressing the corresponding key. As the knob is rotated, the value is immediately changed.


The Control Knob is a stepping control; either coarse or fine step resolution can be selected. In coarse, the speed of knob rotation affects the step size so that changes can be quickly made. Fine provides vernier-like control where step size is set for maximum resolution.


Accidental changes to parameters can be prevented by selecting hold mode. In hold, the knob is not assigned to any variable function.

The Control Knob can also be assigned to variable functions via the HP-IB. In this special case, the knob is enabled for local operation, even if the 1980A/B is in remote mode. This allows the selected function to be adjusted from the front-panel, while all other keys and functions remain in remote.

Procedure To assign the Control Knob to a 1950A function, press the corresponding variable function key:

-  (ch 3 or 4) deflection factor
-  (ch 3 or 4) vertical position

Toggle Control Knob between fine and coarse step resolution by pressing .

To select hold mode, press . Exit hold by assigning the Control Knob to a variable function.



Program Codes



Assign the Control Knob to a 1950A variable function and set step resolution:

PR <code> [, <step>]

- code ::=
 - Ø hold
 - 1 channel 3 deflection factor
 - 2 channel 4 deflection factor
 - 3 channel 3 position
 - 4 channel 4 position

- step ::=
 - Ø coarse
 - 1 fine

Example Assign Control Knob to channel 3 deflection factor, coarse step resolution.


LOCAL (keys)	 (ch 3) 
REMOTE (codes)	identifier _____ PR1, Ø <CR><LF> _____ EOS assignment code _____ _____ step resolution

Control Knob (Cont'd)



Indication Control Knob assignment is indicated by lighting the corresponding variable function key. Also, the LED readout displays the parameter value of the function.

The LED readout displays `Hold` to indicate hold mode is selected. If the Control Knob is rotated while in hold, the advisory `CONTROL KNOB IN HOLD` is displayed.

 lights to indicate that fine is selected.

Comments The Control Knob defaults to hold mode when the 1980A/B makes the remote-to-local transition.

Executing autoscope or selective autoscope assigns the Control Knob to main sweep speed. If the 1980A/B is in remote mode, the Control Knob is enabled as though the program code `RC3,0` was sent.

Executing preset (HP-IB "IN") in remote or local mode assigns the Control Knob to trace intensity. If the 1980A/B is in remote mode, the Control Knob is enabled as though the program code `RC16,0` was sent.

Control Knob step resolution for a variable function may also be changed by the following:


- * Executing autoscope
- * Executing selective autoscope
- * Executing preset (HP-IB "IN")
- * Recalling settings from Save/Recall registers

Delta Volts


Description ΔV provides a convenient means of measuring voltage using the Control Knob. ΔV is a special operating mode of the vertical position variable function in which channel deflection factor is multiplied by change in vertical position. A zero vertical reference point can be set anywhere within the vertical position range. Then, as vertical position is incremented or decremented, the 1980A/B displays a direct reading of the voltage interval between the zero reference and the present trace position. ΔV measurements can be made with both channel 3 and 4 in V vs T mode or with channel 3 and 2 in 3 vs 2 scope mode.

Delta Volts Characteristics (Channel 3 or 4)

range ± 15 times the channel deflection factor
 resolution 0.02 times channel deflection factor
 accuracy $\pm 4\%$ for a change ≤ 10 div

Procedure Select ΔV mode for a given channel and set the zero reference point by pressing  while the Control Knob is assigned to that channel's vertical position variable function.

While the Control Knob is assigned to channel 3 or 4 ΔV , pressing  turns off ΔV mode for that channel.

Select step resolution by pressing .



Program Codes

Turn on ΔV mode for channel 3 or 4 and assign Control Knob:

PV <channel>, <state>

channel ::= 3 channel 3
 4 channel 4

state ::= 0 ΔV off
 1 ΔV on, zeroed, Control Knob assigned

Select Control Knob step resolution:

PR <channel>, <step>



channel ::= 5 channel 3
 6 channel 4

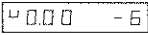
step ::= 0 coarse
 1 fine

Delta Volts (Cont'd)



Example Turn on channel 3 ΔV .

<p>LOCAL (keys)</p>	 (Ch 3) 
<p>REMOTE (codes)</p>	<p style="text-align: center;"> identifier ——— PV3,1 <CR><LF> ——— EOS channel ——— state </p>

Indication When ΔV is on for a channel, the LED and CRT readouts display the ΔV value instead of deflection factor. The LED readout displays  when ΔV is zeroed.

Comments If channel deflection factor is changed after ΔV mode is selected, ΔV is turned off.


