OPERATING AND SERVICE MANUAL

5006A

SIGNATURE ANALYZER

SERIAL PREFIX: 2314A

This manual applies to Serial Prefix 2314A, unless accompanied by a Manual Change Sheet indicating otherwise.

HEWLETT
PACKARD

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains the information necessary to install, operate, and program the Hewlett-Packard Model 5006A Signature Analyzer. The Signature Analyzer with its supplied accessories is shown in *Figure 1-1*.

1-3. MANUAL SUMMARY

1-4. This manual is divided into eight sections, each covering a particular topic of the operation and programming of the HP5006A. The topics by section number are:

SECTION I, GENERAL INFORMATION. Provides the instrument specifications, instrument identification, accessories and recommended test equipment.

SECTION II, INSTALLATION. Provides information about initial inspection, preparation for use, storage, and shipment.

SECTION III, OPERATION. Provides information about operating characteristics, front and rear panel features, Operator's Check, operating instructions, measurement procedures, and programming. Remote programming information for both HP-IB and HP-IL are provided.

SECTION IV, PERFORMANCE TESTS. Provides abbreviated procedures for operation verification, which give the operator a high degree of confidence that the 5006A is operating properly. Also provides expansive performance test procedures which test the electrical performance of the 5006A, using the specifications in *Table 1-1* as standards.

SECTION V, ADJUSTMENTS. Provides the procedures and adjustment locations required to properly maintain the instrument operating characteristics within specifications.

SECTION VI, REPLACEABLE PARTS. Provides ordering information for all replaceable parts and assemblies within the instrument.

SECTION VII, MANUAL CHANGES. This section is reserved for manual change information which effectively "backdates" the technical areas of the manual to apply to older instruments.

SECTION VIII, SERVICE. This section provides the instrument theory of operation, troubleshooting information, repair techniques, and schematic diagrams.

1-5. SPECIFICATIONS

1-6. The specifications for the 5006A are listed in *Table 1-1*. These specifications are the performance standards or limits against which the 5006A can be tested.

1-7. DESCRIPTION

1-8. The 5006A is a test instrument for troubleshooting complex electronic logic circuits to the component level. The 5006A uses the signature analysis (SA) techniques of troubleshooting. Typically, a logic product designed for signature analysis troubleshooting will have a programmed controller and a stored or externally-provided test program which can exercise most of the circuitry.

1-9. ACCESSORIES SUPPLIED

1-10. The accessories supplied with the 5006A are shown in *Figure 1-1*. Their description and part number are given below:

a. Depending on the customer's country, the line power cable supplied has one of six appropriate line (mains) connectors. Refer to *Figure 2-2*, for the part number of the correct cable.

b. Five detachable "grabber" test connectors are supplied with the 5006A. Their part number is 10230-62101. Refer to Section III for description and use.

c. One ground lead for the data probe is supplied with the 5006A. Its part number is 05005-60116.

d. One data probe tip cover is supplied. Its part number is 00547-40005.

e. One Data Probe and Timing Pod holder is supplied. Its part number is 05006-00006.

1-11. INSTRUMENT AND MANUAL IDENTIFICATION

1-12. The instrument serial number is located to the right of the Line Input connector on the rear panel. The serial number is in the form; 0000A00000. The first four digits and the letter are the serial prefix. 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 suffix, however, is assigned sequentially and is different for each instrument. The

Table 1-1. 5006A Specifications

GENERAL

Display: 4 digits. Characters 0-9, ACFHPU.

Fault detection accuracy: 100% probability of detecting single-bit errors; 99.998% probability of detecting multiple-bit errors.

Composite signature:
Maximum number of signatures: No limit. Sums all signatures, triggered by probe switch, following depression of CLEAR key, or power-up.

Signature memory:
Signatures recallable by probe switch: The last 32 signatures triggered by probe switch.

TIMING

Clock:
Maximum frequency: 25 MHz.
Minimum clock time: 15 nsec in high or low state.

Probe:
Setup time: 10 ns with 0.2V overdrive. (Data to be valid at least 10 ns before selected clock edge.)

Hold time: 0 ns. (Data to be held until occurrence of selected clock edge.)

Start, stop, qualifier:
Setup time: 20 ns with 0.2V overdrive. (Data to be valid at least 20 ns before selected clock edge.)

Hold time: 0 ns. (Data to be held until occurrence of selected clock edge.)

Minimum gate length: 1 clock cycle (1 data bit) between START and STOP.
Maximum gate length: No limit.
Minimum timing between gates: 1 clock cycle between STOP and START.

INPUT IMPEDANCE

Probe: 50kΩ to ground nominal.
Pod: 100kΩ to ground nominal.
CMOS sense: 700Ω nominal.

OVERLOAD PROTECTION

Probe:
±150V continuous.
±250V intermittent.
250V ac for 1 minute.

Pod:
±20V continuous.
±140V intermittent.
140V ac for 1 minute.

CMOS sense: 20V dc maximum.

TTL THRESHOLDS

Probe:
Logic one: 2 Volt + .2-.3
Logic zero: 0.8 Volt + .3-.2

Pod: 1.4 Volt ±.6

CMOS THRESHOLDS

Probe:
Logic one: 70% of sensed voltage nominal.
Logic zero: 30% of sensed voltage nominal.

Pod: 50% of sensed voltage nominal.

DISPLAY AND INDICATORS

Signature: Four seven-segment digits with decimal point.

Lamps:
Key status: Recall, edit, signature latch, unstable latch, qualify mode, timing polarities.
Programmable: Remote, talk, listen, SRQ. (Option 030 or 040.)
Status: Composite signature, gate, unstable.
Pulse stretching: 100 msec on gate and unstable lamps.

Probe:
Logic levels indicated: High, low, open and pulsing *with 100 msec stretching.*

Minimum pulse width: 10 nsec.

*Switch: Under normal operation, pushing probe switch enters signatures into memory. End of measurement is indicated by probe light. If SIG LATCH is pushed, signature display will change only when probe switch is pushed. Memory stack is rolled by the probe switch in RECALL mode. A signature in memory is over-written by a new one when the probe switch is pushed in EDIT mode. Composite signature is up-dated if memory is edited. Normally, when the 5006A is under computer control, all measured signatures are sent to the computer. Under special command, only triggered signatures are sent to the computer."**

OTHER

Selectable power:
115V +10%-25% ac line, 48-440 Hz.
230V +10%-15% ac line, 48-66 Hz.
25VA maximum.

Operating environment:
Temperature: 0-55°C.

Humidity: 95% RH at +40°C.

Altitude: 4600M (15,000 ft.)

Size: 89 mm high × 216 wide 279 mm deep. (3-1/2 in. × 8-1/2 in. × 11 in.)

Net weight: 2.4 kg (5.3 lbs)

Shipping weight: 4.1 kg (9 lbs)

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*Specifications describe the instrument's warranted performance. Supplemental characteristics *(shown in italics)* are intended to provide information useful in applying the instrument, but are non-warranted performance parameters.

contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-13. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instruments.

1-14. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you period-ically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-15. 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 office.

1-16. SAFETY CONSIDERATIONS

1-17. The 5006A is a Safety Class 1 instrument provided with a protective earth terminal. This product has been designed and tested according to international safety requirements. Safety information pertinent to the op-eration and servicing of this instrument is included in appropriate sections of this manual.

1-18. Safety Symbols

Note

The symbol ⚠ (ATTENTION) which appears on the panel of the instrument indicates that the user should refer to the instruction manual before operating, in order to avoid possible damage to the instrument. Within the manual, information relating to the ATTENTION symbol will be identified with a ⚠ symbol in the margin.
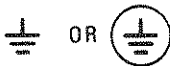
1-19. The following safety symbols are used on equip-ment and in manuals:

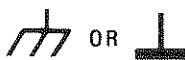|	
⚠	Instruction manual symbol. The product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.
ϟ	Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).
⏚ OR ⏚	Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.
⏚	Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with the symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.
⏚ OR ⏚	Frame and chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.
∼	Alternating current (power line).
===	Direct current (power line).
≈	Alternating or direct current (power line).

WARNING | The WARNING signal 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.

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.

1-20. RECOMMENDED TEST EQUIPMENT

1-21. Equipment required to maintain the 5006A is listed in *Table 1-2.* Other equipment can be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-2. Recommended Test Equipment

Equipment	Required Characteristics	Adjust-ments	Used For			Recom-mended HP Model
			Op. Veri-fication	Performance Tests	Trouble-shooting	
Signature Analyzer	HP Compatible Signatures				X	5006A
Digital Voltmeter	+.001% acc.				X	3445A
Pulse Generator	25 MHz Square Wave			X		8082A
Universal Counter	100 MHz +TI 1ns Resolution			X		5370B
2 Pulse Generators	100 MHz Rate <2 ns transition time			X		8007B
Oscilloscope	100 MHz BW	X			X	1740A
Oscilloscope	275 MHz BW			X		1725A
Logic Lab Breadboard				X		5035T
Microprocessor Lab			X*			5036A
Probe Set						5022A
Tuning Wand	Ceramic Wand	X				8710-0033
Controller	HP-IB or IEEE 488 Compatible		X			HP 85

*Any instrument with an HP compatible digital signature analysis capability can be substituted here.

Note
FOR OPTION 030 (HP-IL INTERFACE) ONLY

For establishing HP-IL based digital troubleshooting stations, the use of the HP-41C or HP-41CV controllers is recommended.

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information for unpacking, inspection, installation, and storage of the HP5006A Signature Analyzer.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, inspect the instrument for visible damage (scratches, dents, etc.). If the instrument is damaged, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Keep the shipping carton and packing material for the carrier's inspection. The Hewlett-Packard Sales and Service Office will arrange for repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. PREPARATION FOR USE

CAUTION

Before connecting the instrument to ac power lines, be sure that the correct fuse is installed and that the voltage selector is properly positioned as described below.

2-6. Power Requirements

2-7. The 5006A requires an ac line power source of 115V, +10%, −25%, 48 to 440 Hz single phase, or 230V, +10%, −15%, 48 to 66 Hz single phase.

2-8. Line Voltage Selection

2-9. The power line voltage is selected by the position of the LINE SELECT switch on the rear panel. Sliding the switch to the left selects 115V operation, sliding the switch to the right selects 230V operation. The voltages available are printed on the switch. The specific voltage selected will be visible on the LINE SELECT switch, as shown in *Figure 2-1*. Before applying power, verify that LINE SELECT switch is properly set for the desired ac supply voltage and that the correct fuse is installed.
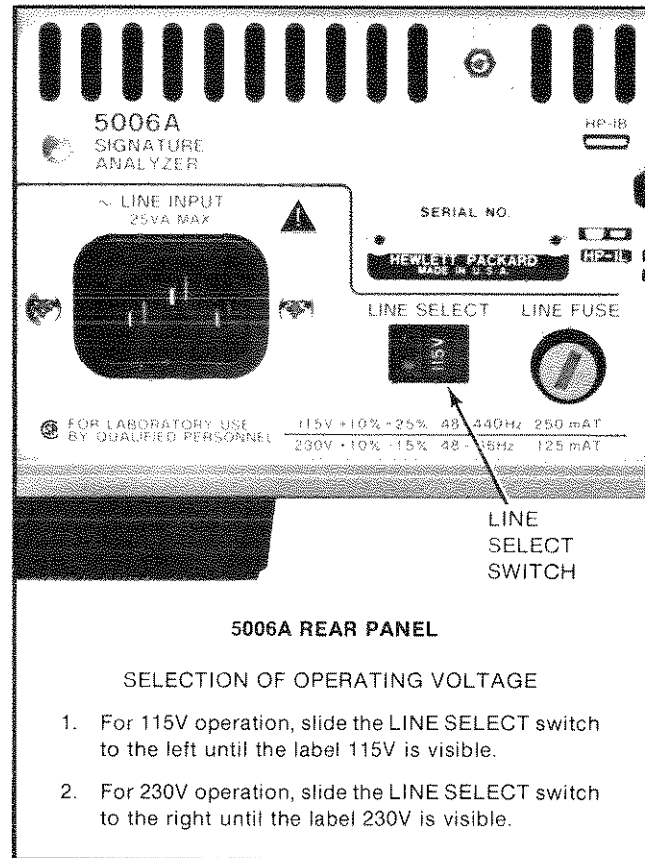

Figure 2-1. Line Voltage Selection

2-10. Selection of the Line Fuse

2-11. The LINE FUSE is accessible from the rear panel. The 5006A will be shipped with the correct fuse for the country of destination installed, and the LINE SELECT switch set properly. To replace the line fuse use a small flat-bladed screwdriver to remove the fuse carrier from the fuseholder. Press in slightly and turn counterclockwise, until the fuse carrier springs free. Replace the fuse in the fuse carrier and reinstall by reinserting and turning clockwise. Be sure to install the correct fuse value; 250 mAT/250V Slow Blow for 115V operation or 125 mAT/250V Slow Blow for 230V operation.

2-12. Power Cable

2-13. The 5006A is shipped with a three-wire power cable. When the cable is connected to an appropriate ac power source, this cable connects the instrument chassis to earth ground. The type of power cable plug shipped with each instrument depends on the country

of destination. Refer to *Figure 2-2* for the part numbers of the power cable and plug configurations available.

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┌─────────────────────┐
│      WARNING         │
└─────────────────────┘
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BEFORE SWITCHING ON THIS INSTRUMENT, THE PROTECTIVE EARTH TERMINAL OF THIS 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 EARTH (GROUNDING) CONDUCTOR.
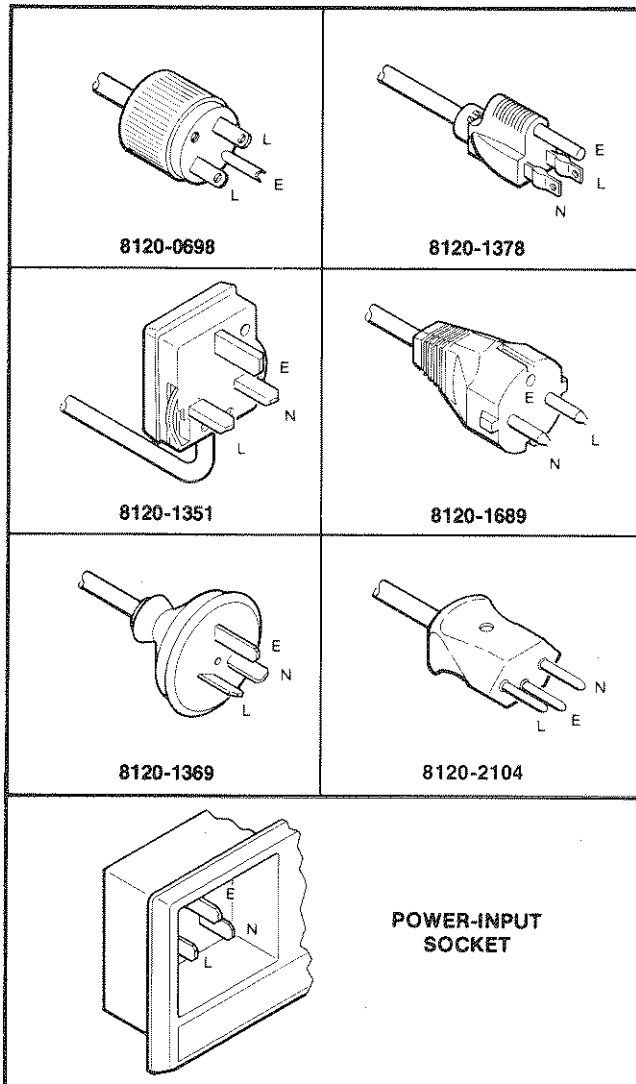

8120-0698	8120-1378
8120-1351	8120-1689
8120-1369	8120-2104
POWER-INPUT SOCKET	

Figure 2-2. Power Cable HP Part Numbers versus Mains Plugs Available

2-14. HP-IB INTERCONNECTIONS (Option 040)

2-15.   The 5006A with Option 040 is compatible with the Hewlett-Packard Interface Bus. Interconnection data concerning the rear panel HP-IB connector is provided in *Figure 2-3*. This connector is compatible with the HP 10833A/B/C/D cables. (See *Table 2-1* for cable descriptions). The HP-IB system allows interconnection of up to 15 (including the controller) HP-IB compatible instruments. The HP-IB cables have identical "piggy-back" connectors on both ends so that several cables can be connected to a single source without special adapters or switch boxes. System components and devices may be connected in virtually any configuration desired. There must, of course, be a path from the controller to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack produces great leverage which can damage the connector mounting. Be sure each connector is firmly (finger tight) screwed in place to keep it from working loose during use.

Table 2-1. HP-IB Cable Descriptions

Model Number	Cable Length
10833A	1 metre (3.3 ft.)
10833B	2 metres (6.6 ft.)
10833C	4 metres (13.2 ft.)
10833D	0.5 metres (1.6 ft.)

The above symbol when located in the upper corner of a page indicates HP-IB information is contained on that page. This information may be operation, performance, adjustment, or service related.