Error Messages

Description If the 1980A/B detects an internal hardware error in the 1980 or 1950A, an error message is displayed in the LED readout. The error message is primarily meant as a diagnostic aid; it indicates a failure that requires the attention of qualified service personnel. Table 3-3 lists the 1950A error conditions that can be detected.

The instrument can be programmed to send the Require Service message when an error condition is detected. The condition can also be read by the system controller, refer to the "Instrument Status" Detailed Operating Instruction. Table 3-3 includes the HP-IB codes for the various error conditions.

Indication When an error is detected, the LED readout displays an error message, such as: Err -34.

Comments If an error occurs during either balance self-cal, RAM test, ROM checksum, or Confidence Test, the error message is displayed briefly in the LED readout. Then the procedure terminates and displays **FAILED TEST** on the CRT.

If a cal factor error occurs, the error message is displayed in the LED readout until any key except  is pressed.

The HP-IB code "25" is sent for many of the error conditions. It is the code for the advisory **FAILED TEST**, which is displayed on the CRT when an error is detected during any of the procedures described in paragraph 3-13, Operator's Checks.



Table 3-3. Hardware Error Codes

LED code	HP-IB Code (ASCII)	Error Description
Err -16	25	ROM 16 Failed checksum
Err -18	25	ROM 18 Failed checksum
Err -20	25	ROM 20 Failed checksum
Err -31	25	Confidence-test vertical channel error
Err -33	25	Confidence-test 10 V signal not found
Err -34	25	Confidence-test 1 V signal not found
Err -35	25	Confidence-test 0.1 V signal not found
Err -36	25	Confidence-test 0.02 V signal not found
Err 41	66	1950A cal factor checksum error
Err 53	79	Channel 3 failed autobalance
Err 54	80	Channel 4 failed autobalance

NOTES





Key

Description The remote operator can simulate the pressing of front-panel keys using the key (PK) command. Although almost every function is addressable using the primary command set, the key command can be used as an alternative.

Procedure Send a series of key codes in the same order as keys would be pressed in local operation.





Program Codes

Enter a key sequence:

PK < code > [, < code >]...

code ::= integer
[d] d

key codes are listed in tables 3-4 and 3-5.

Example Execute the keystroke sequence  (ch 3) .

REMOTE (codes)	<p>PK 80, 76; KY 7; PK 80 <CR><LF></p> <p>identifier ——— key codes ——— EOS</p>
--------------------------	---

Note

KY code must be used for shift (Blue) key.

Indication The PK and KY commands execute as front-panel keystrokes. The same indications result as in local operation.

Comments Although the PK command is interpreted as a keystroke, it does not affect the "last key code" instrument status qualifier.

If the last key code is read when no key has been pressed since power-on, the code "64" is output by the 1980A/B.



Key (Cont'd)

Table 3-4. 1950A Expansion Module Key to PK Code Conversion Table

Ch3 Key	ASCII Code	Ch4 Key	ASCII Code	Key	ASCII Code
	80		81		84
	76		77	Ch3 Probe	85
	72		73	Ch4 Probe	86
	75		78		
	71		74		
	79		82		

Table 3-5. PK Code to 1950A Expansion Module Key Conversion Table

ASCII Code	Key	ASCII Code	Key	ASCII Code	Key
71	(ch3)	76	(ch3)	81	(ch4)
72	(ch3)	77	(ch4)	82	(ch4)
73	(ch4)	78	(ch4)	83	(Not Used)
74	(ch4)	79	(ch3)	84	
75	(ch3)	80		85	Ch3 Probe
				86	Ch4 Probe



Learn Mode

Description The 1950A has learn mode capability which uses the HP-IB controller memory to store instrument configurations (teach). Learn mode provides a fast means of configuring the 1950A from an HP-IB controller (learn), and also, a compact format in which instrument setups can be stored.

The learn string contains all the information that can be stored in the Save/Recall registers. In other words, it includes all variable function parameter values, and all state or mode selections.

Procedure The learn string is transferred as binary data between the 1950A and the HP-IB system controller.



Program Codes

Command the 1950A to output a learn string:

PE

Then address the 1980A/B to talk. The 1950A learn string comprises 33, 8 bit bytes. End-of-String is indicated by setting the EOI bus control line true with the 33rd byte.

To configure the 1950A using learn mode, send a previously acquired learn string as a Data message:

<33 byte string><CR><LF>

Comments If the Measurement System receives a "PE" (teach) program code and is then addressed to talk, it sends the Learn String. The Learn String consists of 33, 8-bit bytes containing information about front panel configuration. This binary data can be stored in the controller's memory for future use. The Learn String includes only those parameters that can be stored in the instrument's internal Save/Recall registers; the contents of the Save/Recall registers, however, are not included in the Learn String. Refer to the "Save/Recall" Detailed Operating Instruction in the 1980A/B Operating and Programming Manual for information about register limitations.

Note

The 33rd byte of the Learn String is sent with the bus EOI line true, to indicate end-of-string.

When the Measurement System is addressed to listen, the binary data can be returned to it in a 33 byte string (learn). The Measurement System interprets the first two bytes to determine that this is a learn String. Following the 33rd byte, the transfer must be terminated with <CR>, and <LF>. When the <LF> is received, the instrument changes state according to the Learn String contents.

Note


During the transfer of the Learn String, the instrument should not be readdressed. If it is the transfer will be aborted. The 33 byte string should be sent or read by the controller using a technique that does not readdress bus devices.

The learn string should not be mixed with any other HP-IB command on the same programming line.

The 1950A control knob information is not contained in the 1950A learn string; the 1950A control knob information is part of the 1980 learn string.

Power-on Sequence and Default Conditions

Description When power is switched on, the 1980A/B performs a series of internal checks and checks on the 1950A. These are transparent to the operator unless an error is found. The following condition may be encountered at power-on:

Hardware error. If a hardware error is detected, an error message is displayed in the LED readout. Error codes and recommended responses are described in the "Error Messages" Detailed Operating Instruction. Pressing any key except  clears the error display.

Reading Values Via HP-IB



Description All variable function parameter values can be read via the HP-IB. Output Data message format for each parameter is described in table 3-6.

Procedure Send a command to select the desired output data, then address the 1980A/B to talk.



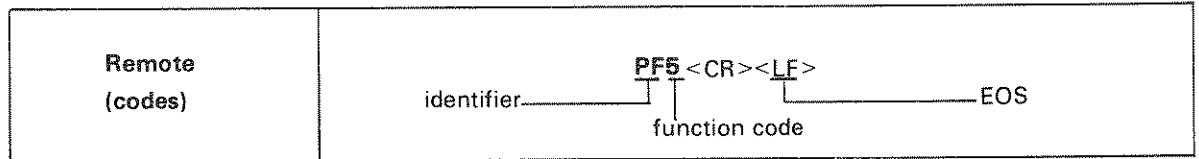
Program Codes

Select parameter value to be output:

PF<code>

- code::=
- 1 channel 3 deflection factor
 - 2 channel 4 deflection factor
 - 3 channel 3 ΔV value
 - 4 channel 4 ΔV value
 - 5 channel 3 position
 - 6 channel 4 position

Example Select channel 3 position value as data output.



Comments The 1950A outputs "E" (uppercase) as the delimiter between the mantissa and exponent in exponential values.

Table 3-6. Data Message Output Format

Variable Function	Units	Output Format
channel 3 deflection factor channel 4 deflection factor channel 3 ΔV channel 4 ΔV	V/div V/div Volts Volts	<SP> {+ -} d.dd {+ -} dd <CR> <LF>
channel 3 position channel 4 position	div div	<SP> {+ -} dd.dd <CR> <LF>

Scope Mode

Description The 1950A has 2 basic display modes: Volts vs time and channel 3 vs channel 2. This instruction provides a description of these modes and general advice on their use.

V vs T is the most commonly used scope mode. Channel 3 or 4 signal inputs (Y-axis) are plotted versus time base signals (X-axis). In V vs T, vertical and horizontal modes can be selected to enable convenient voltage and timing measurements.

3 vs 2 selects an X-Y operating mode. Channel 3 signals (Y-axis) are plotted versus channel 2 signals (X-axis). This mode turns on channel 3 and 2, and it enables their controls. The time bases are disabled.

Scope Mode Characteristics

V vs T Mode

Y-axis

bandwidth dc to 100MHz (limit off)

deflection factor 2 mV/div to 10 V/div

X-axis

timebase range 5 nsec/div to 1 sec/div

3 vs 2 Mode

Y-axis (channel 3)

bandwidth dc to 100 MHz (limit off)

deflection factor 2 mV/div to 10 V/div


X-axis (channel 2)

bandwidth dc to 4 MHz

deflection factor 2 mV/div to 10 V/div

Phase difference $\leq 3^\circ$, dc to 100 kHz

Scope Mode (Cont'd)

Procedure To select the 3 vs 2 scope mode, press .




Program Codes

Select 3 vs 2 scope mode:

PX

Example Select 3 vs 2 mode.

LOCAL (keys)	
REMOTE (codes)	identifier _____ <u>PX</u> <CR> <LF> _____ EOS -----

Indication The selected scope mode is indicated by the lighted 3 vs 2 mode key.


If the CRT readout is on, scope mode is also indicated by the information that is displayed. In 3 vs 2 mode, only vertical channel information is displayed.

Comments In 3 vs 2 mode, channel 2 invert is not permitted.

To exit 3 vs 2 mode, V vs T must be selected.