2-16.   Cable Length Restrictions

2-17.   To achieve design performance with the HP-IB, the proper voltage levels and timing relationships must be maintained. If the system cable is too long, the lines cannot be driven properly, and the system will fail to perform properly. Therefore, when interconnecting an HP-IB system, it is important to observe the following rules.

a.   The total cable length for the system must be less than or equal to 20 metres (65 feet).

b.   The total cable length for the system must be less than or equal to 2 metres (6.6 feet) times the total number of devices connected to the bus.

c. The total number of instruments connected to the bus must not exceed 15.
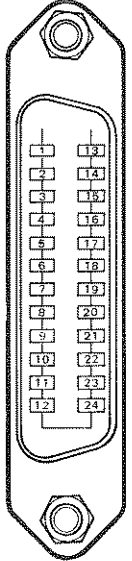
2-18. HP-IB Talk/Listen Address Switch

2-19. The 5006A provides a rear panel HP-IB instrument address selection switch. This switch determines the mode of remote operation as "Talk Only" or "addressable", and selects the HP-IB address. Instructions for changing the address are provided in Section III of this manual.

2-20. HP-IB Description

2-21. A description of the HP-IB is provided in Section III of this manual. A study of this information is necessary if the user is not familiar with the HP-IB concept. Additional information concerning the design criteria and operation of the bus is available in IEEE Standard 488-1978, titled *IEEE Standard Digital Interface for Programmable Instrumentation.*

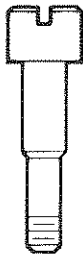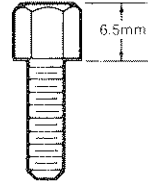| PIN	LINE
1	DIO1
2	DIO2
3	DIO3
4	DIO4
13	DIO5
14	DIO6
15	DIO7
16	DIO8
5	EOI
17	REN
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	SHIELD-CHASSIS GROUND
18	P/O TWISTED PAIR WITH PIN 6
19	P/O TWISTED PAIR WITH PIN 7
20	P/O TWISTED PAIR WITH PIN 8
21	P/O TWISTED PAIR WITH PIN 9
22	P/O TWISTED PAIR WITH PIN 10
23	P/O TWISTED PAIR WITH PIN 11
24	ISOLATED DIGITAL GROUND

THESE PINS ARE INTERNALLY GROUNDED

CAUTION

The 5006A contains metric threaded HP-IB cable mounting studs as opposed to English threads. Metric threaded HP 10833A, B, C, D HP-IB cable lockscrews must be used to secure the cable to the instrument. Identification of the two types of mounting studs and lockscrews is made by their color. English threaded fasteners are colored silver and metric threaded fasteners are colored black. DO NOT mate silver and black fasteners to each other or the threads of either or both will be destroyed. Metric threaded HP-IB cable hardware illustrations and part numbers follows.
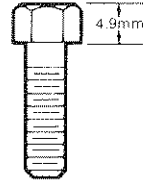
LOCKSCREW 1390-0360

LONG MOUNTING STUD 0380-0643 6.5mm

SHORT MOUNTING STUD 0380-0644 4.9mm

Logic Levels

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0V dc to 0.4V dc and the false (0) state is +2.5V dc to +5.0V dc.

Programming and Output Data Format

Refer to Section III, Operation

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10833A, 1 metre (3.3 ft.), HP 10833B, 2 metres (6.6 ft.), HP 10833C, 4 metres (13.2 ft.), HP 10833D, 1/2 metre (1.6 ft.)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus System may contain no more than 2 metres (6.6 ft.) of connecting cable per instrument.
2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus System is 20.0 metres (65.6 ft.).
3. The maximum number of instruments in one system is fifteen.

Figure 2-3. Hewlett-Packard Interface Bus Connections

2-22. HP-IL INTERCONNECTIONS (Option 030)

2-23. The 5006A with Option 030 is compatible with the Hewlett-Packard Interface Loop. The interface connection is made by a pair of two-wire balanced line cables. The cable is limited to 10 metres (32.8 feet) for unshielded cables (from one device to the next) and to 100 metres (328 feet) for shielded cables. A typical interface connection is shown in *Figure 2-4*.

The above symbol when located in the upper corner of a page indicates HP-IL information is contained on that page. This information may be operation, performance, adjustment, or service related.

2-24. HP-IL Description

2-25. An introductory description of HP-IL is provided in Section III of this manual. As HP-IL is a relatively new concept, it is recommended that users unfamiliar with the Interface Loop concept review this material prior to operating the instrument remotely. Additional information is available in *An Introductory Guide to the Hewlett-Packard Interface Loop*, published by McGraw Hill.
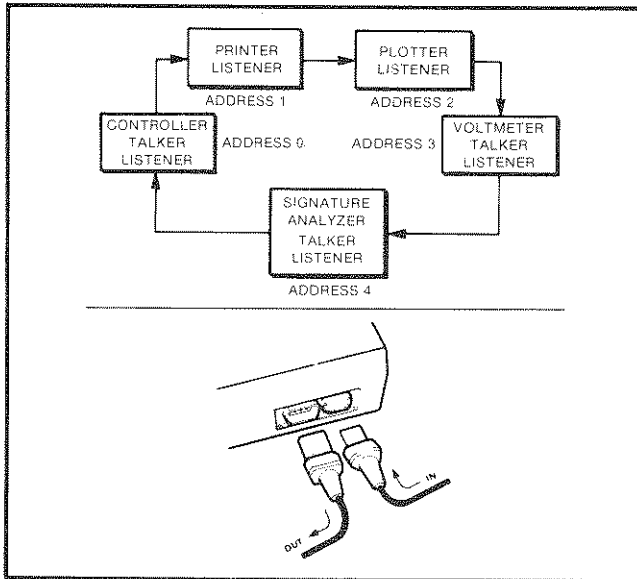

Figure 2-4. Typical HP-IL Interface Connection

2-26. OPERATING ENVIRONMENT

2-27. TEMPERATURE. The 5006A may be operated in temperatures from 0°C to +55°C.

2-28. HUMIDITY. The 5006A may typically be operated in environments with humidity up to 95% at 40°C.

However, it should be protected from extreme temperatures which cause condensation in the instrument.

2-29. ALTITUDE. The 5006A may be typically operated at altitudes up to 4,600 metres (15,000 feet).

2-30. STORAGE AND SHIPMENT

2-31. Environment

2-32. The instrument may be stored or shipped in environments within the following limits:

TEMPERATURE: −40°C to +75°C
HUMIDITY: Up to 95% noncondensing
ALTITUDE: 15,240 metres (50,000 feet)

2-33. The instrument should also be protected from temperature and humidity extremes which cause condensation within the instrument.

2-34. PACKAGING

2-35. ORIGINAL PACKAGING. Containers and materials identical to those used in the 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 any correspondence, refer to the instrument by model number and full serial number.

2-36. OTHER PACKAGING. The following general instructions should be used for repacking with commercially available materials.

a. Wrap instrument in heavy paper or plastic. If shipping to Hewlett-Packard office or service center, attach tag indicating type of service required, return address, model number, and full serial number.

b. Use strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use a layer of shock-absorbing material 70 to 100 mm (3- to 4-inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside container. Protect control panel with cardboard.

d. Seal shipping container securely.

e. Mark shipping container FRAGILE to ensure careful handling.

f. In any correspondence, refer to instrument by model number and full serial number.

SECTION III
OPERATION AND PROGRAMMING

3-1. INTRODUCTION

3-2. This section gives complete operating and programming information for the 5006A Signature Analyzer. Descriptions of all front panel controls, connectors, and indicators, as well as an operator's check, operating instructions, and operator's maintenance, are provided.

3-3. OPERATING CHARACTERISTICS

3-4. The 5006A Signature Analyzer is a test instrument capable of both normal and qualified (QUAL) signature measurements. The 5006A has a maximum clock frequency of 25 MHz. Polarities for the Timing Pod Clock, Start, Stop and Qual inputs are selectable. Input trigger thresholds are preset to standard TTL logic levels (0.8 volts low, 2.0 volts high for Data Probe, and 1.4 volts for the Timing Pod inputs). The thresholds may be modified to CMOS logic levels via a CMOS sense input located on the front panel. In addition to the standard Signature Analysis capabilities, the 5006A features the following unique enhancements to signature measurements.

3-5. Automatic generation of a unique "composite" signature, representative of the set of all signatures intentionally probed since CLEAR or Power-up. This provides a method of verifying the proper operation of an entire IC, bus, or circuit, through a single signature.

3-6. An on-board memory stack which stores up to thirty-two sequential signatures. The signatures in memory can be reviewed, edited, or added-to.

3-7. A selectable Signature Latch function for the display. If enabled, the displayed signature will be held or "latched" in the display until replaced by another triggered measurement or cleared. A selectable Unstable Signature Latch function for the UN-STABLE LED. If enabled, a momentary unstable signature will cause the UNSTABLE LED to light and remain lighted until cleared or the function is disabled.

3-8. Input connectors on the front panel to configure the 5006A for a complete operation verification.

3-9. The 5006A is fully programmable, through either the HP-IB or HP-IL optional interfaces. Interface access is provided not only to the current signature,

but also the keyboard, the signature memory, and the logic probe light. For example, the user can even use the 5006A as an interfaceable logic probe.

3-10. OPERATING INSTRUCTIONS

3-11. Information and instructions for operating the 5006A in both the local and remote modes are provided in this section. The following paragraphs summarize the organization and content of the operating information.

3-12. LOCAL OPERATION. The operating information for local (or manual) operation of the 5006A consists of the following topics:

General Operation Information. Begins with paragraph 3-39, and describes the basic operation of the instrument LEDs, Data Probe switch, Signature Memory, Composite Signature, and selectable functions and polarities.

Front and Rear Panel Features. Consists of Figures 3-9 through 3-12, which locate and describe all of the front and rear panel operator controls and indicators.

Making Signature Analysis Measurements. Begins with paragraph 3-85, and provides a description of the modes of Signature Analysis available, illustrates the timing relationships of the inputs, and lists the recommended procedure for making a measurement.

3-13. REMOTE OPERATION. The remote programming operating instructions begin with paragraph 3-96. A good working knowledge of the local operation of the 5006A is essential for remote programming, as most of the data messages perform the same keystroke-like sequences. Where applicable, program examples are provided. The Remote Operation/Programming instructions describe the following:

Interface Description
Interface Functional Overview
Interface System Terms
Address Selection
Front Panel Interface Status LEDs
Interface Function
Interface Messages
Input Format
Output Format
Measurement Triggering in Remote
SRQ, SRQ Mask, and Status Byte
Device Dependent Commands
Programming Examples

3-14. SIGNATURE ANALYSIS

3-15. Signature Analysis (SA) is a technique for component-level troubleshooting. A Signature Analyzer detects and displays the unique digital signatures associated with the data at nodes in a circuit under test. By comparing these actual signatures to known correct ones, a troubleshooter can quickly backtrace to a faulty node.

3-16. The 5006A Signature Analyzer displays a compressed, four digit "fingerprint" or signature of the digital data stream at a logic node. The special characters presented on the display represent the residue in a CRC (Cyclical Redundancy Code) shift register in the 5006A, after START and STOP signals have been received. The number of data bits between the START and STOP signal can be 1 to ∞ (infinity).

3-17. The four character front panel Signature Analysis display presents numbers in a special set of hexadecimal symbols. The 16 special hexadecimal characters used for signature displays are:

3-18. Notice that the final six symbols are not the common hexadecimal symbols "ABCDEF". The seven-segment LED displays used in the 5006A cannot show a "B" or "D" that would appear different from an "8" or "0", respectively. Also, several other symbols could be misinterpreted as another character when viewed upside-down (e.g. $E \rightarrow \exists$).

Note

No signature appearing on the 5006A display has any particular significance beyond being a correct (expected) signature or an incorrect signature. The number is, however, a residue in the 5006A converted to and displayed in special hexadecimal form.

3-19. SIGNATURE ANALYSIS LITERATURE

3-20. Further Signature Analysis information literature is listed in Application Note 222-0, *An Index to Signature Analysis Publications.* This maintained document lists the description and part number of the available literature concerning Signature Analysis, which can be ordered through the nearest Hewlett-Packard Sales and Service Office.

3-21. DATA PROBE AND TIMING POD HOLDER

3-22. The 5006A provides as an accessory a metal bracket designed as a convenient holder to store the Data Probe and Timing Pod. The holder may be used during either bench or rack mounted operation. For bench operation, the holder may be installed on the left front side of the instrument. For rack mounting, install the holder on the rack flange. Installation of the holder is optional.
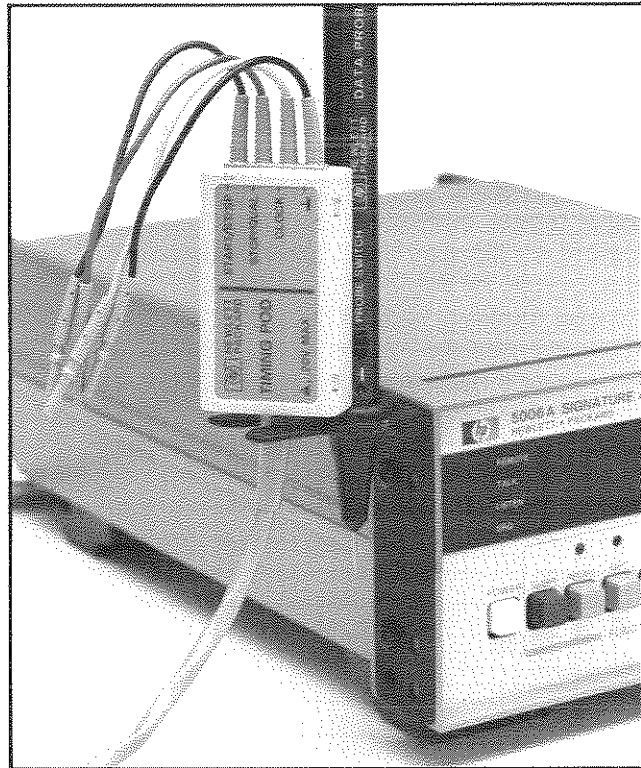
Figure 3-1. Data Probe and Timing Pod Holder

3-23. TEST TERMINAL GRABBER CONNECTIONS

3-24. Five test-terminal grabber connectors are supplied with the 5006A. A grabber can be used on the end of the Timing Pod leads to make reliable electrical connections from the 5006A to the instrument being tested. To connect a grabber to a test lead of the Pod, simply press the grabber on to the lead as shown in *Figure 3-2.* To place a grabber on an IC pin, grasp the grabber and compress the thumbhold. This allows the metal hook to open and be placed on the desired IC pin. To remove the grabber, compress the thumbhold and remove the grabber from the IC pin. A grabber is also provided for the removable ground (⊥) test lead for the Data Probe.
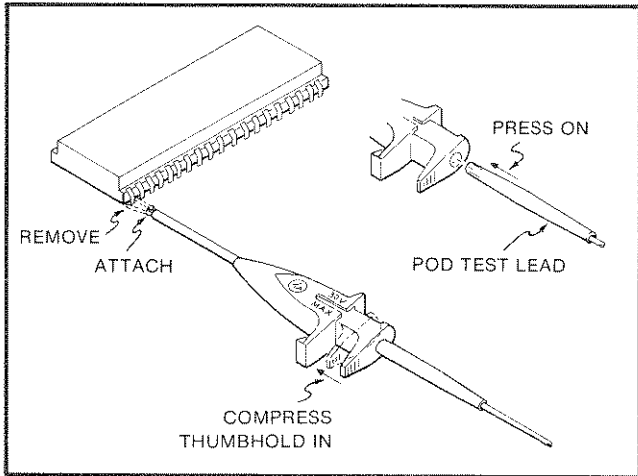
Figure 3-2. Test Terminal Grabber Connections

3-25. TYPICAL CONNECTIONS OF 5006A TO DEVICE UNDER TEST

3-26.   *Figure 3-3* shows the 5006A Signature Analyzer connected to another device, taking signatures.

3-27. PANEL FEATURES

3-28.   The front and rear panel connectors, indicator, and controls of the 5006A are described in *Figures 3-9, 3-10, 3-11,* and *3-12.* These figures locate and describe all operator accessible front and rear panel features.

3-29. OPERATOR'S MAINTENANCE

3-30.   The only maintenance the operator should normally perform is the replacement of the line fuse. This fuse is located on the rear panel. Refer to Section II, Line Voltage Selection, for instructions on changing the fuse.

> ### CAUTION
>
> **Make sure that only fuses with the required rated current and voltage, and of the slow-blow type are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.**

3-31. POWER-UP SELF-CHECK

3-32.   When the 5006A is turned-on, a power-up self-check cycle is automatically started. With no inputs applied to the Data Probe or Timing Pod, the sequence is as follows:

1.   After pressing the POWER switch in to switch the instrument from off to on, all the display segments and LED indicators on the front panel and display, except for the GATE LED, should light momentarily.

2.   After approximately two seconds, the interface address (if installed) will be displayed momentarily, formatted as follows: "Ad.10" for interface address ten.
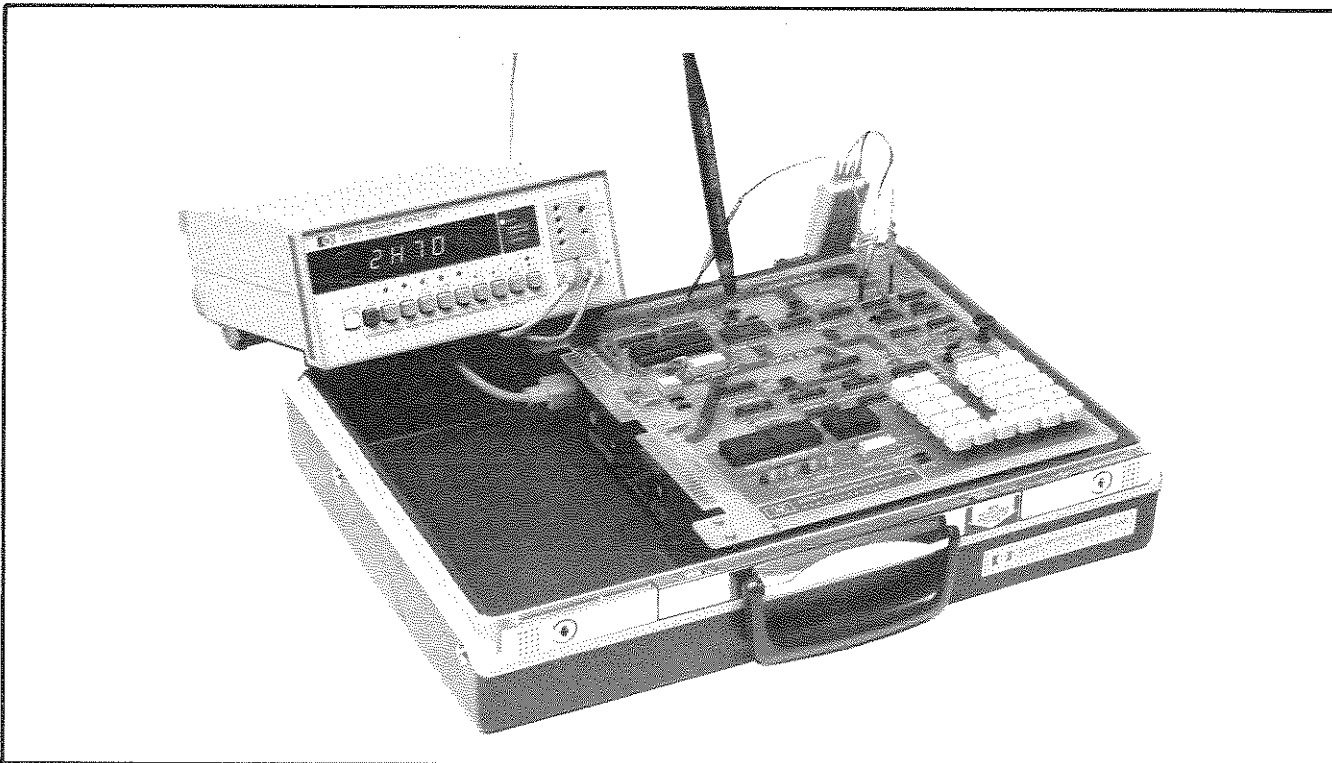

Figure 3-3. Typical Connections of 5006A to Device Under Test

3. Successful completion of the power-up self-check is indicated when the front panel assumes its power-up default state; all FUNCTIONs off, the CLOCK, START, and STOP POLARITIES to "rising edge" (indicated by the lighted LEDs above the keys), QUAL polarity to off, and the four dashes (center segments) of the display are lighted. All other front panel LEDs are off.

3-33. During this cycle, the microprocessor performs a checksum of the internal program in ROM, and a bit pattern is written into and read from RAM. Problems during the power-up self-check will usually result in a visibly improper state of the front panel display and indicators or the display of a numbered error or failure message. Error messages, which are preceded by "Er", can be cleared by pressing the CLEAR key, and the operation reattempted. Failure messages, which are preceded by "F-" or an improper power-up display state may also be cleared by pressing the CLEAR key, but typically indicate service is required.

3-34. ERROR AND FAILURE MESSAGES

3-35. Problems during the power-up self-check, the Operation Verification, or during local or remote operation typically result in an error or failure condition, detected by the 5006A and identified by a specific numbered message. The 5006A separates problems into two classes; Errors and Failures.

3-36. Errors are defined as problems which occur because of the manner in which the instrument is operated, but where no hardware failure is present. These conditions usually indicate an attempted incorrect operation such as an illegal numeric parameter, or an incorrect key operation. Error messages can be "cleared", allowing correction of the problem and the operation to be repeated. Error messages are assigned numbers 01, 02, 50's, and 70's, and are preceded by the letters "Er" in the display. The 5006A Error messages are shown in *Table 3-1*.

3-37. Failures indicate a hardware type problem, and generally require the instrument to be serviced. Failure messages are categorized by area of failure. Failure messages are assigned numbers ranges 10's, 20's, 30's, 40's and 60's, and are preceded by "F-" in the display. The 5006A Failure messages are shown in *Table 3-1*.

3-38. When a problem is detected in either the motherboard or in the interface, the information is transmitted from the one to the other. When the motherboard either finds a problem or receives the code for one from the interface, it stops the operation of the instrument and displays the appropriate code. When the interface detects or receives a problem it stores this information and sets the error bit in the serial poll status byte. The CLEAR key on the front panel must be pressed or a device clear received from the interface to clear the error and resume operation. All other keys and commands will be ignored.

Table 3-1. Error and Failure Messages

Operator EDIT Errors	
Er01	Attempted EDIT with no signatures in memory
Er02	Attempted EDIT of COMPOSITE SIGNATURE
Interface Command/Protocol Errors	
Er50	Unrecognized command
Er51	Illegal numeric parameter
Er52	Illegal character in command
Er55	HP-IL loop protocol error
External Interface Connection Errors	
Er70	Controller connected to talk-only instrument
Microprocessor Failures	
F-10	ROM failure
F-11	Working RAM failure
F-12	Signature memory RAM failure
F-13	Timer failure
Microprocessor to Motherboard Connection Failures	
F-20	Data bus latch failure
F-21	Data bus latch enable failure
F-22	Digit driver failure
F-23	Input port failure
F-24	Nonexistent key failure
Motherboard Failures	
F-30	Data probe does not recognize lows
F-31	Data probe does not recognize highs
F-32	Measurement gate failure, closed when should be open
F-33	Measurement gate failure, open when should be closed
F-34	Incorrect signature
Motherboard to Interface Card Connection Failures	
F-40	Interface power-up failure
F-41	Interface timeout on input
F-42	Interface timeout on output
Interface Card Microprocessor Failures	
F-60	ROM failure
F-61	RAM failure

3-39. GENERAL OPERATION INFORMATION

3-40. Introduction

3-41. The following paragraphs describe general operating features of the 5006A Signature Analyzer.

3-42. Power-Up Default States

3-43. When power is initially applied to the 5006A, the instrument automatically assumes the power-up default states listed in *Table 3-2*.

Table 3-2. Power-Up Default States

FUNCTION	RECALL	OFF
	EDIT	OFF
	SIG LATCH	OFF
	UNSTABLE LATCH	OFF
	QUAL	OFF
POLARITY	CLOCK	RISING
	START	RISING
	STOP	RISING
	QUAL	Inactive

3-44. To change from the power-up state to any other function or polarity, refer to paragraphs 3-68 or 3-77 respectively. The input triggering thresholds for the Data Probe and Timing Pod are preset to TTL levels. To change from TTL trigger thresholds to CMOS levels, refer to paragraph 3-83.

3-45. Operation of the GATE LED

3-46. The flashing front panel GATE LED indicates that the instrument is being clocked and is actively gating. The GATE LED is a hardware driven LED which flashes at either a 5 Hz rate, or the actual gate rate (whichever is slower). It is important to realize that the GATE LED is only an indicator of clock and gate activity. It does not necessarily reflect the actual gate rate or duration.

3-47. Operation of the COMPOSITE SIGNATURE LED

3-48. The front panel COMPOSITE SIGNATURE LED indicates that the current displayed signature is the Composite Signature. The instrument must be in the RECALL function to access and display the Composite Signature. The Composite Signature is also identified by four lighted decimal segments in the display.

3-49. Operation of the UNSTABLE LED

3-50. The front panel UNSTABLE LED indicates an unstable signature condition. A signature must measure identically for two consecutive gate cycles to be considered stable. The UNSTABLE LED will light whenever a signature is found that is not identical to the previous signature. The UNSTABLE LED will turn off when two identical signatures in a row are found, or after 100ms (whichever is longer). If the UNSTABLE LATCH function is active, the UNSTABLE LED will light and remain lighted until the CLEAR function is performed.

3-51. Operation of the Data Probe Tip LED

3-52. The Data Probe tip LED normally operates as a logic indicator, reflecting the electrical activity at the probe tip. The logic state at the tip is sampled over $\approx$100ms intervals. If neither a high nor a low is seen during the interval, the probe LED will be set to DIM (indicating high-impedance). If both a high and a low are seen, the LED will blink on and off to indicate activity. A steady high will cause the LED to turn on BRIGHT, a steady low will cause the LED to turn OFF.

3-53. The only time (other than Self-Test) that the probe LED does not operate as a logic indicator is during a triggered signature measurement. After a trigger (probe switch press) is received, the probe LED will turn on BRIGHT (during the measurement). When the measurement is complete, the probe LED will turn off, then resume normal logic activity.

3-54. Operation of the Data Probe Switch

3-55. The Data Probe switch (pushbutton) acts as a trigger signal to the instrument. The Data Probe switch is the only instrument key which cannot be locked out by the interface, and is one of only two keys (along with LOCAL) still active while in REMOTE. The Data Probe Switch, as shown in *Table 3-3*, is utilized for several functions, depending on the instrument mode of operation.

Table 3-3. Probe Switch Functions

Mode	Data Probe Switch Function
NORMAL	Initiates a "Triggered" signature measurement which is stored in memory and represented in the Composite Signature.
SIG LATCH	Initiates a "Triggered" signature measurement which updates the display. The signature is stored in memory and represented in the Composite Signature.
RECALL	Increments or "rolls" the memory stack through the display. Each keypress decrements the memory one measurement.
EDIT	Initiates a "Triggered" signature measurement which replaces the last signature stored in memory and recalculates the Composite Signature accordingly.
	When used with RECALL, initiates a "Triggered" signature measurement which replaces the currently displayed signature in memory and recalculates the Composite Signature accordingly.
SELF-TEST	Shifts the Self-Test Operation Verification sequence from the general PASS/FAIL test to a single segment display verification routine. Each LED and display segment on the front panel is lighted momentarily. When finished, returns to the standard Self-Test routine.
REMOTE	Performs all functions as in local, plus the following additional uses unique to remote operation; initiates a "Triggered" signature measurement which is then available to the interface, initiates a "Triggered" signature measurement and then automatically outputs the Logic Status of the probe to the interface, can be specified in the Service Request Mask to generate an SRQ condition when pressed.

3-56.   The Data Probe switch is used to select the signatures to be entered into the memory. When the Data Probe switch is pressed during normal operation, the next single measurement to start is known as a "triggered" signature measurement. Triggered signatures are (always) stored into the signature memory, and are the only signatures stored there. Triggered signatures are the only signatures represented in the Composite Signature.

3-57.   With the SIG LATCH function enabled, the Data Probe switch must be pressed to initiate a "triggered" signature measurement (as described in Para. 3-56) in order to update or change the displayed signature. Only triggered signatures will be displayed with the SIG LATCH function. The Data Probe switch allows the user to make measurements in a "sample and hold" fashion.

3-58.   While in the RECALL function, the Data Probe switch is used to increment or roll the memory stack through the display. While in the EDIT function, the Data Probe switch is used to trigger a new signature to replace the signature displayed. The new signature acquired after pressing the Data Probe switch assumes the position and reference number of the previously "recalled" signature.

3-59.   During the Self-Test Operation Verification, the Data Probe switch is used to shift the test sequence to a single segment display verification routine. The Data Probe switch can also be utilized interactively during remote operation.

3-60.   The 5006A Signature Memory

3-61.   The 5006A contains a dedicated memory, to accumulate up to thirty-two triggered signatures. In operation, the signature memory acts as a push-down stack. That is, entries are pushed onto the top of the stack. After the stack is full, signatures are lost off the bottom.

3-62.   The 5006A automatically assigns each stored signature a reference number. This number is used to locate the signature during the RECALL or EDIT functions. The signatures are numbered in the order in which they are entered. The first signature is "1", the second is "2", and so on. Numbering continues incrementally even after the memory is full. For example, if thirty-four signatures were entered into the memory (refer to Figure 3-4), the most recent entry would be number "34" and the oldest retrievable entry would be "3" (1 and 2 would be lost). Numbering continues until either the memory is CLEARED or the instrument is turned off then on. Only two digits are used for numbering. When the number of stored signatures exceeds 99, only the last two significant digits are displayed on recall.

3-63. THE 5006A COMPOSITE SIGNATURE

3-64. The 5006A automatically generates a unique "Composite Signature" after each triggered signature measurement. The Composite Signature is a computed signature, representative of the binary sum of all the triggered signatures accumulated since the last CLEAR or power-up. Only triggered signatures (those preceded by pressing the Data Probe Switch) can affect the Composite Signature. In operation, the Composite Signature is automatically recalculated and updated with each new measurement, based on two factors; the previous Composite Signature and

the new triggered signature. In this manner, the Composite Signature remains representative of all signatures taken, even after signatures have dropped off the bottom of the memory stack.

3-65. The Composite Signature can be reviewed at any time by pressing the front panel RECALL key. In the RECALL function, the Composite Signature is identified in two ways; the front panel COMPOSITE SIGNATURE LED annunciator lights and all four decimal points in the display light. See *Figure 3-5*. To return to normal operation press RECALL a second time to turn the function off.
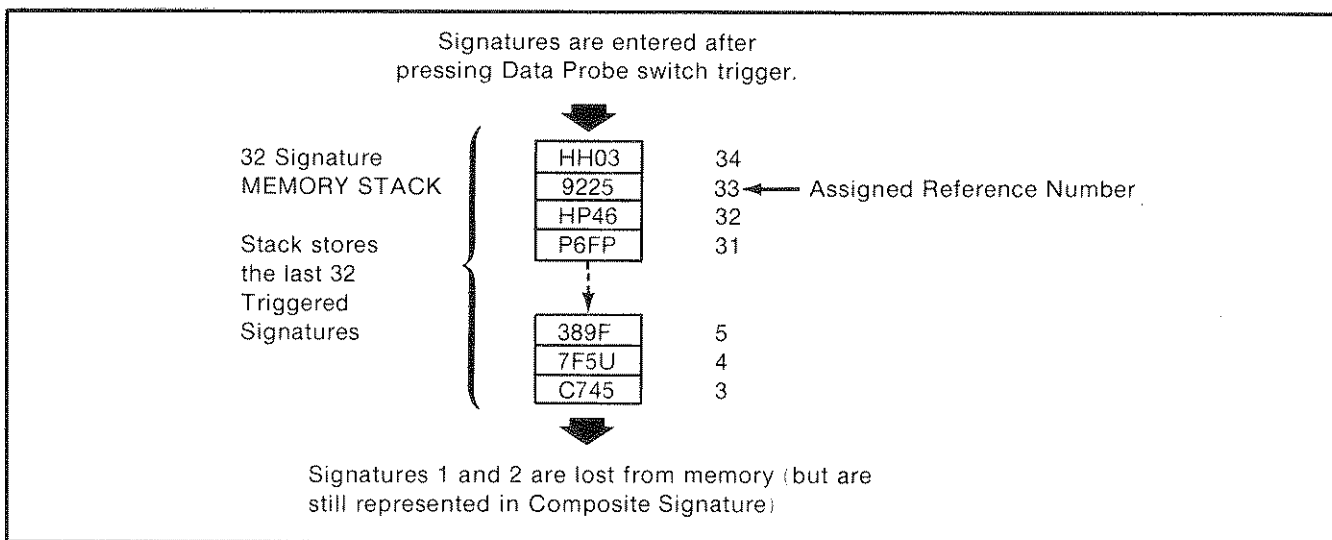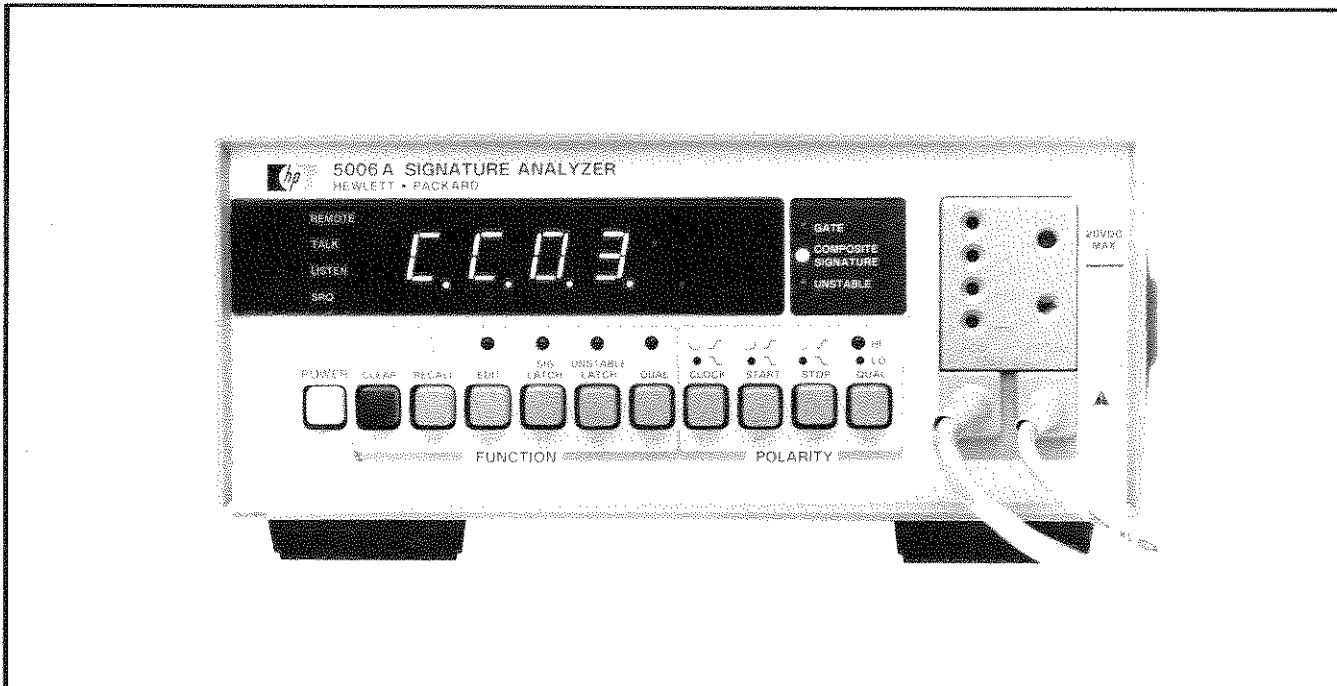

Figure 3-4. Signature Memory

Figure 3-5. Composite Signature Display

3-66. The Composite Signature is very useful for identifying an area of circuitry or a number of nodes by one verified signature. For example, the Composite Signature for all pins of a forty-pin IC may be documented. To verify the proper operation of the IC, probe each pin of the device, entering the signature by pressing the Data Probe switch. The measurements do not have to be entered in any specific order, although entering them in order will keep the pin and reference numbers consistent. When you have finished probing all the pins, press the RECALL key to display the Composite Signture. If the displayed Composite Signature matches the documented signature, all forty signatures are correct.