Soft Key Menus


Description The soft key menus provide many special functions for the remote and local operator by redefining the soft keys. Included in the menu selections are calibration routines, self test routines, and a directory of installed options. In addition, internal enhancement functions are accessed via the soft keys. Table 3-7 summarizes the menu "tree" in the standard 1980A/B with a 1950A Expansion Module installed.

Procedure To call the first level menu (when the menus are off), press .

Menus define the soft keys with labels displayed on the CRT, such as:



soft key number  key function in present menu

When menus are on, pressing  returns the soft keys to their normal functions.






Program Codes


To use menu functions via the HP-IB, send a series of soft key codes in the same sequence as in front-panel operation:


SK <code>[, <code>] ...
code ::=

0		5	
1		6	
2		7	
3		8	
4			

Example Execute the balance self-cal routine for 1980A/B and 1950A and delay self-cal routine for 1980A/B.

LOCAL (keys)	  CALIBRATE & UTILITIES BAL  BAL & DELAY SELF-CAL
REMOTE (codes)	identifier <u>SK0.2.3</u> <CR> <LF> EOS menu selection

Indication When a menu is on or a menu function is executing,  is lighted.

Comments If character intensity is less than level 35, when the menus are called with , character intensity is preset to level 35.

Calling the soft key menus turns on the CRT readout. It also erases any text written on screen via HP-IB.

Soft Key Menus (Cont'd)

Table 3-7. Soft Key Menu Tree

level 1:			
	OPTION MENU		
Soft Key #			
0	menu off		
1	PRESET		
2	CALIBRATE & UTILITIES		
3	CONFIDENCE TEST 1950A/B		
4	FEATURE ROMS		
5	HP-IB ADDRESS MODE		
6	disabled ¹		
7	1950A		
8	OPTION MENU OFF		
level 2:			
	CALIBRATE & UTILITIES	CONFIDENCE TEST 1950A/B	FEATURE ROMS
Soft Key #			
0	menu off	execute test	menu off
1	DELAY SELF-CAL	execute test	disabled ²
2	BALANCE SELF-CAL	execute test	disabled ²
3	BAL & DELAY SELF-CAL	execute test	disabled ²
4	UTILITIES	execute test	disabled ²
5	disabled ¹	execute test	disabled ²
6	FRONT PANEL CAL 1950A/B	execute test	disabled ²
7	FRONT PANEL CAL 1950A	execute test	disabled ²
8	PREVIOUS MENU	PREVIOUS MENU	PREVIOUS MENU
	HP-IB ADDRESS MODE (addressable)	HP-IB ADDRESS MODE (listen only)	HP-IB ADDRESS MODE (talk only)
Soft Key #			
0	menu off	menu off	menu off
1	normal function	normal function	normal function
2	normal function	normal function	normal function
3	INCREMENT ADDRESS	disabled	disabled
4	DECREMENT ADDRESS	disabled	disabled
5	disabled	disabled	disabled
6	CHANGE ADDRESS MODE	CHANGE ADDRESS MODE	CHANGE ADDRESS MODE
7	disabled	disabled	disabled
8	PREVIOUS MENU	PREVIOUS MENU	PREVIOUS MENU
	1950A		
Soft Key #			
0	menu off		
1	normal function		
2	normal function		
3	CONFIDENCE TEST 1950A		
4	disabled		
5	RAM TEST		
6	ROM CHECKSUM		
7	disabled		
8	PREVIOUS MENU		
level 3:			
	UTILITIES	CONFIDENCE TEST 1950A	
Soft Key #			
0	menu off	execute test	
1	normal function	execute test	
2	normal function	execute test	
3	ADVISORIES ON	execute test	
4	ADVISORIES OFF	execute test	
5	RAM TEST	execute test	
6	ROM CHECKSUM	execute test	
7	INT ADJ DELAY OSC RANGE	execute test	
8	PREVIOUS MENU	PREVIOUS MENU	

NOTES: 1. reserved for internal enhancement menu

NOTES: 2. reserved for feature ROM menu

Trigger Source

Description Channel 3 vertical input or channel 4 vertical input can be selected as either the main or delayed trigger source.

Procedure To select vertical channel 3 or 4 as the trigger source press (Main or Delayed) then press or .



Program Codes

Select vertical channel 3 or 4 as the main or delayed trigger source.

PT <trigger>, <source>

trigger ::= 1 Main Trigger
 2 Delayed Trigger

source ::= 3 channel 3
 4 channel 4

Example Assign channel 3 as the delayed trigger source.

LOCAL (keys)	(Dly'd)
REMOTE (codes)	<p>PT 2, 3 <CR> <LF></p> <p>identifier ———— trigger ———— </p> <p>source ———— </p> <p>EOS ———— </p>

Indication Channel number for each trigger is displayed on the CRT.

Vertical Coupling



Description Vertical input coupling can be selected from the front-panel or via the HP-IB. Four input configurations are provided: AC, DC, DC 50Ω, and Ground. The characteristics of each coupling are listed below. Figure 3-4 contains the maximum input voltage derating curve which must be observed for safe operation of the instrument.

Vertical Coupling Characteristics

AC-coupled

bandwidth ~10 Hz to 100 MHz
 impedance 1 MΩ ± 2% shunted by ~16 pF
 input voltage refer to figure 3-4

DC-coupled

bandwidth dc to 100 MHz
 impedance 1 MΩ ± 2% shunted by ~16 pF
 input voltage refer to figure 3-4

DC 50Ω-coupled

bandwidth dc to 100 MHz
 impedance 50Ω ± 3% shunted by ~16 pF
 VSWR typically less than 1.4:1
 input voltage 5 V rms maximum

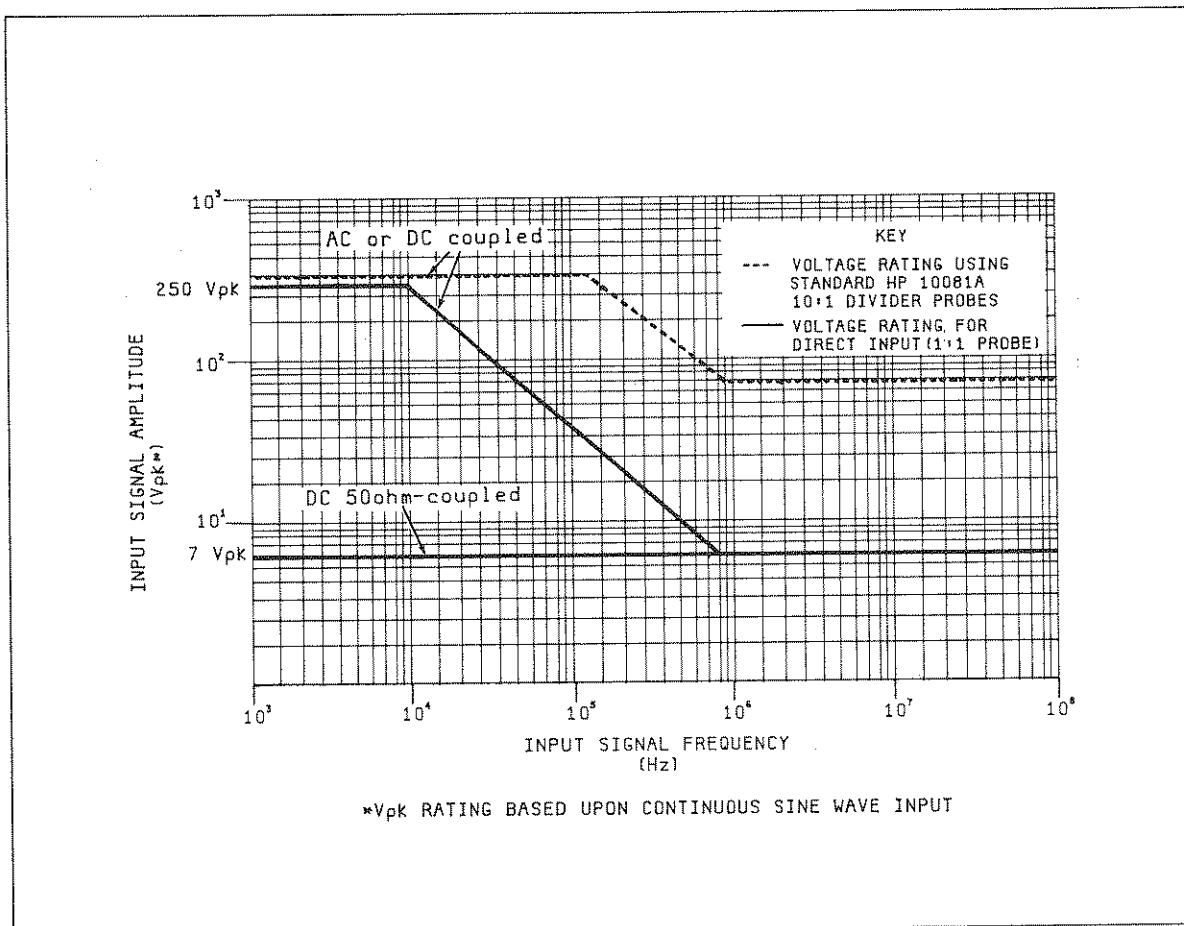
Ground input connector is disconnected from attenuator, attenuator is grounded through 50Ω.