3-67. A Composite Signature can be used to represent as many signatures as you like, from a single pin to an entire circuit board. You should be aware that the larger the number of pins involved, the greater the chance of a duplication or misprobe. Approximately twenty-four measurements per composite signature is generally a safe and convenient amount.

3-68. Selecting FUNCTIONS

3-69. The 5006A provides six measurement functions selectable through front panel keys. The functions are: LOCAL/CLEAR, RECALL, EDIT, SIG LATCH, UNSTABLE LATCH, and QUAL.
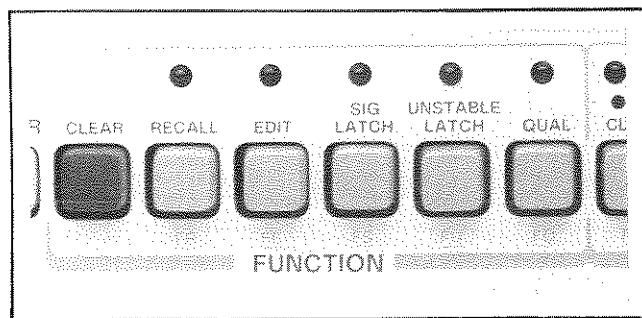

Figure 3-6. Front Panel FUNCTION Keys

3-70. LOCAL/CLEAR. For both local and remote operation, the LOCAL/CLEAR function clears the 5006A display, composite signature, signature memory, and UNSTABLE LED, and resets the gate state machine. It also aborts any measurements in progress and clears any pending "Send Data" commands. If in remote, this function also returns the instrument to local. The CLEAR function may also be used to clear an instrument Error or Fail state. If an Error or Fail message is displayed, the first press of the CLEAR key clears the message from the display allowing the instrument to continue operation (if possible). A second press of the CLEAR key clears the display and memories as described above.

3-71. RECALL. The RECALL function accesses the Composite Signature and signature memory. Pressing the RECALL key selects the function and turns on the LED above the key. If EDIT is disabled (off) and RECALL is enabled (on) the 5006A enters its only non-measuring mode. In this mode, none of the front panel keys other than CLEAR, RECALL, and EDIT can affect operation. The UNSTABLE LED will be off, although the Data Probe LED and GATE LED will retain their normal functions.

3-72. The initial display in RECALL will be the Composite Signature, indicated by the lighting of the front panel COMPOSITE SIGNATURE LED and all four decimal points in the display. The Composite Signature and the most recent triggered signatures (up to 32) can be reviewed by pressing the Data Probe switch. With each press of the Data Probe switch, a two-digit reference number is displayed followed by the corresponding signature. The signatures in memory are accessed in reverse order, beginning with the most recent entries (the highest reference numbers). No more than 32 signatures can be stored at one time. Signatures are reviewed in a scrolling fashion, eventually returning to the Composite Signature, then beginning again.

3-73. EDIT. The EDIT function allows signatures stored in memory to be replaced with new measurements. The EDIT function, by itself, allows the replacement of the last triggered signature placed into memory. EDIT, in conjunction with the RECALL function, allows replacement of any of the (up to 32) signatures in memory. To replace the "last" signature stored, press EDIT (the EDIT LED will light), place the Data Probe tip on the desired node for the replacement measurement and press the Data Probe switch. The last triggered signature stored will be replaced with the measurement just taken. No visual indication of the replacement is returned; however, you may verify the edit through the RECALL function. To edit a signature other than the last entry, select RECALL, then use the Data Probe switch to scroll through the memory until you find the signature you want to edit. The initial display in RECALL will be the Composite Signature, which cannot be edited. Each press of the Data Probe switch will increment the signature memory, displaying first the reference number, then the corresponding signature. The signature which appears in the display is the signature that will be edited. Once the desired signature is displayed, press EDIT. The signature can be replaced by inputting the new signature . The new signature is input by placing the Data Probe tip on the desired node and pressing the data probe switch. Whenever a signature in memory

is edited (replaced), the Composite Signature is automatically recomputed, to reflect the change. Signatures placed in the memory cannot be purged, only replaced through EDIT. You may edit signatures in memory as often and as many times as you wish.

3-74. SIG LATCH. The Signature Latch function selects only triggered signatures to be displayed or made available to the interface. The display will only update when a triggered signature is received. A triggered signature is a signature preceded by a press of the Data Probe switch or the remote GET command. Note that the operation of the UNSTABLE LED is independent of this function. If the probe is placed on an unstable node, the UNSTABLE LED will light even if the probe switch is not pressed. This allows the user to place the probe on a node and determine that the node is stable before enabling the trigger. If an unstable signature is entered, the UNSTABLE LED will not remain latched on unless the UNSTABLE LATCH function is on also. The LED above the SIG LATCH FUNCTION key will be lighted whenever the function is enabled.

3-75. UNSTABLE LATCH. The Unstable Latch function sets the unstable signature circuits to an armed/latch configuration. When the Unstable Latch function is selected, any unstable signature through the probe will cause the UNSTABLE LED to light. Note that this function does not require triggered signatures, and monitors all signatures input through the probe. The UNSTABLE LED will remain lighted until either the CLEAR key is pressed or the UNSTABLE LATCH function is turned off. This mode allows a user to connect the instrument to a system under test, leave it unattended, then return later and determine if the signature had remained stable. The LED above the UNSTABLE LATCH FUNCTION key will be lighted whenever the function is enabled.

3-76. QUAL. The Qual function adds a qualifier to the timing inputs. If QUAL is selected, clock edges will be accepted only when the logic level on the STOP/QUAL input is at the level set by the QUAL POLARITY key. The LED above the QUAL FUNCTION key will be lighted whenever the function is enabled.

3-77. 5006A POLARITY Selections

3-78. The 5006A interprets the Timing Pod input signal levels according to the settings of the POLARITY keys. That is, the active trigger edge (or state) for each of the Timing Pod inputs is selectable with the front

panel POLARITY keys. The power-up state for the POLARITY keys is "rising edge" for CLOCK, START, and STOP, with QUAL set to off.
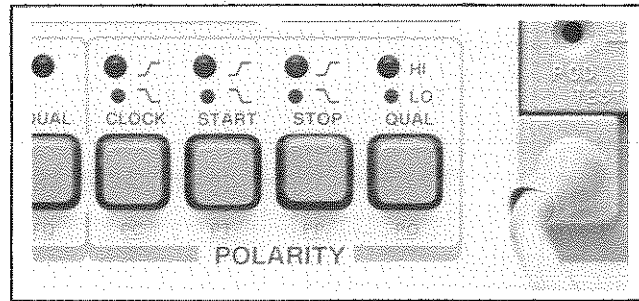
Figure 3-7. Front Panel POLARITY Keys

3-79. All four POLARITY keys, CLOCK, START, STOP, and QUAL, operate in a simple toggle fashion. Each keypress toggles the polarity to the complementary state. To change the POLARITY edges for the CLOCK, START, STOP, or QUAL (if the QUAL function is enabled) Timing Pod inputs, press the corresponding labeled key.

3-80. For any selected POLARITY key, LED indicators above the key identify the active logic edge or level as follows. For CLOCK, START, and STOP inputs, a lighted LED indicates the "rising edge" is selected, an unlighted LED indicates the "falling edge" is selected. For the QUAL input, a lighted LED indicates that a "HI" level is required to enable the measurement, an unlighted LED indicates that a "LO" level is required to enable the measurement. The QUAL Function must be activated before a QUAL Polarity can be selected.

3-81. Trigger Thresholds

3-82. The 5006A is pre-programmed to trigger on the standard logic thresholds for the TTL. The pre-programmed standard trigger threshold values for each input are given in Table 3-4. Notice that both a logic High and Low value are programmed for the DATA PROBE input, while only a logic family mean (midpoint) is required for the CLOCK, START, STOP, and QUAL inputs.

Table 3-4. Preset Trigger Thresholds

Data Probe	Clock	Start	Stop	Qual
2.00V High 0.80V Low	1.40V	1.40V	1.40V	1.40V

3-83. Selecting CMOS Input Logic Thresholds

3-84.   The 5006A is pre-programmed to trigger on standard TTL logic levels. The actual trigger threshold values may be set to any level between +0.9 volts and +14.0 volts. To change the input trigger thresholds, connect the CMOS power supply (any level between +3.0 and 20.0 volts) to the 5006A front panel connector labeled "CMOS". The dc value will be sensed by the 5006A, and the trigger thresholds for the various inputs will be modifided as follows:

Data Probe Input
   Logic one   70% (nominal) of the reference value
   Logic zero   30% (nominal) of the reference value

Timing Pod Inputs
   Logic mean   50% (nominal) of the reference value

3-85. MAKING SIGNATURE ANALYSIS MEASUREMENTS

3-86.   Signature Analysis (SA) employs a unique data compression technique that reduces any long, complex data stream pattern on a logic node to a four-digit "signature". The operator supplies the Start and Stop signals to identify the data stream, and a Clock signal to control the sample rate of the probe input. An illustration of the timing involved in a Signature Analysis measurement window can be seen in *Figure 3-8.*

3-87.   The following paragraphs describe the two signature analysis modes of operation for the 5006A.

3-88. Signature Analysis Measurements (Normal)

3-89.   The 5006A makes Signature Analysis (SA) measurements on TTL and CMOS logic families. The trigger thresholds for the inputs are selectable from the standard preset values for TTL logic families, or determined from an external dc input for CMOS. The edge for the Clock, Start, and Stop inputs is selectable using the POLARITY keys. The Start signal is applied to the START/ST/SP (green) Timing Pod lead. The Stop signal is applied to the STOP/QUAL (red) Timing Pod lead. The Clock signal is applied to the CLOCK (yellow) Timing Pod lead, and the measurement is made through the Data Probe.

3-90.   During SA measurements the front panel GATE LED indicator will flash if there are valid Start and Stop

inputs and an active Clock input. The Data Probe tip LED acts as a logic state indicator, lighting "brightly" for a logic high state, "dimly" for a high-impedance state, and "off" for a logic low state. The Data Probe tip LED will "flash" to indicate activity at the node, however the flash duration is controlled by a pulse-stretching circuit and does not reflect the frequency of the input. The UNSTABLE LED will flash if there is a difference between two or more successive signatures.

3-91. Signature Analysis Measurements (Qualified)

3-92.   The Qualified SA mode is selected by pressing the QUAL function key. The Qualified Signature Analysis mode is similar to the normal mode, but with the following enhancement. In this mode, the STOP/QUAL input on the Timing Pod is sensed as a "data qualifier". Conceptually, the qualifier can be thought of as "enable" signal. By controlling the logic state of this input, the operator can effectively window the signature measurement within a specific stream of data. Refer to *Figure 3-8.* The trigger thresholds for the inputs are selectable from the standard preset values for TTL, or determined from an external dc input for CMOS. The active edge or level for CLOCK, START, STOP and QUAL, is selectable using the POLARITY keys. When in the QUAL Signature mode, the red Timing Pod lead is the QUAL (qualifier) input, and the green Timing Pod lead is both the START and STOP input. The measurement is made through the Data Probe.

3-93.   The operation of the GATE, UNSTABLE, and Data Probe tip LEDs during the SA QUAL mode is the same as in SA normal (see paragraph 3-88).
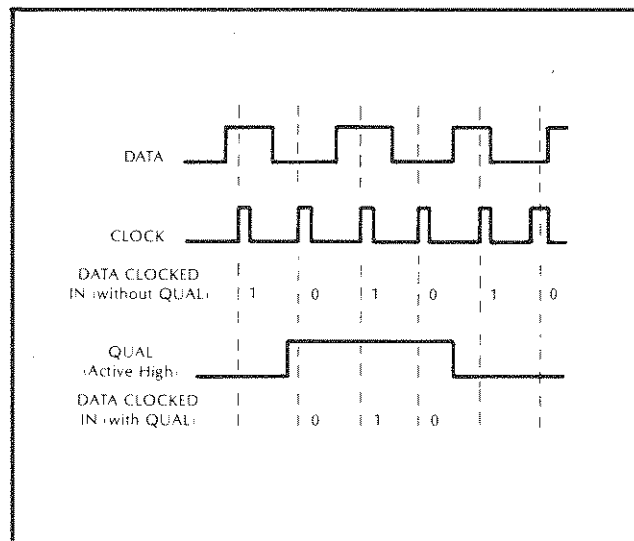
Figure 3-8. Signature Analysis Measurement Timing

3-94. Basic Measurement Procedure

3-95. The recommended sequence for setting-up and making a measurement with the 5006A is given below.

1. Set the 5006A POWER switch to ON. The 5006A should perform a power-up self-check, then preset to the power-up default settings described in paragraph 3-43.

2. Select the desired POLARITY edges for the CLOCK, START, and STOP Timing Pod inputs.

3. Activate the QUAL Timing Pod input, if desired, by pressing the QUAL FUNCTION key. Select the desired active enable level for the QUAL input with the QUAL POLARITY key; when the QUAL POLARITY LED is lighted, the active enable state is "HI", when the QUAL POLARITY LED is off, the active enable state is "LO".

4. If the circuit logic under test is CMOS, input the CMOS power supply (+3V to +20V) into the front panel CMOS connector.

5. Select the SIG LATCH function, if desired, by pressing the labeled FUNCTION key. The SIG LATCH function displays only triggered signatures. The FUNCTION indicator LED above the key should light whenever the function is activated.

6. If desired, select the UNSTABLE LATCH function by pressing the labeled FUNCTION key. The UNSTABLE LATCH function monitors the Data Probe input for an unstable signature, latching the front panel UNSTABLE LED on if one is desired.

7. Connect the Timing Pod leads to the appropriate input signals. The GATE LED should be flashing.

8. Touch the Data Probe tip to the desired node. The node signature should be displayed, unless the Signature Latch function is on. To enter the displayed signature into the 5006A memory, press the Data Probe switch.
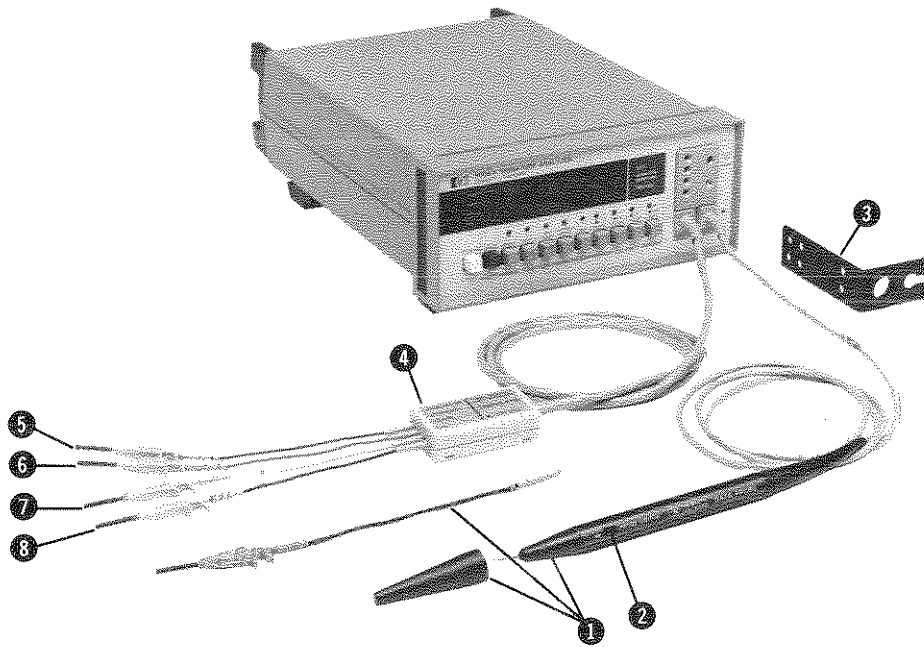
❶	**DATA PROBE, PROTECTIVE COVER, and GND LEAD**	Point of entry for data. The lamp within the probe tip indicates the logic state of the data: ON BRIGHT=High, ON DIM=High-impedance, OFF=Low, FLASH-ING=Activity. Note the removable ground connector wire (internally connected to earth ground) and protective cap cover for the Data Probe.
❷	**DATA PROBE SWITCH**	Used as an operator interactive prompt/response signal.Used to initiate a "trig-gered signature measurement" during SA functions, to scroll through the signature memory in RECALL, or to replace a signature in EDIT. The function of the Data Probe switch is identical for both local and remote operation.
❸	**DATA PROBE and TIMING POD HOLDER**	Accessory holder, used to store the Data Probe and Timing Pod when not in use. May be installed on either bench or rack mounted instruments.
❹	**TIMING POD**	Supplies the four timing inputs START/ST/SP, STOP/QUAL, CLOCK, and $\perp$ (GND) from the unit under test to the 5006A Signature Analyzer.
❺	**START/ST/SP**	Point of entry for START signal in normal SA mode, and for both START and STOP signals in QUAL SA.
❻	**STOP/QUAL**	Point of entry for STOP signal in normal SA and for the QUAL signal in QUAL SA.
❼	**CLOCK**	Point of entry for CLOCK signal during normal and QUAL SA.
❽	**$\perp$ Ground**	Common ground lead between 5006A and device under test for all function modes. Note that this lead is internally connected to earth ground.

⑨ DISPLAY	Contains the four seven-segment LED displays.
⑩ GATE LED	Flashing of GATE LED indicates the 5006A is being gated. It does not indicate the frequency of the gate cycle.
⑪ COMPOSITE SIGNATURE LED	If lighted, indicates that the signature displayed is the computed Composite Signature derived from all the signatures taken since the last CLEAR or POWER-UP condition.
⑫ UNSTABLE LED	If lighted, indicates the current signature measurement is different from the previous signature measurement.
⑬ RECALL LED	If lighted, indicates the RECALL function is activated.
⑭ EDIT LED	If lighted, indicates the EDIT function is activated.
⑮ SIG LATCH LED	If lighted, indicates the SIGNATURE LATCH function is activated.
⑯ UNSTABLE LATCH LED	If lighted, indicates the UNSTABLE SIGNATURE LATCH function is activated.
⑰ QUAL LED	If lighted, indicates the QUAL function mode of SA is activated.

Figure 3-10. Front Panel Indicators

⑱	**CLOCK LED**	LED indicator for the status of the CLOCK Polarity.If lighted indicates rising edge selected, off indicates falling edge.
⑲	**START LED**	LED indicator for the status of the START Polarity.If lighted indicates rising edge selected, off indicates falling edge.
⑳	**STOP LED**	LED indicator for the status of the STOP Polarity. If lighted indicates rising edge selected, off indicates falling edge.
㉑	**QUAL LED**	LED indicator for the status of the QUAL Polarity. If lighted indicates HI level selected, off indicates LO level selected. The QUAL FUNCTION must be selected for QUAL POLARITY to be activated.
* ㉒	**REMOTE LED**	Interface status indicator. Lights when the 5006A is under remote control.
* ㉓	**TALK LED**	Interface status indicator. Lights when the 5006A is addressed to talk.
* ㉔	**LISTEN LED**	Interface status indicator. Lights when the 5006A is addressed to listen.
* ㉕	**SRQ LED**	Interface status indicator. Lights when the 5006A has requested service from the controller. SRQ may (or may not) generate an interrupt in the controller. The setting of the SRQ Mask determines whether or not an SRQ is issued.

Provided only with Option 030 or Option 040.

Figure 3-10. Front Panel Indicators (Continued)

Figure 3-11. Front Panel Controls
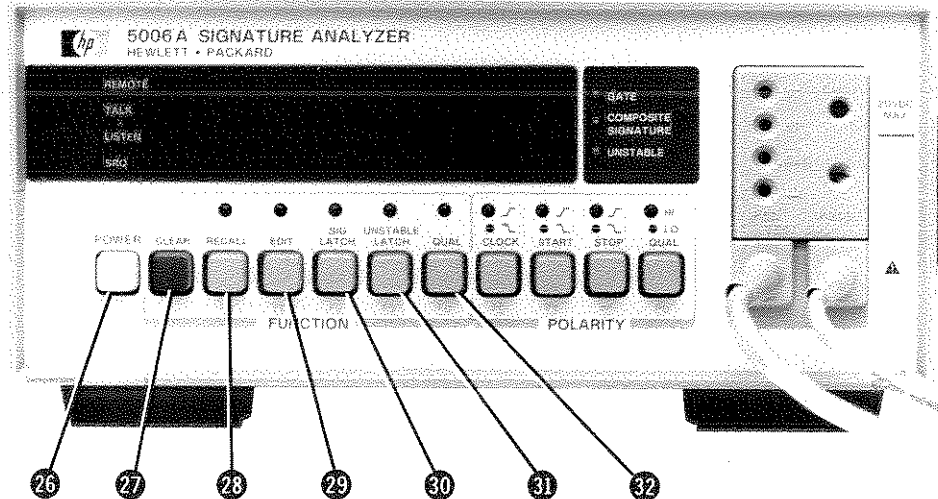
㉖ POWER Key — Main power switch for the 5006A. Press and lock in to power the instrument. Press again, releasing the pushbutton, to remove power. When power is off, there are no components energized within the instrument, however, ac line voltage is present at the rear panel line connector and in the primary winding of the main power transformer.

㉗ CLEAR/LOCAL Key — With no Error or Failure displayed, this key will clear the memory of triggered signatures and the Unstable Signature LED. In remote operation, with no Error or Failure displayed, this key will return the instrument to "Local" operation and clear the memory of triggered signatures (unless the Local Lockout command has been issued). If an Error or Failure is displayed, this key will clear only the Error or Failure display. Pressing the key a second time will complete the CLEAR and LOCAL function.

㉘ RECALL Key — Selects the RECALL function. RECALL first displays the Composite Signature. Pressing the Data Probe switch accesses the triggered signatures stored in memory for review or edit, beginning with the most recent entry. Repeated presses of the Data Probe switch recall each of the stored signatures in reverse order.

㉙ EDIT Key — Selects the EDIT function. EDIT allows replacement of the last triggered signature in memory, or in conjunction with RECALL allows replacement of any stored signature. Replacing a stored signature in memory causes the Composite Signature to change.

㉚ SIG LATCH Key — Selects the SIGNATURE LATCH function, which latches the last signature into the display. The Data Probe switch must be pressed to update the display.

㉛ UNSTABLE LATCH Key — Selects the UNSTABLE SIGNATURE LATCH function, which sets up the UNSTABLE LED to light and remain lighted whenever an unstable signature is detected.

㉜ QUAL Key — Selects the QUAL function mode of SA. In this mode, signature measurement is enabled by either the high (HI) or low (LO) level of the qualifying input signal.

Figure 3-11. Front Panel Controls (Continued)
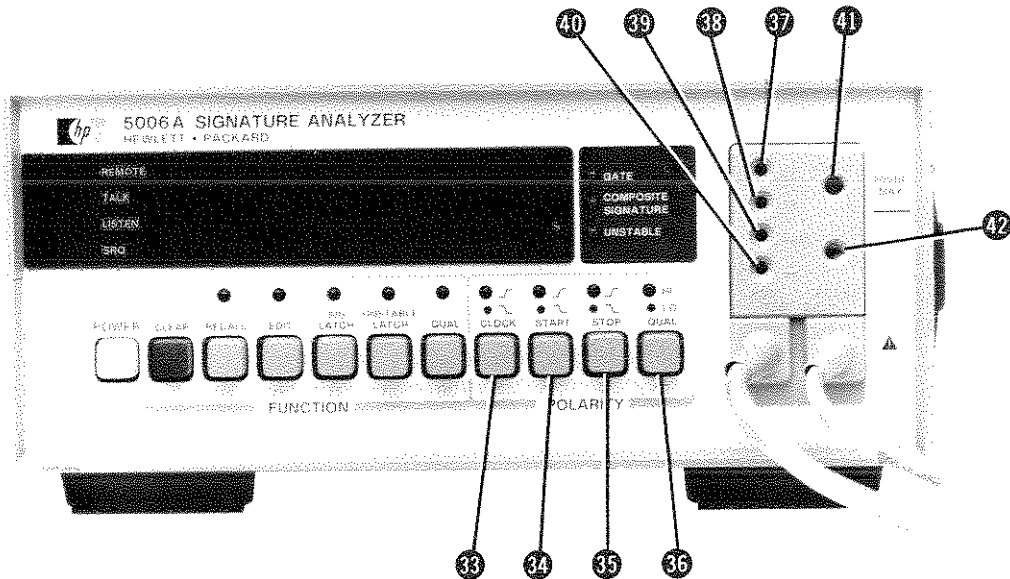
㉝ CLOCK Key	Selects the CLOCK Polarity. Pressing the CLOCK key toggles the current setting of the Clock polarity, indicated by the LED above the key. A lighted LED indicates the rising edge, an unlighted LED indicates the falling edge.
㉞ START Key	Selects the START Polarity. Pressing the START key toggles the current setting of the Start polarity, indicated by the LED above the key. A lighted LED indicates the rising edge, an unlighted LED indicates the falling edge.
㉟ STOP Key	Selects the STOP Polarity. Pressing the STOP key toggles the current setting of the Stop polarity, indicated by the LED above the key. A lighted LED indicates the rising edge, an unlighted LED indicates the falling edge.
㊱ QUAL Key	Selects the QUAL Polarity. Pressing the QUAL key toggles the current setting of the Qual polarity, indicated by the LED above the key. A lighted LED indicates a HI level selected, an unlighted LED indicates a LO level selected.
㊲ ST Connector	Test connector for START Timing Pod lead during Operation Verification test procedure.
㊳ SP Connector	Test connector for STOP Timing Pod lead during Operation Verification test procedure.
㊴ CLK Connector	Test connector for CLOCK Timing Pod lead during Operation Verification test procedure.
㊵ ⊥ Connector	Test connector for ⊥ (GND) Timing Pod lead during Operation Verification test procedure. **CAUTION: This connector is not connected to chassis ground (⊥) and is not at zero volts.**
㊶ CMOS Connector	Input connector for CMOS sense voltage. When using CMOS circuitry, input the corresponding CMOS power supply through this connector to modify the 5006A trigger levels.
㊷ PROBE Connector	Test connector for the Data Probe during Operation Verification test procedure.

Figure 3-11. Front Panel Controls (Continued)

Figure 3-12. Rear Panel Features

⚠
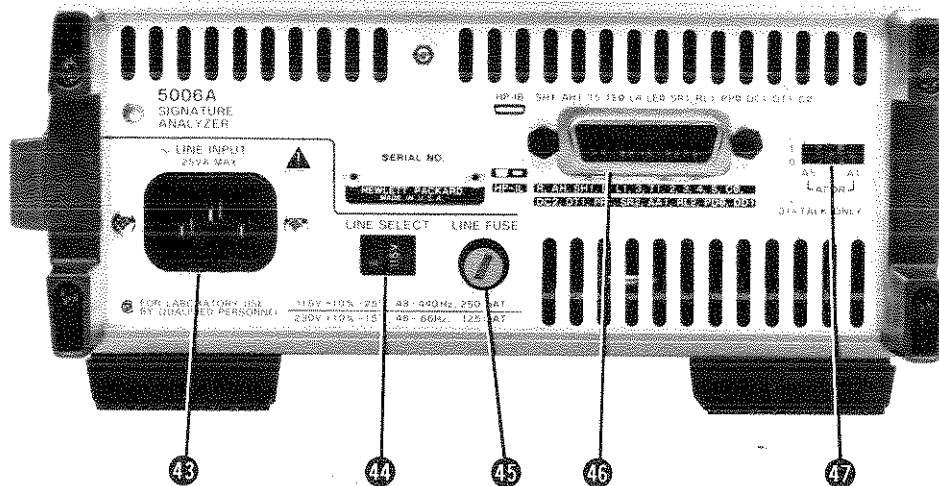
43 **LINE INPUT**	The ac power input connector. Accepts the input ac power cord. Protective grounding conductor connects to the instrument through this connector.	
44 **LINE SELECT SWITCH**	Selects the instrument line voltage. The number visible on the switch indicates the nominal line voltage to which the instrument must be connected (see *Figure 2-1*). Selects either 115 or 230 volts ac.	
45 **LINE FUSE**	The line fuse for the instrument. The fuse value should be 250 mAT for 115 volt operation, or 125 mAT for 230 volt operation.	
46 **HP-IB CONNECTOR** (**Shown in Photo**) or **HP-IL CONNECTOR**	HP-IB Interface Connector for remote operation via the HP-IB. Provided only with Option 040. HP-IL Interface Connector for remote operation via the HP-IL. Provided only with Option 030.	
47 **INTERFACE ADDRESS SWITCH**	Interface address switch, contains switches A1 through A5 to select up to 31 (binary) addresses. Address 31(all switches to "1") selects the TALK-ONLY mode. Provided only with Option 030 or Option 040.	

3-96. REMOTE PROGRAMMING

3-97. Introduction

3-98. The 5006A Signature Analyzer (with Option 040) is compatible with the Hewlett-Packard Interface Bus (HP-IB), and (with Option 030) is compatible with the Hewlett-Packard Interface Loop (HP-IL). Remote programming allows the instrument to respond to remote control instructions and output measurement data via the interface. At the simplest level, the 5006A can output data in the talk only mode to other devices such as a controller or printer. In more sophisticated systems, a controller can remotely program the 5006A to perform a specific type of measurement, trigger the measurement, and output the results.

Note

HP-IB is Hewlett-Packard's implementation of IEEE Std. 488-1978, "Standard Digital Interface for Programmable Instrumentation".

3-99. The programming information in this section, except where noted, applies to both HP-IB and HP-IL interfaces. In general, the HP-IB may be considered a subset of HP-IL, as almost all capabilities of the HP-IB are also capabilities of the HP-IL. Every effort has been made to make the programming of the 5006A consistent, regardless of which interface is configured.

3-100. To remotely program the 5006A efficiently, the operator must be familiar with the selected controller, the configured interface, and the local (manual) operation of the 5006A. Typical controllers for the HP-IB are the 9825A/B, 9826A, 9830A, 9835/45A, or 85A. The typical controller for the HP-IL is the HP 41CV. Users of the HP-IB Interface should find the following manuals useful background information:

Condensed Description of the Hewlett-Packard Interface Bus(P/N 59401-90030)

HP-IB Programming Hints For Selected Instruments (P/N 59300-90005)

Tutorial Description of the Hewlett-Packard Interface Bus (P/N 5952-0156)

3-101. Users of the HP-IL interface may be unfamiliar with the HP-IL system. An introductory description of the interface system, and the Hewlett-Packard Interface Loop (HP-IL) is provided in paragraph 3-105. More detailed information on the HP-IL is available in the following publications:

HP-IL Interface Specification (P/N 82166-90017)

The HP-IL System: An Introductory Guide to the Hewlett-Packard Interface Loop (Published by OSBORNE/McGraw-Hill, 630 Bancroft Way, Berkeley, CA 94710)

3-102. INTERFACE DESCRIPTION

3-103. Hewlett-Packard Interface Bus (HP-IB)

3-104. The Hewlett-Packard Interface Bus (HP-IB) system utilizes a party-line bus structure (devices share signal lines) to which a maximum of 15 devices may be connected in one contiguous bus. Sixteen signal lines and 8 ground lines are used to interconnect devices in a parallel arrangement and maintain an orderly flow of device and interface related information.

3-105. Hewlett-Packard Interface Loop (HP-IL)

3-106. The Hewlett-Packard Interface Loop (HP-IL) is a two-wire serial interface that provides programmable control of instruments while being easy to use and understand. The controller and all devices in the loop, including the 5006A, are connected together in series, forming a continuous loop communications circuit. Any information (instructions or data) that is transferred among HP-IL devices is passed from one device to the next around the loop (one direction only). If the information is not intended for a particular device, that device simply passes the information on to the next device in the loop. When the proper device receives the information, that device responds as directed. In this way, the controller or the 5006A can send information to and receive information from each device in the loop, according to the device's capability.

3-107. The 5006A may be connected anywhere in the interface loop. The loop consists of up to 30 devices plus the controller using simple addressing. When installing or removing the 5006A (or any other device) it is a good practice to turn off the controller first. Then simply disconnect the loop in one place and connect the 5006A at that point. Remember, the interface cables must form a continuous loop. All HP-IL connectors are designed to ensure proper orientation and indicate the direction of information transfer.