Procedure Select the vertical coupling for channel 3 or 4 with the following keys:

	AC coupled
	DC coupled
	DC 50Ω coupled
	Ground (decoupled)

The instrument accepts coupling key entries only if the channel is on or is a trigger source.

Vertical Coupling (Cont'd)



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Figure 3-4. Maximum Input Voltage vs Frequency

Vertical Coupling (Cont'd)



Program Codes


Select vertical coupling:

PC <channel>, <coupling>

channel ::= 3 channel 3
 4 channel 4

coupling ::= 0 Ground
 1 AC
 2 DC
 3 DC 50Ω

Example Select DC coupling for channel 3.

LOCAL (keys)	 (channel 3)
REMOTE (codes)	<p>PC3,2 <CR> <LF> EOS</p> <p>identifier _____ _____ _____ _____ </p> <p>channel _____ _____ coupling _____</p>

Indication Vertical coupling is indicated by the lighted coupling key.

Comments At power-on, DC 50Ω coupling is changed to DC as a default condition.

Vertical Deflection Factor

Description Vertical deflection factor (channel sensitivity) is adjustable from the front-panel or via the HP-IB. Because it is a continuously calibrated function, waveforms can be accurately scaled for vertical axis measurement or reference.

Deflection Factor Characteristics

range 2.00mV/div to 10.0 V/div
 resolution 3 digits
 Accuracy ±3%

Procedure Press (channel 3 or 4) and change deflection factor with the Control Knob. Use to select step resolution.

To toggle between inverted and noninverted display, press or .



Program Codes

Enter channel 3 or 4 sensitivity:

PS <channel>,[<polarity>]<setting>

channel ::= 3 vertical channel 3
 4 vertical channel 4

polarity ::= + non-inverted display
 - inverted display


value ::= exponential
 {n.dd|nd.d|nnd}{e|E}{+|-|<SP>}[d]d
 2.00e-03 to 1.00e+01 V/div

Example Change channel 3 deflection factor to -100 mV/div.

LOCAL (keys)	(ch 3)
REMOTE (codes)	<p>PS3,-100e-3<CR><LF></p> <p>identifier ——— channel ——— polarity ——— value ——— EOS ——— </p>

Vertical Deflection Factor (Cont'd)

Indication Deflection factor of enabled channels is displayed on the CRT.

When the Control Knob is assigned to channel deflection factor, the LED readout displays the parameter value and the corresponding key (channel 3 or 4 ) is lighted. Also, the channel name is displayed by the CRT readout in inverse video.

Comments When a recommended HP 10080 series miniprobe is connected, channel deflection factor is entered and displayed as the total deflection factor at the probe tip.

Vertical deflection factor can only be changed if the channel is on or is a trigger source.

Vertical Mode


Description In V vs T mode, the 1950A can display channel 3, channel 4 or both channels 3 and 4. Also, the algebraic sum of channels 3 and 4 can be displayed.

Multiple waveforms are displayed using alternate or chop display mode. In alternate, traces are displayed on alternate sweeps. Chop mode displays all traces during each sweep by switching between vertical (and horizontal) signal sources at a 400 kHz rate. The display is blanked during switching time. When automatic selection is enabled, multiple traces are displayed in alternate for sweep speeds slower than 1 msec/div and in chop for sweep speeds faster than 1 msec/div.




3 + 4 mode allows a summed waveform to be viewed. It provides a differential mode of operation when channel 3 or 4 is inverted.



Differential Mode Characteristics


bandwidth dc to 20 MHz
 CMR at least 20 dB with common mode signal
 amplitude equivalent to 10 div and one
 channel adjusted for optimum rejection

Procedure Press  to toggle channel 3 on or off.

Press  to toggle channel 4 on or off.

Press  to display the algebraic sum of channels 3 and 4. To return to normal channel display, press  or .

To select alternate or chop vertical display mode, press  or  respectively.

Press  for automatic alternate/chop selection.



Program Codes

Select vertical mode:

PM < mode >

- mode ::=
- Ø channels 3 and 4 off
 - 1 channel 3 on, channel 4 off
 - 2 channel 4 on, channel 3 off
 - 3 channel 3 + channel 4
 - 4 channels 3 and 4 on

Vertical Mode (Cont'd)



Select mode of display:

PM <mode>, <display mode>

- display mode::=**
- 1 alternate sweep
 - 2 chop sweep
 - 3 automatic selection

Example Display channel 3 and 4 in chop mode.

LOCAL (keys)	
REMOTE (codes)	<p>identifier ——— PM4,2 <CR> <LF> ——— EOS</p> <p style="margin-left: 100px;"> </p> <p style="margin-left: 100px;">display mode</p>

Indication Vertical mode and vertical display mode selections are indicated by lighting the corresponding keys. Also, the CRT readout displays the deflection factor of the enabled channels.