3-108. INTERFACE FUNCTIONAL OVERVIEW

3-109. Each device on the interface may possess one or more of the following major device capabilities: Controller, Talker, or Listener. The controller, as the name implies, has the responsibility to control inter-

face activity. The controller, of course, must be equipped with the proper interface module. Controllers transmit all device independent commands to other devices in the interface and usually have Talker and Listener capabilities. The 5006A cannot serve as a controller. Only one device in the interface may be the active controller at any one time.

3-110. Talkers are devices that have the ability to send data or device dependent commands through the interface. Note that a talker will not actually send its data or information until told to do so by the controller. The 5006A has Talker capabilities. When the 5006A is talking on the interface, its TALK annunciator will turn on. In special situations, one device may be classified as a Talk-only device and sends information to Listen-only devices. Such a system would not have a controller. For example, the 5006A can be configured for Talk-only mode and send measurement results to a printer.

3-111. Listeners are devices with the capability to receive information over the interface. When the 5006A is "listening", its LISTEN annunciator turns on. Listeners must also be enabled by the controller to receive the information.

3-112. INTERFACE SYSTEM TERMS

3-113. The following paragraphs define the terms and concepts used to describe HP-IB and HP-IL system operations.

a. Address: Each device in the interface is assigned an address. The address is used to specify which device on the interface will receive information or send information.

b. Byte: A byte is a unit of information consisting of 8 binary digits called bits.

c. Device: Any instrument or unit that is HP-IB or HP-IL compatible is called a device.

d. Device Dependent: An action a device performs in response to information sent through the interface. The action is characteristic of a particular instrument and will probably vary from device to device.

e. Device Independent Command: A command pre-defined by the interface standard to have a specified bit pattern and resulting action.

f. Device Dependent Command: A command not

pre-defined by the interface standard, which is specific to a particular instrument or family of instruments. Device dependent commands are usually sent as ASCII strings of characters.

g. Frame: Messages sent through the HP-IL interface as a sequence of eleven bits are called a message "frame".

h. Polling: Polling is a process typically used by a controller to locate a device that has requested service from the controller. There are two types of polling, Serial Poll and Parallel Poll:

1. Serial Poll. When the controller executes a serial poll, the addressed device sends one byte of operational information called a status byte. If more than one device in the interface is capable of requesting service, each device on the interface must be serial polled until the device that requested service is located.

2. Parallel Poll. When the controller executes a parallel poll, all devices on the interface respond, each one setting or clearing a particular data bit to indicate whether or not it requested service.

3-114. ADDRESS SELECTION

3-115. Manual Addressing. To use the 5006A in a system, set the rear panel address switches to the desired address. Addresses 0 through 30 represent the addressable mode range. Address 31 selects the TALK ONLY mode. The addressable mode is used when the 5006A functions as a talker and listener. The TALK ONLY mode is employed when the 5006A is operating in an output-only condition (no controller on the bus) and sends its data to another device on the bus, such as a printer, set to LISTEN ALWAYS.

3-116. The five rightmost switches, A5 through A1, set the addresses of the 5006A. *Table 3-5* shows all possible address settings and the corresponding ASCII codes used by some controllers for talk and listen. The 5006A is factory set to address 10 as shown in *Figure 3-13*.
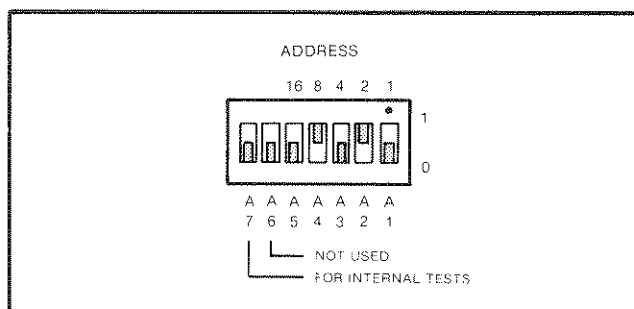
Figure 3-13. 5006A Address Switches

Table 3-5. Address Selection

ADDRESS

16 8 4 2 1

A A A A A A A
7 6 5 4 3 2 1

└── NOT USED
└──── FOR INTERNAL TESTS
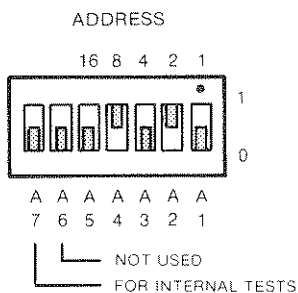
(Shown in addressable mode, and address 10)

NOTE

Select the decimal listen address from the table below and set the
address switches to the corresponding positions.

ASCII CODE CHARACTER		ADDRESS SWITCHES					5-BIT DECIMAL CODE
LISTEN	TALK	A_5	A_4	A_3	A_2	A_1	
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
—	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
Ø	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21*
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30

*Address "21" is the preset controller address for HP controllers.

3-117. Auto-addressing. Auto-addressing is a method of setting the instrument's address, unique to HP-IL, and is provided by the HP85, 75, and 41. When auto-addressing is enabled, each device in the loop is assigned an address by the controller. The assigned address will probably be different than the factory preset address. The 5006A, for example, has a preset address of 10. If the 5006A is the only device in the loop with the controller, the controller will assign it an address of "1". The address permits the controller to specify or select a particular device in the loop when sending commands. As shown in *Figure 3-14*, addresses are assigned to particular devices sequentially around the loop in the direction of information flow. The first device after the controller is assigned an address of "1". The second device is assigned the address "2", and so on around the loop. The controller has an address of "0".

Figure 3-14. Typical HP-IL System Addressing

3-118. FRONT PANEL INTERFACE STATUS LEDS

3-119. The four Interface Status LEDs on the front panel indicate the remote status of the 5006A. The REMOTE LED lights to indicate that the 5006A is under remote control. The TALK LED lights to indicate that the 5006A is addressed to talk (send data). The LISTEN LED lights to indicate that the 5006A is addressed to listen (receive commands). The SRQ LED lights to indicate that a service request condition exists (as determined by a set service request mask bit).

3-120. When the 5006A returns from remote operation to the local mode, the REMOTE LED turns off. The TALK or LISTEN, and SRQ LEDs will remain in their current state. If the 5006A is unaddressed, the SRQ LED will remain in its current state. In the TALK ONLY mode, the TALK LED is always lighted.

3-121. INTERFACE FUNCTION

3-122. The capability of a device connected to the bus (or in the loop) is specified by its interface functions. These functions provide the means for a device to receive, process, and send messages over the interface. *Table 3-6* lists the 5006A interface functions using the terminology of the IEEE 488-1978 standard and of the HP-IL Interface Specification. These functions appear on the rear panel near the interface connector, as follows:

HP-IB   SH1,AH1,T5,TE0,L4,LE0,SR1,RL1,
PP0,DC1,DT1,C0

HP-IL   R,AH,SH1,D,L1,(T1,2,3,4,5)C0,DC2,DT1,
PP1,SR2,AA1,RL2,PD0,DD1

3-123. The number following the interface function code indicates the particular capability of that function.

Table 3-6. Interface Functions

Interface Function Subset Identifier	HP-IB Interface Function Description
SH1	Source handshake. Full capability.
AH1	Acceptor handshake. Full capability.
T5	Talker. Includes serial poll, talk-only, unaddress if my-listen-address (MLA) capabilities.
TE0	Extended talker. No capability.
L4	Listener. Includes unlisten if my-listen-address.
LE0	Extended listener. No capability.
SR1	Service request. Full capability.
RL1	Remote/local. Full capability.
PP0	Parallel poll. No capability.
DC1	Device clear. Full capability.
DT1	Device trigger. Full capability.
C0	Controller. No capability.

Table 3-6. Interface Functions (Continued)

Interface Function Subset Identifier	HP-IL Interface Function Description
R	Receiver. Full capability.
AH	Acceptor handshake. Full capability.
SH1	Source handshake. Full capability.
D	Driver. Full capability.
L1	Listener. Basic listener.
T1	Talker. Basic talker.
T2	Talker. Serial poll.
T3	Talker. Send device ID.
T4	Talker. Send accessory ID.
T5	Talker. Talk-only.
C0	Controller. No capability.
DC2	Device clear. Full capability.
DT1	Device trigger. Full capability.
PP1	Parallel poll. Full capability.
SR2	Service Request. Full capability.
AA1	Auto address. Simple addressing.
RL2	Remote local. Full capability.
PD0	Power down. No capability.
DD1	Device dependent commands. Full capability.

3-124. The 5006A can operate (as listed in *Table 3-6*) as both a talker and listener. The 5006A output format is the same regardless of the mode (talk only or addressable).

a. TALK. The 5006A can be addressed to Talk by a controller or by the TALK ONLY interface function. When addressed as a Talker, the 5006A will send data to other devices on the interface, depending on the function selected. The TALK ONLY function is selected by setting the interface address switches, located on the rear panel, to address "31".

b. LISTEN. When addressed as a Listener, the instrument will accept commands via the interface. These commands are used to program the instrument's operation.

c. SERVICE REQUEST (SRQ). SRQ can be sent active on the interface whenever an enabled status bit is set. The 5006A can also request service asynchronously from the controller. Refer to the "RMnnn" command described in paragraph 3-158.

d. REMOTE/LOCAL: On power up, the 5006A is under front panel (local) control. To program the 5006A, it must be placed in Remote. Once in Remote, programmable functions cannot be changed by front panel control. The LOCAL key may be used to return the 5006A to local control. This key may be disabled with the Local Lockout (LLO) command. In LLO, the interface command NRE (Not Remote Enable) must be sent to disable LLO and return the instrument to local operation.

e. PARALLEL POLL: The 5006A with HP-IB does not support parallel poll. The 5006A with HP-IL does support parallel poll.

f. DEVICE CLEAR: When a group or selected device clear is received, the instrument resets and clears the display.

h. DEVICE TRIGGER: When a device trigger is received, the 5006A flags the next measurement as a triggered measurement.

i. CONTROLLER: The 5006A cannot act as a controller.

3-125. INTERFACE COMMANDS

3-126. The commands that the HP5006A recognizes can be separated into two classes: device dependent commands and device independent commands. Device dependent commands are those that are unique to the instrument and are defined by the instrument designer. They are normally sent to an instrument as ASCII strings, as, for example, in the HP85 command OUTPUT 710; "FR1", which turns on the Recall function.

3-127. Device independent commands, on the other hand, are defined by the interface standard document and are the same in all instruments. These commands are identified by a three letter mnemonic such as GTL, which represents Go to Local. Device independent commands are sent as specially encoded bytes on

the interface and not as ASCII strings. Thus these commands cannot be sent using the OUTPUT statement on the HP85. However, many controllers do incorporate a command of the form SEND 7; CMD nnn, where nnn is the decimal equivalent to the bit pattern corresponding to a particular device independent command.

3-128. INTERFACE CAPABILITIES

3-129.   Since the device independent commands are standardized and are the same in all instruments, the functions these commands perform can be listed on

the instrument in a standardized manner. This is known as the interface capability label.

3-130.   Table 3-7 provides a list of the interface capabilities of the instrument.

3-131. DEVICE INDEPENDENT COMMANDS

3-132.   Table 3-8 provides a list of supported device independent command mnemonics. The command's full name, whether the command is used on HP-IB, HP-IL, or both, and a description of the function of the command.

Table 3-7. 5006A Interface Capabilities

HP-IB	HP-IL	Description
SH1	SH1	The instrument can generate messages.
AH1	AH	The instrument can interpret received messages.
	R	The instrument can receive messages.
	D	The instrument can drive the HP-IL loop.
T5	T12345	The instrument can function as a talker. In addition, it can operate as a Talker Only instrument and can respond to serial poll, send device ID, and send accessory ID.
TE0		The instrument cannot function as an extended talker.
L4	L1	The instrument can function as a listener. In addition, it will untalk itself if addressed as a listener.
LE0		The instrument cannot function as an extended listener.
SR1	SR2	The instrument can generate a service request. In addition, the instrument can generate an IDY frame on HP-IL.
RL1	RL2	The instrument can operate in both remote and local modes. In addition, it can respond to local lockout.
PP0	PP1	The instrument does not support parallel poll on HP-IB. On HP-IL, the instrument does support parallel poll.
DC1	DC2	The instrument supports both the device clear (DCL) and selected device clear (SDC) commands.
DT1	DT1	The instrument can be remotely triggered.
C0	C0	The instrument cannot function as a controller.
	AA1	The instrument can be remotely addressed with simple (non-extended) addresses.
	PD0	The instrument cannot be remotely powered down.
	DD1	The instrument responds to the device dependent listener (DDL) command.

Table 3-8. 5006A Device Independent Commands

Mnem	HP-IB	HP-IL	Name
AAD n		X	Auto Address n
AAU		X	Auto Address Unconfigure
ATN	X		Attention (See Note 1)*
DCL	X	X	Device Clear
DDL n		X	Device Dependent Listener
EAR		X	Enable Asynchronous Request
EOI	X		End or Identify (See Note 1)*
ETE		X	End of Transmission, error
ETO		X	End of Transmission, OK
GET	X	X	Group Execute Trigger
GTL	X	X	Go To Local
IAA		X	Illegal Auto Address
IDY	X	X	Identify
IFC	X	X	Interface Clear (See Note 1)*
LAD n	X	X	Listen Address n
LLO	X	X	Local Lockout
MLA	X	X	My Listen Address
MTA	X	X	My Talk Address
NOP		X	No Operation
NRD		X	Not Ready for Data
NRE	X	X	Not Remote Enable (see Note 1)*
NULL	X	X	Null
PPD		X	Parallel poll disable
PPE n		X	Parallel poll enable
PPU		X	Parallel poll unconfigure
REN	X	X	Remote Enable (See Note 1)*
RFC		X	Ready For Command
SAI		X	Send Accessory Identification
SDA		X	Send Data
SDC	X	X	Selected Device Clear
SDI		X	Send Device Identification
SPD	X		Serial Poll Disable
SPE	X		Serial Poll Enable
SST		X	Send Status
TAD n	X	X	Talk Address n
UNL	X	X	Unlisten
UNT	X	X	Untalk

*Note 1: These messages are sent on single lines on HP-IB, rather than as complete bytes.

3-133. The response of the instrument to the device independent messages is listed below:

AAD n   The instrument accepts n as its address, then transmits ADD (n+1) to the next instrument on the loop.

AAU   The instrument's address returns to the power-up default set by the rear panel switch.

ATN   Alerts the instrument that a device independent message is coming.

DCL   If the instrument is not in an error state, this command aborts the current measurement, aborts all pending send data commands, resets the gate state machine, and clears the composite signature, signature memory, and unstable LED. This is equivalent to the front panel clear button.

DDL n   If the instrument is a listener and is not cur-
rently auto-addressed, the auto-address
function in the instrument will be disabled
if n=0 and enabled if n=1. This command
allows the instrument using HP-IL to more
closely resemble one using HP-IB, as with
auto-addressing disabled the instrument
will always use the address set by the rear
panel switches. The user should note that
disabled auto-addressing is an abnormal
state of the instrument and should only be
used with caution.

EAR   The instrument is enabled to source an IDY
frame when it requires service.

EOI   If Attention is false and the instrument is
a listener, EOI acts as a message delimiter.

ETE   No effect when received by the instrument.

ETO   No effect when received by the instrument.

GET   If the instrument is addressed to listen, GET
causes the next measurement to be a trig-
gered measurement. This is equivalent
to pressing the Data Probe switch.

GTL   If the instrument is addressed to listen,
GTL causes the instrument to go to its local
state. Local lockout is not cleared.

IAA   No effect when received by the instrument.

IDY   The instrument includes its parallel poll
status bit in IDY command and retransmits it.

IFC   The instrument untalks and unlistens.

LAD n   If n matches the instruments address, the
instrument becomes a listener.

LLO   The front panel Clear/Local key is disabled.

MLA   MLA is that particular LAD n for which n
matches the instrument address.

MTA   MTA is that particular TAD n for which n
matches the instrument address.

NOP   Asynchronous service requests are disabled.

NRD   The instrument stops sending data until an
SDA is received.

NRE   The instrument goes to local and local lock-
out is cleared.

NUL   No effect when received by the instrument.

PPD   If the instrument is a listener, parallel poll
is disabled.

PPE n   Parallel poll is enabled. The instrument uses
n to determine the proper parallel poll
response.

PPU   Parallel poll is disabled whether or not the
instrument is a listener.

REN   The instrument is enabled to enter the re-
mote state on the next addressing as a
listener.

RFC   The instrument holds the RFC byte until
ready for the next command.

SAI   The instrument sends the number 81 in
binary. This identifies the instrument as an
instrument with measurement or detection
capabilities.

SDA   The instrument sends a data message.

SDC   If the instrument is a listener, SDC will cause
the same response as DCL.

SDI   The instrument sends the string "HP5006A"
to identify itself.

SPD   Disables serial polling.

SPE   Enables serial poll and causes the instrument
to send its serial poll status byte.

SST   The instrument sends its serial poll status
byte.

TAD n   If n matches the instrument address, the
instrument becomes a talker.

UNL   The instrument ceases to be a listener.

UNT   The instrument ceases to be a talker.

3-134. META MESSAGES

3-135.   In order to simplify the use of the HP-IB and
HP-IL interfaces, HP has developed what is called the
Meta Messages concept. Rather than requiring the
user to remember all the device independent mes-
sages and their interactions, useful sequences of these
commands have been integrated into a single com-
mand on many of HP's controllers. For example, to
clear the the instrument at address 10 using the device
independent commands, it is necessary to send the
sequence ATN, UNL, MTA, LAD 10, SDC. In the HP85,
the command CLEAR 710 causes this sequence to be
sent with no further user interaction. This greatly sim-
plifies the use of the interface.

3-136.   Many of the meta messages as implemented
on the HP85 may be sent in either of two forms, either
with or without addressing. The form with addressing

will normally listen address the instrument. For example, the command REMOTE 7 will send a REN without making any instrument a listener, while the command REMOTE 710 will send REN and then make the instrument a listener. In the following tables, the form with addressing is shown.

3-137. *Table* 3-9 lists the meta messages, their results in the HP5006A, and typical interface message sequences corresponding to them. The sequences are typical in that different controllers may send different sequences, while still obtaining the same results.

Table 3-9. Meta Messages

Message	Description/Response
DATA	A means to send device dependent commands and receive measurement data. HP-IB: [UNL, MTA, LADn, data] HP-IL: [UNL, MTA, LADn, SDA, data]
TRIGGER	Will cause the next measurement to be a triggered measurement. [UNL, MTA, LADn, GET]
CLEAR	Will clear the display, composite signature, memory, unstable LED, and gate state machine if not in error state. If in error state, clears error only. [UNL, MTA, LADn, SDC]
REMOTE	Disables front panel keys (except for Clear/Local). [REN, UNL, MTA, LADn]
LOCAL	Enables the front panel keys. [UNL, MTA, LADn, GTL]
LOCAL AND CLEAR LOCKOUT	Enables the front panel keys and clear local lockout. [NRE]
LOCAL LOCKOUT	Disables the Clear/Local key when in remote. [LLO]
SERVICE REQUEST	This command is ignored when received by the instrument. It will be sent by the instrument when an enabled service condition is present.
STATUS BYTE	Presents status information. HP-IB: [UNL, MLA, TADn, SPE, data, SPD, UNT] HP-IL: [UNL, MLA, TADn, SST, data, UNT]
STATUS BIT	Single bit parallel poll response indicates whether this instrument is requesting service. [IDY]
PASS CONTROL	Not supported.
ABORT	Terminates bus communications by unlistening and untalking all instruments. [IFC]
DEVICE ID	Causes the instrument to send the string "HP5006A". [UNL, MLA, TADn, SDI, data]
ACCESSORY ID	Causes the instrument to send the number 81 in binary. This identifies the instrument as a measuring instrument. [UNL, MLA, TADn, SAI, data]

3-138. *Table 3-10* lists the meta messages and the HP9825, HP85, and HP41C commands that correspond to them. (Only the addressed form is shown for the commands that support both the unaddressed and addressed forms. The HP41C requires the address selection to be made using a SELECT statement). The table assumes the instrument is set to address 10 and the interface to select code 7.

3-139. SRQ, SRQ MASK, AND STATUS BYTE

3-140.   When in remote operation, the 5006A can send a service request (SRQ) to the controller under any, all, or none of the following conditions, as defined by the Service Request Mask. The Service Request Mask (RM command, see paragraph 3-158) must be set prior to the condition.

1.   Data ready. A measurement has been completed and is available for collection.

2.   Trigger Occurred. The Data Probe switch has been pressed, after the ST command was sent. Pressing the Data Probe switch selects the next measurement as a "triggered" measurement.

3.   Error or Fail. An Error or Failure condition exists, and is displayed.

4.   Local. Instrument is in local.

3-141.   In general, the controller can read the 5006A Status Byte at any time to check selected operating conditions. During remote operation, you may selectively program the 5006A Service Request Mask (RMnnn) to identify the conditions which you feel may require service or data collection.

3-142.   Once SRQ has been sent, the controller can identify which condition or conditions caused the Service Request by reading the Status Byte. When the Status Byte is read, conditions that have occurred since the last clear will be set to 1 whether or not enabled as a condition to generate SRQ. Sending a "rds (710)" with the 9825A, or "A=SPOLL (710)" with the 85A requests the eight-bit binary Status Byte. The number returned will be a decimal equivalent to the sum of the different status bits set, as shown in *Table 3-11*.

Table 3-10. Meta Messages and Controller Commands

Message	HP9825	HP85	HP41C
DATA	wrt 710; A$ red 710; A$	OUTPUT 710; A$ ENTER 710; A$	OUTA INA
TRIGGER	trg 710	TRIGGER 710	TRIGGER
CLEAR	clr 710	CLEAR 710	
REMOTE	rem 710	REMOTE 710	REMOTE
LOCAL	lcl 710	LOCAL 710	LOCAL
LOCAL/CLEAR LOCKOUT	lcl 7	LOCAL 7	
LOCKOUT	llo 7	LOCAL LOCKOUT 7	
SERVICE REQUEST		STATUS 7,1; A	
STATUS BYTE	rds (710)	SPOLL (710)	INSTAT
STATUS BIT		PPOLL (7)	
PASS CONTROL			
ABORT	cli 7	ABORTIO 7	STOPIO
DEVICE ID		SEND 7; CMD 255	FINDID
ACCESSORY ID		SEND 7; CMD 254	

Table 3-11. HP5006A Status Byte

D7	D6	D5	D4	D3	D2	D1	D0
0	SRQ FLAG	POWER ON	LOCAL	0	ERROR or FAIL	TRIGGER OCCURRED	DATA READY
128	64	32	16	8	4	2	1

3-143. For example; the instrument requested service (SRQ) and a reading of the Status Byte returned a value of "99". This can be interpreted as $64 + 32 + 2 + 1 = 99$, meaning the SRQ FLAG is set, power is on, a trigger (data probe switch) occurred, and data is ready. The bits of the status byte are set regardless of the service request mask, however, if that bit is masked out, it will not generate an SRQ.

3-144. DEVICE DEPENDENT COMMANDS

3-145. Input Format

3-146. The 5006A will accept command strings in either upper or lower case. Spaces and commas between commands are ignored. Semicolons are interpreted as command terminators. In addition, parity bits will be ignored. Depending upon the controller, this can help to speed up programming. The following command statements will produce identical results:

OUTPUT 710; "FQ1,FS1,FU1,PC2,PT2,PP2,PQ1"

output 710; "fq1,fs1,fu1,pc2,pt2,pp2,pq1"

3-147. Command Descriptions

3-148. All local functions are programmable with individual command codes via the interface. In general, all functions operate the same in remote as in local. The 5006A commands are described in the following paragraphs and listed in *Table 3-12*.

3-149. The listed command set contains several commands which may appear redundant in function or unrelated to the 5006A (i.e.; F0, F1, and RS). Many of these commands have been included simply to provide programming compatibility with the 5005B Signature Analyzer.

3-150. The following paragraphs describe the programmable function and polarity commands for the 5006A. Bold type denotes the default states assumed on power up.

3-151. Function Commands

FRn RECALL
  FR0 = RECALL function disabled.
  FR1 = RECALL function enabled.

FEn EDIT
  FE0 = EDIT function disabled.
  FE1 = EDIT function enabled.

FSn SIG LATCH
  FS0 = SIGNATURE LATCH function disabled.
  FS1 = SIGNATURE LATCH function enabled.

FUn UNSTABLE LATCH
  FU0 = UNSTABLE LATCH function disabled.
  FU1 = UNSTABLE LATCH function enabled.

FQn QUAL
  FQ0 = Clock QUALified function disabled.
  FQ1 = Clock QUALified function enabled.

3-152. Polarity Commands

PCn CLOCK POLARITY Select
  PC1 = Clock triggers on rising edge of signal.
  PC2 = Clock triggers on falling edge of signal.

PTn START POLARITY Select
  PT1 = Start triggers on rising edge of signal.
  PT2 = Start triggers on falling edge of signal.

PPn STOP POLARITY Select
  PP1 = Stop triggers on rising edge of signal.
  PP2 = Stop triggers on falling edge of signal.

PQn QUAL POLARITY Select
  PQ1 = Qualify set to active high level.
  PQ2 = Qualify set to active low level.

3-153. SEND DATA COMMANDS

3-154. Measurement Triggering in Remote (Default Mode)

3-155. The 5006A (with no latch Functions enabled) normally operates in a free-run status, with the instrument self-armed. When proper Start, Stop, and Clock inputs are connected, the 5006A will take measurements continuously, with the latest completed data available to the interface after the measurement is completed. As data becomes available, it does not automatically transfer to the controller unless specifically requested, and is normally replaced after the next measurement is completed. If the controller sends the command "GET" or the operator presses the Data Probe switch, the next measurement will be a triggered measurement. When the controller sends a "Send Data" command, the specific action is performed, then on the next measurement cycle the 5006A returns to its default condition of continuous measurements.

3-156. Command Descriptions

3-157. The following paragraphs describe the send data commands for the 5006A. Sending one of the following commands will cause the 5006A to respond by returning the requested data, then return to the previous state. The receipt of any device dependent command will abort any pending send data command and cause the instrument to revert to the continuous measurement mode.

SE   Send Error Code

Causes the 5006A to send the error code to the controller. This code is the two digit decimal number which corresponds to the error or failure condition, as shown in *Table 3-1*. If no failure has occurred, the error code returned will be "00".

SI   Send Device Identification

Causes the 5006A to respond with "HP5006A CR LF". This command is useful for ascertaining the address of the 5006A or for determining which instrument has been assigned to a particular address.

SL1   Send Logic Probe Current State

Causes the 5006A to send the current state of the Logic Probe. Upon receipt of the Send Logic Probe State command, the instrument will send out one of the following messages; HI, LO, PU, or FL. The message corresponds to the current logic probe indication as follows: (HI) High, (LO) Low, (PU) Pulsing, or (FL) Floating.

SL2   Send Logic Probe Triggered States

Causes the 5006A to send a summary of the Logic Probe states which occur during the next triggered gate cycle. Upon receipt of the Send Logic Probe Triggered command, the instrument will cease sending signatures and will wait for a trigger. Once a trigger is received, the instrument will look for highs and lows at the data probe. When the end of the gate interval is detected the instrument will send out one of the following messages; HI, LO, PU, or FL. The message corresponds to the logic probe indications which occurred during the triggered gate cycle as follows: (HI) Highs but no Lows occurred, (LO)

Lows but no Highs occurred, (PU) both Lows and Highs occurred, or (FL) neither High nor Low occurred.

SP   Send Polarities

Causes the 5006A to send the current state of the polarities. Upon receipt of the Send Polarities command, the instrument will send a decimal number, corresponding to the sum of the binary weights of the polarity bits set as follows:

Bit	Meaning	Weight
Bit7	Always 0	128
Bit6	Always 0	64
Bit5	Qualifier Level (1=HI)	32
Bit4	Qualifier Enable (1=Enabled)	16
Bit3	Always 0	8
Bit2	Stop Edge (1=rising)	4
Bit1	Start Edge (1=rising)	2
Bit0	Clock Edge (1=rising)	1

For example, if QUAL Function was enabled and the QUAL level set to HI and the Stop, Start, and Clock edges were set to rising, the 5006A would return the decimal number "55". This represents the sum of the set bits (32 + 16 + 4 + 2 + 1).

The intent of this function is to allow a controller to store the state of the instrument temporarily so as to return it to that state at a later time. The data is not intended for user interpretation.

SS1   Send Triggered Signature

Causes the 5006A to send the next triggered signature. A triggered signature is the first complete signature which follows a trigger from either the Data Probe switch or the GET command.

If the instrument is operating as a talker, it will normally transmit all signatures as available to be sent to the interface. The Send Triggered Signature command inhibits the instrument from sending signatures until a triggered signature is received. Once a triggered measurement has been sent, the instrument returns to its normal mode of sending all signatures.

SS2   Send Unstable Signature

Causes the 5006A to send the next unstable signature.

If the instrument is operating as a talker, it will normally transmit all signatures as available to be sent to the interface. The Send Unstable Signature command inhibits the instrument from sending signatures until an unstable signature is taken. Once an unstable measurement has been sent, the instrument returns to its normal mode of sending all signatures.

ST   Send Trigger Bit

Causes the 5006A to set the triggered bit (Bit 1) in the status byte when a triggered measurement occurs.

3-158.   Receive Data Commands

3-159.   The following paragraphs describe the receive data command codes for the 5006A.

RAnnn   Receive Digit A Display Data

Upon receipt of the RAnnn command, the instrument will load the binary value of "nnn" into the register corresponding to the "A" digit of the display.

RBnnn   Receive Digit B Display Data

Upon receipt of the RBnnn command, the instrument will load the binary value of "nnn" into the register corresponding to the "B" digit of the display.

RCnnn   Receive Digit C Display Data

Upon receipt of the RCnnn command, the instrument will load the binary value of "nnn" into the register corresponding to the "C" digit of the display.

RDnnn   Receive Digit D Display Data

Upon receipt of the RDnnn command, the instrument will load the binary value of "nnn" into the register corresponding to the "D" digit of the display.

For each of the Receive Digit commands (RA, RB, RC, RD) the binary value of "nnn" is interpreted as follows:

BIT	MEANING	WEIGHT
Bit7	Segment decimal point	128
Bit6	Segment a	64
Bit5	Segment b	32
Bit4	Segment c	16
Bit3	Segment d	8
Bit2	Segment e	4
Bit1	Segment f	2
Bit0	Segment g	1

For example, if the instrument received the command "RA255" display digit A register would be loaded with the value "255". The value, interpreted as $128 + 64 + 32 + 16 + 8 + 4 + 2 + 1$, would enable all the segments and decimal point in digit A (leftmost digit in display).

The assignment of display digits and digit segments is as follows:

DIGIT A   DIGIT B   DIGIT C   DIGIT D

RMnnn   Receive Service Request Mask

Upon receipt of the RMnnn command, the instrument will load the binary value of "nnn" into the service request mask register. The SRQ/line bit will be set if a bit in the status byte becomes set and the corresponding bit in the service request mask is set. To specify the service request mask, send the RM command followed by a decimal number representative of the binary sum of the bits that you want enabled. Only the five LSB can be masked or unmasked. You may send any number between 0 and 255, although only the five least significant bits are used. The binary value of "nnn" is interpreted as follows:

	BIT	MEANING	WEIGHT
Not Maskable	Bit7	Always 0	128
	Bit6	SRQ	64
	Bit5	Power On	32
Maskable Bits	Bit4	Instrument in Local	16
	Bit3	Always 0	8
	Bit2	Error or Fail Condition	4
	Bit1	Trigger occurred after ST command	2
	Bit0	Data Ready	1

For example, sending the command "RM7" will generate a service request (SRQ) after; an Error or Fail condition or a trigger occurred or data is ready (4 + 2 + 1). Sending the command "RM0" masks off (or disables) all SRQ conditions. The condition or conditions which caused the service request may be determined by reading the Status Byte.

RPnnn   Receive Data to Write to Polarities

Upon receipt of the RPnnn command the instrument will load the binary value of "nnn" into the polarity register. The binary value of "nnn" is interpreted as follows:

BIT	MEANING	WEIGHT
Bit7	Always 0	128
Bit6	Always 0	64
Bit5	Qualifier Level HI	32
Bit4	QUALIFY FUNCTION	16
Bit3	Always 0	8
Bit2	Stop Edge Rising	4
Bit1	Start Edge Rising	2
Bit0	Clock Edge Rising	1

Although each of the Polarity states can be programmed individually, via each keys unique command (PC1, PC2, etc.) the RPnnn command allows all of the Polarity settings to be specified in one command. This is particularly useful in conjunction with the SP command. These two together allow a polarity setup to be stored in the controller and later re-established.

You should also be aware of the interactive relationship of the QUALIFY Function and Qualify level within this command. If your RP command does not set the QUALIFY FUNCTION (16), no QUALIFY level will be set. To set the QUALIFY FUNCTION on and QUALIFY level LOW, send "16"; to set the QUALIFY FUNCTION on and QUALIFY level HI, send "48". For example, if the instrument received the command "RP55", the polarity register would be loaded with the value "55". The value, interpreted as 32 + 16 + 4 + 2 + 1, would enable the Clock QUALIFY FUNCTION and set the QUAL level to HI, the Stop, Start, and Clock edges to rising.

3-160. Other Device Dependent Commands

3-161.   The following paragraphs describe additional device dependent commands. These commands are included to ensure programming compatibility with other remote programmable signature analyzers, such as the HP5005B.

RS   Reset

RS. This command is equivalent to FR0, FE0, FS0, FU0, FQ0, PC1, PT1, PP1, PQ0.

PSn   Probe Switch Enable

PS0. Upon receipt of the PS0 command, the instrument sets the RECALL, EDIT, SIG LATCH, and UNSTABLE LATCH functions to the disabled state (FR0, FE0, FS0, FU0), then clears the SS1 and SS2 commands and resets the gate control state machine.
PS1. Upon receipt of the PS1 command, the instrument sets the RECALL, EDIT, SIG LATCH, and UNSTABLE LATCH functions to be disabled state (FR0, FE0, FS0, FU0), then sets the SS1 command and resets the gate control state machine.