Comments If the 1980A/B is in dual horizontal mode, chop mode is not permitted for main or delayed sweep speeds faster than 1 μ sec/div. The display mode will default to alternate mode (unlighted) when either sweep speed is faster than 1 μ sec/div. If sweep speed is changed to 1 μ sec/div or slower, the original vertical display mode is restored.

Vertical Position

Description The vertical position of channel 3 or 4 is adjustable from the front-panel and via the HP-IB. Trace baseline can be positioned as much as 10 divisions off screen.

Vertical Position Characteristics

Position range -15.00 to +15.00 div
 resolution 0.02 major division
 accuracy $\pm(2\%$ of reading + 0.3 major division)

Procedure To adjust the vertical position of channel 3 or 4, press  (channel 3 or 4), then adjust the Control Knob for desired setting.



Program Codes

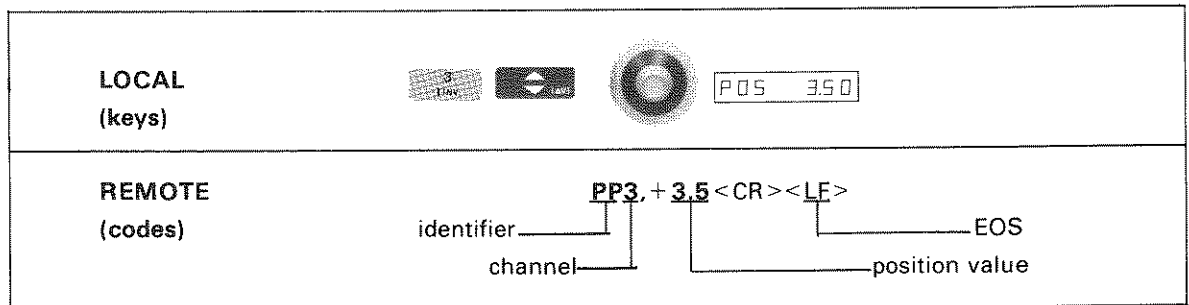
Set channel 3 or 4 vertical position:

PP<channel>,<value>


channel ::= 3 channel 3
 4 channel 4

value ::= decimal
 [+|-|<SP>][d]d.d[d]
 -15.00 to +15.00 divisions
 value must be a multiple of 0.02 div

Example Change channel 3 position to +3.5 divisions.



Vertical Position (Cont'd)

Indication When the Control Knob is assigned to vertical position,  is lighted and the LED readout displays the parameter value.

Comments The vertical position of a channel cannot be changed if the channel is off or only used as a trigger source.

If an odd integer (to the nearest hundredth) is entered via the HP-IB, it will be rounded to the nearest even value; positive values are rounded down, negative values are rounded up.

A probe key closure at channel 3 or 4 causes a momentary shift in the vertical position of that channel's trace for trace identification.



3-22. HP-IB CODES AND FORMAT SUMMARY

General Input Data Message Format:

<program code>[;<program code>]...[;>CR>]<LF>

format rules: The 1980A/B sends and receives Data messages in standard ASCII code.

<LF> is used as the End-of-String (EOS) message for all input Data messages.

If several program codes are sent in a Data message, all but the last must be delimited by a semicolon (;).

Program codes consist of a two character identifier (prefix) and a parameter field containing zero, one or several parameters.

Unsigned parameters are interpreted as positive values.

In integer parameters, leading zeroes may be omitted.

Multiple parameters within a program code are delimited by a comma (,).

The character "E" or "e" is used to delimit the mantissa of exponential parameters.

Exponential parameters may be entered in scientific or engineering notation.

In Data messages, spaces (<SP>) are permitted only following program code identifiers and parameter delimiters.

The maximum Data message length is 127 characters including: <CR>, <LF>, <SP>, comma and semicolon.

The instrument cannot be unaddressed during input or output Data message transfers. If the instrument is unaddressed and then readdressed, the data transfer is aborted and a syntax error is reported.

All valid program codes for the Expansion Module are listed in Table 3-9. Specific format requirements and parameter descriptions are included.

General Output Data Message Format:

<SP><setting value><CR><LF>

During Learn String outputs, the instrument sets the EOI bus control line true with the last character of the string to indicate end of string. All other output Data messages use <LF> for the EOS message.

Table 3-9 includes specific descriptions of output Data message format.