Fn   HP5005B Compatible Function

F0. Upon receipt of the F0 command, the instrument sets the RECALL, EDIT, SIG LATCH, UNSTABLE LATCH, and QUAL functions to the disabled state (FR0, FE0, FS0, FU0, FQ0).
F1. Upon receipt of the F1 command, the instrument sets the RECALL, EDIT, SIG LATCH, UNSTABLE LATCH functions to the disable state and sets the QUAL function to the enabled state (FR0, FE0, FS0, FU0, FQ1).

ID   Device Identification

ID. This command is identical to the Send Device Identification command (SI). It causes the 5006A to respond with "HP5006A CR LF".

QMn   Service Request Mask

QMn. This command is identical to the Receive Service Request Mask command (RMn).

SMn   Set Service Request Mask

SMn. This command is identical to the Receive Service Request Mask command (RMn).

Table 3-12. Instrument Program Command Set

FUNCTION SELECT COMMANDS	
*F0	Function Signature Analysis NORM (FR0,FE0,FS0,FU0,FQ0)
*F1	Function Signature Analysis QUAL (FR0,FE0,FS0,FU0,FQ1)
FR0	Function Recall Disable
FR1	Function Recall Enable
FE0	Function Edit Disable
FE1	Function Edit Enable
FS0	Function Signature Latch Disable
FS1	Function Signature Latch Enable
FU0	Function Unstable Latch Disable
FU1	Function Unstable Latch Enable
FQ0	Function Qualifier Disable
FQ1	Function Qualifier Enable
*RS	Send Reset
POLARITY SELECT COMMANDS	
PC1	Set CLOCK to Rising Edge
PC2	Set CLOCK to Falling Edge
PT1	Set START to Rising Edge
PT2	Set START to Falling Edge
PP1	Set STOP to Rising Edge
PP2	Set STOP to Falling Edge
PQ1	Set QUAL to HI Level
PQ2	Set QUAL to LO Level
DATA PROBE SWITCH COMMANDS	
*PS0	Data Probe Switch Disable (FR0,FE0,FS0,FU0)
*PS1	Data Probe Switch Enable (FR0,FE0,FS0,FU0,SS1)
SEND DATA COMMANDS	
SS1	Send next Triggered Signature
SS2	Send next Unstable Signature
SL1	Send Logic Status/Current State
SL2	Send Logic Status/Triggered State
SE	Send Error
SP	Send Polarities
SI	Send ID
*ID	Send ID
ST	Send Trigger Bit
RECEIVE DATA COMMANDS	
RPnn	Receive Polarities
RAnnn	Receive Display Digit A
RBnnn	Receive Display Digit B
RCnnn	Receive Display Digit C
RDnnn	Receive Display Digit D
RMnnn	Receive Service Request Mask
*QMnnn	Receive Service Request Mask
*SMnnn	Receive Service Request Mask

*Note: These commands are included to ensure programming compatibility with other remote program-mable signature analyzers, such as HP5005B.

3-162. PROGRAMMING EXAMPLES

3-163. The following examples demonstrate programming capabilities of the 5006A. The examples are written for the HP85A controller. A summary of the program operation and a line-by-line description are provided for each example.

EX1   Initializing the Front Panel
EX2   Sending a Signature to the Controller
EX3   Displaying the Contents of the Status Byte
EX4   Displays User Message on 5006 Display

EX5   Collects and displays accumulated signatures on controller
EX6   Reads the Logic Probe Status

3-164. The examples listed in this section assume a 5006A address setting of "10" (Address switches to "01010"). The 5006A is addressed to talk and listen by using the code "710" where "10" is the 5006A address and "7" is the interface select code. The ASCII characters for the same switch settings are "J" for a talk address and "*" for a listen address. These characters would be used if the controller were an HP9830A calculator (or 9825A/B when using the "cmd" statement).

EXAMPLE 1. INITIALIZING FRONT PANEL

The following example demonstrates how to initialize the front panel of the 5006A. The program clears the 5006A, then requests the instrument identification. The response is read into "A$", which is then displayed. The program sends the a command string which sets all functions to their "0" or inactive (default) states. The following command "RP7", sets the Clock, Start, and Stop Polarities to "rising".

```
10 CLEAR 710
20 OUTPUT 710 ,"ID"
30 ENTER 710 , A$
40 DISP A$
50 OUTPUT 710 ,"FE0,FR0,FS0,FU0
   ,FU0"
60 OUTPUT 710 ,"RP7"
70 END
```

LINE 10: Clears the 5006A at address 10.
LINE 20: Send "ID" command to 5006A. The ID command requests an instrument to return its identification; the 5006A will return "HP5006A CR".
LINE 30: Read 5006A "ID" response into A$.
LINE 40: Display contents of A$.
LINE 50: Set all functions to "0".
LINE 60: Set all polarities to "rising".
LINE 70: End program execution.

EXAMPLE 2. SEND SIGNATURE TO CONTROLLER

The following example sends the "SS1" send data command to the 5006A. This command causes the 5006A to send the next triggered signature. A triggered signature is the first complete signature after pressing the Data Probe switch. The controller loops through a serial poll step until the value of the DATA READY bit (LSB) of the status byte is not zero, indicating a triggered signature was taken and is ready to send. The signature data is entered into "A$", then displayed on the HP85 screen, with a beep. The program then repeats.

```
10 CLEAR
20 DISP "PROBE MODE  PRESS PROB
   E SWITCH  TO STORE SIGNATURE
    IN CONTROLLERDISPLAY"
30 OUTPUT 710 ;"SS1"
40 S=SPOLL(710)
50 IF BIT(S,0)=0 THEN GOTO 40
60 ENTER 710 , A$
70 DISP A$
80 BEEP
90 GOTO 30
100 END
```

LINE 10: Clears the HP85 display.
LINE 20: Display operator prompt message.
LINE 30: Send "SS1" command to 5006A. The SS1 command sends the next triggered signature back over the interface.
LINE 40: Read the status of 5006A by a serial poll at address 10.
LINE 50: If value of bit 0 of the status byte is "0" (no data ready), then loop back to line 40.
LINE 60: Read 5006A status response into A$.
LINE 70: Display contents of A$.
LINE 80: Beep.
LINE 90: Return to line 30.
LINE 100: End program execution.

EXAMPLE 3. DISPLAY CONTENTS OF STATUS BYTE

The following example reads the status byte of the 5006A by a serial poll at address 10. The value returned is input into "A". The program then displays the meaning of each bit and the corresponding value returned in the status byte.

```
10 A=SPOLL(710)
20 DISP "REQUEST SERVICE
        =",BIT(A,6)
30 DISP "POWER-UP
        =",BIT(A,5)
40 DISP "INSTRUMENT IN LOCAL ST
   ATE  =",BIT(A,4)
50 DISP "ERROR OR FAILURE OCCUR
   ED    =",BIT(A,2)
60 DISP "TRIGGER AFTER ST COMMA
   ND    =",BIT(A,1)
70 DISP "DATA READY
        =",BIT(A,0)
80 END
```

LINE 10: Read the status of 5006A (into A) by a serial poll at address 10.

LINE 20: Display "REQUEST SERVICE=" followed by the value of bit 6 of status byte.

LINE 30: Display "POWER-UP=" followed by the value of bit 5 of status byte.

LINE 40: Display "INSTRUMENT IN LOCAL STATE=" followed by the value of bit 4 of status byte.

LINE 50: Display "ERROR OR FAILURE OC-CURRED=" followed by the value of bit 2 of status byte.

LINE 60: Display "TRIGGER AFTER ST COM-MAND= followed by the value of bit 1 of status byte.

LINE 70: Display "DATA READY=" followed by the value of bit 0 of status byte.

LINE 80: End program execution.

Running the program produces a display similar to the following:

```
REQUEST SERVICE                = 0
POWER-UP                       = 1
INSTRUMENT IN LOCAL STATE      = 0
ERROR OR FAILURE OCCURED       = 0
TRIGGER AFTER ST COMMAND       = 0
DATA READY                     = 1
```

EXAMPLE 4. SENDING TO THE 5006A DISPLAY

The following example demonstrates how to program the segments of the 5006A display digits, to generate a unique message. This function may be used interactively during a program to guide the operator with a specific instruction or response.

```
10 OUTPUT 710 ;"FS1"
20 OUTPUT 710 ;"RA123RB29RC15RD
   29"
30 WAIT 3000
40 OUTPUT 710 ;"RA109RB223RC126
   RD91"
50 WAIT 3000
60 OUTPUT 710 ;"FS0"
70 END
```

LINE 10: Send "FS1" command to 5006A. The FS1 command activates the Signature Latch function.

LINE 20: Send display data for the four display digits generating the message "goto".

LINE 30: Wait three seconds.

LINE 40: Send display data for the four display digits generating the message "26.05".

LINE 50: Wait three seconds.

LINE 60: Send "FS0" command to 5006A. The FS0 command disables the Signature Latch function.

LINE 70: End program execution.

The program begins by sending the command "FS1" which enables the Signature Latch function. The Signature Latch function latches the display data until it is replaced by new triggered data. This allows the unique displays to remain displayed for a length of time specified by WAIT statements. The command strings in lines 20 and 40 specify the segments of each digit (A, B, C, D) to be lighted. The 5006A interprets the decimal number following each digit data command (e.g. RA123) as a binary value corresponding to the segments of the digit as follows:

BIT	MEANING	WEIGHT	
Bit7	Segment decimal point	128	
Bit6	Segment a	64	64
Bit5	Segment b	32	32
Bit4	Segment c	16	16
Bit3	Segment d	8	8
Bit2	Segment e	4	---
Bit1	Segment f	2	2
Bit0	Segment g	1	1

$$\overline{}$$
123

The command code "RA123" lights the a, b, c, d, f, and g segments of display A. The remaining commands are intrepeted in a similar fashion, and produce a display of "goto". After a three second wait the sequence is repeated, to display "26.05". The display "26.05" may be used to identify the circuit node location U26, pin 5.

The assignment of display digits and digit segments is as follows:

DIGIT A   DIGIT B   DIGIT C   DIGIT D
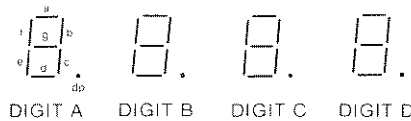
EXAMPLE 5. STORE, RECALL AND EDIT SIGNATURE MEMORY

The following example sets the 5006A up to take signatures when the Data Probe switch is pressed. The HP85 display prompts when a signature may be taken. As signatures are taken, they are entered into the signature memory and displayed on the HP85 screen. The HP85 also displays the programmed softkey labels, which allow the operator to select the RECALL function. During RECALL, the signature memory may be reviewed with SCAN or modified with EDIT. The signature memory reference number for any stored signature is not accessable directly. In this example, the reference number is computed using values stored in an internal addressable RAM, and then displayed on the HP85 screen.

```
5 DIM A$[4]
10 C=0
20 ON KEY# 1,"RECALL" GOTO 170
30 CLEAR
40 KEY LABEL
50 DISP ,"PRESS PROBE SWITCH TO
   STORE   SIGNATURES"
60 DISP
70 CLEAR 710
80 OUTPUT 710 ,"F0"
90 WAIT 500
100 OUTPUT 710 ;"SS1"
110 S=SPOLL(710)
120 IF BIT(S,0)=0 THEN GOTO 110
```

LINE 05:   Dimension A string variable to 4 characters.
LINE 10:   Initialize variable C; set value to "0".
LINE 20:   Assign K1 softkey label; "RECALL". If K1 is pressed, program goes to 170.
LINE 30:   Clears the HP85 display.
LINE 40:   Displays the softkey labels.
LINE 50:   Displays the operator prompt message "PRESS PROBE SWITCH TO STORE SIGNATURES".
LINE 60:   Generates CR and LF for cursor.
LINE 70:   Clears the 5006A at address 10.
LINE 80:   Send "F0" command to 5006A, which sets all functions to off.
LINE 90:   Wait 500 msecs.
LINE 100:   Send "SS1" command to 5006A, which sends the next triggered signature.
LINE 110:   Read the status of 5006A by a serial poll at address 10.
LINE 120:   If value of bit 0 of the status byte is "0" (no data ready), then loop back to line 110.

```
130 ENTER 710 ; A$
140 BEEP
150 DISP A$
160 GOTO 90
170 OUTPUT 710 ;"FR1"
180 ENTER 710 ; A$
190 CLEAR
200 KEY LABEL
210 DISP ;"COMPOSITE SIGNATURE
    ";A$
220 IF C=1 THEN GOTO 290
230 ON KEY# 1,"SCAN" GOTO 280
240 ON KEY# 2,"EDIT" GOTO 380
250 KEY LABEL
260 ON KEY# 1,"SCAN" GOTO 280
270 GOTO 260
280 IF C=1 THEN GOTO 170
290 TRIGGER 710
300 ENTER 710 ; A$
310 OUTPUT 710 ;"SR35"
320 ENTER 710 ; A
330 OUTPUT 710 ;"SR28"
340 ENTER 710 ; B
350 C=A/2+B+1
360 DISP ;C;" ";A$
370 GOTO 260
380 OUTPUT 710 ;"FE1"
390 DISP ;"TAKE A NEW SIGNATURE"
400 OUTPUT 710 ;"SS1"
410 S=SPOLL(710)
420 IF BIT(S,0)=0 THEN GOTO 410
430 OUTPUT 710 ;"FE0"
440 BEEP
450 GOTO 170
460 END
```

LINE 130:   Read 5006A signature value into A$.
LINE 140:   Beep.
LINE 150:   Display contents of A$.
LINE 160:   Return to line 90 to take the next signature.
LINE 170:   Send "FR1" command to 5006A, which enables the RECALL function.
LINE 180:   Reads the Composite Signature value (accessed by RECALL) into A$.
LINE 190:   Clears the HP85 display.
LINE 200:   Displays the softkey labels.
LINE 210:   Displays "COMPOSITE SIGNATURE" followed by the value of A$.
LINE 220:   If the value of C equals 1, go to 290.
LINE 230:   Assign K1 softkey label; "SCAN". If K1 is pressed, program goes to 280.
LINE 240:   Assign K2 softkey label; "EDIT". If K2 is pressed, program goes to 380.
LINE 250:   Displays the softkey labels.
LINE 260:   Assign K1 softkey label; "SCAN". If K1 is pressed, program goes to 280.
LINE 270:   Go to line 260.
LINE 280:   If the value of C equals 1, go to 170.
LINE 290:   Send trigger command to address 10.
LINE 300:   Read 5006A signature value into A$.
LINE 310:   Send "SR35" command to 5006A. The SR35 command requests the value at address "35" of an internal register.
LINE 320:   Reads the value of register address location 35 into variable A.
LINE 330:   Send "SR28" command to 5006A. The SR28 command requests the value at address "28" of an internal register.
LINE 340:   Reads the value of register address location 28 into variable B.
LINE 350:   Computes the value of the signature memory reference number for the displayed signature.
LINE 360:   Displays the computed signature memory reference number followed by the corresponding signature value.
LINE 370:   Go to line 260.
LINE 380:   Send "FE1" command to 5006A. The FE1 command enables the EDIT function.
LINE 390:   Displays the operator prompt message "TAKE A NEW SIGNATURE".
LINE 400:   Send "SS1" command to 5006A, which sends the next triggered signature.
LINE 410:   Read the status of 5006A by a serial poll at address 10.
LINE 420:   If value of status byte is "0" (no SRQ), then loop back to line 410.
LINE 430:   Send "FE0" command to 5006A. The FE0 command disables the EDIT function.
LINE 440:   Beep.
LINE 450:   Go to line 170.
LINE 460:   End program execution.

EXAMPLE 6. READING LOGIC STATUS OF THE DATA PROBE

The following example sets the 5006A up to return the logic status of the Data Probe, each time the Data Probe switch is pressed. The status returned is then displayed on the HP85 screen, in an unabbreviated form (i.e. FL will be displayed as "FLOATING").

```
10 OUTPUT 710 ,"SL2"
20 ENTER 710 : A$
30 IF A$="PU" THEN GOTO 80
40 IF A$="HI" THEN GOTO 100
50 IF A$="LO" THEN GOTO 120
60 DISP "THE NODE PROBED WAS FL
   OATING"
70 GOTO 10
80 DISP "THE NODE PROBED WAS PU
   LSING"
90 GOTO 10
100 DISP "THE NODE PROBED WAS HI
    GH"
110 GOTO 10
120 DISP "THE NODE PROBED WAS LO
    W"
130 GOTO 10
140 END
```

LINE 10: Send command "SL2" to 5006A. The SL2 command requests the logic status of the Data Probe on the next triggered signature.

LINE 20: Read 5006A response into A$.

LINE 30: If value of A$ is "PU", go to Line 80.

LINE 40: If value of A$ is "HI", go to line 100.

LINE 50: If value of A$ is "LO", go to line 120.

LINE 60: Display operator prompt message for FLOATING probe response.

LINE 70: Go to line 10.

LINE 80: Display operator prompt message for PULSING probe response.

LINE 100: Display operator prompt message for HIGH probe response.

LINE 110: Go to line 10.

LINE 120: Display operator prompt message for LOW probe response.

LINE 130: Go to line 10.

LINE 140: End program execution.