Table 3-8. Program Code Prefix Function Cross Reference

Code Prefix	Function
PC	Vertical Coupling
PE	Learn Mode (teach)
PF	Reading Values (output front panel)
PK	Key
PM	Vertical Mode (channel selection)
PP	Vertical Position
PR	Control Knob (assignment)
PS	Vertical Deflection
PT	Main and Delayed trigger source
PV	Delta Volts
PX	Scope Mode 3 vs 2



Table 3-9. Program Codes and Format Summary

Function	Program Code (ASCII)	Function	Program Code (ASCII)
CONTROL KNOB Assign control knob: hold channel 3 deflection channel 4 deflection channel 3 position channel 4 position Select step resolution coarse steps fine steps	PR <entry> [, <mode>] entry ::= 0 1 2 5 6 mode ::= 0 1	SCOPE MODE 3 vs 2	PX
DELTA VOLTS vertical channel 3 vertical channel 4 ΔV off ΔV on (and zeroed)	PV <channel>, <mode> channel ::= 3 4 Mode ::= 0 1	VERTICAL COUPLING channel 3 channel 4 GND AC DC DC 50 Ω	PC <channel>, <coupling> channel ::= 3 4 coupling ::= 0 1 2 3
KEY Valid keycodes are listed in table 3-10 and 3-11.	PK <code> [, <code>] code ::= integer ¹ dd	VERTICAL DEFLECTION channel 3 channel 4 non-inverted display inverted display deflection factor (Volts/division)	PS <channel>, [<polarity>] <value> channel ::= 3 4 polarity ::= + - value ::= exponential {n.dd nd.d ndd} {E e} [+ -][d]d 2.00e-03 to 1.00e+01 V/div
LEARN MODE Specify Learn String output: Configure the 1950A using the Learn String:	PE output format: 33 eight bit bytes EOS = EOI bus control line true <33 byte string> <CR> <LF> Note: The Learn String must be transferred without sending UNL or UNT.	VERTICAL MODE Select input channels: channels 3 and 4 off channel 3 on, channel 4 off channel 4 on, channel 3 off channel 3 + channel 4 channel 1 and channel 2 on Select alternate or chop: alternate sweep chop sweep automatic selection	PM <mode> <display mode> mode ::= 0 1 2 3 4 display mode ::= 1 2 3
MAIN/DLYD TRIGGER SOURCE Assigns main trigger Assigns delayed trigger vertical channel 3 vertical channel 4	PT <trigger>, <source> main/dlyd ::= 0 1 source ::= 3 4	VERTICAL POSITION channel 3 channel 4 position (divisions)	PP <channel>, <value> channel ::= 3 4 value ::= decimal [+ -][d].d[d] -15.00 to +15.00 div
READING VALUES Select function to be read: channel 3 deflection factor channel 4 deflection factor channel 3 ΔV channel 4 ΔV channel 3 position channel 4 position	PF <code> Format # code ::= 1 F1 2 F1 3 F1 4 F1 5 F2 6 F2 F# Output Format F1 <SP>{+ -}d.ddE{+ -}dd <CR> <LF> F2 <SP>{+ -}dd.dd <CR> <LF>		

Note: ¹In integer parameters, leading zeroes may be omitted.



Table 3-4. 1950A Expansion Module Key to PK Code Conversion Table

Ch3 Key	ASCII Code	Ch4 Key	ASCII Code	Key	ASCII Code
	80		81		84
	76		77	Ch3 Probe	85
	72		73	Ch4 Probe	86
	75		78		
	71		74		
	79		82		

Table 3-5. PK Code to 1950A Expansion Module Key Conversion Table

ASCII Code	Key	ASCII Code	Key	ASCII Code	Key
71	(ch3)	76	(ch3)	81	
72	(ch3)	77	(ch4)	82	(ch4)
73	(ch4)	78	(ch4)	83	(Not Used)
74	(ch4)	79	(ch3)	84	
75	(ch3)	80		85	Ch3 Probe
				86	Ch4 Probe



3-23. NOTATION CONVENTIONS AND DEFINITIONS

The following conventions are used in this manual in descriptions of remote (HP-IB) operation:

- < > Angular brackets enclose descriptive words that are used to symbolize a program code parameter or an HP-IB command.
- ::= "is defined as". For example, <A> ::= indicates that <A> can be replaced by in any statement containing <A>.
- [] Square brackets indicate that the enclosed items are optional.
- { } When several items are enclosed by braces, one, and only one, of these elements must be selected.
- | "or": Indicates a choice of exactly one element from a list. For example, <A> | indicates <A> or but not both.
- ... An ellipsis (trailing dots) is used to indicate that the preceding element may be repeated one or more times.

The following definitions are used:

- d ::= A single ASCII numeric character, 0-9.
- n ::= A single ASCII nonzero, numeric character, 1-9.
- <LF> ::= ASCII linefeed (decimal 10).
- <CR> ::= ASCII carriage return (decimal 13).
- <SP> ::= ASCII space (decimal 32).